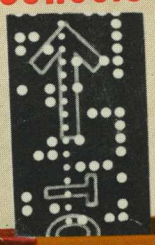
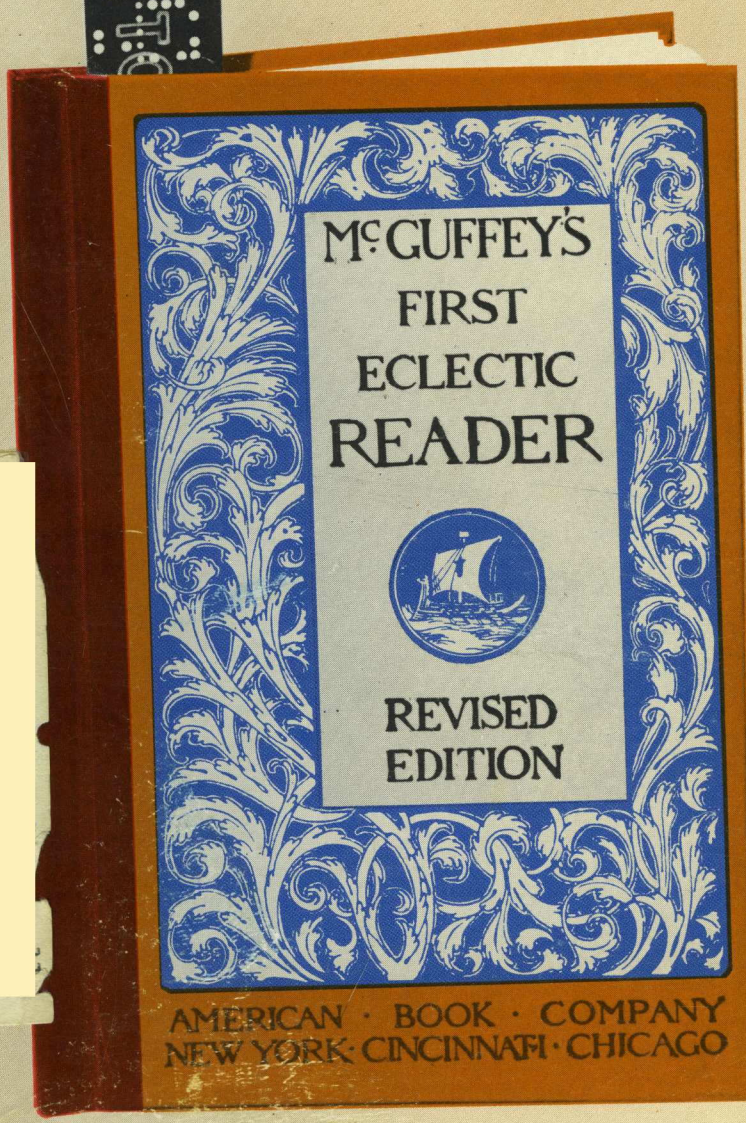
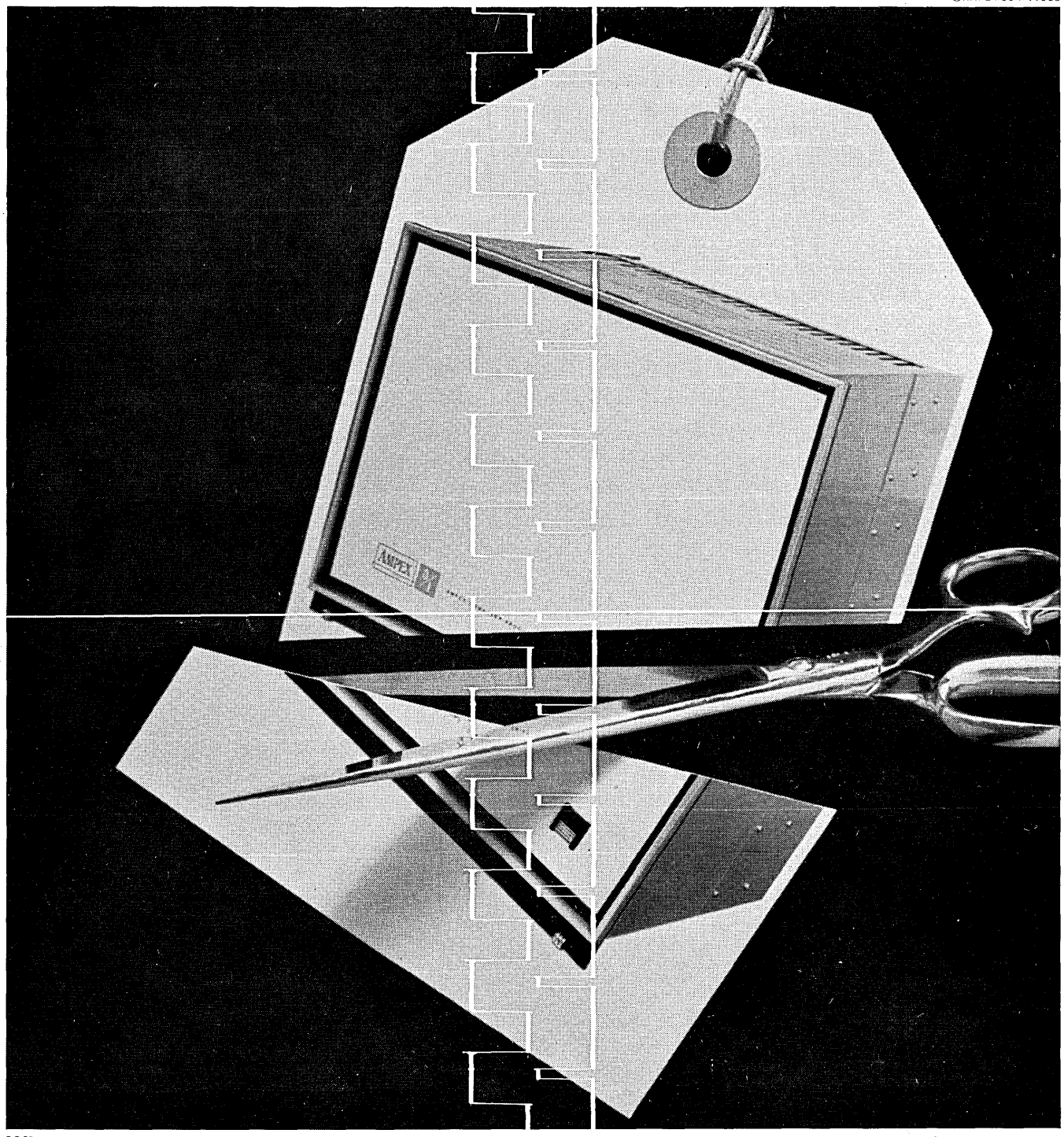
DATAMATION 63®

June

edp
&
schools

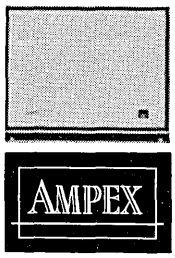






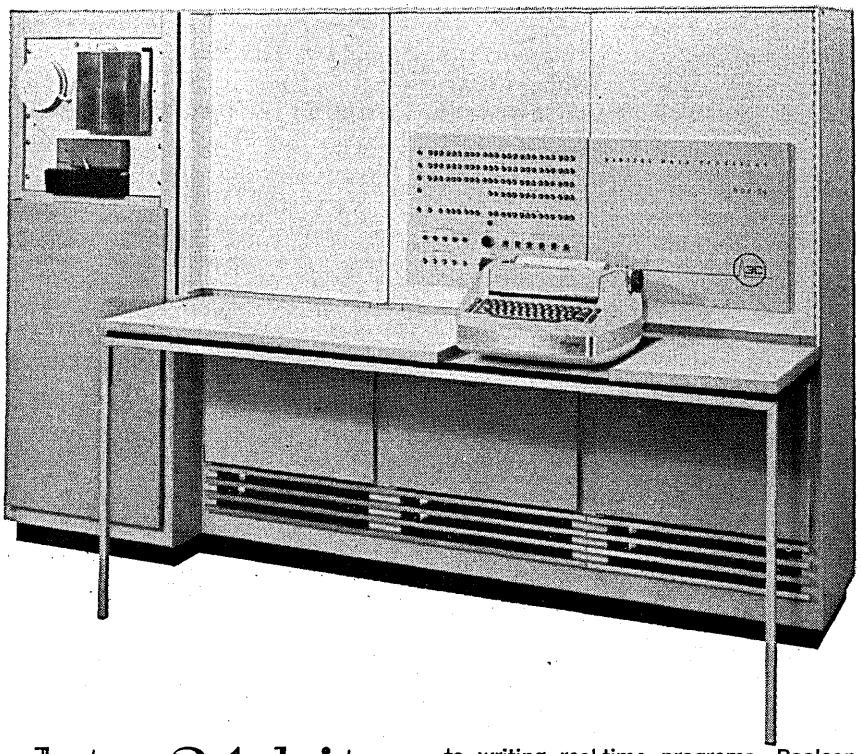
Who made the best medium-speed core memory faster—and then cut your cost 25%? AMPEX

Yesterday the best core memory for small-to-medium capacities was the Ampex RVQ series. It was reliable. And it did the job. But Ampex wanted to make the best better. Today it is. It's called the RVS. And here's how it's better. Memory cycle: 5 microseconds—1 microsecond faster than the RVQ. Word length: 8 to 40 bits—4 bits longer than the RVQ. And the cost? 25% less than the RVQ. The RVS has a capacity up to 4,096 words. At the same time, it has the flexibility needed for random access applications or high speed sequential or buffer operation. It operates on conventional unfiltered and unregulated AC power. It's designed for rack mounting—a 40-bit word RVS takes up only 15¾ inches of rack space. It's reliable. It's simple to operate. And it has a flip-down front panel for easy maintenance. The RVS is just one instance of the constant refinements made by Ampex to make sure you get the finest equipment in the world. That's the Ampex tradition. For information, write to Ampex Corporation, Redwood City, California.



CIRCLE 1 ON READER CARD

$87,000



*DDP–24 IS NOT designed to be all things to all people. DDP-24 IS a fast digital computer, versatile, a sophisticated "component" built to move in company with a precision team in complex real-time on-line configurations. Equally comfortable performing off-line engineering and scientific computations. Reliable? Very.**

DDP-24 pays for itself on a diet of challenge. DDP-24 hardware, comprehensive software, user services and options belong in the hands of qualified professionals who know their applications and how to evaluate a computer against these selected applications. Under these conditions DDP-24's are a lot of computer for the money.

DDP expanded to 24 bits Faster arithmetic unit Comprehensive software

DDP-24 is a parallel 24-bit word, core memory, sign-magnitude, binary, general purpose computer, with indexing and indirect addressing. Instruction repertoire includes multiply and divide, load and store, shifting, logical, jump, index, and input/output. Standard memory capacity is 4096 words (optionally expandable).

Simplicity, maintainability, user convenience are factors of design. Regulated power supplies and power failure protection preserve integrity of computation. Ready and interrupt modes give DDP-24 master or slave relationship with external equipment. Optional independent memory banks and fully buffered channels give true input, output, and compute overlap.

SPEED

Computation rate is 100,000 additions per second. Multiplication takes 31 microseconds, division 33 microseconds. Times include instruction and operand access. Other arithmetic speeds:

Add floating point	125μ/secs. max.
Multiply floating point	99μ/secs.
Add double precision fixed	55μ/secs.
Add double precision floating	181μ/secs.
Multiply double precision fixed	263μ/secs.
Multiply double precision floating	371μ/secs.

Core memory cycle time is five microseconds with three microsecond access. Input and output can occur asynchronously and be interleaved with processing at transfer rates up to 166,000 24-bit words per second.

INPUT-OUTPUT

Strong input-output capabilities enhance communication with surrounding equipment; offer unique freedom of system implementation. Standard DDP-24 incorporates an eight-bit I/O character buffer register and channels, a 24-bit parallel input channel, a 24-bit parallel output channel, sixteen lines for external sense inputs, eight output control pulse lines, and four interrupt lines capable of asynchronous operation with the associated four basic input-output channels. Standard I/O equipment: typewriter, paper tape reader, punch.

SOFTWARE

Programming software provided with the DDP-24 is comprehensive; satisfying professional programmers writing complex routines, mathematical analysts, and the occasional user. Fortran II, DAP, and DIP are modular, patterned after SHARE, easily adapted to specific hardware configurations. Diagnostics for rapid isolation of programming and system faults are included. Also provided: mathematical subroutines, number conversion, memory dump, library routines, master executive program, load program, and computer exercise routines.

Fortran II compiler permits investigation and development of math models prior to writing real-time programs. Boolean augmentation and macro calls are provided.

DAP — DDP-24 Assembler Program — with one-to-one and one-to-many assembly, facilitates tight real-time programs in convenient language.

DIP — DDP-24 Interpretive Program — permits users with minimum programming experience to generate scientific computation routines after only half a day's study.

OPTIONS

To offer still greater system adaptability and functional capabilities, extensive standard options and peripheral equipment are available for the DDP-24:

☐ core memory expansion to 16,384 words, with special expansion 32,768 words. (directly addressable) ☐ additional index register ☐ word forming buffers ☐ character I/O buffer registers ☐ interrupt lines ☐ eight level hardware interrupt priority system ☐ additional sense lines ☐ output control pulses ☐ parallel I/O channels.

I/O control units for maximized interlace and truly simultaneous operation: ☐ direct memory access control unit with unlimited channels ☐ fully buffered I/O control unit with unlimited channels.

Peripheral equipment optionally available: Magnetic tape control and transport units, A/D, D/A converters, card adapter, high speed line printer and adapter, digital plotter and adapter. Digital Resolver, satellite computer, increases DDP speed up to 10 times for algebraic and trigonometric functions. Other peripheral requirements can be fulfilled. Write for the full story.

**Design is typical 3C. Modular construction is with S-PAC digital logic modules. Based upon a million PAC-hours of life test without failure the DDP-24 calculated MTBF is over 4000 hours.*

COMPUTER CONTROL COMPANY, INC.

OLD CONNECTICUT PATH, FRAMINGHAM, MASS. • 2251 BARRY AVENUE, LOS ANGELES 64, CALIF.

CIRCLE 3 ON READER CARD

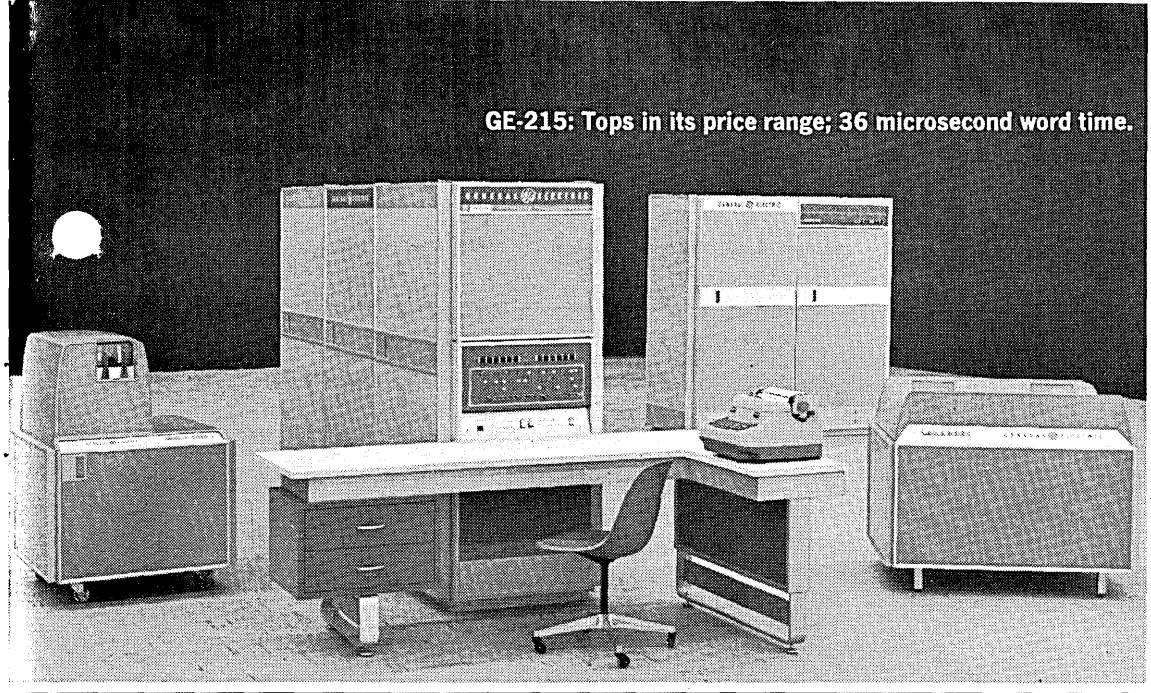
THE COMPATIBLES

General Electric's new growth-oriented family of computers for business data processing and scientific problem solving

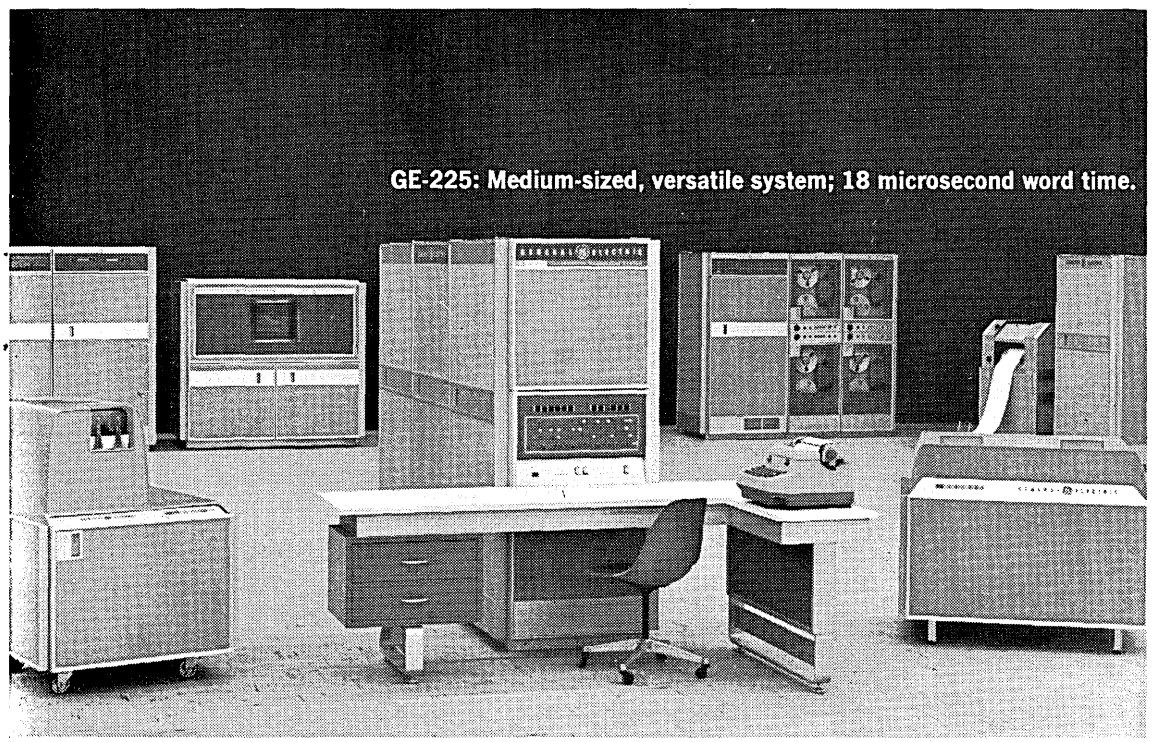
What's in it for you? Plenty. You can move up from a smaller system to a larger system by changing just the central processor. You use the same programs–only they run faster. You use the same peripheral equipment–only you apply it more efficiently. And you don't have to retrain your people.

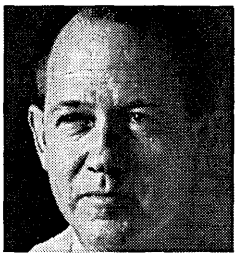
So before you buy or replace your system, investigate The Compatibles. Write General Electric Computer Department, Section J-6, Phoenix, Arizona.

CIRCLE 4 ON READER CARD



"The GE-215 got us started at a minimum cost...and when we're ready for more capacity and speed, we can step up to the GE-225 and GE-235 without changing programs or peripheral equipment."



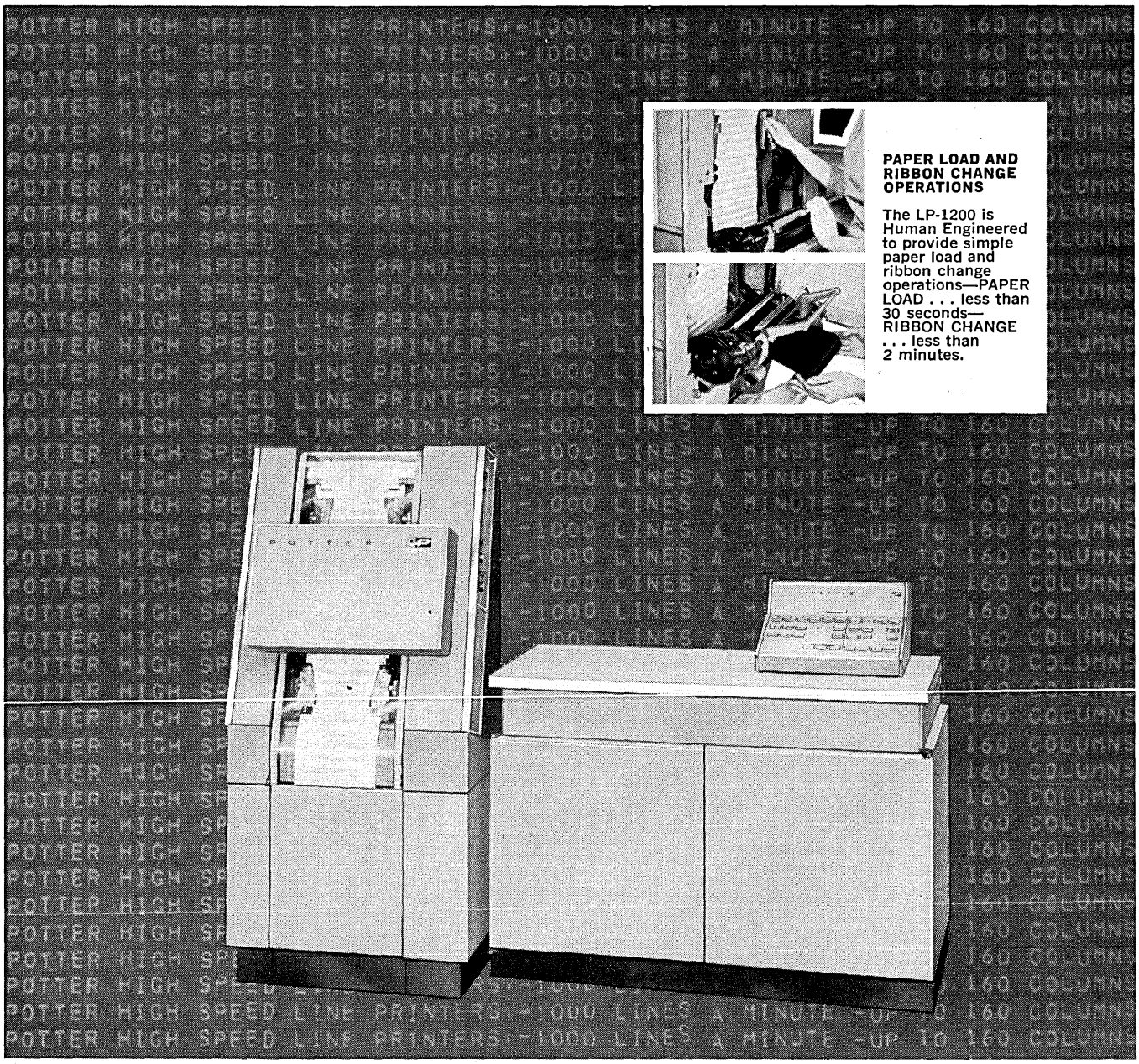


"Our GE-225 has served us well ...but now we need a more powerful system. So we're going to upgrade to a new GE-235. Same programs and peripherals. We'll make the switch over a weekend."

"We started right off with a new GE-235...because we needed a system that would give high speed and capacity, and that would be flexible enough to handle both business data processing and scientific problem solving."

Progress Is Our Most Important Product

GENERAL ELECTRIC



PAPER LOAD AND RIBBON CHANGE OPERATIONS

The LP-1200 is Human Engineered to provide simple paper load and ribbon change operations—PAPER LOAD . . . less than 30 seconds—RIBBON CHANGE . . . less than 2 minutes.

This Printer System Can Save $50,000 Per Year In Computer Time!

The LP-1200 High Speed Printer System provides unusual savings of computer time through the use of magnetostrictive delay lines. This innovation permits compatibility with the fastest systems — conserves computer loading time by 20:1 or more!

Is your computer system fast enough to take advantage of LP-1200's performance? If so, our representative can show you how computer time savings of up to $50,000 a year can be realized. Write today, for full information.

THE LP-1200 FEATURES:

- **LOW COST BUFFER STORAGE** . . . Computer proven Magnetostrictive Delay Lines provide compatibility with the fastest computer systems.
- **NEW DELAY LINE AMPLIFIER** . . . Peak Detection circuit improves reliability at higher frequencies.
- **QUALITY HIGH SPEED PRINT-OUT** . . . Vacuum Paper control, coupled with high speed paper feed produces clean, sharp impressions.
- **HUMAN ENGINEERING** provides . . . quick, front paper loading, ease of ribbon change, access to drum and hammers, convenient operating controls.
- **ADDITIONAL FEATURES** . . . non-wearing Elastomeric torsion bearings assure long hammer life; low inertia drive belts minimize clutch and brake wear.
- **12 WEEK DELIVERY**

POTTER INSTRUMENT COMPANY, INC.
PRINTER DIVISION • *East Bethpage Road • Plainview, New York*

T.M.

CIRCLE 5 ON READER CARD

DATAMATION 63

the automatic handling of information

volume 9, number 6

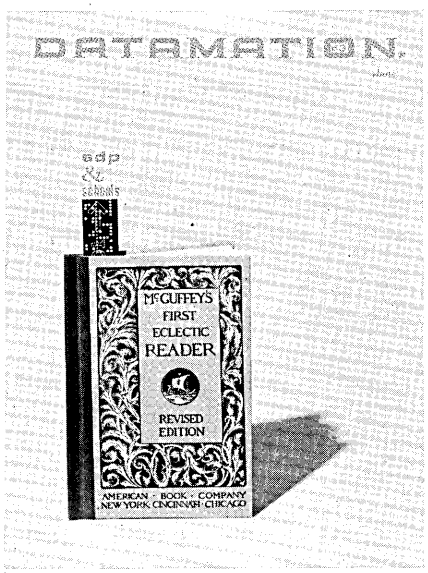
Feature Articles

Departments

THIS ISSUE — 46,433 COPIES

Cover

The results of a recent three-day educational data processing workshop are summarized this month in an article by Assistant Editor Ed Yasaki. Symbolizing the growing interest in (educational) dp—the merging of the old and the new—is our cover, designed by Art Director Cleve Boutell.



Circulation audited by Business Publications Audit BPA

Member, National Business Publications NBP

DATAMATION is published monthly on or about the tenth day of every month by F. D. Thompson Publications, Inc., Frank D. Thompson, president. Executive, Circulation and Advertising offices, 141 East 44th St., New York 17, N.Y. (MUrray Hill 7-5180). Editorial offices, 1830 W Olympic Blvd., Los Angeles, 6. Published at Chicago, Ill. Controlled Circulation paid at Columbus, O. Form 3579 to be sent to F. D. Thompson Publications, Inc., 201 N. Wells St., Chicago 6, Ill.

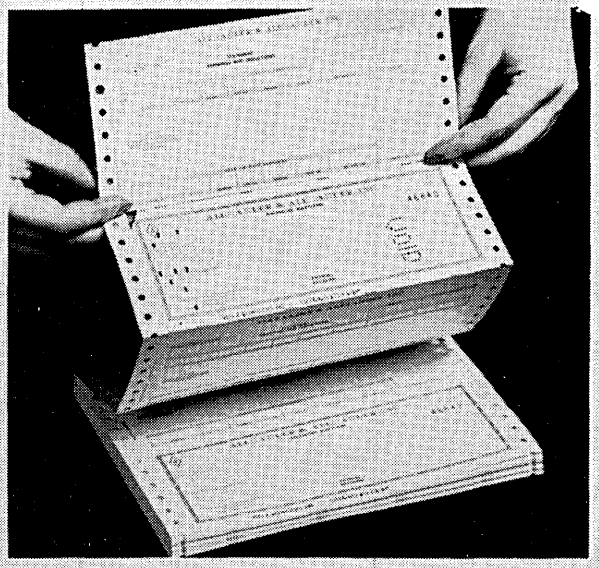
Printed by Beslow Associates, Inc.

EDITORIAL OFFICES

1830 WEST OLYMPIC BLVD.
LOS ANGELES 6, CALIF.

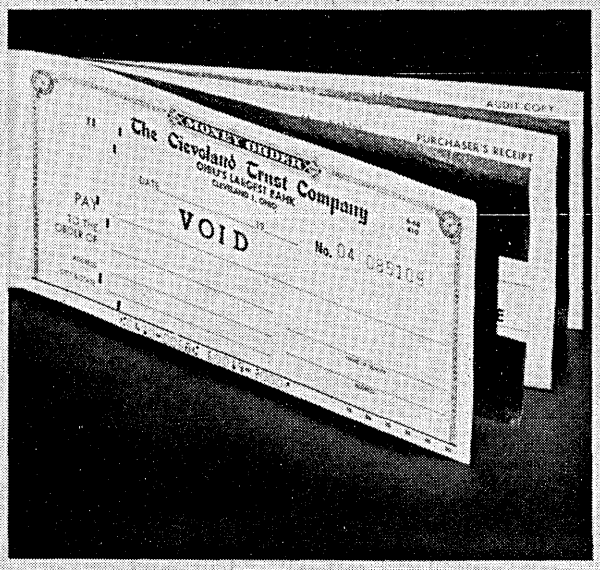
Microfilm copies of **DATAMATION** may be obtained from University Microfilms, Inc., 313 No. First St., Ann Arbor, Mich.

Moore tab card forms



CONTINUOUS TAB CARD VOUCHER CHECKS—The only long grain continuous tab card without a spacer chip, used on any detacher.

TAB CARD SETS provide means for automating source documents and supply all the copies required to complete the transaction.

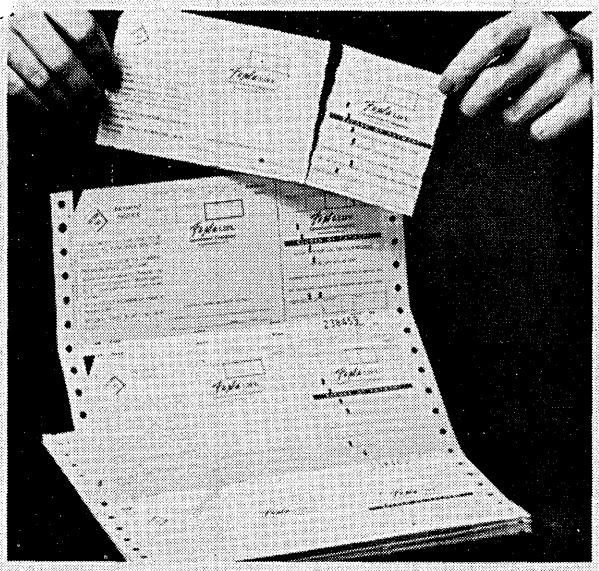


APPEALING—Handsome appearance of your forms through the unlimited design possibilities offered in Moore tab card forms.

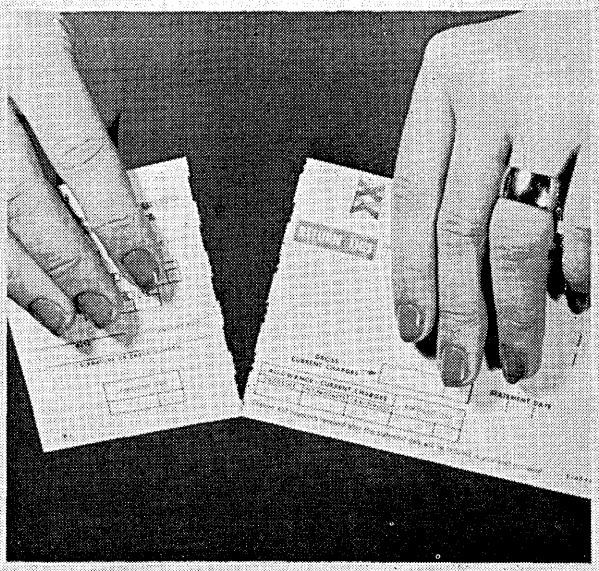
The Moore line of business forms, always the most complete in the industry, has been expanded to include tab card forms in every basic forms product. They will perform efficiently in any system use.

This wide range of tab card forms constructions provides for recording source data by whatever means is best suited to the specific application.

All Moore tab card forms are made with the paper grain running the long dimension of the card form, providing maximum dimensional stability. Many optional features are available . . . prepunching, magnetic ink print-

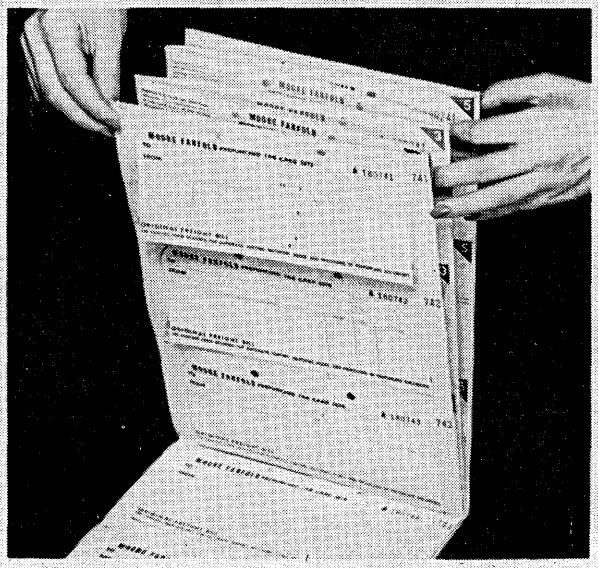


CONTINUOUS TAB CARDS—For punch card automation plus high-speed continuous forms writing in single or multiple part forms.



DOCUMENT CARD FORMS—Multi-purpose single cards. The return stub serves as automatic input into data processing equipment.

FANFOLD TAB CARD FORMS—They combine the advantages of tab card forms with the speed and economy of fanfold writing.



for every system need

ing, systems, perforations and scores, etc.

Use of Moore tab card forms provides a machineable document which assures the following advantages: Greater accounting accuracy • Automatic filing, sorting and reference • Low operating cost.

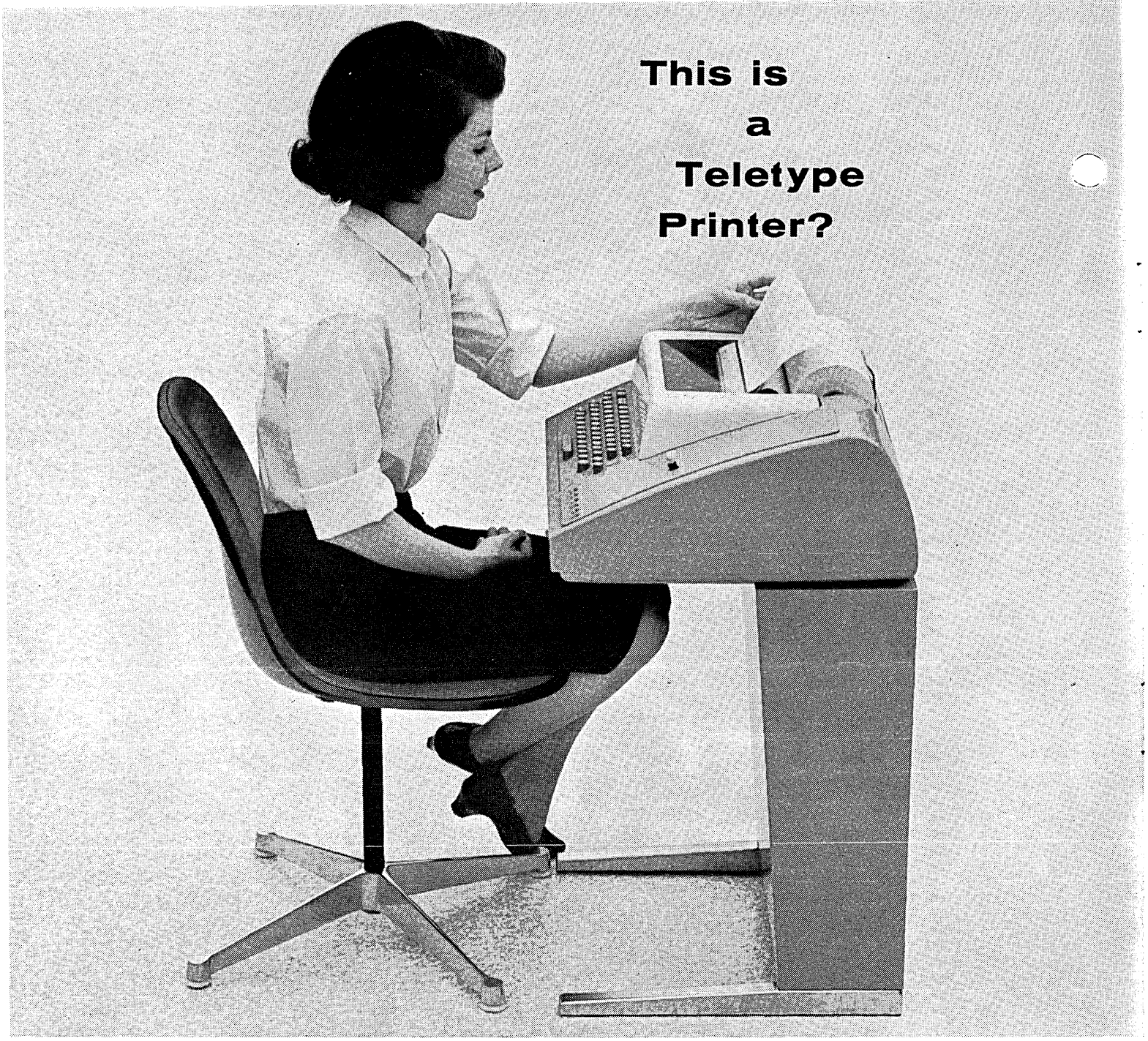
The Moore man will be glad to demonstrate these efficient tab card forms. If you work with forms we can show you how to make forms work for you.

'The right business form for every form of business'

Niagara Falls, New York • Park Ridge, Illinois • Denton, Texas
Emeryville, Calif. • Over 500 offices and factories in North America

MOORE BUSINESS FORMS INC

CIRCLE 6 ON READER CARD



Right! It's the Model 33, a completely new printer made by Teletype Corporation.

If you're wondering what happened to the more familiar one—we're still building that, too.

You see, we designed the Model 33 to fit a new set of requirements. It has a 4-row keyboard that eliminates shifting for figures and common punctuation marks. This saves operator time, cuts errors and means that every typist in your office can be a competent operator with only a few minutes' instruction.

The Model 33 uses a new 8-level message and data communications code. The 8-levels make it compatible with many computers and data handling systems.

Styling—while it's just part of what's new—is smart, functional, and as modern as a man-made satellite. Features include lighted push-button controls, easy paper insertion, and automatic station identification.

There are three models in this compact, economical "33" group—the send-receive printer with keyboard, the receive-only printer without keyboard, and the automatic send-receive set with self-contained tape punch and reader.

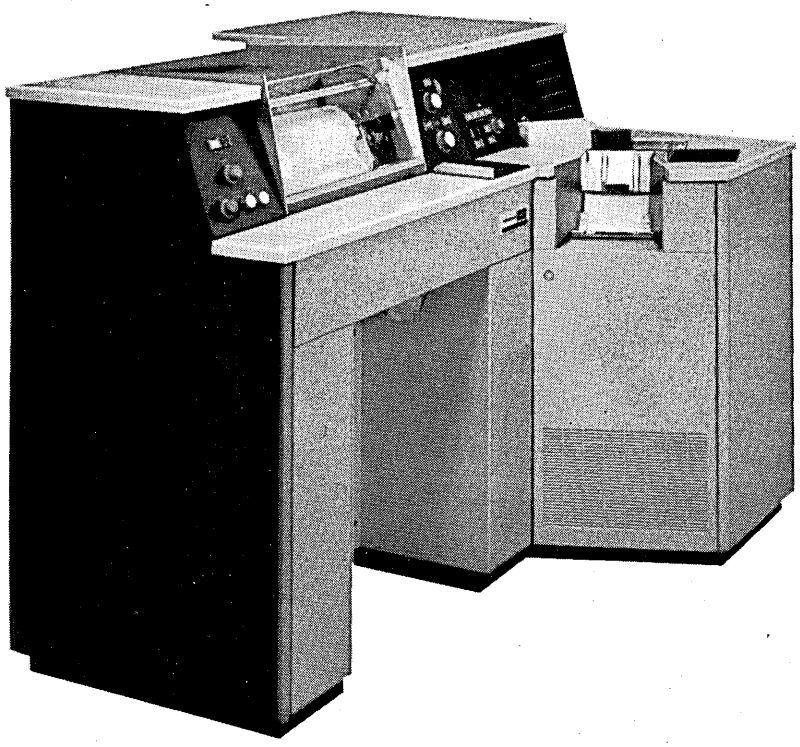
For users who require a 5-level communications code, there is a new Model 32 group with similar styling and economy.

We would like to send you more information on this new Teletype message and data communications equipment. Contact: Teletype Corp., Dept. 81F, 5555 Touhy Avenue, Skokie, Illinois.

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

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

CIRCLE 7 ON READER CARD



The 1004 Card Processor: big computer features at the cost of standard punched-card equipment.

Quick! What company makes it?

UNIVAC, of course. The 1004 has the simplicity of punched-card equipment and the advances of electronic computers.

It does more than any punched-card calculator, faster! It reads, prints, adds, subtracts, multiplies and divides in one card pass—up to four hundred 80- and 90-column cards per minute—performing as many as 9 operations per program step. It edits, spaces and punctuates 132-character lines, using dollar signs, decimal points, asterisks, total and sub-total signs, etc.

It does more than the largest conventional card-accounting machine, faster! The magnetic core memory has three times the storage capacity of the largest accounting machine, and every core location is always available for computing. Access time: 8 microseconds!

The UNIVAC® 1004 Card Processor measures 71″ x 63″ x 55″. But don't be deceived by its attractively trim dimensions—it is *not* a stripped-down computer. (It is programmed on an external plugboard of the same kind your present operators are used to.)

Available in three models at monthly rentals from $1150 to $1500, the UNIVAC 1004 is *the* choice wherever punched card equipment is used. UNIVAC DIVISION OF SPERRY RAND CORPORATION

letters

computers, pragmatics of

Sir:
The article, "Whatsa Computer, Mr. Fritz?" (April, p. 19), put me in mind of a weary search I once made. An acquaintance had told me of a fine article in the 11th edition of the Encyclopedia Brittanica on the theory of polar planimeters. There was. And after weeks of search, I found it under "Calculating Engines." Blessings on the short form, "computer."
GEORGE R. MENEELY, M.D.
Director, Dept. of Scientific Assembly
American Medical Association
Chicago, Illinois

Sir:
For the record, it should be known that the Pertometer was designed to perform computations for networks too small to justify the use of large computers (electronic, that is). Should this enterprise happen to develop into a profitable venture, it will do so because it has satisfied a genuine need, and not because of any fancied exploitation of the term, "computer."
G. T. MUNDORFF
M M Sales
Montrose, California

Bizmac bizniz

Sir:
Your editorials are filled with the gentle, tongue-in-cheek prod which our highly precise, technical world needs to give it balance. Unfortunately, I believe the April issue has taken the "one step beyond" propriety. In discussing the sale of the RCA Bizmac for some $6,000 (April, p. 17), you have failed to observe one very sobering fact: the U.S. government sold this equipment at a *loss* of over $4 million.

Since I find that I work several hours each day for Uncle Sam, and that *I am not reimbursed* [italics added] for this labor, I do not take kindly to the expenditure of government funds in the above manner.
JERROLD ASHER
General Precision Inc.
Burbank, California

(Editor's Note: It is difficult to balance savings effected by utilizing computers against the depreciated value of hardware at resale time. Claims of savings are made by ATAC (through RCA), however. So your tax-money was allegedly well-spent. You must remember that you are reimbursed daily for the effort you expend to support your government's operations in such areas as . . . well, there's always . . . What was your question again?)

stand corrected

Sir:
On page 46 of the April issue of *Datamation*, my address and employment were shown incorrectly as Lincoln Laboratory, Lexington, Mass. It would be appreciated if you could enter a correction in a forthcoming issue.
CLAUDE A. R. KAGAN
Research Leader
Western Electric Co. Inc.
Princeton, New Jersey

sharing ALGOL credit

Sir:
Re: "ALGOL on the 7090," April, p. 28, proper credit for writing the SHARE ALGOL processor's input translator belongs to John Brigham and Fred Gerbstadt who were members of the programming research organization I head. I am sure they join me in congratulating Marge Lietzke and the rest of the committee on a job well done.
B. D. RUDIN
Programming Research
Lockheed Missiles & Space Co.
Palo Alto, California

greater efficiency

Sir:
Dan McCracken's article, "Source Program Efficiency" (Feb., p. 31), certainly makes some good points on the use of compilers. The example given in the first rule was, I feel, a rather poor choice. In fact, the FORTRAN statements

```
Y = (A + B) ** 3 -
    (A + B) ** 2 + 7./(A + B)
```

and

```
T = A + B
Y = T ** 3 - T ** 2 + 7./T
```

produce exactly the same object code in 7090 FORTRAN.

Following the principle (not the example) of Dan's first rule, the following code produces object programs 9.7 and 14.5 per cent more efficient, respectively:

1)
```
T = A + B
T2 = T * T
T3 = T2 * T
Y = T3 - T2 + 7./T
```

2)
```
T = A + B
Y = T * (T * T + T) + 7./T
```

JOHN MORRIS
Sperry Rand Systems Group
Great Neck, N.Y.

"We've found Extra Length Computer Audiotape definitely superior"

says Kenneth Sassaman, Data Processing Manager for Blue Shield Medical Service Association of Pennsylvania

"With 4½ million subscribers we process thousands of claims every week. Before we used Extra Length Computer Audiotape we frequently had to interrupt our claims payment runs to change reels because our program requirements exceeded 2400-ft. tape lengths. These frequent reel changes often caused print-out errors. But now we process all our claims on Extra Length Computer Audiotape and save time with less reel mounting and dismounting. With 50% more tape on the same size reels we require fewer tapes to store the same amount of information. As a result, we have less dollar value tied up in tape. We put the new tapes into operation in an existing program without making any modifications. In over six months of heavy use we haven't had a single permanent read-write failure. We've had *no* problems with the tape. We've found Extra Length Computer Audiotape definitely superior."

Extra Length Computer Audiotape uses a 1-mil "Tempered Mylar" base instead of conventional 1.5-mil polyester film. As a result you get 1800 ft. on 8½-inch reels, 3400 ft. on 10½-inch reels. Although thinner, the new tape is slightly stronger than 1.5-mil tapes. Like all Computer Audiotape, the new tape is 100% certified against defects and is offered with certification of 556 and 800 bits per track-inch. For additional information on Extra Length Computer Audiotape and regular Computer Audiotape, in Standard and Heavy Duty types, contact your local representative or write to Audio Devices, Dept.*

*DUPONT TRADEMARK FOR ITS POLYESTER FILM.

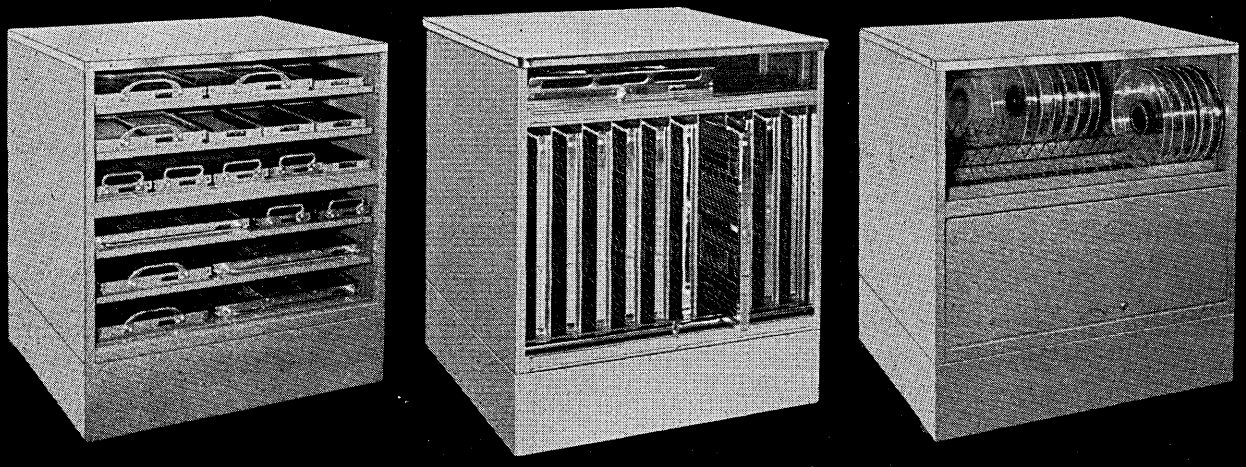
AUDIO DEVICES, INC. 444 Madison Avenue, New York 22, N.Y.

CIRCLE 12 ON READER CARD

DESIGN

makes the difference*

— CONTROL PANEL AND MATERIAL STORAGE CABINETS
with Optional Doors and Locks —



Model #1155 Cabinet
Panel Storage

Model #1155 Cabinet
Converted for 407 Storage

Model #1155 Cabinet
Converted for Reel Storage

FROM 402 TO ➡ 407 TO ➡ COMPUTER

With the SAME Piece of Equipment

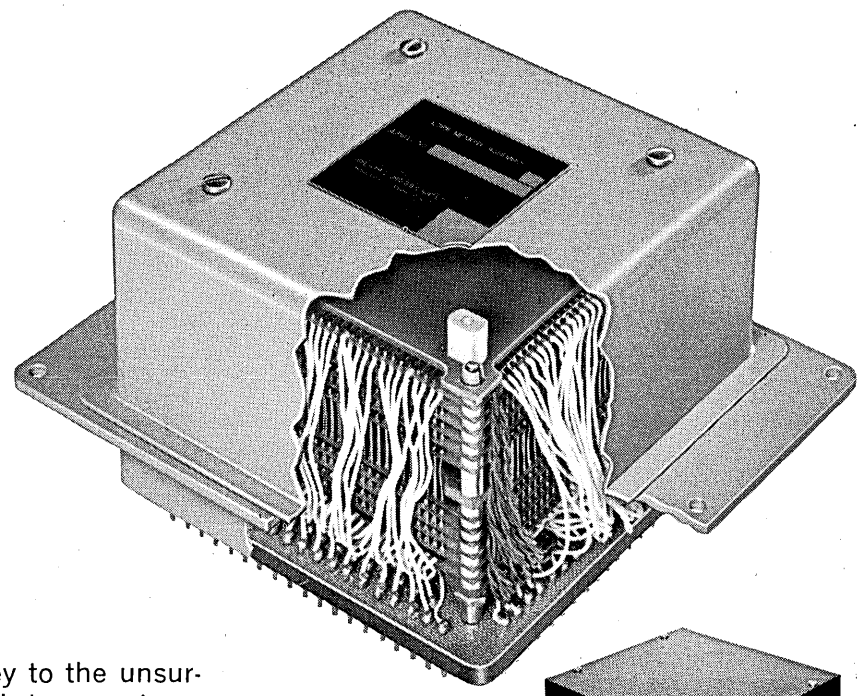
*ALL Systems Metal Products are unconditionally guaranteed for FIVE YEARS, under normal usage.
Your SYSTEMS Representative can show you the difference in full detail.

SYSTEMS DIV. SYSTEMS MANUFACTURING CORPORATION
SALES COMPANY
EXECUTIVE OFFICES and PLANT: 13 BROAD ST., BINGHAMTON, N.Y.

— Finest Quality Data Processing Accessories Since 1945 —

CIRCLE 13 ON READER CARD

It isn't the heat ...it's the uniformity



That word "uniformity" is the key to the unsurpassed performance of Fabri-Tek temperature-controlled core memory stacks.

A unique system developed by Fabri-Tek insures evenly distributed heat throughout every plane. The optimum temperature is maintained within narrow limits through the entire stack. The result is complete elimination of output drift, outstanding stability even in rapidly changing ambients.

The photographs on this page show part of the range of Fabri-Tek temperature-controlled stacks. Those illustrated run from a 4096 x 12 stack to an 8192 x 32 stack. Temperature (and performance) is uniformly stabilized in any size.

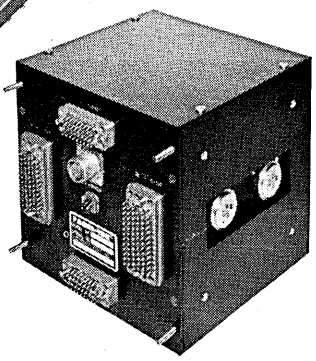
Normal production stacks are rugged, too, withstanding high level shock and vibration.

Planes used in the temperature-controlled stacks are, of course, of traditional Fabri-Tek quality. Electrical characteristics are exactly matched to customer system requirements. An active product assurance group constantly monitors all factors affecting product quality.

What's your memory problem? All of the above solutions to temperature control of memory stacks were solved by Fabri-Tek—using a common method in various configurations. We have more than 450 people whose sole business is developing and producing highest quality magnetic memory components and systems. May we help you?

Fabri-Tek, Incorporated, Amery, Wisconsin
Telephone: COngress 8-7155 • TWX: Amery 8931

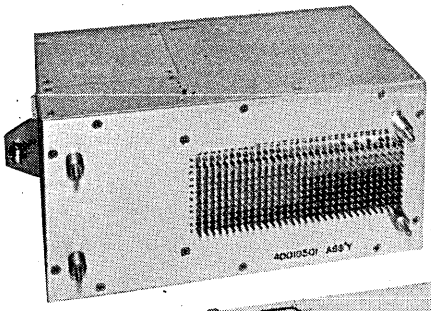
FABRI-TEK

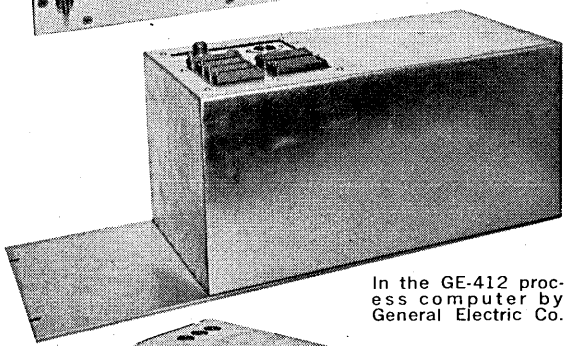


Used in Polaris program by Hughes Aircraft Co. and Control Data Corporation

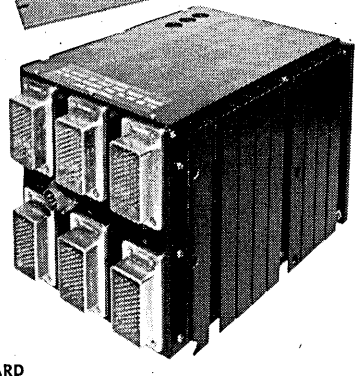
In the 8400 Series computer by Collins Radio

In AN/UYK-1 computers by Thompson Ramo Wooldridge





In the GE-412 process computer by General Electric Co.



In the RCA 4100 series computers by Radio Corporation of America.

CIRCLE 14 ON READER CARD

BUSINESS & SCIENCE

ALL OUT WAR... ON PAPER

Evidently tired of playing patty cake, RemRand has launched a two-fisted paper attack upon Number One which all but spells out IBM. Highlighting that other company -- "Univac's giant competitor" -- as the most advertised, publicized, quoted and promoted, the ad claims only for Univac that it is "the most advanced." A sample of follow-up ad copy: "You can't help being impressed with the sheer magnitude of our giant competitor (if you're buying sheer magnitude)." It's the boldest approach since Honeywell started the ball rolling with their "There's a little bit of chicken in all of us."

Meanwhile, GE ads in April showed an oven assembly line; IBM refrains from advertising products at all.

LIGHT LIFTING DUE FOR NEW BOEING 1107

Boeing will firm up its order for an 1107 as soon as lease details have been ironed out. Expected in September, the system will include 65K core memory, four drums, six tapes. Approximate rental: $65,000/month. Boeing will put nearly all new g-p engineering work on the system, using Univac's FORTRAN-IV, and shifting from other computers only "easily converted" existing work, using LIFT (Leven-o-seven Internal FORTRAN Translator). Main reason for going to the 1107: savings over further exploitation of currently installed machines.

THE ABC's OF CDC: ACQUISITIONS, BLACK INK AND MYSTERY COMPUTERS

Still making like a light-heavyweight contender, but putting on weight fast, Control Data heads into its fourth fiscal quarter with a healthy financial report and accelerating acquisition activities. Black ink income for the first nine months: nearly $38.5-million, up 39 percent over the similar period in '62. Profits for the same period were over $1.75-million, a 68 percent hike over last year. Per share earnings were 45¢ compared to 27¢ for last year's first nine months. The current report does not include the acquisition of Bendix Computer, nor the addition of Meiscon Corp., civil and industrial engineering consultants. The company has entered into an agreement to purchase a printed circuit facility, and is also

acquiring Electrofact, N. V. of The Netherlands, manufacturers of measuring, recording, and control devices for process applications. CDC is also one of three firms which reportedly "have expressed an interest" in Diginamics Corp., Minneapolis manufacturer of digital control equipment.

The latest stockholder's report notes the order of five 924A's by Douglas Aircraft. DATAMATION has learned, however, that Douglas will be getting eight 924A's for real-time automatic checkout and static firing of the Saturn S-IVB at three Douglas sites. A ninth 924A will also be used by the Corps of Engineers on the same project. North American is also getting a handful of the same system for work on another stage of Saturn.

Never officially announced, the 924A is essentially a buffered 924, a system advertised in the August '62 DATAMATION, but not pushed publicly since. The basic 924 (sans typewriter) has a rental range of $8-11K, reportedly nearly $5K less than its original going rate. The 924A rents for $9-12K. Both systems include six data channels, console and paper tape reader/punch. Average access time is quoted as 18 usec; average add time as 9.2 usec.

CDC remains mum on its giant 6600, but Livermore expects delivery of the only order yet announced in late February -- a six-month delay over the delivery date quoted in the May '62 DATAMATION for the 5.8 megabuck system. Livermore, by the way, currently employs two 7094's, one LARC, one STRETCH, a 1604A and a 3600, with another 3600 expected later this year. Another 3600, tied to four 160A's, has been ordered by Argonne National Labs, CDC reports.

Meanwhile, out on the Pacific coast, the old Bendix facility is turning out a G-20 a month and refurbishing the still-kicking G-15. These two activities will probably carry the plant's 400 employees to the end of the year. What happens then is anybody's guess: CDC does not plan to manufacture any of its existing line there. Over 20 G-20's have been installed; to move closer to the 100 mark once set by Bendix as the break-even point for this system, CDC is pushing the G-20A, which combines a main frame and a 160A as an off-line subsystem controller. The G-20A will include a coupling unit called the GC-11.

PROFITS = PICASSO FOR PALEVSKY?

A hefty youngster which celebrates its 2nd birthday next October, Scientific Data Systems claims it will be the third computer manufacturer to go into the black. The timetable for this painfully elusive industry goal: the end of June. A genuwine Picasso on the walls of President Max Palevsky's otherwise prosaic office gives credence to the boast. It is the gift of some presumably grateful company directors.

SDS unleashes its third system, the 9300 (see p. 46) this month in its bid to capture a sizeable chunk of

the g-p scientific and on-line system computing market, bucking the likes of the 924, G-20 and 7040. The first 9300 will be delivered to Boeing next January as part of a real-time simulation system. No other orders have been announced. SDS is also moving into the process controls field through arrangements with Honeywell and Leeds & Northrup. So far, 10 SDS 910's have been sold as process control units. The 910 is called the 610 by Honeywell and replaces their 290, which has gone military as the 290M.

Another two-year-old company, Recognition Equipment, Inc., of Dallas, has ordered 25 910's as part of its optical character recognition systems. The 910 is linked with an electronic character reader which scans an entire character at a time and averages 2000 cps. The first 910 was delivered to ERI in May and will be part of the first ERI system going to a San Francisco insurance firm in August. Subsequent deliveries will be made to a major airline and a large board of education. Average ERI system price: $350K.

Back at SDS, Palevsky says that as of mid-May, 27 910's and 920's had been delivered. The 9300 campaign will kick off next month by proclaiming a "computer which is faster than the 7090 and sells for $215,000." SDS does not plan to buck the 7090, however, Palevsky says.

HUGHES DYNAMICS: NESTED SUBSIDIARIES

Hughes Dynamics, a subsidiary of Hughes Tool Co., has purchased a subsidiary of its own: Advanced Information Systems, formerly a subsidiary of Electrada. The AIS staff of 15 will operate as a semi-autonomous group for the time being and will maintain a permanent "R&D" effort in the management and use of large files in addition to its regular sofware and systems development work. Charles Roach, former AIS director of Medical Info Systems, and his staff will man a similar effort within Hughes Dynamics.

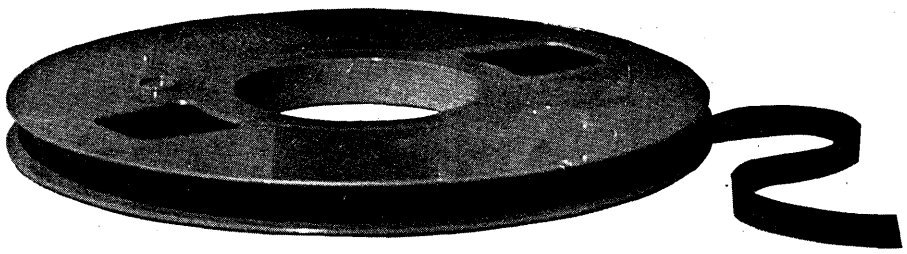
Hughes D. has also obtained an option to purchase the majority of the stock of Dashew Business Machines, Inc., which logged some $3.3-million in sales in '62. The move is subject to the approval of the state of California and stockholders. Dashew, which also has subsidiaries, manufactures embossing and code punching machines and related source data collection devices.

How AIS and Dashew will fit into some general Hughes Dynamics corporate pattern is yet to be revealed. To further complicate matters, H-D has established an Educational Services division.

CLIPPINGER LEAVES X3.4 CHAIR

Dick Clippinger has resigned as chairman of ASA's X3.4 Subcommittee on Programming Languages. The reason, according to Clippinger: the press of his duties as newly-appointed associate director of Product Planning for Honeywell's EDP division. He will continue to serve as chairman of Subcommittee 5 of ISO/TC 97, the international programming languages committee. Clippinger's replacement remains to be confirmed by X3.

MAC PANEL COMPUTER TAPE WITH MAGNE-FLO COATING ASSURES UNIFORMLY CONSISTENT SIGNAL OUTPUT



YEARS OF RESEARCH AND DEVELOPMENT HAVE RESULTED IN A MAGNETIC COMPUTER TAPE WITH PHYSICAL AND MAGNETIC PROPERTIES SECOND TO NONE!

In its own specially designed and constructed tape research, manufacturing and testing facilities, MAC Panel has developed an advanced gravure coating technique that assures greater tape reliability and performance.

MAC Panel's gravure technique has been greatly improved and refined. We call this new technique MAGNE-FLO coating.

Just one of the benefits of this major new production technique is a uniform oxide coating thickness throughout the entire tape width and length. Under magnification, all base materials are revealed as having an uneven thickness . . . hills and valleys across the width of the web. Normal blade coating techniques fill in these valleys with a thick oxide deposit and skim over the hills with a much thinner coating of oxide. The marked variation in coating thickness across the width of the tape can result in a variation in signal response from channel to channel, from reel to reel.

MAC Panel Computer Tape with unique MAGNE-FLO coating provides a uniformity of signal output unexcelled in the field today.

Ask your MAC Panel representative for a sample reel. Test it yourself . . . you'll be back for more.

MAC PANEL COMPANY, High Point, North Carolina MAC PANEL
Division of Adams-Millis Corp.

Representatives throughout the United States, Canada, Latin America and Europe

CIRCLE 16 ON READER CARD

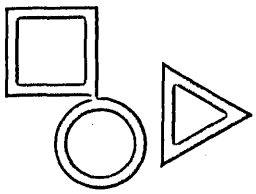
$100,000 more in annual sales volume... $20,000 less in yearly operating costs... vastly improved customer service. This is what Bell System DATA-PHONE service has achieved for Bergen Drug Company, wholesaler of Hackensack, N.J. Used with card-punching equipment, DATA-PHONE service enables the firm to send great quantities of inventory, sales and billing data over regular telephone lines at a 1600-words-per-minute clip.

Operator at Bergen Drug's South Brunswick division places a DATA-PHONE call to the firm's headquarters in Hackensack. Next, machines will "talk" to machines, exchanging data from 12,000 punched cards in six hours.

Are you transmitting your business data as quickly and profitably as you might be? Talk with one of our Communications Consultants and find out. Just call your Bell Telephone Business Office and ask for him. Do it today.

BELL TELEPHONE SYSTEM

CIRCLE 17 ON READER CARD



EDITOR'S READOUT

RAISING STANDARDS: FACTS OF LIFE AND THE FUTURE

A member of last month's SJCC panel which conducted a not-too-critical evaluation of the current state of the art said it: "It's time to set up standards for machine language. Period."

The remark stimulated many questions, more retorts . . . some thought. Leap-frogging more basic, current problems, it still focused attention on one of the information processing industry's most pressing issues: that of standardization.

Raising the cry for standardization should not obscure, however, some basic facts of life:

- **Standardization progress, like a glacier, moves slowly.** This is partly because the work is generally conducted by part-time, widely scattered committees made up of people who spend most of their time doing other things . . . earning a living, for instance. And it's partly because standardization can be as rigidly and frigidly binding as a glacier. Another panelist summed it up: "A bad standard is worse than no standard at all."

- **Standardization progress is being made.** ASA's X3.2 subcommittee on coded character sets and data formats has developed a new code for information interchange of recognized technical excellence which has already received broad support from the U.S. Government and in Europe. We understand there has been solid progress in FORTRAN standardization.

- **There's still plenty of standardization work to do.** As one SJCCer put it: "After 15 years, our industry has no standard glossary of plain, simple English words." Why not?

Perhaps before we start trying to guzzle, we should learn to swallow . . . before we attempt to set machine language standards, we should establish a standard definition of . . . oh, microprogramming, say. But it doesn't really hurt, in the meantime, if one corner of the industry communal conscience has been alerted to the notion of standardized machine languages: It's a marvelously naughty, delicious idea.

EDUCATIONAL DATA PROCESSING

by ED YASAKI, Assistant Editor

"Even though present applications of data processing systems in education are limited in scope, if the results of current research are applied to the future configuration of school systems, and if centralized data processing continues to expand, educators are in for a major technological change in their profession."

This statement by Don D. Bushnell, System Development Corp., Santa Monica, Calif., with its qualifying phrases, reflects a growing concern of educators. And justifiably so. Cases in point:

- Already, some 1,000 school districts throughout the U.S., exclusive of the more than 400 college computing centers, are employing dp equipment.
- No standardized system of data collection and reporting has been established nationally by educators, and only a handful of states has made any move toward standardization within its borders.
- Duplication of research in educational data processing (edp), while not wasteful per se, could lead soon to an unwarranted expenditure of effort.

Concerned over the direction which edp is and will be taking, the national Association for Educational Data Systems was formed last year, and held its first national conference last month. The association hopes to coordinate efforts and cooperate in the development of information and materials related to edp. Early this year, more than 30 educators attended a three-day workshop on edp, reported to be the first in the educational research area. The meeting, at SDC, was to share research results, applications and existing programs, and to establish guidelines for continued research. It was cosponsored by AEDS, the American Education Research Assn., California Educational Data Processing Assn., and SDC.

Covered were six topic areas: scheduling, system design and analysis, information retrieval systems, simulation and modeling, school administrative services, and programmed instruction.

In the system design and analysis topic area, a total systems approach to the installation of an edp facility was proposed by Ellis P. Myer, Experimental Computer System Development, SDC. "Unfortunately, we humans tend to categorize data and its processing into separate, distinct tasks and then deal with each individually," Myer said. "As a result, we lose perspective of the system as a whole. The design of an integrated, effective data processing system is possible only when the total system is considered." In the system design, he continued, it is inadequate merely to convert the manual processes of the present system which is limited by the capabilities of present equipment. Thus the need arises for an alteration of thinking and a restatement of goals. "The educator has an opportunity to achieve new freedom from clerical drudgery, but the freedom can become maximal only if he is willing to accept new concepts."

The design of a total information system, however, requires reorganization and rethinking of such a scale that it has generated more talk than action, according to John W. Hamblen, Data Processing & Computing Center, Southern Illinois Univ., Carbondale. More has been accomplished in this area for the military than elsewhere, he said, with a gradual emergence at this time of only basic guidelines. These are building blocks for educational information systems also, he added.

Research in the area of class scheduling by computers has been more active in Europe than in the U.S., it was observed. At Purdue Univ., Lafayette, Ind., the assignment of students to a predetermined schedule of classes is operational, and next fall more than 18,000 students will be scheduled to classes in less than six hours of 7090 time. The operation was described by James F. Blakesley, Schedules and Space, Purdue. The 90's output includes class lists, enrollment reports, fees, etc. Additional information, not as yet completely systematized, will be space inventory and utilization reports, academic faculty load information, and cost study data.

In an experimental stage at Purdue is the construction of an "optimum" schedule of classes which will have simulation capabilities for operational and capital budgeting requirements, along with the development of staff, space, and student schedules.

"Men's minds are adaptable to change if change is understood and is reasonable," Blakesley said. "Any action or system imposing unknown and, therefore, unwarranted changes will be considered unreasonable, and will be subject to resistance, whether it be an administrative or governmental decree or computer-oriented system. Time, therefore, for testing, experimenting, discussing, and modifying proposed changes must be allowed if a good system is to be made an acceptable, workable, and beneficial process." If any computer system for scheduling is to be deemed a success, he added, there must be sufficient time to educate both students and staff of the importance of having a choice of *course* instead of a choice of *hours*, and to accept the resulting (reasonable) time schedules.

In this system, utilizing a manually-prepared master schedule, "the optimality of the assignments is governed by the goodness of the master schedule . . . Since the master schedule is prepared by hand without rigorous logic checks, no guarantee (of inherent conflicts) can be made," according to A. G. Holzman and I. B. Turksen, Univ. of Pittsburgh, Pa. Presently being researched at Pittsburgh is the feasibility of constructing a master schedule which will satisfy the constraints imposed by student course requests, faculty availability, and facility availability.

In the information retrieval systems area, Dr. Allen Kent, School of Library Science, Western Reserve Univ., Cleveland, Ohio, commented that the success – or lack of it – of an IR system is difficult to measure without reading the entire file. And this superfluous reading is the object of an IR library system such as has been established at Reserve. Furthermore, he added, one has difficulty measuring the relevance of the output to the question asked because this relevance varies among researchers, and even with an individual over a short span of time. IR systems, he noted, are overly expensive for present hardware.

personality picture for counseling

Two papers in the area covered a conceptualization of a system for counseling and guidance, and an operative system at the Univ. of Pittsburgh. John F. Cogswell, Education Research & Development, SDC, proposed a large-storage computer, operating in real time, which would make accessible a current personality picture of each student. Based upon the most current personality model for understanding students, the picture would be constructed from data supplied from appraisal tests, records of past achievement, teachers' observations, parents' comments, the student's statements, and related school test scores. The information would be weighed, organized, and integrated according to the current personality model. To keep the picture of each student updated continually, the system facilitates the immediate input of information from all relevant sources.

"Retrieval capabilities of the system are designed so that displays abstracted from the central personality picture vary with the needs of the particular inquirer or decision-maker," Cogswell said. "In other words, the displays that are automatically abstracted for the teacher are different in format and symbol from the displays for students, counselors, parents, administrators, etc. In this way, retrieval capabilities are designed to take into consideration the needs and frame of reference of the various inquirers."

An operative IR system at the Univ. of Pittsburgh is in the field of school law. Pennsylvania statutes and the attorney general's opinions relating to education have been placed on mag tape. A concordance also has been prepared, with all words listed alphabetically and their frequency of occurrence noted. Further, each word is codified to show the document in which it occurs, and whether it appears in the title, heading, or body, and the line number within the document. This explicit identification is being used in various ways now and will permit experimentation in the future, according to Dr. J. William Asher, Program in Educational Research, Univ. of Pittsburgh.

"By knowledge of the frequency of occurrence of various words and the words representing key concepts in the legal questions, a strategic approach can be developed which will yield a maximum number of valuable documents while keeping the number of irrelevant or semi-relevant documents retrieved to a minimum," Dr. Asher reported.

A search through the entire library takes about 43 minutes, and the cost of placing material into it runs slightly more than a half cent per word. "We found that the most productive use was by those whose primary concern is with statute law – lawyers and administrators in the state Department of Public Instruction and those closely associated with them, such as the state legislature. This was not because the school solicitors and the school law classes did not find the techniques valuable, but because the state department users found the techniques so useful."

Without a computerized system, Dr. Asher said, a change of terms from, say, "handicapped children" to "exceptional children" would have been impossible. The same is true with the change of name from State Teachers Colleges to State Colleges, or movement of the school fiscal year to the "first of July" from the "first Monday in July."

"We have wondered why the Psychological Abstracts and Education Index don't use these now standard general techniques as much as the Biological Abstracts are doing. Imagine getting an index to the Psychological Abstracts by author and concept with each issue and at the end of a year almost immediately after the October issue. Using the current *full text* journal abstract or the author's summary and conclusions, plus a few added words for major concepts not specifically mentioned, it is currently feasible with these standard techniques to give exact document numbers or page and volume number printouts or full text printouts – all for about a half cent per word input, and with little or no high-priced, professional editing."

A measure of the utilization of dp by educators might be made by the number of position papers presented in the area of simulation and modeling; there were more (six) than in any other area except programmed instruction (seven). Notable for its absence was any paper on the human cognitive processes. Two broad areas covered were teacher training and educational systems.

"The complexity and detail of replication necessary for simulating an entire educational system and the variety of analytical techniques needed to study, manipulate, and alter the imitation of reality have now become possible with a digital computer," reported Don D. Bushnell, Educational Research & Development, SDC. However, not only is simulation expensive but it also presents problems of fidelity, reliability and validity which should not be ignored, Bushnell said.

The application of PERT to a "continual progress learning" situation, in which students are allowed to progress through programmed learning material at their own rate of speed, was suggested by Donald G. Marsh, Education Research & Development, SDC. Marsh drew the analogy of a school and a manufacturing process "where the delivery of raw materials to the plant is similar to the introduction of students into a curriculum . . . At certain intervals in the cycle, tests are taken to ensure the quality of the end product which, in the case of a school, is developing the student to his highest potential."

In the System Design and Analysis workshop are (clockwise from left) Richard Harsh, John Caffrey, Robert Gates, Knight Campbell, Ben Dysart, Ellis Myer, John Hamblen, and James Blakesley.

Certain PERT techniques can be applied to the control of the learning situation of the continual progress plan by the assignment of system variables. Milestone numbers

within a course, he said, could chart the student's progress; a student's expected rate and expected quality of learning are two other variables, both updated according to the student's performance. This performance could then be compared with the milestones by teachers and administrators who would interrogate the system and institute necessary control measures.

Applying control measures to an entire student body, however, presents an entirely different problem. As a methodology for predicting the effects of changes within an instructional system, College Simulation (COSIM) has been under development, and a paper presented, by B. Y. Kersh and J. H. Beaird, Oregon State System of Higher Education, Teaching Research, Monmouth, Ore.

By June, 1963, it is estimated, COSIM will be able to predict the effect on a student body of increased numbers of entering freshmen and transfer students, stricter probationary policies, stricter grading standards, and similar changes. The impact will appear as conflicts in student programs, changes in class size, delays in completing requirements for degrees, drop-out and probation patterns. "A specific institution, Oregon College of Education, is being modeled primarily so that COSIM may be validated against existing records and student questionnaire data," Beaird said. "However, since the computer program is based on the SIMPAC (Simulation Package) compiler program, which is generally applicable to any organization, COSIM may be used as a basis for simulating other instructional institutions as well."

A similar model of a high school system was described by Dr. Frank A. Yett, Department of Education, UCLA. More inclusive than COSIM, this 7090 program (coding for which has just begun) includes the instructional process, status and activities of individual students and teacher, as well as a detailed logistic analysis of the entire system.

An unusual departure is a possible emphasis on individual study and study in much smaller groups than is practiced today. The student receives periodic staff attention and attends occasional impromptu groups, receiving staff assistance when needed. Pupil evaluation also is more frequent than is found in high schools today. In group study projects, both the group's effort and the individual pupil's contribution are evaluated.

Dr. John Caffrey, Harvard Univ. (at left), and Dr. Alvin Grossman, Calif. Dept. of Education.

Simulation and modeling also have been used for the design of school bus routes, as reported by Dr. Roscoe A. Boyer, School of Education, Univ. of Mississippi. Criteria for determining the most efficient route have been established for a program which, reportedly, lends itself also to other education problems: location of school buildings (reversal of the bus problem), location of college classrooms, estimating construction costs of school buildings, design of school buildings, and preparation of budgets.

computer simulation for teacher training

Simulation for the training of teachers already is being applied. At the Oregon State System of Higher Education, a classroom environment is established with film clips of students' answers and questions. Operating on a real-time basis, films to be shown are selected from among several available, depending upon the student teacher's response to classroom situations. Building upon this technique, UCLA's simulation laboratory is concerned with the transfer of principles learned in college classrooms to the elementary or senior high school classroom. Described by Dr. M. C. Wittrock, Department of Education, UCLA, the lab uses both film clips and written material as stimuli. Included among the latter are student examinations and essays to be graded. These studies are being made both to train teachers and to test the effectiveness of education courses.

Taking a macrocosmic view of dp in school administrative services was Dr. John E. Bicknell, Minnesota State Department of Education. He expressed the need "to develop a whole new way of thinking among school administrators and boards of education . . . The need is not to do more easily and quickly the things we have been doing all along. Rather, the need is to utilize equipment and techniques so that we can do many things hitherto impossible. This will require a massive effort to reeducate administrators and school board members in dp concepts." The responsibility for this reeducation process, he said, should rest with state departments of education.

Taking a similar view was Dr. Alvin Grossman, Center for Research in EDP, Calif. State Dept. of Education, who said, "What is needed is the development of a comprehensive school information system for planning and control. A great number of districts are headed at top speed toward establishing some sort of dp system with little or no idea of why – or what will happen when the system is established. Many of today's edp installations generate reams of paper data with no planned system of preparing logical reports. A school information system which selects, rejects, edits, headlines, and turns data into 'education intelligence' is essential to effective school operation."

An effective school information system, he said, enables an administrator to see patterns or trends within his district and to identify those areas which require his immediate attention. Effective decisions require both timely and accurate information. A state education employee, Dr. Grossman nevertheless commented that within a state a system should be installed upward from the grass-roots level, rather than imposed or organized from the top down.

According to Dr. Elmer G. Wagner, Stanford Univ., Palo Alto, Calif., "Administrations in business, government, the military, and schools can make effective decisions only when supplied with adequate 'intelligence' and this information must be analytical in nature and broad in scope." The need, he said, was for an integrated dp system for school administrative services with the dp organization under the direct authority of the superintendent – assuring equitable availability of the facility to all departments within the system.

Among uses of the dp facility cited were financial accounting and population studies of both schools and communities for the superintendent, financial and attendance accounting, scheduling, registration, test scoring and reporting for the principal, and reporting of classroom information for the teacher.

ekg, eec in programmed teaching

Research in programmed instruction, it was observed, lay more in the area of technologies rather than in the details of format. Not only has the fixed-sequence program been supplemented with branching procedures, but experiments in the physiological measurement of students during the instructional process has been undertaken by the Univ. of Illinois' Coordinated Science Laboratory.

"Electrocardiogram data has already been acquired, and electroencephalogram, galvanic skin response, and respiratory rate data are planned in the near future," according to the Laboratory's Dr. Donald L. Bitzer. "The strategy is to analyze the physiological data and attempt to determine exactly when the student has discovered insights into the lesson material, as well as determine his level of activation. If such information can be deduced from the data, we could use the physiological measurements as another input to the computer to use in the decision-making process." Although the laboratory's system can handle 1,000 students, it is felt that 30 student stations are sufficient to test both the educational and systems hypotheses. And with data transmission between the stations and the computer thus minimized, Dr. Bitzer reported, it would be possible to place student stations in homes. The student could then dial in over telephone lines to the central computer facility for home instruction.

In the area of fixed vs. flexible-sequence programming, Dr. John E. Coulson, Education Research & Development, SDC, reported a significant advantage in the latter, or branching, procedure. "We have come to the conclusion that extensive exploratory work is needed to identify critical instructional variables, and interactions among method, student, and task variables before we rush into additional experiments of the formal, experimental-group-vs.-control-group variety."

Another problem, he said, lay in the inability of students to apply relatively minute information learned to the solution of larger problems. "The use of external panels and displays in conjunction with the item sequence appears to be a promising technique for providing a frame of reference to the student. A panel may contain an outline of the major steps required in the solution of a problem, such as writing a computer program; each of the major steps in the outline can be numbered. The panel can be available to the student as he progresses through program frames containing detailed information about the individual steps. At various points throughout the program, frames refer by number to corresponding steps in the panel outline. In this way, the student can concentrate on the analysis of individual frames, and also view the frame or step in the perspective of the overall solution."

Research in programmed learning, undertaken at IBM, not surprisingly involves the use of computers in the role of a teaching machine. "The so-called teaching machines and programmed texts currently in use have, with few exceptions, sacrificed flexibility for the sake of simplicity," according to Dr. Werner G. Koppitz, Thomas G. Watson Research Center, IBM. "This makes teaching with these devices rigid and often cumbersome; the crucial advantage of programmed teaching – individualized instruction – cannot fully be realized." Computers, he said, overcome these handicaps.

IBM's research indicates that students need not be reinforced to prevent their making errors, Dr. Koppitz said. Indeed, the challenge of errors and the satisfaction of overcoming them may be stronger reinforcement than giving correct answers in the first place. IBM tested its system with three divergent learning tasks: stenotypy, German, and statistics.

The Stanford Research Institute, Palo Alto, Calif., recently made a study of programmed learning and adult education, in an attempt to ascertain the most effective teaching method for adults. One hundred journeyman electricians who volunteered for this experiment were divided into three groups. One was taught by an instructor using visual aid material; another group utilized both programmed instruction and a live instructor; and the third used only programmed instructions (Auto-Tutor Mark II machine).

Contrary to an expected variance in mean scores among the three groups, no significant differences emerged. "However, when differences in I.Q. were controlled statistically, those in the automated instructional modes with low I.Q. performed significantly higher than those in the conventional course," reported David S. Bushnell of the Institute. In studies of attitude, it was found that the class with both live and machine instruction best met the expectations and needs of the trainees. The completely automated class was second, and the conventional a close third.

This type of education might be termed rote learning, and those who advocate the utilization of programmed instruction for rote areas only are taking the "limited view," according to Dr. Harry F. Silberman, Educational Research Development, SDC. Creativity, too, is fair game for programming, he said. "Those who take the limited view are paradoxically concerned that programming will eliminate response variation in children," Dr. Silberman said. "In fact, however, students are more restricted by the limitations of their own ignorance than they are by external constraints imposed by any program . . . Researchers in the programmed instruction field are currently attempting to program behavior often described as 'critical thinking,' 'creativity,' 'conceptualization' or, in general, the higher mental processes." At SDC, he reported, programming research in four areas is being undertaken: reading, arithmetic, geometry, and Spanish. The criterion of learning in each case includes a measure of transfer, the student's ability to apply specifically-programmed facts or concepts to the learning – on his own initiative – of new concepts.

Programming research has been undertaken at Arizona State Univ., Tempe, as related by Dr. Richard E. Schutz. Present experimentation, he said, is with programs of 500-1,200 frames in the areas of fractions, punctuation, and capitalization for fourth through sixth graders. However, the complexity of branching options and the difficulty of monitoring the work of numerous students make the inclusion of a computer in the system almost mandatory, he added. Hardware would be for display and storage.

The introduction and impact on the nation's educational system of edp and allied technologies was the concern expressed by Dr. Murray Tondow, Palo Alto, Calif., Unified School District. "I am deeply concerned with the lack of appreciation of these changes upon the human element in the educational system, and the concomitant result of insufficient study of the problem," he said.

Tondow foresees a fundamental alteration within a decade of the role and responsibility of both teachers and students. From their present, principal role as disseminators of facts, teachers will give meaning to facts, and help each student to develop problem-solving skills and a framework for decision making. Programmed instruction, then, would replace, not the teacher, but one of his functions, freeing him for responsibilities that only the better teachers today are assuming. The importance thus arises of training new teachers and preparing present teachers for these "traumatic changes." The burden of both technological and curricula changes, Tondow said, "will soon become unbearable for the teacher. Should this happen, the program and service that technology can offer education will not become a reality." ■

PROGRAMMING ON-LINE SYSTEMS

part two: a study of hardware features

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Synopsis—*In the first of this two-part article, application areas and problem characteristics of the programming aspects of on-line systems were surveyed. The concluding segment discusses the Executive Control programming requirements.*

The principal functions which the Executive Control must handle are shown in the diagram (cf. *Datamation*, May, '63, p. 33), and are as follows:

Queue Monitoring and Scheduling

In the real world it is not always possible to schedule inputs so that each response is completed before a succeeding input is submitted. Furthermore, it would not be desirable to do this scheduling external to the system. Many on-line systems, therefore, require a capability for scheduling of a queue. This queue may consist not only of task items generated by the inputs, but also of subtasks which are subordinate functions called out by an input. Thus, an input may require a response composed of a number of more or less independent I/0 functions intermixed with computing functions. In addition, certain tasks may be placed in the queue under internal scheduling as a function of counters or a real-time clock. In missions where several instruction sequences (threads) are being executed simultaneously on a time-shared basis, the individual functions are scheduled as separate items in the queue in order that they may be "sandwiched" in with each other, thus making more efficient use of both internal processor and I/0 capacity.

Monitoring of the queue takes place under the following circumstances:

(1) The processing of an item currently in the queue becomes completed.
(2) An interrupt or alert is detected.
(3) An addition or change is made to the queue.

When any of these events takes place, the Executive Control must re-examine the queue to determine a new schedule and select the next item to be processed. Since the queue reflects priority, changes made in priority constitute changes to the queue. If the equipment is to be assigned dynamically by the Executive Control, new assignments will be made at this point and new items initiated as appropriate.

The most practical method of determining which task item can be added to the in-process status is to examine an equipment assignment table to determine what resources (entire modules or storage segments) are available, and to select the highest priority item which can be executed on that equipment. On the other hand, it may be desirable, or even necessary, to pre-empt other running items in order to obtain equipment to execute high priority items. In some cases, as for example with high-rate radar inputs, it may even be necessary to dedicate equipment for standby service in order to guarantee a sufficiently rapid response if and when that on-line device initiates an interrupt.

As is seen, a scheduling algorithm would be required for each application. This algorithm is a function of parameters such as:

(1) priority of a task
(2) precedence rules, such as a completion of a prerequisite task
(3) deadline to be met
(4) available equipment
(5) pre-emption possibilities
(6) dumping, restoring and relocation economics.

The concept of deadline in scheduling introduces priority with respect to time in addition to priority with respect to importance. Thus, the payroll may have top priority but with a distant deadline, in which case lower priority jobs with earlier deadlines would take precedence. Associated with this concept is a requirement for knowledge of program running time and of real time.

Although queuing theory is not within the scope of this paper, it is interesting to note some of the consequences of the scheduling algorithm selected for queue processing. If the queue operates on a first-in, first-out basis, all the items in the queue will, of course, eventually be processed, albeit not in the most efficient manner. On the other hand, if the queue is processed according to some pre-established priority scheme, it is entirely possible that low-priority items might be delayed an intolerable length of time. A third way of ordering the queue (dynamic ordering) makes it possible to increase the efficiency of the system. In this method all entries in the queue are available for processing at any one time, and the entry which will be selected for processing is that entry which can be processed most efficiently. For example, as each record is read from a tape, the queue may be scanned for entries which require the record.

I/0 Monitoring

One of the most demanding aspects of real-time systems is control of the various peripheral devices in the system. This section deals with peripherals such as tapes, drums, discs, etc., which are exclusively under control of the computer. A later section deals with monitoring of the real time devices (Communication Monitoring).

Typically, the large data base characteristic of some real-time applications requires extremely efficient data handling in order to meet the real-time requirement. On the other hand, because real-time applications must often be multi-programmed, it is possible that conflicts may develop over usage of I/0 channels and peripheral equipment. For this reason central control of I/0 may be necessary.

In order to achieve a balance between the overhead generated by a central I/0 control and the efficiency required by the system, it is often necessary to make an exhaustive study of the I/0 requirements. Some of the subjects of such a study are discussed below.

Retrieval—In systems in which the chief occupation is retrieval of data on a random basis it is convenient to generate, in addition to the task queue, an I/0 queue which is processed by an I/0 monitor. The I/0 monitor has the capability of examining this queue whenever Executive Control is entered. Thus in systems in which the queue is not priority ordered the I/0 monitor can select from the I/0 queue those items which can be retrieved most efficiently at any given instant. This will, of course, give an effect similar to batch processing. Furthermore,

I/0 items can be entered into the queue asynchronously at the same time the computer is still searching for other I/0 items. Finally, if the data base occupies more than one unit of storage, the I/0 monitor can be designed to search simultaneously all units in a convenient and timely manner. The chief attribute of an I/0 monitor with respect to retrieval, however, is that it provides the programmer with some "free" look-ahead features.

Update in Real Time—In some respects, updating in real time is the same type of operation as retrieval. However, if every record is to be updated, the overhead of the I/0 monitor may cost more than it is worth. In certain cases, depending upon the processing time required for each update, the I/0 efficiency may be improved. If this time is short, it may be advantageous to update two storage units simultaneously, reading the records together and updating both records during the following read time. The possibility of this depends almost wholly on the application.

Dumping and Restoring—In a multiprogrammed system it is often necessary to dump certain parts of primary storage and to restore them at a later time for continued operation. This is usually done under control of the Executive Routine. The Executive Routine must therefore have available the necessary I/0 programs with the capability of relocating the programs when returning them to primary storage.

Variable Assignment of Equipment—In multi-computer, multi-module systems the various modules of storage may be assigned and reassigned dynamically during operation. In this case central I/0 control is necessary since the individual programs do not necessarily know which storage units have been assigned to them.

File Security—Under certain circumstances file security must be maintained—both from accidental destruction due to programming errors and from reading or destruction by unauthorized persons. Centralized I/0 control may be used in order to implement this security.

Equipment Utilization

On-line system requirements have accelerated the current trends to decentralized computers and multi-module configurations. It is not unusual to talk in terms of arithmetic units, memories, buffers, communication multiplexers, consoles, etc., as well as tape units, drums, card readers, and discs. These modules may all be present in numbers and, in general, require inter-module communication capability. More important, however, they may, depending upon the complexity of the mission, require centralized control for efficient and economic use.

The Executive Control program for a complex (multi-thread) mission will necessarily coordinate the usage of equipment. In order to do this it must maintain a dynamic record of equipment assignments and usage. Equipment status may be defined in a number of ways depending upon particular mission characteristics. In general, however, equipment falls into one of three classes: unassigned, temporarily assigned, and permanently assigned or dedicated. Unassigned units may be called into use temporarily to meet certain demands and then returned to the pool for reassignment. Some modules must be dedicated, either because of the frequency of their use or because it is too time-consuming to switch them from one job to another.

The Executive Control program determines the requirements for equipment as they are generated by the operational programs and assigns the equipment as it becomes available. Clearly certain equipments, such as tape units and some segments of mass storage, must be dedicated because of the permanence of the information contained therein. Other equipments, such as computers and other mass storage areas, may be used only for scratch storage or for intermittent tasks.

One of the complex aspects of equipment assignment is the determination of when a task or job may be preempted in order that a higher priority task may be executed. When computers are interrupted, the contents of core may be temporarily stored and later restored for continuation. In the case of tape drives, however, it is not always safe to interrupt even a scratch tape unless it can be determined that the information contained thereon is no longer useful. The same, of course, may be said of scratch segments of drum or disc.

Rollback and Recovery

An important consideration in real-time systems is the area of error detection and system recovery. System requirements vary, but virtually all real-time systems require rollback procedures of one kind or another in case of failure. The Executive Control must be constantly cognizant of the status of the system and capable of initiating this rollback procedure.

It is impossible to discuss rollback and recovery procedures in general terms. Each individual application has different requirements. One missile range safety requirement is such that error determination and recovery must take place within 100 ms. Thus, in case of failure, standby equipment must be alerted and placed in operation within 100 ms, precluding the use of auxiliary storage for programs. At the other extreme, whole operations may be repeated in order to recover from an error. At some point between these are systems which require that the status of the system be preserved at intervals—say, 15 minutes—and all subsequent inputs stored. In case of failure during any period, recovery can be achieved by rolling back to the beginning of the interval and reprocessing the inputs. The latter examples may imply recovery in non-real time.

Although recovery in case of failure during a file updating process can be a serious problem, the most challenging recovery problems are those where rapid turnover to a standby computer is required. In at least one case, BMEWS,[28] the error detection and recovery problem is solved by operating two computers in parallel. As each operation occurs, the answer is verified between the computers. If a deviation occurs, the operator is apprised of the fact, and human judgment is made as to which computer is producing the better data. Manual turnover is then instigated simply by switching to the trusted computer. This system does not, of course, provide the reliability or the automaticity which would be provided by three computers where a majority decision could rule. However, its reliability could perhaps be improved by repeating steps when discrepancies occur and by automatic reasonableness checks on the computations.

Since parallel operation is very expensive, a more economic system is to have the standby system engaged in "production" type or "off-line" computing while in the standby state. In this case, a failure in the main computer must initiate standby programs in the standby computer. The amount of data which must be turned over to the standby computer is a function of the application. Whether turnover can occur at all is a function of the type of failure and the special features of the hardware available to affect turnover. Some of these features include timers which automatically set an interrupt or external signal if not periodically reset ("watchdog timers"), interrupts triggered by power failure which allow some 10 ms of computing time before complete failure, and interrupts (from special equipment) which require a predetermined response and which otherwise will indicate failure ("dead-

[28]Blumenthal, S., "An Approach to On-line Processing," *Datamation*, June 1961.

man"). Clearly the effectiveness of these hardware features depends on the kind of failure which takes place. A transient pulse, for example, could occur without triggering any of the above, but could nevertheless affect the accuracy of computation. As a matter of fact, the effect of transients may not be discovered until recovery is impossible.

Diagnostics

The problem of program recovery and fault discovery are closely related. In the previous section, consideration was given to recovery from computing errors which may be detected by examination of the output data. Some of these errors may be prevented by periodic health checks of the system. The amount of checking which can be done is, of course, a function of the time available between operational processes. In most systems, however, at least some time must be reserved for this checking. For this purpose a background diagnostic can be devised which in effect occupies the system completely during what would otherwise be a period of idleness. On the other hand, it may be necessary to insure that sufficient diagnostic checking is done by giving the diagnostic program a priority, and initiating it by means of an interrupt from the clock or special counter. In systems where the basic operational cycle is based on a well-defined programming loop, the diagnostic program must be handled just as any other function in the loop.

The scope of the diagnostics can vary considerably, but in most cases they may be confined to testing communications and status of peripheral devices. In multi-computer systems this may include cross-checking between the computers. As a matter of fact, where multi-computer communications are involved, it is often useful to transmit data from a dummy calculation with each communication. Thus the transmitting computer might perform a carefully selected set of instructions which exercise all of the circuits and transfer a coded result along with the communication.

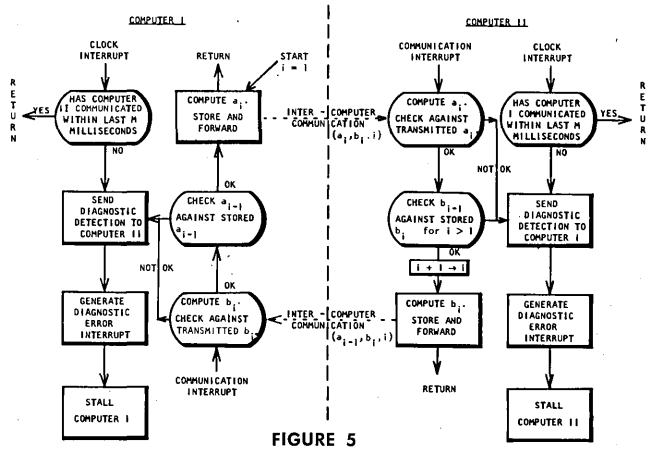

FIGURE 5
COMPOSITE HEALTH CHECK IN A MULTI-COMPUTER SYSTEM

The receiving computer would perform the same exercise and compare this against the one received and the pattern which is prestored. A discrepancy indicates failure either in the transmission or in the computation unit of one of the computers. In any case, further diagnostic checking is called for, and this might be handled in a special routine for the purpose. A possible organization of this health checking is shown in Figure 5.

The chief purpose of the diagnostic health check is to discover failure at the earliest possible time and, hopefully, to take corrective action before any data is lost. Some failures may affect the data, but not the running programs. These failures are most likely to be discovered by reasonableness checks on the data. Other failures may cause certain elements of equipment to stall. These are most likely to be discovered by periodic health checks. Failures which cause the program to stall, obviously, cannot be discovered by programming methods. To overcome this contingency, hardware features such as the watchdog timers and deadman devices discussed at the end of the previous section, are employed.

Communication Monitoring

In addition to serving as standard I/O monitor to the system, the Executive Control must monitor the communications with the external world. These communications may originate from many sources and may be indicated to the system in many ways; these depend somewhat upon the hardware available. Some of the possibilities are as follows:

1) Some computers are provided with buffers which accept input data into specified locations automatically without intervention of the computer. The data may or may not be accompanied by an interrupt. Furthermore, it may be sampled either as a result of the interrupt, at some specified interval, or on request.

2) Some communications are indicated to the computer by an external interrupt which requires that a communication path be set up for transferring the content of the communication.

3) Some communications may be indicated to the computer by an alert rather than an interrupt. (See Interrupt Handling below for definitions.) In this case, the computer must scan the communication lines periodically in order to service them.

Whatever the communication interface employed, it is incumbent upon the Executive Control program to meet the timing requirements and prevent saturation or loss of data. To accomplish this task it is necessary to define the basic data cycle for each application. Two illustrations of different on-line systems are presented here.

For the first case we consider a completely automatic on-line data collection system where certain data is entered randomly and where there is a requirement to sample six channels of this data at 200 times per second. The latter requirement leads to the definition of the basic cycle of five ms; i.e., the Executive Control must guarantee that the six channels will be read every cycle time. Thus the concentric circles of Figure 6 reflect relative priority of the five indicated operational tasks with the larger circles representing jobs of higher priority. For this particular case the innermost circle represents the background diagnostic which is the lowest priority task.

Digital readouts are on the next level and occur asynchronously with respect to all other events. The next level of priority is that of the analog readout function which must be triggered every five ms. The one kilocycle clock interrupt is shown to be of higher priority. This signal provides the necessary timing information to the Executive Control in such a way that five ms intervals can be measured. The remaining, and highest priority function, is the I/O interrupt.

Part of the job of the system designer and programmer is to determine the order or priority of such functions. It can be seen readily that the analog readout function must pre-empt the background diagnostic and the digital readout. It is assumed that the digital buffers can hold their information until it can be transferred into the machine.

The one kilocycle clock is given a higher priority than the analog readout routine since it is important not to lose any clock counts even if the readout routine requires more than two ms to execute. This could easily be the case if more than six channels were being read or, as in some

cases (although not in this one), if it is not possible to predict exactly how long the I/Os (the outer circle) may take. The I/Os are given the highest priority in most cases

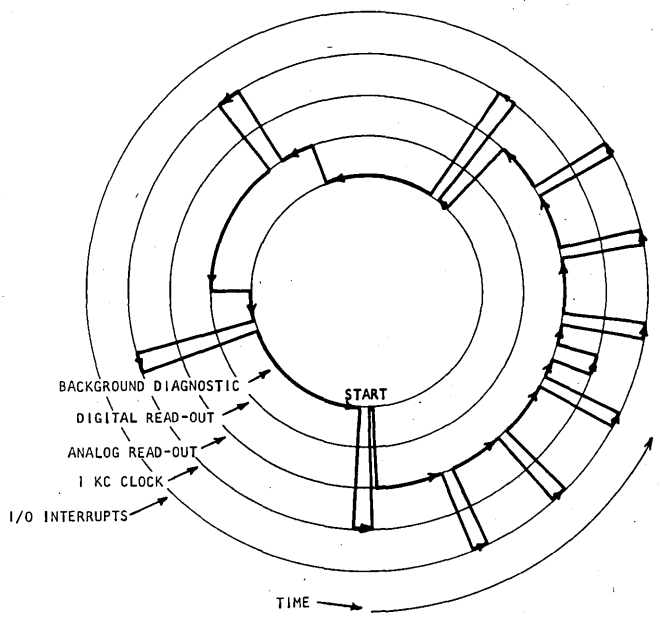

FIGURE 6

BASIC DATA CYCLE FOR AUTOMATIC DATA COLLECTION SYSTEM

since a delay may result in the loss of data. In this example, they are given highest priority because useful computing cannot proceed without the data. It is therefore necessary to honor them immediately in order to achieve the greatest efficiency. The time in the I/O interrupt routine is sufficiently short so that no clock interrupts will be lost.

A second example is an on-line man/machine communication console. Here, an analysis of a typical transaction must be made and its effect on program organization analyzed. Consider, for example, the composition of a message request where a question such as:

"List all airfields in United States having runways longer than 9,000 feet, and a long range bomber wing in ready status"

may be asked of the system.

Based on our experience, the following human actions may be required at the console:

Elapsed message entry time:	30 seconds
Number of function keys pressed:	5
Number of displays presented:	7
Number of alpha-numeric characters entered:	50

	Interval Between Events	Average Processing Time per Event	Number per Message	Total Processing Time	
				Computing*	1/0 (Disc)
Complete Message	30 sec.	200 ms	1	200 ms	
Function Key	6 sec.	50 ms	5	250 ms	
Display Change	4 sec.	150 ms (1/0)	7		1050 ms
		10 ms (comp)	7	70 ms	
A/N Entry	200 ms	1 ms	50	50 ms	
TOTAL				570 ms	1.05 sec.

*Assumes 12 usec memory cycle

FIGURE 7

PROCESSOR SERVICING IN MESSAGE ENTRY

An analysis of these actions with respect to computer requirements is shown in Figure 7. For a medium-speed computer, the total computing and I/O time required to process this input over the projected 30-second period is 570 ms and 1.05 sec respectively. The latter figure assumes the use of a disc storage device with average access time of 150 ms.

From Figure 7 it is determined that 200 ms represents the basic data cycle if the operator is to be allowed to input at a peak rate of 60 words per minute. It is noted that the processor can be time-shared with over 50 consoles if the I/O is buffered and there are multi-channel accesses possible. On the other hand, if the system is I/O limited, then the number of consoles that can be handled is less than 28.

As is seen, communications may range from simple measurements to full text messages. Furthermore, in some cases (as in radar inputs) the usage of the message is a function only of the source, while in other cases (as in communication consoles) the message itself may determine its usage. In this respect the Executive Control must have a message interpretation function capable of analyzing console messages and initiating appropriate responses. This will be discussed under Special Subordinate Control Routines.

Interrupt Handling

Perhaps the most significant hardware feature of concern to the system designers and programmers in a real-time system is the interrupt procedure. This feature produces the following signals:

(a) End of an operation – as with the termination of a buffered internal memory to tape transfer.
(b) Beginning of an operation – as with an external signal indicating the presence of data in a communication register.
(c) Status condition – as with an alarm signal detecting the presence of some error condition; e.g., floating point overflow.
(d) Special signal – such as a real time clock.

By use of these signals the programmer is able to manage more efficiently the housekeeping, timing and scheduling normally required in an on-line system.

The evolution of the interrupt concept reflects the expanding use of computer systems in on-line operations. The increasing number of I/O channels, decentralization of the processor to multi-computer and memory modules, and varying sources and rates of input data have led to sophistication of the interrupt which is best appreciated when looked upon in historical perspective. It is important to note that the extent of sophistication of the interrupt is not necessarily related to the price of the data processor.

An interrupt is defined to be an automatic change in program flow as a result of a hardware detected change in condition of the data processing system. Certain gray areas exist in identifying an interrupt as, for example, the features of the transfer trap mode and "store location and trap" in the IBM 7090 and the "Interpret" instruction of the UNIVAC 1105. The transfer trap mode causes an automatic branch to a specified location in memory whenever any transfer instruction (except one specially exempted from trapping) is encountered, while the other examples are special kinds of branch instructions which cause a transfer of control to a specified location. The implicit transfer of the trap mode qualifies it as an interrupt in the sense of this article, whereas the other examples, being computer instructions, are not considered interrupts.

In the most modern on-line computers, the number of unique interrupt locations has tended to increase, and the concept of priority sequencing of interrupts has been exploited. Priority sequencing may be defined as the ability to select, by hardware techniques, interrupt source accord-

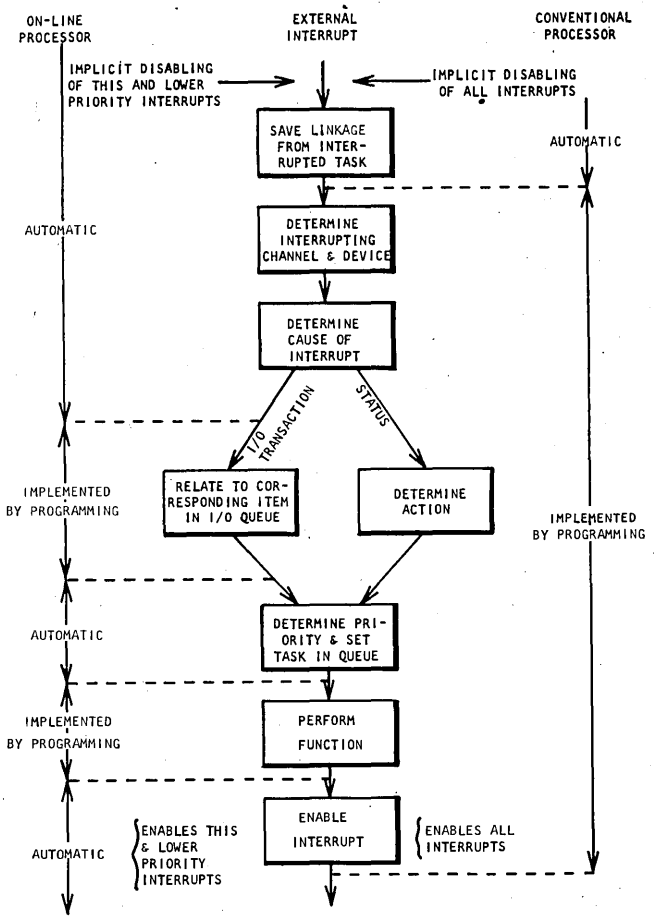

FIGURE 8

INTERRUPT HANDLING IN CONVENTIONAL & ON-LINE PROCESSORS

ing to some well specified rule. Typically, the scanner cycle is sequential and priority is not indicated. However, if the scanner returns to a start position after honoring any interrupt, a priority is established.

The effect of this additional capability is compared to that of the conventional data processor in Figure 8, where the hardware software balances are shown. The hardware features of the on-line processor reduce the programming overhead of the Executive Program to a few instruction times whenever program changes are instituted.

The importance of automatic interrupt and priority handling is best seen in the first application discussed in the selection on Communication Monitoring, above. Using a real-time computer to implement the priority scheme shown in Figure 6 is relatively simple, since all of the management and control aspects are taken care of automatically by the hardware. Thus, if the computer is operating on a program of one level of priority, it can be interrupted only by higher levels, and when this does occur, control is automatically transferred to the interrupting program. The only executive function that need be performed by the interrupting program is the safe-storing of machine registers which may be used by that program. Upon termination, this program would restore these registers prior to a return to the interrupted program. This procedure holds not only for two programs, but also for any number of nested interrupts.

Without the hardware interrupt and/or priority feature, the Executive Control program would have to perform these functions. In the case of priority, this means the maintenance of the Task Queue mentioned in the section on Queue Monitoring and Scheduling. If interrupt signals are not available, the executive would need to scan the communication lines sufficiently often to insure that inputs are recognized and not lost. For example, in the case of the second example of the section on communication monitoring, the scanning would be required to take place at least every 200 ms. Without hardware interrupt capability from either the keyboard or a real-time clock, this could require the breaking-up of all operational programs into segments requiring less than 200 ms for their execution so as to assure re-entry into the executive at least that often.

Special Subordinate Control Routines

Many applications can be significantly improved by the use of special subordinate control routines. These routines are special purpose, but are subordinate to some higher order executive which maintains responsibility for the system as a whole. For example, in multi-computer systems each active module (memory or computer) must retain its own executive control for communication with the "master" module and with any special equipment which may be under its exclusive control. A second example is a subordinate control for scheduling and sequencing test commands in spacecraft vehicle checkout. This executive function is principally concerned with maintaining the clocks and the timing of the scheduled events. It therefore carries a high priority in the system as a whole. On the other hand, it can be singled out as a subordinate function to the overall system control which included I/O, console operations, and communications with the ground support equipment.

A third example of a special subordinate control routine may be found in systems employing on-line consoles. It has already been stated that the Executive Control must have a message interpretation capability to handle messages originating at man/machine communication consoles. Associated with this, it is convenient to have a special control for handling displays. This is because the handling of displays can be generalized to a large extent. Consider, for example, the most common computer functions associated with displays:

1) searching for a particular display in mass storage
2) filling in blanks in displays, including selecting entries from lists (data entry)
3) storing displays in mass storage
4) extracting information from displays
5) reproducing displays on other media.

These functions and combinations thereof serve to define console procedures in much the same way as computer instructions serve to define programs. Thus a simple console procedure may include:

1) the computer searches for a specified display
2) the operator fills in a blank in the display, and
3) the computer extracts the information from the filled-in position and stores it for later use.

The keys on a display console may be used to initiate procedures of this type. The procedures themselves may be defined in terms of a set of pseudo-instructions which perform the functions listed above. The subordinate control routine sequences through the pseudo-instructions interpretively, on demand by the console operator, as indicated by pressing the appropriate keys. In this manner, sets of procedures may be combined to form processes which are controlled strictly by the order in which the function keys are pressed. ■

Additional Reference Material

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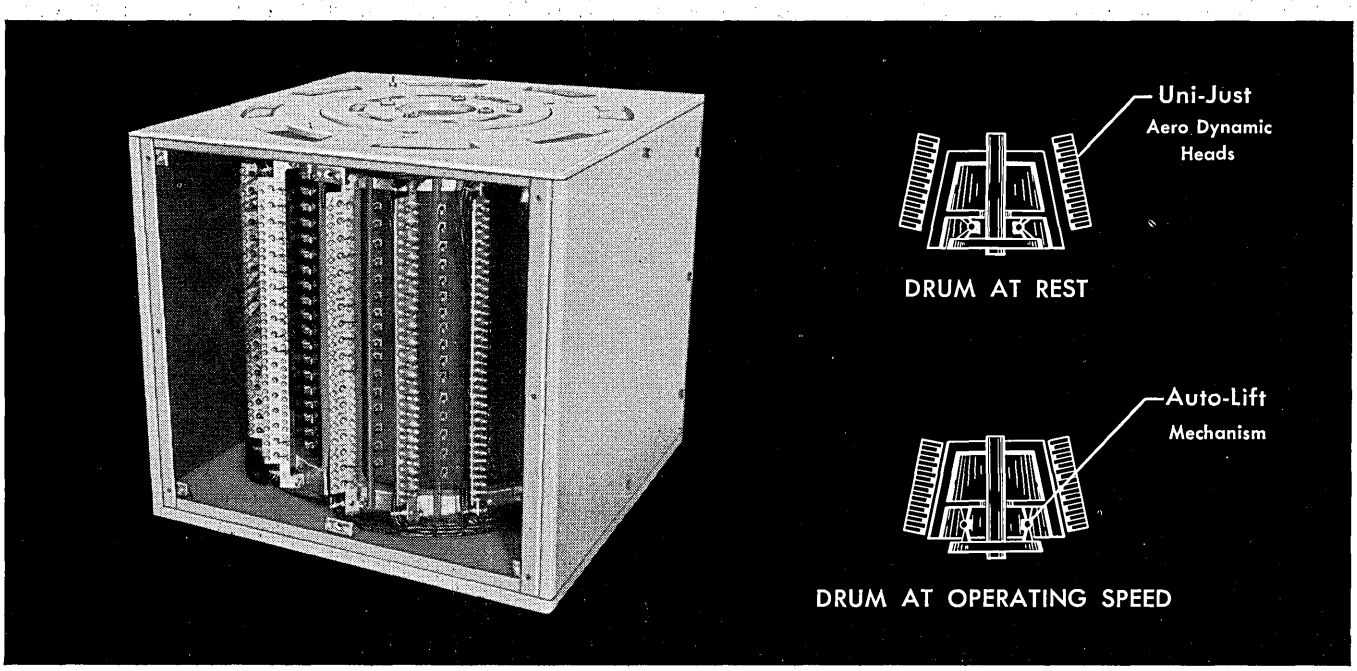
Shafritz, A. B., A. E. Miller, and K. Rose, "Multi-level Programming for a Real-Time System," Proc. of the EJCC, Dec., 1961.

HERE'S RELIABILITY AND MAINTAINABILITY

Bryant Auto-Lift* Drums with Uni-Just* Aerodynamic Heads



AUTO-LIFT DRUM FEATURES:

- No head-drum contact.
- Centrifugal lift raises tapered drum to heads at operating speed.
- Tapered drum retracted axially on stop cycle.
- One simple, fail-safe Auto-Lift regardless of number of heads.
- Auto-Lift maintains fixed adjustment of heads.
- Auto-Lift is automatic, requires no external power, controls or adjustment.
- Auto-Lift unit unaffected by temperature, shock, or vibration.
- Full range of standard sizes and speeds in production.
- Interchangeable production parts throughout.
- All drums expandable to full capacity in field.
- Motor and bearings field serviceable without loss of data.

UNI-JUST AERODYNAMIC HEAD FEATURES:

- True aerodynamic heads fly continuously — no skipping or bouncing.
- Negligible playback envelope modulation.
- Fail-safe individual adjustment to match playbacks.
- Individual heads replaceable without loss of data.
- Head adjustment and replacement with drum running.
- Full range of frequency and pulse density satisfied by production heads.
- Unlimited recording modes.

*Trademarks

STANDARD SPECIFICATIONS

MODELS:
Series 5000 — 5 inch diameter — 4710 bits/track**
Series 7500 — 7.5 inch diameter — 7080 bits/track**
Series 10000 — 10 inch diameter — 9240 bits/track**
Series 18500 — 18.5 inch diameter — 17400 bits/track**
CAPACITIES: **300 bits per inch.
Up to 16.5 megabits at 300 BPI with single bit alteration.
Higher capacities available using NRZ, block format.
AVERAGE ACCESS TIME:
2.5 to 33.3 milliseconds depending on drum size.
MOTORS:
900 to 12,000 RPM, Induction or Synchronous.
MAGNETIC MEDIUM: hard oxide coating.
READ-WRITE HEADS:
Individually adjustable, true aerodynamic heads.
ENVIRONMENT:
Storage: — 65°F to + 160°F.
Operating: + 32°F to + 140°F.
Thermal shock: Drum with covers in place will withstand 50°F step change in operation.
Altitude: Operating to 15,000 feet.
Humidity: to 95% RH.
Shock: 5 G's any plane with standard mounts.
Vibration:

0- 10 CPS	5 mils excursion.
10-250 CPS	2 mils excursion.
25- 50 CPS	1 mil excursion.
Over 50 CPS	0.5 mil excursion with maximum acceleration of 2 G's.

Military Auto-Lift Drums are also available to meet these typical specifications: Mil-E-5400, Mil-E-4970, Mil-E-4158, and Mil-E-16400.

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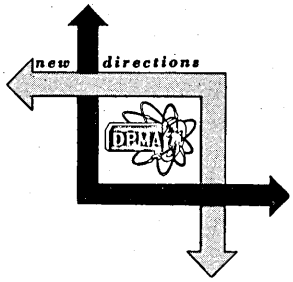
CIRCLE 18 ON READER CARD

June 25-28, Cobo Hall, Detroit

1963 INTERNATIONAL DATA PROCESSING CONFERENCE



More than 60 speakers in business and dp fields are scheduled to address 3,000 registrants at the 1963 International Data Processing Conference, June 25-28, at Cobo Hall, Detroit, Mich. Sponsored by the Data Processing Management Assn., the conference will feature exhibits by more than 200 firms. The conference theme is "New Directions in Data Processing."

Registration is open to anyone interested in systems, management, and data processing. Fee for the full program, including luncheons and banquet, is $75 for members, $85 for non-members. The registration desk in Hall B will be open Monday from noon-10 p.m., and Tuesday and Wednesday, 8 a.m.-10 p.m. A hard-bound copy of the conference proceedings will be distributed to each attendee at the registration desk.

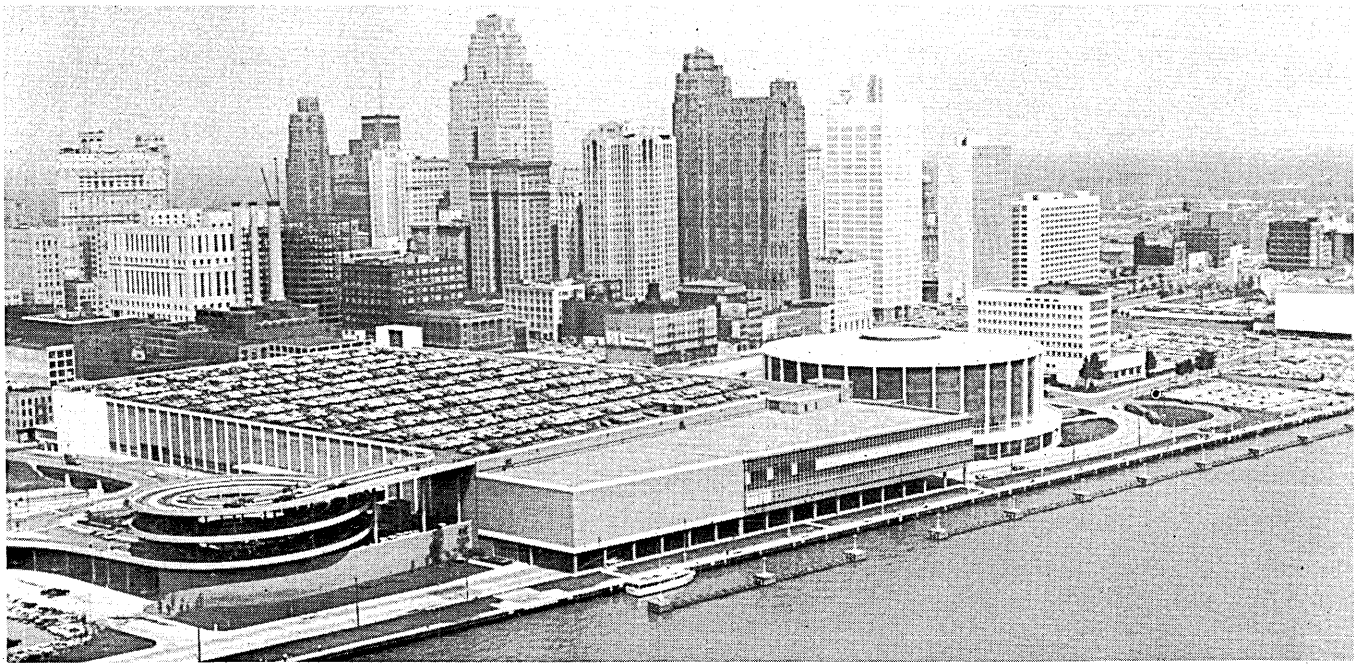
Beginning Wednesday afternoon, 60 seminars in 37 topic areas are scheduled in three categories: data processing management (not equipment-oriented), computer management, and punched card management. Most of the seminars will be presented twice.

The exhibit area, in Hall B, will be open on Tuesday from noon-9 p.m.; Wednesday, 10 a.m.-9 p.m.; Thursday, 10 a.m.-6 p.m., and on Friday from 9 a.m.-noon.

Tours are scheduled for Tuesday morning and afternoon, a day before formal sessions begin. Attendees have the option of visiting the Ford Motor plant in the morning and either the Ford Museum or Greenfield Village in the afternoon, or touring the U.S. Rubber Tire Co. in the morning and the Scott Paper Co. after lunch. Simultaneous visitations, on Thursday morning, are to computer installations at Michigan Consolidated Gas Co. and National Bank of Detroit.

The Ladies Program consists of brunches, luncheons, tours, and the conference banquet on Thursday. Fee is $28. ■

cobo hall



a review

DPMA: ITS FUNCTION & FUTURE

by R. CALVIN ELLIOTT, Executive Director, Data Processing Management Association

On July 1, 1962, the National Machine Accountants Association became the Data Processing Management Association, thus giving official recognition to the vastly changed conditions of the industry and the role of its personnel. In view of those changes, propelled by the widening use of digital computers and associated electronic equipment, and reflected in the expanding responsibilities of the data processing function in government and industry as well as the rising managerial status of professionals in the field, it was obvious that the term "machine accountant" was no longer meaningful. It was obvious too that NMAA was no longer merely an organization of tab supervisors. A new professional data processor was being created with a combination of line-and-staff responsibilities requiring strong technical know-how as well as managerial abilities. Data Processing Management, a field still emerging, and evolving, had come into its own.

Since its founding in 1951 as a loosely connected handful of local chapters whose members were primarily involved with the supervision of punched card accounting departments, DPMA has grown to 190 chapters, representing more than 16,000 data processing professionals in the United States, Canada, and Japan. Its members are engaged in supervisory or staff capacities in various aspects of the entire spectrum of data processing activity, from manual to electronic, from pure research to commercial enterprise, from esoteric to mundane.

DPMA is also in a state of consolidation which is giving greater meaning and purpose to the international organization along with higher goals and expectations for its members. Structurally, this has been promoted by its recent reorganization into 13 divisions with chapter representation at both the division and international level. Under the leadership of Elmer F. Judge, international president, the division structure has helped to build a stronger, more cohesive international organization at the top, but with greater opportunities for the voice of the membership to be heard.

In brief, DPMA strives to fulfill three primary functions:

1. To aid the association's members in developing and improving their professional capabilities.
2. To improve public understanding of data processing and its benefits, particularly at the executive level.
3. To assist in the establishment of suitable industry standards.

To accomplish these objectives, the DPMA works at two echelons—the chapter (local) level and the headquarters (international) level. Many of its projects are coordinated through the international headquarters at Park Ridge, Ill., but implemented by the members of the individual local chapters. In such cases, the headquarters staff attempts to provide the chapters with all of the tools necessary to get the project done.

Local chapters, which are fairly autonomous in their daily activities, undertake numerous projects on their own, also, including the conduct of educational seminars for their membership; the exchange of helpful data processing information; programs to introduce data processing courses into local schools; and, of course, a full and varied social program for the enjoyment and fellowship of their members. Some of these projects border on the unusual. The chapter in Indianapolis has, for instance, undertaken to support—by providing a series of speakers, by offering its counsel, and by donating various data processing supplies—the state penal institutions' program to provide inmates with a background in data processing as a part of their rehabilitation training program. A similar program is being conducted in Los Angeles. Some chapters have taken action to establish standards which will curtail the activities of bogus "edp training schools" within their areas.

These and other worthwhile projects are formulated by the officers and committee chairmen of the local chapters, and help to extend the influence and accomplishment of the DPMA throughout the communities which they serve. Projects of national importance, however, are most effectively coordinated through the international headquarters, which can help to direct them more efficiently and can aid the efforts of the individual chapters by providing them with the necessary information and materials to conduct the project.

From its first National Conference in 1952, which boasted such industry pioneers as Howard Aiken, Herbert Mitchell, and C. C. Hurd as speakers, the DPMA annual

International Conference has remained the outstanding educational event of the year.

Because of the wide appeal for such conferences and the difficulty of servicing the membership in both the east and west in any one year, the International Board of Directors decided at their recent mid-year meeting in Chicago, to offer a semi-annual conference in November or December. This conference, with the full range of seminars, papers, and exhibits will be held at some location west of the Mississippi.

DPMA's most important contribution continues to be in the area of education, both for and by its members. Through the Education Department, headed by Jim Adams, DPMA has been able to assist the Department of Health, Education and Welfare in developing a recommended post high school two-year curriculum in electronic data processing, as well as a curriculum for summer institutes to train teachers. In addition, DPMA services have been offered to the Department of Labor to assist in determining the effects of computers on office personnel as well as associated effects on the national employment picture.

By far the most ambitious program undertaken for both members and non-members is the Certificate in Data Processing, for which the first examinations were held in 1962. Inaugurated in response to the growing need for continuing education in our rapidly changing profession as well as the necessity to provide a guideline of study for those persons preparing for careers in data processing, the CDP has found wide acceptance. A total of 1,417 persons sat for the examinations given in 1962. On November 23, the 1963 examination, as revised by the Certificate Advisory Council, will be offered at approximately 50 university test centers in the United States and Canada.

An excellent example of the development of nationally sponsored but locally administered programs is the Future Data Processors course for secondary schools. FDP is an introductory course in automatic data processing which covers approximately 20 hours of instruction. Course materials, which include an instructor's manual and student handout kits, are purchased by chapters from DPMA headquarters. The course is offered to selected high school seniors as an extra curricular class which includes field trips to data processing installations.

The FDP program is still too recent to measure its success, but its acceptance by chapters and school districts has been gratifying. In fact, the introduction of this course into the high school has brought to light an even greater need to educate secondary school teachers in the methods of automatic data processing. In several school districts, notably Detroit, Mich., and Hammond, Ind., special "FDP" courses for teachers have been conducted by the chapters.

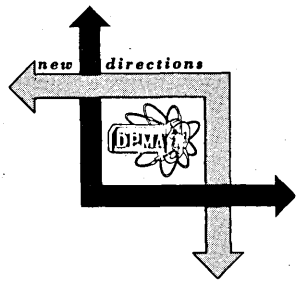
Future goals call for stepped up effort to assist universities and colleges in the development of curricula in data processing as well as contributing materials, equipment, and talent to the education of teachers in the field. DPMA's annual publication of the catalog of Audio-Visual Aids is part of this program.

In the near future DPMA plans to publish a high school textbook on automatic data processing which will replace the FDP student handout material and supplement the instructor's manual. The book will be a joint effort of educational representatives from seven computer manufacturers. In line with this outside educational activity are plans to create an orientation program in data processing for company executives from various other departments. The objective is to present the benefits of using computers for obtaining information for decision-making. As with FDP, this program will be developed by headquarters for local implementation.

Beginning in June of this year, DPMA will publish a new official magazine, the monthly Journal of Data Management, which will be sent to all members.

A long range goal of the Association is to expand the quality and content of the Certificate in Data Processing, to make it a more meaningful instrument of professional stature. Another is to make our members aware of their responsibilities to the community, to share their knowledge, to participate in projects like Future Data Processors and teacher education. Of primary importance, however, is DPMA's dedication to the advancement of the data processing profession by increasing the professional value of the individual. ■

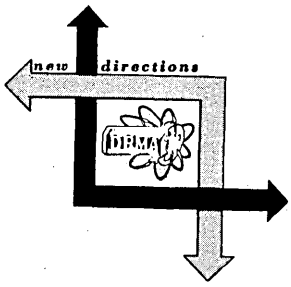
SPECIAL EVENTS...



Formal sessions of the 1963 International Data Processing Conference open Wednesday, 9:30 a.m., in the Ballroom. Following welcome addresses by John C. Drew, DPMA international VP, Detroit mayor Jerome P. Cavanaugh, and Elmer F. Judge, DPMA international president, the general assembly will hear the keynote address by Ray R. Eppert, president, Burroughs Corp. His talk bears the title of the conference theme, "New Directions in Data Processing."

That evening, 8-10 p.m., the Executives' Forum will be held in the Ballroom. The topic, "How Can Data Processing Best Serve Top Management?" will be discussed by a panel of six executives, moderated by Edward C. Bursk Sr., editor, *Harvard Business Review*. They will discuss the role of dp in corporate policy and management decisions.

The luncheon speaker on Friday will be Dr. E. Dana Gibson, professor of office management, San Diego, Calif., State College, who has just completed a 10-month world tour, studying the current status and practices in dp by foreign firms. He will discuss their effects on the U.S. competitive position in world trade. ■



THE PROGRAM

SEMINARS	Data Processing Management	Computer Management	Punched Card Management
WEDNESDAY 2:00 P.M. to 4:30 P.M.	10 12 14 24 32	40 42 46 58 60 64 66 68	70 72
THURSDAY 9:00 A.M. to 11:30 A.M.	11 13 15 25 29 37	41 43 47 59 61 67 69	73 77
THURSDAY 2:00 P.M. to 4:30 P.M.	16 18 20 22 30 34	44 48 50 52 54 56 62	74 78
FRIDAY 9:00 A.M. to 11:30 A.M.	17 19 21 23 27 31 35	45 49 51 53 57 63	75 79

DATA PROCESSING MANAGEMENT

10 11 The Rising Status of Data Processing Personnel
Alfred J. Drucker, Manager, Management Development, IBM Eastern Region, New York, N.Y.
Panel: Charles W. Gilbert, Editor, Business Automation, Elmhurst, Ill. Alan D. Meacham, Editor, Data Processing, Detroit, Mich.

12 13 Effects of Data Processing on Non-Data Processing Personnel
Adrian A. Flakoll, Industrial Relations Administrator, Lockheed Missiles & Space Co., Sunnyvale, Calif.
Panel: Wilbert M. Remington, Director, Machine Data Processing, The Detroit Edison Company, Detroit, Mich.

14 15 The Management Information System
Charles W. Neuendorf, Chairman, Equipment & Systems Marketing Div., Systems Advisory Bd., Burroughs Corp., Detroit, Mich.

16 17 Economic Aspects of Data Processing
Douglas Axsmith, McKinsey & Co., New York, N.Y.

18 19 Gaining The Auditors Confidence
Kenneth Cadematori, Price-Waterhouse & Co., New York, N.Y.
Panel: Harold Weiss, Consulting Application Engineer, GE Computer Dept., Phoenix, Ariz.

20 21 External Support For Data Processing
W. H. Evans, Executive Vice Pres., Assn. of Data Processing Service Associates, Abington, Pa.
Panel: Frank H. Gille, President, American Data Processing Inc., Detroit, Mich.
W. R. Simmermacher, Director of Education, IBM Data Processing Div., White Plains, N.Y.
Dr. Everett C. Yowell, Director, Sales Support, P-P Systems & Sales, National Cash Register Co., Dayton, Ohio

22 23 Use of Consultants
Alfred L. Baumann Jr., Assistant Comptroller, Michigan Bell Telephone Co., Detroit, Mich.
Panel: Donald Wood, Touche Ross Bailey & Smart, Detroit, Mich.

24 25 Banking
John S. Kindy, Director, Federal Reserve Marketing Activities, Burroughs Corp., Detroit, Mich.

27 Utilities
John P. Bromley, Assistant Controller, Consumers Power Company, Jackson, Mich.

29 Retailing
C. Robert McBrier, Vice President, Finance, Woodward & Lothrop, Inc., Washington, D.C.

30 Government
Vico E. Henriques, EDP Consultant, Budget Div., State of New York, Albany.

31 Transportation
W. R. Plugge, Director, Technical Reservations System, American Airlines, Briarcliff Manor, N.Y.

32 Insurance
David M. Irwin, Administrator, Industry Marketing Operations (Insurance), RCA, Camden, N.J.

34 35 Manufacturing
Harold C. Plant, Administrator, Computer Applications (Manufacturing), RCA, Camden, N.J.
Panel: Donald Pietro, Lockheed Aviation Corp., Burbank, Calif.

37 School System Administration
Dr. John W. Sullivan, Professor of Administrative Sciences, Wayne State University, Detroit, Mich.
Panel: A. W. Flowers, Asst. Supt. Scottsdale School System, Scottsdale, Ariz.
Dr. Charles K. Pullen, Director, Research & Statistics, State Dept. of Education, Nashville, Tenn.

COMPUTER MANAGEMENT

40 41 Management of the Computer Department
Marvin Wofsey, Mgr., EDP Lab., Center for Technology & Admin., The American University, Washington, D.C.

42 43 Sequence of Installation Procedures
Andrew J. Allott, Acting Chief, Resources Div., Data Systems Office, U.S. Army Materiel Command, Washington, D.C.

44 45 An Introduction To Software
Daniel D. McCracken, President, McCracken Assoc., Ossining, N.Y.

46 47 Computer Evaluation
Gomer H. Redmond, Manager, Corporate Systems & Procedures, Chrysler Corp., Highland Park, Mich.

48 49 Random Access vs. Sequential
Lawrence S. Wolfe, Consulting Application Engineer, GE Computer Dept., Phoenix, Ariz.

50 51 COBOL Experience Reviewed
Charles A. Phillips, Director, Data Processing Group, BEMA, New York, N.Y.
Panel: Thomas Browning, Owens Illinois Glass Co., Arthur Whitmore, Westinghouse Electric Co., John Jones, U.S. Air Force

52 53 Data Communications For Computer Processing
Harvey J. McMains, Administrator, Data Communications Planning, American Telephone & Telegraph Co., New York, N. Y.
Panel: H. M. Silveira, Jr., Product Marketing Administrator, Communications Systems, IBM Data Processing Div., White Plains, N.Y.

54 The Use Of Decision Tables
Thomas F. Kavanagh, Consultant, Material Control R & D, GE Production Control Service,

New York, N.Y.
Panel: Morton Allen, Material Control R & D, GE Production Control Service, New York, N.Y.

56 57 New Directions In Computer Equipment
Samuel Alexander, Chief, DP Systems Div., National Bureau of Standards, Washington, D.C.

58 59 Simulation By Computer
Fred B. Cornish, Mgr., Mgmt. Sciences, Burroughs Corp., Detroit, Mich.

60 61 Information Retrieval
H. Peter Luhn, Consultant, Armonk, N.Y.

62 63 PERT And CPM By Computer
Stanley F. Buckland, Management Scientist, Burroughs Corp., Detroit, Mich.

64 Operational Accounting and Operations Research
Dr. Arvid W. Jacobson, Head, Detroit Research Institute, Detroit, Mich.
Panel: Don Curtis, Mgr., Mgmt. Services, Touche Ross Bailey & Smart, Detroit, Mich.
Morgan Edwards, Operations Research Staff, Ford Motor Co., Detroit, Mich.

66 67 Inventory Control and Scheduling
Albert J. Matthies, Operations Research Analyst, Burroughs Corp., Detroit, Mich.
Panel: Edwin M. McPherson, Mgr., Manufacturing Markets, Industry Marketing Operations, RCA, EDP Div., Camden, N.J.

68 69 Parts Generation Procedures
Clayton Kerr, General Coordinator, Methods & Controls, Chevrolet Div., General Motors Corp., Detroit, Mich.
Panel: Michael A. Scafuri, General Coordinator, Methods & Controls, Chevrolet Div., General Motors Corp., Detroit, Mich.

PUNCHED CARD MANAGEMENT

70 Management Of A Punched Card Department
William R. Ferguson, Mgr., Data Processing, American Standard, Industrial Division, Dearborn, Mich.

72 73 New Directions In Punched Card Systems Design
Dr. Gibbs Myers, Manager, Systems & Procedures, General Precision, Inc., Aerospace Group, Clifton, N.J.
Panel: R. J. MacGuire, General Precision, Inc., Aerospace Group, Clifton, N.J.

74 Data Collection and Transmission For Punched Cards
Leighton F. Smith, Arthur Andersen & Co., Chicago, Ill.

75 Information Retrieval By Punched Card
John Burgeson, Systems Engineer, IBM Corp., Akron, Ohio

77 Personnel Accounting
Ronald W. Drake, Mgr., Mechanical Acctg., Clark Controller Co., Cleveland, Ohio

78 Financial Reporting
Glen Black, Manager, Data Processing, Huck Manufacturing Co., Detroit, Mich.

79 Marketing Assistance
Martin C. Martin, Project Manager, Electrical Design Automation, IBM Corp., Milwaukee, Wis. ■

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from Radiation, Inc.

NEW HIGHSPEED PRINTER

A new high speed, electrosensitive printer system capable of 62,500 cps has been built by Radiation Inc., Melbourne, Fla. The alphanumeric printer, designed primarily as output for high speed digital computers, will be used by the Lawrence Radiation Laboratory in its A.E.C.-sponsored work on thermo-nuclear fusion.

The printer operates in a "line-at-a-time" mode, printing 31,250 alphanumeric, 120-character lines per minute. The input data rate: 60,000 cps. The paper is moved at 96.7 ips under a row of 600 fixed styli. Styli are selected according to the character to be printed, and energized with high velocity current pulses. Letters and numbers are formed by controlling the flow of electrons through the chemically-impregnated recording paper, which reacts chemically or physically to cause a rapid and permanent color change in the compounds.

performance characteristics

Each alphanumeric character is supplied to the printer in a six-bit-parallel form at a 62.5 KC rate from a 112.5 ips mag tape (half-inch) with a data density of 556 bpi on each of seven tracks. Each character is formed by groups of five styli which are energized sequentially with seven groups of pulses derived from a five-by-seven matrix character generator.

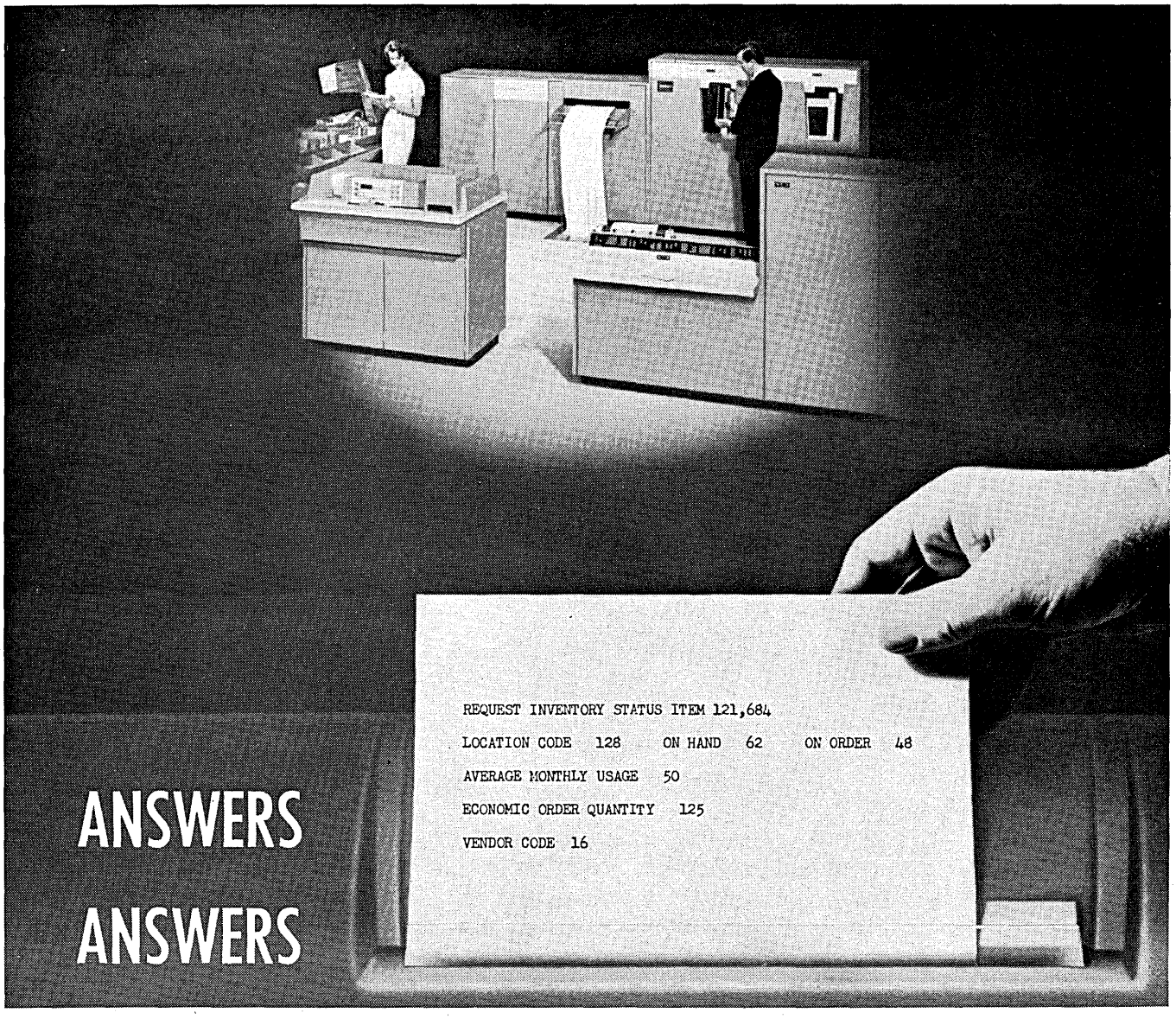
The data is printed one line at a time with each line containing 120 characters. Printing speed is 31,250 lpm. Each line is formed by seven sequential groups of 600 pulses to 600 fixed styli. The electrosensitive paper is 12″ wide, with 10.4″ used for writing. Characters are 0.100″ high and 0.060″ wide. Spacing between characters is 0.022″, and spacing between lines is 0.055″.

system operation

For continuous printing, two tape transports are utilized with the printer controlling automatic transfer between the two tape units. After parity checking to detect errors, input data is directed to one of two recirculating buffers, each capable of storing a complete line of data in six-bit binary form. When one buffer has been filled, data input is transferred to the second buffer, and printout of the data in the first buffer is started.

A 120-position decommutator controls the selection of the appropriate five of the 600 recording styli and their associated stylus amplifiers. Characters are formed one horizontal row at a time (five of the 35 matrix code bits are printed for each circulation), and hence the data is circulated through the buffer seven times to complete the printing of a line. Additional recirculation without data printout results in a space between lines before the printout of the second line of data from the second buffer is initiated.

Control of the printer and format of the output data are accomplished primarily by pre-programming the input data tape. The top and bottom margins of each page and partial pages are obtained by interrupting the mag tape transport at the end of each page of printing. This requires that the input data be of a format in record lengths of not more than 7,200 characters of 67 lines, since the mag tape can be interrupted only at an inter-record gap.



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NCR

CIRCLE 19 ON READER CARD

Allied in no way with the trio of executives in the consulting field which preceded it, this interview is with Edwin R. Gamson, VP and general manager, Ampex Computer Products Co., Culver City, Calif. He was VP of Telemeter Magnetics Inc. when it merged with Ampex in 1960, and was named to his present position in 1962. Gamson is a member of the administrative committee of the IEEE's Professional Group Component Products.

a printout from tape

THE VOICE OF AMPEX

Q: What is Ampex doing, specifically, about thin film research and production?

A: Ampex is aware of the strides being made in film research, both magnetic and cryogenic, and in our central research group, located in Redwood City, California, a continuous surveillance program is being implemented and manned to keep abreast of the field. In addition, we are currently working on the manufacturing technique associated with thin film. It is in this area, we feel, that a breakthrough must come. In the Computer Products Division in Los Angeles, we have people concerned with process technology as associated with films. We want to be ready for this film technology when it matures. We have the circuitry associated now with high speed ferrites; we feel that ferrites have a tremendous future and a continued niche in the memory field. We do not have anything in our plans to introduce a thin film memory of either the small scratch pad type or main, large capacity type in the next several months. We feel that the state of the thin film art does not go far enough from an economic and technological standpoint for us to manufacture memories out of films. We don't need it as a glamour item. Basically, the film is an excellent device (now and in the next several years, as we see it) for small scratch pad memories. Our primary business however, is in large, central store devices.

Q: What increase in cost do you see for thin film memories over core memories, in terms of reasonable production today?

A: At present, about 200%. I am talking not only of the film, but also associated circuitry. The film is an open magnetic loop device – a planar circuit. Because of this, it requires very large drive currents – very expensive circuitry – to get in. What you get out are very small signals, again requiring very sophisticated circuitry to get usable output. Therefore, even a small scratch pad memory is very expensive.

Q: At present, how much more efficient is thin film circuitry over core memories, in terms of speed?

A: Well, I think anyone who has surveyed this field would look at it and say it's a marvelous concept; it should be much more efficient. You can lay down a plane of whatever number of bits, all at one time, all in place. It sounds great, except that this isn't the way it happens. Reproducibility is a problem. Because of this I feel that ferrites, from a technique standpoint, working with discrete elements and being able to reject bad ones and accept good ones – rather than throw away a whole plane – have an advantage. Ferrite cores are limited in speed by how close you get the elements together; transmission line characteristics start to enter when you get into the sub-microsecond speed areas. A planar construction doesn't allow you to get the element bits sufficiently close together to have it much more efficient than ferrite cores – in fact, not as efficient.

Q: Do you feel that not having a production capability at this time would impair your competitive position in the future?

A: Ampex, through its history, has been a production-oriented shop. When the industry and the technology of films provides a reproducible economic process, we will be in it with both feet, and it's not going to take us long. We don't think we are behind that much that we couldn't catch up in the technology. On the other hand, we have some added advantages that allow us to have a little lead time – the market impact with our existing memories, the customer relationships that we now have. We are now working toward 20-mil outside diameter cores. Center to center spacing, because our cores are on an angle, can be approximately 15-mil. If you were to try to get the same sort of spacing, which is important to speed, using a thin film, you wouldn't have enough film there to get the output required. So I don't think today there is a magnitude difference. There is some difference in small memories, but not in the main store.

Q: How far are we from the feasible use of thin films?

A: I think there are some breakthroughs of a very sophisticated nature that must come about. It is conceivable that we can develop, through plating techniques, the correct and very intricate masking, but to develop a method of closing the magnetic path is another story. If this happens, I see the possibility of a breakthrough. It is going to take something like that. It is going to take a new construction philosophy, an ultra-sophistication in tolerances that just doesn't exist, even in our sophisticated mechanization of today's industry. The ferrite memory array has a pretty crude manufacturing process; in fact, today, most assembly of ferrite cores is manual. We are starting to sophisticate that, but we don't have to go anywhere near the ultimate of sophistication that is necessary with even the most gross kind of film. Look at the product, a bit on film, and recognize the speed that people are talking about. There was a 4,096 film memory, 25 bits, I believe, produced overseas for a well known company in this country; they were able to obtain a one usec cycle time. As you probably know, Ampex is now producing 32,000-word memories of 56 bits using only a 30-mil core that operate in one usec total cycle time.

Q: For how long will core memories continue to dominate?

A: We are continuing to plow money into the ferrite field. If we spent 10 per cent of the millions of dollars that have been spent by the government and private organizations in films, I think we would be much further ahead today in ferrite storage technology. Film tech-

niques are important and will be with us someday, but not, in my opinion, as storage for the main memory of a computer. I think ferrites will have a position of advantage as the central memory for another five to 10 years. On the other hand, in the small scratch pad area (small number of words), I can see a marriage of logic and memory in film technology, where one can pay a lot of money per bit because you have only a few bits doing something that never could be done with ferrites. But applying this technique to very large capacity, mass memories, which is what the industry now needs and will continue to need, is extremely costly; I don't see the breakthrough that will change the economic cost. On the other hand, in the ferrite end of things, I see certain breakthroughs happening. For example, five years ago, we were making a 100-mil core and said this is the ultimate in size, we just can't handle anything smaller; we soon had an 80-mil outside diameter core. That was the ultimate – but we soon had a 50. We are now operating with 30, and, in the development sections of our company, are working with a 22-mil outside diameter core. We are beginning to feel that the 22-mil core is about as far as we can go in size in handling with present, relatively crude techniques – people with needles. So we are starting an investment in mechanization. I think we have just started to scratch the surface on ferrites. Further, I can't underplay the cost of scrap. We have gone from the hand testing of each core of several years ago to an automatic testing at present. We can very quickly test 4,000 cores and throw out the two that are bad. In a thin film plane of 4,000 bits, they can test pretty fast, but they'll have one or two bad ones and that will mean a plane will go. So this is an economic factor that has to change.

Q: How far along are you on mechanized core array production?

A: For the last two years, we have been in the semi-automatic production of cores. We don't spread it around too much, but now it is becoming fairly well known. Core production itself is a highly mechanized, automated process; we are using mechanized processes now for the stringing of the arrays. The reason the industry hasn't moved toward total automation, in my opinion, is the investment required. In an operation such as ours, supplying memories of various sizes and bit lengths to industry, we would have to design an automatic machine or an assembly method that is completely flexible. One day we might have to make 16,384-word arrays, another day 64 by 64 or 4,096-arrays; our production runs in this industry are quite short. The industry has to mature first. I'd say we are on the very sharp part of the obsolescence curve; we are starting to get up to the top, flattening off. I think you will see now in our industry, as in every other, a standardization, a maturing of the industry, a flattening of the obsolescence curve which will provide an incentive for mechanization and automation. I think we at Ampex are in a very good position in that area. But this is why it has been an antiquated kind of approach. Right now, we are working very actively on deposition methods of array stringing.

Q: Assuming that in the near future it becomes feasible to mechanize core string, what effect would it have on the price of core arrays?

A: Labor input of core array stringing amounts to about 70 per cent of the cost. We can reduce this, I would think, by 80 per cent. Ampex has looked for a lower labor market in order to become competitive in the foreign market with our memories; in fact, we have a company in Hong Kong that strings core arrays. This facility is providing us a cost and quality advantage without mechanization because we can afford to have a high inspection-assembly ratio, which is a very important part of the array stringing.

Q: RCA recently announced microferrites and will shortly announce a main frame, tentatively called the 401, which will include a microferrite memory and the usual core. What has Ampex to compete with in this area?

A: We will be able to offer a comparable speed for the comparable capacity (or very close to it) ferrite memory. We do not have a product, at this time, that competes directly with the microferrite. But the microferrite, as with thin film memories now available, has a capacity of a small number of words; it's a scratch pad and that's all. RCA intends to use it, and we aren't at present in the scratch pad memory market.

Q: How does Ampex view disc files as an encroachment on the use of tape drives?

A: Well, I think we see an increasing need for random access memories, disc files being one of the first, and I feel that Ampex will be remiss if we don't invest a considerable amount of our development dollars in meeting this market. We are not, at this time, feeling the impact of disc files on our tape sales because they are doing a different job, but I definitely feel that we should consider this as a business and growth opportunity. Just what we're doing, I can't say. The disc file approach involves the movement of a large object very rapidly to a precise location. We feel that this is a limiting factor. Many manufacturers of discs are having trouble going to higher capacities and greater bit densities because of the fundamental physical law; it's hard to move something that is heavy and fast, and to a precise point. That doesn't mean that there isn't a need for random access memories and larger capacity.

Q: Does Ampex plan to expand into any other directions in the computer or peripheral equipment field?

A: We have definite plans for growth in the peripheral products areas. I might add that we feel that in order to assure our ultimate customer, the computer manufacturer, the type of service, penetration and future growth anticipating his needs, we cannot compete in this business with him; we cannot be providing a machine technology as well as a peripheral technology.

Q: What are Ampex's interests at the present in the area of peripheral equipment?

A: We aren't making any announcements at this time on our peripheral products. We are interested in the general field; we think it is a good business to be in. We think the philosophy of a peripheral product supplier, under one corporate structure, with many products, is a sound, economic kind of growth business, and that is what Ampex philosophically wants to be in all its divisions.

Q: What products can you definitely exclude?

A: Well, I can't see that the central processor would ever be considered a peripheral product. I don't think that we would be interested in card equipment. We are not excluding the field of optical scanning.

Q: Have you excluded disc files?

A: My comments regarding disc files were on the presently available technology. The disc file of tomorrow and the disc file of an outfit like Ampex could be as different as night and day. No, I wouldn't say that we are excluding that as we are card equipment.

Q: When can the field expect some announcements as to a new direction for Ampex in terms of peripheral equipment or new additions to a line of equipment?

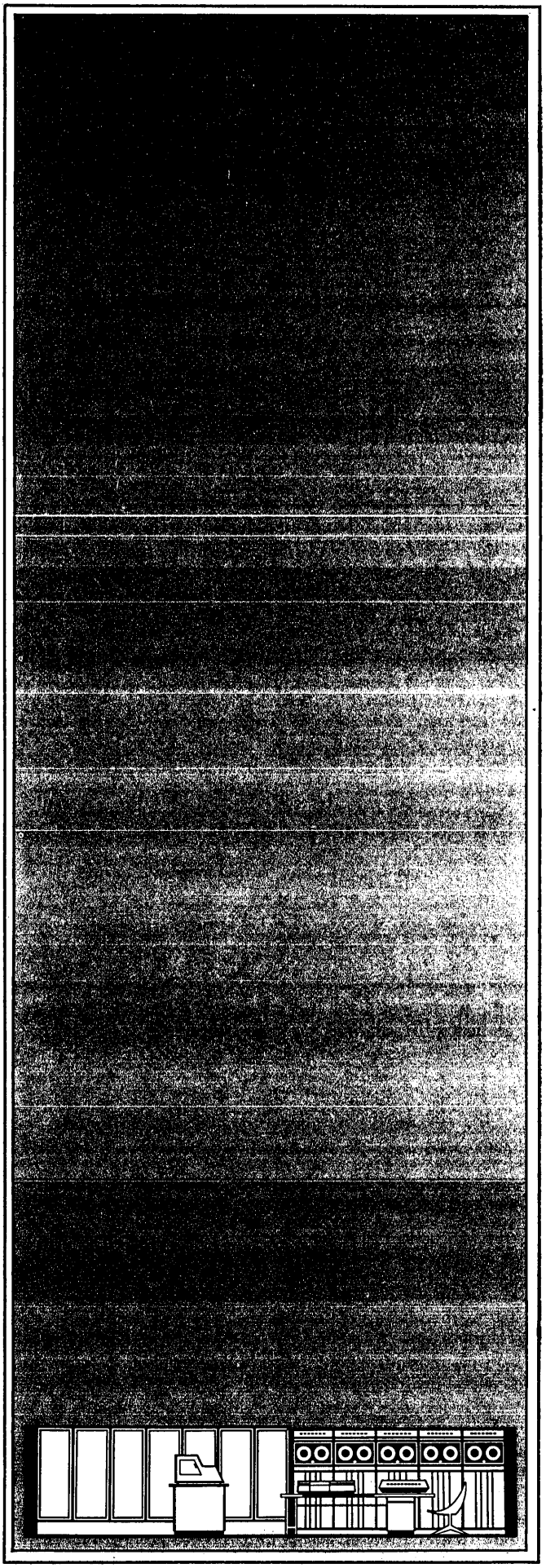
A: We now produce and have announced a combination tape memory which is a tape buffer unit. It is not a new product – it is a marriage of our existing products – but to some it could be considered a new peripheral. What I think you mean is something completely foreign to our

Look what Honeywell has done with FORTRAN IV

Now you can compile 1000 statements per minute

By taking full advantage of the Parallel Processing features of Honeywell 800 and 1800 computers, Honeywell has come up with an advanced version of its AUTOMATH compiler that is not only extremely fast (over 1000 statements per minute on the H-1800), but uniquely equipped to get a given program on the computer, run, and off again faster than ever before.

Called AUTOMATH 1800, this new algebraic compiler utilizes and is fully compatible with FORTRAN IV language.



Load-and-Go action with short turn-around time

Honeywell Parallel Processing allows the input operations of the next job to proceed while compiling and executing the present job and printing the last job. Each job goes through from input to printing without being delayed by other jobs in the stack. Parallel Processing and the systems monitor allow this coordinated peripheral and compile-execute operation to proceed and keep the computer operating at full speed.

All of this is done automatically on a routine basis without need for operator scheduling or intervention. Parallel Processing enables the H-1800 central processor not only to compile and execute the programs, but also do the work conventionally delegated to several satellite machines. Thus, even though programs are stacked for efficient handling, there is a dramatic reduction in the turn-around time (the period between submission of a program and the availability of results).

Optimization techniques increase effective memory capacity

Extensive sharing of program and data areas through dynamic memory allocation overlay techniques has been utilized to conserve memory. As a result, many programs that are too large for execution under conventional systems may now be run successfully. More memory space is made available, too, for the parallel operation of a number of smaller programs.

Automatically detected shortcuts speed object program execution

Honeywell's new AUTOMATH 1800 compiler automatically detects redundant computations appearing in sequences of statements. With conventional FORTRAN compilers, this ability is limited to redundancies in a single statement. Honeywell's compiler will also automatically resequence portions of statements to avoid unnecessary repetition of computations in loops.

Read-write-compute overlap capabilities fully utilized

Automatic double-buffering of all peripheral and tape operations reduces object program running time by permitting overlap of all reading, writing, peripheral and computing operations. A technique of anticipating the next peripheral instruction makes this possible.

Additional speed in the input-output area is achieved through improved methods of interpreting format control statements. The power of the input-output package is sufficient to the extent that only one copy is needed to service all programs that may be running in parallel.

Diagnostic features aid the programmer

The ability of the compiler to detect programming errors and inconsistencies during checkout has been greatly expanded. The programmer is alerted, not only to the existence of questionable items, but to the specific offending statement.

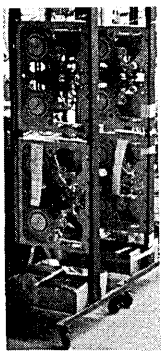
Write for more details

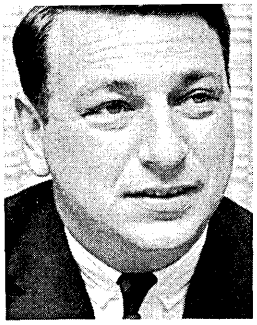
A technical bulletin describing the abilities and advantages of the Honeywell AUTOMATH 1800 compiler is available. Write to Honeywell EDP, Wellesley Hills 81, Mass. In Canada, Toronto 17, Ontario.

Honeywell

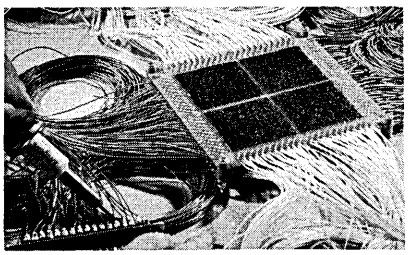
ELECTRONIC DATA PROCESSING

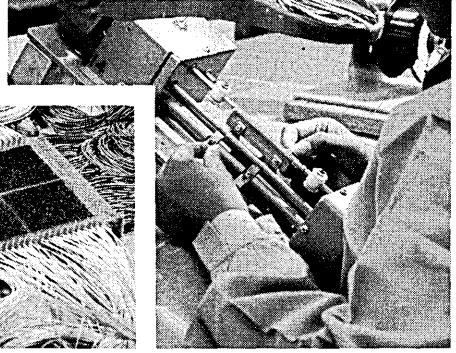
CIRCLE 20 ON READER CARD

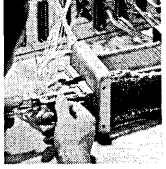


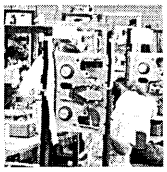


EDWIN R. GAMSON









THE VOICE OF AMPEX . . .

existing line of ferrites and tapes, and how soon we would be announcing it. Frankly, I don't know.

Q: Whom do you consider as your chief competitor?

A: We think that as an OEM (Original Equipment Manufacturer) supplier we must maintain a continuous leadership both technically and economically or, very rightfully so, our customers would be our major competitors. Now, there are many companies in various facets of our field but there is no direct competitor who covers the product line and scope that Ampex has in either tape or memory products. Not to mention Indiana General would be remiss on my part; they are certainly fundamentalists in ferrite technology but do not, in my opinion, have a broad product line in core memory systems. They certainly have a nice line in cores and I would consider them a competitor. I think RCA is an excellent example of a good competitor in core memories. They too have some research fundamentalists in Dr. Rajchman's group, keeping them well ahead of most of the field in ferrites. On the other hand, I think our research group headed by Dr. Wickham is doing some excellent things in material breakthroughs. Anyone who offers a product similar to what Ampex offers is a competitor, and Potter and Ferroxcube both fall into this category.

Q: Who would you consider your major customers?

A: Domestically, General Electric, Philco, RCA, NCR to cite a few. And there are many others that domestically fall into this special systems market. We still serve Remington Rand for example. Internationally, we have more impact in the OEM field: Olivetti, Ferranti, Siemens, Fuji to cite a few. This is primarily in the tape area overseas; we are just starting to move fairly heavily into the memory field and are getting some acceptance.

Q: Do you do any business with IBM?

A: In only a small way — in military applications. That is, the Computer Products Division.

Q: In terms of manufacturers, do you expect a growth or contraction of the peripheral equipment field?

A: I think the EDP market is growing by about 15 per cent per year. This will always bring in a large number of firms with a product idea or product spin-off that will hit the market and perhaps succeed as long as they stay within this niche. I think we will also have, however, a few large peripheral suppliers — manufacturing, engineering, development concerns — that do cover a broad product base.

Q: There has been some thought that computer manufacturers would prefer, from an economic standpoint, to produce their own peripheral equipment and memories. Do you think this will affect your business materially?

A: No. I'd like to be very bullish on this. I feel that never before in the history of any industry have there been so many major industrial concerns — the RCA's, the GE's and RemRand's competing for such a small part of the market because of the IBM domination. Because of this, I think the management of these organizations are going to be extremely cost-conscious as to where they invest their dollars. And if a peripheral company can provide the continued impact of products, economics, and service, I think it's an obvious conclusion that they will buy from this company. On the other hand, if the peripheral industry lets them down, they will be forced to invest in their own development. I think we're seeing one or two moving in that direction only in part because they still remain and will continue, in my opinion, to remain a customer of a good peripheral supplier.

Q: In the growth of the small peripheral equipment manufacturers, Ampex has been a spawning ground. Would you care to comment on the reason for this?

A: In whatever industry, there will always be the creative leader who gets into the market first, who develops the market potential and entrepreneurs along with it. Within its ranks will be someone who sees an opportunity, and sometimes is encouraged by the parent company to take this opportunity to branch out alone.

Q: Why doesn't this happen at, say, IBM?

A: I think the reason for that is a simple one of economics. IBM management people are most mature, and know what it takes to start a company like this. Peripheral products are components and can be component parts and devices. I don't think you find very many automotive people leaving a company to form another automobile company, but I do think you find automobile people forming a fender painting company.

Q: Would you say that Ampex has spawned more than its share of smaller companies?

A: Ampex has been more of a leader, but at least one of the Ampex spin-offs has returned during the past year.

Q: Do you see any major organizational changes in your company that might affect the Computer Products Division?

A: No. As a matter of fact, I speak now for the strength of a very stable, progressive management team that's going to be around for quite a while. The changes that have been effected are already, for the most part, more than a year old and this has settled down to where we have been, and will continue to stay, stable.

Q: What do you foresee as IBM's future position in the industry?

A: I think IBM's position will become smaller, as a percentage. I feel there is a very sophisticated management group in several companies of sufficient financial backing and support, now competing with IBM, that have made it known through years of investment and losses that they intend to stay in this business. Some of them are taking IBM head-on; some of them are moving into areas that they are specialists in, and I feel that they're going to do a better job in their specialty than a generalist like IBM can — and will take that market away. I don't see any major trend that IBM's customers are unhappy with them and, therefore, will buy from a competitor just because it isn't IBM; this is childish. But I do see the person who requires an industrial computer for control going to an organization that knows more about that business perhaps than IBM — and this is starting to happen. I see a tremendous growth of the non-IBM computer firms and this must mean, if my logic is right, that IBM will diminish, but both will grow.

Q: The general trend is toward compatibility with IBM

equipment – tape drives, for instance. Is this part of what Ampex is contributing, a move toward compatibility?

A: When you have a dominant company, such as IBM, and IBM users with a tremendous investment in programs and tapes, particularly, and the only thing that would keep them from going to other equipment is this huge investment, I think this compatibility is a good and sound factor. Ampex is certainly taking not only a following position but, I would say, leadership position in providing equipment to IBM's competitors.

Q: A leader in following?

A: A leader – we have to be a follower from the standpoint of our customers.

Q: Isn't this a reversal of the position of the field?

A: I think you are right; I think it is a reversal. But does any company that is a supplier to the competitors of the leader try to break the trend as a component supplier? I think it would have been a mistake to try to create an Ampex-dominant role which is not compatible with a given system. Our customers and ourselves are leaning towards supplying IBM compatibility. Now, that's not the entire business, and I want to be sure that you understand that. But IBM compatibility is becoming more and more a part of the request-for-quote specs that we are receiving.

Q: The statement has been made that computers will tend to look more and more alike. Is this why manufacturers might be able to compete with IBM – the similarity in design? How do you think this will affect your production of both ferrites and tapes?

A: I agree with that and, if anything, we are trying to push it in that direction because we are able to get the most mileage out of our own individual products. Tailoring them for various interfaces is always a very expensive thing. I mentioned before that manufacturers in the computer business are trying to reduce their investment list, and can do this by standardizing components. We're trying to help them do that and, in fact, are pushing in that direction ourselves. So I think this trend – and I believe it is a trend – enhances Ampex's position.

Q: Will it, in fact, lower costs to the consumer, namely, your customers?

A: It has to mean that, yes.

Q: What do you feel are new directions in tape drives?

A: I feel that the newer tape drives and anything that Ampex is now investing in will have higher reliability and lower down time. It may be higher in initial cost, but the total cost over a period of time will be considerably lower. There will be longer development periods, fewer model changes, and a much more sophisticated internal reliability testing program. This is where we're expending our efforts.

Q: Is there a trend toward increasing the speed of tape drives?

A: Yes, it will continue for awhile. We're not designing in a vacuum so when we commit to a program, it's because product planning with our customers indicates that future models will require higher density and higher transfer rate – higher speed drives. There are definite programs in our advanced development area for future higher density, higher speed products. But interestingly enough, the lower end is becoming more and more important – the low cost tape memory with low speed, 30-36 ips, and densities of 200-556 bits per inch. We're finding a market potential for this now. Let me cite an example. I'd call it a one-by-four system: One electronics associated with four drives, which is a common interest of the lower cost, small computer manufacturer. I don't mean small manufacturers, but manufacturers of small computers. They would like to pay $22-23,000 for this kind of a four-drive transport system; we are very definitely involved in developments in this area and will be in the foreseeable future. I believe DATAMATION feels that the major part of computer growth in the next decade will be in smaller computers, as contrasted to the large, STRETCH-type. We are feeling the pulse, and have been for over a year now, of this market and have been moving in that direction. This affects core memories, as well, and they're willing to trade capacity for speed as long as it's low in cost; our direction of development is also moving in that direction. What's so romantic about a half-microsecond cycle time if it costs a dollar a bit? If you give them 10 times the capacity at 10 cents a bit, it disappears.

Q: Do you see any trend toward a decrease in special purpose computing equipment?

A: No, I don't see any trend down. I see a growth—not as rapid as the forecasters of the market in general, but I certainly see continued growth for special systems requirements, and we are very much involved in supplying these areas. Economics becomes extremely important to the very competitive firms in this business and, consequently, they are happy to deal with someone who says, "This is standard; we can paint it and change it and play with the dial a little to fit your application." And that's the way we've operated. We have a steady base of products designed with the ultimate users in mind. We try to meet most of their objectives in the standard product, and still be able to tailor it. Now, you talked about the trend toward formation of small companies. Here is an area where they can do a great job—in being flexible, fast on their feet, and able to supply a specific component part. Frankly, we are gearing ourselves to be just as flexible. Being a larger organization, it takes a definite interest on the part of management to push in that direction.

Q: Speaking of management, there was a great deal of talk earlier about the losses which Ampex has experienced. What role does the Computer Products Division play in this picture?

A: Well, I'm not going to answer that specifically about Computer Products. I might just say, in answer to the general question, that I hope there's as much talk about the current profit picture which Ampex has as there was about the old loss picture. Every one of our divisions is a growth kind of operation, and definitely contributes to the growth of Ampex. I also want to say that a recovery of an organization in short time must reflect the basic soundness of its product and plan base. It can become chronic with a corporation if it's a two, three, or four-year recovery, but you will note that in Ampex's case, this was a one-year recovery. I'd like to say trends this year also indicate that it's a continued recovery.

Q: Does Ampex have any plans to build a computer of its own at this time?

A: We specifically do **not** intend to move into the computer business.

Q: If we were to project a little into the future—say, 10 years—how does Ampex view the computer of the future?

A: I think every trend indicates that the computer of the future will be a very large memory-oriented computer. I think there will be a working memory, a **fixed** look-up store, scratch pads, and a lot of peripheral tie-in. This was a prediction that might have been 'way out two years ago, but I think trends today indicate that this is in fact the case, what with random access disc files associated with tape transports and other forms of memory. The trend is toward the large, time-sharing, memory-dominated computer along with, but not in place of, the small computer. I do not feel that these are mutually exclusive. And there will still be the special purpose computer—for process control, for example. ■

THE 9300

third in the SDS line

Not yet two years old, Scientific Data Systems, Santa Monica, Calif., has announced its third computer, the 9300. Logically and electrically, it is similar to the 920, with which it is program- and peripheral-compatible. The 9300 is a binary, gp computer with a fixed-point add time, including memory access and indexing, of 1.75 usec. Memory is expandable from 4-32K in 4,096-word modules; word size is 24 bits plus a parity bit. The software package includes FORTRAN II and a symbolic assembler.

The 9300 is designed for scientific computations and integration in real-time simulation and telemetry systems. Optional features include priority interrupt (up to 1,000 channels), and floating point arithmetic ($45K) with 14 usec add and multiply times for a 39-bit mantissa plus nine-bit exponent. Up to eight buffered I/O channels, each with a transfer rate of 2 million cps simultaneous with computation, are available.

The instruction format provides for a 14-bit address, a six-bit op code, three index registers, indirect addressing, and programmed operators. The latter is an automatic subroutine entry technique that permits subroutines to be treated by the programmer as instructions. Indirect addressing and indexing may be multi-leveled.

The 9300 memory is composed of from one to eight random access core modules of 4,096 words each. The eight modules are divided into four pairs so that four of the modules can be addressed directly by the computer at any time. A program-controlled switch determines which of the pair is connected to the computer; 1.75 usecs are required to change the state of the switch. Memory protect registers are available.

Four types of I/O are provided. The first consists of up to eight Automatic Data Channels. Each contains a one-word buffer assembly register, a six-bit character register, and an interlace control register. The latter, which is set by the program, holds the memory address of the first word to be operated upon, and the number of words to be transferred. The addressing capability of this register is 32,768 words. This type of I/O can operate either on characters (IBM format) or on words, at the discretion of the programmer. The maximum transfer rate is 1.75 usec per word, or up to 2,285,000 cps.

The second type of I/O permits words to be transferred under program control simultaneously with the operation of the Automatic Data Channels. A third type permits the setting and sensing of up to 16,000 control inputs and outputs. Finally, up to 1,000 channels of priority interrupt are available. Each channel has a number associated with it which indicates its priority and the position in the memory to which the program counter is set when the channel is activated. Any priority interrupt can, in turn, be interrupted by a higher priority without losing the results of computation that have been completed to that point.

Execution times for fixed point operations are: double-precision add, 3.5 usec; multiply, 7.0 usec; half-word multiply, 3.5 usec; divide, 19.25 usec; shift, 1.75 usec.

Peripheral equipment includes IBM-compatible mag tape units with transfer rates of 15, 41.7, and 83.4KC, card reader-punch, tape reader-punch, drum and disc memories, and 300-lpm printer.

Price of a system with 4K memory, paper tape I/O, console typewriter, and one automatic I/O channel is $215K. The 9300 is not presently being leased. ■

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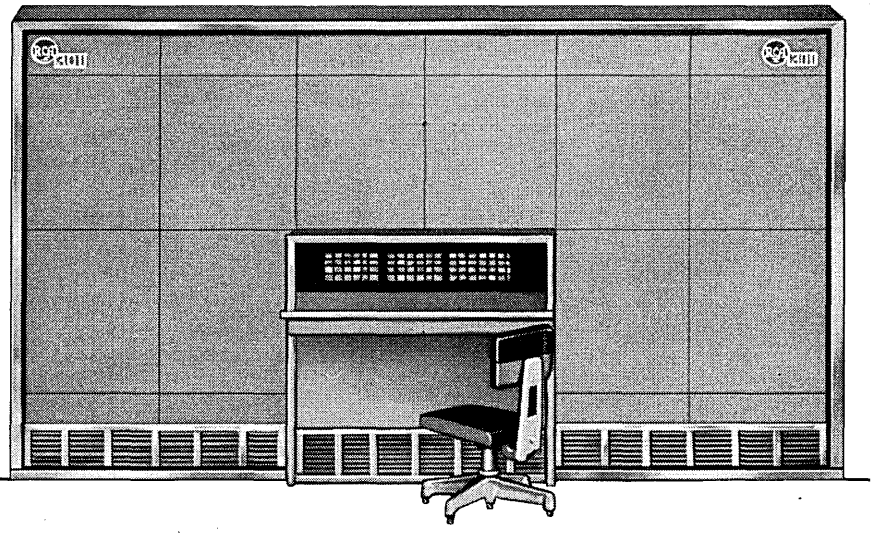
"Very interesting... any references?"



Big companies, little companies, government agencies, all have one thing in common. They choose and use RCA computers. The low cost, high volume 301. The medium range 501. The massive capacity 601. For other references, contact

RCA ELECTRONIC DATA PROCESSING
CHERRY HILL, N. J.

The Most Trusted Name in Electronics

CIRCLE 22 ON READER CARD

NEW DISC FILES

from Burroughs . . .

A disc file system with an average access time of 20 milliseconds has been announced by the Burroughs Corp., Detroit, Mich. It features a read-write head for each track.

Designed for initial use with the B5000 and B200, it is expandable in modules of 9.6 million characters each. Up to 50 modules can be utilized with the B200, and 100 with the 5000. The discs, 26½″ in diameter and with 182 tracks on each surface, rotate at 1,500 rpm. Each surface has three zones, with bit densities of from 1,000-1,100 bpi. Data tracks can be segmented into 96, 240, or 480 characters each. The transfer rate is 100,000 cps, and the time required to scan a single module is two minutes.

Remote communications capability includes utilization of almost 6,000 teletype stations and a network of 120 typewriter stations for remote interrogation. The control unit handles up to 15 inquiry terminal units; each terminal can handle as many as 399 teletype or eight typewriter stations. Location of TT stations is limited only by accessibility to telephone lines; typewriters may be located a maximum of 2,000 feet from the file, and all may be operated at the same time.

Both teletype and typewriter input and output are completely buffered. A 240-character buffer is provided for TT operation to and from the computer, and separate 30-character input buffers for each typewriter station. Output buffering for typewriters is 240 characters.

Rental for a B200 disc file system with one storage module is $2,630, plus $990 per additional module; the one-module system for the B5000 is $2,820. Purchase prices are $118,000 and $127,000, plus $44,500 per module.

from General Precision . . .

A line of mass-storage devices has been announced by General Precision's Information Systems Group. Included are 10 disc and three drum models. Unannounced is a prototype disc file system reportedly for military command and control applications.

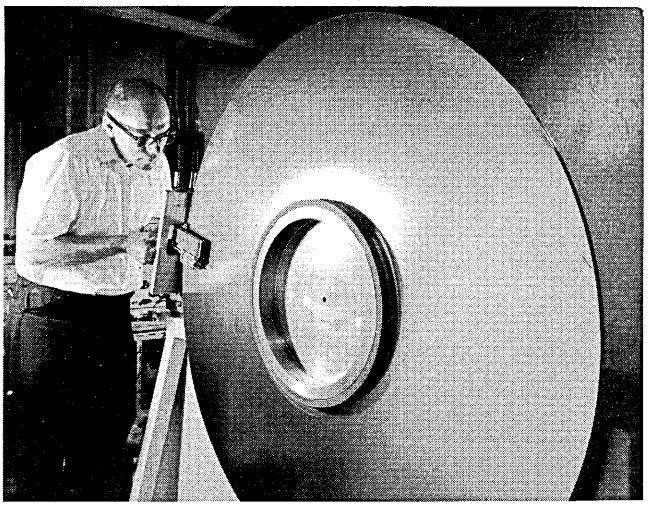
Two series of discs have been announced, ranging in size from 4″ to 24″ in diameter, and for recording on one or both surfaces. Bit capacity per disc is from 19,200 (one side, 4″ diameter) to 7,680,000 (two sides, 24″). Maximum bit density is 400 bpi. The discs are of nickel cobalt plated over an aluminum base. A read-write head for each track is utilized.

Eighteen drums from eight to 16″ in diameter comprise the new series. They range in length from eight to 32″, and in capacity from 512,000 to 4,100,000 bits. Among engineering features are an integral air circulation system, lifetime-lubricated bearing assemblies, and integral induction motor drive.

Delivery time for all lines is from 12 to 16 weeks.

The prototype disc file is said to be an associative memory system utilizing six 48″-diameter discs with 256 tracks on each surface. Capacity is 153 megabits. With a single-zone, single-frequency operation and fixed-position (one track per head) flying heads, average access time is 33 milliseconds. Rotational speed is 900 rpm, and the data transfer rate is 350,000 cps.

The unit includes the logic circuitry for searching stored information on the basis of content alone. The user thus need not be concerned with the physical location of data being recorded, stored, or read. The control unit consists of a core buffer, switching and control logic, and error-checking electronics. ■



CIRCLE 24 ON READER CARD

NEWS BRIEFS

3C ANNOUNCES SUCCESSOR TO DDP-19

A medium-scale successor to the DDP-19 has been announced by Computer Control Co., Framingham, Mass. The DDP-24 is a parallel, binary, gp computer with an access time of three usec. Core memory is expansible from 4-16K 24-bit words. Fixed point add time is 10 usec; double precision, floating point add time is 323 usec.

Standard I/O equipment include a 300 cps paper tape reader, 60 cps punch, and typewriter. Additional peripherals available include mag tape control and drive, card adapter, printer, A/D and D/A converter, and digital plotter.

The software package has FORTRAN II and a symbolic assembly program. The basic system price is $87K.

HONEYWELL EXPECTS PROFITS BY END OF 1964

Profitable operations of its EDP division by the end of 1963 is anticipated by Honeywell, the company president reported. The division experienced continued operating losses on quarterly increases in new business, with "improved performance" in deliveries and financial results during the latter half of the year.

The company reported a sales value of 100 megabucks for installed systems through the end of the year. Approximately 80 per cent of these are leased.

The company's overall sales increased 26 per cent over the previous year, reaching a record 595.9 megabucks. Per share earnings were $3.72, up from $3.48 in 1961.

ADAPTIVE MACHINE CREATES CATEGORY OF CYBERNETICS

A sub-category of artificial intelligence, paralleling bionics but separate from it, reportedly has been created. It has been named I-Tronics by the Air Force's Rome Air Development Center, Intelligence and Electronic Warfare Laboratory.

Developed by the laboratory is a machine called CHILD (Chemical Hybrid Intelligent Learning Device) which reportedly exhibits intelligence without necessarily simulating biological systems.

Replacing amplifiers and capacitors, CHILD utilizes as the analog memory element the solion tetrode, manufactured by Self-Organizing Systems Inc., Dallas, Tex.

ON-LINE DEVICE PRINTS PERT CHARTS

The automatic drawing of PERT charts was demonstrated recently by North American Aviation Inc., El Segundo, Calif. The chart is reproduced by General Dynamics/Electronics' SC 4020, which prints an image from a cathode ray tube onto a 9" x 9" hardcopy or 35 mm film. The present network limitation is 150-500 events on a non-linear time scale (sequence representation).

PERT-NAP (Network Automatic Plotting) reportedly is capable of automatic plotting of the initial network, in addition to daily updating. Plans are to release the 7090-94 program through SHARE about July 1.

TUNNEL DIODE MEMORY INSTALLED IN STRETCH

A tunnel diode memory, reportedly the first in an operating computer, has been installed as a register unit to modify instructions in a STRETCH at IBM's Poughkeepsie development laboratories. It is in a developmental stage.

The register size is 17 words of 74 bits each. Although the cycle time is stated as 600 nanoseconds, speeds of 200 nanoseconds have been reached in engineering tests.

The basic memory component is a circuit with a tunnel diode, a resistor and an inductor, encased in a plastic cell. A total of 1,258 such cells are mounted on two 4½" x 16" printed circuit cards. The electronic switching device was invented less than six years ago.

ENGLISH-LANGUAGE COBOL RECOMMENDED BY GERMANS

COBOL in the English language has been recommended for the present as a programming language and for the preparation of object programs by the Technical Committee for Information Processing (FNI) in the German Institute of Standardization (DNA).

"FNI hopes that this recommendation will further the international standardization in the field of programming languages, and will facilitate the exercise of influence on, and the rapid adaptation to, future developments of COBOL," the committee reports. "In addition to other technical advantages such as freer choice of identifiers, an important advantage for those using and preparing compilers is that different syntactical structures of COBOL dependent on the natural language used are avoided.

"FNI is not unaware of the disadvantages involved in this recommendation, such as a certain increase in difficulty for the inexperienced German reader of COBOL programs, but feels that it can be asserted that the conceptional difficulties are in any case greater than those involved by notation.

"FNI will, of course, give a description in German of a programming language intended to be standardized. Subcommittee 5 is at present engaged in finding German equivalents for the necessary technical terms of COBOL."

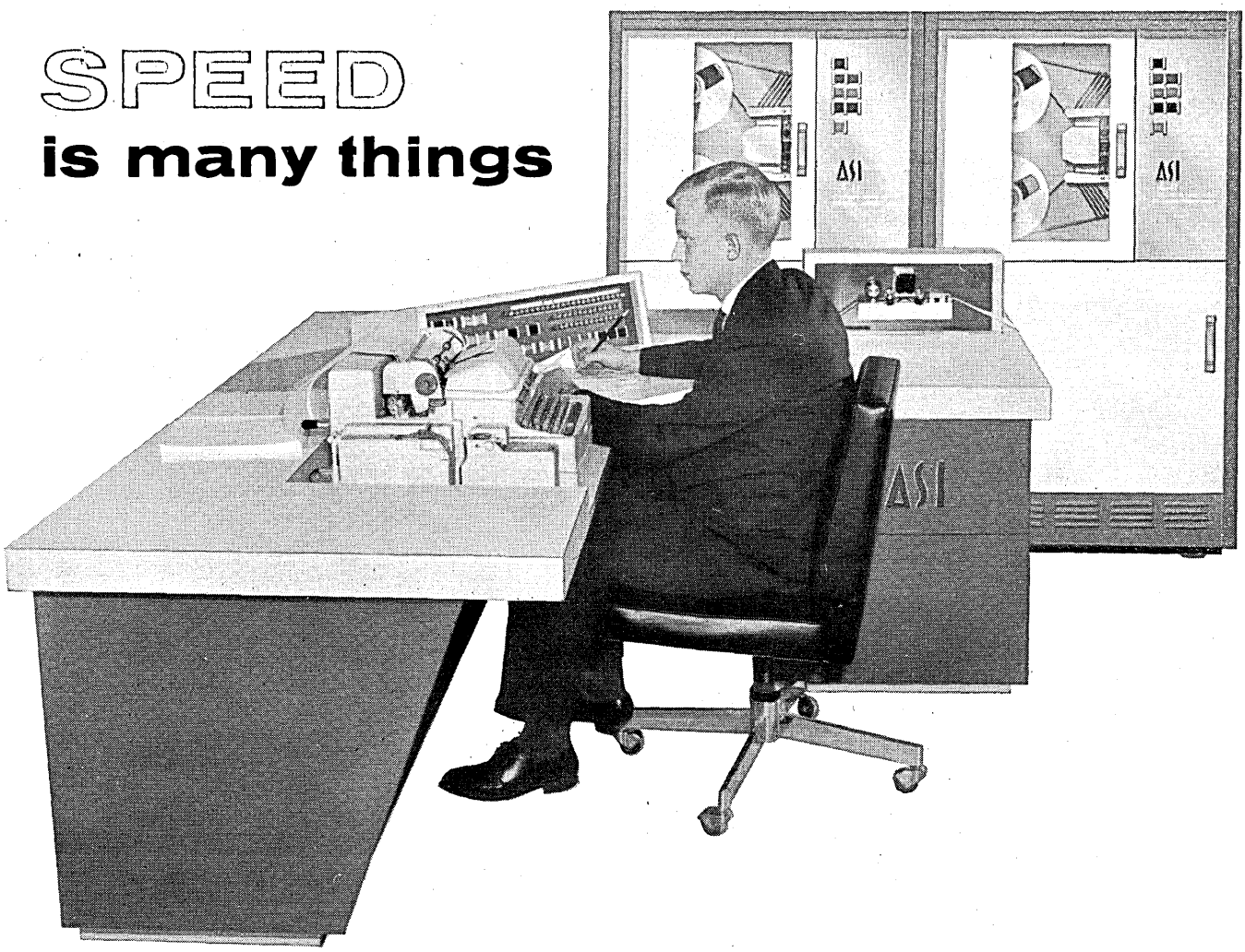
H-400 CHECKS CREDIT RATING OF MAIL ORDER PURCHASERS

A Honeywell 400 is being utilized by a national, commercial reporting firm to check the credit status of new subscribers to mail order plans, such as book and record clubs and credit card plans. The Hooper-Holmes Bureau Inc., Morristown, N.J., presently is processing about 25,000 new subscribers per day, and expects to increase this to 300,000 within the next year.

The configuration includes a 3K memory, five mag tape units, printer, card reader-punch, and two H-480 data communications units. Monthly rental of the system is $11K.

Names of new subscribers to mail plans are compared against a master

SPEED
is many things



Actual working speed—meaningful speed—in a computer is a combination of many factors. Consider our ASI-210. Its short 2-microsecond total memory cycle is important, but even more important are the design features that make it possible to use this speed in normal operations.

ASI-210 is proving in actual use that its overall computer speed is unsurpassed in its size and price range. We planned it that way by building in adequate memory capacity, convenient instructions, a full complement of arithmetic commands, fast and easy communication with peripheral devices — plus user-oriented software.

The result is an exceedingly useful and versatile computer. It is available at an eminently reasonable price. We'd like to tell you more about our ASI-210, and we'd like to tell you about new resources and new capabilities that have become available through our recent acquisition by Electro-Mechanical Research, Inc., Sarasota, Fla.

Write for our ASI-210 bulletin, or ask an ASI representative to tell you how the newly combined technical resources of ASI and EMR can solve your specific computation problem. Contact Advanced Scientific Instruments, 5249 Hanson Court, Minneapolis 29, Minn.

ASI-210 FEATURES: Completely solid state, 2-microsecond total memory cycle, parallel operation, 21-bit words, 4096-word randomly addressable core memory expandable in modules to 32,768 words, 6-microsecond add time, 50-microsecond multiply time, high speed I/O simultaneous with computation.

Trapped program interrupt, indirect addressing, multiple index registers, built-in muliply and divide, Fortran compiler, assembler and complete diagnostic routines, paper tape system included.

Power consumption under 1750 watts, standard 110/220 volt 60 cycle AC. No special temperature or humidity control needed. ASI equipments are IBM compatible.

PERIPHERAL EQUIPMENT: Options include magnetic tape units, typewriters, punch card units, line printers, additional assembly registers, converters and plotting equipment.

EXCITING OPPORTUNITIES for computer-oriented professionals continue to exist in our rapidly growing organization. Write or call today.

ASI

MORE COMPUTATION PER DOLLAR

CIRCLE 25 ON READER CARD

NEWS BRIEFS . . .

file of 1,000,000 persons who have failed to pay for past mail order purchases, and verified within 24 hours. Data transmission is by data-phone through the company's transmission center in New York City. Additional centers are planned in Chicago and Los Angeles.

INVENTORY CONTROL SYSTEM WITH LGP-30 ANNOUNCED

An inventory control system consisting of the LGP-30 and the Wilson Inventory Management Plan has been announced by General Precision Inc., Glendale, Calif. It is called the LGP-33 Electronic Inventroler.

Representing some 500 pages of mathematical formulas for ordering stock, it is said to operate with any existing inventory record-keeping procedure. It is for companies with inventories valued at $250K or more.

The LGP-33 rents for $1,155 per month, and sells for $25,765. It is reportedly not available to current renters of the LGP-30.

AUTONETICS DISCONTINUES ITS RECOMP LINE

The second computer manufacturer in as many months has announced its demise. Following the acquisition of Bendix Computer by Control Data Corp. on March 21, the Autonetics Div., North American Aviation Inc., announced the discontinuation of manufacture of its Recomp line, effective April 24. The company will continue to service hardware in use.

Autonetics, which recently was reportedly attempting to purchase another computer company, failed to reach the break-even point on its Recomp line. It reports more than 100 installations of its II's and III's.

UNIVAC GETS USN CONTRACT ONCE AWARDED TO BENDIX

A Univac III has been selected for a pilot shipyard installation in BuShip's efforts to develop a computerized management information system. It is the contract awarded, although never signed, to the former Bendix Computer Div. (See *Datamation*, March 1963, p. 47.)

After being proved out at the Boston Naval Shipyard, additional systems installations are expected at six other naval shipyards. The expected annual rental for the pilot system is approximately $350K.

CASE INSTALLS 1107 WITH $500K NSF GRANT

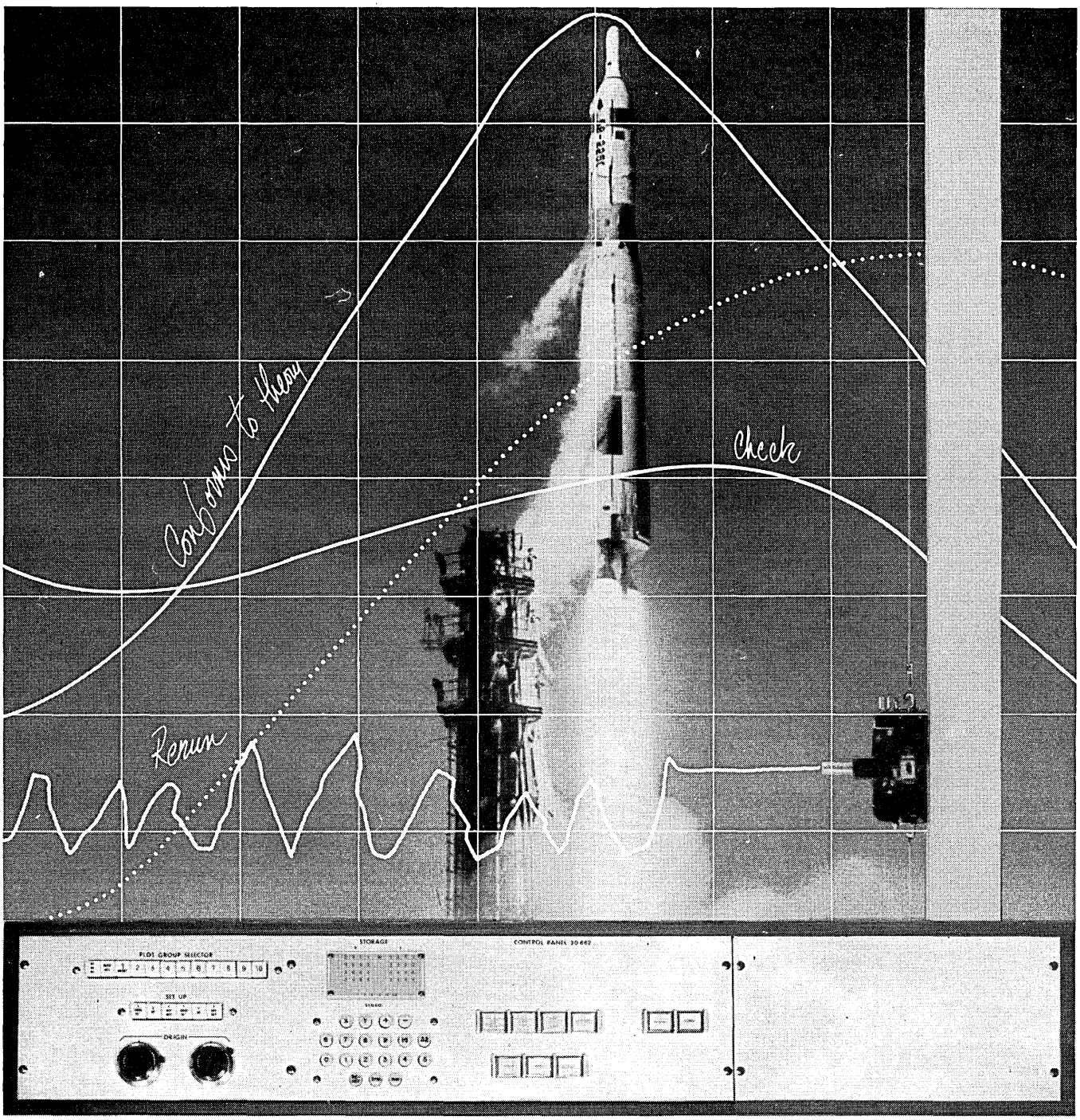
The National Science Foundation has awarded a $500K grant to Case Institute of Technology, Cleveland, to be applied toward the 2.3-megabuck 1107 which was installed in May. The configuration includes a 32K core and 746K drum memory, 10 mag tape units, paper tape system, two 600-lpm printers, two card readers, and one card punch.

Main use of the hardware will be in education, with almost every student writing and running several problems. Research will also be conducted in the solution of complicated mathematical problems. The computer is scheduled to be on the air by July 1.

1st 601 IS ON THE AIR AT N.J. BELL

The first operational RCA 601 is processing 35,000 bills daily for the New Jersey Bell Telephone Co., involving 14 million toll calls placed each month in the northern half of the state. The configuration includes four 301's and 17 mag tape units.

To process one bill, 17 passes are required. Pertinent data from each toll call made is recorded on punched tape at the local exchange, trucked to



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

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

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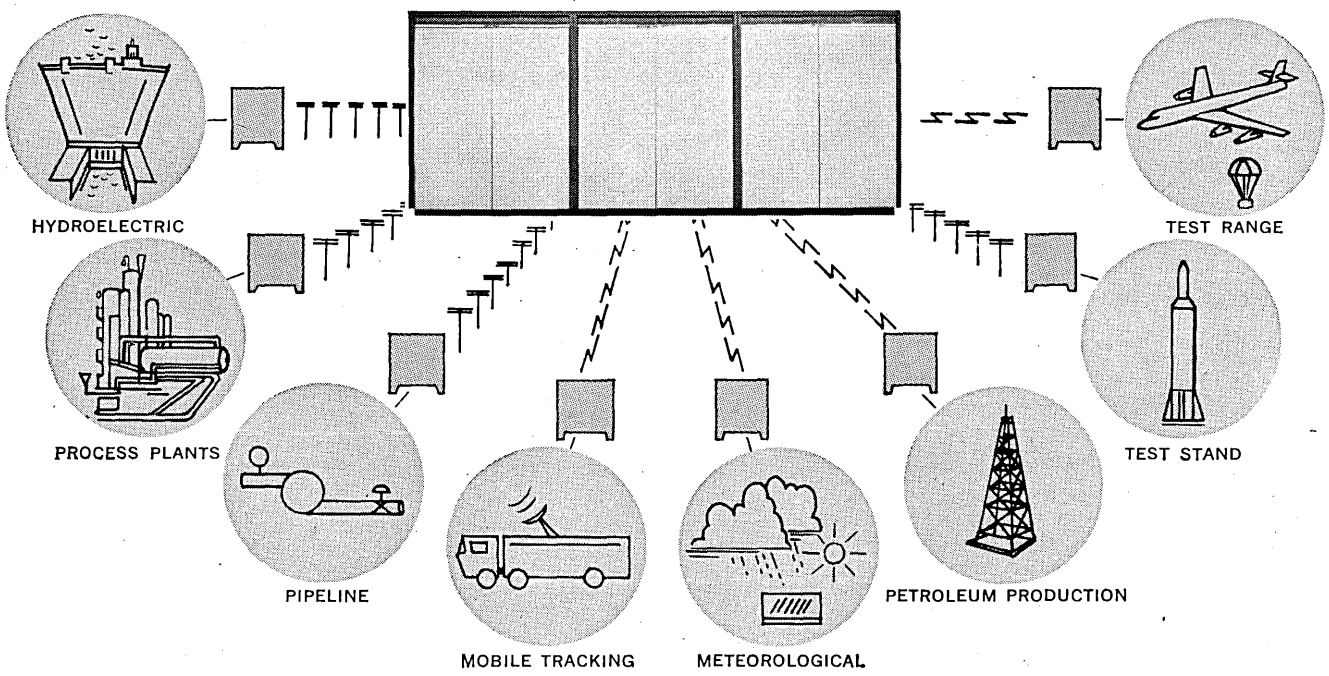
ADVANCED SYSTEMS ANALYSIS AND COMPUTATION SERVICES/ANALOG COMPUTERS/HYBRID ANALOG-DIGITAL COMPUTATION EQUIPMENT/SIMULATION SYSTEMS/ SCIENTIFIC AND LABORATORY INSTRUMENTS/INDUSTRIAL PROCESS CONTROL SYSTEMS/PHOTOGRAMMETRIC EQUIPMENT/RANGE INSTRUMENTATION SYSTEMS/TEST AND CHECK-OUT SYSTEMS/MILITARY AND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

CIRCLE 26 ON READER CARD

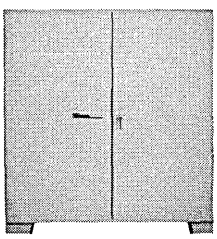
ANOTHER
NEW
PRODUCT
FROM
DAYSTROM



TELEMETROL™

Off-the-shelf, modular telemetry hardware for remote data acquisition and supervisory control

If you are involved in remote data acquisition in any of these or similar fields, you owe it to yourself to get the full story on *proven* TELEMETROL, integrated telemetering hardware you can buy as pieces or as complete systems. ■ The basic TELEMETROL network consists of a central receiving and command station connected by wire or by radio to multiple field satellite stations. The central station can be a Daystrom 636 Computer, a Daystrom Manual Central, or an existing computer installation. Each communication link can service up to 32 field satellite stations. A single TELEMETROL network can be expanded to receive and command over 128 separate communication links. ■ For more information on TELEMETROL, its low cost, versatility and expandibility, circle the reader service number, or call your local Daystrom office.



DAYSTROM, INCORPORATED
CONTROL SYSTEMS DIVISION
Miramar Road, La Jolla, California • Telephone: 454-0421 Area Code 714

CIRCLE 28 ON READER CARD

NEWS BRIEFS . . .

the computer central at Teaneck, and converted to mag tape. Invoicing is done every other day.

In time, the system will be assigned such other tasks as the production of traffic pattern studies and statistical analyses.

● The first two printers off the production line of Data Products Corp., Culver City, Calif., have been shipped to Scientific Data Systems, Santa Monica, Calif. The 300-1pm printer is designated p-3300.

● Rental of its off-line digital incremental plotting systems has been instituted by California Computer Products Inc., Anaheim, Calif. The 570 mag tape system with the 565 plotter rents for $1,075, plus $300 for a service policy.

● A Univac II has been utilized to eliminate duplicates, sort, and print annual report mailing labels for Pacific Mutual Life Insurance Co., Los Angeles, Calif. The process, which formerly required six weeks by a mailing firm, took 12 to 14 hours of computer time. Some 250,000 labels were printed from among 350,000 policies in more than 40 states. The system configuration includes 12 tape units and a 600-lpm printer.

● A machine which will produce diagrams and schematics utilizing standardized symbols, letters, and numerals is being engineered by the Mergenthaler Linotype Co., Brooklyn, N.Y. Diagrams will be on photographic film or paper, up to 28″x40″. The operator, working a keyboard, will be able to observe as the drawing progresses. The manufacturer makes no mention of future flowchart applications.

● A contract for the programming of a multi-computer system has been awarded to Informatics Inc., Culver City, Calif., by the Jet Propulsion Lab. The programs are for data display and recording at the Deep Space Instrumentation Facility, Goldstone, Calif., tracking station.

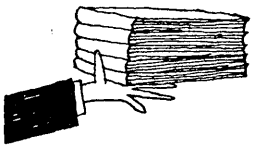
● A 1.6 megabuck contract for two 110 ground computer systems has been awarded to RCA Data Systems Div., Van Nuys, Calif., by NASA's Marshall Space Flight Center, Huntsville, Ala. They will be utilized as the control element in the automatic checkout of the Saturn I Block II vehicle booster.

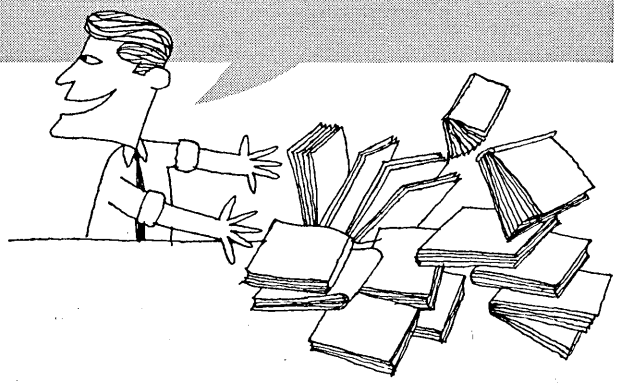
"Wouldn't it be simpler to have one reference source for just about every known computer?"

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

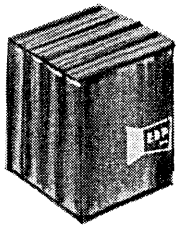
"Right here. Auerbach/BNA Standard EDP Reports cover 44 major computer systems in use in the U.S.A."

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





"Use the convenient order form below."



Gentlemen:

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

Name _____ Title _____

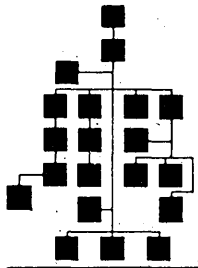
Company _____

Address _____

City _____ Zone _____ State _____

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

CIRCLE 30 ON READER CARD



people IN DATAMATION

■ Dr. George Brown, director, Western Data Processing Center, UCLA, leaves this month for a one-year research sabbatical in Europe. During his absence, Dr. Clay Sprowls, currently assistant director, will serve as acting director.

■ Borge M. Christensen, former manager of special systems studies, has been named to the newly-created position of manager of GE Computer's Information Processing Center, Phoenix, Ariz. He will be responsible for marketing and programming services in five Western states and Southern California.

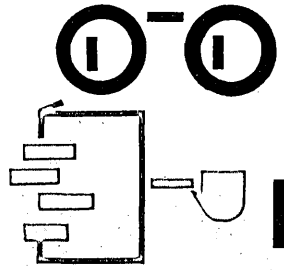
■ J. Chuan Chu, formerly director of product planning for Honeywell EDP, has been named VP for planning and engineering. Prior to joining Honeywell, he was director of engineering at Univac where he was chief engineer on the LARC project.

■ Dr. Henri M. Semarne has joined Hughes Dynamics Inc., Los Angeles, Calif., as director, Information Systems. He was formerly an independent consultant.

■ Kenneth R. Jackson has been named assistant general manager of the Computer Div., Packard Bell Electronics, Los Angeles, Calif. He was formerly director of plans and programs.

■ Lester L. Kilpatrick has been elected chairman of the board of California Computer Products Inc., Anaheim, Calif. He retains the position of president. Dr. Donald W. Gade, chief engineer, has been elected senior VP.

■ Dr. H. D. Brown has joined Computer Usage Co. Inc. as director of Scientific Services in the Washington, D.C., office. He was formerly in charge of basic physics, applied mathematics, and computing for the Savannah River lab of DuPont's Atomic Energy Div.



NEW LITERATURE

FUNCTION MODULES: This illustrated brochure presents, in logic designer terminology, the 400 series line of computer system function modules. NAVIGATION COMPUTER CORP., Rittenhouse and Van Buren Sts., Valley Forge Industrial Park, Norristown, Penna. For copy:
CIRCLE 130 ON READER CARD

POWER SUPPLIES: A two-color catalog includes specifications of a complete line of semiconductorized, precision power supplies as well as a chart listing the specifications of the company's line of vacuum tube supplies. POWER DESIGNS, INC. 1700 Shames Drive, Westbury, N.Y. For copy:
CIRCLE 131 ON READER CARD

LGP-21: An illustrated brochure outlines technical specifications, features, software availability, optional equipment and applications for the LGP-21. COMMERCIAL COMPUTER DIVISION/GENERAL PRECISION, INC., 101 W. Alameda Ave., Burbank, Calif. For copy:
CIRCLE 132 ON READER CARD

AUTOMATION & SOCIETY: A bound volume of papers presented at the Fourth Joint Automatic Control Conference is available. Cost of this 1,000 page volume is $7.50 plus $1.50 for domestic mailing. RAYMOND C. MAYER & ASSOC., INC., 51 East 42nd Street, New York 17, N. Y.
CIRCLE 133 ON READER CARD

PRICE LIST: This bulletin and price list on the company's line of digital clocks, calendars, counters, and timers includes technical details and engineering specifications as well as prices on over 50 standard models. CHRONOLOG CORP., 2583 West Chester Pike, Broomall, Penna. For copy:
CIRCLE 134 ON READER CARD

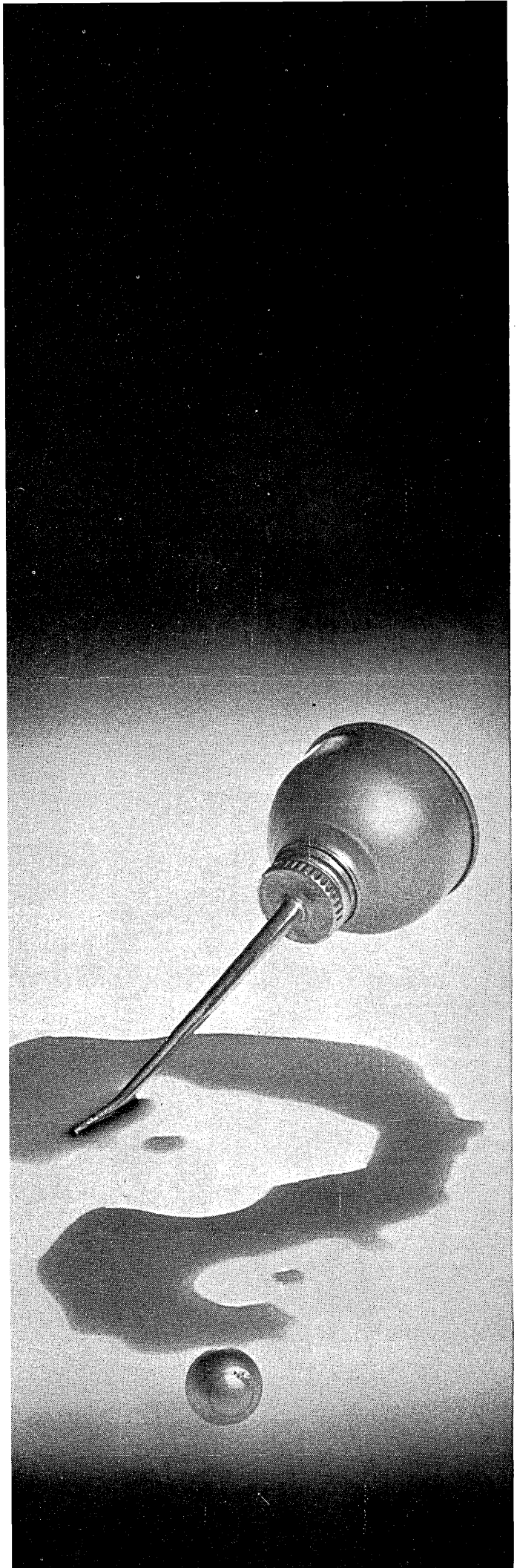
MAG TAPE: Features, specifications and a description of the Micro Tape Transport 555 are presented in this four-page booklet. DIGITAL EQUIPMENT CORP., 146 Main St., Maynard, Mass. For copy:
CIRCLE 135 ON READER CARD

PROGRAMMED DATA PROCESSORS 1 & 4: Two eight-page brochures on these two gp computers include discussions on central processor options, instructions, programming aids, and input-output options. DIGITAL EQUIPMENT CORP., Maynard, Mass. For copy:
CIRCLE 136 ON READER CARD

MARK 200 SYSTEMS: Six catalog sheets illustrate and describe four types of forced fluid ink writing systems and two types of pressure-thermal writing systems used in readout of analog computers,, telemetry, and test systems. BRUSH INSTRUMENTS, 37th and Perkins, Cleveland 14, Ohio. For copy:
CIRCLE 137 ON READER CARD

PRINTING SYSTEMS: Five product data sheets offer descriptions, illustrations, specifications and features of the 3317, 3314 and 3333 high speed printers, the 3303 on-line printer and the LP-1200 line printer. POTTER INSTRUMENT CO., INC., 151 Sunnyside Blvd., Plainview, N. Y. For copy:
CIRCLE 138 ON READER CARD

INTEGRATED CIRCUITS: A 16-page brochure details the PEC integrated circuit technique, describes the manufacturing process and discusses design considerations for integrated circuitry. Various case histories and illustrations are included. CENTRALAB, THE ELECTRONICS DIV. OF GLOBE-UNION INC., 900 E. Keefe Ave., Milwaukee 1, Wis. For copy:
CIRCLE 139 ON READER CARD



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

How Do lubricants affect fatigue?

Everyone knows what a lubricant does. Or do we?

Besides reducing wear and friction, there is growing evidence that a lubricant profoundly affects the fatigue life of the component being lubricated. Members of our staff, for example, have observed 30-to-1 differences in the fatigue life of bearing balls due to lubricant variation. The study covered some sixty base oils from eleven chemical classes.

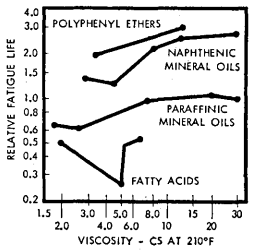
True, the evidence comes from bench tests. Its exact prediction of service experience is open to question, since tests were run at greatly elevated loads to shorten fatigue times to minutes.

But it offers some highly intriguing leads . . . leads we're following up by evaluating the many possible lubricant properties that may control the fatigue process. Viscosity is one. Antiwear characteristics, reactivity, and polarity are others. More rings in the lubricant molecule, for instance, usually result in longer life. And apparently there's an optimum wear rate for maximum life. Additives and precoatings play significant roles.

Research such as this is adding to our knowledge of the chemical and physical processes going on at contacting surfaces. It may well lead to improved performance of tomorrow's mechanical systems through controlled friction, reduced wear and fatigue. It's another illustration of how General Motors research people are working to find a better way.

General Motors Research Laboratories

Warren, Michigan



Effect of lubricant composition on fatigue.

CIRCLE 34 ON READER CARD

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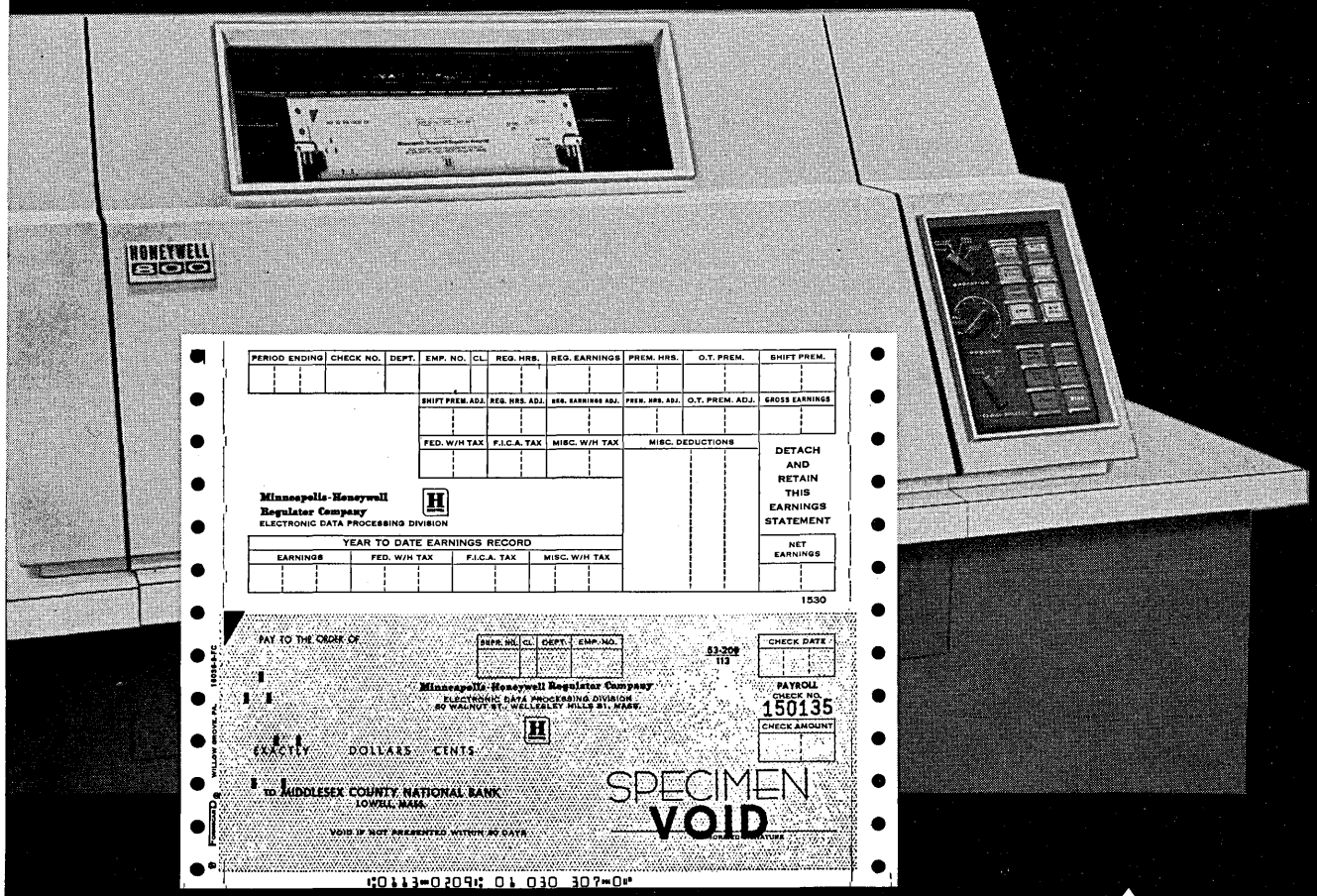
FORMSCARD®

the *only* continuous tab card with *no* medial waste strips

HONEYWELL occupies a position of unquestioned leadership in the field of data processing equipment. In an industry built on accuracy, speed and efficiency, their use of FORMSCARDS for their own Payroll Checks is a vote of confidence we rate of great significance, These checks are run over the HONEYWELL 800 Printer. HONEYWELL research has proved what other business leaders already know . . . FORMSCARD'S unique design means greater speed, accuracy and efficiency. If these are part of *your* business philosophy, follow the leaders . . . use FORMSCARDS!



Available with vouchers of any size at side, top or bottom—Easily separated manually or on any burster—Can be part of multiple part sets—Available pre-punched—Will operate efficiently over *any* printer, at *any* speed.

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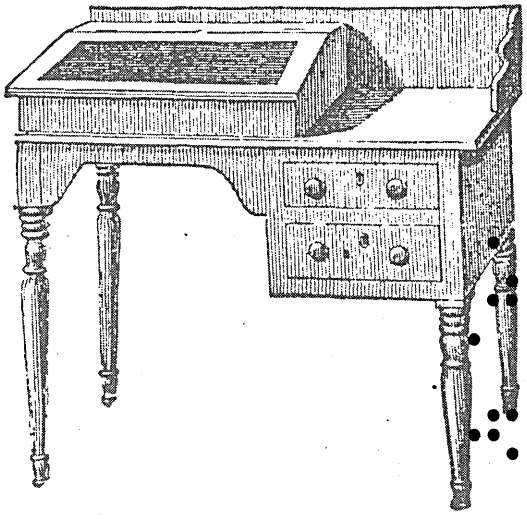
Manufacturers of line-hole continuous business forms. Samples on request—sales representatives in principal cities.

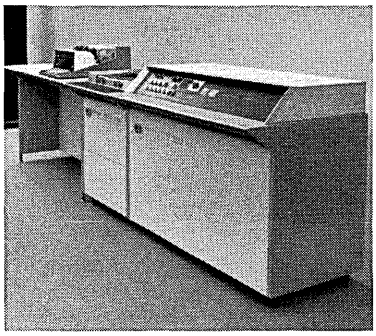
CIRCLE 35 ON READER CARD



THINK DESK-SIZED COMPUTER

Why buy a giant-sized electronic computer? Why pay for computing capability that's far beyond your need—and your budget? A **desk-sized**, general-purpose digital unit from General Precision may meet your requirements nicely—and save you money, too. General Precision computers are performance-tested and value-proven in hundreds of applications. They're solving tough problems in engineering departments, scientific laboratories, academic institutions, and varied business enterprises across the nation. Call, wire, or write today to learn which computer best fits your operation and your budget. Each purchase price and leasing plan includes use of an extensive program library covering most applications. Begin now to think desk-sized! **LGP*21 General-Purpose Computer** Low-cost, solid-state, stored-program digital computer. Practical for small firms or small departments of large firms. Disc memory: 4096-word capacity. Broad input/output flexibility. Plugs into any convenient standard outlet. **LGP-30* General-Purpose Computer** First—and most widely used—desk-sized, general-purpose digital computer. Performance-tested in scores of applications. An ideal student training aid. **RPC*4000 Electronic Computing System** Versatile system consisting of completely transistorized RPC 4010 digital computer and RPC 4500 tape-typewriter system. Magnetic drum memory: 8008 words. Can solve problems in engineering design, data reduction, statistical analysis, and advanced systems design.

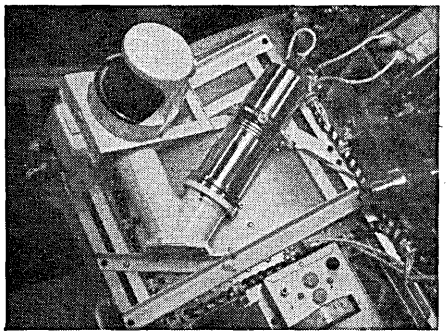
COMMERCIAL COMPUTER DIVISION
GENERAL PRECISION
INFORMATION SYSTEMS GROUP
101 W. Alameda Ave., Burbank, California

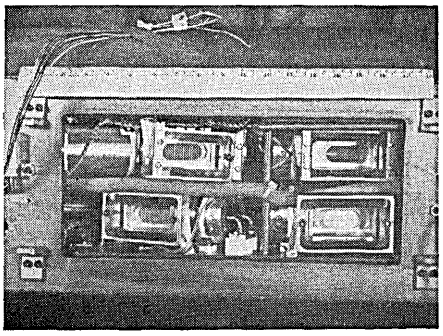


G3-144

*Trademark, General Precision, Inc.

CIRCLE 36 ON READER CARD





Here, in Lockheed Missiles & Space Company's Physical Sciences Laboratories, scientists are engaged in a comprehensive space physics research program embracing experimental and theoretical work in space radiation, aurora, atmospheric structure, geomagnetic micropulsations, x-ray astronomy, and the propagation of electromagnetic waves in space. Experimental programs include the measurements of geophysical and space properites, both in space and in the laboratory.

Currently, measurements of variations on the earth's magnetic field are being made at remote islands in the Pacific Ocean, providing clues to the effect of solar activity on its shape and stability. The influence of solar wind on the geomagnetic field is also being investigated in laboratory experiments, by bombarding magnetic fields with clouds of highly ionized gases.

Scientists at Lockheed are engaged in a continuing program of designing and placing density gages, mass spectrometers, ion traps, and similar instruments on space vehicles to measure the density, composition, and temperature of matter in space. These experiments lead to a better understanding of the chemical reactions occurring in the atmosphere high above the earth.

Important investigations of the low energy x-rays emitted by stars are being carried out and interpreted to give information on the structure of stellar coronas.

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

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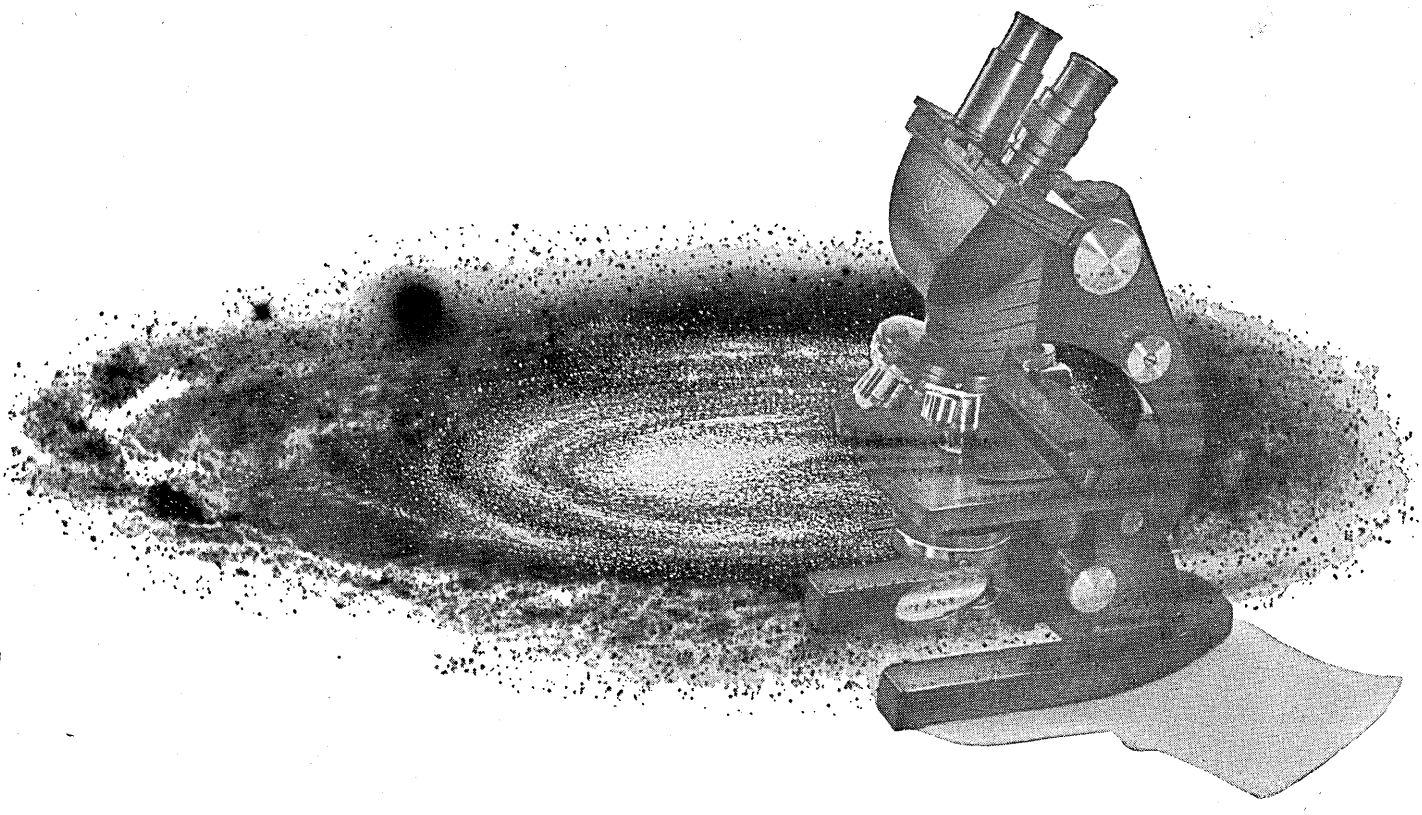
Continuing investigation of matter and forces in space



NEW FIRMS & mergers in DP

■ Management Data Services Corp., Dallas, Tex., has acquired the assets and facilities of Business Management Service Corp., Dallas dp firm servicing primarily petroleum and insurance firms. MDS this summer is installing a 1620 with on-line Calcomp plotter.

■ Formation of the Financial Computer Center of Eastern New York Inc., Schenectady, N.Y., will be complete this fall with installation of a GE-225. It has been formed by nine banks in upstate New York to handle their checking accounts. Combined assets of members place the corporation among the 125 largest banking institutions in the country.

■ Computer Applications: Software-Hardwear (CASH), former systems consultants for Rose Marie Reid Swimsuit Co., Van Nuys, Calif., has formed a service bureau with a GE 225 within the swimwear firm. Wayne E. Zahrt, former dp manager with RMR, has been named CASH manager, and William J. Lance Jr., former RMR controller, is acting operations supervisor.

■ Computer Usage Co. Inc., New York, has acquired Systems Analysis Corp., Palo Alto, Calif., analysis and programming firm. CUC exchanged 12,000 of its common stock for all outstanding shares of SAC. Dr. David G. Willis, president of SAC, has been appointed manager of the CUC San Francisco area office.

■ The Teleregister Corp., Stamford, Conn., has acquired an 80 per cent interest in Computer Dynamics Corp., Silver Spring, Md., which specializes in computer systems analysis, programming, and operating services. The latter is engaged primarily in government contract work, and the former in commercial contracts. Vincent R. Grillo Jr. will continue as president of Computer Dynamics, which will operate as a Teleregister subsidiary

■ The TRC Service Corp., subsidiary of The Travelers Research Center, Hartford, Conn., has been formed to provide scientific dp services to industry and government. It will be installing a 7040 and 1401 in September.

■ Control Data Corp., Minneapolis, Minn., has entered into an agreement to acquire Beck's Inc., St. Paul electronics firm. Purchase price, in CDC stock, was not announced. Formed in 1947, Beck's is engaged in the development, manufacture, and sale of printed-circuit boards used in computers and other electronic equipment. CDC reportedly plans to continue the sale of printed-circuit products and to utilize Beck's production facilities.

■ A joint Belgian-American company in the field of automatic information processing has been formed in Brussels by FMA Inc., El Segundo, Calif., and the financial firm, Societe Generale de Belique. The new company, Compagnie Europeene pour la Technologie de l'Information, will engage in the research, development, manufacture, and distribution of equipment for the automatic processing of documents and other graphic information.

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

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

CIRCLE 39 ON READER CARD

Now: 5 different DISCfILE™ memory systems... 155 million to 920 million bit capacity...and simultaneous dual access

DISCfILE—most thoroughly "on-line" proven mass random access disc memory—has been expanded to accommodate up to 920 million bits with unique dual accessibility so two computers can utilize a single DISCfILE system at the same time. That's because two logic elements and one-per-disc linear head positioners provide simultaneous access to any two discs in the system—effectively doubling transfer rate while cutting access time in half.

Never before have you been offered such flexibility in a disc memory system. You can choose according to your needs... and as your requirements increase, expand the system with additional DISCfILE units installed on-site. All the while you're assured of using a system proven by more than two dozen successful field installations. DISCfILE, applied to any digital data system, multiplies capacity by orders of magnitude while simultaneously shrinking space requirements.

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dp/f-5020 155 million bit storage on 16 discs... 400 bpi ...one logic element

dp/f-5024 230 to 920 million bit storage...one to four 16-disc units...600 bpi...one logic element

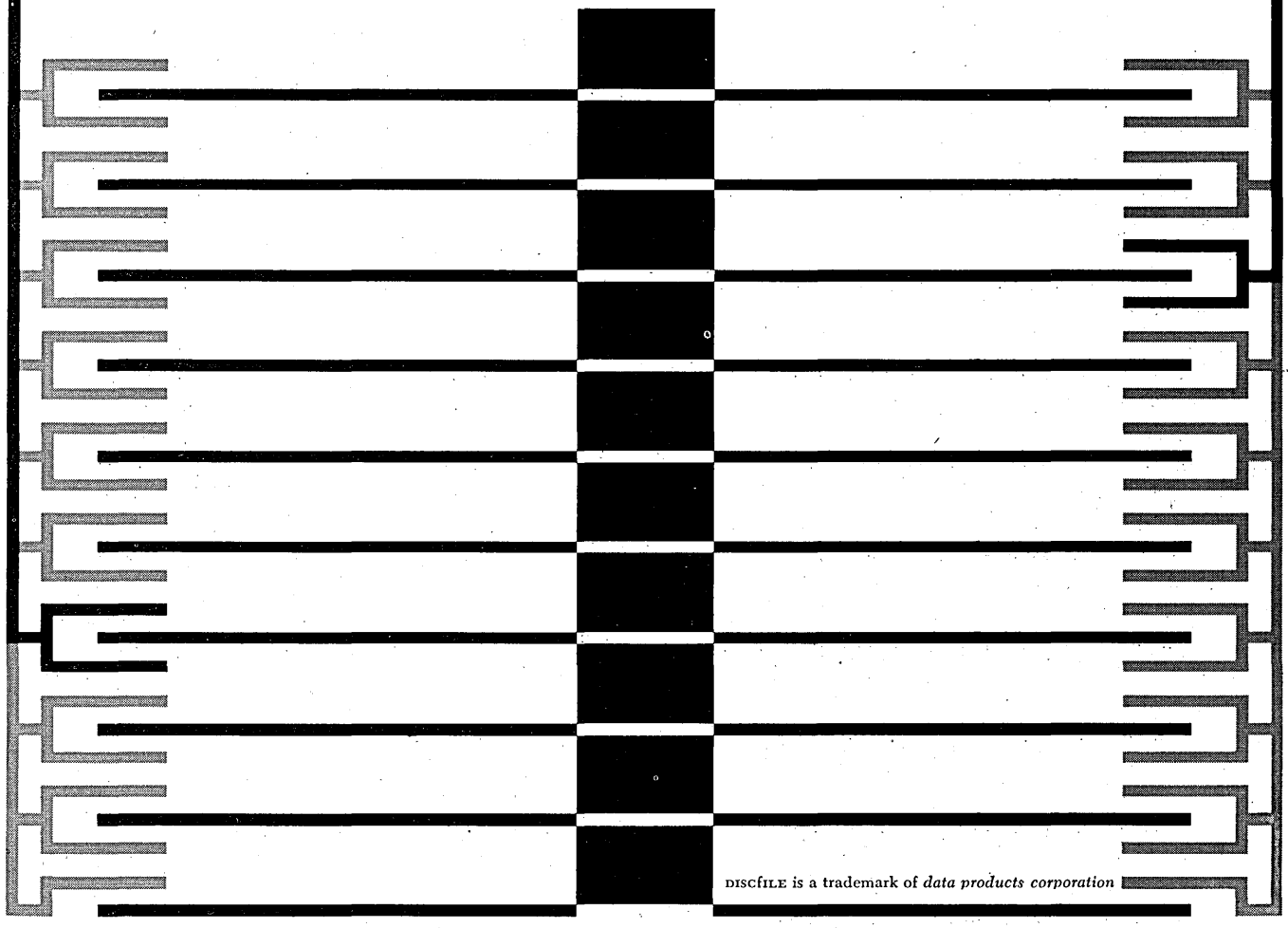
dp/f-5025 230 to 920 million bit storage...one to four 16-disc units...600 bpi...two logic elements...*simultaneous dual access*

dp/f-5034 460 to 920 million bit storage...one or two 32 disc units...600 bpi...one logic element

dp/f-5035 460 to 920 million bit storage...one or two 32-disc units...600 bpi...two logic elements ...*simultaneous dual access*

Write: Room 634 / 8535 Warner Drive / Culver City / California / Phone: 837-4491

data products corporation



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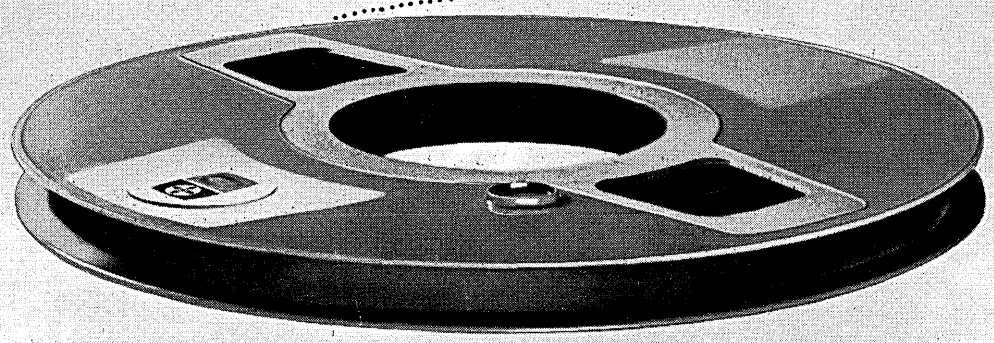
Computape, They tell me you're running around a lot lately.

Only in the best of computer circles, Penelope. In business of all kinds, in banks, in laboratories — wherever reel-iability is really in demand, I guarantee 556 or 800 bits per inch with no dropout for severest computer applications.



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556 or 800 bits per inch. No dropout. That's a real guarantee of reliability. *That's a reel of Computape* — product of the first company to manufacture computer and instrumentation tape *exclusively*. Investigate new Computape today. Better still — *immediately*

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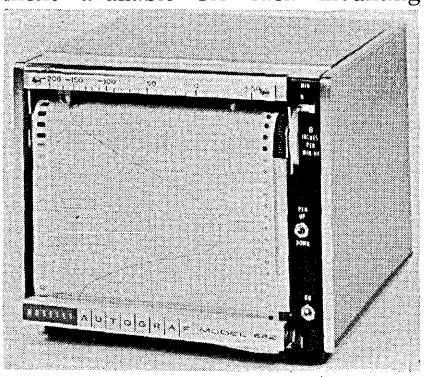
COMPUTRON INC.
122 Calvary Street, Waltham, Massachusetts

CIRCLE 42 ON READER CARD

NEW PRODUCTS

strip chart recorder

Autograf Model 682 has been designed for tracing temperatures in research, testing and industrial work. It is a servo potentiometer type instrument available for rack mounting



singly or in pairs, or for bench-top operation. The standard unit is priced at $675. F. L. MOSELEY CO., 409 N. Fair Oaks Ave., Pasadena, Calif. For information:

CIRCLE 200 ON READER CARD

plotter

The 566 is able to automatically produce fully annotated graphs of output data from gp digital computers at 18,000 line segments per minute in increments of .005 inches. The company has instituted a new rental system for its plotters. CALIFORNIA COMPUTER PRODUCTS, INC., 305 Muller Ave., Anaheim, Calif. For information:

CIRCLE 201 ON READER CARD

talk converter

This digital-to-voice converter/multiplexer is compatible with any high-speed dp system. The equipment is adaptable to the presentation of any special purpose verbal messages. NORTH ELECTRIC CO., Galion, Ohio. For information:

CIRCLE 202 ON READER CARD

tape reader

Model B2500 bi-directional photoelectric perforated tape reader offers single speeds at 100-300 characters per second and is able to stop on the character at either speed. The machine is priced at $1,050. DIGITRONICS CORP., Albertson, N.Y. For information:

CIRCLE 203 ON READER CARD

mag core memories

Series TCM-32 consists of five random access, magnetic core memories which are available in parallel word lengths from eight to 48 bits and have capacities of from 128 to 4096 words. COMPUTER CONTROL CO., INC., Old Connecticut Path, Framingham, Mass. For information:

CIRCLE 204 ON READER CARD

aperture card maker

This three-unit device converts standard tabulating cards into aperture cards at the rate of 2,000 per hour. Other machines include a punch and film mounter. The respective machines will rent for $100, $15, and $20 per month. THE SCIONICS CORP., 7400 Deering, Canoga Park, Calif. For information:

CIRCLE 205 ON READER CARD

micro tape transport

Key features of the 555's electrical design are phase recording and a permanent timing track. Read, write and search speed is 80 inches per second and searching is bi-directional. DIGITAL EQUIPMENT CORP., 146 Main St., Maynard, Mass. For information:

CIRCLE 206 ON READER CARD

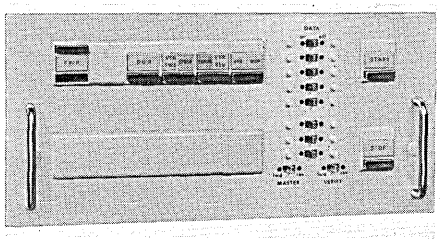
card reader

This magnetic ledger card reader automates processing of hard-copy records used with the 390. Ledger cards can be read by the device at up to 2,750 cards per hour. The unit is priced at $5,500. NATIONAL CASH REGISTER CO., PUBLIC RELATIONS DEPT., Dayton 9, Ohio. For information:

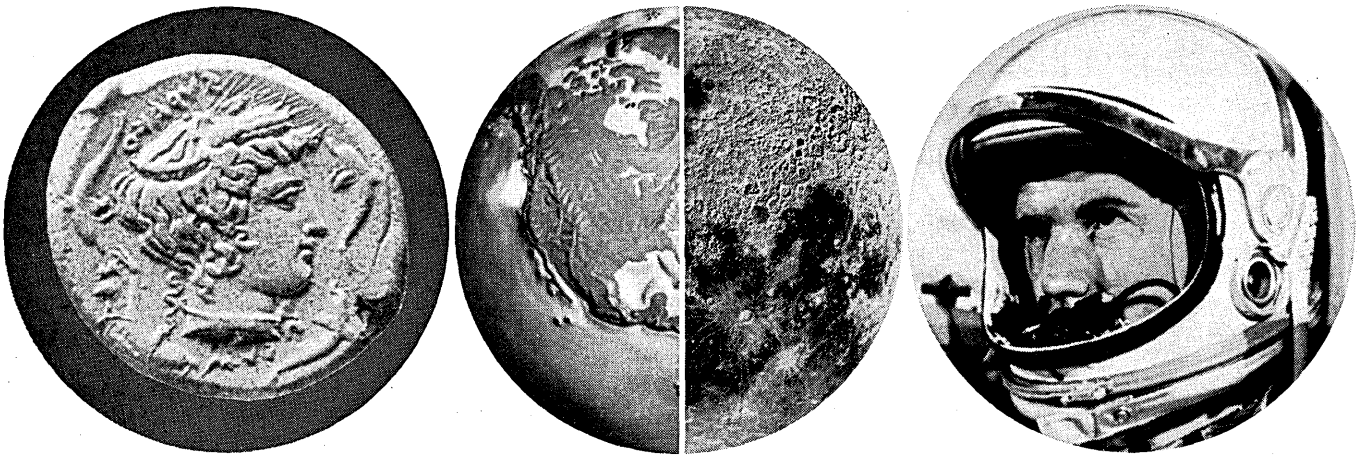
CIRCLE 207 ON READER CARD

control package

The 1644 provides control logic for direct duplication of a master tape, verification of a tape in a bit-for-bit comparison with a master tape, and



GENERAL ELECTRIC ENGINEERING OPPORTUNITIES



ACT NOW FOR ASSIGNMENTS ON PROJECT APOLLO

"The requirement for the Integration and Checkout program arises from the unique characteristics... of Apollo ...which distinguishes it from other projects. These include (1) the serious consequences of failure as measured in terms of national prestige, human life and cost; (2) the complexity... in terms of the technology required and the numbers and types of industrial contractors involved; and (3) the long period of operations in the space environment with no significant maintenance or repair possible."

National Aeronautics and Space Administration
at the Aeronautics and Space Committee Hearings,
U.S. House of Representatives, 1963.

General Electric's Apollo Support Department has been selected to assist NASA in the integration support, checkout and reliability assessment of the Apollo system. Without doubt, it takes an unusually mature and competent man to perform under the realization that his individual work can be of significant importance to such a program.

If you are the kind of person who thrives on such responsible work, there's a place for you with General Electric. We've already put together the most impressive team ever assembled in the General Electric Company for this program... however, there are *many* opportunities still available to the *right* men. From the listings below you can determine your own opportunities. **Contract Programs:**

CHECKOUT... work consists of two distinct parts. First, a continuation of current engineering study efforts to provide NASA with checkout systems analysis, standardization studies, an integrated space vehicle checkout system specification, studies of test procedures, the application of advanced checkout techniques to Apollo, and system checkout engineering support at NASA field centers. Second, provision of checkout equipment to be included within the integrated launch control and checkout system.

RELIABILITY ASSESSMENT... effort includes assisting NASA in assessing overall mission reliability and safety levels, implementing a reliability and failure data system, and reviewing reliability and quality procedures and controls.

INTEGRATION SUPPORT... assist in identification and documentation of equipment and procedure interfaces within the Apollo project. Studies of integration methods and their application to Apollo including configuration control, and data handling.

Engineering experience required in: SYSTEMS and SUB-SYSTEMS CHECKOUT and TEST PLANS, DESIGNS and OPERATIONS

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- ☐ Guidance Control Systems
- ☐ Telemetry Systems
- ☐ Electronics Packaging Design
- ☐ Logic Design
- ☐ Human Factors
- ☐ Systems Engineering
- ☐ Cryogenics
- ☐ Engineering Writers
- ☐ Computer Engineering
- ☐ Computer Programming
- ☐ Data Processing Display
- ☐ Circuitry & Circuit Design
- ☐ Data Analysis
- ☐ Launch Facilities Systems
- ☐ Instrumentation & Simulation Systems

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Write today to: Mr. P. W. Christos, Apollo Support Department, General Electric Co., Support Building, Room 56-F, P.O. Box 2500, Daytona Beach, Florida. (Your inquiry will be held in strict confidence. Please include your salary requirements.)

APOLLO SUPPORT DEPARTMENT
A Department of the Command Systems Division

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CIRCLE 75 ON READER CARD

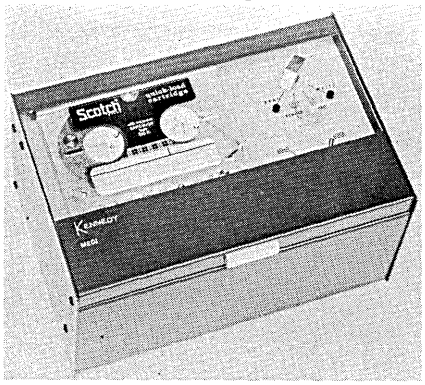
NEW PRODUCTS . . .

verification of a tape in a bit-for-bit comparison with a master tape with duplication of the master tape as a result of comparison. Data is processed at the rate of 75 cps with the 575 perforator and 464 reader. Price of the 1644 is $1,500. TALLY REGISTER CORP., 1301 Mercer St., Seattle 9, Wash. For information:

CIRCLE 208 ON READER CARD

digital data recorder

The M201 is able to read and write at 65 eight-level bcd cps, starting and stopping for each character. Tape cartridges, each holding 350,000 bcd

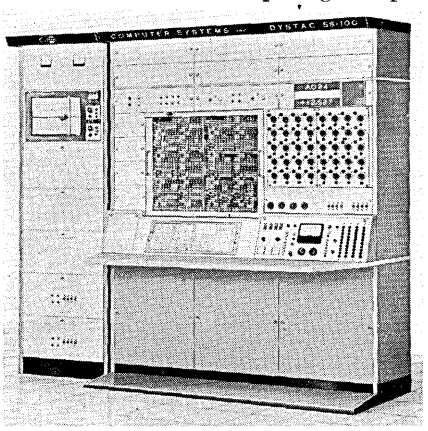


characters, are used for tape loading. Priced at $1,385. KENNEDY CO., 2029 North Lake Ave., Altadena, Calif. For information:

CIRCLE 209 ON READER CARD

gp analog computation

The transistorized DYSTAC SS-100 has a computing range of plus 100 to minus 100 volts. The 100 volt level makes possible a dynamic range of 10,000 to 1 with computing compo-



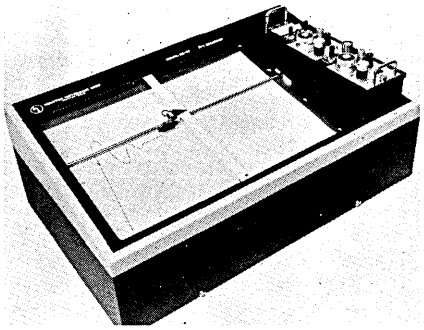
nent accuracies of 0.01% at the lower range of the time scale. COMPUTER SYSTEMS, INC., Industrial Park, Fort Washington, Penna. For information:

CIRCLE 210 ON READER CARD

x-y recorder

The HR-97 features 1 mv/in. basic sensitivity, 0.25% of full scale accuracy, 15 in/sec. pen speed, zener refer-

NEW PRODUCTS . . .



ence voltages, snap-on pen assembly and vacuum paper holddown. Price: $1,350. Another unit, the HR-96T, costs $895. HOUSTON INSTRUMENT CORP., 4950 Terminal Ave., Bellaire 101, Tex. For information:

CIRCLE 211 ON READER CARD

imprinter

This imprinter, model 874, has been specially designed for department store credit card use. The 874 can be used to imprint sales checks with the customer name, address and account numbers in thick sales books and can be converted to imprint individual sales checks with slight modification. FARRINGTON MANUFACTURING CO., Needham Heights 94, Mass. For information:

CIRCLE 212 ON READER CARD

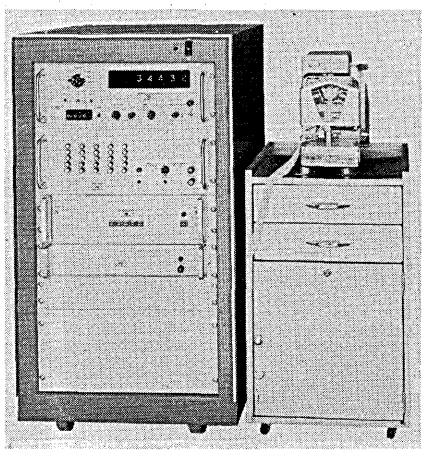
perforator adapter

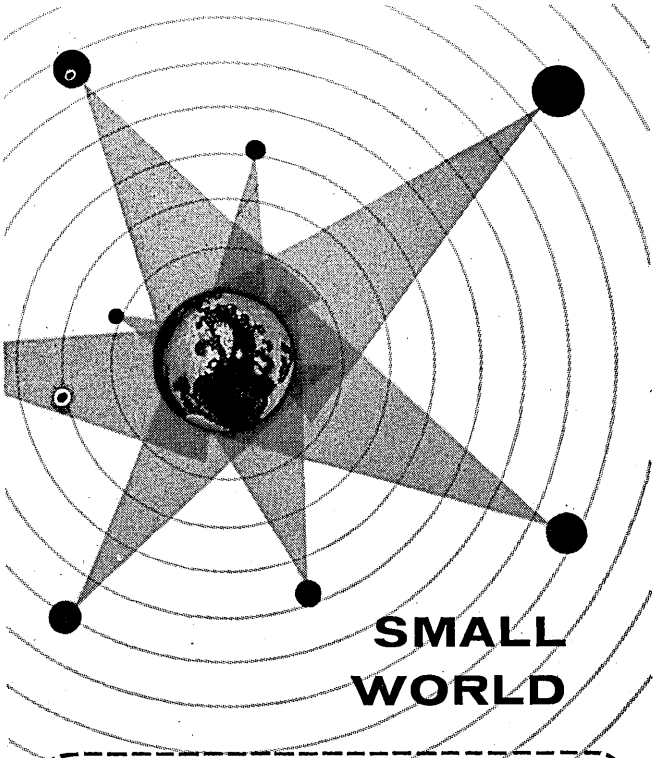
Model 403A tape perforator adapter couples electronic counters with 1-2-4-8- bcd output to Tally series 420 paper tape perforators. The 403A has a punch speed of 60 cps and is priced at $1,050. COMPUTER MEASUREMENTS CO., DIV. OF PACIFIC INDUSTRIES, INC., 12970 Bradley Ave., San Fernando, Calif. For information:

CIRCLE 213 ON READER CARD

data acquisition system

The DY-2010B provides digital measurement of dc inputs from a few millivolts to several hundred volts. When





SMALL WORLD

"It is the policy of the United States to establish in cooperation with other countries . . . a commercial communications satellite system . . . which will contribute to world peace and understanding."

— COMMUNICATIONS SATELLITE ACT OF 1962

To assist NASA in evaluating a variety of feasible types of satellite communication systems, from the viewpoint of interactions of physical system characteristics with national policy goals, TECH/OPS System Scientists are creating a new SMALL WORLD . . . a computer simulation which includes numbers, altitudes, orbits and physical descriptions of various satellites; number of sites, tracking antennas and receivers and transmitters for ground stations; traffic demand patterns and launch schedules. The simulation will help to assess cost-effectiveness, quality, economic and policy implications for each type of system.

TECH/OPS work on COMSAT is typical of the Company's work in the System Sciences . . . CORG, OMEGA, 473L, TRAG, VALOR . . . to name a few other programs. Programs which have a direct influence on military and government planners and decision makers.

If you would like to work in an environment where your individual contributions count, we would like to hear from you. Positions are available at TECH/OPS in the Washington, D. C. area for experienced Operations Analysts and Computer Programmers.

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FREE Data Processing Opportunities Bulletin

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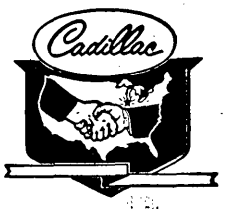

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Single computer installations
Multiple computer installations
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General purpose computers
Special purpose equipment
Common memory systems

Experience is required in design of clock controlled programs, executive control techniques, minor cycle programming and basic understanding of computer operation.

For further details, write to:
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CIRCLE 82 ON READER CARD

NEW PRODUCTS . . .

used with the DY-2401A integrating digital voltmeter, it will automatically scan multiple channels of dc voltage and frequency, and measure the input. The DY-2010B is priced at $10,800. DYMEC, DIV. OF HEWLETT-PACKARD CO., 395 Page Mill Rd., Palo Alto, Calif. For information:

CIRCLE 214 ON READER CARD

a-d converters

This series of four all-silicon analog to-digital converters can operate at speeds in excess of five microseconds per bit. The units have accuracies to ±0.01% and will withstand operating temperatures from 0°C to +100°C. Binary models are available in 10-bits plus sign and 13-bits plus sign; BCD models are available in three and four decimal digits plus sign. Price for 14-bit, 14,000 conversions per second converter is $3,700. SCIENTIFIC DATA SYSTEMS, INC., 1542 15th St., Santa Monica, Calif. For information:

CIRCLE 215 ON READER CARD

d/a converter

The transistorized DA2-13C features a one-word data register that holds the last word put in until the new word arrives. Accuracy of the unit is ±.01% and word lengths range from two to 13 bits. The converter is available as a bipolar unit or polar unit. The basic DA2-13C is priced at $1,500. GENERAL AUTOMATION, INC., 8 East Butler Ave., Ambler, Penna. For information:

CIRCLE 216 ON READER CARD

compact edp system

The Gamma 10 consists of a central processing unit, a card reader punch, and a printer. This system can perform a group of operations which have previously required a variety of additional punched card equipment. The card reader punch is able to read and punch at the rate of 300 cards per minute. BULL CORPORATION OF AMERICA, 1 E. 57th St., New York 22, N. Y. For information:

CIRCLE 217 ON READER CARD

pj-2 printer

This electronically controlled printer has been designed to print functional time and elapsed time of any EDP and EAM computing system on a tab card. The instrument also visually provides total functional time and total elapsed time on non-resettable tamper-proof totalizers. STANDARD INSTRUMENT CORP., 657 Broadway, New York 12, N. Y. For information:

CIRCLE 218 ON READER CARD

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COMPUTER SALES ENGINEERS • APPLICATIONS ANALYSTS • COMPUTER TIME SALESMEN
PROGRAMMER ANALYSTS • SYSTEMS PROGRAMMERS

MARKETING DIVISION – Nationwide Locations

COMPUTER SALES ENGINEERS: Openings exist now for persons with digital computer experience in sales, engineering and/or applications programming.

APPLICATIONS ANALYSTS: Positions include consulting with customers to analyze their problems for computer applications. Experience required in scientific programming for medium or large-scale computers. Knowledge of FORTRAN or other scientific compilers is helpful.

SEND RESUME TO: H. H. TRADER, **CONTROL DATA CORPORATION, 8100 34th AVENUE SO., MINNEAPOLIS 20, MINN.**

DATA CENTERS DIVISION – Minneapolis, Palo Alto and Washington Locations

SALES REPRESENTATIVES: To sell computer time and programming and analysis services for our Data Centers Division. The centers now in operation are located in Palo Alto, California; Minneapolis, Minnesota; and Washington, D. C.

QUALIFICATIONS: A minimum of two years' direct experience and a familiarity with programming techniques is required. A college degree is preferred.

PROGRAMMER ANALYSTS: You will be analyzing customer problems for computer application. In addition, you will be involved in sales support work and the preparation of programming proposals.

QUALIFICATIONS: You must have a minimum of two years' direct programming experience with large-scale systems and some experience in software development.

SEND RESUME TO: H. H. TRADER, **CONTROL DATA CORPORATION, 8100 34th AVENUE SO., MINNEAPOLIS 20, MINN.**

COMPUTER DIVISION – Nationwide Locations

INSTALLATION SUPPORT: Technical representative at customer site. Responsibilities include orientation, training, programmer consultation and systems analysis for large-scale CONTROL DATA® 3600 and 1604 computer customers. (Various locations in continental United States.) Large-scale computer experience and B.S. degree are required.

COMPUTER DIVISION – Palo Alto Location

SYSTEMS PROGRAMMING: Participate in the development of advanced programming systems including compiler development, monitor and executive routines and language analysis. Digital computer experience and B.S. degree are required.

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

SEND RESUME TO: M. D. WALTER, **CONTROL DATA CORPORATION, 3330 HILLVIEW AVE., PALO ALTO, CALIF.**

CONTROL DATA
CORPORATION

An Equal Opportunity Employer

COMPONENT PRODUCTS

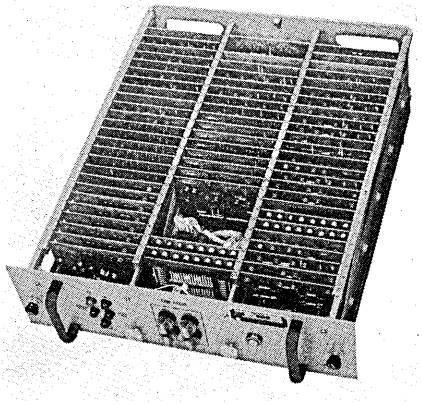
data logger
This automatic transistor diode tester, the series 900, can be punched-card programmed to conduct up to 24 different measurements in any order. Self-checking, decoding logic, power supplies, reference voltages, digital loop and data logging systems are features of the 900. FAIRCHILD SEMICONDUCTOR, 545 Whisman Rd., Mountain View, Calif. For information:

CIRCLE 219 ON READER CARD

dual power supply
This series of dual supplies consists of 21 combinations of six basic individual supplies. All units may be operated in constant current or constant current modes with current limiting in the voltage mode and voltage limiting in the current mode. Prices range from $298 to $758. TRYGON ELECTRONICS, 111 Pleasant Ave., Roosevelt, N.Y., For information:

CIRCLE 220 ON READER CARD

core storage
Model KD-5020 magnetic core storage device uses printed circuit techniques and is able to store up to 256 characters. Stored information can be delivered to a receiving device character



by character at a rate of up to 10,000 bits per second. INTERNATIONAL TELEPHONE AND TELEGRAPH CORP., 320 Park Ave., New York 22, N.Y. For information:

CIRCLE 221 ON READER CARD

a to d converters
The 3000 series combines 13 basic circuit cards to form 1,088 standard production line models. Two basic accuracies and speeds are offered: decisions made at 2.5 microseconds per bit yield 20,000 or more conversions per second for 10-binary bit converters; and decisions made at four microseconds per bit, which yield about 13,500 conversions per second for 14-binary bit converters have a basic accuracy of 0.01%. ASTRODATA INC., 240 E. Palais Rd., Anaheim, Calif. For information:

CIRCLE 222 ON READER CARD

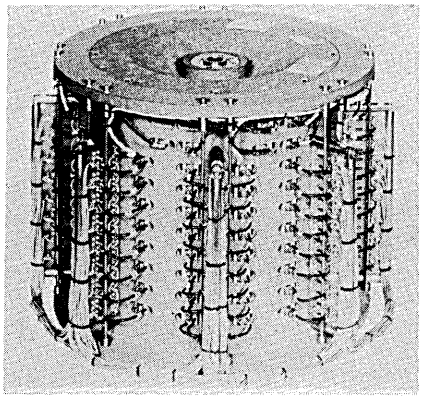
magnetic coating
DATAKOTE can be applied to discs up to 39″ and drums to 18″ in diameter, as well as rods and tubes. It is said to have a hardness of 50-55 on the Rockwell C scale, offer superior uniformity and magnetic properties to exact specifications. LOCKHEED ELECTRONICS CO., 6201 E. Randolph St., Los Angeles 22, Calif. For information:

CIRCLE 223 ON READER CARD

thin films
These thin films operate at drive currents of 20 to 30 milliamperes and are compatible with molecular integrated circuits. The thin film has a flux of about 0.2 millimaxwells and generates an output voltage of a few tenths of a millivolt when switched in 10 nanoseconds. UNIVAC DIV. OF SPERRY RAND CORP., Blue Bell, Penna. For information:

CIRCLE 224 ON READER CARD

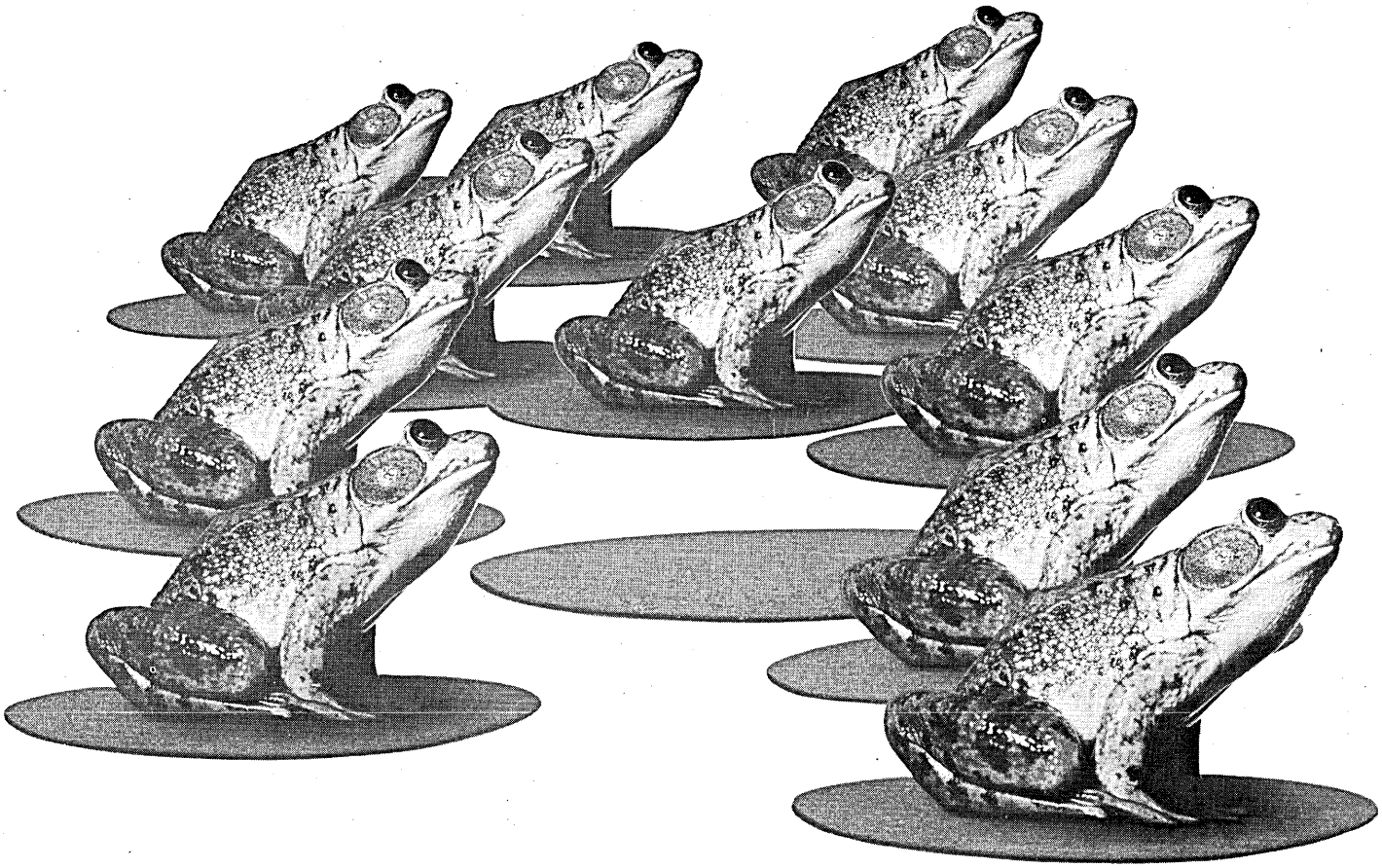
drum & recording head
The D500 series of magnetic drums has packing densities to 1200 per inch NRZ and total storage capacities from 475,000 bits to 16,650 bits NRZ. The D500 series is compatible with a



new aerodynamic contract head designed to operate at constant spacing of .0001″ from the rotating member, regardless of speed. MAGNE-HEAD, 3216 W. El Segundo Blvd., Hawthorne, Calif. For information:

CIRCLE 225 ON READER CARD

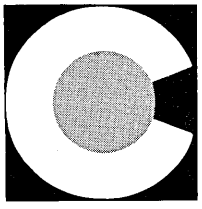
PHOTO CREDITS: H. CHARLES LAUN AND R. C. HERMES FROM NATIONAL AUDUBON SOCIETY



Hope springs eternal...

Most men who seek earnestly for job serenity are hoping against hope that their next move will be their last.... Even so, a man is inclined to risk such a jump if reasonably assured that he and his family will live happily ever after.... In order to clear the air for programmers contemplating a job change, Computer Concepts submits the following resume of the occupational climate in which we operate in Washington, D. C., Los Angeles, California and New York City: You will sit in concert with seasoned veterans of the industry, free to extend your capabilities

in such activities as machine translation, computer efficiency studies, computer applications, management information systems and operations research. . . . Salaries range to $20,000 annually, and relocation expenses are paid. . . . If you have a minimum of 2 years computer programming experience and are contemplating a leap this year from your launching pad, send resume to: 1012 14th Street, N.W., Washington, D.C., **COMPUTER CONCEPTS, INC.**



CIRCLE 86 ON READER CARD

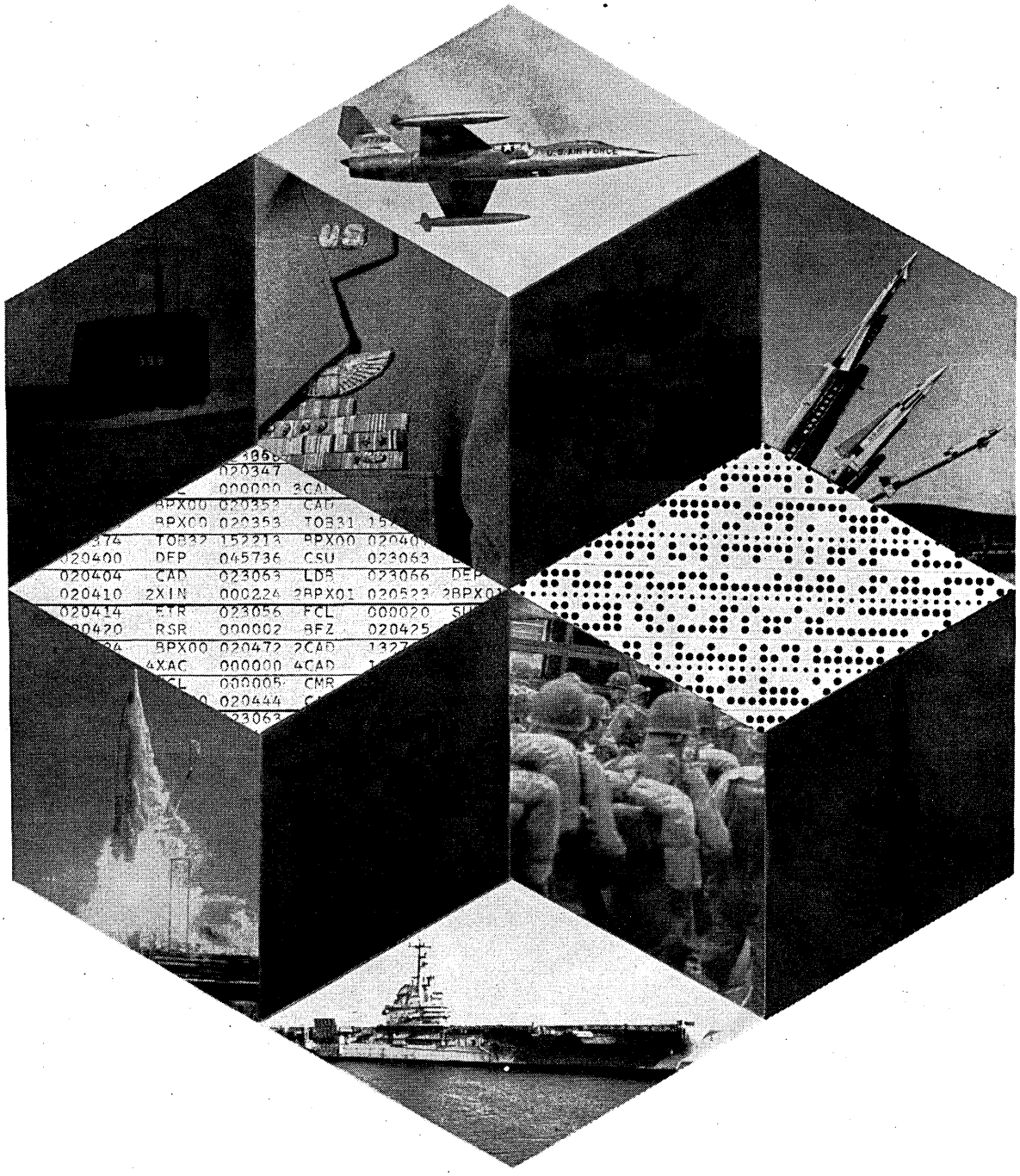
Decision-Making: Deploy or not?...When and where?

The costly, complex weapons systems of today make such a decision far more difficult than in the past. World-wide forces and events are frequently involved. The time for decision has been compressed, the information on which it must be based has been multiplied in volume, variables, interrelationships. This new era of decision-making has led commanders and governmental leaders to make use of man-machine systems which provide information processing assistance. SDC's staff of scientists, engineers and computer programmers have been developing these huge systems for more than eight years. They help develop the system itself, not the hardware within the system. Specifically, they analyze system requirements, synthesize the system, instruct computers which are the core of the system, train the system, evaluate the system, adapt it to the changing needs of its users. And in so doing, they consider the interaction and effect of men, doctrine, tradition, training; of organizations, chains-of-command and chains-of-succession; of communications, traffic centers, command posts, computers and displays. Computer programmers, human factors scientists, operations research scientists and systems-oriented engineers interested in joining this rapidly expanding field and working in a close interdisciplinary effort are invited to write Mr. A. E. Granville, Jr., SDC, 2401 Colorado Ave., Santa Monica, California. Positions are open at SDC facilities in Santa Monica; Washington, D. C.; Lexington, Massachusetts; Paramus, New Jersey; and Dayton, Ohio. "An equal opportunity employer."

SDC

System Development Corporation

Systems that help men make decisions and exercise control



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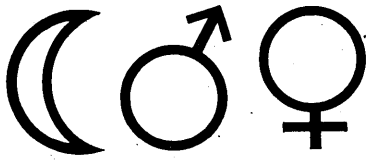
CIRCLE 87 ON READER CARD

ADVERTISERS' INDEX



A current Bellcomm project

The Moon, Mars, Venus, long objects of wonder, are now destined for exploration. ⬆ As you read this, Bellcomm is at work for NASA—planning early phases of this vast exploration, analyzing systems needed for landing man on the moon. ⬆ If you're qualified, you might like to join the vanguard of the expedition. There are rewarding openings in such fields as computing and programming, physics, mathematics, engineering, man-machine relationships, aerodynamics and aeronautical engineering. ⬆ Bellcomm, the newest company of the Bell System, is an equal opportunity employer located in Washington, D. C. Résumés will be promptly and carefully considered. Address them to Mr. W. W. Braunwarth, Personnel Director, Bellcomm, Inc., Room 1101T, 1100 17th Street, N.W., Washington 6, D. C. ⬆

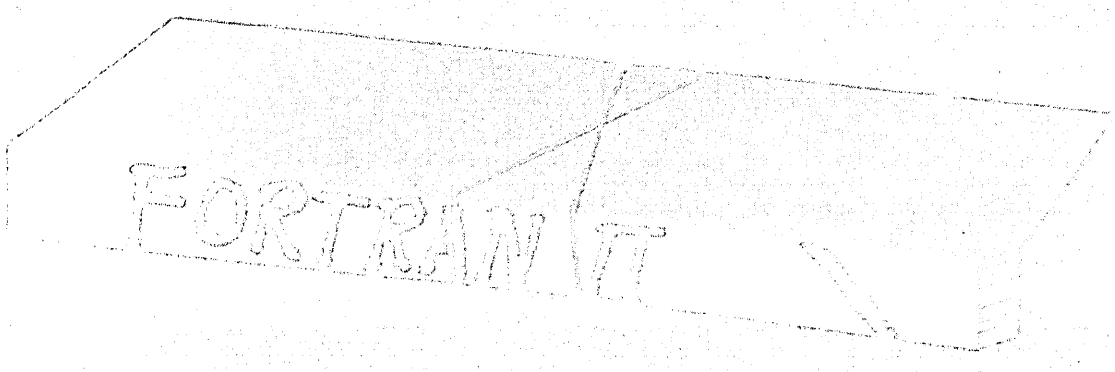
BELL SYSTEM

BELLCOMM, INC.

A Bell Telephone System Company

CIRCLE 90 ON READER CARD

breakthrough in compilers....



1 COMPILER ☐ 83 CARDS ☐ 2981 INSTRUCTIONS

A new method of compiler construction has been developed [illegible] by the DIGITEK CORPORATION. This method drastically reduces the time and cost of compiler production. A case history:

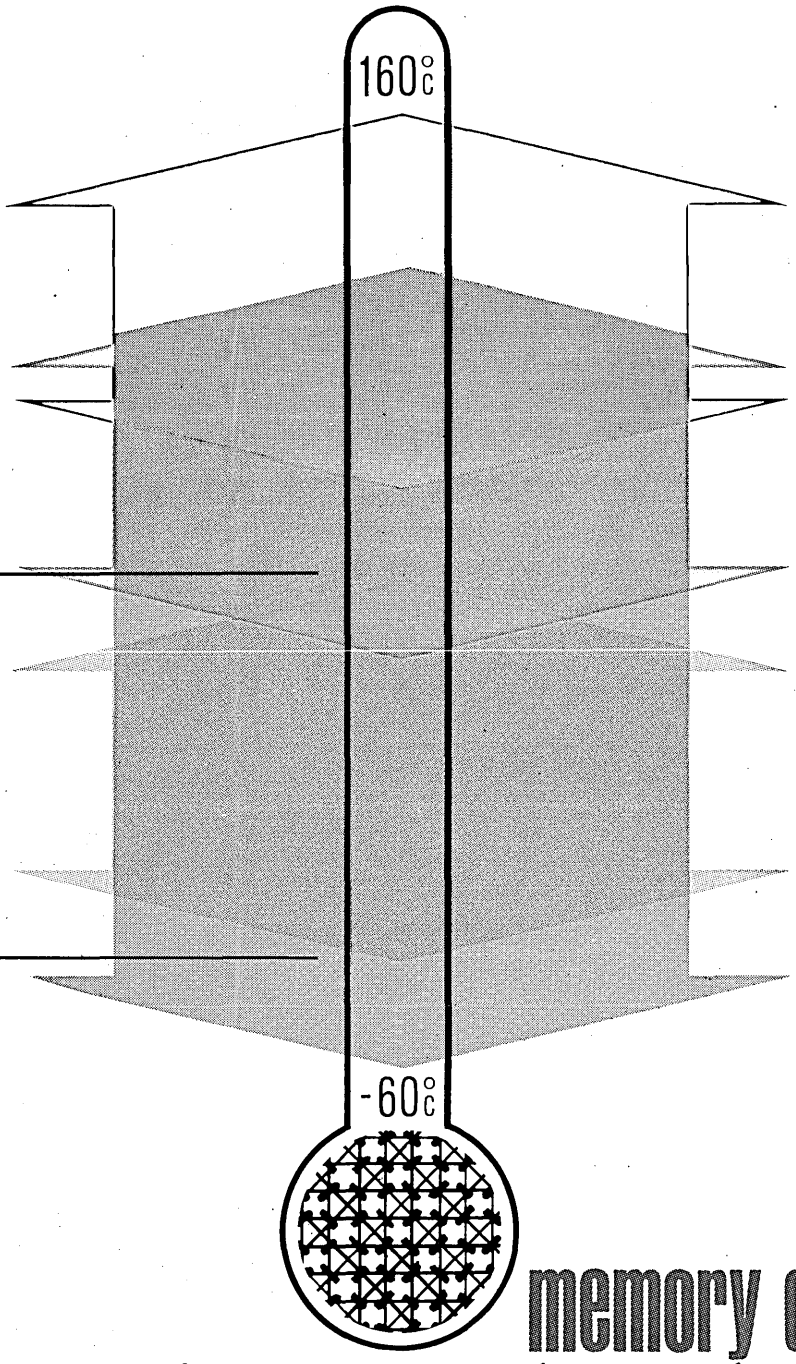
SDS 900 FORTRAN II [ ] IBM compatible [ ] all statements [ ] one pass [ ] 4K core [ ] no auxiliary memory [ ] room for 300 symbols and labels [ ] seven times faster than comparable compilers [ ] efficient machine code [ ] backward DO loops [ ] nested subscripts [ ] mixed mode expressions [ ] new compiler minimal machine configuration holds entire compiler [ ] no reloading between compiles [ ] good diagnostics [ ] fixed price contract [ ] delivered on time

This method is applicable to any programming language for any computer. FORTRAN IV and JOVIAL systems are under construction. Research is being conducted in the areas of functional hierarchies, communication stacks, predictive scans, status control and tree algorithms. Compiler customers include SDS, HUGHES, and DAYSTROM.

Prices start at $30,000; delivery times start at six months.

DIGITEK CORPORATION

1000 CENTINELA AVENUE INGLEWOOD, CALIF. PHONE [illegible]



operates over any 80°C range without compensation

memory cores extra wide temperature range at no extra cost

Ferrites with new low coefficients-of-temperature have enabled Ferroxcube to develop memory cores with extended operable temperature ranges—at the same price as regular ferrite cores. The new cores will operate over any 60°C to 80°C temperature range **without drive compensation** within their total operating range of −60°C to +160°C. Planes and stacks can now be produced without fear of spot heating or regard to ambient conditions. Because these cores are non-magnetostrictive, they can be rigidly encapsulated for ruggedization.

Send for complete technical information

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CIRCLE 2 ON READER CARD