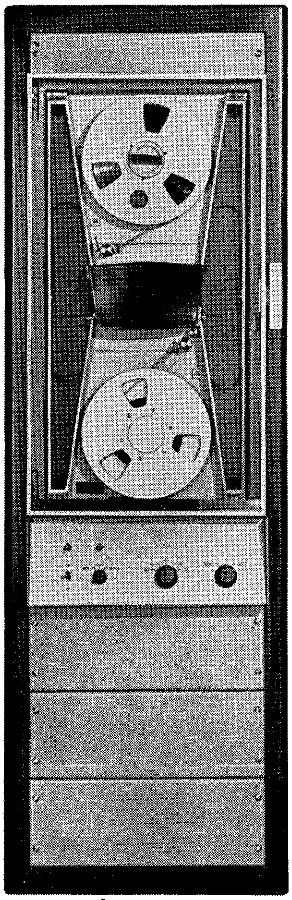
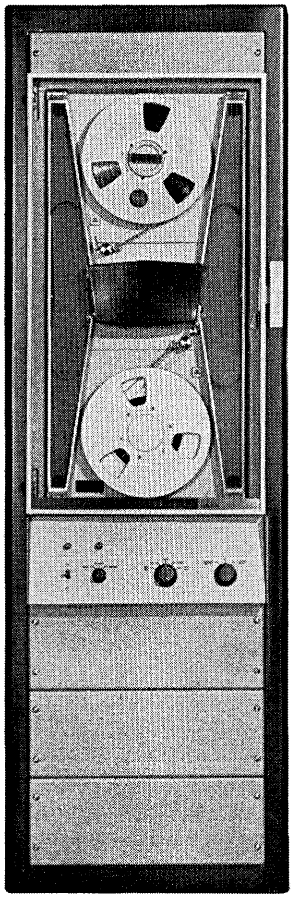
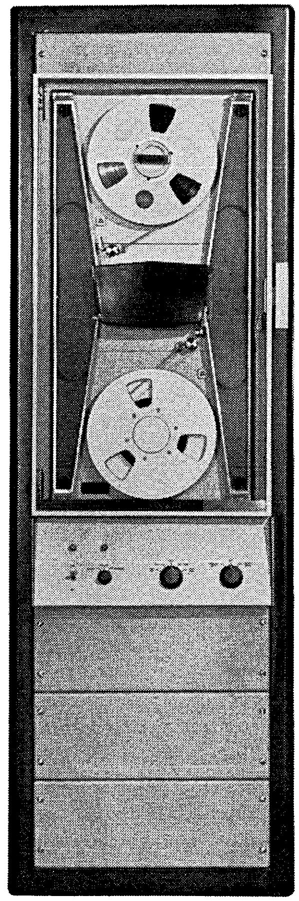
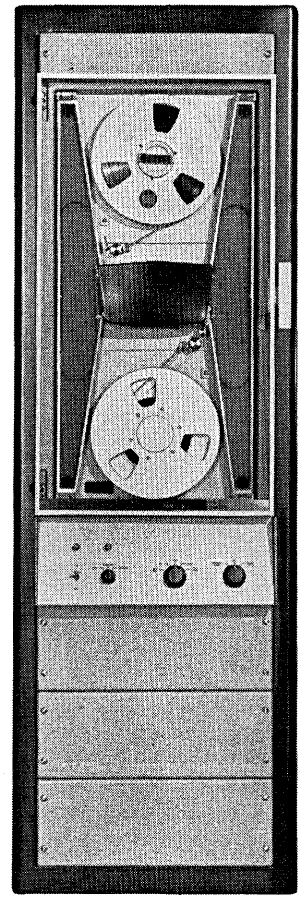
DATAMATION

61

July

TABULAR FORM IN DECISION LOGIC

PAGE 22

ON & ON & ON & ON

That's the way it goes ("it" being the Ampex TM-2 digital tape handler). On and on, with hardly a pause for maintenance. Completely new servo and tape guide systems give the TM-2 extremely long term performance stability. Improved vacuum buffer columns gently hold the tape supply and take-up loops. Specially developed inertia brakes give reliable stop times and short stop distances at high tape speeds. Start time of 2.0 ms and stop time of 1.5 ms are consistent under the most rigorous programs. And the TM-2 has a 90 Kilocycle character transfer rate. Why not send for all the facts: Ampex Computer Products Company, P.O. Box 329, Culver City, California.

AMPEX 0/1 T.M.

AMPEX COMPUTER PRODUCTS COMPANY

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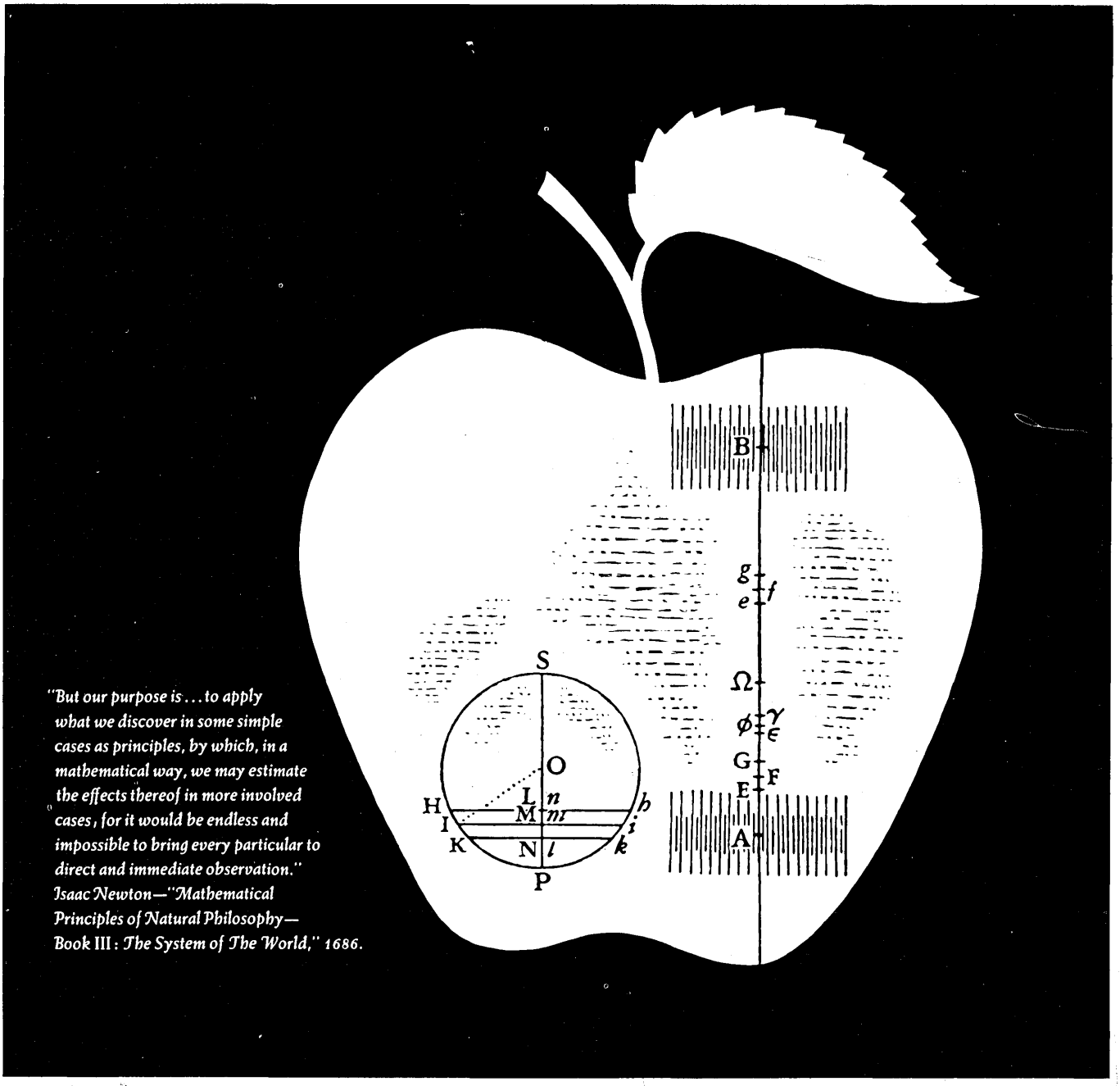
CIRCLE 1 ON READER CARD

Data Analysts for **S**pace **T**echnology **L**eadership



"But our purpose is . . . to apply what we discover in some simple cases as principles, by which, in a mathematical way, we may estimate the effects thereof in more involved cases, for it would be endless and impossible to bring every particular to direct and immediate observation."
Isaac Newton—"Mathematical Principles of Natural Philosophy—Book III: The System of The World," 1686.

REPRINTS OF THE DRAWINGS CREATED FOR THIS SERIES, SUITABLE FOR FRAMING, ARE AVAILABLE ON REQUEST.

In a discipline that follows the tradition of Newton, Data Analysts at Space Technology Laboratories, Inc. are applying "principles" to the evaluation of complex data as a means of accelerating man's conquest of space. At STL, those responsible for Space Technology Leadership look to the Computation and Data Reduction Center to identify and evaluate applied mathematical principles from diverse observations. In so doing, STL Data Analysts daily employ advanced analog and digital processing techniques and devices in solving problems concerned with analyzing data acquired from ballistic missile and space vehicle testing. All qualified applicants, regardless of race, creed, color or national origin, who seek greater stimulus and responsibility in this rewarding discipline are invited to communicate with Dr. R. C. Potter, Manager of Professional Placement and Development.

SPACE TECHNOLOGY LABORATORIES, INC. P.O. BOX 95005Y, LOS ANGELES 45, CALIFORNIA
a subsidiary of Thompson Ramo Wooldridge Inc.

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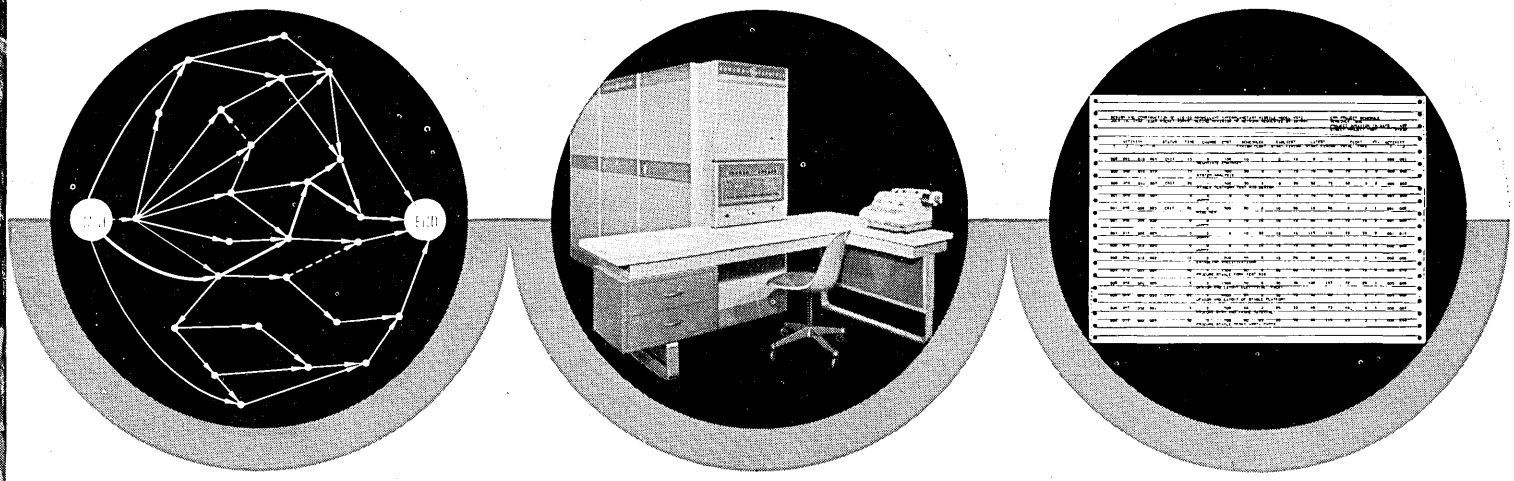
All qualified applicants considered regardless of race, creed, color, or national origin.


taking the guesswork out of decision-making.



PRECISE PROJECT PLANNING WITH THE GE 225 AND CPM

● To drastically reduce the need for managerial guesswork and to deliver precise data required for timely decision-making, General Electric *now* offers Critical Path Method (CPM) processing capability on the GE 225 computer.

● A new, advanced technique for project planning, scheduling and control, CPM can pinpoint your critical jobs to prevent bottlenecks before they result in costly and unnecessary delays.

● CPM is based on a pictorial project representation—an "Arrow Diagram" or "Project Network"—which shows the relationship and sequence of work to be done.* As employed by the GE 225, the Critical Path Method can be used for all types of project problems—from manufacturing, maintenance or construction planning to corporate planning, product launching and missile countdown.

● The CPM program developed specifically for the GE 225 efficiently processes *both* COST *and* TIME information on each job in the project to obtain *minimum* time-cost schedules. As a result, management and project personnel alike obtain pertinent and timely information on plans and schedules.

● The GE 225 CPM application is an advance providing for automatic event re-numbering and direct priority weighting of each project job in the most efficient manner.

● General Electric sales representatives, backed up by new General Electric Computer Department Information Processing Centers, can further explain this exciting and flexible use for a GE 225 and are ready NOW, working with your consultants and management, to integrate information handling equipment into your business.

● The application of the GE 225 to CPM represents one of many new advances pioneered by General Electric. It would be a wise move for you to investigate the benefits of the Critical Path Method, GECOM and other General Electric advances—all available for the GE 225. GECOM is the General Compiler which processes English language statements (COBOL), Algebraic expressions (ALGOL), Structured decision tables (TABSOL) and the File and Report Information Processing Generators (FRINGE).

For more information, write to General Electric Company, Computer Department, Section 65J7, Phoenix, Arizona, or contact your nearest General Electric Computer Department district office listed below.

Atlanta: 270 Peachtree St. N.W., 522-1611 • **Boston:** 140 Federal St., HU 2-1800, Ext. 311 • **Chicago:** 840 S. Canal St., WA 2-5611, Ext. 587 • **Cleveland:** 215 Euclid Ave., SU 1-6822 • **Dallas:** 3200 Maple Ave., RI 8-0589 • **Detroit:** 680 Antoinette St., TR 2-2600 • **Houston:** 4219 Richmond Ave., MO 7-3301 • **Kansas City, Mo.:** 106 W. 14th St., GR 1-2919 • **Los Angeles:** 1010 S. Flower St., DU 1-3641 • **Louisville:** Bldg. 6, Appliance Pk., GL 4-7511 • **Minneapolis:** 6th & Hennepin, FE 2-7569 • **New York:** 122 E. 42nd St., PL 1-1311, Ext. 2235 • **Philadelphia:** 2 Penn Center Plaza, LO 8-8085 • **Phoenix:** 3550 N. Central Ave., AM 4-3741 • **Pittsburgh:** 1634 Oliver Bldg., Mellon Sq., AT 1-6400, Ext. 566 • **San Francisco:** 235 Montgomery St., DO 2-3740 • **Schenectady:** Bldg. 2, 1 River Rd., FR 4-2211, Ext. 5-4405 • **Seattle:** 710 Second Ave., MA 4-8300 • **St. Louis:** 818 Olive St., GE 6-4343 • **Syracuse:** 1010 James St., GR 6-4411, Ext. 6141 • **Washington, D.C. Area:** 7401 Wisc. Ave., Bethesda, Md., OL 2-8100. **In Canada:** Canadian General Electric Co., Ltd., Electronic Equip. and Tube Dept., 830 Lansdowne Ave., Toronto, Ontario, Canada. **Outside U.S.A. and Canada:** Producer Goods Export Dept., International General Electric Company Div., 150 E. 42nd St., New York City, N.Y., U.S.A.

INFORMATION PROCESSING
AUTOMATED BY GENERAL ELECTRIC

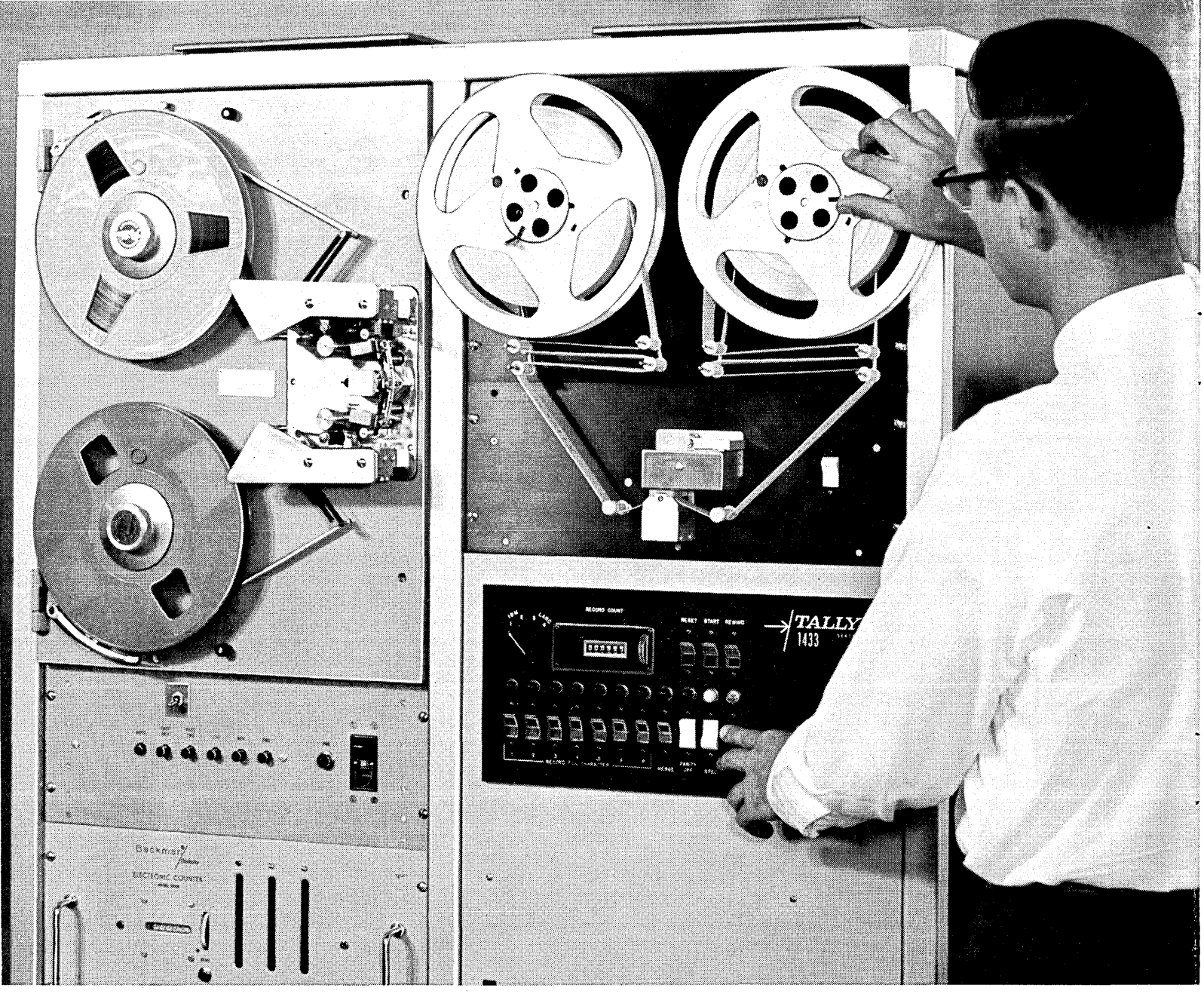
CIRCLE 4 ON READER CARD

Progress Is Our Most Important Product

GENERAL ELECTRIC

*THIS METHOD WAS DEVELOPED BY MAUCHLY ASSOCIATES, AMBLER, PENNSYLVANIA—TORONTO, CANADA.

CPA-65 (6-61)



How to convert perforated to magnetic tape at a reasonable cost (NOW)

Tally's new solid state Model 1433 Paper-to-Magnetic Tape Converter is not 10 years ahead of its time. You can solve today's media conversion problems with both integrity and economy.

Normally, input and output data are completely identical in content. The output record is a bit for bit image of input data. A universal code conversion feature is, however, available.

Without changes or adjustments, the Tally converter will accept paper, foil, or plastic tapes in widths varying from 5 through 8 levels. It writes data on magnetic tape compatible with IBM 727, 729 Mod 1, and Remington Rand computer formats. Other formats are also available.

Complete in itself, the system includes a 120 cps paper tape reader, a Potter magnetic tape handler, and necessary electronics. Price of the Model 1433 begins at $26,500. Delivery is currently 120 days. More information can be obtained from your Tally engineering representative or by writing

TALLY
REGISTER CORPORATION
1310 Mercer Street • Seattle, Washington
MAin 4-0760
OFFICES IN ALL MAJOR CITIES

CIRCLE 5 ON READER CARD

SEE US AT WESCON—BOOTH 2516

DATAMATION 61

the automatic handling of information

volume 7, number 7

Staff

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10373 W. PICO BLVD.,
LOS ANGELES 64, CALIF.

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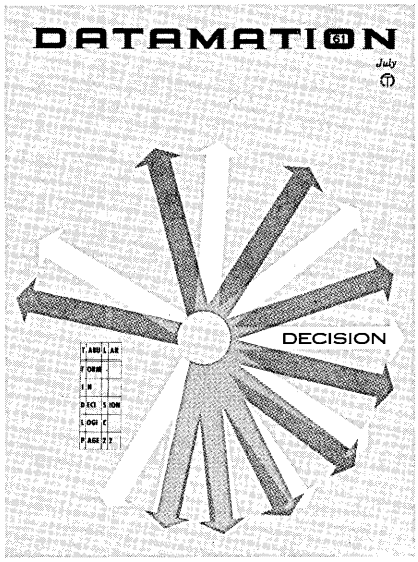
THIS ISSUE — 34,450 COPIES



Cover

As a graphic expression of "Tabular Form," this month's cover design may not express its fullest potential in decision logic but nevertheless, conveys a sprightly analogy to author Burton Grad's stimulating assessment beginment on page 22.

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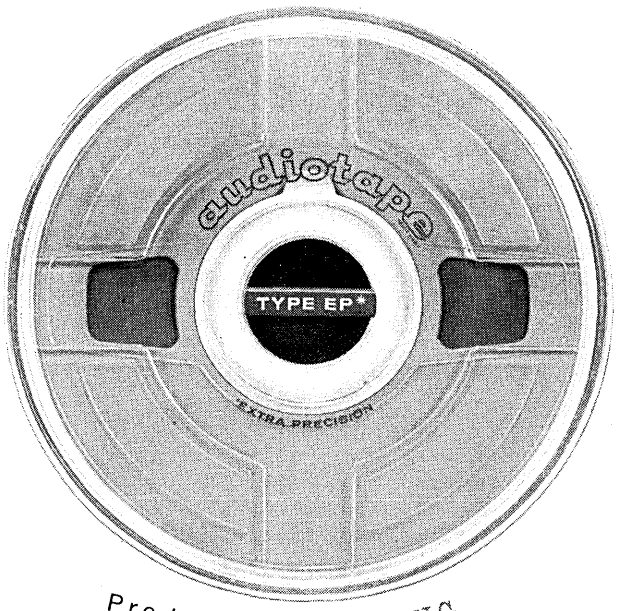
SELECTED BY THE NATION'S LEADING COMPANIES

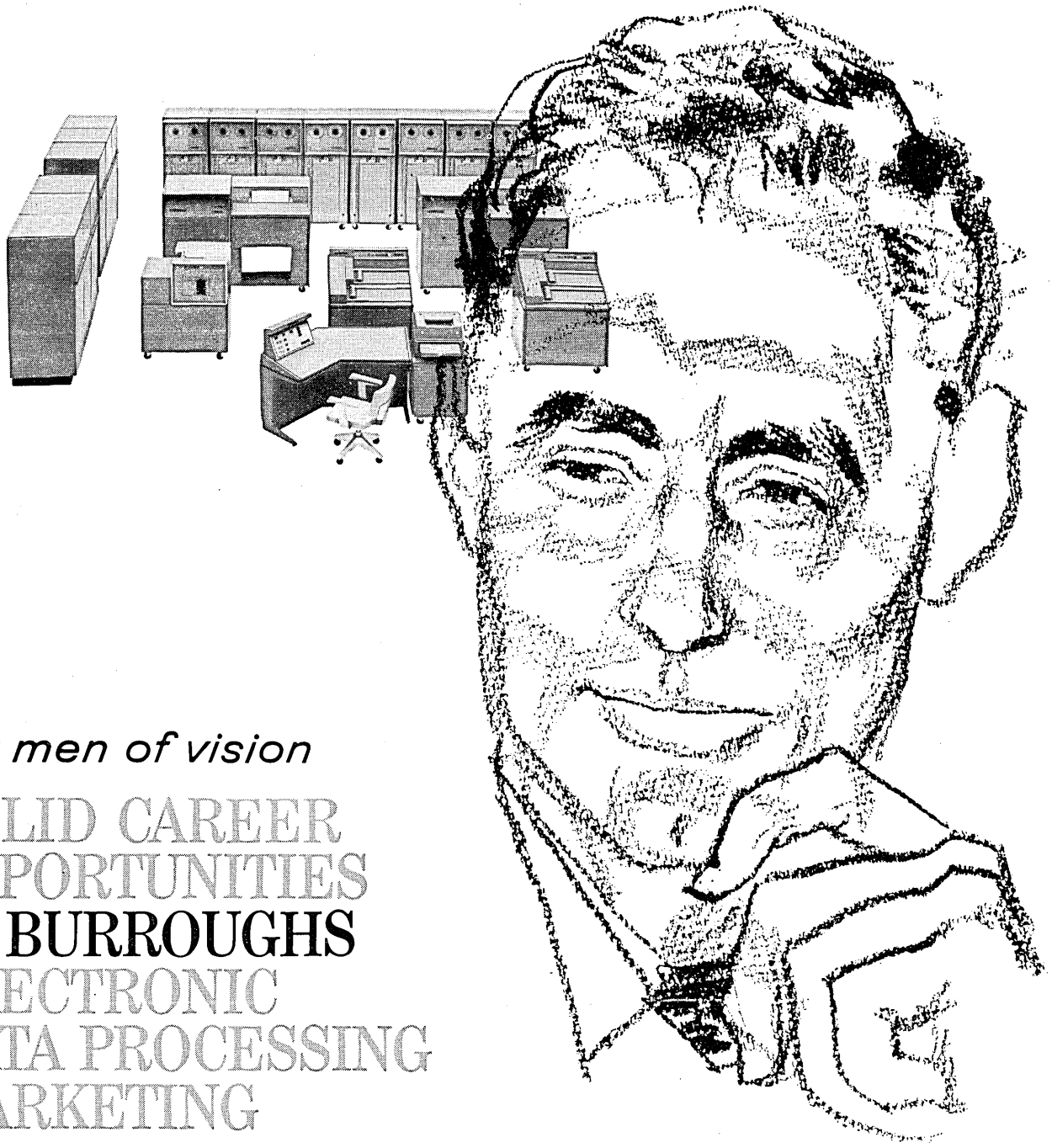


Products are judged by the customers they keep. And for years EP Audiotape, the extra precision computer tape, has been ordered (and reordered) by the most prominent firms in the country. ■ The reasons are evident. Stringent manufacturing procedures insure tape of the finest quality—a fact confirmed by the continuing tests of customers' own engineers. ■ The precision built into EP Audiotape is complete assurance that it will perform and perform consistently on computers, in telemetry, seismography and automation. ■ Why not investigate EP Audiotape for your computer? Every reel is 100% certified according to all the computer manufacturers' own specifications. ■ For more specific product information, get in touch with Computer Department, AUDIO DEVICES, INC., 444 Madison Avenue, New York 22, N. Y.

■ **TYPE EP AUDIOTAPE . . . THE EXTRA PRECISION COMPUTER TAPE**

BOEING
SQUIBB
CONVAIR
RAYTHEON
RAND CORP.
CON. EDISON
BACHE & CO.
FORD MOTOR CO.
ESSO STANDARD
GENERAL MOTORS
MERCK & CO., INC.
MONTGOMERY WARD
SOCONY MOBIL OIL CO.
HUGHES AIRCRAFT CO.
AMERICAN TEL. & TEL.
DOUGLAS AIRCRAFT CO.
WESTERN ELECTRIC CO.
MERRILL LYNCH, PIERCE,
FENNER & SMITH, INC.
LOCKHEED AIRCRAFT CORP.
SPACE TECHNOLOGY LABS.
SYSTEM DEVELOPMENT CORP.
SOUTHERN RAILWAY SYSTEM
ILLINOIS CENTRAL RAILROAD

CIRCLE 6 ON READER CARD



For men of vision

SOLID CAREER OPPORTUNITIES IN BURROUGHS ELECTRONIC DATA PROCESSING MARKETING

Waiting for you at Burroughs Corporation are some of the industry's most challenging and rewarding career opportunities. An extensive and purposeful research and development program has spurred the introduction of several major systems this year—including the pace setting new B 5000, the first computer specifically designed to implement problem oriented languages. There are more to come. A planned program of future releases will insure continuing growth opportunities. Substantial opportunities now await qualified personnel in the following positions:

Special computer representatives: To promote the sale of this advanced data processing equipment, working with experienced account representatives. Opportunities to advance are wide open because of Burroughs practice of developing management personnel from within. Salary plus override will be attractive to experienced computer sales representatives.

Sales technical representatives: To assist sales representatives in technical aspects of sales presentations and guide installations of systems. You will receive progressively more challenging assignments in either scientific or business data processing. You'll qualify with strong magnetic tape installation experience or sound punch card systems background, and receive a salary commensurate with experience.

Openings are available in major cities throughout the U.S. Call the manager of our office near you, or write in confidence to L. D. Staubach, Director of Marketing Placement, Burroughs Corporation, Detroit 32, Michigan.

Burroughs—TM

Burroughs Corporation

All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

CIRCLE 70 ON READER CARD

1961 IMPORTANT DATES

• The Northwest Computing Association Annual Conference will be held July 21-22 in Vancouver, British Columbia, Canada. For information contact Northwest Computing Assoc., Box 836, Seahurst, Washington.

• A two week summer course in digital control systems engineering will be held at Case Institute of Technology July 31 through August 11. For information contact Dr. Harry Mergler, Case Institute of Technology, University Circle, Cleveland 6.

• The G-15 Users Exchange Conference will be held August 10-12 at the Denver Hilton, Denver, Colo.

• WESCON is scheduled for the Cow Palace in San Francisco, Calif., August 22-25. For information contact WESCON Business Manager, 1435 La Cienega Blvd., Los Angeles, Calif.

• SHARE VII meeting will be held from Aug. 23-25 at the Statler Hilton Hotel, Washington, D.C. For information, contact Dr. Aaron Finerman, Computing and Data Processing Div., Republic Aviation, Farmingdale, Long Island, N.Y.

• The National Symposium on Space Electronics and Telemetry will be held in Albuquerque, N.M., September 6-8. For information contact Dr. B. L. Basore, 2405 Parsifal, N. E., Albuquesque, N.M.

• International Symposium on the Transmission and Processing of Information will be held at the Mass. Institute of Technology, Cambridge, Mass. September 6-8. For information contact Peter Elias, RLE, MIT, Cambridge 39, Mass.

• The 1961 Annual Meeting of the the Association for Computing Machinery will be held at the Statler Hilton, Los Angeles, on September 5-8. For information contact Benjamin Handy, Chairman Local Arrangements Committee, Litton Industries, Inc., 11728 W. Olympic Blvd., Los Angeles, Calif.

• The Third International Congress on Cybernetics is scheduled for Namur, Belgium, September 11-15. For information contact Secretariat of The International Association for Cybernetics, 13 rue Basse Marcelle, Namur, Belgium.

1ST B-5000 TO FLY AT HUNTSVILLE

The first installation of the Burroughs B-5000 has been set for the NASA's giant center at Huntsville, Alabama in the fall of 1962, according to a letter of scheduling issued by the computation center. Hardly a newcomer to the Huntsville complex, Burroughs maintains five, 205's at the computing center, plus one at Cape Canaveral and two at Redstone. (see DATAMATION, July/Aug., 1960). Optimistic guesswork from Burroughs hints at the sale of 100, 5000's during the life-span of the system.

Early this Fall, count on Burroughs for announcement of its third solid-state entry, the B-260. Aimed at the business field, the 260 will be similar to the 270, a banking machine announced this Spring. However, the 260 will be sold without the 270's special equipment for magnetic character reading and printer for banking applications.

A NEW GP ENTRY FROM COMPUTER CONTROL

In the new hardware department, DATAMATION has learned of a forthcoming entry in the small to medium-size class of solid-state gp equipment to be introduced and manufactured by Computer Control's Western Division in Los Angeles. Tentatively dubbed the Digital Data Processor (DDP), the machine has a core memory of 4K words expandable to 16K. It is a single address, parallel, binary computer with a word size of 25 bits and average access time of 2.5 microseconds. Complete memory cycle time between memory accesses is 5 microseconds. A Flexowriter will be used as the basic I/O device although paper and magnetic tape, IBM cards and other I/O devices will be available.

The DDP has a compiler and library of elementary function routines in both floating and fixed point, double and single precision arithmetic. The compiler includes symbolic program assembly and algebraic formula translation.

Scheduled for announcement within the next few months, rental would be approx. $3,200 and sale price about $150K.

IMPACT OF U.S. COMPUTERS IN ENGLAND

A candid view of U.S. influence on computing in Great Britain was voiced last month by the London firm, Computer Consultants, Ltd. Their opinion: "Considering the size of their organization, up to now IBM has made little impact on the British computer market. They have, however, been engaged in preparation work and the outcome of this will become only too apparent in the coming months. Between now and June, 1962, they will be making over 80 installations of one computer alone. This means that by this time next year the balance of power, computerwise, will have shifted radically in Britain.

"Their most comparable competitor, I.C.T. (International Computers & Tabulators, Inc.), who still have well over 80 per cent of the punched card market, appears to us to be at a disadvantage with only one computer to offer and that in a somewhat incomplete stage of development from a magnetic tape point of

view. Some merger of this company with another company, probably American, seems inevitable unless they have a very closely guarded dark horse in some undisclosed stable.

"Americans are making more advances towards the British market and it looks as if the computer field is going to be yet one more activity which will be dominated by our western cousins. Particularly as Remington Rand have now made their first British sale (Univac 80), which could open the flood gates for others."

LIGHTENING FLASHES FROM RCA

Project Lightening, occasionally mentioned, but rarely described in detail, concerns government-subsidized r&d in high speed circuitry which may see fruition in advanced hardware from RCA within the not-too-distant future. Other computer manufacturers involved in this project are RemRand and IBM.

A core plus tunnel diode memory with access time in the one millemicrosecond range (approx. 300 to 1,000 times faster than present models) is a concept which has been reported to DATAMATION as having been achieved in the laboratory. Still posing engineering blocks, however, is the problem of microminiturization aimed at improving reliability of a super high-speed system.

In actual hardware development, speeds may be about 10 per cent slower but the cost of such a system could be comparable to the 601 (approx. $32,000-$68,000 per month). At present, about three years of research lies ahead before a Lightening system could be ready for delivery to the Bureau of Ships.

C-E-I-R ORDERS TWO STRETCH UNITS

Following IBM's recent announcement of a substantial price reduction for STRETCH, DATAMATION has learned from C-E-I-R President Dr. Herbert Robinson that this firm has ordered two STRETCH configurations. The first installation is set for November, 1962 on the West Coast. Provisionally scheduled for Los Angeles, Dr. Robinson feels that it may be switched to another West Coast location. The second STRETCH is due on the East Coast in mid-1963. No specific location has been announced although New York City is probable.

As for work to occupy these super systems, Dr. Robinson expects a large segment from the field of economic data processing in addition to scientific dp. He does not feel that success of the operation will hinge on high speed data transmission although he did state that developments "might break in this field" prior to C-E-I-R's first STRETCH installation.

On software, Dr. Robinson felt that IBM would deliver its promised set of programs although the population of STRETCH programmers would be limited.

At Los Alamos, the world's first STRETCH configuration is now OFFICIALLY on the air.

10, G-20s SET FOR '61 DELIVERY

Two complete G-20 systems per month are expected to roll off the Bendix production line this year, according to Maurice Horrell, general manager of the computer division. This new schedule amounts to a doubling of production with 10 systems planned for delivery by the end of this year. Since the introduction of the computer, total dollar value of orders on hand has increased 1,900 per cent. Bendix has also increased its field force by 45 per cent in the past year largely to support the G-20.

ANOTHER SUPERIOR PRODUCT USING TEXAS INSTRUMENTS COMPONENTS

Data-stor's* Model 59 Digital Magnetic Tape System reflects the design and engineering know-how obtained during 12 years active participation in missile programs including Atlas, Polaris and Titan. The Model 59 was built to fulfill critical demands for reliable, high-speed data processing and storage equipment.

Superior performance of Texas Instruments transistors in other high-reliability military equipment prompted Data-Stor to specify Texas Instruments components to these critical tasks in the Model 59 System.

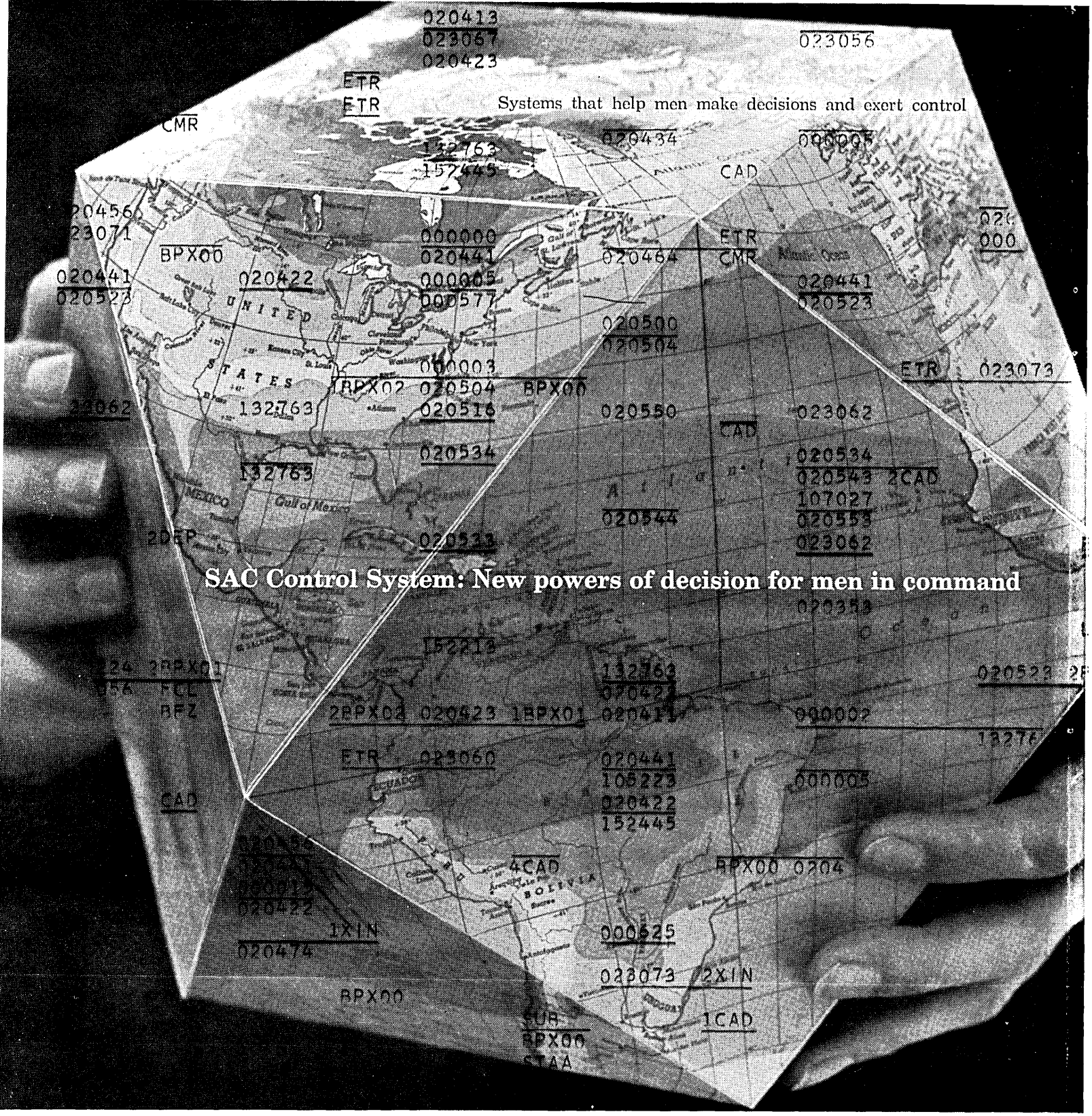
Here's how Data-Stor engineers evaluated TI's components: "Texas Instruments transistors meet our exacting demands for performance and reliability."

*Data-Stor – a division of Cook Electric Company, Chicago

SEMICONDUCTOR-COMPONENTS DIVISION
PLANTS IN DALLAS, TEXAS
BEDFORD, ENGLAND
AND NICE, FRANCE

TEXAS INSTRUMENTS
INCORPORATED
13500 N. CENTRAL EXPRESSWAY
P. O. BOX 5012 DALLAS 22, TEXAS

#17969



This world-wide communication network will help Strategic Air Force leaders exercise command and control almost in response to events of the moment. Yet the forces involved are dispersed throughout the world, the volume and complexity of information unprecedented. ¶ The SAC Control System will be a product of the new technology of automated information processing assistance. We have helped create this new technology, beginning with our work on SAGE. In projects such as SAACS and SAGE, we perform system analysis, information processing system design, and training of personnel in system use. And as a continuing effort, we carry on research into future generations of these control systems.

Scientists and engineers interested in joining an interdisciplinary approach to system development are invited to inquire about our rapidly expanding efforts. Positions are open for Computers Programmers, Operations Research Scientists, Engineers, Human Factors Scientists at our Santa Monica, California, Lexington, Massachusetts, Washington, D. C., and Paramus, New Jersey facilities. Please address Mr. A. C. Granville, Jr., SDC, 2401 Colorado Avenue, Santa Monica, California. All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

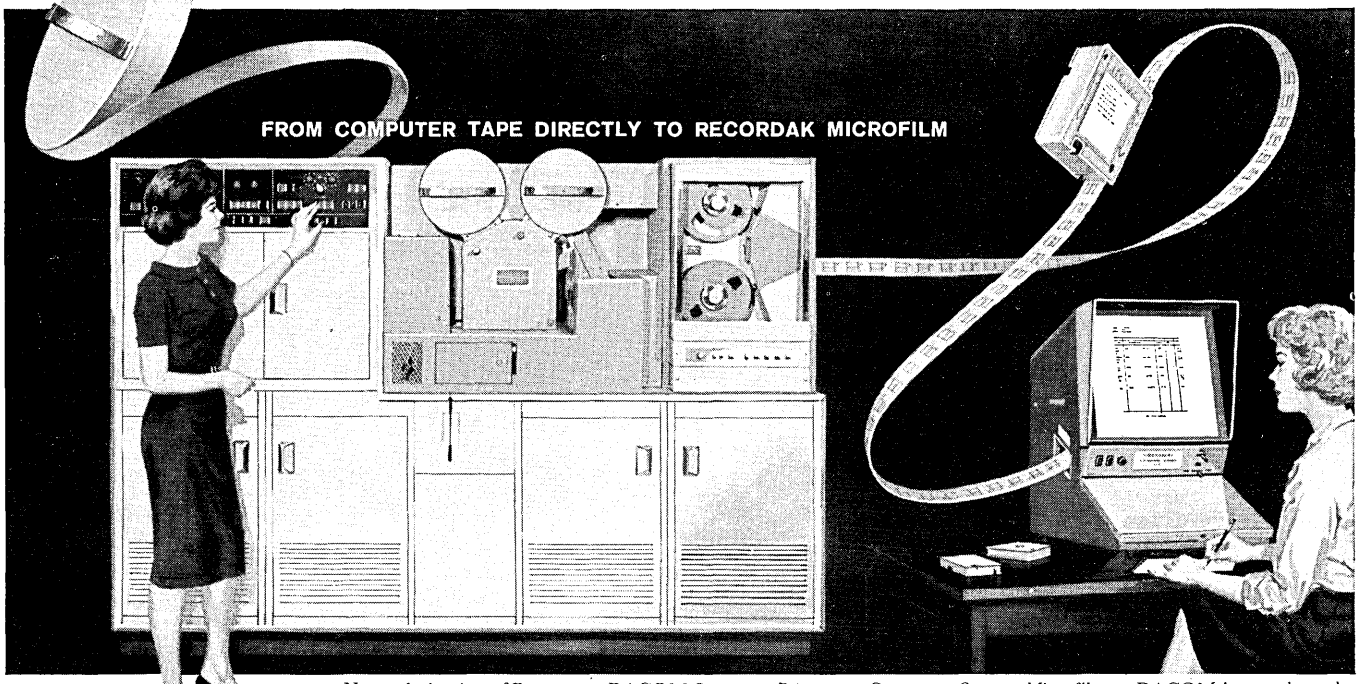
SDC
SYSTEM DEVELOPMENT CORPORATION

CIRCLE 71 ON READER CARD

The globe shown is the Dymaxion projection by R. Buckminster Fuller. It depicts the spherical world as a flat surface with a minimum of distortion.

New RECORDAK DACOM System

translates computer language into plain English at speeds up to 20,000 characters per second!



Name derivation of RECORDAK DACOM System—*DA*tascope *C*omputer *O*utput *M*icrofilmer, DACOM is a trademark.

The RECORDAK DACOM System delivers incredible printout speeds which equal or exceed computer speeds . . . provides indexed microfilm records which are much easier to file and use . . . introduces important advances in point plotting and logic diagramming.

First, let's consider the importance of the RECORDAK DACOM System as a Print Out Medium.

Its great advantage in speed over mechanical printers turns lag time into productive time, allows a more continuous work flow. And its increased versatility gives you still greater return on your investment in electronic computers. Look at just a few examples of how the RECORDAK DACOM System can be applied to varied operations.

- *It optically combines* computer data with any office form design . . . gives you, for example, a complete customer statement on a single film image. Paper facsimile copies of exceptional clarity can be produced at high speed from your microfilms by photographic and other rapid copying methods.
- *It provides* the fastest, most accurate method of point plotting.
- *It records on film* logic diagrams of electronic circuits.

Graphic Arts quality

Along with increased speed and versatility, the DACOM System provides graphic arts quality in any type style you select. Look at DACOM film in a RECORDAK Film Reader and you'll find it hard to believe that the images produced from invisible pulses on magnetic tape are even sharper than the type on this page.

How RECORDAK DACOM System simplifies data storage and speeds reference

- The decoded information on as many as *eight* 2,400-ft. reels of magnetic tape can be recorded on a *single* 100-ft. roll of 16mm RECORDAK microfilm.
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editor's readout

A PLEA FOR UNMUDDLING

A well-heated topic for after-dinner conversation, publication editorials, guest spots for industry affairs and for just spouting-off, has long centered about "automation and its effect on the working force." DATAMATION makes no bid to join the fracas but rather, an earnest plea for unmuddling an overly cloudy scene.

Prior to the advent of EDP, **automation** consisted of all things with suspicious movement from ball bearings to electric pencil sharpeners. Since the computer shoved its console through the door, the meaning has been expanded somewhat and now includes all things movable and stationary, particularly those which are plugged in and hum.

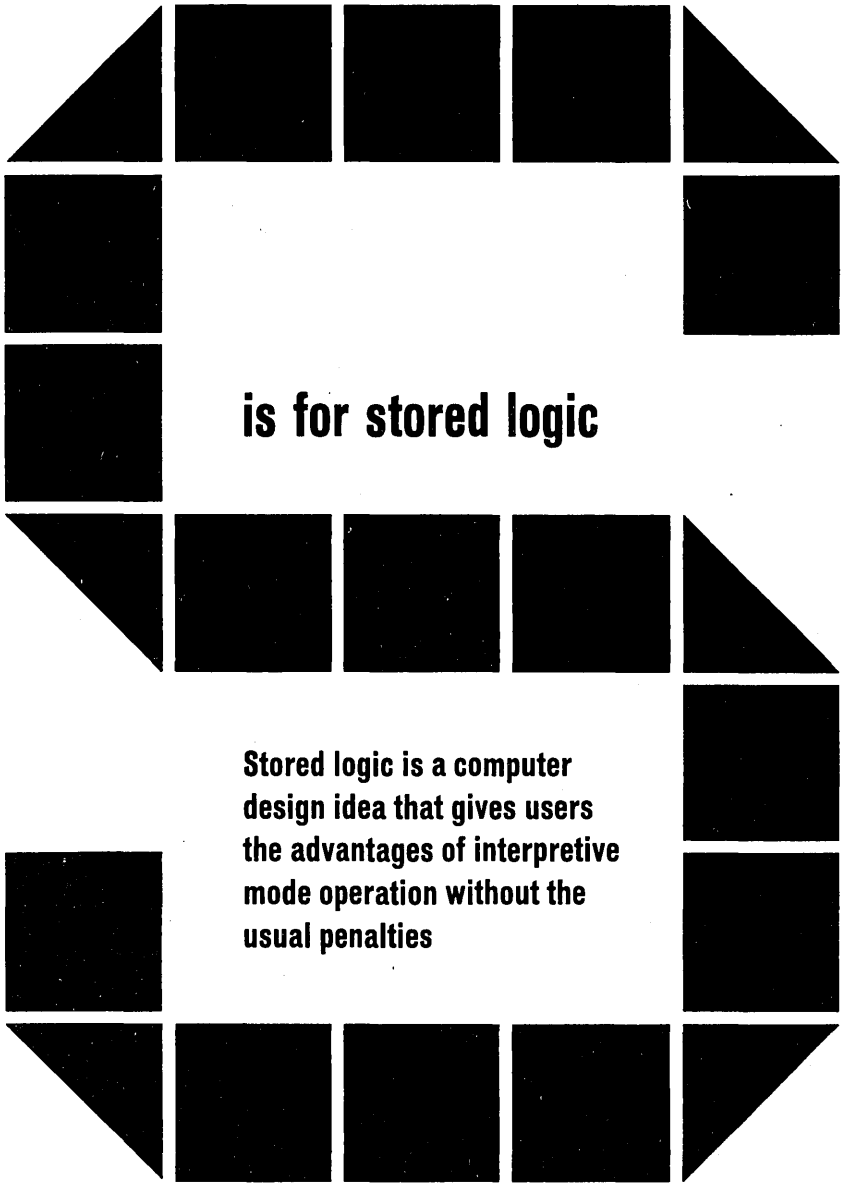
The ease with which an opinion may be ventured in this area (regardless of its value or point of view) is a frightening spectacle. In an industry barely out of the embryo stage and so rapidly accelerating as to leave a dearth of statistical introspection in its wake, labor statistics based on EDP installations, are tossed about with careless abandon. Rarely is a viewpoint expressed which implies the need for more reliable information.

Two points of view are of course, predominant: "Yes, we have a problem!" and "No, we ain't!" There is a third viewpoint which combines the best elements of the first two and subsequently, becomes equally ludicrous. The resultant chaos figuratively cries for clarification and a specific change in menu. To this end, we offer some basic hypotheses which should find general acceptance:

1. An electronic, digital computer performs a function differing substantially from a conveyor belt. Not only does the function differ, but the resulting labor problems or lack of them, are quite dissimilar and should be treated as such.
2. A telephone is not a computer nor is a photo-copying machine, a ball point pen, or a machine which gums labels. In addition, computers are not likely to replace these office tools or the people who use them.
3. Process control by computer is such a spanking new venture with so many variables that even the most astute labor economist would be hard pressed to speak with authority. The implication is that others considerably less qualified, should not speak at all.
4. The area of scientific and engineering study also utilizes EDP to the tune of several thousand installations throughout the country. The coincidental effect of this work accelerating the opening of new areas for employment and business expansion might well be viewed with some interest. For this purpose, some intelligence and acumen are required.
5. Computers may perform with high reliability and acceptance in a number of areas. Other areas of limited application but nevertheless, recepients of much consumer-oriented publicity include: sausage manufacturing, raisin growing, wine tasting, and stuffing tooth paste into tubes of varying dimension. These should not be viewed as threats to national employment due to the encroachments of EDP.

It **is not unreasonable** to assume that computing in the future will have a profound impact on almost every aspect of our economy and culture. However, to attempt to predict the effect of this impact on our present labor force without substantial facts, **is unreasonable.**

Without burying one's head in too much sand, it is important to accurately define the scope of a discussion on "automation and its effect on the working force," and once defined, to probe what information is available with caution and critical judgment. Of intrinsic value, is the acquisition of facts, rather than opinions. Once a sufficient quantity of reliable data can be stored, the solution may well become apparent in a matter of microseconds.



Computer people will admit that when a general purpose machine is operating in an interpretive mode it may spend most of its time doing non-productive work loosely called "housekeeping" functions. There's nothing wrong with this, as long as a user is willing to sacrifice efficiency for convenience. However, there are users and users, and many of them resent having to accept penalties of any kind—for any reason. Others need to have a computer that will perform as efficiently in many different modes as it does in the characteristic mode for which it was designed. Ordinary interpretive systems simply can't do this.

The basic trouble stems from the fact that computers and people (not counting programmers) don't speak the same language. The user often has to "command" his machine in codes archly called pseudo-instructions. The computer can't work from pseudo-instructions, but has to translate them into logic steps that will open gates, start counters, trigger flip-flops, and otherwise cause the machine to react to the problem.

It is this roundabout way of doing things that gives interpretive systems their bad reputation. (Small wonder, when a routine may take an ordinary computer ten to fifteen times as long to run interpretively as it would if the computer were lucky enough to be working from instructions originally wired into its back panel!)

It would be nice if all instructions could be wired into the computer in exactly the form that every present and future user would possibly desire. Of course, that's just dreaming. There are always new users and new problems.

A practical approach is to wire in only the basic (or generic) elements of all instructions, in order to get machine efficiency—and store in the computer's memory the logic for putting together the endless varieties of instructions and routines that users inevitably think up once they get their hands on a new computer.

This is the approach used by Ramo-Wooldridge in the design of its "stored logic" computer. The first model in R-W's stored logic line is the AN/UYK-1, an inexpensive machine being built for the Navy for general shipboard use. To illustrate its efficiency: the AN/UYK-1 can do a 15-bit basic add in 12 microseconds; a 30-bit arithmetic sine instruction, composed from some 30 generic commands, will take about six milliseconds. With 54 types of basic command elements, most of which have 32 options, the AN/UYK-1 offers its users more than 1100 generic portions (called logands, from LOGic commANDS) from which to compose instructions. These tailor-made instructions can be used directly by the programmer to solve his problems.

Recent contract awards for stored logic computers have created opportunities for adventurous programmers, systems analysts and circuit design engineers interested in helping to exploit the inherent advantages of the Stored Logic concept.

All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

Contact Mr. Theodore Coburn at

RAMO-WOOLDRIDGE

A DIVISION OF

Thompson Ramo Wooldridge Inc.

8433 FALLBROOK AVENUE, CANOGA PARK, CALIFORNIA

FROM UNIVAC®

AUGUST 1960—Univac® Larc I, world's most powerful computing system, passes acceptance test

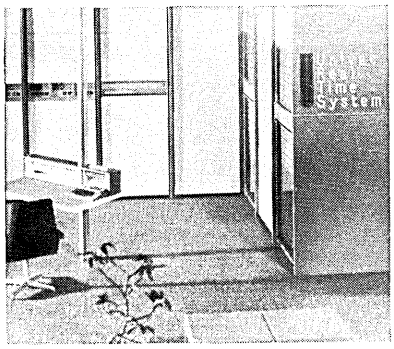
Univac Larc I has been operating since August 1960 at the Atomic Energy Commission's Lawrence Radiation Laboratory at the University of California. Only one other accepted computer in the Free World compares to Univac Larc I in size, speed, and power. The other computer: Univac Larc II—installed and now delivering results for the U.S. Navy, Bureau of Ships, David Taylor Model Basin. Univac Larc I and II are achievements which are equal in importance to the invention of the world's first electronic computer. All three, achievements of Univac.

DECEMBER 1960—Univac announces major breakthrough—new Univac 490 Real-Time System

Distance and time gap no longer limit the effectiveness of data communications. For now Univac 490 Real-Time System takes questions from hundreds of remote points, updates master records, and transmits answers in a matter of seconds.

For example, data fed to the central system over a communications network from distant, far-flung sales points can be used simultaneously to reduce your inventory, explode cost factors, and even alter production schedules when necessary. Or, in the case of an airline reservation system, the transmitted data could be constantly updating the system's seat inventory or passenger records.

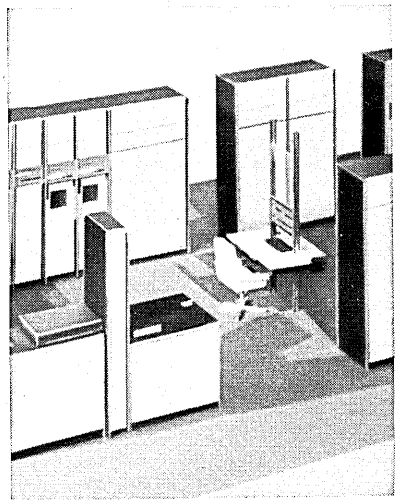
The new Univac 490 Real-Time System processes all data, corrects its files, and answers the problems of each location as if it were in the adjoining room.

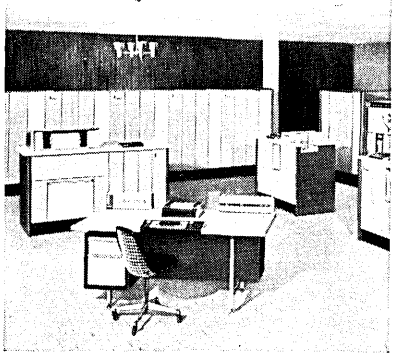


DECEMBER 1960—World's first commercial thin-film memory computer introduced by Univac

Univac Division scientists have introduced ferromagnetic film which is the fastest and most advanced computer memory ever developed.

Coupled with this major advance came the first commercial computer of its type in the world, Univac 1107 Thin-Film Memory Computer. This powerful system provides fantastically fast access to stored information. Previous computers measured access time in millionths of a second. Now with Univac Thin-Film it is rated in nanoseconds—billionths of a second!





MAY 1960—Univac introduces a high-performance, low-cost data processing system: Univac III

Univac III offers large-scale performance at lower cost per unit of output than any other system in the market.

Developed by the men who invented the world's first electronic computer, Univac III incorporates the most advanced solid-state circuitry and data processing concepts. For example: because of a new character packing technique, information which previously required 20 reels of magnetic tape can be stored on only one reel of Univac III tape and read off at the rate of 200,000 digits every second.

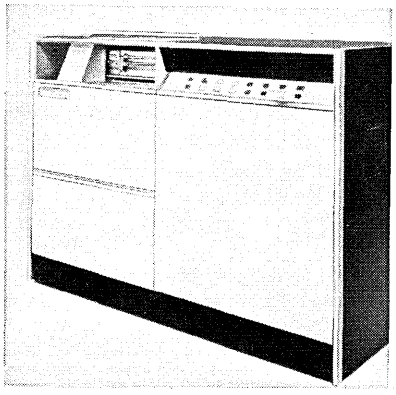
No other commercial computer combines such great application flexibility, high-computing speeds and accurate performance in a single system!

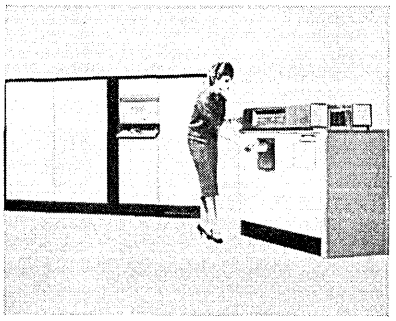
MARCH 1960—New Compatible High-Speed Printer provides complete systems compatibility

From Univac, another giant step forward: the new Univac Compatible High-Speed Printer. Users of competitive equipment are no longer bound to one manufacturer.

Model I of the new Univac High-Speed Printer operates off-line with Univac systems. Model II operates off-line with computer systems of another leading manufacturer.

Both models have been thoroughly field tested and are already in use delivering dollar-saving advantages never before possible.





AUGUST 1960—Univac announces STEP—a computer plan that keeps pace with your growing needs

STEP—a solid-state system designed to take a business across the crucial step from mechanized tabulating into electronic data processing—was announced to Business-America by Univac in August 1960.

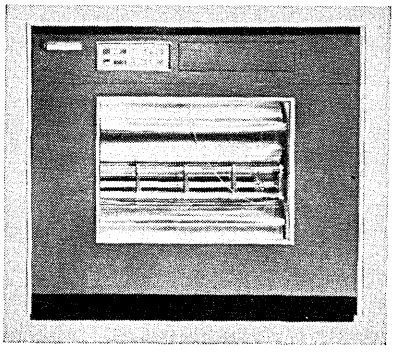
Univac STEP (Simple Transition to Electronic Processing) is economical, versatile, and can be installed without disturbing normal work. Yet there is nothing unsophisticated about it. Built around four units—a Central Processor, a High-Speed Reader, High-Speed Printer, and a Punch Unit—STEP can perform many varied record-keeping jobs. Examples are payroll, sales analyses, and production scheduling. And STEP'S building-block concept permits the addition of equipment options to meet increased data-processing needs.

OCTOBER 1960—Univac scores again with development of Randex super-capacity storage system

Randex, the new Univac super-capacity drum system, stores over 24 million easily accessible characters per unit. And up to 10 units can be utilized for a total of a quarter billion usable storage positions.

Another big plus for Univac Randex is its remarkably fast access time—as low as 35 milliseconds to read or write 48 10-digit words and signs.

Designed for both Univac Solid-State and STEP Plan Computers, Randex accelerates and simplifies the processing of a wide variety of applications and gives users an extreme degree of versatility and flexibility.



Tabular form has shown promise of being an effective way to organize and present decision logic for systems analysis and computer programming. Experience to date clearly indicates the need for further exploration and development of tabular form to determine its range of application and assess its future potential. This report has the dual purpose of sketching the historical background on the development of tabular form, and indicating its possible advantages.

TABULAR FORM IN DECISION LOGIC

by BURTON GRAD, IBM Corporation,
Thomas J. Watson Research Center,
Yorktown Heights, N.Y.

Glancing around the office, I can see three young women busily engaged in the various duties of a typical work day. Let me tell you about them. Blond Marilyn is a chatterbox. Penelope and Theresa enjoy going to the movies. Marilyn is married, but the other two are single. Penelope has an attractive figure, while Marilyn is somewhat on the plump side. Theresa's quiet moods contrast to Penelope's happy ones, but they both seem to enjoy life in native Manhattan. Marilyn has dimples; Theresa may be recognized by her amber eyes and red hair. Unlike the others, Marilyn prefers Shakespeare and country living in Chappaqua.

Without looking back, can you recall all of Penelope's characteristics? Do you have a clear image of each girl and know what data is missing or where there are inconsistencies? To help answer these questions, let's rearrange the information. Displayed in tabular form, it would appear as in Figure 1:

Name	Marilyn	Penelope	Theresa
Marital Status	Married	Single	Single
Hair Color	Blond		Red
Figure	Plump	Attractive	
Enjoys Movies		Yes	Yes
Prefers Shakespeare	Yes	No	No
Residence	Chappaqua	Manhattan	Manhattan
Features	Dimples		Amber Eyes
Characteristics	Chatterbox	Happy	Quiet

Figure 1

From this illustration, some of the advantages of tables over narrative style for comparative data display can be readily appreciated: **Conciseness and clarity** is achieved by classifying data; **Completeness** is insured by revealing areas where information is missing; **Meaningful relationships** are recognized quickly and easily with the two dimensional structure.

While recognizing these advantages many will point out that tables are merely a systematic way to present static data. Do they have a worthwhile function in a more dynamic situation—that of decision making? Would tables be valuable in systems analysis and computer programming? Before we explore some preliminary answers to these questions, let's look at a brief history of tables.

universality of tables

Tables, whether statistical, financial, or analytical, have gained widespread recognition; they seem to be a natural form for expressing relationships among variable factors where there are many possible patterns for arranging the significant information. This fact is substantiated by the profusion of examples in everyday life:

> The ubiquitous government reports with ponderous breakdowns of the GNP or a simple recap on whooping crane birth rates and population.
>
> The multiplicity of financial reports showing the status and growth of businesses.
>
> The economic forecasts of things to come ranging from hula-hoop production to manned satellites in the burgeoning 60's and beyond.
>
> The daily scratch sheet, the box scores of runs, hits and errors for the latest baseball games, and the highs, lows, and closing prices for stocks – all in the local newspaper.

And the list grows.

application to computers

Since the early days of computer development, programmers have used analytical tables to convert arguments into precise functional values; they have also employed matrix structure and notation to handle common information with relatively complex structure. In the past few years, however, there has been substantial interest in probing the potential applications of tabular form for recording the decision logic itself. This exploratory work in developing decision tables has involved consideration of man-to-machine as well as man-to-man communication.

In systems analysis and computer programming, decision tables, like conventional data tables, retain a two-dimensional structure to portray significant relationships. The form, however, is considerably more elaborate to show multiple conditions and actions interlocked through position. Within a decision table any language from a business jargon to the most machine-oriented may be utilized to express the decision logic.

There are other well-known methods to describe a business system: narrative, flow charts, and logical equations. Narrative form, unfortunately, is often wordy, requiring prepositions, conjunctions, and other superfluous elements for readability; there is a certain lack of form and physical relation which may lead to inaccuracy and inconsistency if the user is not extremely careful. Flow charts require lines and connectors to show relationships; when these become too numerous, the logic may be difficult to follow and the layout may demand excessive space. Logical equations are symbolic and abstract as, for example, Boolean algebra applied to computer programming. The main limitations are the need for special skills and background to algebraically describe decision rules and the attendant difficulty in communicating equations in a business environment. Shortcomings in these well-known methods have encouraged systems analysts to take a harder look at other alternatives.

Tabular form for decision logic seems likely to satisfy this search since it compensates for many of the limitations of the other forms by providing compact expression of decision rules, visually effective display of meaningful relationships, and straightforward indication of logical correspondence. The significant difference between tabular form and other methods is not in the notational scheme used, but rather in the physical layout for recording the systems description or programs.

Let's now examine the use of decision tables. It is not intended to suggest that this form is superior to existing languages where they are appropriate for a specialized class of problems, e.g., FORTRAN for algebraic calculations, report generators for preparing output documents. Rather, the feeling is that no method today is well-designed for systems men to use for describing complex logical decisions; therefore, decision tables may well fill a current void in a total systems analysis and programming package.

extended entry tables

One type of decision table is called EXTENDED ENTRY. Figure 2 illustrates a simple application:

	Rule 1	Rule 2		Rule 30
Age	≥25 <35	≥25 <35		≥65
Health	Excellent	Excellent		Poor
Section of Country	East	West		West
Rate/1000	1.57	1.72		5.92
Policy Limit	200,000	200,000		20,000

Figure 2

The first decision rule (columns 1 and 2) can be paraphrased: If age is greater than or equal to 25 and less than 35, and health is excellent, and section of country is East, then rate per thousand is 1.57 and policy limit is 200,000. The underlined words are implied by the table layout. The other rules are alternatives to this one, so that logically, it does not matter which rule is examined first; only one rule can be satisfied in a single pass through this decision table.

As in most disciplines, a vocabulary is needed to describe the special properties and characteristics of decision tables. Fortunately, a glossary of terms for tabular form is already

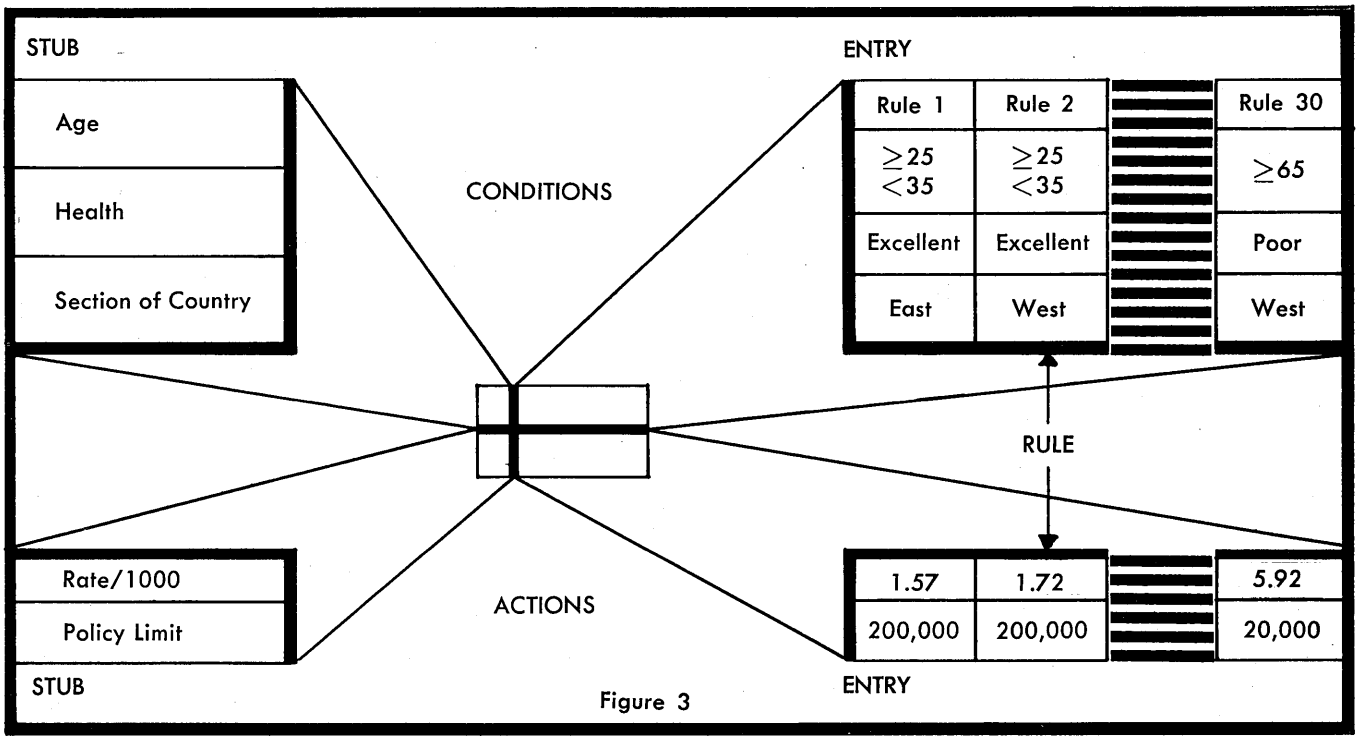


Figure 3

in existence from the statistical and financial fields; these supply an appropriate starting point.

Using the information from the insurance example (Figure 3), the decision table is shown in an exploded view, Figure 3 to show recommended titles: (see preceding page).

The double lines serve as demarcation: CONDITIONS are shown above the horizontal double line, ACTIONS below; the STUB is to the left of the vertical double line, ENTRIES are to the right. Each vertical combination of conditions and actions is called a RULE. By adding to the elements shown a title section at the top of the table which is called a TABLE HEADER, and a RULE HEADER over the entries, the essential nomenclature is complete.

limited entry tables

LIMITED ENTRY tables offer a different approach to stating the decision logic. This type of table is shown in Figure 4:

	Credit Limit is OK	Pay Experience is Favorable	Special Clearance is Obtained	Approve Order	Return Order to Sales
Rule 1	Y			Y	
Rule 2	N	Y		Y	
Rule 3	N	N	Y	Y	
Rule 4	N	N	N		Y

Figure 4

The first rule (rows 1 and 2) is read: If credit limit is OK then approve order. Again, the underlined words are implied by the form. In limited entry tables the entire condition or action must be written in the stub; the entry is "limited" to reversing a condition or ignoring a condition or action. In contrast, extended entry tables have a part of the condition or action "extended" directly into the entry. While this decision table (Figure 4) is arranged quite differently, the same table elements are present. Structurally, the table appears as in Figure 5:

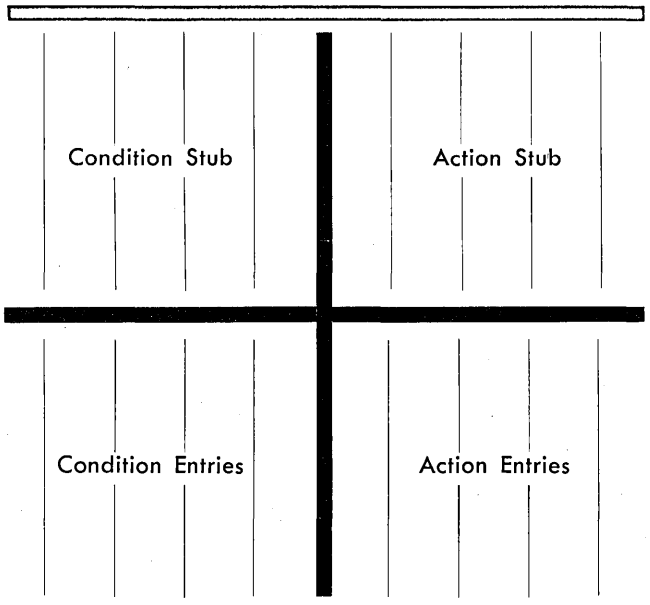


Figure 5

Limited entry permits only a few values in an entry:
Y = yes
N = no
Blank = not pertinent (e.g., condition or action need not be considered in the current rule)

business applications

Examples of successful applications of decision tables in business are as yet few in number, but some of the pioneering work can be reviewed briefly.

Initial work on the use of tabular form for recording decision logic was performed by General Electric's Integrated Systems Project from the fall of 1957 through 1959; during that period, I was the project leader. Many individuals were involved in this development work which concentrated on the use of tabular form to express the logic of product design, operation planning, cost determination, quality assurance planning, etc. This project developed extended entry decision tables for man-to-machine communication.

Mr. T. F. Kavanagh, in commenting on this work at the 1960 Eastern Joint Computer Conference,[1] noted, "the decision . . . table is a fundamental language concept . . . broadly applicable to many classes of information processing and decision making problems; . . . tables force a step-by-step analysis of the decision, . . . are easily understood by humans regardless of their functional background . . . (they are) simple and straightforward (enough) that . . . specialists can write tables . . . with very little training; . . . tables are easy to maintain (and) errors are reported at the source language level."

From late 1958 to the present time, Sutherland Company, a consulting firm in Peoria, Illinois, has been using tabular form for expressing what they call management decision rules. They have applied these techniques to a number of their clients' problems (e.g., a logistics study for Norton Air Force Base) with quite satisfactory results. In particular, they have used decision tables to record the logic for payroll, order processing, sales analysis, general ledger accounts, accounts payable, accounts receivable, and cost accounting. There has been no published material to date on the Sutherland work but available information indicates that limited entry decision tables are being used.

In 1959, Hunt Foods and Industries began experimenting with tabular form for man-to-man communication in computer systems planning. Material on this approach was the first to be released, in late 1959, describing how limited entry tables were used for systems analysis. Explorations were also carried out on complex relationships among individual decision using prior rule and sub-routine techniques. Many business systems were documented with decision tables: stock-control, credit analysis, sales analysis, and traffic.

In his report on the work at Hunt Foods, Mr. O. Y. Evans states, "The tabular approach . . . aids . . . in visualizing the numerous relationships and alternatives . . . (and) permits data rules to be readily reviewed for omissions and inconsistencies; . . . (in addition it) provides flexibility in changing any portion of the analysis."

Since early 1960, IBM has been actively engaged in exploring the value of tabular form both for systems analysis and for computer programming. The company has initiated joint projects with several customers to evaluate the effectiveness of various tabular forms, to explore alternative methods of implementation, and to investigate opportunities for incorporating these developments as an adjunct to existing languages. Since there are many different aspects of tabular form which still need to be examined, language implementing programs have not been prepared. These studies have developed and formalized mixed limited and extended entry tables, stubless tables, and unconditional decision tables.

The CODASYL Systems Group, which is part of the Development Committee of the Conference on Data Systems Languages, has been looking into the application and use of decision tables since late 1959. Their particular goal has been the creation of a systems-oriented language which would enable systems analysts to communicate their basic

decision logic either to computer programmers or to automatic program compilers. This organization contends that tabular form is one currently known technique which would aid in achieving effective mutual understanding of business decisions while maintaining machine independence. Their efforts have included research on generalizing tabular form to combine limited and extended entry format in a given table, as well as studies on more complex methods of sequence control, rule structure, and rule execution logic.

an example

To illustrate some of the possible advantages of decision tables, a composite tabular form is shown in Figure 6; these tables describe the logic of a file maintenance procedure. There are two input files (Detail and Master), each sequenced by identification number. The principal output is a similarly sequenced Master file incorporating additions and changes and omitting deleted records. The logic is based on having three internal areas: (1) Detail, (2) Master, and (3) New Master. "Read" as used here means "obtain the next record in the referenced file." "Write" means "produce an output Master record from the indicated source area." These are not detailed, precise tables for machine compilation, but rather the equivalent of a block diagram.

value of decision tables

So far, decision tables have been discussed in the light of known applications and attributed values and advantages. Though many current developments are still in the realm of "company confidential," several projects have indicated results that enable us to discuss the value of tables in concrete terms.

Recalling the three benefits mentioned previously, some studies claim that decision tables appear to be superior to other methods for representing complex decision logic in that they provide or encourage:

clarity and conciseness
completeness
meaningful relationships

To indicate the potential results from use of tabular form, the following statements paraphrase various user opinions: **Clarity and conciseness** – Decision tables are easy to prepare, read, and teach to others; experience shows that nonprogrammers can learn to prepare satisfactory tables in less than a day. The amount of writing, or number of words, lines, and symbols used in describing complex decisions, is reduced by 25-50% as compared to flow charting. For certain specific cases, problem statement and programming time combined have been reduced significantly. **Completeness** – Tabular form allows effective visual or desk debugging both by the analyst and the reviewer. There are fewer errors to start with since the analyst tends to catch his own mistakes; moreover, the reviewer will typically detect a high percentage of the remaining errors

TABLE 001 — Update

Rule No.	01	02	03	04	05	06	07	08
Start	Y	N	N	N	N	N	N	ELSE
End of Detail		N	N	N	Y	Y	N	
End of Master		N	N	Y	N	Y	N	
Detail		<Master	=Master				>Master	
Detail an "Addition"		Y		Y				
Do Error Routine								X
Move Master to New Master			X					
Move Detail to New Master		X		X				
Set Addition Switch	OFF	ON	OFF	ON	OFF	OFF	OFF	OFF
Write Master					X		X	
Read Master	X				X		X	
Read Detail	X	X		X				X
GO TO TABLE	001	002	002	002	001	END	001	001

TABLE 002 — Change

Rule No.	01	02	03	04	05	06	07
Detail	<New Master	>New Master	>New Master	=New Master	=New Master	=New Master	ELSE
Addition Switch ON		Y	N		Y	N	
Detail a "Change"				Y			
Detail a "Delete"					Y	Y	
Write New Master		X	X				
Do Error Routine	X						X
Do Change Routine				X			
Do Delete Routine					X	X	
Read Master			X			X	
Read Detail	X			X	X	X	X
GO TO TABLE	002	001	001	002	001	001	002

Figure 6

by visual examination. Finally, experience shows that with this foundation and suitable test problem construction, it is easy to rapidly detect the balance of the errors during machine debugging.

Meaningful relationships – Table structure serves to improve systems logic by aligning alternatives side by side. It also sharpens cause and effect understanding, so relationships which are accidental or incidental become clearer. Furthermore, actions based on similar or related conditions are apt to be drawn into the same table, making it easier to appreciate and consider dependent factors.

The evidence quoted on the advantages of decision tables for systems analysis and computer programming is based on actual study projects. Some of these studies even tested decision tables on various data processing machines. There are many current studies which are experimenting with a variety of tabular forms.

future direction

With all its potential advantages, it is apparent that tabular form has not yet achieved full growth and stature; there are major technical and application areas still unprobed, awaiting only the touch of creativity to make practical breakthroughs. Current table methodology, for example, does not yet provide an effective systems-oriented language. Unable, then, to describe the decision logic in a systems-oriented language and untrained to an adequate degree in knowledge of equipment capabilities, the systems analyst often severely constrains the computer programmer.

What then of the future? Would it be desirable to directly incorporate tabular form into existing language processors such as Autocoder, FORTRAN, Commercial Translator, or COBOL, to describe complex decision procedures with decision tables? Would this approach significantly improve logical analysis? Would it simplify programming, debugging, and maintenance?

Would it be advantageous to try to create a systems-oriented language using tabluar form as a primary method for describing decision logic? Should we carefully consider the relative advantages of using interpretive rather than compiler techniques for applying tabular systems-oriented languages to computers?

We are witnessing a literal explosion in scientific technology, not the least of which is the rate of innovation in computer hardware. Laboratory shop-talk treats subjects like thin magnetic films, microminiaturization, and masers, as if they were accomplished facts; and before we realize it, they often are. Progress in language concepts, though, lags seriously behind hardware advances. Failure to keep pace can be attributed to several factors: inadequate effort, requirements for compatability with existing systems, and lack of problem recognition. Facing opportunities like automated product engineering and real-time control, we are handicapped by the limitations of current ways to describe business systems. Tabular form, one significant new tool for methods and systems people, may help to accelerate business language development and to advance systems technology.

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(2) Evans, Orren Y., "Advanced Analysis Method for Integrated Electronic Data Processing," IBM General Information Manual, #F20-8047.

EDP highlights at

1961 WESCON

Increasing attention will be focused on the computer industry and peripheral EDP areas at the 1961 WESCON scheduled for San Francisco's Cow Palace, August 22-25.

Included among field trips of particular interest in the field of information processing is a tour of the computer and microelectronics laboratories at the Stanford Research Institute. Visitors will hear the SRI technical staff discuss the neuristor, all-magnetic logic techniques, microelectronics, and pattern recognition.

Demonstrations of magnetic logic circuitry, a small all-magnetic arithmetic unit, and various storage techniques will be presented. The tour is planned for 1 p.m. Thursday, August 24.

The technical program offers a number of computer-oriented sessions. Session 3, Tuesday, August 22, is entitled **High Speed Logic,** and will be conducted at 10 a.m. in Room C. Topics of the papers will include "Relationships Between Device and System Design Factors in UHF Computers," "ASI – A High Speed Anti-Saturation Inverter Logic Circuit," and "A Tunnel Diode – Tunnel Rectifier, 15 Nanosecond Memory."

Session 7, scheduled for Room B at 2 p.m., is entitled **Solid State Devices.** Papers include "Superconductor Solenoids," and "Parametric Quartz Amplifier."

Session 8, **Computer Applications,** will be conducted at 2 p.m. in Room C. Papers planned for presentation will be "Plato: An Automated Teaching Device," "The User Looks at the Information Storage and Retrieval Field," and "An Advanced Digital Data System for Use in Nuclear Reactor Development."

Thursday, August 24, will include session 23 on **Nanosecond Techniques** at 10 a.m. in Room C. The papers given will be "Nanosecond Pulse Measurements," "A Triggered Nanosecond Pulsed Light Source," and "Analysis and Measurement of Phase Characteristics in Microwave Systems."

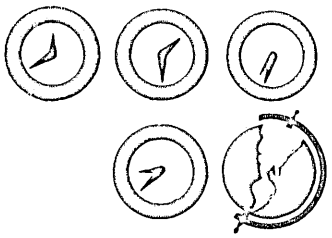
Session 38 on Friday, August 25, will concern **Computer Theory** and will be presented at 2 p.m. in Room C. The papers will include "A Decision Theoretic Approach to Machine Learning and Pattern Recognition," "Diode and Transistor Logic in Synthesis of Unit-Time Arithmetic Circuitry."

Companies in the EDP field that have exhibit booths include Adage, Inc., Ampex Computer Products Co., Autonetics, Burroughs Corp., Computer Control Co., and Computer Equipment Corp.

Computer-Measurements Co., A. B. Dick Co., Digital Equipment Corp., Fairchild Semiconductor Corp., Ferranti Electric, Inc., Laboratory For Electronics, Litton Industries, Motorola Semiconductor Products, Inc., The National Cash Register Co., Packard Bell Computer Corp., RCA, Royal McBee Corp., Space Technology Laboratory, Inc., Sperry Rand Corp., Telex, Inc., and Texas Instruments Inc.

The four-day event, which includes 40 technical sessions and nearly 1200 exhibit booths, is expected to draw an attendance of over 35,000.

The social events will include an all-industry banquet, Thursday, August 24, in the Grand Ballroom of the Fairmont, and a cocktail party two days earlier.



DATAMATION *news briefs*

IFIPS-62 CONGRESS CALLS FOR PAPERS

A call for papers has been issued for the 1962 IFIPS Congress and Exhibition, scheduled for Munich, Germany, from August 27 to Sept. 1. Abstracts of the papers should be sent to Dr. E. L. Harder, Westinghouse Electric Corp., East Pittsburgh, Penna. by September 15th. The abstracts should be between 500 and 1000 words. They will be considered by the international program committee, and authors of selected abstracts will be invited to submit their complete papers in either French or English for consideration by the program committee in March, 1962.

2,200 MILE DATA LINK FOR DOUGLAS AIRCRAFT

Installation of a Kinetape, magnetic tape transmision system by the Collins Radio Co. has given to Douglas Aircraft Co. a 2,200-mile high speed data link (2400 bits per second) between its missile plant in Charlotte, N.C., and its computer center in Culver City, Calif. Previously the link operated with Collins Kinecard. A 1401 is located at the Charlotte plant and a 7090 is in Culver City.

CIRCLE 106 ON READER CARD

INFO RETRIEVAL STUDIES AT WESTERN RESERVE

A pilot study in information retrieval for education research has been initiated at Western Reserve University's Center for Documentation and Communication Research with support of the U.S. Office of Education.

Questions in educational research are requested for either broad or narrow selections of literature in order to pre-test the system on the basis of user requirements. A significant sample of questions will be searched and the results made available to the sender for evaluation.

SDC GETS DOD CONTRACT FOR DAMAGE ASSESSMENT

Systems Development Corp., Santa Monica, has received a three million dollar contract for design and development work on a Joint Service activity to be known as the Department of Defense Damage Assessment Center. SDC will be responsible for selected computer model development and computer programming for the complex to support the center.

SDC's Damage Assessment is one of two departments which make up the firm's newly formed Washington division. The division is directed by Benham E. Morriss. The division's other department is concerned with communications control.

ADAPT COMPILER ANNOUNCED BY COMPUTER SCIENCES

Computer Sciences Corp. has announced ADAPT, a new programming system for business data processing. The system is problem-oriented and permits the programmer to deal almost entirely with the basic functions common to EDP operations.

The first ADAPT compiler, now in test status and promised for delivery on September 1st, is designed for the 1401. CSC is offering a package consisting of the ADAPT language, the 1401 compiler and programming training in both the use of the language and logic of the compiler.

CIRCLE 107 ON READER CARD

AUTOPRINT LANGUAGE FOR MACHINE TOOLING

A new computer language has been designed to broaden the use of numerically-controlled machine tools for automated production of complex parts. IBM's AUTOPRINT program enables the user to describe the surfaces of the three-dimensional shape to be milled, rather than each path the tool must follow to machine the part. The program was written for 704's, 709's and 7090's.

Vocabulary of AUTOPRINT consists of 110 words. Using this language, the part-programmer describes each geometric surface of the shape to be machined, defines the relationships of these surfaces to each other and specifies the machining requirements such as tolerances and tool size.

CIRCLE 108 ON READER CARD

● General Kinetics, Inc., Arlington, Va., has received a contract from Remington Rand Univac to provide an ALGOL 60/FORTRAN II compiler-translator for the Univac 1107 thin film memory computer. No delivery date was disclosed.

● RCA has dedicated its new $4,000,000 data processing Center in Palm Beach Gardens, Florida. The new facility will act as a production plant for the 301. The Chase Manhattan Bank has ordered ten 301 systems and three 501's from RCA.

● Control Data Corp. has announced the opening of East and West Coast regional offices. In the New York area, offices will be located in the Newark Airport Terminal building in New Jersey. In Los Angeles, CDC will be at 8665 Wilshire Blvd.

● A series of new "package" programs are now available for companies which do not have computers. The services will be available at three newly opened National Cash Register Processing Centers in New York, Dayton, and Los Angeles, each utilizing a NCR 304 system.

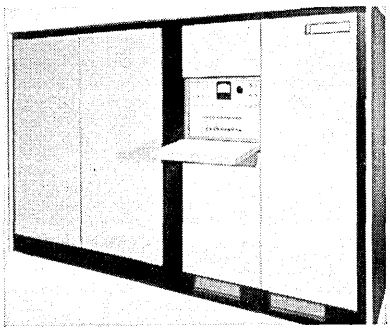
CIRCLE 109 ON READER CARD

● The A. C. Nielson Co. will install a Honeywell 800 in its Chicago office. Installation is scheduled for late next fall.

MOLECULARIZED COMPUTER FROM WESTINGHOUSE

"Mole-E-Com," a molecularized, digital computer, reportedly one-tenth the size and weight of a transistorized machine with similar capabilities, is under development at Westinghouse Electric Corp.'s air arm division in Baltimore. The device is aimed at application in the special purpose field. About 18 months remain prior to installation and although no commercial application has been planned for the present, Westinghouse officials state, "there is nothing to keep us out of the commercial field."

In place of transistors, resistors or tubes, a solid semiconductor crystal is utilized with six molecular blocks. Later developments may reduce the number to three. Reduced size, eventual reduction in cost of EDP equipment and easy serviceability in the replacement of components are three of "Mol-E-Com's" principal advantages for users.

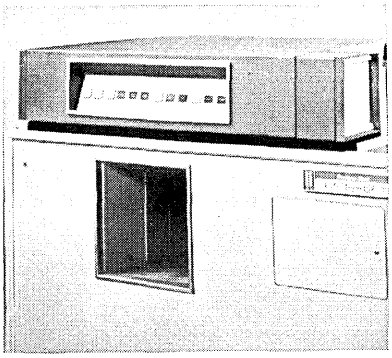


JANUARY 1961—Univac Solid-State and STEP Plan Computers equipped to handle competitive magnetic tape

New Compatible Synchronizers with modified tape units—developed by Univac Division—permit Univac Solid-State and STEP Plan Computers to directly handle competitive magnetic tape systems.

Because of this new development, users of large-scale competitive equipment who are ready to reinforce their installations with satellite systems can now take full advantage of the more versatile internal memory capacity of Univac Solid-State Computers.

This will mean far better performance in satellite system applications, such as short runs, one-time jobs, and special analyses and reports which are not practical to program on large-scale systems.



JANUARY 1961—Short-card feed announced for Univac High-Speed Reader

A new short-card feed option for Univac Solid-State and STEP Plan High-Speed Readers now makes possible computer processing of stub cards.

The 90-column reader will accept 16, 27, and 29 as well as full 90-column cards. The 80-column reader will accept 22, 23+, 51 and 66, as well as full 80-column cards.

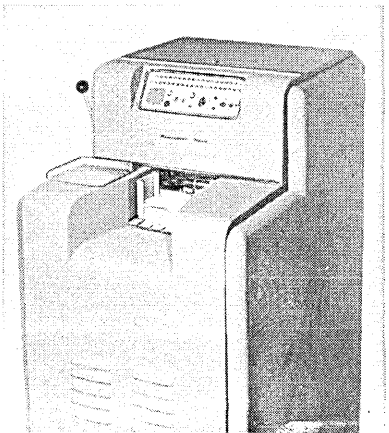
Switching between card sizes in any given system can be accomplished in a matter of minutes. All you need do is adjust the card transport mechanism to accommodate the desired card size. Short card documents can then be processed at the same fast speeds and with the same high degree of reliability as full-size cards.

SEPTEMBER 1960—

Univac introduces another first for 90-column punched-card users: new Univac Optical Scanning Punch

The new Univac Optical Scanning Punch translates ordinary pencil marks into machine language. Any soft black lead pencil may be used and no special symbols are needed. It reads and punches up to 6000 digits per minute—senses and punches up to 40 columns of marking on one side, 80 columns using both sides.

Now, with the Optical Scanning Punch, you can record data at its source and automatically convert it into machine language for faster, more efficient data processing. You can automate your order processing—control the inventory with new speed and accuracy—mechanize your complete accounting operation.

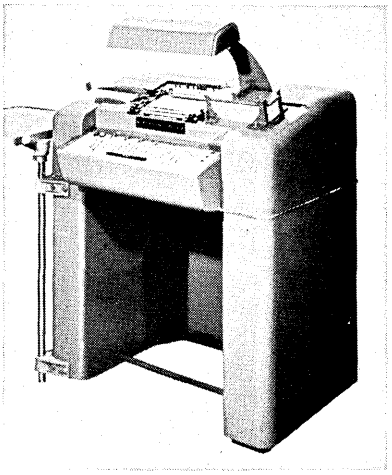


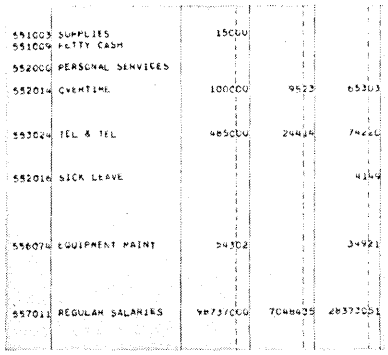
NOVEMBER 1960—Univac develops new Photoelectric Key Verifier

Univac introduces another new development in tabulating equipment—the Photoelectric Key Verifier! It photoelectrically senses errors in punched-card data and segregates error cards.

In one pass, the new Photoelectric Key Verifier can verify either Univac 64-character punching, or standard 90-column, 37-character punching, used by tabulating machines.

With its foolproof method of operation, the new Univac Photoelectric Key Verifier assures the highest quality of input accuracy—a factor vital to data processing efficiency.

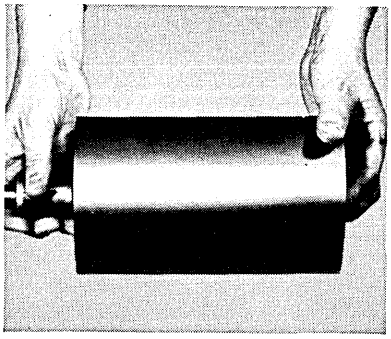




JANUARY 1961—New variable line spacing option for Univac Solid-State and STEP Plan high-speed printers

Thanks to this new development, the Univac High-Speed Printer will print eight lines per inch rather than the standard six lines per inch. And by programming the unit to advance two lines at a time instead of one, it will print three lines per inch under six lines per inch control, or four lines per inch under eight lines per inch control.

This is a distinct advantage since the four lines per inch mode is usually required for continuous tabulating card forms and various other documents. What's more, considerable savings in paper and space can be realized.



JANUARY 1961—9200-word drum developed for Univac Solid-State 80/90 central processors

Data-processing specialists have frequently stated that the most significant factor in determining computer efficiency is the internal memory capacity of the system. Univac Solid-State Computers have always had a large memory and now it's increased still more—9200 ten-digit words plus signs!

Here are some of the numerous benefits to be derived from this new feature: one-run processing; elimination of extra setups, reduced operator intervention, lessened processing time, increased versatility, simplified programming.

FEBRUARY 1960—Paper Tape Reader for Univac 60 and 120 Computers perfected by Univac

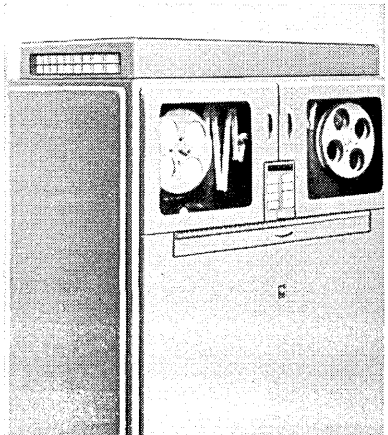
From Univac—a new development for today's modern business data processing—a common language Paper Tape Input device for Univac 60 and 120 Computers.

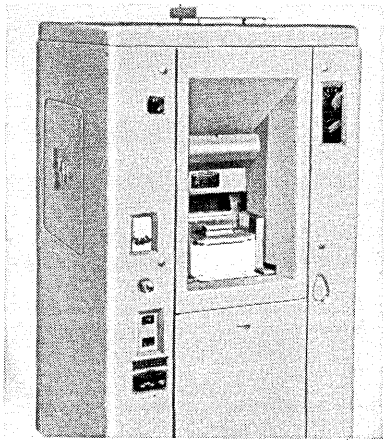
The new Paper Tape Reader permits data on paper tape to be fed directly into the computer. It processes common language paper tape prepared by tape-punching typewriters, wire communication equipment, and transaction recording and window posting machines, at the rate of up to 8800 characters per minute.

This new Univac unit completely eliminates the need for separate tape-to-card conversion, providing greater time-savings and money-savings in data processing systems.

FEBRUARY 1960—Selective Posting Interpreter developed by Univac

Another major development by Univac in tabulating equipment—the Selective Posting Interpreter. This highly versatile machine senses information from a selected master card in a group of master cards, retains the information, and prints it on every card that follows. By control punching, sensing is suppressed from all other master cards. Once a setup has been made, it will be retained for printing on all cards until cleared by control punching. There are no limitations to the number of detail cards which can be printed from each master card group.





more to come from UNIVAC

HOW TO LOSE MONEY IN COMPUTING

a layman's guide

by JACKSON W. GRANHOLM,
Thousand Oaks, California

One must first adopt the outlook that there is a need to lose money. Money lost will go into circulation in order to bolster our economy, promote the common welfare, and enable friends and neighbors to achieve a higher standard of living. Moreover, in inflationary times, it behooves one to get as far in debt as possible. Since money gets to be worth less and less, debts automatically decrease, even if no payment is made on their principal, and one is able to gain by continually staying in the raunchiest financial position possible.

With this thought in mind, a careful look at the computing business is surely in order. Electronic computing, Data PROcessing, EDP, or Automaticizationmanship, as it is variously and commonly called, offers outstanding opportunities in our day and age for the rapid loss of money.

Since this present work is necessarily limited in scope, we propose not to consider those fringe or "twilight" areas which surround computing itself, such as consulting and/or publishing; but, rather, we will deal somewhat directly with two cornerstones of computing, namely: (1) The Manufacture of Computing Devices, and (2) The Use of these Same Devices.

In the first instance, the manufacture of computers, it is of course, necessary to get into this business before one can begin to lose money in it. Analogy is useful here. Presume that you are the President of the Ball-of-Wax Manufacturing Company, or, say, the Competing Equipment Corporation of America. You are presently engaged in building and selling a standard line of forged, zinc-plated manhole covers with a side-line in saffron-oil mayonnaise. Your profit picture is good – too good. Taxes are high and you feel strongly the need to add a loss leader. Manifestly you are admirably suited to get into the manufacture of computers.

Two courses are open. You may buy up a small company already in the business and turn it into your computing machine division or you may form your computing machine division from scratch by hiring savy people.

The former course has certain drawbacks. There are a number of small companies around which are for sale, and their loss picture is most attractive, but they are usually in the "systems" business, something much broader in scope and more erudite than the mere making of computers. Only the larger companies can afford the staff and overhead to get down to doing simple things. These small companies frequently do have a well-qualified staff consisting of 1.5 engineers and a telephone.

The founding of a new division is by far the more challenging course to take, and it bears promise of losing really large amounts of money faster. There are two kinds of people mixes which customarily make up the new computing machine division. The first consists of hiring a crew made up exclusively of engineers and related technical people. The second is achieved by hiring a staff made up completely of salesmen.

The first method gets more immediate results. It leads to "Pooble's Profit Curve of the First Kind," wherein the net of the division goes immediately negative and remains so for all time. This curve is shown in figure 1.

Method two produces "Pooble's Profit Curve of the Second Kind." In this instance, in which the staff consists entirely of salesmen, orders roll in madly at first, particularly if these salesmen can pronounce words ending in the suffix, "-tronic." However, as soon as the customers become fully aware of your highly-developed abilities to sell over-heated air and deliver crud, the profit curve falls even more steeply than in the first instance and, furthermore, remains at lower levels. Thus it is gratifying to note that the integral of Pooble's[1] Second Curve over a suitable period of time, 1.2 years, say, or more, is frequently a larger negative number than the same function of the corresponding curve of the First Kind. (see figure 2)

Having put the staff on board in the new activity, now named the Magnificent Automatic Devices, or MAD Division, one is faced with the problem of the first job. After

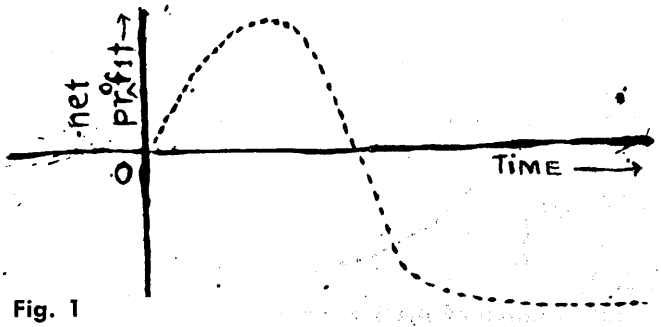


Fig. 1
Pooble's Curve of the First Kind.

all, one must have something to build before one gets really "in"[2] the computing business.

A government contract is, by all odds, the proper way to begin. Once one has established a high enough overhead structure he is automatically qualified to bid on these contracts, many of which deal with the development of new computing machines.

To land such a contract one proceeds on what is known as the "Infinitesimal Bid-Massive Overrun" basis. With such a contract one is well on his way to becoming a power in the computing business, illustrating the remarkable fact that, as Nattkarl has pointed out, "In order to lose money at a really respectable rate it is not actually necessary to have any of one's own."

Once the government contract is in house, you, as president of the parent corporation, can begin to devote your thoughts to the commercial marketing of your product. A thinly-disguised copy of the government machine will do, one with, say, the number changed.

The marketing activity itself offers a great opportunity to lose money. You will find it necessary to establish an "Outlandish Claims" department under a man of at least Junior Vice President Rank. Without such a department your marketing literature will seem dull indeed compared to that of your competitors.

Another department will handle "Ridiculous Estimates" such as first delivery date, compiling speeds for various macro-languages, cost of installation, forecast unscheduled down time, etc.

With delivery of the first machine, scheduled to occur always no less than 8.2 months prior to release of the first reference manual, one is really on his way to losing money on a grand scale.

There are many other tried and true techniques for pouring funds down the drain. A quick scrutiny of what others are doing will suggest some of these. If you are worth your salt as president, you will, of course, soon be inventing new methods of your own.

But the manufacture of computing machines is not the only way to lose money in the computing business. The use of these contraptions offers opportunities unparalleled in history to dump moola overboard. The ways to get this done are not spectacular and obvious, but they are every bit as real as those in a hardware shop.

When one considers establishing a computing lab, he must first face the decision, according to all the authorities, of how to run it. Two mutually-incompatible ways are allowed: open shop and closed shop. The proper approach to this decision is to defer it – indefinitely.

The decision about macro- or pseudo-languages in which to do one's primary work is also vital. The rugged individualist who ignores all vendor-supplied methods is rare these days, but there are things to be said in his favor. It is probably better to select three or four well-known systems (such as GLOBOL, FRAMTRAN, and IMBECILE '61) and alter these slightly, writing one's own, in-house version.

One should, by all means, keep the library in a binary deck, or the closest equivalent possible with the machine selected. A random file of insertion cards for this deck should be kept handy, enabling programmers to invent new modes of operation with abandon and ease.

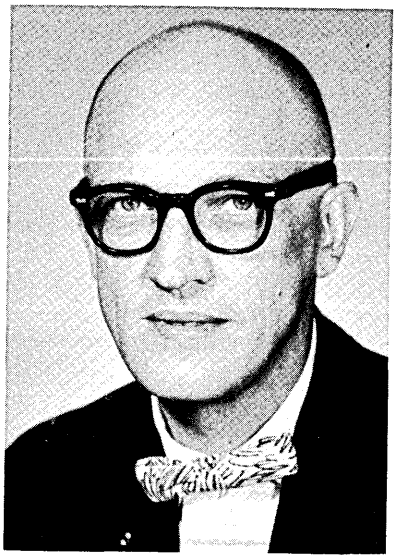
The choice of a computer yields ways to get together with the manufacturer in compounding massive losses. One should always believe a casually-mentioned probable delivery date implicitly, and hasten to assure his comptroller that payroll will be done completely on this machine two days after delivery. Even a short-sighted manufacturer who actually delivers on time can be depended upon to cooperate by failing to send blueprints to his customer engineers.

The scheduling of machine use is no job for a weenie. This important key to big losses needs a competent and calm dunderhead in charge. He will soon devise ways to get a minimum two-day delay assigned to all high-priority work. A qualified assistant can see that a suitable number of compiling tapes are erased prior to listing.

Choosing key punch girls for properly-developed surliness is frequently overlooked. Clark's method of hiring on the basis of bust measurement and supplying on-the-job training would seem to be as sure-fire as any.

But the inventive machine room supervisor can find ways to get the job done. According to Smith, in the average company with a computing laboratory the overhead for computing should be at least 1.32 times that of all other departments combined. This provides a target at which to aim, and the qualified computer man can easily exceed it.

Unfortunately, in spite of the best laid plans and all-out efforts of all hands, it occurs at times that something profitable is done with computers. For these embarassing situations we can offer no cogent comment other than, "Grin and bear it!" or ". . . Try, try again!"



Jackson W. Granholm

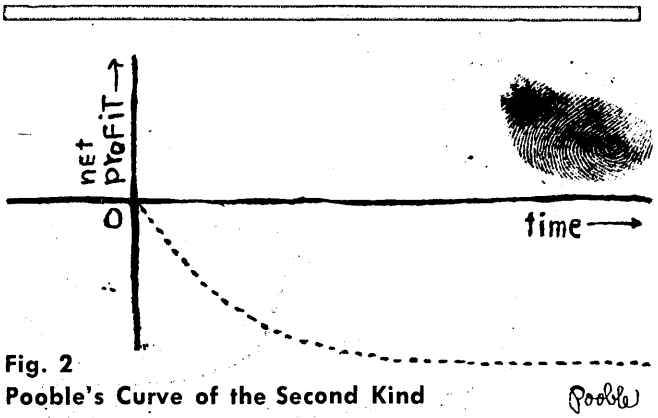


Fig. 2
Pooble's Curve of the Second Kind

NOTES

[1] Economic Phenomena Related to the Presence of the Overflow Bit, Pooble, Rupert B., MacRandom & Sons, New York, 1959. (Dr. Pooble a noted authority is former director of the Institute of Human Foibles, Harvard Univ.)

[2] "In" is used here in the Penn-Metcalfe, or economic sense, rather than in the Flynn, or sociological, sense.

through the looking glass:

SOFTWARE IN SICKNESS AND HEALTH

an editorial commentary
by Dr. H. R. J. GROSCH, Contributing Editor

The big, stored program, general purpose computer has been with us for only a decade or so; the first electronic digital equipment, less than fifteen years; the first "production" computing center, exactly twenty. Yet machine rentals exceed $600 million a year in this country alone, and $750 million worldwide. Within two years the U.S. figure should top one billion and the world, $1.3 billion.

There are well over 100,000 users in this country; allowing for the fact that many of them are part time – open shop customers, for example. I would put the number of equivalent full timers at about 60,000. On the manufacturers' side, the figure would be slightly higher: engineering, production, maintenance, and sales totalling perhaps 80,000 bodies, less than half of them having a deep interest in the field.

In less than two decades we've gone through mechanical counters, relays, and vacuum tubes deeply into solid state devices – diodes, cores, transistors. Tunnel diodes, thin magnetic and semiconductor films, and cryogenic assemblies are on the near horizon. Buffered I/O, parallel processing, and soon perhaps, some primitive form of associative memory will have made more powerful logical organizations available.

And yet, for all the growth, for all the improved speed and reliability, for all the increases in public interest and acceptance, our situation is not sound. Our accomplishments have not kept up with our sophistication. Some of this is inevitable, Parkinsonian, thermodynamic – but only some. The excitement is still there, and the youth and vigor. But nothing very startling emerges. We're on a high plateau to be sure. Can we resume the climb?

In my view, we have to exonerate the hardware boys. Sure, they've had some painful episodes: LARC turned into a cowbird, and STRETCH into a shrug. As the Red Queen said, "*I* could show you hills, in comparison with which you'd call that a valley." The GAMMA 60 failed to appear, and the 304 failed not to! But on the whole, hardware is terrific: the 7090 was a *tour de force*, the 1401 an immediate triumph; the 160 is cute; the G-20 challenging; the tape drives on the 800 look wonderful; even readers work pretty well.

Now look at the software side: the SOS fiasco in Los Angeles and elsewhere; the Wall Street 501 delays; the Norfolk 220 debacle; gross failures to meet schedule on the part of almost every programming system package, whether written in-house or contracted out. Even some of the hardware misfortunes I've referred to have software implications; STRETCH would have checked out much closer to schedule if earlier and stronger efforts had been devoted to diagnostics and systems programming.

The milling around in the huge cooperative programming projects is nothing less than a professional scandal. COBOL, like crabgrass, is here to stay; any poison strong enough to kill it would stunt the whole field for years. But the various ALGOL groups ought to agree on just one thing, just once, and head for the Elephants' Burial Ground.

The proprietary packages are grandiose, over-advertised, and 'way late, but at least the guilt is always obvious. Comparing FACT to COBOL, no doubt, the Red Queen said, "You may call it 'nonsense' if you like, but I've heard nonsense, compared with which that would be as sensible as a dictionary!"

That reminds me, I hear the boys at White Plains have taken up a private collection to buy a plaque for Charlie Phillips' office to commemorate the Pentagon effort to encourage small businesses by ordering, and in some cases even using, BIZMAC, RAYDAC, and OARAC.

Look around at your next SHARE meeting. Have you realized that a typical one costs about $600,000? Count the bodies, multiply by salary plus overhead, add travel and living expenses, throw in a *soupcon* for decreased efficiency back at the ranch (newer installations only; the older shops have SHARE experts whose absence is immaterial). Make you feel a little, ah, bloated? It does me; I was one of the Founding Fathers, but I ceased being proud of the fact years ago. That 1111-foot shelf of distributions is about 1110.1 feet too long.

OK, so I think hardware is flourishing and software is in trouble. How did it get that way? I have some suggestions. The first and most important cause was pride –

pride in a wonderful new tool that only we fully appreciated, pride in a new skill, pride in a new profession and new associations. We knew how to steal a march on the logical designers; if they left out floating point or longitudinal tape check sums, we put them back in. We drew up lists of special characters that printers had to print. At universities, tantalized by cut-rate equipment and itching to influence a field the math department refused to recognize, we invented new programming languages — and new human dialects in which to describe them! In dozens of mature open shops, bored with teaching John Backus' FORTRAN, we began writing our own "improved" versions. And in the manufacturers' own software groups, urgent salesmen egged us on to wilder and wilder promises. Maddened by the scent of the saguaro blossoms, one of our colleagues has even volunteered to combine COBOL, ALGOL, and a lusty report generator and cram the result into the sullen cores of his starveling. Another Lost Dutchman!

Pride shades easily into purism, the sin of the mathematician. To be the leading authority, indeed the only authority, on ALGOL 61B mod 12, the version that permits black letter as well as Hebrew superscripts, is a satisfying thing indeed, and many of us have constructed comfortable private universes to explore. The only solution I know is to strap a full set of Whitehead and Russell (not paperback) around the poor culprit's neck and topple him gently into ten feet of distilled water!

And in the other direction, there is commercialism. The COBOL announcements reek of it. If the hardware doesn't get too good a reception, promise the prospects a glamorous software package; as the White Queen said, "The rule is, jam tomorrow and jam yesterday — but never jam *today*." The consulting companies are hungry, and promise instant LP and condensed COBOL at painless prices. "You look a little shy: let me introduce you to that leg of mutton," said the Red Queen. Not all of these remote-control ventures have prospered, but as the Queen pointed out, "It isn't etiquette to cut anyone you've been introduced to."

And finally there is ignorance: the hallucinatory optimism of the novice customer; the determined benightedness of the vice president who allots $40 million to engineering, manufacturing, and sales but skimps on software; the lack of acquaintance with a major new tool that leads top management in a user company to assume that programming costs are minimized by an open shop, where instead they are increased, but hidden.

As you've probably guessed by now, I'm against pride, purism, commercialism, ignorance, and *lots* of other things. So what's to be done. **First,** no more of these gigantic cooperative projects: no more COBOL, no more ALGOL. **Second,** system manufacturers should guarantee delivery dates for clearly specified software packages, along with hardware, with heavy financial penalties for failure to meet schedules. **Third,** manufacturers should not on the one hand set up straw man users groups in advance of anything worth exchanging, nor on the other hand be doormats for SHARE manipulation.

A few footnotes to these imperatives: I would not limit *ad hoc* association of two or three neighboring installations, but the PACT thing was already too large; to go interdisciplinary, intermachine, and international in one swell foop is just laughable. A minimum software package should contain a powerful assembler/compiler, conversion and other I/O routines — as the White Queen asked, "What's one and one and one and one and one and one and one and one and one and one?" Some sorting and report-generating routines, a few basic mathematical functions, and a set of diagnostics for the console specialist: that's about it. For giant machines of the future, executive routines will be vital; since we don't know much about writing such toughies, or even about specifying them, we shouldn't expect guaranteed delivery for this generation of machines.

Another caveat: recruits for programming systems groups should have had "working" computer experience. Too often bright youngsters are taken from college right into Aunt Grace's boudoir, and attempt chunks of COBOL, tackle self-compiling compilers, argue learnedly about standards, and even rise to supervisory and management jobs without ever sharing in the day-to-day operation of a data processing or computing installation. Experienced programmers should be interchanged between customer support, programming aids, and engineering (diagnostic and simulation) units. It's good for the manufacturer, and good for the individual. Incidentally, this is easier if geographical relocation is not required; a few miles between software and hardware boys is healthy, but a hundred is too much.

User groups should exchange brief descriptions of applications and techniques, not the programs themselves. The effort of standardization and documentation is mighty seldom warranted; if one outfit hits the jackpot and everybody wants the word, a full writeup in fairly standard language (the latter should be high to discourage the usual completist tendency among program librarians). Meetings should be primarily social; if at the factory, there may be a few factual presentations by the sponsor, but no padding; attendance should be very strictly limited, say to one manager and one technician per installation.

For a **fourth** major suggestion, let's put the standards effort on a clearly understood footing immediately. There are major competitive efforts under way with IFIPS, AFIPS (ex-JCC), NOMA/ASA, OEMI, ABA and other auspices. I'm not so much worried about the battle of Bright and Bemer as I am about the way the field, and especially its hardware aspects, is pulling away from us. As the Red Queen put it, "It takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!"

And for my **fifth** and last suggestion: every major software group should have a properly proportioned R/D effort. It should if at all possible, be out in the open, budgeted for, not bootlegged. At a computer manufacturer, it may involve better diagnostics, a more sophisticated assembler, logical simulation generators. At a very large user, where heavy operating experience is available, it may be executive routines. At ordinary user installations, it may well have to be tied to the subject matter of the shop: the next machine, a difficult future application. Even here, though a little experimentation with nonpaying areas is justifiable: some game playing, music composition if there's a counterpoint man in the house, an experiment in information retrieval with the library, trials in character recognition. University groups should find this especially easy, except perhaps for the financial support; unless they have a major project like APT, they should not monkey with programming aids. Why do unsponsored development work for a manufacturer? And why compete for sponsorship with Fletch and Elmer, who are *much* better salesmen? IT's undignified!

We're on a plateau because we have lost sight of the original goal — to see more deeply into nature, to operate business more efficiently, to facilitate the interactions of human beings. Too much time has been spent in polishing, arranging and admiring our tools; not enough in tackling new projects. If we can change that, as the Red Queen promised, "In the Eighth Square we shall be Queens together, and it's all feasting and fun!"

over 2,500 expected to attend

ACM CONFERENCE AND EXHIBIT SEPT. 5-8, LOS ANGELES

Sixty-one exhibit booths have been reserved by 35 companies for the 1961 ACM National Conference to be held September 5-8 at the Statler-Hilton Hotel, Los Angeles.

Three special panel sessions have been scheduled for 3:15 p.m. on the opening day, September 5. "University Education in the Computer Era" is the title of one session, with George Forsythe of Stanford University, acting as chairman. JUG – sponsored discussion of "Operating Systems for Large Scale Computers" is the second of the three sessions. Frank Engel of Westinghouse Electric Co. will be chairman of this session.

The third of the three sessions is "Numerical Control of Machines." S. M. Matza of IBM will be chairman.

The exhibit, titled the International Data Processing Exhibit, marks the first showing of hardware, components and EDP systems ever held in conjunction with an ACM conference.

Computers and data processors, components, paper tape equipment, output devices, communications equipment, data gathering and preparation devices, and peripheral equipment will all be displayed.

Also included among the exhibitors will be the services offered by C-E-I-R, Inc., Idaho Maryland, Service Bureau Corp., and System Development Corp.

Over 2,500 registrants are anticipated to attend the exhibits and 18 technical sessions of contributed papers and 10 sessions of invited papers. The contributed papers will include those on numerical analysis and mathematical applications, business data processing and business languages, computer engineering and systems, translators, compilers and artificial languages.

The invited papers are highlighted by "Mechanization of Science" by R. W. Hamming of Bell Telephone Laboratories, September 6th at 10:35 a.m. in the Pacific Room; "Mathematical Experimentation and Biomedical Research" by Richard Bellman of The Rand Corp., September 6th at 2:40 p.m. in the Pacific Room; and "Is Artificial Intelligence Just Around the Corner?" by E. S. Moore of the Bell Telephone Laboratories, September 7th, at 2:40 p.m. in the Golden State Room.

The technical program's opening session is scheduled for 2 p.m. on Tuesday, September 5. The opening remarks will be presented by B. F. Handy, Jr., general chairman of the national conference and chairman of the Los Angeles chapter of ACM.

Following Handy's remarks, H. D. Huskey of the University of California will give the presidential address. This will conclude activities for the opening session.

The following day, Wednesday, September 6, will feature the beginning of the regular technical sessions. Included among the topics will be "Learning and Automata," "The General Problem of Computing Language," "Forgetting in an Associative Memory," "Compiler Structure Theory," and "Stored Logic Computing."

Informal "halls of discussion," pre-scheduled and impromtu, will also be included in the program. Those scheduled at present, include business data processing mathematical programming and programming training.

Bound preprints containing four-page summaries of all papers will be available at time of registration.

Field trips scheduled for conference attendees will include tours of The National Cash Register Company and Bendix Computer Division. The trips will be scheduled in late afternoon so that actual manufacturing processes may be observed. Two other tours are planned to computer user sites.

A block of rooms has been set aside in the name of the conference at the Statler-Hilton Hotel. Reservations should be made directly with the hotel. Additional space has been reserved on the UCLA campus. Chartered buses will be provided for registrants between the campus and the hotel.

A list of the exhibitors, as of June 25, includes Addressograph-Multigraph Corp., Ampex Computer Products Co., Bendix Computer Division, Burroughs Corp., California Computer Products, C-E-I-R, Inc., Clary Corp., Computer Control Co., Control Data Corp., Dashew Business Machines, Inc., DATAMATION, Datanamics, Inc., Digital Equipment Corp., The Digitran Co., EDP Weekly, Ferranti Electric Inc., and General Dynamics/Electronics.

Idaho Maryland Industries Inc., International Business Machines, Inc., Librascope Division, General Precision, Inc., Magnavox Research Laboratories, The National Cash Register Co., The Pacific Telephone and Telegraph Co., Philco Corp., Recordak Corp., Service Bureau Corp., Soroban Engineering, Inc., Space Technology Laboratories, Inc., System Development Corp., Teletype Corp., and Uptime Corp.

Members of the steering committee discuss plans for the 16th national conference of the ACM. Left to right: James Tupac (Rand Corp.), treasurer; John A. Postley (Electrada Corp.), vice chairman; Benjamin F. Handy, Jr. (Litton Systems), general chairman; Sherman Klein (Hughes Aircraft), secretary; and J. Don Madden (System Development Corp.), advisory committee.

COMPUTER SIMULATION OF HUMAN THINKING AND PROBLEM SOLVING

By HERBERT A. SIMON, Carnegie Institute of Technology, and ALLEN NEWELL, The Rand Corporation

PART TWO: Conclusion

There are many human activities to which we would apply the term "thinking" but not the term "problem solving." There are also many activities we would usually call "learning" rather than "thinking." We would ordinarily call a child's acquisition of speech, "learning." We propose to consider the acquisition of speech as an example of human cognitive activity that is, at something of an opposite pole from the rather highly verbalized, somewhat conscious, practiced problem solving of an intelligent and educated adult. We can then judge whether the processes at these two poles are quite different or basically the same.

Speech acquisition has been about as well studied as any non-laboratory complex human activity, and from our review of the literature, we judge that there is general consensus about the particular facts we shall use.[9] If we are wrong in that assumption or in our interpretations of the facts, Professor Miller is one of the best-equipped men in the country to put us straight.

central representations

We consider an infant who has already learned the names of a few objects – as evidenced by the fact that he can point to them or fetch them when they are named by an adult – but who has not yet pronounced their names. From his behavior, we can infer that when the child perceives the spoken word "ball," his perception has some kind of internal representation in the brain that permits it to be associated, through previous experience, with some internal representation of a visually perceived ball.

To say the word "ball," the child must, in addition, store some kind of program capable of energizing, through motor (efferent) channels, the muscles involved in speech production – in the production of the specific phonemes of that word. Let us call the "whatever-it-is" in the central nervous system that represents internally a perceived sensory stimulus an **afferent** or **perceptual symbol.** Let us call the "whatever-it-is" that represents the program for initiating the motor signals an **efferent** or **motor symbol.**

Learning to speak, in this formulation, means acquiring the motor symbols that correspond to perceptual (auditory) symbols of words already known, and associating the former with the latter. Now the difficulty is that there is no way in which the corresponding perceptual and motor symbols can "resemble" each other – can symbolize the appropriateness of their association by resemblance. The correspondence is purely arbitrary.[10] The infant is faced (if he only knew it!) with the immense inductive task of discovering which motor symbols will cause speech production that, when he hears it, will produce, in turn, an appropriate auditory symbol to be perceived and recognized. And the task appears at first blush to have little structure that would permit it to be approached with some less arduous technique than trial-and-error search.

There is ample evidence that much trial-and error search is indeed required before the infant acquires the skill of speaking. The child imitates the adults around him, and he imitates himself (echoic speech). Gradually, over many months, he acquires the motor symbols that enable him to produce sounds which he hears as the expected auditory symbols. In the early stages, the child's acquisition of a speaking vocabulary appears to be paced by the task of developing the new motor symbols. At later stages, he is able to produce a word relatively easily once he has learned to recognize the corresponding auditory symbol.

factorization

A little reflection will persuade us that something more than trial and error is involved. If that were all, the three hundredth word would be no easier to pronounce than the first. The child learns to learn. In what does this consist?

Although the motor symbol cannot be compared with the perceptual symbol, the **correct** perceptual symbol for a word can be compared, through imitation, with the perceptual symbol produced by the attempt to pronounce the word. If these are different, modification of the motor symbol can be attempted until an auditory symbol resembling the correct one is perceived.

Thus far we have been assuming that the units in terms of which these transactions take place are words. But there is no reason for this assumption – the child might well attend to particular syllables, phonemes, or even components of phonemes. The auditory symbols for words can be compound symbols or **expressions** – strings of phonemes, each phoneme itself encoded in terms of its component frequencies and other characteristics. It is even more plausible to suppose that the motor symbols would be constructed from smaller units, for each word involves a temporal succession of syllables, each syllable a temporal succession of phonemes, and each phoneme a whole set of signals to the several muscles involved in that part of the speech act. Thus, one of the many components of the motor symbol for the spoken word "dog" might be the signal that pushes the tongue against the palate in the initial "d" phoneme of this one-syllable word.

the learning process

There is considerable evidence today that this picture of the processes of word-recognition and word-production is correct, at least in broad outline. Many of the components involved in both auditory and motor symbols have been tentatively identified, and there is good experimental evidence for some of them.[11] But what does the picture, if true, contribute to our understanding of the child's acquisition of speech?

It means that the inductive learning need not be blind inductive learning – attempting to associate by pure trial and error each of a large number of words with an appropriate motor symbol chosen from the myriad of producible sequences of speech sounds. On the contrary, to the extent that specific factors in the auditory symbol vary with specific factors in the motor symbol (e.g., as one of the format frequencies in vowel sounds varies with the size of the resonating mouth cavity), the search for the correct symbol can be very much restricted. Components can be corrected on a one-at-a-time basis. For example, the child trying to pronounce "dog" can at one time, attend to the correctness of the vowel, at another time to the correctness of the initial consonant, or even to the aspect of the initial

consonant associated with tongue position.

Thus, the hypothesis of factorization is supported both by experimental evidence that it does take place, and by theoretical reasons why it "should" take place – why speech acquisition would be very much easier with it than without it. Trial-and-error acquisition of words without factorization would require a search, in each instance, for the correct motor symbol from among tens of thousands of possible symbols. Trial-and-error acquisition of phonemes would require a search from among only a few hundred phonemes (much fewer are actually used, of course, in any single dialect). Trial-and-error search among phoneme **components** would be even more restricted – there are, for example, probably only a half dozen distinguishable tongue positions. Thus, by factorization of the total space of possibilities, a very limited trial-and-error search of the factors can be substituted for an immense search of the product space. Moreover, once the child has acquired motor symbols corresponding to the common phonemes, acquisition of new words (new combinations of these same phonemes) could be very rapid.

summary: the child's acquisition of speech

Let us now summarize our description, partly factual, partly hypothetical, of the speech acquisition process. The child acquires perceptual auditory symbols corresponding to words he has heard and has associated with visual symbols. He tries, on a trial-and-error basis, to produce words, hears his productions, and compares these auditory symbols with those already stored. When he detects differences, he varies the motor symbol to try to remove them. As he learns, he detects that changes in certain components of the motor symbols alter only certain components of the auditory symbols. Thus he is able to factor the correction process and thereby accelerate it greatly.

acquisition of speech by GPS

Now it is very easy, with a few changes in vocabulary, to translate this whole description back in terms of GPS. When the translation has been made, we shall see that the processes just described are the methods of GPS.

Let us, in this translation, call the auditory symbols **objects.** We assume that there exist central processes that modify motor symbols – that change one or more of their components. We will call these processes **operators.** A change in a motor symbol will, in turn, change the auditory symbol that is perceived when that motor symbol produces a sound.

The child detects **differences** between the object he has produced (i.e., his perception of the sound) and the correct object (his perception of the sound when produced by adults). He applies operators to the motor symbol to modify the sounds he produces, hence the object perceived; and he compares the latter again with the correct object. This search process continues until he can reproduce the perceived object.

But this does not account for the factorization, which we have argued is so crucial to the efficiency of the learning process. How will GPS learn (1) which differences in objects are associated with which operators upon the motor symbols, and (2) how to factor objects and operators? Although the answers to these questions are far from certain, a scheme we have proposed elsewhere would enable GPS to handle these tasks also.[12] We will sketch it briefly:

1. Given a set of differences and a set of operators, GPS can, with modest amounts of trial and error, detect which operators are relevant to producing or eliminating which differences. To take a crude, but simple, example: it takes relatively little trial and error to discover what differences in the perceived sound are associated with changes in the rounding of the lips while producing a vowel. The factorization has already largely been carried out by nature, so to speak, because changes in only a few aspects of the motor signal will change only a few aspects of the perceptual symbol.

2. The GPS processes can themselves be employed to discover inductively a "good" factorization – a "good" set of differences. To do this, GPS must be supplied with some very general criteria as to what constitutes such a good set. The criteria would be of the following sorts:

   a. Only one or a few operators should be relevant to each difference (so that, given a difference, an appropriate operator can be found without too much search).
   b. Only one or a few differences should be associated with each operator (so that the sounds produced can be varied factor by factor).

   and a few others of the same general kind.

With such a set of criteria provided, finding a good set of differences simply becomes another kind of problem to which GPS can apply its problem-solving methods. What are the objects, differences, and operators in terms of which this new kind of problem is formulated? To avoid unnecessary confusion, we will capitalize the terms OBJECTS, DIFFERENCES, and OPERATORS in speaking of the new problem context in order to distinguish them from the objects (perceptual symbols), differences, and operators (changes in motor symbols) involved in the original task of acquiring speech.

The OBJECTS for the new problem-solving task are the **sets of differences** in the original task environment. The new DIFFERENCES designate to what extent particular sets of differences meet the **criteria** we have just listed. OPERATORS are processes for altering the set of differences under consideration by deleting differences from the set, adding differences, or generating new differences for possible inclusion. GPS then tests in what respects particular OBJECTS (sets of differences) are DIFFERENT from the desired OBJECT (as indicated by the criteria). It seeks to remove these DIFFERENCES (modify the set of differences) by applying OPERATORS (by adding, subtracting, or modifying differences).

Since this scheme has not been realized on a computer, we cannot tell how effective GPS would be in handling it. All we can say is that it is a problem whose solution can be attempted with the means at the disposal of GPS.

A due respect for parsimony would suggest, then, that instead of postulating quite different processes for the acquisition of such skills as speaking from those postulated for adult problem solving, we embrace tentatively the hypothesis that the processes are in fact the same – that the General Problem Solver provides a description of both processes. This hypothesis would provide a sharp focus for empirical research into the early speech behavior of the child.

the state-process dichotomy

Let us accept this hypothesis for the moment: that the same system of ends-means processes is involved in learning speech and in problem solving. Can we explain why a system of ends-means analysis should provide the basis for adaptive behavior in both classes of situations. We shall try to provide an explanation for the generality of ends-means processes by showing how these arise quite naturally from the problem that any organism must solve if it is to use its sensory and motor apparatus effectively to survive.

relation of perceptual to motor symbols

The terms "perceptual" and "motor," or "afferent" and "efferent," reflect the dual relation that every adaptive organism has with its environment. It perceives aspects of the environment, and its acts upon the environment. It must be able, therefore, to transmit, store, and operate upon internal representations – perceptual symbols – that stand for its perceptions; and it must be able to transmit, store, and operate upon internal representations – efferent or

motor symbols – that can serve as signals to its effectors. The organism survives by associating appropriate motor symbols with the perceptual symbols that stand for various classes of perceptions.[13]

In particular, the organism can perceive, at least grossly, its own behavior caused by its efferent signals. Hence, among the perceptual symbols that it can store are symbols that stand for the perception of corresponding motor signals. Languages are especially adapted to facilitate this correspondence. Language behavior, built from limited alphabets of unit behaviors, is highly stylized so that to each distinct language "act" will correspond an easily perceivable and distinguishable perceptual symbol.

Nevertheless, the relation of a particular language efferent – say that which energizes the word "dog" – to the corresponding perceptual symbol is arbitrary. There is no more resemblance between the auditory "dog" and the motor symbol which produces that word than between "dog" and "Hund." If it is to be learned, the correspondence must be learned as a pure fact. By building up a dictionary relating motor with perceptual symbols – including language-symbols – the organism gains the ability to produce the actions it "intends." In the last section we explored how this ability could develop in the case of speech.

The duality of our relation with the environment reveals itself in the vocabulary of natural languages – particularly in the distinction between nouns and adjectives, on the one hand, and verbs, on the other. We have **clean** clothes (a perceptual symbol) because they have been **washed** (a motor symbol). It is a fact stored in our "table of connections" that when we wash clothes they become clean. As we build up our vocabulary, however, we pass more readily from the one mode of discourse to the other. Thus, the clothes, in the last example, might also have been **cleaned.** As we learn what actions have what effects, changes in objects are named by the processes that produce them, and processes by the effects they create.

the problem of translation

It is precisely this duality of language – or, more broadly, of the internal symbols employed in thought – that makes behavior problematic. The world as it is and as it is desired is described in a **state language,** a language of perceptual symbols. Possible actions are described in a **process language,** a language of motor symbols. The problem of adapting is the problem of finding the statement in the process language that corresponds to the difference between existing and desired states of affairs in the state language.

But the problems that GPS was designed to handle can be viewed in exactly the same way. What is involved in discovering a proof for the Pythagorean Theorem? The **theorem** is a symbolic object in the state language: "The square on the hypotenuse of a right triangle is equal to the sum of the squares on the sides." By comparing this therom, so stated, with the axioms and previously proved theorems, we detect differences between them. A **proof** of the theorem is a symbolic object in the process language. This object – the justification that we generally write down alongside the successively modified axioms and theorems – describes the sequence of operations that eliminates the differences between axioms and desired theorem. Given a set of axioms, for every theorem defined in the state language, the theorem can be represented in the process language by the sequence of operations that constitutes its proof.

Thus mathematics, and problem-solving generally, is an imitation of life. Problem-solving activity uses the very fundamental processes that all adaptive organisms must have if they are to coordinate successfully their perceptual and motor pictures of the world. Ends-means relations, far from being highly special, are reflections of the basic state-process dichotomy, the dichotomy between perceiving and acting.

the difficulty of the environment

How hard a problem will be depends on the simplicity or complexity of the rules that define the correspondence between the two languages. An example of a relatively simple correspondence is the relation between the decimal and octal representations of integers. There is a simple and direct algorithm that solves all problems of the form: if **a** is the decimal representation of a number, what is its octal representation?

At the other extreme, the correspondence between the vocabularies may be purely conventional or arbitrary. Then rote learning is the only means for building up the translation dictionary, and if the correct translations must also be discovered, immense amounts of trial-and-error search may be required.

The aspects of the environment with which we, as organisms, deal effectively reach neither of these two extremes. The translation between the state language that describes our perceptions of the world and the process language that describes our actions on the world is reducible to no simple rule, but it is not, on the other hand, arbitrary. Most of our skill in dealing with the environment is embodied in elaborate **heuristics,** or rules of thumb, that allow us to factor – approximately – the complex perceived world into highly simple components and to find – approximately and reasonably reliably – the correspondences that allow us to act on that world predictably. This is the skill that the adult businessman uses when he makes a decision, the skill of the scientist in his laboratory, the skill of the subject in a problem-solving experiment, the skill of a child learning to speak.

What we have proposed is that at the core of these heuristics – the portion that is not bound up in special skills – is the organized system of ends-means processes, of state-process translations, that the General Problem Solver describes. We have proposed that, in Mr. Pitts' words, is a first approximation to "the hierarchy of final causes traditionally called the mind."

NOTES

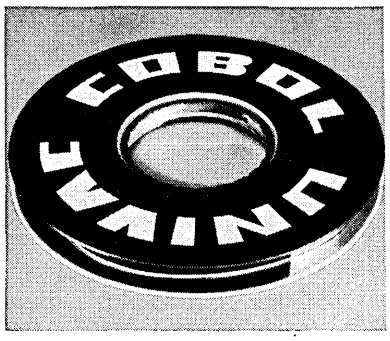
[9] See, for example, C. E. Osgood, Method and Theory in Experimental Psychology, (New York: Oxford U. Press, 1953) pp. 683-690; G. A. Miller, "Speech and Language," Chapter 21 in S. S. Stevens, ed., Handbook of Experimental Psychology (New York: Wiley, 1951); and G. A. Miller, Language and Communication (New York: McGraw-Hill, 1951), Chapter 7.

[10] We shall have occasion to qualify the adverb "purely" when we come to consider the factorization of words into phonemes and phoneme components.

[11] For a general introduction to these topics, see G. A. Miller, Language and Communication, Chapter 2. An excellent recent survey is Richard Fatehchand, "Machine Recognition of Spoken Words," in F. L. Alt, ed., Advances in Computers (New York: Academic Press, 1960), pp. 193-321. See also J. W. and C. D. Forgie, "Results Obtained from a Vowel Recognition Computer Program," The Journal of the Acoustical Society of America, 31:1480-89 (1959), and A.M. Liberman, et al., "Minimal Rules for Synthesizing Speech," ibid., 31:1490-99 (1959). The last three references cited illustrate, incidentally, the large role that computers are playing in linguistic and phonetic research.

[12] The full account of this learning scheme is given in A. Newell, J. C. Shaw, and H. A. Simon, "A Variety of Intelligent Behavior in a General Problem Solver," pp. 153-187 in M. C. Yovits and S. Cameron, eds., Self-Organizing Systems (New York: Pergamon Press, 1960).

[13] We need hardly say that this description does not commit us to any over-simplified reflex-arc picture of the peripheral and central systems. GPS is a concrete example of a system of the sort we are describing. In it, the perceptual-motor associations are represented by the table of connections between differences and operators. The use it makes of these connections, and consequently the relation of response to stimulus, is highly complex.



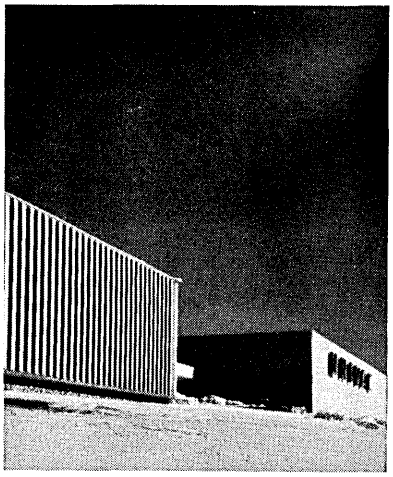
16

DECEMBER 1960—COBOL goes into action with help of Univac

During a demonstration conducted December 6th and 7th, before the Executive Committee of the government-sponsored conference on Data Systems Languages, Univac played a vital role in what was called "an important milestone in the progress of data processing."

Using COBOL (Common Business Oriented Language), our technicians programmed the Univac II in English to display the practicality of COBOL as an effective programming language for business-type problems. This same Univac COBOL program, with minor modifications, was then successfully compiled and run on another manufacturer's computer system.

With Univac COBOL your employees can learn to program in days instead of weeks, program changes are made more accurately and faster, and programming costs are substantially lower.



17

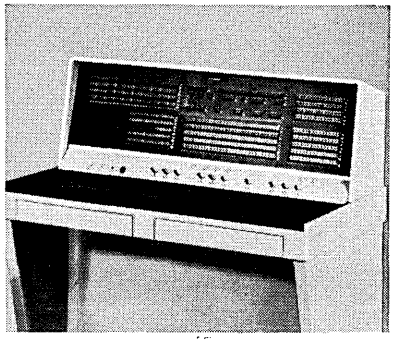
DECEMBER 1960—New Univac laboratory houses one of the largest computation centers in the world

Univac's new Engineering Center in Whitpain Township, Pennsylvania, features one of the world's largest and most complete computer centers. When completed, this modern fully-equipped research and development facility will contain working installations of the full spectrum of Univac equipment. Keeping pace with the Univac program of planned growth, this new center covers over 300,000 square feet of floor space with adequate room for expansion. The facility serves as a work center for engineering and programming projects, and also aids in strengthening our continuing program to provide you with better, more advanced service.

20

AUGUST 1960—Univac develops advanced Real-Time Computer for U.S. Navy

A new, extremely compact electronic computing system which collects, processes, and evaluates naval tactical data—and recommends courses of action in virtually "zero" time—has been developed for the U.S. Navy by Univac. One of the fastest computers ever built, it completes an instruction in only 20 millionths of a second. A general-purpose, stored-program computer, its random-access memory can hold one million bits of information. Thirty of these bits may be extracted from any location in the memory in only 2.5 millionths of a second!



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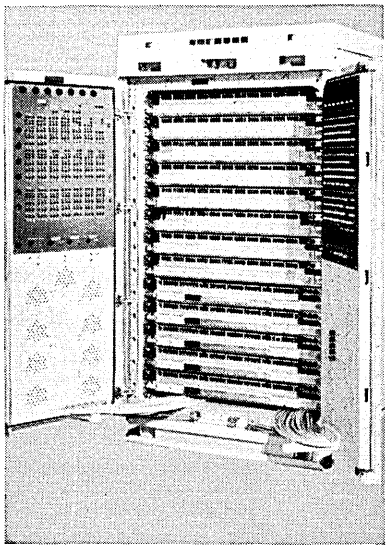
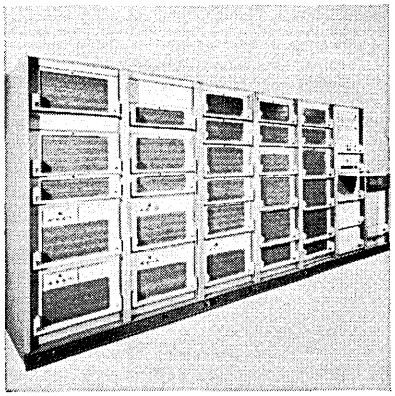


DECEMBER 1960—Univac perfects new Military Real-Time Computer

The Univac 1206 Military Real-Time Computer is a general-purpose computer built to rigorous military environmental specifications. It operates under the most severe conditions of shock and vibration — on ships, submarines, airplanes, trucks, trailers, and rail cars. Typical applications include: technical data analysis, range instrumentation, real-time guidance, tactical control, and other applications where rugged construction and high computational ability are required. Designed for processing large quantities of complex data, the Univac 1206 employs random access storage of information. Average execution time for an instruction is 14 microseconds.



SEPTEMBER 1960—Target Intercept Computer designed and developed by Univac for Nike Zeus anti-missile missile

Univac, working in close cooperation with Bell Telephone Laboratories, has developed a military high-speed, high-reliability computer for guidance of the Army's Nike Zeus anti-ICBM missile.

Speed, accuracy, and reliability are key factors in this system. Speed because once a target missile is detected, only minutes remain in which to intercept and destroy it. Accuracy because the Univac computer must fix launching time, project exact intercept time and place, and send steering orders to guide the Nike Zeus to its target. Reliability because the Univac computer must continue to adjust its computations up to the last moment of guidance, when the target missile is destroyed.

5 major developments in systems

6 major developments in peripheral equipment

4 major developments in tabulating equipment

5 major developments in computer engineering and facilities

FROM UNIVAC

DIVISION OF SPERRY RAND CORPORATION

. . . and more to come in '61!

CODASYL o.k.'s publication of COBOL-61 executive committee resolves not to abdicate maintenance

COBOL-61 was published last month following approval of a recent Executive Committee meeting of the Conference on Data Systems Languages (CODASYL), held in The Pentagon. Distribution is expected to be completed this month, and copies may be obtained by writing to the Superintendent of Documents, Government Printing Office, Washington 25, D.C.

As an important addition to the manual, one of the introductory pages contains a listing of thirteen manufacturers showing 36 models of EDP equipment for which they intend to provide COBOL compilers and the target dates for such compilers.

COBOL-61 updates the COBOL report issued in April, 1960, which set forth initial specifications for the COmmon Business Oriented Language. In announcing publication, Charles J. Hitch, Assistant Secretary of Defense (Comptroller), said, "The need for and the importance of an English language programming technique such as COBOL cannot be doubted when 11 manufacturers in a highly competitive field work together voluntarily and cooperatively toward a common end.

"It is also significant," he added, "that 11 American and two European manufacturers have made commitments to implement COBOL on over 30 different models of computers."

In their last meeting, the CODASYL Executive Committee felt that there was a strong possibility of additional compatibility demonstrations of COBOL compilers before the end of this year (see DATAMATION, page 30, February, 1961). The Committee also noted a recent Department of the Air Force action in making the use of COBOL and the availability of a COBOL compiler "an important factor" in the selection of equipment.

Commenting on a report in the April issue of DATAMATION, Executive Committee Chairman Charles A. Phillips stated that there had been no overtures from the Office Equipment Manufacturers' Institute (OEMI) or the X3 Sectional Committee concerning COBOL maintenance. It was subsequently reported by John L. Jones, representing users and as a member of the X3.4 Subcommittee on problem-oriented languages, that proposals within such subcommittees that OEMI take over maintenance of COBOL were not accepted.

Chairman Phillips stated that his report to DATAMATION followed Executive Committee action in December which confirmed the fact that recognition of COBOL and its acceptance as the standard problem-oriented language, or a part of such language, by the OEMI and the X3 Sectional Committee, is a desirable objective, and such recognition and acceptance would be an obvious prerequisite to any efforts to improve or maintain COBOL.

It was the consensus of the Executive Committee at its most recent meeting, that they firmly resolve not to abdicate the maintenance of COBOL to any group.

In attendance at this meeting were Phillips, Jones, Gregory M. Dillon, DuPont Co.; Daniel A. Goldstein, Sperry-Rand Corp.; Robert B. Curry, Southern Railway System, and Joseph A. Wegstein, National Bureau of Standards.

SCHEDULE FOR DEVELOPMENT OF COBOL-61 COMPILERS

(As published in the COBOL-61 manual, June, 1961)

Company	Equipment Model	Target Date for Compiler
Bendix Computer	G-20	1962
Burroughs Corp.	B-5000	Customers will be able to program in COBOL from a programming manual to be made available in August, 1961. The operating compiler will be available for customer use in 1962.
Control Data Corp.	CDC-1604	February, 1962
	CDC-924	February, 1962
Ferranti, Ltd.	Atlas	Not yet established
General Electric	GE-225	September, 1961
	GE-304B	July, 1961 (joint implementation with NCR)
IBM	705-II without I/O	4th quarter, 1961
	705-III/7080	4th quarter, 1961
	709/7090	4th quarter, 1961
	7070/7074	4th quarter, 1961
	1410	4th quarter, 1961
	1401 (with 12,000 & 16,000 positions of memory)	1st quarter, 1962
	1401 (with 4,000 & 8,000 positions of memory)	2nd quarter, 1962
International Computers & Tabulators, Ltd.	ICT-1301	1962
Minneapolis-Honeywell	MH-400	4th quarter, 1962
	MH-800	4th quarter, 1962
National Cash Register (joint implementation effort with G.E.)	NCR-315-Tapes	January, 1962
	NCR-315-CRAM	May, 1962
	NCR-304A	July, 1961
	NCR-304B	July, 1961
Philco Corp.	2000 series (210, 211 & 212 main frames)	October 1, 1962
RCA	RCA-301	1st quarter, 1962
	RCA-601	3rd quarter, 1962
	RCA-501	COBOL Narrator completed in 1960 (COBOL-60)
Remington Rand Univac	UNIVAC II	Completed in 1960 (COBOL-60)
	UNIVAC Solid State a. Compilation on UNIVAC II	March 1, 1961 (COBOL-60)
	b. Compilation on USS/T	3rd quarter, 1961 (COBOL-61)
	UNIVAC III	2nd quarter, 1962 (COBOL-61)
	UNIVAC 1107	3rd quarter, 1962 (COBOL-61)
	UNIVAC 490	3rd quarter, 1962 (COBOL-61)
Sylvania Electronic Systems Data Systems Operations	9400	1st version, Dec., 1961
	MOBIDIC	1st version, May, 1962

(other Fieldata equipment compiled on MOBIDIC —completion dates contingent on Army plans).

THE MAGNACARD SYSTEM

for high speed data control

by ROLF E. WESTGARD, Magnavox Research Laboratories

Magnacard is a general-purpose EDP system with the special feature of being able to store, search, and update large masses of data at high speeds. Magnacard's file storage method provides automatic access to a large quantity of magnetically coded or microfilmed information. This concept utilizes small magnetic cards as the basic medium of storage. These cards are manipulated within the system at speeds up to 90 cards per second for typical sorting, merging, and file processing operations.

Conventional magnetic tape reel systems are well adapted to applications where records and transactions can be prearranged in a logical sequence. Magnacard systems are similarly suited to such problems with an information transfer rate between the magnetic cards and the central processor of 90,000 characters per second. However, many applications requiring random access to records with selective rather than complete updating of the file, can also be handled by the Magnacard system.

The basic Magnacard system consists of the following elements: the magnetic card with a capacity of 756 alphanumeric characters of information; the transport and control units, which perform all the required sorting, file updating, and searching operations; the Magnacard file storage units, which provide automatic access in seconds to 900,000 magnetic cards; the central processor, a general-purpose digital computer with 4,096 twelve bit words of core memory and an add time of 12.8 microseconds; the input-output equipment, which includes a 1000-line-per-minute printer, high speed paper tape reader and punch, and an optional controller for punched cards or magnetic tape reel units; and the Magnascriber, which permits the key-driven recording of information on magnetic cards. This system is offered for sale or lease in the lower price range for computer systems.

Operation of the system is normally under control of the central processor which communicates with the File Storage System and with input-output equipment through the on-line control units.

Master file information is recorded on 3″ by 1″ mylar base magnetic cards which are stored in 3000-card capacity magazines in the File Storage System. The on-line File Storage System can store a total of 700,000,000 alphanumeric characters or a combination of 450,000,000 characters and 900,000 microfilm images. A digital computer may control as many File Storage Systems as it has input-output channels available. The magnetic cards from the magazines in the File Storage System are processed by the Card Handling Unit where the cards are read, up-dated, and manipulated under command of the central processor.

Input to the system can be from the Magnacard reading stations on the Card Handling Unit at the rate of 5400 magnetic cards per minute, from the high-speed paper tape reader, or from 80-column punched cards and magnetic tape through an optional control unit.

Output from the system includes the updated magnetic cards, the 1000 line-per-minute printer, the high-speed paper tape punch, or an optional control for 80-column cards and magnetic tape.

Information is recorded on the cards and read by techniques similar to those used with magnetic tapes; that is, using a sequence of magnetic spots recorded in channels along the length of the card. The recording density is 100 bits to the inch. The information is recorded in 20 parallel channels, 18 being used for recording data, one for a parity channel, and the other for the clock channel. Thus, three 6-bit alphanumeric characters are recorded in each column of the card. Each card has a total capacity of 756 alphanumeric characters plus horizontal and longitudinal parity. The clock frequency on the card is 30 KC, thus providing for a 90 KC character information transfer rate. As newer computers with faster memory access become available, the card recording density will be increased providing rates up to 180 KC.

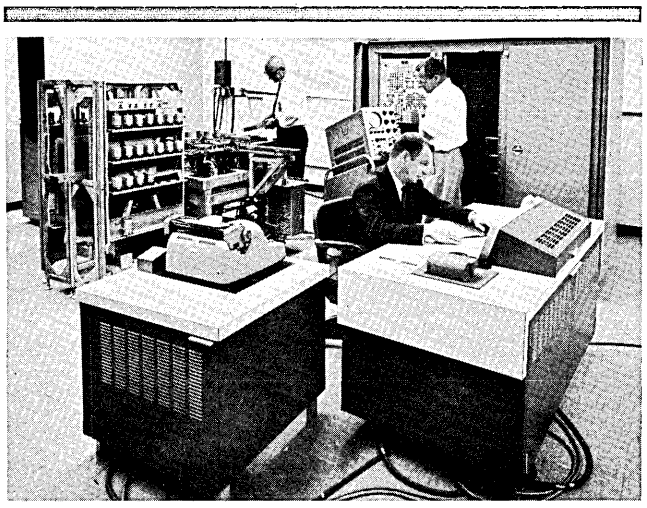
Magnavue is a new concept in data storage and retrieval combining magnetic recording and reading potential with a visual document presentation. This system is essentially an extension of the Magnacard system with the Magnavue cards being compatible with Magnacard equipment.

For viewing purposes, the card will be held at a viewing station where the cards will be displayed while the drum is rotating. Copies can be made using standard processes.

The Magnacard data handling unit consists of five basic items: the four vacuum drums, the five feed-stack stations, the four transfer valve assemblies, the two hold stations, the two read heads and the write head.

For reference purposes, the vacuum drums are denoted A, B, C and D in the accompanying diagram.

Each vacuum drum has an associated feed-stack station with the B drum having two such stations. The feed-stack stations are dual purpose with the feed position of the station allowing the release of cards onto the drums and the



The Magnacard System

stack position allowing the stacking of cards from the drums. The reversal of the feed-stack stations from one status to the other is automatic and requires about 0.4 seconds. The stations are capable of accepting 3,000-card magazines for storage of the cards. The cards are fed from a magazine onto a drum at rates up to 90 cards per second. Feeding of cards can be either continuous at the maximum card rate or intermittent with cards being released singly at rates up to the maximum rate.

The two hold stations are located on the A and C drums and serve three purposes: they allow a card to be stopped on the drum after it has been read without removing it from the processing flow. This permits time for additional processing of data before writing the data on the card. They allow cards to be merged from two separate feed stations into a single stack station. They permit other cards to be transferred onto the same drum for simultaneous circulation.

The two read heads are located on the A and C drums respectively about a card length ahead of the hold station on that drum. The write head is located on the C drum about a card length following the hold station. Additional read and write heads are optional.

The basic file storage unit is a vertical file which holds ten 3,000-card capacity magazines. A vertical file may be associated with each feed stack station of the four drum card handler. On command of the central processor, a magazine is extracted from a feed station on the four drum handler by the vertical file, the vertical file is positioned so that the desired magazine is adjacent to the feed stack station, and the new magazine is inserted. This operation requires approximately three seconds.

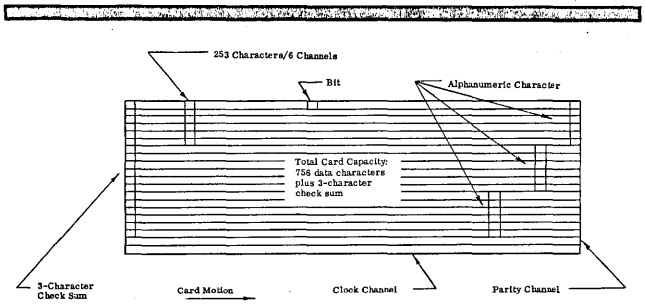
Each horizontal file (for larger storage) has a total capacity of 450,000 cards or 337.5 million characters. Two horizontal files may be associated with each four drum handler. A medium or large scale computer may control several four drum handlers providing several billion characters of on-line storage.

The data processor utilized in this Magnacard system is Control Data Corp.'s 160. This machine is a general-purpose internally programmed digital computer with 4096 twelve-bit binary words of core memory. When used with the Magnacard system, it will have a high-speed paper tape reader, a high-speed tape punch, and a 1000-line-per-minute printer. The print line is 120 characters. The system has a memory cycle time of 6.4 microseconds, and it can execute 60,000 instructions per second. In addition to the input-output devices mentioned above, the computer can communicate with an electric typewriter, magnetic tape units, and IBM punched card equipment.

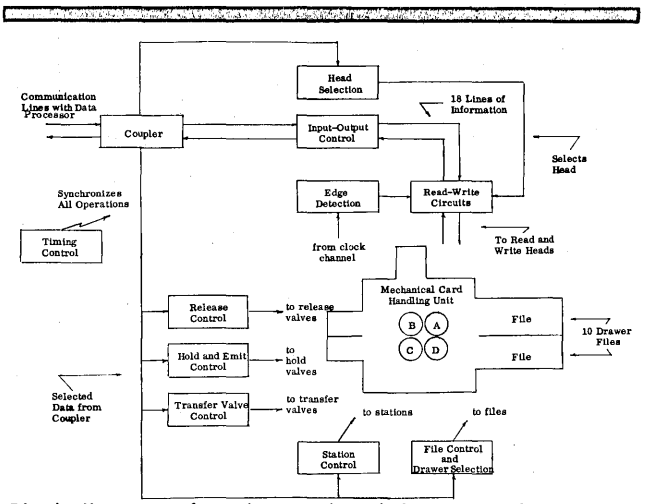
Any general-purpose digital computer may be used to control Magnacard handling equipment. Separate plug-in packages on the Magnacard Control Unit are used to accommodate the system to the logic of the particular computer being used to control the system.

The Magnascriber is a typewriter size device which provides key driven recording on the individual magnetic cards. Operator training is minimized by the simplicity of the unit and the similarity of its keyboard to that on the IBM keypunch. 128 characters may be recorded on a single card. The cards are fed and stacked automatically. An indexing device tells the operator at what point on the card she is recording.

A Veriscriber, in development at Magnavox Research Laboratories, will provide automatic key driven verification of data recorded on the magnetic cards by the Magnascriber.



Magnetic card data structure



Block diagram of card control and data control

applications

The Magnacard system has special capabilities requiring high volume file processing, a great deal of manipulation and rearranging of data, large capacity on-line storage, a combination of sequential and random processing, or the storage and presentation of graphic information.

To accomplish any of these requirements, the Magnacard system can:

1. Process a file at 90 KC without the necessity for rewriting the inactive portion of the file. At the same time, information can be added to or deleted from the file by simply adding or removing magnetic cards. The rate of processing can be effectively increased by skipping sections of the file on which there is no activity.

2. Manipulate information in the same way as on a conventional magnetic tape system by treating each magazine station as a magnetic tape unit. However, much greater flexibility is achieved by utilizing the system's ability to sort the magnetic cards which is inherent in the system design. For example, in sorting, the sort need only be carried to the point where the cards themselves need to be sorted, and this can then be accomplished independent of the central processor. The central processor merely sends a command to the four drum control unit which defines the sort field and the cards to be sorted, and the operation is then completed by the four drum handler and file system. Collating and file search operations can be performed in the same manner.

3. Provide on-line storage, processing, and retrieval of millions of microfilm images and several billion characters of information. The compete processing of files of very large size can be accomplished without human intervention normally required for tape changing, etc.

Graphic records as large as 12′ by 12′ can be compressed onto a single Magnavue card. These cards can be inserted anywhere in the files in any desired ratio to the magnetic cards. Thus, the accompanying digital information can be as complete and current as the system requires by simply updating, removing, or adding magnetic cards.

CIRCLE 101 ON READER CARD

a Philco satellite for the 2000

THE 2400 FOR BALANCED I/O

by WARREN PATTERSON, Computer Division, Philco Corporation

Since the first generation of large solid-state computers was placed on the market by Philco in 1958, the Philco 2000 series' line of compatible processors from the 210 to 211 to 212 has offered a speed increase greater than ten to one.

The requirement for balanced Input-Output systems to serve throughout the growth range of the 2000 systems has resulted in the Philco 2400 concept.

The 2400 paves the way for users to expand their 2000 system or to progress naturally into networks of integrated systems. When the 2400 coordinates data traffic on-line, to and from remote processors, its basic functions are more fully utilized.

The 2400 system has a stored-program processor to control all phases of I/O traffic for 2000 systems, and broadens the scope of I/O functions which were formerly directed by buffer-controller units. Hardware controller units used to be rigidly built to match the unique features of each I/O device. They required plugboard programs plus programmed format tapes (in the case of the printer).

Program control in the 2400 stresses the basic similarity of all I/O devices, from punched card to data link. A minimum of hardware controls for each type of I/O is built into standard 2400 I/O channels.

Eight I/O channels are independent and character-oriented, hence are adaptable to the advanced types of devices now being developed for the commercial market such as character readers, visual displays, microwave links, "compatibility" tape units, and analog-to-digital converters.

Program addressing can select at least eight similar input-output stations on any I/O channel. Electronic switching, which connects I/O channels for program control, is an 8 x 2 selection matrix. This allows any two of the eight channels to be operating at the same instant. Program jumps provide access to other devices so that interweaving of sub-routines assures concurrent running for several devices.

One central memory and stored-program processor are used on all I/O operations and data preparation functions. The 2400 System has an asynchronous organization of System Controls, Core Storage, Arithmetic Section, and the multiple I/O channels.

Data flow between sections is a character-at-a-time stream of seven-bit characters. Data operations and instruction format are variable-length.

Core storage, from 8 to 32K characters, provides individual addressing of each seven-bit character, of a variable-length field, or of a string of N characters. Therefore, data can be handled in either a Code format or Image (binary) mode.

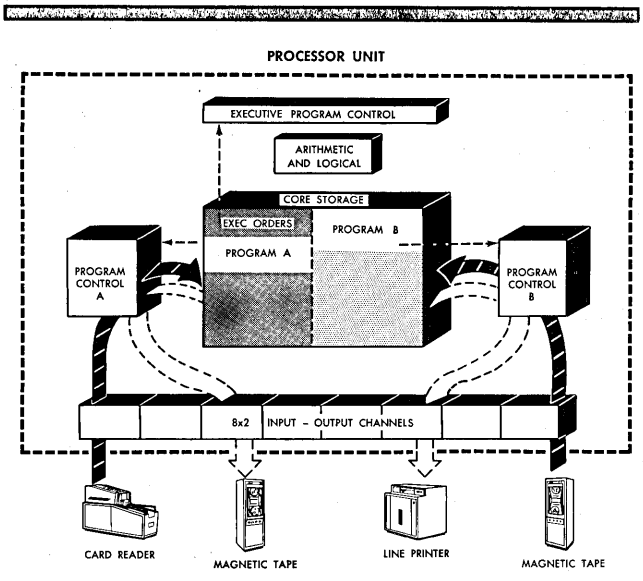
Core storage is accessed in a forward or reverse sequence, depending on the operation.

Two program controls can access different halves of memory simultaneously. Each program can access at least one character every six microseconds. Overall I/O capacity thus allows transferring more than 333,000 characters per second.

The split-memory feature is a programmer's option because either program control can access any memory area on a first-come, first-served basis.

The 2400 Processor has two levels of system control with a macro-micro relationship.

The upper level of system control is called Executive Control. Its stored orders initiate sub-routines, monitors the status of I/O devices, determines the next operation, and communicates with the operator.



The lower-level Program Control is assigned by an Executive-level CONNECT order to a specific I/O device, a specific sub-routine, and memory zones. The lower-level Program Control then proceeds independently to sequence the sub-routine. A typical sub-routine (using the Card Reader) reads one or more cards, edits and checks the selected columns, translates code, converts the data to packed binary form; the packed data is stored in block format, ready for transferring to magnetic tape; all audits and counts are performed. The assigned program control will remain connected to the I/O device until the sub-routine terminates and releases control. By relieving the 2000 of its data preparation work, the 2400 saves 25% of running time for the 2000 processor.

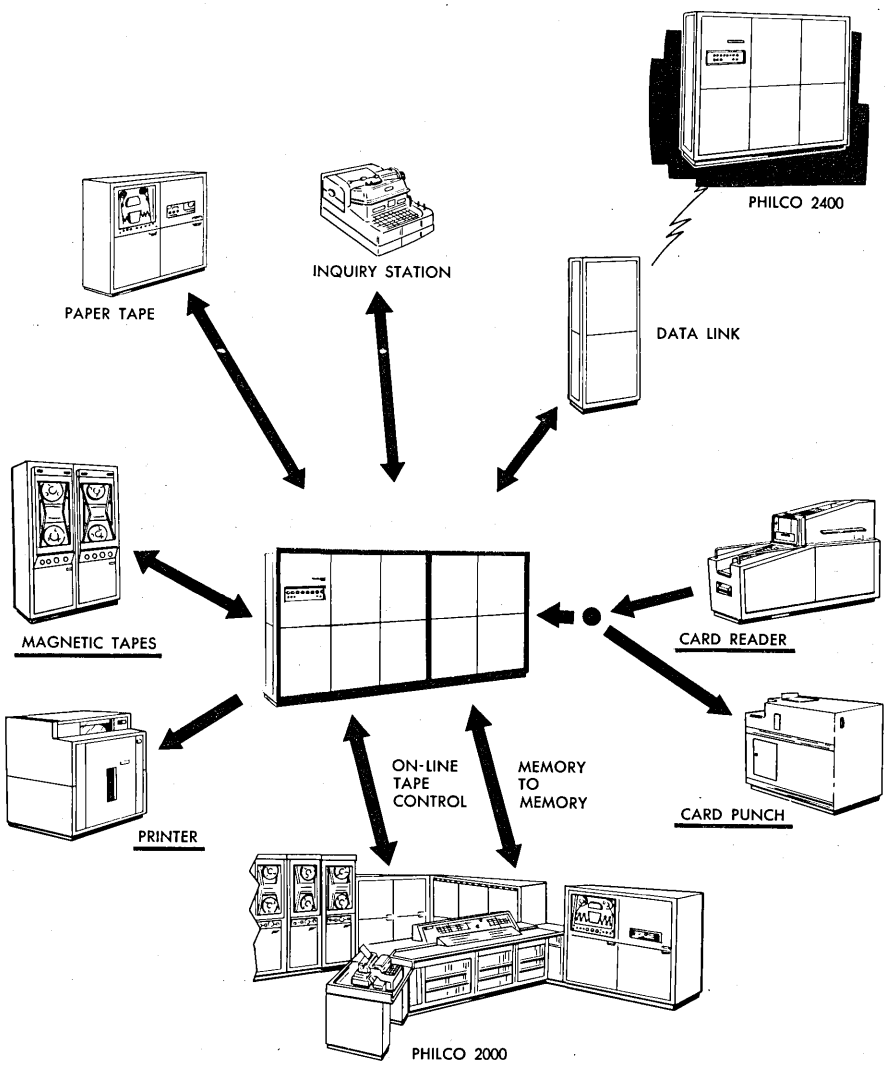
Once the Executive level has initiated sub-routine operation (by a CONNECT order), it is concerned with checking the status of the system, determining which sub-operation is to be "connected" next.

Sub-routine addresses are 12-bit (two-character) binary addresses, allowing a range of 0-4095 characters above each base address. The base addresses A, B, and C, as assigned by a CONNECT order, can specify any memory locations. Each address of the sub-routine is indexed by one of the three base address registers. The base address, or indexing registers can be changed by another CONNECT order at the Executive level.

There are two identical program control sections at the lower level. Each can independently execute sub-routines for any I/O function. A complete I/O operation, such as Punched Card-to-Packed Binary Tape, is a repeated cycling of the sub-routines that control a Card Reader and a Magnetic Tape for the desired format. Each cycle of the operation and each sub-routine is initiated by an Executive CONNECT order.

Two complete I/O operations can run simultaneously and independently. Each of these parallel operations may be running two or more devices concurrently. Sub-routines are relocatable, since they contain addresses which are relative to any memory base. Compilations of sub-routines is not necessary, since Exec Orders provide the parameters which might vary from day to day, such as memory allocation, device assignment, and schedule of operations.

Exec orders scan I/O channels for demand inputs. A sequence of CHECK orders can individually scan the status of eight inquiry stations or eight data links on a single I/O channel more than four thousand times per second. Real-time scanning of I/O stations and of "connected" I/O operations is independent of both active sub-routines. The decision to "connect" a device in response to a demand input is made by the CHECK order. For on-line operation with other Philco 2000 or 2400 processors, interrupts can be initiated by the sending station.



Expanded Philco 2400 for Data Traffic Control. Underlined captions comprise basic system: tapes, card reader, card punch, printer.

CIRCLE 103 ON READER CARD

For real-time control

THE L-3060

Development of one of the world's fastest and most powerful solid-state computing systems, the L-3060, was announced last month by General Precision's Librascope Division, Glendale, Calif.

Aimed at the real-time control market, a typical, "distributed" configuration has high-speed core memory access to 144K words with a word length of 50 bits. There are four computers in each system with a 1.5 microsecond memory. The system will perform 2,480,000 operations per second with an average access time of .75 microseconds.

Mode of operation is binary, parallel, with complete variable-field operation. A typical system features a shared core memory of 8,192 words (duplexed), random access to 3,250,000 words stored in four magnetic disc files and six magnetic tape storage files of 9,000,000 words. Data representation is in fixed and floating point arithmetic with direct, indirect and immediate addressing.

There are a total of 63 index registers and 103 basic single-address instructions. Two real-time clocks operate at 2 megacycles.

Deliveries of L-3060 are on an 18 month basis, according to Librascope president W. E. Bratton. The system evolved from Librascope's Air Traffic Control Central Data Processor built for the FAA.

In this case, a processor of modest speed is combined with well-organized buffers and off-line drum files and the ATC system is capable of growing modularly. The L-3060 is a generalization of this system philosophy. It combines high-speed computers, buffers, and rapid access bulk storage units.

design concept

The basic design criterion for the L-3060 centers on the use of computers in a distributed complex as part of command and control systems.

The L-3060 derives its modular basis by implementation of a trunkline organization. Up to four computers, in the initial configuration, may receive input information from, or send output information to, as many as three buffers via the buffer-processor trunkline. Similarly, all the computers in the system may communicate with one another via a shared memory. Finally, all the computers may communicate with any of the disc file or magnetic tape units via the file trunklines.

The concept of the trunkline allows one to start with a minimum system, as dictated by either requirements or economics. As new functions are required, equipment can be tied into the then existing trunk with no modification to the existing system.

Index Registers are available in each central computer processor. These registers are physically located in a separate core memory and are associated with a separate high-speed arithmetic unit for rapid address modification.

Each index register is 48 bits in length and contains three 16-bit subregisters: a tally register, a refill register, and an increment. The tally register is used for address modification and/or counting in the usual fashion, the increment determines the amount of change in the tally register, and the refill register may be used to reset the tally register without an additional memory access. A large number of index register manipulation commands are available.

The computers use basically a single address instruction with a sequentially accessed program. Instructions are read from memory in sequentially progressing addresses until the sequence is altered by a transfer command. The single address of the instruction usually refers to the operand address; however, this conventional operand addressing method is complemented by various address modification features.

Two instruction formats are used in the L-3060 computer. The type 1 instruction format, holds instructions which may specify a field in the operand. In this format, forty-five of the forty-eight bits of a computer word are used to hold the operation code, field selection bits, index tag, immediate address, indirect address, and the operand address.

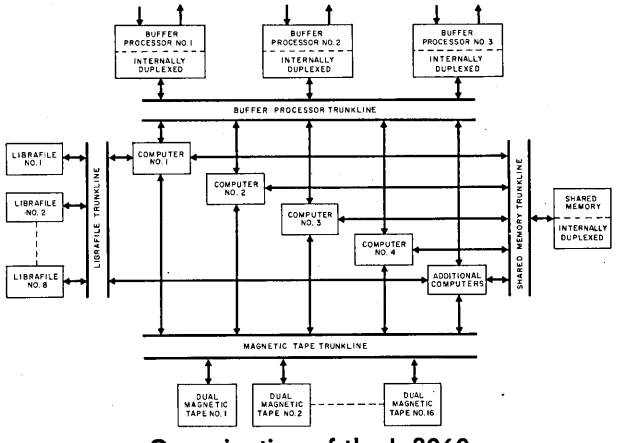
The type 2 instruction format is used for instructions requiring an increment for certain index modifications. The instruction consists of the operation code, an increment field, an index tag, immediate address, indirect address, and the operand address.

The operation code specifies the operation which is to take place. Nine bits are reserved for the operation code in both type 1 and type 2 instructions. This allows the flexibility of adding instructions or other programming features when special requirements are to be met, or as increased capability is desired.

The type 1 instruction format contains two groups of six bits, designated as the X and Y bit field selectors. The six "X" bits specify the number of bits to the left of the most significant bit of the desired field, while the six "Y" bits specify the number of bits to the left of the least significant bit of a field. As an example, the field that would include the most significant twenty-four bits of a word which would be designated by an "X" of O and a "Y" of 23.

Variable field selection acts as a vernier for the memory address by giving the programmer the capability of selecting any single bit, or groups of bits, in the entire memory. Thus, many groups of information can be stored in the same memory address, even though each group must be operated upon individually. Variable field selection increases the effective memory capacity by providing the capability of "packing" data into memory words, and also increases the effective computing rate by eliminating the need for separate extract and mask operations.

Positions 32 to 47 of both type 1 and type 2 instructions generally contain the core memory address, or a number which, when modified, becomes the address of the operand. These sixteen bits are capable of addressing the 32,768 words of computer core memory and also a potential 32,768 words of shared memory.



Organization of the L-3060

CIRCLE 100 ON READER CARD

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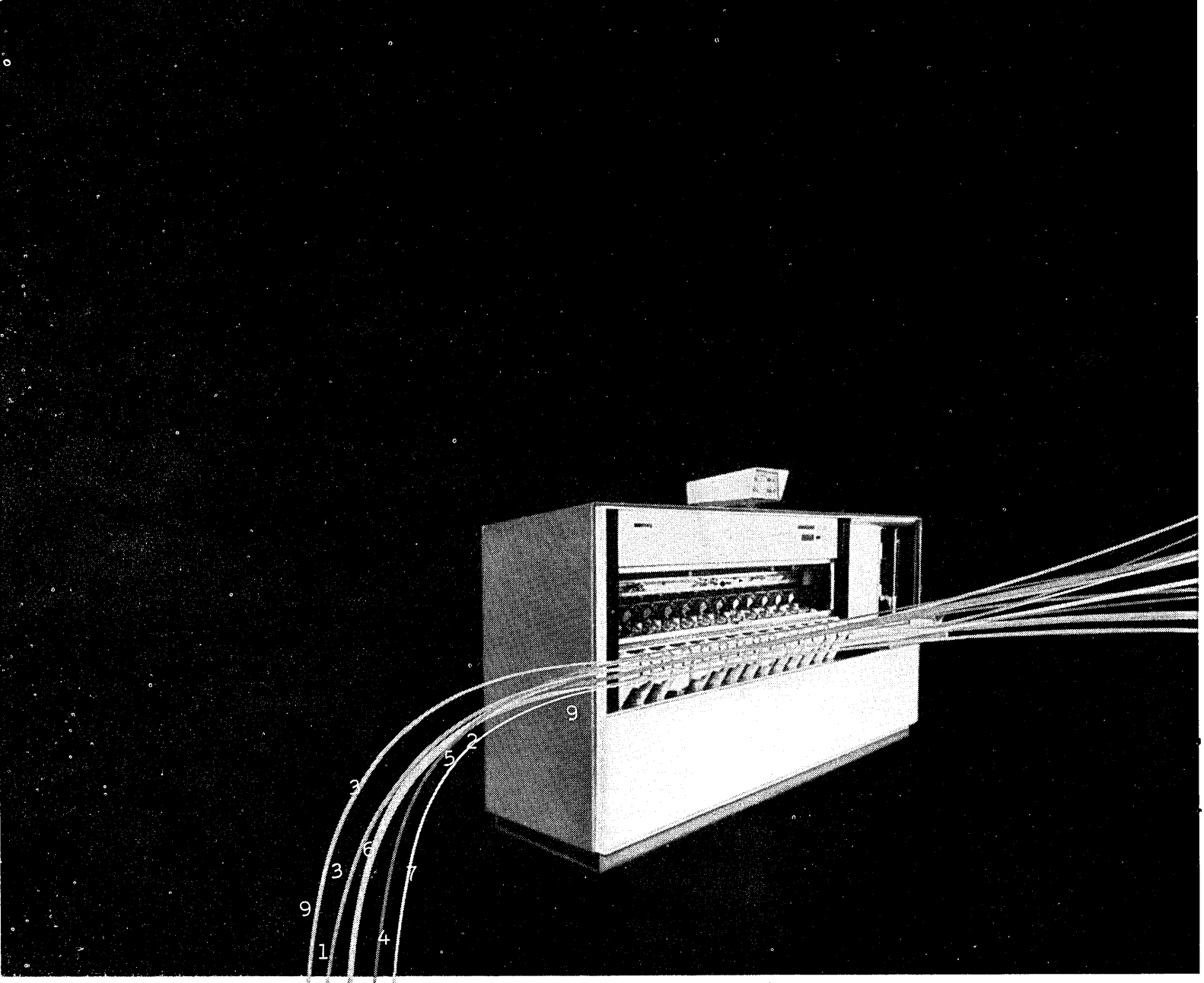
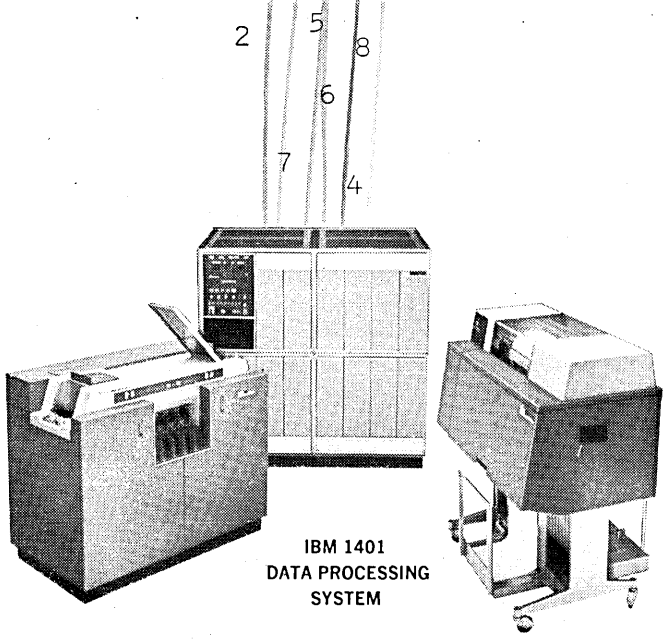
CIRCLE 73 ON READER CARD



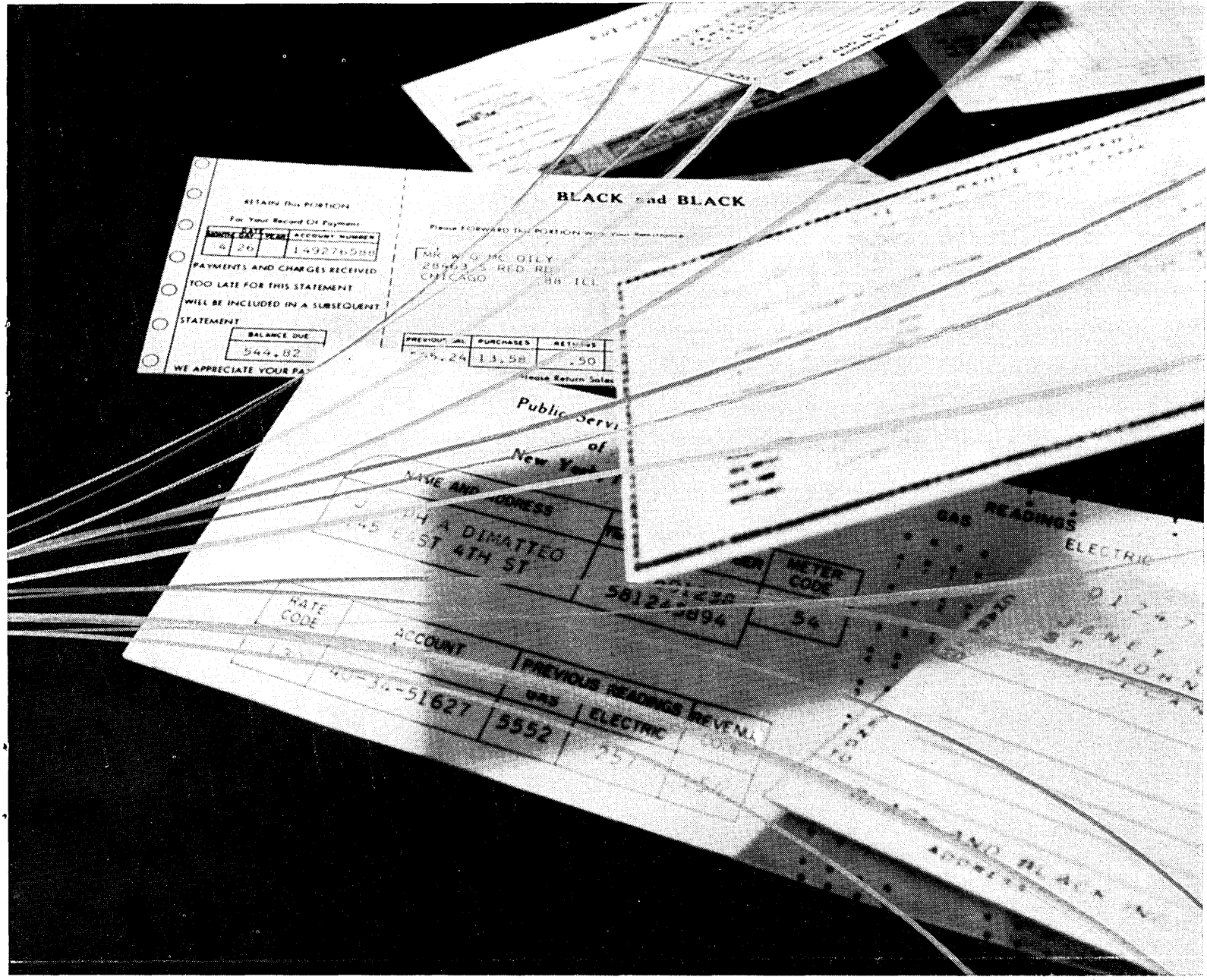


IBM 1401
DATA PROCESSING
SYSTEM

IBM® 1418 Optical reads printed

Direct input to a computer *without manual keypunching*—that's how the 1418 dramatically boosts input speeds, and raises over-all efficiency.

Typical example: in a job that normally would call for 20,000 punched cards, the 1418 reduces 200 hours of keypunching and verifying to *one hour* of "reading." The 1418 reads numerical data and marks on bills, invoices, checks and other papers at speeds up to 480 characters a second... and up to 400 documents a minute.



Character Reader numbers directly into the 1401 system

Reading is *optical*—no special inks required. Documents prepared on 407 accounting machines, 1403 printers, typewriters equipped with IBM 407 type, or credit imprinters with elongated 407 type, are the "reading matter" for the 1418. Since your 1401 computer controls the feeding of documents into the 1418 reader, you can get either continuous or interrupted feeding for special processing.

Depending on your needs, there are two 1418 models to select from. One has three stacking hoppers. For more complex sorting jobs, there's another with thirteen which sorts documents either under 1401 control, or independently.

Optional features include: a second optical reading station which permits two lines to be read on a single pass; a mark reading station for reading pen or pencil marks optically.

For more facts about how the 1418 increases the through-put of your 1401 System, call your IBM Representative.

IBM®
DATA PROCESSING

CIRCLE 11 ON READER CARD

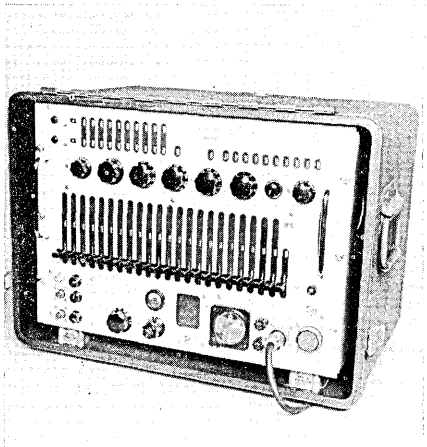
analog-to-digital converter

A new analog-to-digital converter, the ADC-1B, has recently been announced. Because it uses standard voltages, circuits and logic throughout, the bit rate, word length, type of code, voltage range and output format can be changed to adapt the unit to specific applications either as a system component or as a self-contained instrument. Maintenance of the unit has been reduced to routine substitution of cards. Five different types of digital logic cards are used. Applications include data translation/processing systems, digital quick-look systems, and portable data acquisition systems. SYSTEMS ENGINEERING LABORATORIES, 4066 Northeast 5th Ave., Ft. Lauderdale, Fla. For Information:

CIRCLE 200 ON READER CARD

digital clock

A single, compact unit of the model 801 digital clock, combines a crystal oscillator, parallel binary time register, WWV receiver and time synchronizer for correction to the National Bureau of Standards. Time information, either solar or sideral, can be read out as parallel binary bits by a digital computer or paper tape perforator. Out-

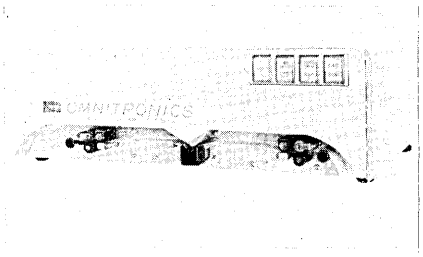


puts include precision time as a 28 bit binary number, a pulse which occurs at a preselected time and WWV audio signals. AC input power can be 60 or 400 cps, and an internal inverter allows power input from 24V DC source. GENERAL MILLS, INC., 1620 Central Ave., Minneapolis 13, Minn. For information:

CIRCLE 201 ON READER CARD

bi-directional tape reader

The application of reflected chopped light enables the use of ac coupled amplifiers in the new bidirectional photoelectric tape reader model PTR-71. The bidirectional drive enables tape reversal to be accomplished using a unidirectional synchronous speed motor. Tape reading applications for the



PTR-71 include input to digital computers, communication systems, tape converters, ground support equipments and numerical machine tool control. OMNITRONICS, INC., 511 No. Broad St., Philadelphia 23, Penna. For information:

CIRCLE 202 ON READER CARD

dual-purpose printer

A high-speed printer, the IBM 1404, combines the printing of either individual cards or continuous paper forms as direct output from the 1401. It incorporates all the basic continuous form features of the 1403 and, is equipped with a new card document station. A number of variables determine the card-per-minute printing speed, and its maximum card output is 800 per minute. The document station will handle any size card from 51 to 160 columns wide. Continuous paper forms are printed up to 600 lines per minute, and blank spaces on forms are skipped at speeds in excess of the printing rate. Printing and punching of cards can be performed during the same operation. IBM CORP., DATA PROCESSING DIV., 112 E. Post Rd., White Plains, N.Y. For information:

CIRCLE 203 ON READER CARD

data communicator

The DC-11 data communicator, a basic accessory to the G-20 computer, has enabled an increase in speed and overall system work capacity. One hundred thousand records of 80 alpha-numeric characters can be sorted in less than 18 minutes and a 250 x 250 matrix inversion can be performed in 40 minutes. The four channels of the DC-11 are each capable of relaying data between the G-20's central processor and a number of different input/output devices. THE BENDIX CORPORATION, COMPUTER DIVISION, Department E-29, Los Angeles 45, Calif. For information:

CIRCLE 204 ON READER CARD

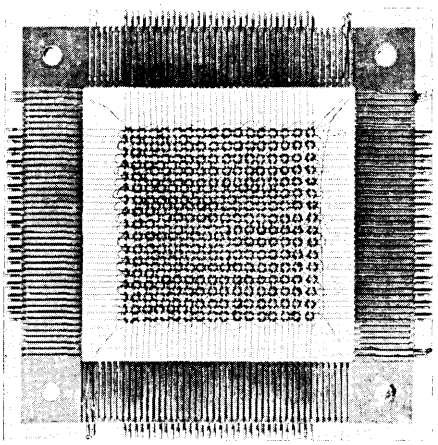
bi-directional tape handlers

Two new high-speed, bi-directional perforated tape handlers: model 4588, handles 1,000 feet of five to eight-level four mil tape interchangeable at speeds up to 150 characters per second, and the 4599 has the same abilities, but functions at speeds up to 250 characters per second. Both tape handlers have 10½-inch reels, are designed to function with reader models 3500 and B3500, and are suitable for standard rack mounting. DIGITRONICS CORP., Albertson Ave., Albertson, Long Island, N.Y. For information:

CIRCLE 205 ON READER CARD

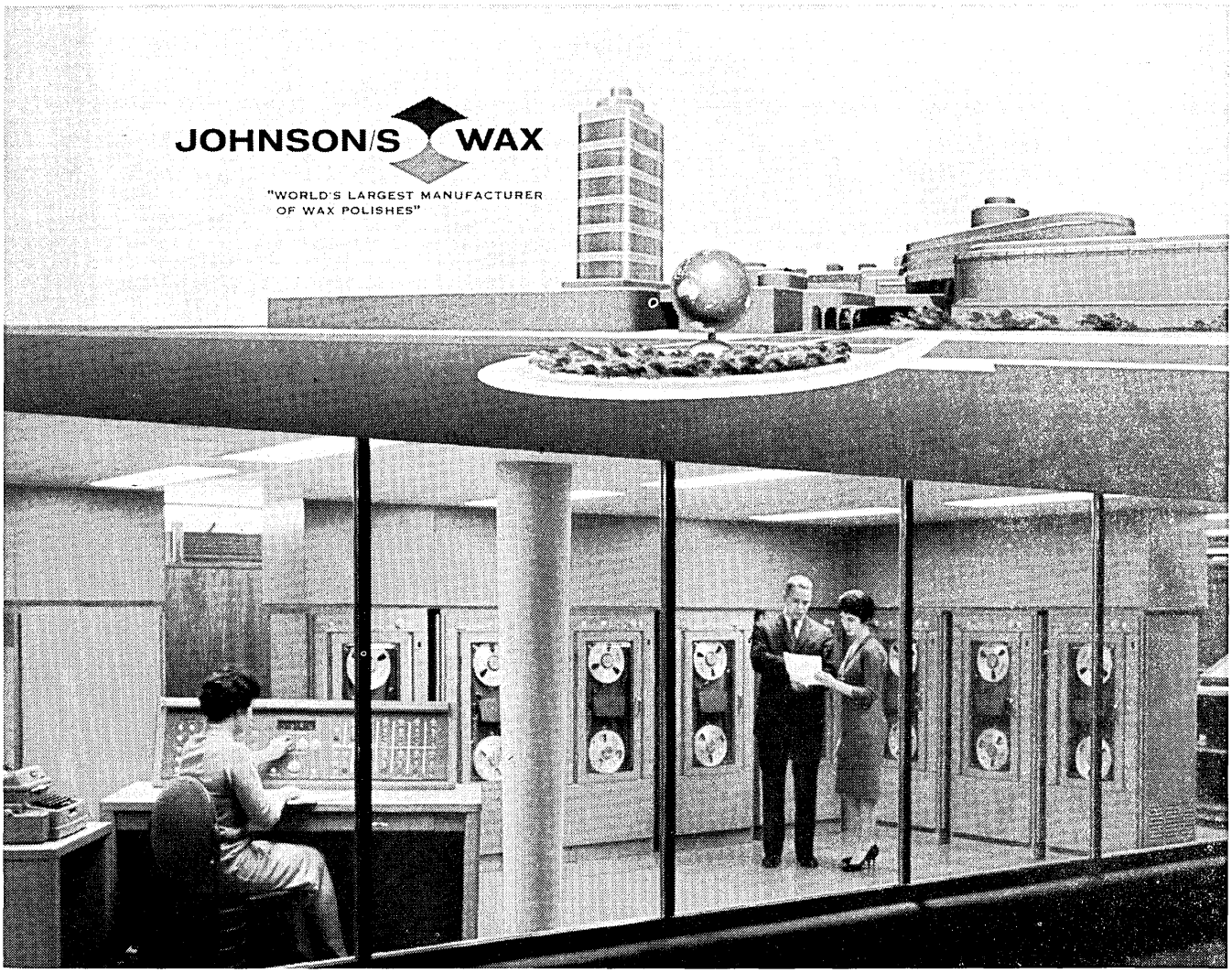
memory planes

A new standardized line of 4-wire coincident current, memory planes for use in random access type memories has been announced. All matrix terminal connections are multiple wire wrapped and dip soldered, and all memory cores are tested on electrical parameters and statistically checked both before and after assembly in the



array. Compactness of design, achieved by wafer construction and by wiring memory cores on 50 mil centers, enables a reduction in stack dimensions. FERROXCUBE CORPORATION OF AMERICA, Saugerties, New York. For information:

CIRCLE 206 ON READER CARD



"National* 304 Data Processing System has proved to be a highly profitable investment!"

—S. C. JOHNSON & SON, INC., *Racine, Wisconsin*

"The National 304 enables us to know *today* where we are *today*. For example, we can now bill customers on the same day items are shipped from warehouses anywhere in the United States. This has enabled us to pick up working capital equivalent to three days' sales—an important saving.

"We can now take action *today* on inventory requirements based on last night's actual inventory and unfilled orders position. As an initial result, we have reduced finished inventories by 10%, with the potential of greater reductions in the near future.

"Our manufacturing and production scheduling are now more closely coordinated with sales needs than ever before. And, our field warehouses are stocked more intelligently, enabling us to serve our customers better.

"Fundamentally, the National 304 has given us faster and more accurate control over sales efforts, production, inventory, credit, and customer billing. It has sharpened management reflexes, enabled us to harness data in time to be used most profitably, and meets our demands for the factual data necessary to make management decisions in time to be most effective.

"At this stage of our installation progress it is difficult to assign a definite money value to all these advantages. However, we know their value represents a highly profitable return on our investment."

Howard M. Parkard

President
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National*

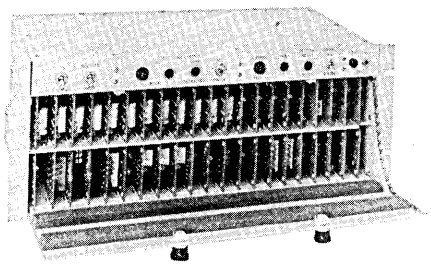
ELECTRONIC DATA PROCESSING
ADDING MACHINES • CASH REGISTERS
ACCOUNTING MACHINES • NCR PAPER

CIRCLE 12 ON READER CARD

New Products

buffer/control equipment

A new series of RBP buffer/control units is specifically designed for driving rotary-bar printing mechanisms. All standard commercially available RBP printers are accomodated by the design, which accepts inputs from magnetic tape, magnetic drum and shift



registers. Standard models are available with capacities of 24, 36, 72, 120, and 160 characters. Characters up to 6 bits in length are loaded serially up to 100,000 per second. Two manual operations are provided to facilitate maintenance and checking. DI/AN CONTROLS, INC., 40 Leon St., Boston 15, Mass. For information:

CIRCLE 207 ON READER CARD

magnetic tape cleaner

The model CT-2 magnetic tape cleanerer utilizes the Kinesonic transducer to obtain both sonic and ultrasonic cleaning of tape. It may be used for preventive maintenance by magnetic tape users. The CT-2 is adaptable to ¼", ½" or ¾" tape. It can handle standard reels of 6", 8", 10½" and 14" in diameter containing any length and tapes of a thickness from ½ mil to 5 mils. GENERAL KINETICS INC., 2611 Shirlington Rd., Arlington 6, Va. For information:

CIRCLE 208 ON READER CARD

pre-programming patchboard

Pre-programming patchboards have application where flexible program control is required in digital and analog computers. A range of sizes, from 200-600 contacts and in multiples of 600 contacts is available as well as a full compliment of single and multiple conductor self contacting type patchboards. VECTOR ELECTRONIC CO., 1100 Flower St., Glendale 1, Calif. For information:

CIRCLE 209 ON READER CARD

circuit blocks

Twelve basic circuit blocks, designed for digital equipment and other applications where logic functions are required, have been introducd. Each circuit block consists of one or two basic logic circuits performing specific functions, enabling the design engineer to think in terms of complete logic systems. Individual components are mounted on a printed wiring board, placed in a synthetic resin case, and capsulated to provide protection against shock, vibration and other atmospheric effects. AMPERE ELECTRONIC CORP., ICOMA DIV., 230 Duffy Ave., Hicksville, Long Island, N.Y. For information:

CIRCLE 210 ON READER CARD

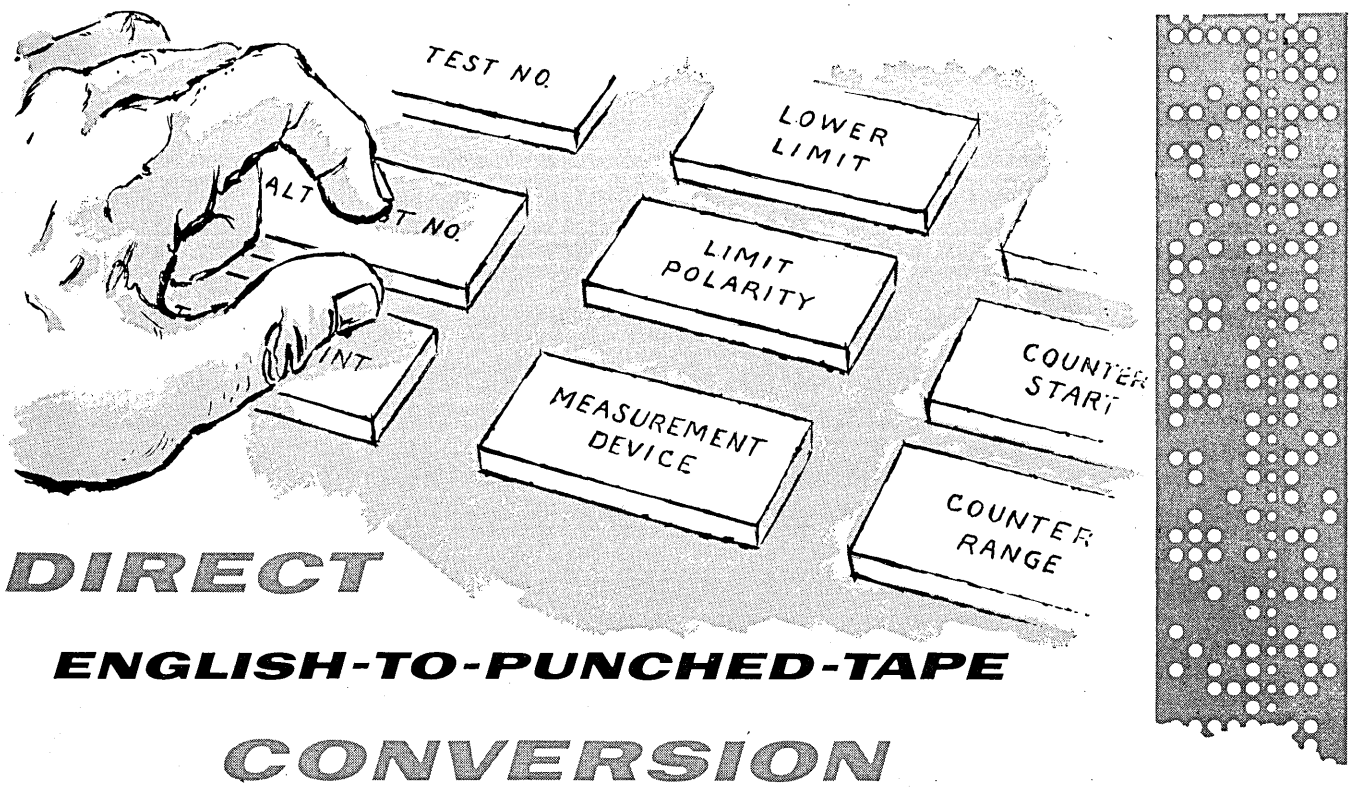
plug-in adapters

New plug-in adapters to use the model 560R digital X-Y plotters on-line with medium-scale digital computers are now available. Its function is to accept incremental computer output signals and convert to plotter signals and is used to provide a quick analysis of computed data, formula and reduced experimental data. Adapters are now available for the LGP-30, Recomp II, RPC 4000, 1620 and the 1401. CALIFORNIA COMPUTER PRODUCTS, INC., 8714 Cleta St., Downey, Calif. For information:

CIRCLE 211 ON READER CARD

7000 data system

A new series 7000 digital data alarm



DIRECT ENGLISH-TO-PUNCHED-TAPE CONVERSION

The McDonnell TAPE* automatically prepares punched tape. TAPE's logic circuitry electronically analyzes word-group and numerical keyboard commands and converts them to complete coded programs. Punching mechanisms instantly deliver the finished tape. Editing, verifying, duplicating or correcting is accomplished quickly and automatically.

TAPE Slashes Time and Costs

Programming time, operator training, schedule delays, as well as large computers, key punches and other peripheral equipment are eliminated. Small size permits installation in laboratories or wherever finished tape is used. Unskilled operators learn to use TAPE in minutes. The McDonnell TAPE has demonstrated the capability to prepare 25,000 feet of perfect tape at less than half the cost and in less than one-third the time required to prepare the same tape with the best standard computer preparation method available.

A prototype McDonnell TAPE is operating which prepares tape for the AN/GJQ-9 missile and aircraft automatic checkout system. Minor modification readily adapts the keyboard and logic circuitry to tape preparation requirements of other industrial and military operations.

Whatever your punched tape requirements, you are invited to visit McDonnell and operate TAPE.

Tape Automatic Preparation Equipment

For descriptive literature, write:

Electronic Equipment Division
Dept. 952
McDonnell Aircraft, St. Louis, Missouri

MCDONNELL

ELECTRONIC EQUIPMENT DIVISION

Airborne Antennas • System Trainers • Simulators • Radio Beacons • Telemetry • Specialized Digital Computers • Microwave Components • Automatic Flight Control Systems • Automatic Checkout Equipment

MCDONNELL AIRCRAFT • ST. LOUIS

CIRCLE 14 ON READER CARD

scanning, telemetering, and recording system measures, converts, transmits, and records analog values in digital form. The new system is of modular building block design. It automatically scans and measures inputs from transducers located at remote sites, converts this data into digital form and telemeters it to a central control station for recording. MONITOR SYSTEMS, INC., A SUBSIDIARY OF EPSCO, INC., Fort Washington Industrial Park, Fort Washington, Pa. For information:

CIRCLE 212 ON READER CARD

t-pac serial memories

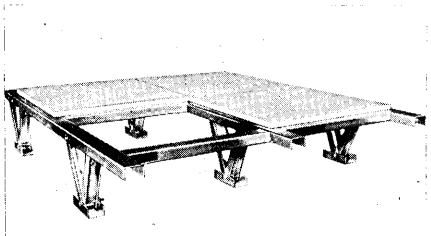
Five new serial memories, model SM-10, with delays of 19 to 2000 microseconds contain a driver circuit, a magnetostrictive delay line and an amplifier-reshaper. It is driven by a standard LE-10 logical element T-PAC which furnishes "write-in" and "erase" control logic. Negation output drive capability is 40 T-PAC unit loads, with an assertion output drive capability of 20 T-PAC unit loads. One unit has storage capacities up to 2000 bits and greater loop storage can be obtained by cascading. COMPUTER CONTROL CO., INC., 983 Concord St., Framingham, Mass. For information:

CIRCLE 213 ON READER CARD

New Products

elevated flooring

Strato-Floor is a new type of elevated flooring designed for use in computer installations, or whenever extensive cabling and wiring systems require under-the-floor space and immediate accessibility. Modular 24″ x 24″ panels are made of plastic molded around cross-laminated plywood. The floor is



designed to support a live load of 250 lbs. per square foot, and a point load of 1000 lbs. Steel stringers are bolted to a new kind of adjustable jack designed in a triangular shape. Deflection is claimed to be minimized under even the heaviest loads, STRATO-FLOOR, INC., 795 East 152nd St., Cleveland 10, Ohio. For information:

CIRCLE 214 ON READER CARD

network analogue

The newly designed precision resistance network analogue contains 150 current injection sources for simulating parameters, and may be combined with a digital computer for calculation of electron trajectories. This system is self contained and includes the resistance network board of x, y, or r, z coordinates, 150 current injection potentiometers, three dc power supplies, a digital voltmeter and a vacuum tube voltmeter. LITTON INDUSTRIES, RESEARCH LABORATORY, San Carlos, Calif. For information:

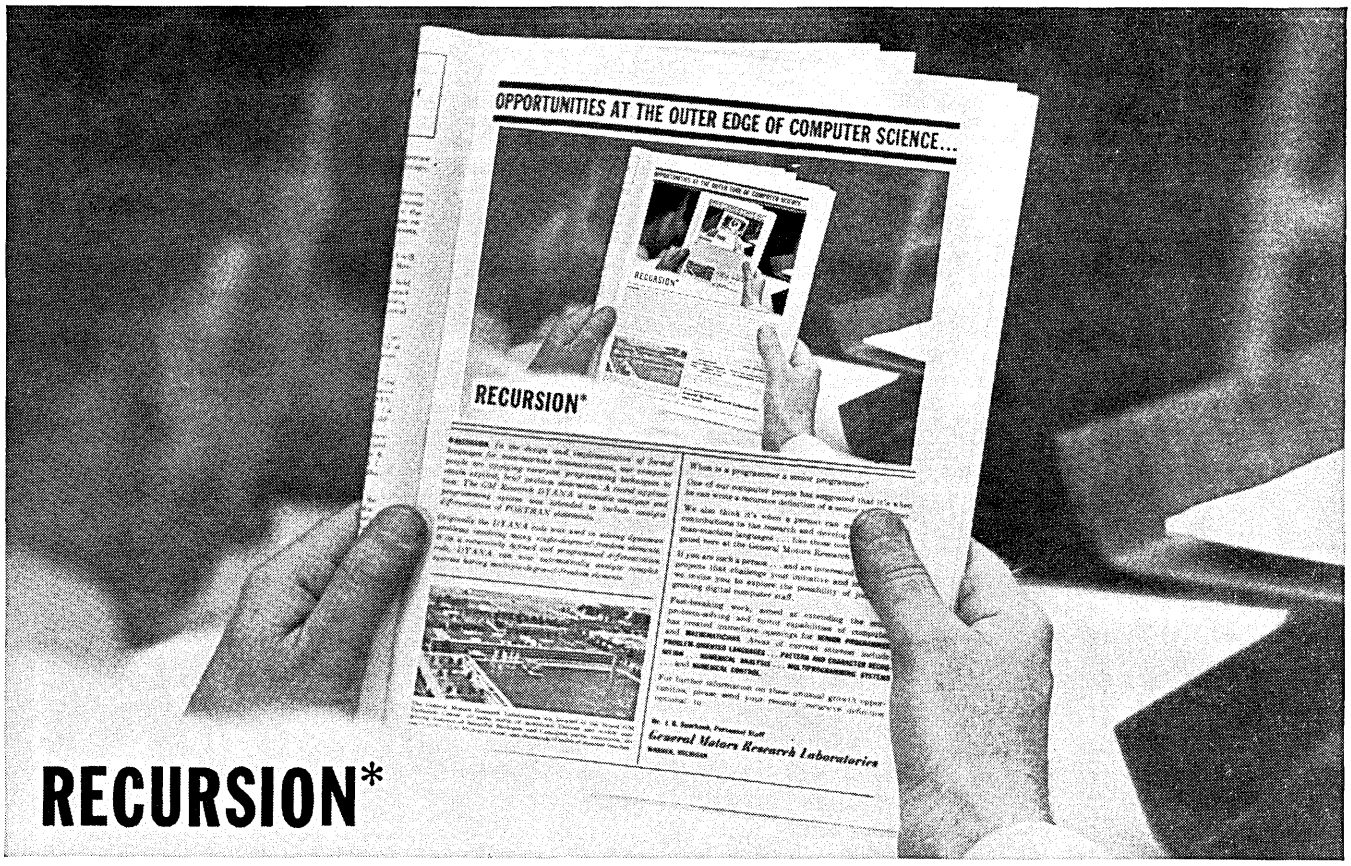
CIRCLE 215 ON READER CARD

character generator

A new, solid state character generator combines continuous straight and curved lines to form digits, letters and symbols in a fully transistorized package and can be used with any cathode ray tube display. Character rates for the full alphanumeric unit are up to 50,000 per second. The two sizes available are the C36000, 4″ x 6″ x 7″, and CL36000, packaged on a standard 5¼″ relay rack panel for use as a computer module. RMS ASSOCIATES, INC., 805 Mamaroneck Ave., Mamaroneck, N.Y. For information:

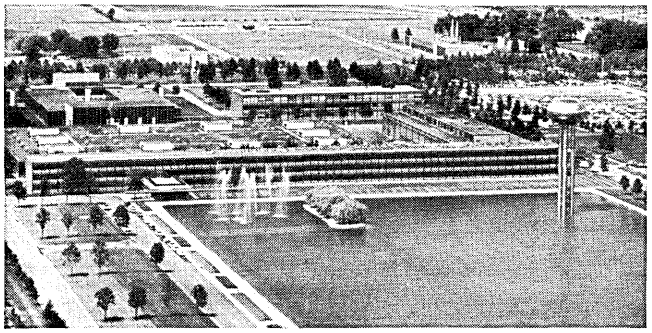
CIRCLE 216 ON READER CARD

OPPORTUNITIES AT THE OUTER EDGE OF COMPUTER SCIENCE...



***RECURSION.** *In the design and implementation of formal languages for man-machine communication, our computer people are applying recursive programming techniques to obtain explicit, brief problem statements. A recent application: The GM Research DYANA automatic analyzer and programming system was extended to include analytic differentiation of FORTRAN statements.*

Originally the DYANA code was used in solving dynamics problems involving many single-degree-of-freedom elements. With a recursively defined and programmed differentiation code, DYANA can now automatically analyze complex systems having multiple-degree-of-freedom elements.



The General Motors Research Laboratories are located at the famed GM Technical Center, 13 miles north of downtown Detroit and within easy driving distance of beautiful Michigan and Canadian parks, campsites, ski resort areas (76 in Michigan alone) and thousands of miles of summer beaches.

When is a programmer a senior programmer?

One of our computer people has suggested that it's when he can write a recursive definition of a senior programmer.

We also think it's when a person can make significant contributions to the research and development of formal man-machine languages . . . like those now being investigated here at the General Motors Research Laboratories.

If you are such a person . . . and are interested in computer projects that challenge your initiative and imagination, we invite you to explore the possibility of joining our growing digital computer staff.

Fast-breaking work, aimed at extending the sensor, problem-solving and motor capabilities of computers, has created immediate openings for **SENIOR PROGRAMMERS** and **MATHEMATICIANS.** Areas of current interest include: **PROBLEM-ORIENTED LANGUAGES . . . PATTERN AND CHARACTER RECOGNITION . . . NUMERICAL ANALYSIS . . . MULTIPROGRAMMING SYSTEMS . . .** and **NUMERICAL CONTROL.**

For further information on these unusual growth opportunities, please send your résumé (recursive definition optional) to:

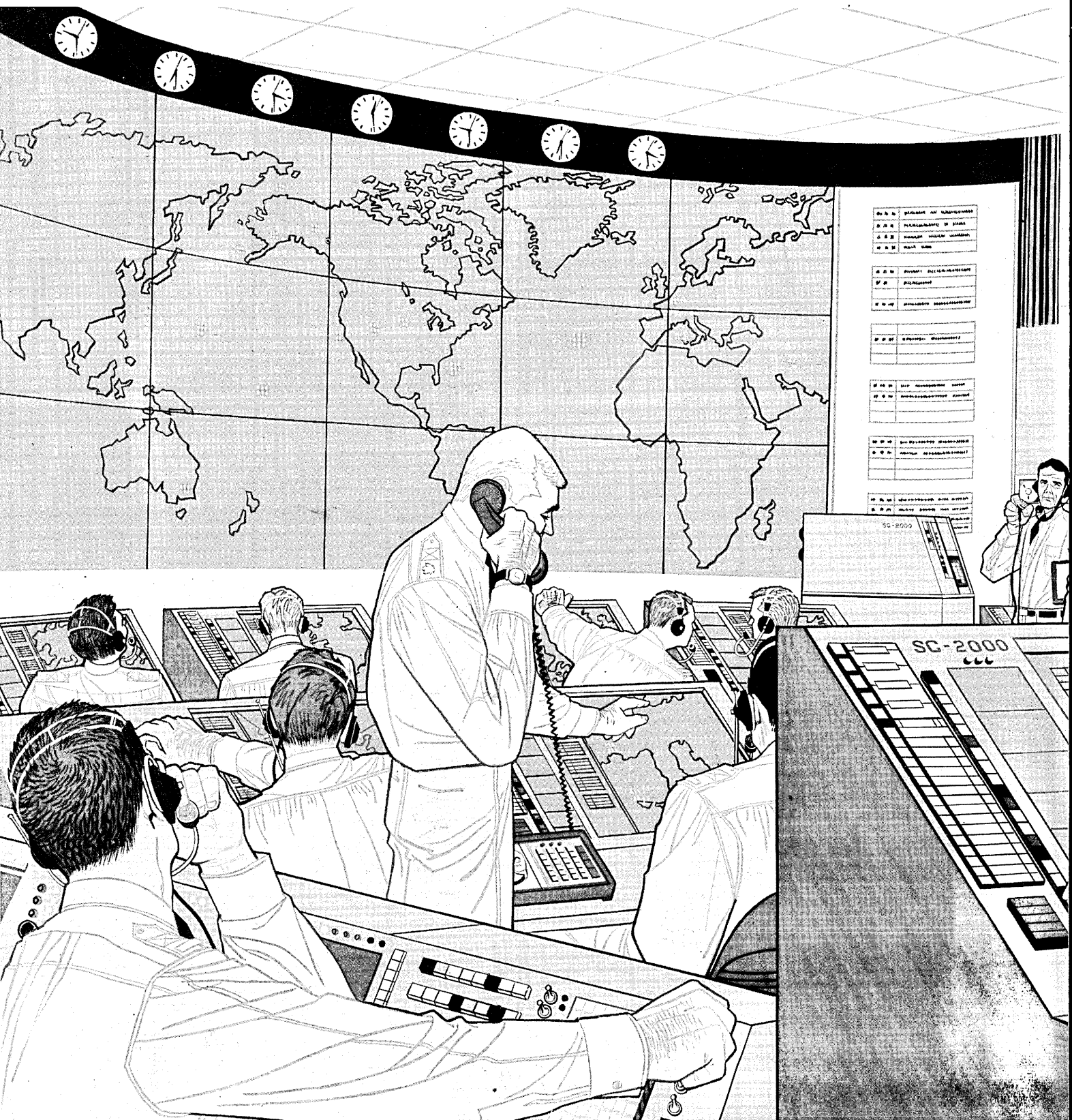
Mr. J. B. Sparhawk, Personnel Staff

General Motors Research Laboratories

WARREN, MICHIGAN

CIRCLE 74 ON READER CARD

Less than 2 seconds from computer to large



screen display WITHOUT DARKENING THE ROOM!

The new, advanced S-C 2000 bright display system developed by General Dynamics/ Electronics produces an entire large screen display less than two seconds after data are transmitted from the computer. The unique yet simple principle of the S-C 2000 results in high-contrast storage displays with unsurpassed brightness and resolution for information presentation on both console and large screens.

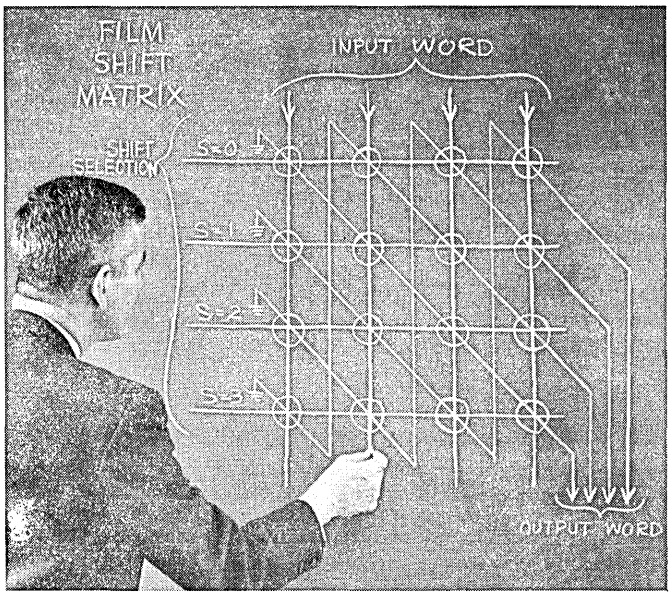
The S-C 2000 will display both video and alphanumeric data of all kinds simultaneously with any type of overlay. Display information need be transmitted only once from the data source owing to the inherent storage capability of the S-C 2000. The unit also provides both fail-safe retention of data and various types of permanent hard copy. Completely dry processing is incorporated with data rates of 40,000 separate characters per second. Scale changing, category commands and display selection are accomplished at the control console, without interrupting the computer.

A capability exists for seven color displays or data may be viewed as white against black or black against white. Resolution is 2000 lines on each axis. The S-C 2000 was developed under the auspices of the U. S. Air Force and Mitre Corp. If your requirements include computer display systems, we invite you to write for more information on the S-C 2000, a product of the company that produced the display control center for Project Mercury, General Dynamics/ Electronics, Information Technology Division, Dept. B-39, Box 2449, San Diego 12, California, or contact the representative in your area.

The first developmental S-C 2000 console delivered to Mitre Corp.

GENERAL DYNAMICS | ELECTRONICS

CIRCLE 15 ON READER CARD



This logic array has been developed in the Remington Rand Univac Mathematics and Logic Research Department. In simplified form, each circle represents a film element that AND's the bits from the horizontal and vertical lines to produce an output on the diagonal line. The input word is therefore left-circular shifted S places in passing to the output. Such matrixes can produce arbitrary right or left shifts, either circular or open-ended, in a single clock period for full length computer words. Film logic arrays open a new field of high speed, high density logic devices.

No where in the computer industry will qualified applicants find greater opportunity for both personal and professional reward than they will today at Univac. Highly significant positions involving work such as that outlined above are now available. You are invited to investigate them immediately.

SAINT PAUL, MINN.

- COMPUTER APPLICATIONS ANALYSTS
- ENGINEER WRITERS
- COMPUTER PROGRAMMERS
- MILITARY SYSTEMS ANALYSTS
- COMPUTER LOGICAL DESIGNERS

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Remington Rand Univac

DIVISION OF SPERRY RAND CORPORATION

There are also immediate openings in all areas of digital computer development at our other laboratories. Inquiries should be addressed to:

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New York 10, New York

All qualified applicants will be considered regardless of race, creed, color or national origin.

WORLD'S LARGEST ANALOG INSTALLATION

The world's largest general purpose analog computer, designed and built for the National Aeronautics and Space Administration, is seen undergoing final inspection and check-out at Electronics Associates, Inc. West Long Branch, N.J. All units of the computer were installed at NASA's Langley Field, Va., research center this spring. It occupies more than 1,800 sq. ft of foor space and comprises five separate PACE 231R computer consoles.

CIRCLE 105 ON READER CARD

MINIATURIZED! LIGHTWEIGHT!

IN-LINE DATA READOUT

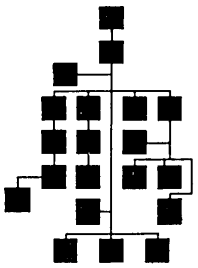
Readouts that do more than display numbers

Ideal for airborne computers, control systems consoles, other electronic test equipment. Features twelve messages per unit, choice of words, numbers, or color. Lightweight, only 3½ ozs. Price $35.00. Write today for complete specifications and quantity prices.

Series 120 000

INDUSTRIAL ELECTRONIC ENGINEERS, Inc.
5528 Vineland Avenue, North Hollywood, California

CIRCLE 16 ON READER CARD



people moving up

☐ William R. Lonergan has been been named manager of product planning and applied programming for the Univac Division of Sperry Rand Corp. He was formerly manager of product planning and market analysis for Burroughs.

☐ Dr. Warren A. Christopherson has been named manager of a new solid-state memory development group at IBM's engineering center in San Jose. He was recently promoted to senior engineer in the General Products Division's development laboratory.

☐ Planning Research Corp., Los Angeles, has appointed Jack C. Van Paddenburg as manager of data processing. He joins the firm from IBM where he acted as an industrial operations analyst. He has also been associated with Aerojet-General and The RAND Corp.

☐ Albert D. Bosson, assistant secretary of the Connecticut General Life Insurance Co., has been elected president of the RCA 501 Users Association. The election was held during a recent two-day discussion by representatives of 45 companies.

☐ Dan L. McGurk has been appointed associate general manager, and Louis B. Perillo has been named director of marketing for TRW Computers Co., Los Angeles. McGurk, whose responsibilities will include general administration and management functions, has been with the firm since 1958. Perillo joined TRW in 1959 as manager of contracts and proposals.

☐ R. A. Sweet has been appointed manager of the newly created systems programming department at Bendix Computer. Sweet has been with Bendix since 1956.

☐ Jerrier A. Haddad has been promoted to vice president and assistant general manager of the IBM Data Systems Division. George A. Kennard has also been promoted to general manager of the Advanced Systems Development Division, and Dr. Charles R. DeCarlo was named director of education for IBM.

DATA-PHONE: An illustrated brochure-kit contains information on Data-phone, a new concept in data transmission. Complete descriptions, specifications, physical characteristics, power requirements and interface specifications are given. Uses include inventory control, transmission of payrolls, sales orders, supply ordering, transmission of waybills, delivery of transportation tickets and transmission of payments. ADMINISTRATOR, DATA-PHONE SERVICE, A.T.&T., 195 Broadway, New York 7, N.Y. For copy:

CIRCLE 260 ON READER CARD

DIGITAL RECORDER: Six-page flyer describes IDR 6150 incremental digital recorder system. Features and technical specifications are listed, as well as applications including use in computer programming. MINNEAPOLIS-HONEYWELL REGULATOR CO., INDUSTRIAL SYSTEMS DIVISION, 10721 Hanna St., Beltsville, Md. For copy:

CIRCLE 261 ON READER CARD

MAGNETIC TAPE RECORDER/REPRODUCER: A four-page bulletin describing the new VR-2600 wide-band magnetic tape recorder/reproducer is now available. The features are presented in detail, along with illustrations. Installation can be in a fixed base, mobile, shipboard, trailer, blockhouse or laboratory environment. CONSOLIDATED ELECTRODYNAMICS CORP., 360 Sierra Madre Villa, Pasadena, Calif. For copy:

CIRCLE 262 ON READER CARD

T-PAC DIGITAL MODULES: A new twelve-page catalog on the one megacycle, T-PAC plug-in digital modules has been published. Included are specifications on T-PACs and auxiliary equipment. Various sections are devoted to compatible TCM random acces magnetic core memories and the series of T-PAC testers designed to supplement large T-PAC system installations. COMPUTER CONTROL CO., INC., 983 Concord St., Framingham, Mass. For copy:

CIRCLE 263 ON READER CARD

MAGNETIC TAPE REWIND UNIT: A high speed, universal hub, magnetic tape rewind unit is described in a data sheet, now available. Features of the TR-300 are presented along with a complete list of specifications which include power input, rewind speed, reel size, tape tension and size. AUTOMATION DIV. OF ELECTRONIC ENGINEERING COMPANY OF CALIFORNIA, 1601 East Chestnut Ave., Santa Ana, Calif. For copy:

CIRCLE 264 ON READER CARD

MAGNETIC CORE TESTER: Technical bulletin 60-L, describes model 1300 magnetic core tester, a high speed, multiple output generator. A full description, specifications, block diagram, waveforms and timing charts, and highlights are given in this illustrated brochure. Range and flexibility are shown in a detailed operational description, and typical applications are outlined. RESE ENGINEERING, INC., A and Courtland Streets, Philadelphia 20, Penna. For copy:

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DIGITAL MEASURING SYSTEM: A fully illustrated 12-page data file describing an all-purpose digital measuring system built around a universal counter-timer is now available. The DME system measures dc volts, ac volts, resistance, frequency period, frequency ratio, and time interval. The brochure presents detailed specifications, advantages, principles and analysis of operation. COMPUTER MEASUREMENTS CO., 12970 Bradley Ave., Sylmar, Calif. For copy:

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MODEL GP-48 X-Y PLOTTER: A technical bulletin, describes the 48″ x 48″ X-Y plotter. The bulletin indicates how the plotter uses digital logic in plotting and repeating. Also, the choice of inputs and outputs is covered along with the various heads available for printing, scribing, inking, reading and exposing light-sensitive films. GERBER SCIENTIFIC INSTRUMENT COMPANY, 89 Spruce Street, Hartford, Conn. For copy:

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INFORMATION HANDLING: A new brochure contains a description of the development and implementation of modern systems for information handling. Major steps in attacking problems in information handling include an understanding of customer goals, analysis of the system under consideration and an implementation program in terms of new procedures and equipments: ISR DIV. OF FMA, INC., 4925 Fairmont Ave., Washington, D.C. For copy:

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THE THEORY OF AUTOMATA: Three reports – one summarizing the results obtained by the researchers, and two discussing specialized phases of the experiment – presenting data compiled on "the theory of automata" have been released. In this investigation of learning, using digital computers, the areas of machine game playing, machine dreaming, and machine-human cooperation are delved into with the possibility of developing an advice giving machine. "General Switching Theory," 67 pages, order PB 171 555, $1.75. "A Strategic Pattern Recognition Program for the Game GO," 97 pages, order PB 171 549, $2.25. "Symbolic Logic and Automata," 36 pages, order PB 171 548, $1.00. OTS, U.S. DEPARTMENT OF COMMERCE, Washington 25, D.C.

PERIPHERAL EQUIPMENT: A brochure, describing a complete line of peripheral equipment for the PB250, is now available. Specifications of magnetic tape units, photo electric tape readers, card readers, high speed buffers and memory extension chassis are included in this six-page illustrated catalog. PACKARD BELL COMPUTER, 1905 Armacost Ave., Los Angeles 25, Calif. For copy:

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DATA PROCESSING SYSTEM: A new catalog lists all currently available material on the 2000 EDP system. The catalog includes a list of programming, research and development notes, subroutines, program reports, brochures, manuals, charts and general descriptions of the company's systems such as the 2000, 2400 and C-3000. PHILCO COMPUTER DIV., 3900 Welsh Road, Willow Grove, Pa. For copy:

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210 DATA ACQUISITION: The model 210 data acquisition and dp systems are described in a new eight-page bulletin. Photos, specifications, applications, descriptions, accessories and optional peripheral equipment are discussed. SYSTEMS DIV. OF BECKMAN INSTRUMENTS, INC., 2400 Harbor Blvd., Fullerton, Calif. For copy:

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MERGERS & NEW FIRMS IN DP

✓National Data Processing Corp., Dallas, has signed a long term marketing and manufacturing agreement with International Computers and Tabulators Ltd., London. I. C. T. has rights to market NDP equipment on an exclusive basis throughout Western Europe, the British Commonwealth, South Africa, and in other countries in which I. C. T. is established. NDP has the option to acquire rights to market or manufacture certain I. C. T. equipment in the United States.

CIRCLE 272 ON READER CARD

✓TRW Computers and the Swartwout Division of Crane Co. have agreed to provide automatic control systems to the chemical petrochemical and petroleum industries. The agreement makes the complementary equipment and technical resources of each company available to the other.

CIRCLE 273 ON READER CARD

✓Advanced Scientific Instruments Inc., a new Minneapolis firm specializing in digital electronics and computing instruments, was recently formed. Thomas S. Steele and William L. Borgerding have joined the firm's technical staff. Steele was formerly with General Mills, Inc., and Borgerding served five years with the same firm.

CIRCLE 274 ON READER CARD

✓S.E.D. Memories, Inc., Rutherford, N.J., was recently formed to develop, design and manufacture magnetic recording heads for digital and analog tape systems. D. A. Giffin, vice president of sales and E. J. Foster, vice president of engineering, were both formerly with Shepherd Industries.

CIRCLE 275 ON READER CARD

NEXT MONTH IN DATAMATION

Microminiturization, thin magnetic films, and cryogenic research are subjects for special editorial treatment in a Computer Components section on tap for August. Complete program and exhibit details of ACM's September conference and EDP-oriented pointers for WESCON '61 will also be featured. An editorial bonus: details of a new gp computer to be announced exclusively in DATAMATION.

For high capacity storage

THE 1301 TO STEP UP 7000 SERIES

The new 1301 disk storage unit, announced last month by IBM, can be linked to any of five of the firm's intermediate to large solid-state computers or shared by any two of them.

Each 1301 unit holds from 50 to 56 million characters depending on the computer employed. A total of five units can be used with any of the five computers: 1410, 7070, 7074, 7080, and 7090.

The rate at which the 1301 reads characters in sequence into core storage is between 75,000 and 90,000 characters a second depending on the system to which it is linked.

Each file contains one or two modules of 20 rapidly revolving disks for data storage. The unit has a read/write head for each disk surface. These heads, at the end of comb-like access arms, are aligned in a vertical cylinder.

This arrangement makes possible the picking up and depositing of data in corresponding data tracks with no access movement.

While reading in the same cylinder, as many as 102,000 characters in a module, 204,000 characters in one disk storage unit, or 1,020,000 characters in a maximum system of five units may be reached with no access motion. These figures vary slightly with the computer used.

The read/write heads are part of a gliding shoe designed to fly along the disk surface. These shoes actually glide on a layer of air created by rotation of the disk at 1,800 rpm. There is an equilibrium of forces which keeps the head balanced less than a hair's breadth above the disk surface.

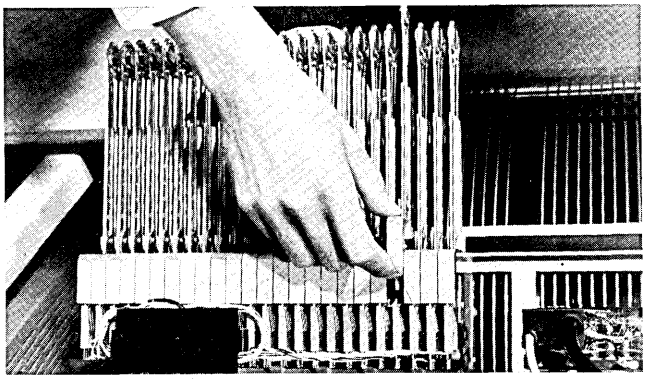
The 1301 makes feasible a number of new applications not previously possible within the computing range of the associated systems.

All of the programs, or job instructions, for an IBM 7090 can be stored on a single unit. Instead of the usual several minutes required to set up a 7090 for a two or three minute processing job, the 1301 can place another program into the computer within seconds.

Sharing the same 1301 file, the scientific 7090 and commercial 7080 can have a wider range of both scientific and commercial programs.

The unit is scheduled for shipment to customers starting in the third quarter of 1962. Rental ranges are from $2,100 per month to $3,500. Purchase prices are from $115,500 to $185,500.

Linkage of the 1301 to any one of the five IBM computers requires a control unit and in some cases, adapters and data channels. This will increase the price range to a rental of $4,400 – $7,135 per month and purchase price to $231,000 – $339,500.



Access arms from IBM's new 1301 disk storage unit are easily removed for servicing.

CIRCLE 102 ON READER CARD

CYBERNETICS or CONTROL AND COMMUNICATIONS IN THE ANIMAL AND THE MACHINE by Norbert Wiener, 1961, M.I.T. and John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N.Y., 242 pp., $6.00.

This edition deals with the study of human control functions and the mechanico-electrical systems designed to replace them. The application of statistical mechanics methods to communications engineering is described, with subject matter ranging from such control mechanisms as mathematical calculators to the nerves and brain of the human body.

ERROR-CORRECTING CODES by W. W. Peterson, 1961, M.I.T. and John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N.Y., 285 pp., $7.75.

This text is devoted to error-detecting and error-correcting codes for information transmission and storage systems, and details how to implement codes in practical systems, with emphasis on types of codes that have mathematical structure. The first five chapters review coding theory and systems known before 1958; the last seven chapters discuss more recent developments in terms of both theory and implementation. Five appendixes provide supplementary information, including a table for the entropy function and a table of irreducible polynomials over GF(2).

TRANSISTOR LOGIC CIRCUITS by Richard B. Hurley, 1961, John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N.Y., 363 pp., $10.00.

This volume covers both logical mathematics, logical routines and blocks, and the transistor circuits that implement the mathematics and blocks. The first part leads from elementary binary arithmetic and Boolean algebra through minimization techniques and implementation concepts. This is followed by a basic treatment of diodes and transistors with a section combining the mathematics with the devices into logic circuits. The latter part deals with sequential systems and a presentation of applicable concepts and mathematics, and finally, a treatment of circuits appropriate to these systems.

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Hermann Hankel

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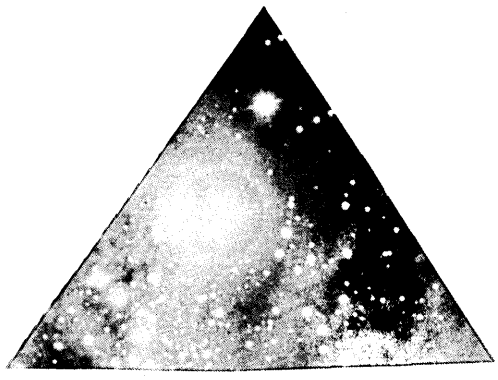

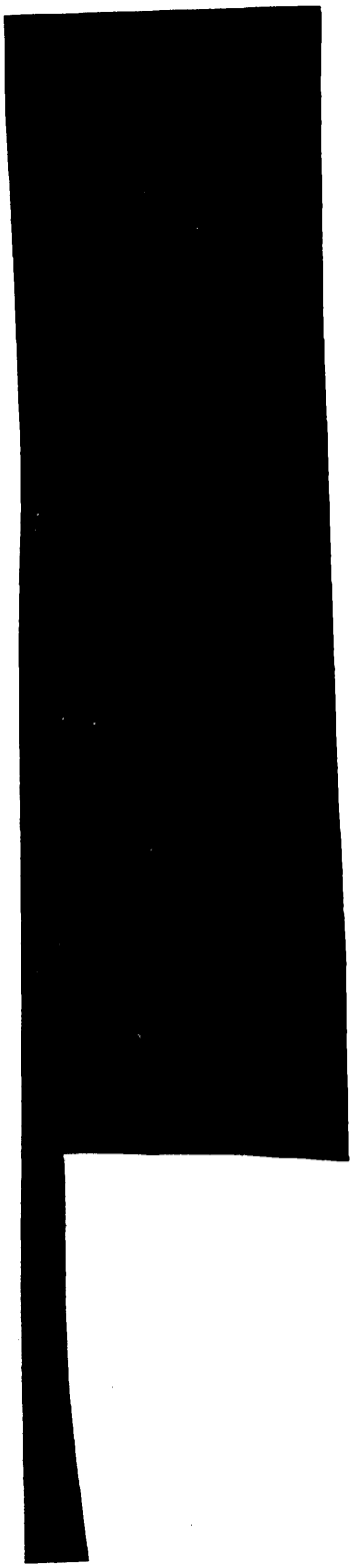

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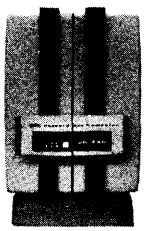

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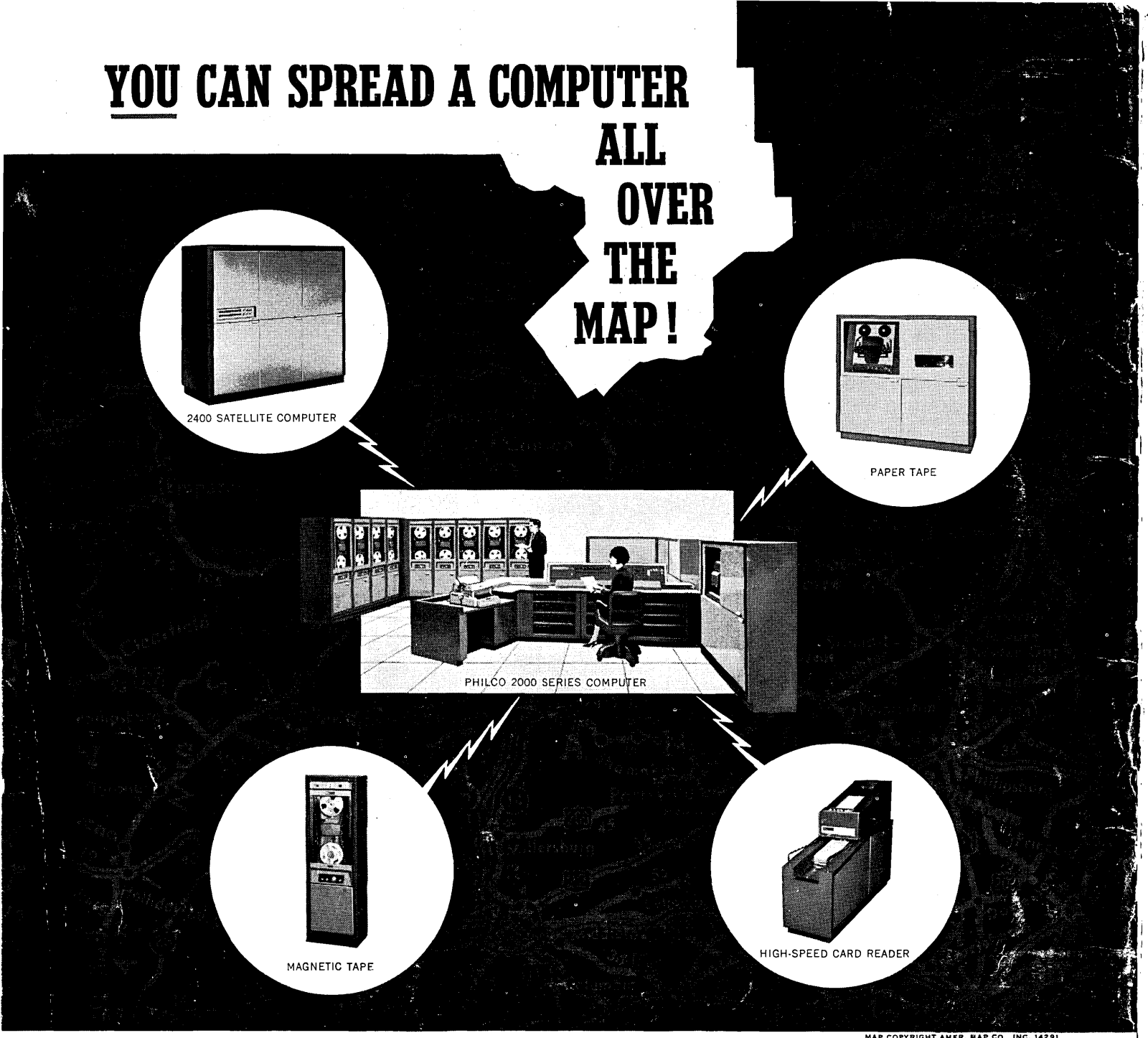

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