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BUSINESS

DATA

PROCESSING

HURRAHS

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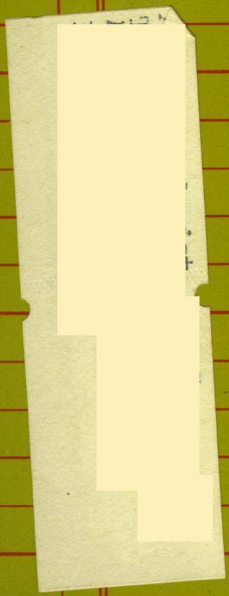
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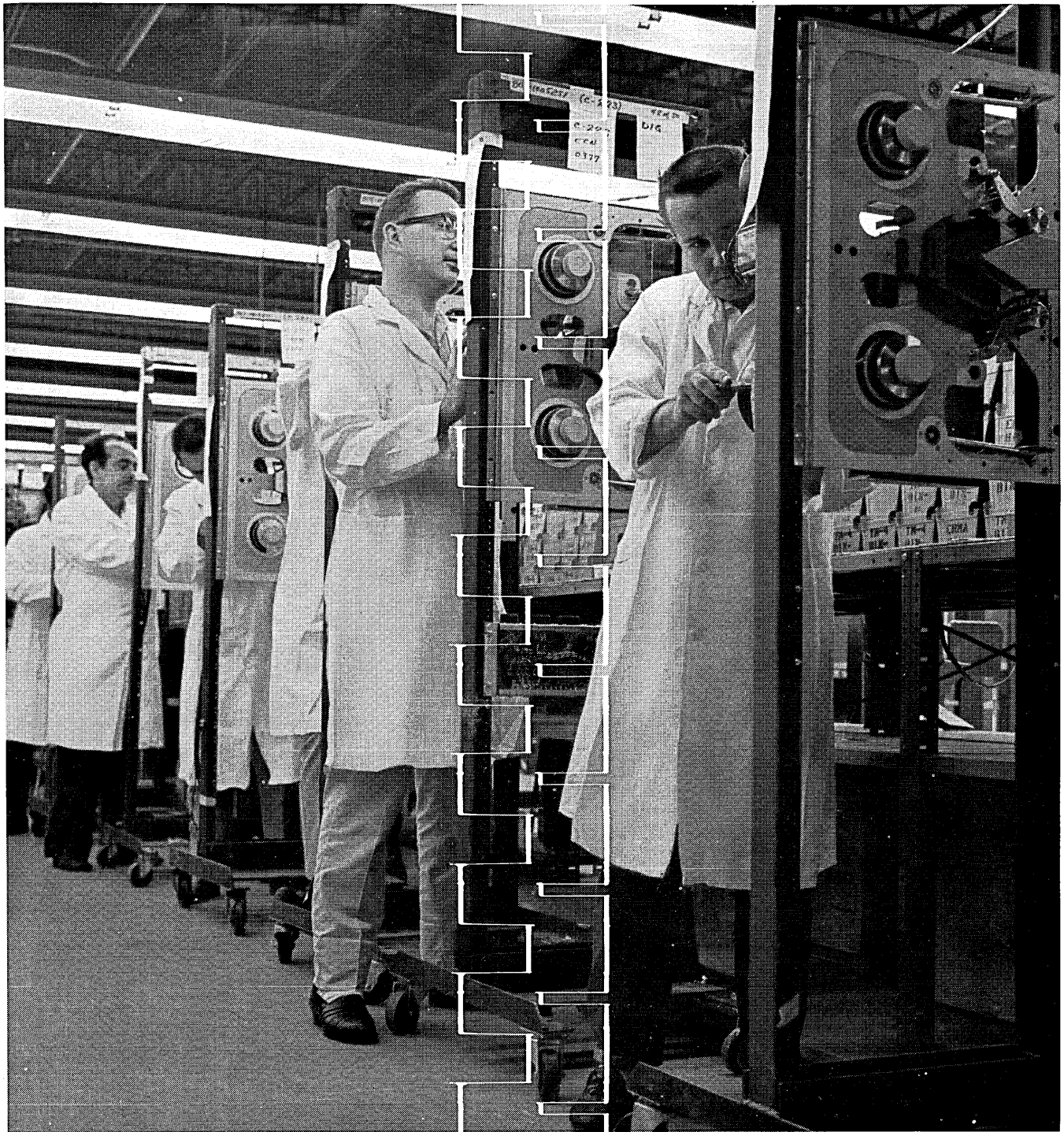
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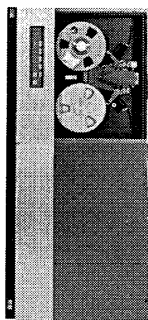
& HURDLES



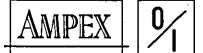


Who says you can get fast delivery on advanced tape memory systems? AMPEX

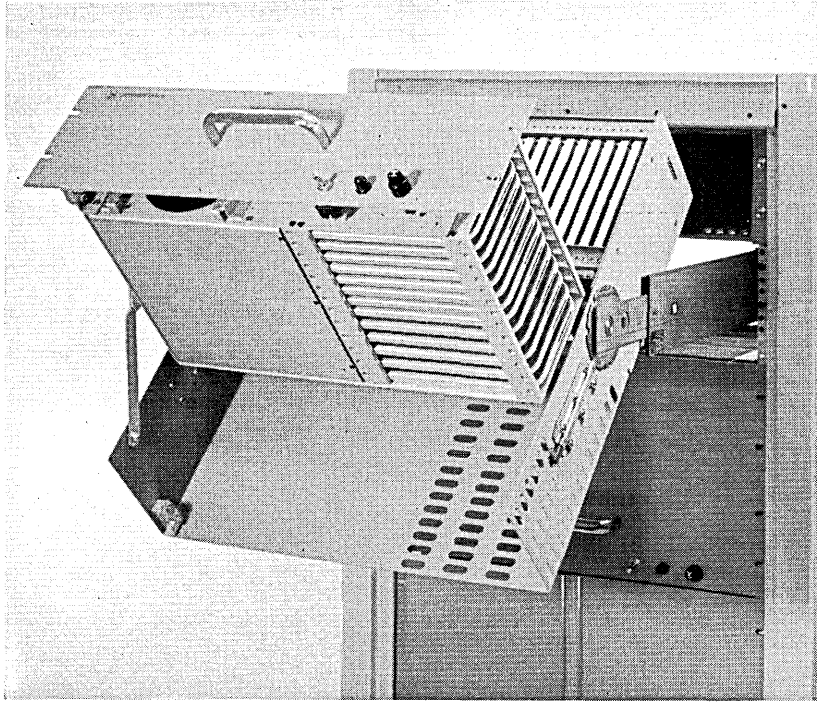
We took the world's most advanced high speed and medium speed tape units and added solid state electronics. Result: the Ampex TM-2100 and TM-4100 tape memory systems. We can deliver them to you practically off the production line. Performance? The TM-2100 operates at speeds up to 150 ips; the TM-4100 at speeds up to 75 ips. Both systems read, write and check digital data. They're compatible with most computer formats at 200, 556 and 800 bpi. And you can have either system in a 19" rack



mount, a tri-sectional cabinet, or any way you want it packaged. Or you can get either tape transport by itself. (As many as ten transports can operate on one set of electronics.) Ampex Computer Products Co., Culver City, California. A division of the only company providing recorders, tapes and core memory devices for every application: Ampex Corporation, 934 Charter Street, Redwood City, California. Term financing and leasing available. Sales, service engineers the world over.



NEW



Front Access Core Memories with Logic Flexibility

Computer Control 5 microsecond random access magnetic core memories are now available in slide-out, break-open 1- and 2-block units. The TCM-32 unit above offers complete, front-of-rack access. Logic modules are easily removed, and memory core and wiring arrays exposed. All indicators (optional) mount on front panel. Units are functional and practical. Height: 5 $\frac{1}{4}$ " for a single block; twice that for a 2-block drawer. Word capacities, up to 4096; word lengths to 32 bits in a 2-block unit. (A 1-block unit has a 1024 word capacity and a 16 bit word length.) Flexible? Very. Designed around 3C's extensive line of S-PAC digital modules, 3C core memories can be integrated easily into surrounding logic. Design is conservative. Operating margins are broad. Options and accessories are available. Off-the-shelf delivery runs 30-90 days. Prices are attractive. Write for the full story.



COMPUTER CONTROL COMPANY, INC.

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

sensible . . .

BECAUSE YOU BUY NO MORE THAN YOU
NEED AND NO LESS THAN WILL DO THE JOB

new PHILCO PACT pricing

Now computer pricing

has caught up with the computer age through Philco PACT Pricing. (PACT: **P**ay **A**ctual **C**omputer **T**ime) It's pricing that's as up-to-date as 1963 . . . pricing that saves you money when you use your computer and when you don't use your computer.

For a minimum investment

PACT gives you maximum computer time. It allows you to use the computer by the hour . . . not by the day. For Philco 4000 Series users PACT ends the 176 hours-per-month sacred cow of the computer industry . . .

And why not?

With PACT you can now tie the cost of your computer to throughput . . . and PACT gives the benefits of efficiency to the one who deserves them . . . the user.

It makes a real difference

If you have an application with peak loads (and who doesn't) . . . or if you feel you need a real computer but can't make the 176-hour gamble.

Low basic charges

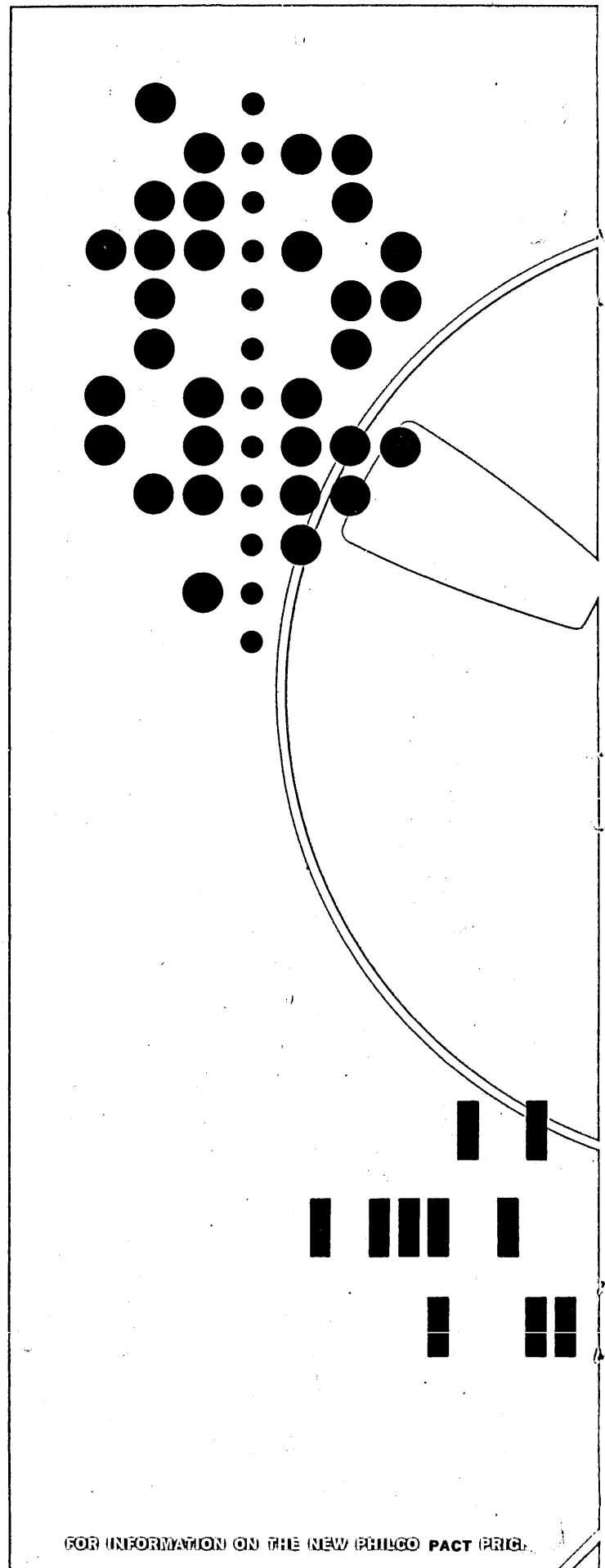
PACT pricing brings you a new 4000 Series computer with 8-thousand characters of memory and four magnetic tapes, a printer, a card reader and punch for less than . . .

\$4000 per month

plus approximately \$22 an hour. Of course, you get more than the computer. This price includes the extensive 4000 software package and Philco service and back-up support.

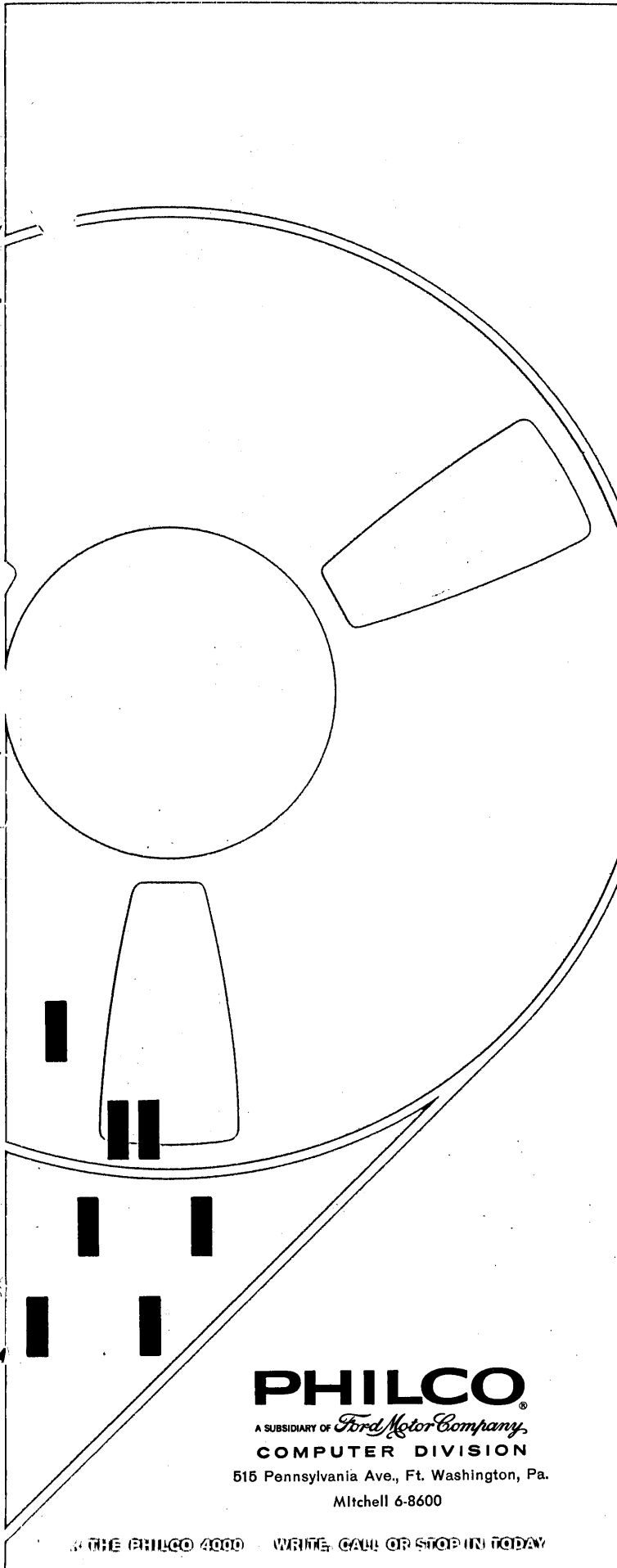
PACT couldn't be better

even if you worked out the plan yourself it's today's most sensible pricing for today's most sensible computer.



FOR INFORMATION ON THE NEW PHILCO PACT PRICING

DATAMATION



PHILCO

A SUBSIDIARY OF *Ford Motor Company*

COMPUTER DIVISION

515 Pennsylvania Ave., Ft. Washington, Pa.

Mitchell 6-8600

THE PHILCO 4000 - WRITE, CALL, OR STOP IN TODAY

economy

IS WHAT WE DESIGNED IN...

NOT WHAT WE LEFT OUT

new PHILCO 4000 Series

You need the BEST computer available

Which is the best?

The one that fills your needs... sensibly.
So if you need real capability and real flexibility

plus low cost

we're pretty sure a Philco 4000 Series computer
will qualify as the best for you.

To begin with it's fast...
(effective memory access time: 3 microseconds)
fast enough to do almost any job.

And that's not all...

within the Philco 4000 Series you can choose
some of the fastest
and some of the slowest input-output devices...
it depends on your needs and your pocketbook.

More flexibility

There's been a lot of debate
about fixed and variable word length computers.
With the Philco 4000 Series there's no need to debate.
It works fixed or variable word length...
whichever fits the individual program best.

Everyman's computer?

We wish it were.
If you need a small special purpose computer,
a Philco 4000 probably has too much stuff.
And if you need fantastic power,
we recommend a Philco 2000 Series computer.

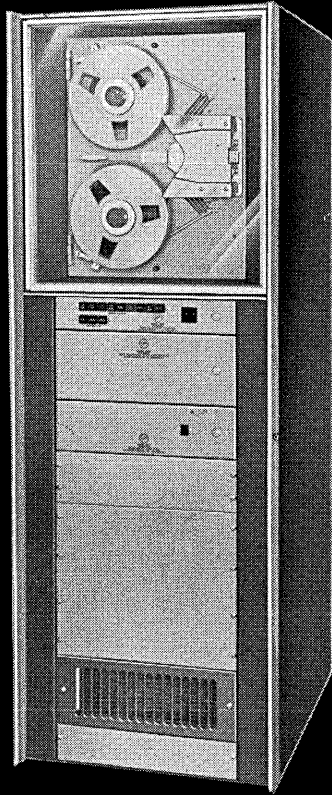
But if you're in the middle

(and most of us are these days) we think
a Philco 4000 will measure up to your unique needs
for scientific or business applications, or both.
Because the 4000

**is today's most sensible computer—
with today's most sensible pricing.**

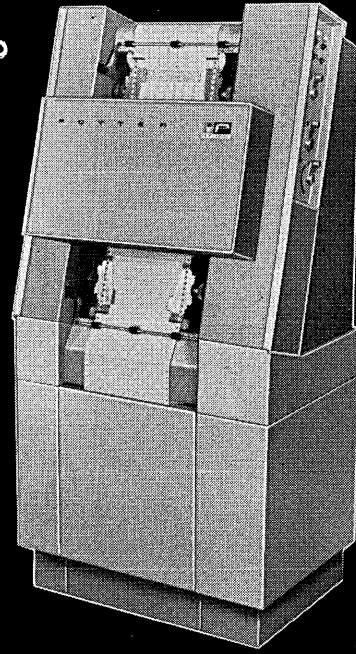
To prove our point we would appreciate an opportunity
to measure Philco 4000 cost and performance
in terms of your specific needs.

WHAT ARE YOUR DELIVERY REQUIREMENTS?



STANDARD TAPE TRANSPORTS

4 WEEKS



STANDARD PRINTERS

12 WEEKS



NEW PRINTER DIVISION

Broad acceptance of our product line coupled with the fact that so many Potter "specials" are now industry standards has resulted in such dramatic growth that we have increased our plant and production capacity by more than 65%. This new production capability can directly benefit you through faster delivery. For example, we can deliver our standard transports in 4 weeks, and standard printers in 12 weeks from receipt of order. If you require fast delivery—with no sacrifice in performance or reliability, write us today.



T.M.

POTTER INSTRUMENT COMPANY, INC.
TAPE TRANSPORT DIVISION 151 Sunnyside Boulevard • Plainview, New York
PRINTER DIVISION East Bethpage Road • Plainview, New York

CIRCLE 5 ON READER CARD

volume 9, number **2**

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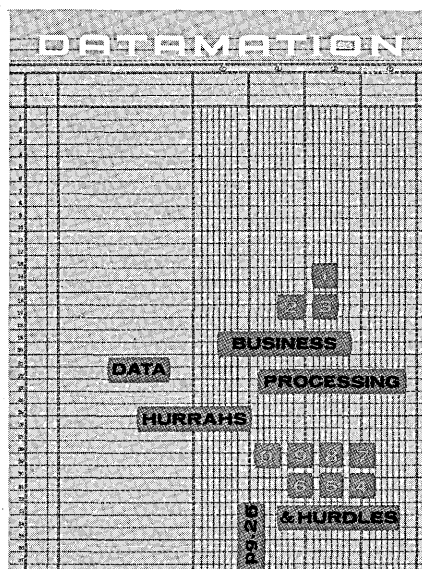
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THIS ISSUE—45,279 COPIES

Cover

The growth of business data processing is reflected throughout this month's issue with special emphasis and prescriptions for ailments requiring early diagnosis and intelligent care. Cover design by Art Director Cleve Boutell.



Circulation audited by
Business Publications Audit

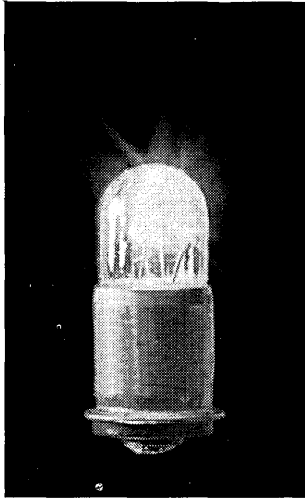


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Business Publications

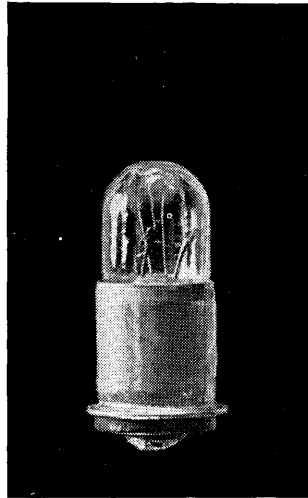


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THE PROCESSOR IDLE LIGHT:



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



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

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

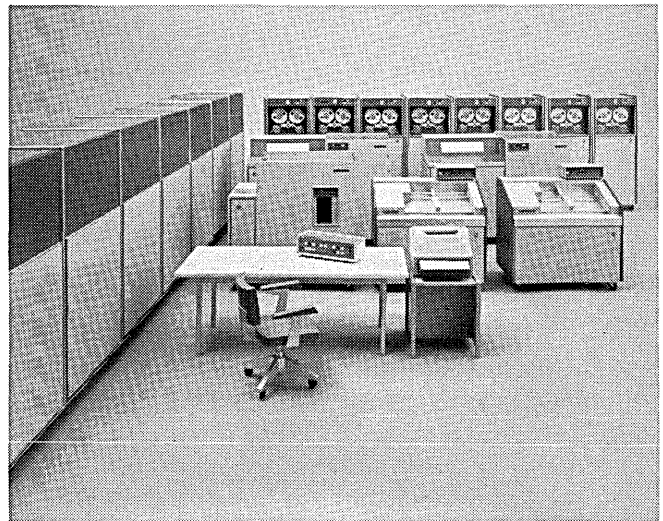
To start with, there's the B 5000's unique way of handling interrupts. To all outward appearances, it simply ignores them. What really happens, though, is this: Through interrupt detection that's built right into the hardware, interrupt conditions are fielded and electronically tossed to the MCP (Master Control Program) for appropriate handling. Meanwhile, the current program goes right along, uninterrupted.

Or, if preferred, another program is run instead. Either way, it all happens so fast that the processor idle light is left completely in the dark.

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

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

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



Burroughs—TM

Burroughs Corporation



important DATES

- The American Management Association's annual Data Processing Conference will be held Feb. 25-27 at the Statler, N.Y.C.

- The 1963 winter meeting of SHARE will be held Feb. 25-March 1 at El Cortez Hotel, San Diego, Calif. The RCA Users will hold their quarterly meeting March 4-5 at the Statler, Boston, Mass.

- The IEEE is sponsoring the Pacific Computer Conference, which will be held at the California Institute of Technology, Pasadena, on March 15-16.

- The IEEE International Conference on Nonlinear Magnetics will be held at the Shoreham Hotel, Washington, D.C., April 17-19.

- The 1963 Spring Joint Computer Conference will be held May 21, 22 and 23rd at the Cobo Hall, Detroit, Michigan.

- The Fourth Joint Automatic Control Conference will be held at the University of Minnesota, Minneapolis, on June 19-21. Sponsors are the American Institute of Chemical Engineers, IEEE, and American Society of Mechanical Engineers.

- The annual International Data Processing Conference and Business Exposition, sponsored by the Data Processing Management Association, will be held June 25-28, at Cobo Hall, Detroit, Michigan.

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

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

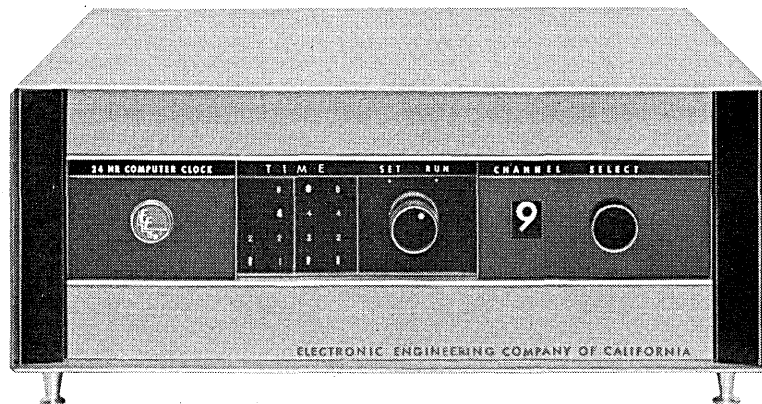
- The Fifth International Automation Congress & Exposition has been scheduled for November 19-21 at the Sheraton Hotel, Philadelphia.

- The 1964 Spring Joint Computer Conference will be held at the Washington Hilton Hotel, Washington, D.C., May 26-28.

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

February 1963

*make your computer
punch this time clock!*



EECO's New DATACHRON[®] Provides Real Time Data To Your Program

Available for the first time... a computer time clock which, under your program control, provides real time data to the computer storage.

Two models available: EECO DATACHRON 790 supplies data on a 24-hour basis; EECO DATACHRON 791 on

an elapsed-time basis. Both can be used with any IBM computer equipped to use 729 Tape Unit Models II, IV, V, VI and the 7330 Tape Unit.

Uses BCD coding referenced to 60 cps AC power frequency. Interrogation time approx. 10 milliseconds.

What DATACHRON[®] Does For Your Computer System

- measures machine usage time
- supplies simple, complete documentation for reports
- sends time to computer storage
- employs same cabling as tape unit
- operates without computer modification
- adds on easily to existing program
- provides reference source for real time simulation problems

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of California

EE2-61R



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CIRCLE 7 ON READER CARD

SPIEGEL

1061 W. 35TH STREET

EXECUTIVE OFFICE

CHICAGO 9

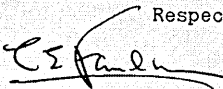
Mr. Les Banks
Vice President Sales Research
Columbia Ribbon & Carbon Co.
Glen Cove, N. Y.

Dear Mr. Banks:

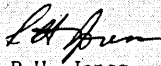
Since the introduction of the Columbia's SF-100 Mylar Ribbon into the Computing Center at Spiegel, Inc., we have used it exclusively for the printing of turn-around documents that are read on our Optical Scanner. The figures printed using the SF-100 Mylar Ribbon have a far better print quality than those printed with a fabric ribbon. Thus, the Mylar Ribbon has contributed greatly to the reduction in the number of rejects that we formerly experienced on our Scanner. It is also much cleaner to handle.

We feel fully confident in endorsing this ribbon for applications of this type.

Respectfully yours,



C. E. Faulkner
COMPUTING CENTER
MANAGER



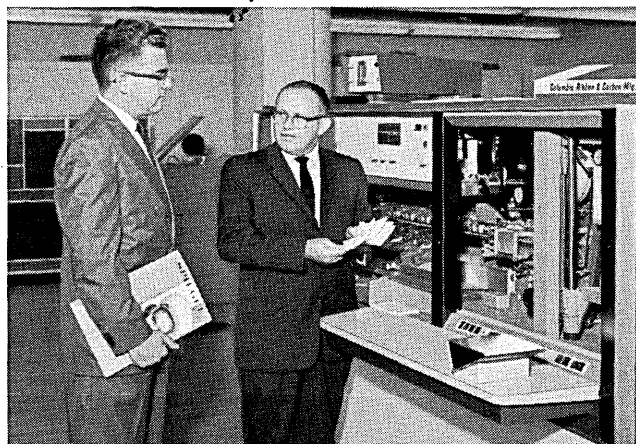
R. H. Jones
COMPUTING CENTER
SUPERINTENDENT

bg

SPIEGEL COMPUTING CENTER COUNTS ON COLUMBIA SF-100 MYLAR* RIBBONS



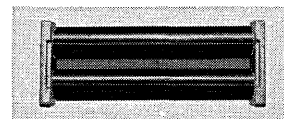
Messrs. Faulkner (left) and Jones examine Columbia SF-100 Mylar Ribbon in high speed chain printer at Spiegel, Inc. computing center.



Messrs. Faulkner (right) and Jones examine turn around documents produced with Columbia SF-100 Mylar Ribbon to be read on Spiegel's optical character reader.

FREE DEMONSTRATION. Spiegel, Inc.—one of the world's largest mail order firms—and other businesses, banks, insurance companies and public utilities are capitalizing on the superior results produced by the Columbia SF-100 Mylar Ribbon. For a free demonstration write: Columbia Ribbon and Carbon Mfg. Co., Inc., 303-2 Herbill Road, Glen Cove, New York.

*DuPont trademark



Columbia
SF-100 RIBBONS

DATAMATION

CIRCLE 8 ON READER CARD

standard heads

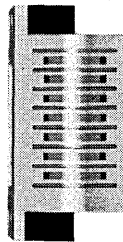
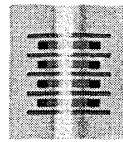
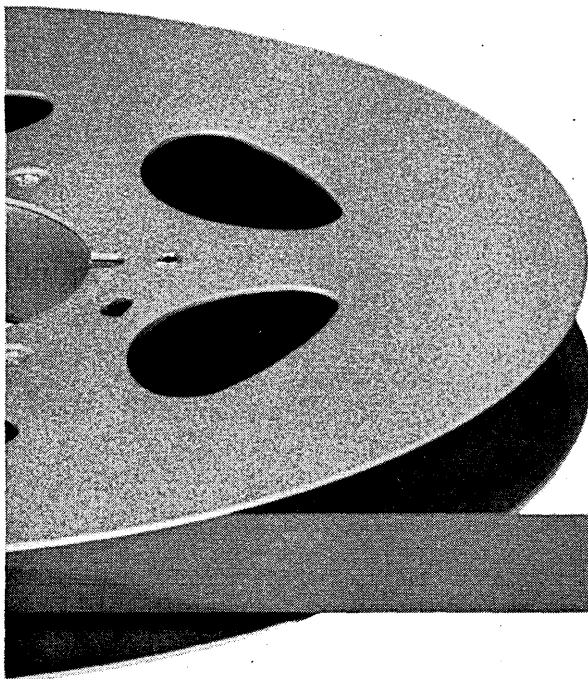
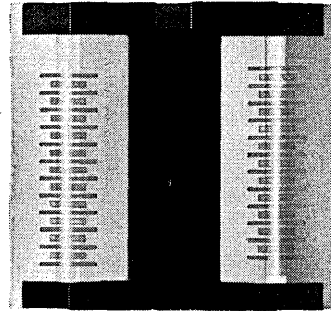
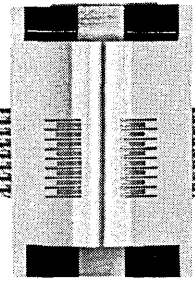
○ by Brush

○ fill 90%

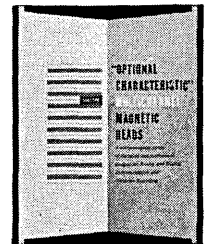
of all

Magnetic Head

Applications



Why such an all-out claim? Because only Brush has kept pace with the many design requirements in recording technology. Continuous analysis of current and future trends enables us to maintain a design improvement program incorporating all field-proven advances in our *standard* heads. It's a must . . . to satisfy *all* customer requirements. The result? We've been able to standardize and meet all but a few highly specialized applications. You save engineering and testing time . . . and money. If you're one of the few with a "special" problem, Brush obviously has the engineering capability and manufacturing facilities necessary to fulfill *your* magnetic head application. With both standard and special heads, detailed mechanical drawings and specifications plus actual electrical characteristics are available *before the fact*. You can accurately predict system performance without costly time-consuming tests. Write now for our design and specification bulletin "Optional Characteristic Heads".



brush INSTRUMENTS

DIVISION OF

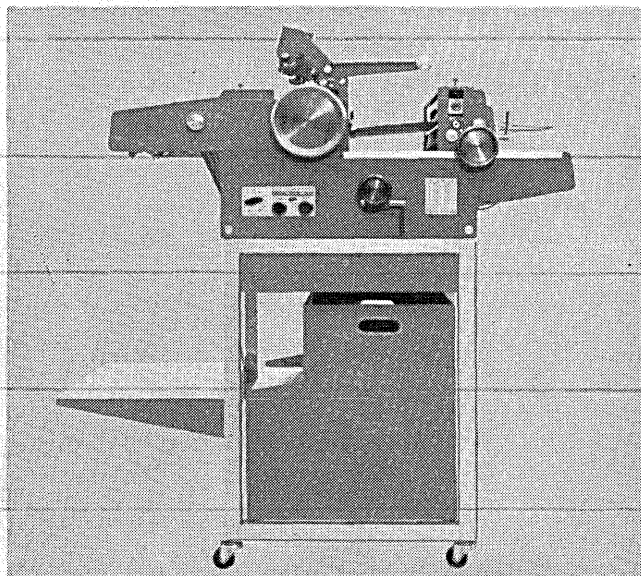
37TH AND PERKINS

CLEVITE
CORPORATION

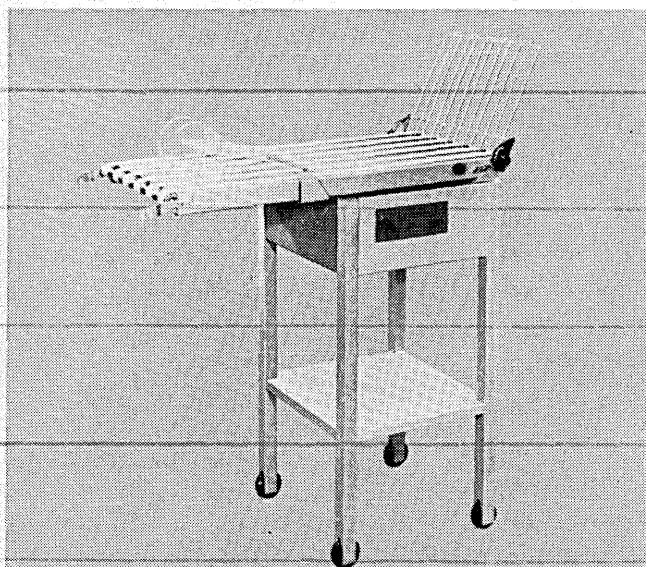
CLEVELAND 14, OHIO

CIRCLE 10 ON READER CARD

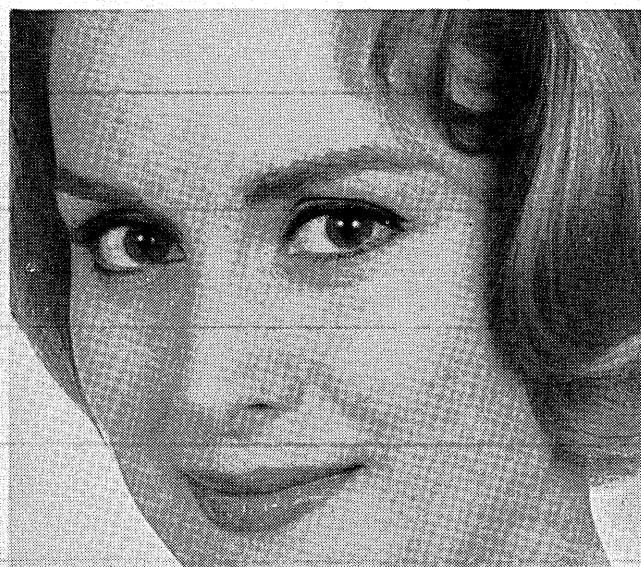
**automate
your
output...**



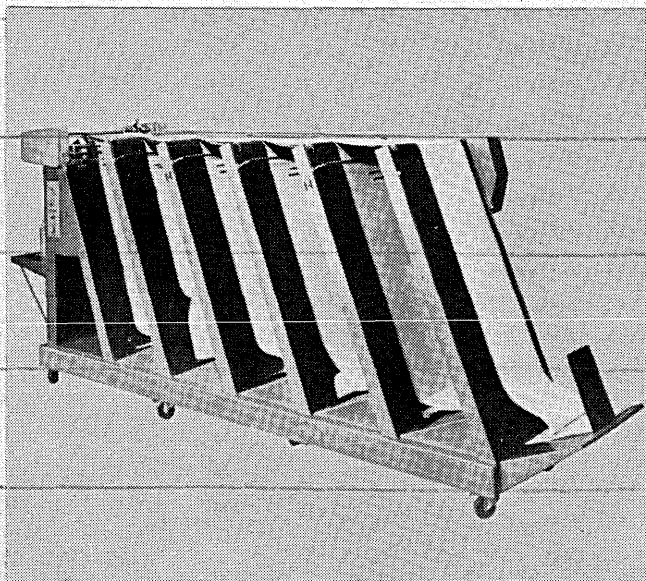
DETACHER for economical high-speed handling of continuous forms and continuous tab cards. Imprints with sharp, clear impressions in accurate register; detaches precisely; slits, removes margins cleanly, sharply; stacks.



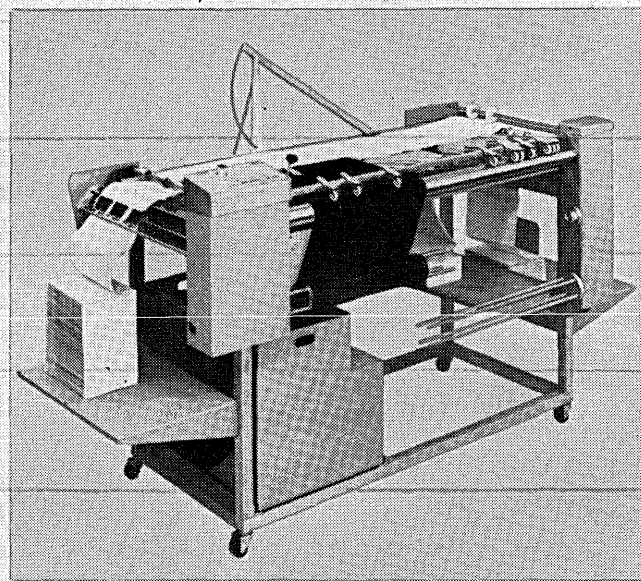
FORMS STACKER—A 'Conveyor Belt' type that mechanizes output of any Moore Detacher. Offers guaranteed sequence stacking. Enables Detacher to handle longer runs without frequent stops for unloading. A real timesaver.



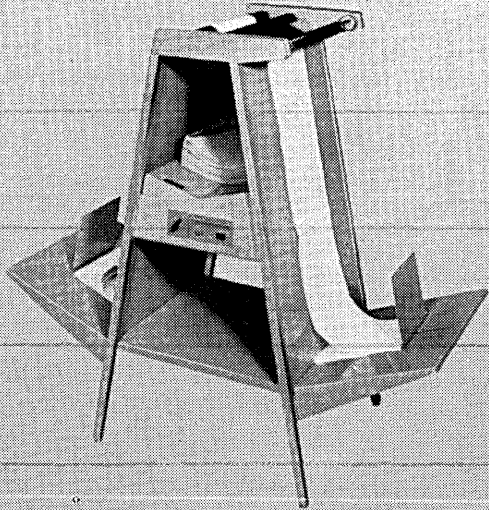
GOOD LOOKS, GOOD TASTE—Moore's line of equipment has been redesigned to perform dependably, and to reflect the distinguished look that is characteristic of today's modern office designed for efficiency and speed.



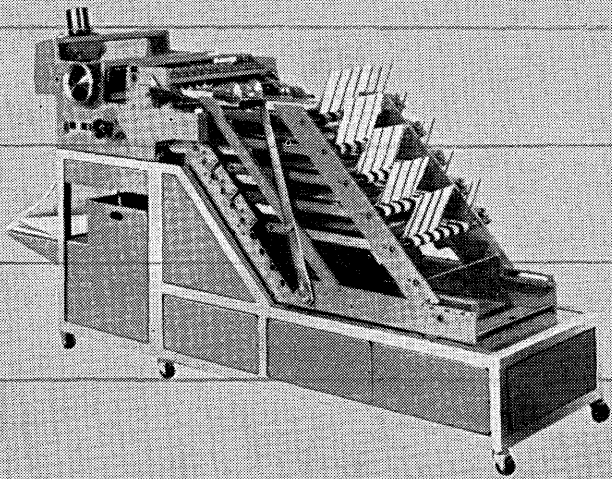
MULTI-WEB DECOLLATOR Model 8210 decollates multi-part continuous forms in one operation. Slits 1 or both margins; removes and rewinds carbon on spindles; separates, stacks all parts continuously into neat piles.



DELEAVER Model 230—Ideal for any deleaving-detaching operation where set detaching is required. Some parts can be folded continuous while 1 or more parts are detached. Use in tandem with any Moore detacher.



FORMS DECOLLATOR—The fastest decollator made for removing carbons from multiple-part continuous forms. Has a slide-out shelf for easy loading. Handles various sizes without adjustments. Refolds into neat packs.



DETACHER-SORTER offers off-line sorting; combines sorting with detaching of continuous forms. Handles 1-part forms and random-sorts the detached sheets into 1 of 6 pockets by optical scanning preprinted marks.

**with Moore's
new forms-
handling
equipment**

These are some of the machines in Moore's family of forms-handling equipment—the industry's most attractive.

Each unit is designed and built to save time and cost in high-speed runs, by the world's leading manufacturer of forms and systems.

The machines have the clean modern design line typical of the styling of Walter Dorwin Teague Associates, and harmonize with any office decor.

This equipment is the hallmark of efficiency and control, with high operating speeds built in for quick handling of output. The machines are compact and sturdily constructed for trouble-free heavy-duty operation.

There is a Moore machine for every after-writing operation, dependably built to promote fast, smooth, uninterrupted work flow in processing of data.

Have you problems in handling forms? Ask the Moore representative for details of these machines (and others not shown) in the complete Moore line.

'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

letters

with spice and sugar . . .

Sir,

Let's cut out the childish palaver of the so-called experts (RAND Symposium 1962), whose caliber can be questioned by anyone without inside knowledge. I am sitting on the receiving end, having to live with the software garbage manufacturers are turning out these days, and things look different here.

Why don't these so-called experts sit down and make what they are now selling work and optimize the h... out of it, instead of worrying about tomorrow? I have heard of better high school debates!

What was voiced that hasn't been "old hat" for a long time, and what useful knowledge did the participants take home?

Outside of wasting so much precious space on such useless hogwash, I think you are tops in your field and I look forward to more useful information on your pages.

LOU HAAS
Cocoa Beach, Florida

and cheek in tongue . . .

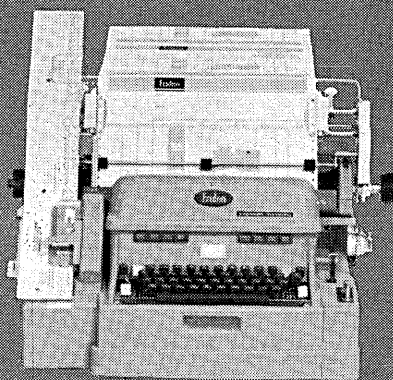
Sir,

Was it with tongue in cheek that you presented the December issue of *Data-mation*? Notwithstanding the usual excellence of its content, its inimitable humor was refreshing during the end-of-year schedule bursting rush.

Mr. Patrick's editorial eulogizing the standards' effort followed by the "Bibliography of Glossaries" was a Shavian stroke. If "I'm Bigger (than) Most" can't agree on one from among nine of their own choices, we indeed face a hapless task.

Alas, not even "GIRLS" have remained unscathed. And all along I thought they were made of "sugar and spice and everything nice." Perhaps the Messers. Postley and Buetell, authors of "Generalized Information Retrieval and Listing System" could be persuaded to market the files from which they drew their example! Could advanced data reduction techniques, perhaps, reduce the availability of Olga Pryzbylski—such proportions and bank account should not go unnoticed? Miss D. Dumm and Miss E. Dummer are obvious in their unfortunate choice of acronym. Recompiling might help their cause.

STEPHEN Z. GUNTER
Jet Propulsion Lab., CalTech,
Pasadena, California
P.S. The best glossary is undoubtedly



PAPERWORK

How Friden gets rid of it for this top insurance agent

"There's a great deal of paperwork in the insurance business," says Mr. William Malcolm of the Malcolm Agency in Milford, Connecticut, "but now I get all my necessary papers created without the work. They are prepared on my Friden Flexowriter®."

The Flexowriter automatically prepares policies, promotional literature, insurance surveys, invoices and statements for Mr. Malcolm. The machine even prepares material for photo-offset printing.

All necessary information is stored in punched tapes. When fed into the Flexowriter, the machine automatically types the information at 100

words a minute, error-free.

The results? "I spend more time selling and servicing my customers; my staff does too," says Mr. Malcolm. "We've added 300 new policies in the past year without increasing the staff to handle the great amount of paperwork usually involved."

Paperwork? Let Friden cut it down for you. Call your local Friden Systems man, or write: Friden, Inc., San Leandro, California.

Friden

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

CIRCLE 12 ON READER CARD

contained in *Computer Programming Handbook* by Robert Nathan and Elizabeth Hanes, 1962, Prentice-Hall, Inc., Englewood Cliffs, N.J. Reason: R. Nathan is my boss.

no! mine's better . . .

Sir,

I think it quite commendable that you published such an extensive bibliography of glossaries. I am sure it will be useful to the general public. However, I do feel personally slighted for you left out the most important one.

In my book, *Computer Logic*, 1960, Prentice-Hall, Inc., I have combined several other glossaries and added many definitions of my own . . .

IVAN FLORES
Computer Consultant
Norwalk, Connecticut

ALGOL: a growing glow

Sir:

The facts concerning ALGOL development are these:

1. X3.4 has selected three languages for processing as American standards: ALGOL, FORTRAN, and COBOL.
2. Work is just starting on FORTRAN; will soon start on COBOL.
3. IFIP ALGOL Working Group 2.1 had its first meeting in Munich August 28-30 and plans:
 - a. to propose ALGOL-60 as an international standard.
 - b. to define I-0 conventions for ALGOL-60.
 - c. to define an ALGOL-60 subset.
 - d. it noted that many new ALGOL-60 compilers are being created in both the United States and Europe.

R. F. CLIPPINGER
EDP Division,
Minneapolis-Honeywell
Wellesley Hills, Mass.

Datamation vs. Russia et al

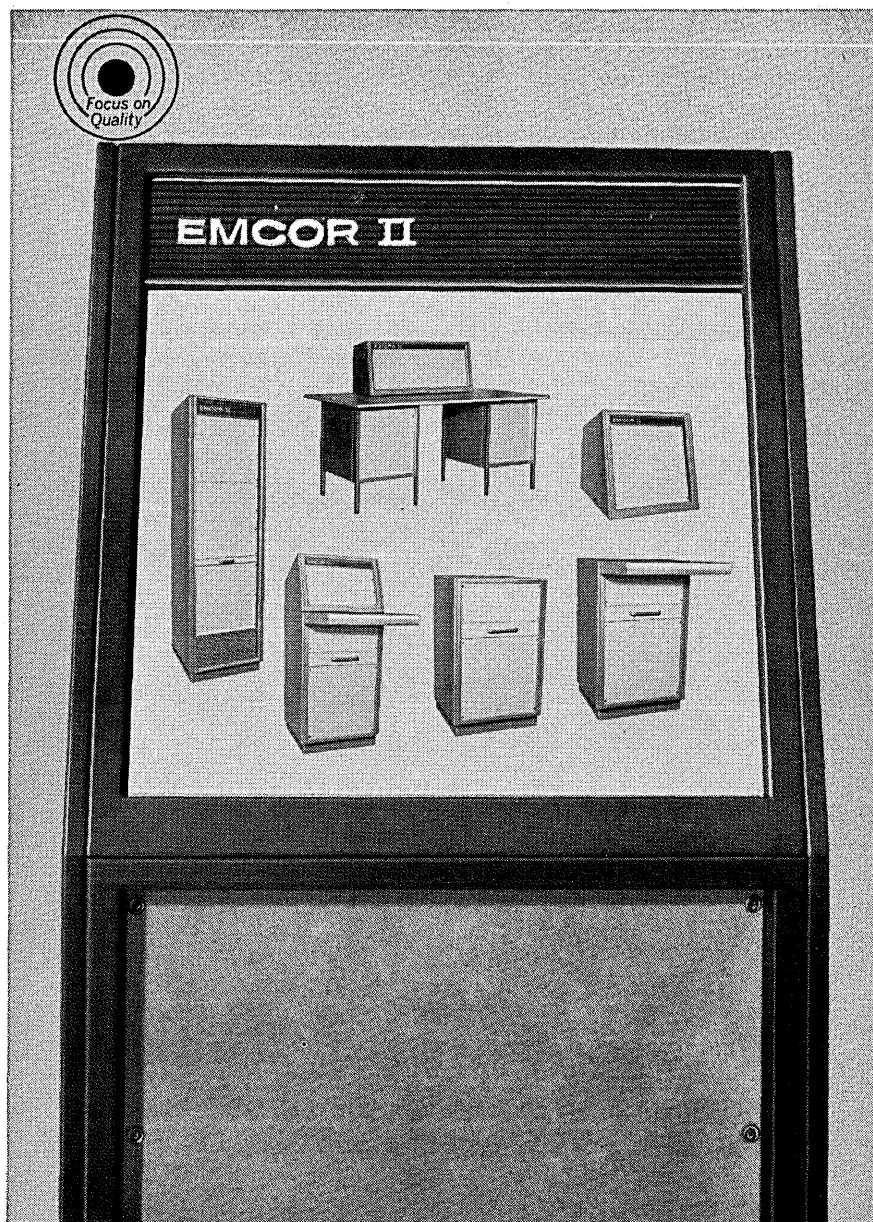
Sir,

My hat is off to you for your editorial on "The Game of Limited Exchange" (October, 1962). This is one of the more realistic outlooks on the Russian attitude towards exchange programs of any type that I have read.

Your summary of a solution to this attitude, by inducing a greater willingness to communicate by screening the literature sent to non-allied and Iron Curtain countries, would bring larger results if more institutions cooperated.

JOHN HOY
Uniform Tubes, Inc.
Collegeville, Pennsylvania

February 1963



EMCOR[®] II Modular Enclosures hold the answer to your enclosure problems

Your imagination creates the custom look for your equipment with EMCOR II Modular Enclosures. EMCOR II Enclosures have basic points of modification which provide each customer with product individuality. Select recessed, flush or extended panel mountings; choice of trim or grillwork extrusions; nameplate style variations, double width frames, pontoon bases and side panels—all designed to give you custom type enclosures without the cost of custom fabrication. A few of the many EMCOR II Enclosure configurations are shown above. Contact your local Ingersoll Products Sales Engineering Representative or write for full details.

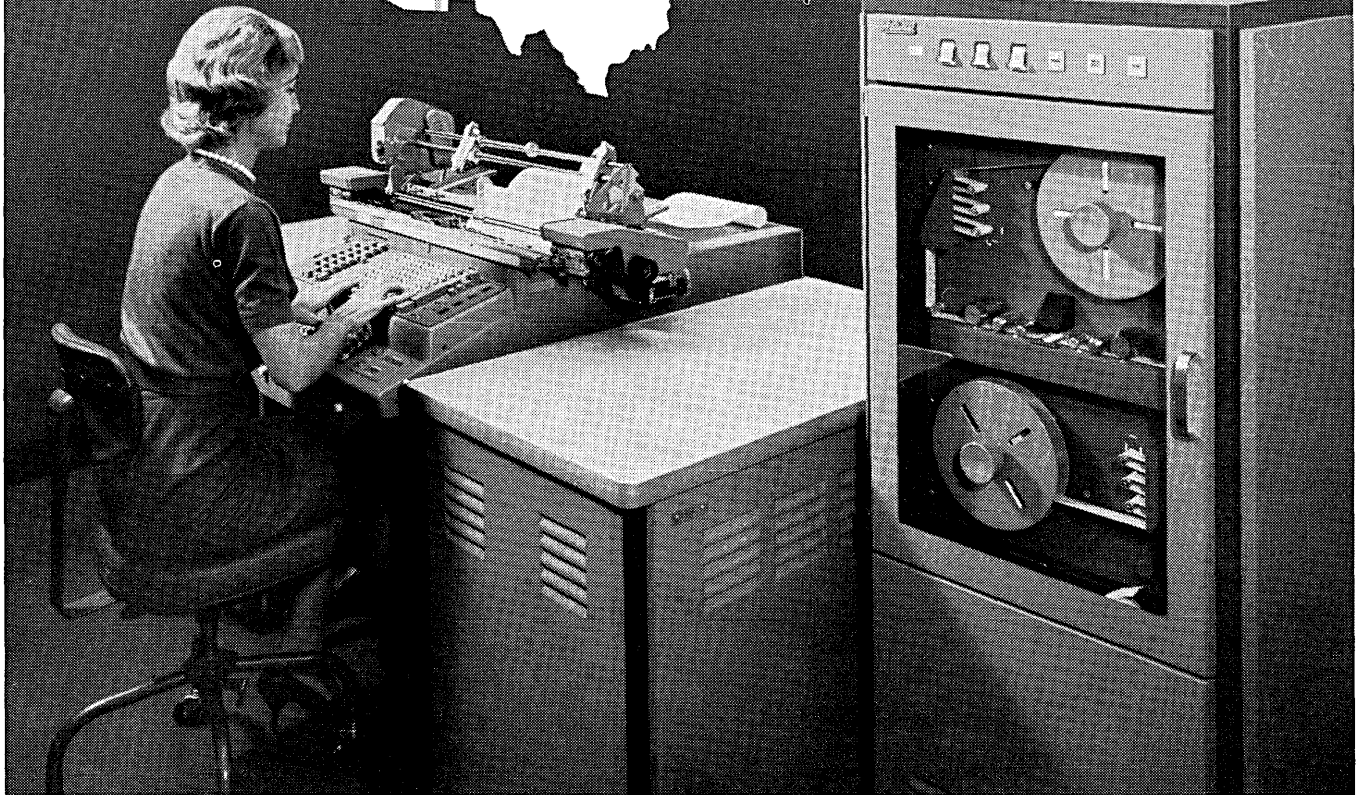
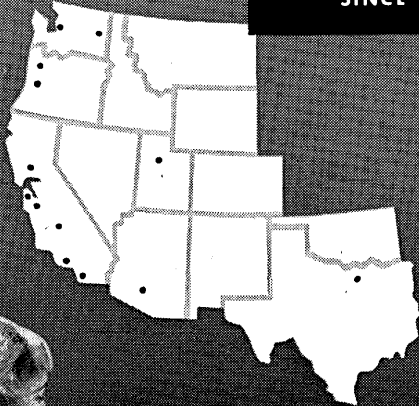
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EMCOR II
LITERATURE.



EMCOR—The Original Modular Enclosure System By
INGERSOLL PRODUCTS
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1000 W. 120th ST. • DEPT. 1248 • CHICAGO 43, ILL.

CIRCLE 13 ON READER CARD

Soulé
SINCE 1911



"Why we chose the NCR 390 Computer." SOULÉ STEEL COMPANY

A major manufacturer and erector of steel and reinforced concrete structures. Headquarters, San Francisco.

"In our opinion 'experience is a good teacher.' This may be an old cliché but we feel it is a good one. We have used NCR Accounting Machines for years. We have always found the equipment to equal or better the standards specified by NCR representatives. Our experience with the NCR 390 is no exception.

"Two major factors dominated our thinking and planning for the 390: ONE: We were able to modify existing equipment and utilize it to provide input for the

computer. We are able to continue processing daily transactions and as a by-product provide punched paper tape for high-speed processing of volume distribution data into summary form. This enables us to speed closing of cost records and provide management with faster reports.

"TWO: The NCR 390 utilizes a record that can be processed electronically and at the same time furnishes a historical record for reference. We like records that can be readily referred to for cost informa-

tion and other data necessary in estimating and bidding on contracts.

"We now consolidate accounting work that was previously done in the field and other branch locations. We feel the NCR 390 is a practical, low-cost answer to our data processing needs."

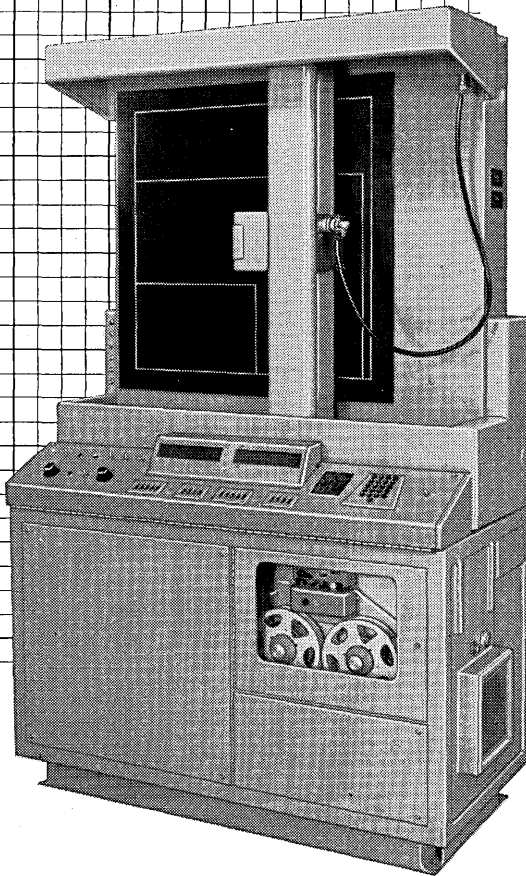
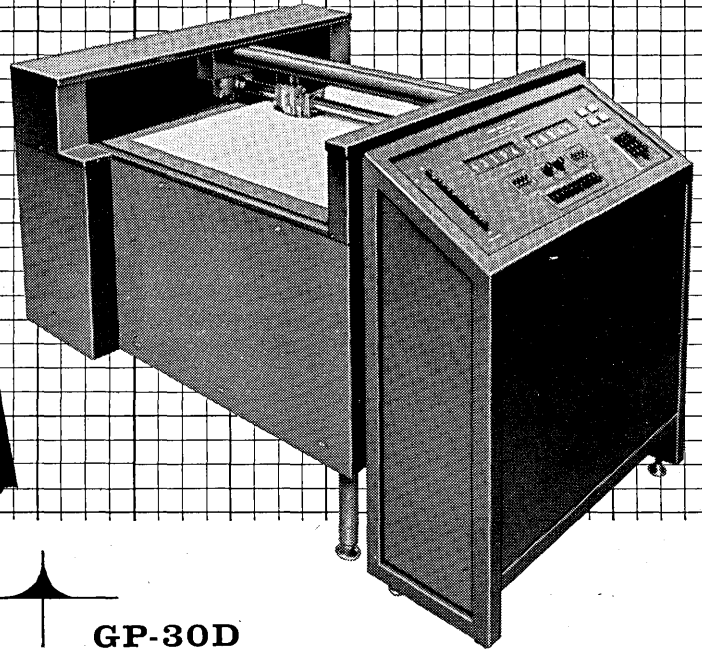
Edward Lee Soule, Jr., President
Soulé Steel Company

NCR PROVIDES TOTAL SYSTEMS—FROM ORIGINAL ENTRY TO FINAL REPORT—THROUGH ACCOUNTING MACHINES, CASH REGISTERS OR ADDING MACHINES, AND DATA PROCESSING
The National Cash Register Co. • 1,133 offices in 151 countries • 79 years of helping business save money



DATAMATION

**Gerber
Plotters**
... accuracy and speed
combined with
**Unprecedented
Reliability**



GP-30D

Gerber Commercial Plotter TRIED AND PROVEN

Plots to $\pm .002''$ —repeats to $\pm .001''$ —over full 30" x 30" plotting surface. Pinpoint precision around the clock, seven days a week.

Max. slewing speed: 20" per second.

Plotting speeds: 90 points per minute up to 3" spaced points from IBM cards . . . 42 pts. per min. at random . . . 90 pts. per min. with paper tape input.

Inputs: magnetic tape, punched tape, punched cards keyboard.

GP-30DV

Gerber Militarized Plotter NEW AND PROVEN

This is the military version of GP-30D, with a vertical table, but the same basic design and capabilities. It is built to MIL-E-16400-D (for ship-board use) as modified by customers' requirements. Also available with 45" x 60" table.

So successfully did the commercial plotter—the GP-30D meet all requirements for plotting accuracy and reliability that it was relatively easy to adapt it to the most rigorous military specifications.

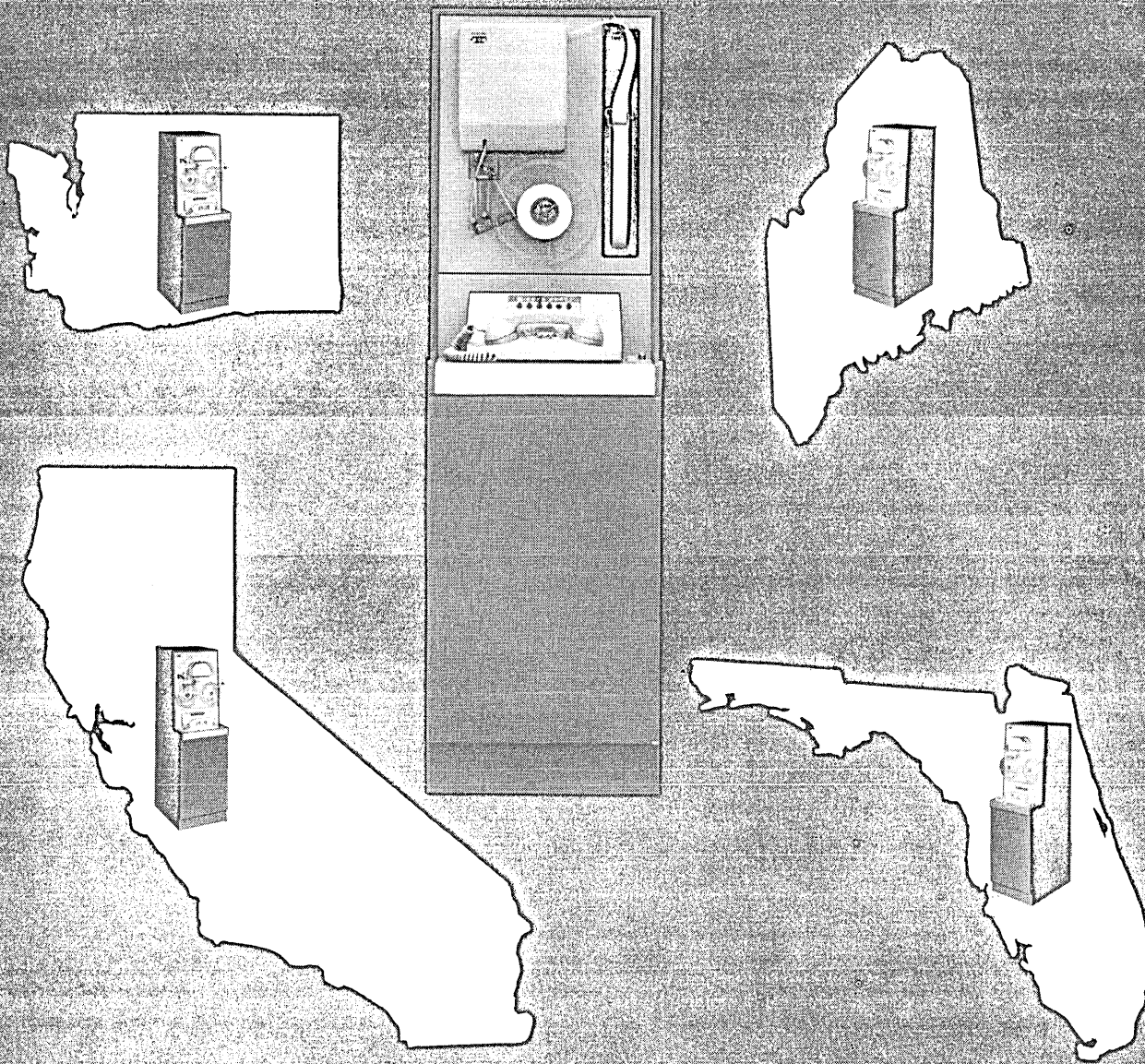
The Gerber Scientific Instrument Company will be pleased to send you details, specifications and costs on any plotting instrument—standard or custom designed—from 30" x 30" to 6' x 12' or larger. Let us send you literature.



THE GERBER SCIENTIFIC INSTRUMENT CO.

P. O. Box 305 • Hartford, Conn.

Branch sales and service offices at: Washington, D.C. RE 7-6992 • Los Angeles, Calif. MU 1-5745 • Toronto, Canada AX 3-7011



How to centralize a decentralized operation

Now you can send 50,000 bits of data across the country in little more time than it takes you to read this text. How? With Teletype tape-to-tape equipment using conventional telephone lines. These Teletype consoles are designed to eliminate high-volume communication problems often associated with data processing systems involving multiple locations.

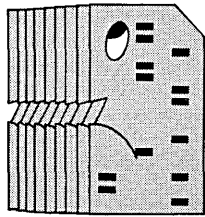
The punched tape from the receiver console can be fed into a computer for further processing. This means that data acquisition and other computer functions can be programmed and coded at remote locations, then transmitted to the home office, untouched by human error.

Made for the Bell System and others who require the highest reliability at the lowest possible cost, Teletype tape-to-tape equipment is quickening the reflexes of some of the country's largest data processing centers.

Find out how you can integrate Teletype high-speed tape-to-tape equipment with existing systems or those being planned. Write to Teletype Corporation, Dept. 81B, 5555 Touhy Avenue, Skokie, Illinois.



TELETYPE®
CORPORATION SUBSIDIARY OF Western Electric Company INC.



Let's cut the cards

(like out)

EECO'S computer tape conversion service converts directly from tape to tape

EECO'S Computer Tape Conversion Service converts data directly from format to format at one-eighth the cost of conversion via cards! And it's as fast as moving paperwork from your IN to your OUT tray! Eliminates the needless cost and time of punching and reading cards. EECO is equipped to accept tapes from any of the following computers and directly convert them fast and economically to a format designed for any of the others:

IBM 650/705, 704, 705, 7070, 709, 7090, 1401, 1410

Burroughs
205, 220, B5000

RCA 501, 301/501 compatible, 601/501 compatible

Remington Rand
Univac I, II, 1103 Scientific Series, 1105, Solid-state 80 and 90

Paper Tape
5-, 6-, 7-, or 8-level tape, including Friden-Flexowriter, Teletype, NCR and IBM 1620 Paper Tape. (Any coding can be read or punched.)

Of course, we can accept and generate IBM 80-column cards with Hollerith coding, too.

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 **Electronic Engineering Company**
of California

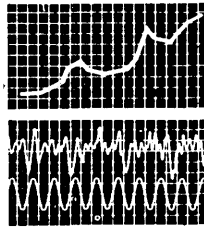
1601 E. Chestnut Avenue • Santa Ana, California • Phone: 547-5501 P.O. Box 58 • Representative in Western Europe and Israel: Electronic Engineering S.A., C.P. 142 Fribourg, Switzerland.

EE 2-57



CIRCLE 42 ON READER CARD

DATAMATION



BUSINESS & SCIENCE

GUESSTIMATES & THE EDP MARKET

The favorite of all New Year Bowl games is a contest requiring no particular skill, practice sessions or teamwork. Price of admission is nominal and regardless of the crowd, everyone sits on the 50 yard line. The name of the game is "Projection--EDP."

The rules are surprisingly simple: check the scores of last year's game and raise them beyond the scope of reason and a notch below fantasy. The highest number wins.

As in previous years, the '63 Bowl Game produced an astonishing variety of numbers suggesting a potential bonanza for all firms presently in the field. Despite the fact that the majority of computer manufacturers admit to heavy losses which they optimistically hope may be somewhat reduced in '63, facts of this nature are omitted from the rosy glow of recent projections.

A brief sampling of such guesstimates indicates a rise in computer sales for '63 ranging from 20-100 per cent, an increase in the total market from \$3-\$5 billion and manpower requirements expanded from 100,000 in '62 to 150-250,000 this year. Estimates on the number of installations predict a jump from the '62 figure of 8,500 to a '63 total ranging from 10-22,000.

The non-availability of reliable statistics on the computing field is indicated primarily by the lack of definition of what elements or businesses make up the industry. The Dept. of Commerce, for example, estimates that '63 shipments will reach a high of \$1.7 billion or about 10.5 per cent over 1962 but included in this estimate are various "accounting machines, cash registers, adding and calculating machines," and a strong suggestion that all forms of "self-regulated equipment and machines" used in "precision metalworking, machine and process control . . ." are also included.

The largest customer of computing equipment, the Federal government, plans to spend "15 per cent more in 1963 for automatic data processing equipment than it spent in 1962." Total expenditures are estimated by BuBudget at approximately \$688 million for 170 new machines bringing the government's total to 1,170. Unfortunately, the aforementioned expenditure includes salaries, maintenance, site preparation and supplies, in addition to the hardware, with no breakdown as to rentals vs. purchased machines.

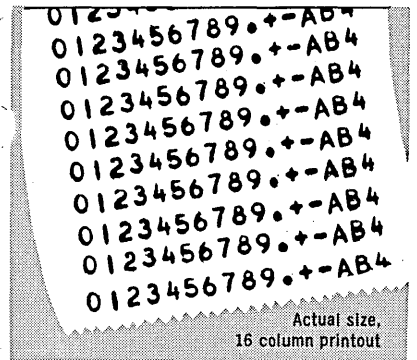
Most important in this crowded statistical vacuum is the corporate policy of IBM which forbids the announcement of installation figures. Controlling the major segment of the edp market, no accurate estimate

February 1963

19

MONROE 

A DIVISION OF LITTON INDUSTRIES



1040 Lines Per Minute Solid State Printer 4 Line Coded Input

MONROE DATA/LOG[®] MC 10-40

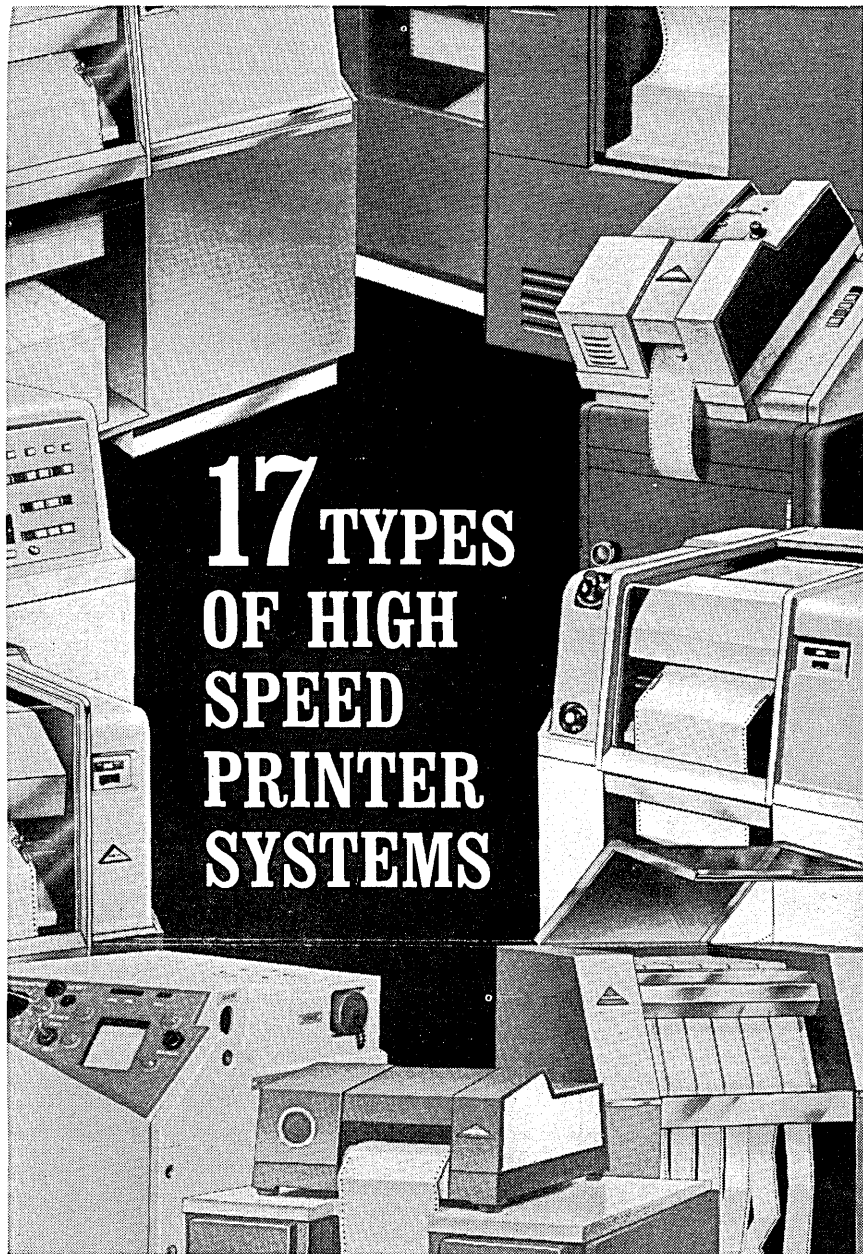
- 4 COLUMNS \$1570.
- 8 COLUMNS \$1760.
- 12 COLUMNS \$1950.
- 16 COLUMNS \$2140.

- Printing rate: 1040 printed lines per minute, 17.3 per second
- Input character code: Any 4 line coded input
- Column capacity: 4, 8, 12, or 16 columns
- Printable characters per column: 15 printing positions and blank
- 0 through 9 plus 5 special characters (+, -, decimal, A and B are standard)
- Character pitch: 10 characters per inch
- Line spacing: 6 or 3 printed lines to the inch
- Paper: 2 1/4" width, roll or folded
- Ribbon: 2" wide, 30 yards long, nylon black only
- Mounting: Rack or self enclosed
- Dimensions: 12 1/4" high, 19" wide
- Construction: Modular, solid state, printed circuit boards
- Power input: 95 to 130 volts, 60 cps
- Self-contained regulated power supply
- Option: Register available for columns parallel, bits parallel, pulse input
- Transfer time: 2 microseconds or less.

Warranty: One year's parts and maintenance by Monroe, on yearly maintenance contracts thereafter.

DELIVERY: 30 DAYS

Electronics Components Division
Monroe Calculating Machine Co., Inc.
60 Main Street, San Francisco, California



17 TYPES OF HIGH SPEED PRINTER SYSTEMS

And each of these systems may be adapted to meet the particular requirements of the data processing equipment with which it is to be associated.

Included are various types and sizes of Line Printers, High Speed Systems, Listers, Print Stations, Multiple Tape Units and Automatic Magnetic Ink Encoders... also special Airborne Systems, Military Message and Foreign Language Printers.

Under development are a Bilingual Printer System, a Low Cost Printer System and a MICR Printer System. Why not get your next printer from Anelex, the supplier to 56 computer manufacturers throughout the world. Write for further information today.



MAJOR EDP EQUIPMENTS

ANELEX[®]

155 CAUSEWAY STREET, BOSTON 14, MASSACHUSETTS

CIRCLE 17 ON READER CARD

DATAMATION

CIRCLE 41 ON READER CARD

of the size of the industry (defined or undefined) is possible without IBM's cooperation.

Finally, the two sources from which professionals might expect reasonably accurate statistical reports are the Association for Computing Machinery (ACM) and the American Federation of Information Processing Societies (AFIPS). Unfortunately, both organizations remain embarrassingly silent.

CEIR
DOES IT AGAIN!

Reviewing its operations for 1962, CEIR announced last month that it has doubled its losses over the previous year despite a 50 per cent increase in gross income.

Losses for the company began in earnest in 1960 (\$259,188); tripled in 1961 (\$967,862) and last month, CEIR reported a whopping '62 loss of \$1,909,293.

Important contributors to last year's financial summary is a write-down of the book value of CDC's 1604/160A, purchased and installed in the Los Angeles office last year and scheduled for removal this year. A loss of \$384,365 is attributed to this equipment. Secondly, the cancellation of two STRETCH machines resulted in CEIR providing six programmers for one year on software development to be used both by IBM and CEIR, and which CEIR has charged as a loss of \$72,000.

President Herbert Robinson told shareholders that losses on operations in the second half of '62 were only half those of the first half and that a profit is being made in the first quarter of FY '63.

Robinson explained, "While the company has been through a most trying period--during which it has extended itself physically and financially to a degree which incurred calculated risks of considerable magnitude and caused heavy losses over the last two years--it has now completed this phase of its growth and is in a strong position to move steadily forward from a solid base."

A final footnote for skeptical computerites: following announcement of their annual report, CEIR stock climbed from 6½ late in December to 8½ in mid-January.

SPIFFINESS
& NEW RATES AT CSC

Unquestionably one of the more sprightly and costliest computer consultant's offices may be viewed by the less fortunate masses at Computer Sciences Corp. in El Segundo, Calif. Opened late last year as an accompaniment to the first 1107 installation, CSC's decorating bill is estimated between \$150-200K (a final total was not in at press time).

To recover from the move as well as meet a payroll for over 200 employees, CSC president Fletcher Jones offers time on the 1107 in an unusually packaged departure from the customary prime shift concept.

The new CSC price schedule is based on convenience of scheduling (to CSC) as well as the amount of time or size of contract purchased. However, no contracts or firm prediction of time are required in advance of a customer using the machine. Prices and discounts are fixed on a monthly basis after the fact.

A basic price of \$450 per hour is charged for 24-hour jobs from \$0-5K contracts. For \$5-10K, the rate is \$438.75; \$10-20K at \$427.50; \$20-30K at \$416.35;

\$30-45K at \$405, and for contracts in excess of \$77K, a minimum rate of \$360 is offered. In the upper bounds of the scale, \$550 per hour is charged for non-periodic runs at precise times known in advance; \$575 for periodic runs at precise times known in advance, and \$625 for frequent shots on short notice.

To help overcome the reprogramming problem for 90 users, CSC will offer FORTRAN IV. Demonstration problems are now being accepted and if checkout is completed soon, CSC may announce the compiler's availability before IBM, an interesting accomplishment.

THE MANUFACTURERS:
SOME HIGH & LOW LIGHTS

IBM: Revenue for '62 estimated at a poverty-stricken \$1.9 billion and net profit about 239 megabucks. The few flies hovering in this splendid ointment include a slightly diminished backlog of 1401 orders (estimated at about 7,000 last year) and the usual Justice Department headaches such as last month's announcement that IBM will divest itself of any remaining capacity to produce more than half of the nation's tab cards.

CONTROL DATA: The often-discussed transitional stage for CDC should be experienced in '63. Stock price fluctuates at about 53 times estimated earnings with a listing on a major exchange expected early this year. Three major questions, however, are: How many 3600s can be sold in '63? Can the rate of 12 160-A orders per month be maintained? Can a weenie meet its specs for a super (5.5 megabuck) computer when a super organization failed?

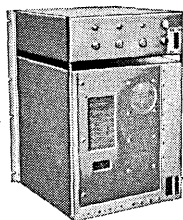
RCA: With the first 601 finally on the air at N.J. Bell Telephone, foreign orders for the 301 and 501 now at 158, and a total of more than 290 systems shipped, the prospects for RCA EDP appear promising although skepticism may still be warranted. To be sure, the immense early losses of the division will be substantially reduced BUT the initial boom of foreign sales are not likely to be sustained at a comparable rate; a profit-earning increase in 601 sales will require additional investment in the scientific market, and RCA is not about to repeat its pre-1960 investments. Finally, the 301 market just isn't unlimited. RCA's solution: a fast, medium-scale entry due for announcement early this year.

HONEYWELL: An annual rental income from its 400 and 800 systems estimated at a promising 12 megabucks in '62 is still far behind the 27 megabuck output reported for the division last year. Honeywell, however, has firmly committed itself to producing a profit by '64, and shows comparatively little restraint in sustaining its rate of investment (i.e., last month's announcement of an expansion in marketing activities).

PACKARD BELL: Despite a record sales volume of 49.6 megabucks for the FY '62, Packard Bell reported a net deficit of 1.4 megabucks, due to losses on fixed government contracts. Accounting for slightly better than 20 per cent of the firm's business, the computer division reported sales of 11.4 megabucks, with a backlog of 3.8 megabucks at the end of the fiscal year. Installations of the PB 250 are over 130, an increase of 30 since June. Orders for the 440 are still to come.

NEW RCA MEMORY SYSTEM OPERATES FULL CYCLE IN 375 NANOSECONDS

**Utilizes New Microferrite Arrays
For Superior Performance At Lower Cost**



RCA's new Microferrite memory system achieves ultra-high speed and high reliability in a compact, plug-in package. This new RCA memory system uses standard RCA Microferrite cores and advanced assembly techniques. Here are some of the outstanding advantages of this new, complete memory system:

- **Broad Application**... Can be used for scratchpad or buffer memory applications ...available in capacity ranges from 32 to 1024 words, 1 to 72 bits.
- **High Efficiency**... At drive current levels below 350 ma the new RCA memory system delivers outputs to 50 mv per bit and has superior noise discrimination.
- **Inherent Reliability and Ruggedness**... Mechanized production techniques permit more precise control of each fabrication step...produce a rugged, high-reliability structure designed to meet military mechanical and environmental specifications.
- **Important Economy**... Use of Microferrite cores and mechanized production techniques keep Microferrite memory system prices lower than other systems of comparable speed.
- **Immediate Adaptability**... Standard components and circuits used in the new RCA Microferrite Memory System make it compatible with existing systems.
- **Plug-in Design**... Each stack, all associated circuitry and entire memory system are "plug-in-designed" for fast, easy installation—minimum down-time.
- **Quick Delivery**... RCA can deliver the standard Microferrite memory system in short delivery cycles.
- **Custom Systems**... RCA Memory Specialists are ready now to custom design systems of 1/2 usec or less to meet your requirements. Whatever your requirements, custom or RCA standard, your

local RCA Semiconductor and Materials Division Field Representative is prepared to provide a completely coordinated application service for all RCA Computer Memory Products. Call him today at your nearby RCA Field Office.

For technical information on new RCA Microferrite Memory Products and Systems, write RCA Semiconductor and Materials Division, Commercial Engineering, Section FD1, Somerville, N. J.

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THE MOST TRUSTED NAME IN ELECTRONICS



Super Phone

It's an apt name for a DATA-PHONE data set; for it can telephone machine talk as well as people talk.

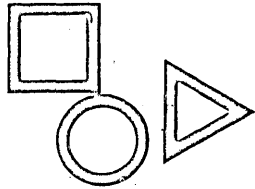
It gives business machines a voice to send great volumes of data anywhere there are regular telephone lines.

Anything that can be put on punched cards or tape can be telephoned automatically and accurately—16 times faster than people talk in normal conversation.

DATA-PHONE service can save time and money for your business... give you tight control of operations. Talk to one of our Communications Consultants about it. Just call your Bell Telephone Business Office and ask for him.



Bell Telephone System



EDITOR'S READOUT

BUSINESS DATA PROCESSING: HURRAHS & HURDLES

Holding promise of economic salvation for many computer manufacturers, the burgeoning field of business data processing may be compared to green apples on a tree being plucked and eaten. The result is a satisfied appetite followed by an embarrassing stomach-ache. Apples, of course, are insensitive to their disposition and in due course, the tree will replenish its supply.

While the analogy may not be applicable to all hungry men, it focuses on the core of one of the industry's more obvious trouble spots: a mushrooming expansion of new business applications with virtually no preparation, or at best, inadequate education and training.

The explosion in sales of business computers has been comparatively recent and to many veterans in the field, it was unexpected and almost unbelievable. An estimated 8,000 small machines (1401-1410 class) are presently on order with the surface of the market barely being scratched. Within two years it is expected that more than 25,000 computer installations will be tallied in this country, a 200 per cent increase over existing machines on the air. In personnel, a need for over 150,000 programmers is projected for 1965. About 75 per cent of available machine time and accompanying man years will be charged exclusively to business applications.

Reasons behind this enormous increase in machine sales are both valid and foolish. Certainly, greater efficiency and economies in numerous clerical operations and accounting procedures may be expected but instant decision making, major cutbacks in personnel, and programming for the layman are at present and for the next few years, fanciful pipe dreams.

The corporate executive, however, must learn his lessons after some pain and much cost. The manufacturer's salesman is hardly the most honest of educators and the somewhat better informed consultant frequently sacrifices a high moral principle for the sake of a promising contract. Quite often, feasibility studies and their evaluation are delegated to staff accountants, tab room supervisors and other representatives of the "great unwashed." While their honesty may be less questionable than salesmen or consultants, their inability to cope with the problem generally results in misery for both manufacturer and user.

Psychological motivations for purchasing machines vary somewhat from economic reasoning, but are often far stronger and tend to override the fear of venturing into an unknown and costly area without qualified support. Foremost and yet the oldest of rationalizations is the fact that "Jack has one in his shop." The equally important fact that Jack may be in serious trouble with his machine is easily overlooked particularly since Jack doesn't like to talk about his problems.

Secondly, the proliferation of unrealistic publicity found in the consumer press plays an important part in soothing economic fears and prompting the purchase of a "magic brain." Not only is the owner of edp equipment painted as a suave, modern day dignitary, but he has also joined the scientific elite equipped to vary the parameters in sausage recipes and simulate moon landings. Finally, the machines are eye-fetchers; that is to say the consoles and tape drives are sterling examples of sprightly packaging. The main frame is rarely noticed. As the chrome on Detroit products overshadow abominable gas mileage, so does the console's blinking lights remove thoughts of serious edp problems.

The result is that business installations have exceeded a reasonable rate of growth and the pains accompanying overanxious progress are just beginning.

The programming problem, for example, is the most obvious. COBOL is being used in a few installations but at present, hardly fulfills its well-advertised reputation of either compatibility with machines other than the one it was designed for, or simplicity of use. Professionals with many years of experience are required to write COBOL programs and debug them. High

school graduates equipped with a self-teaching manual can lead an edp installation back to coding in octal absolute.

A second problem is that of recruiting, training and retaining personnel. An important promise of the computer salesman, however, is a drastic reduction in the clerical work force, if not immediately, then certainly on expansion of the particular business. The problem of staffing the computer installation is often explained as a simple process of selecting a few employees for retraining by the manufacturer. Unfortunately, this is not borne out by experience. In most installations, the number of personnel employed *increases* after the arrival of a computer, and the salaries of systems analysts, programmers, operators, etc., are considerably higher than those provided in a tab room operation. Finally, the physical conversion of a tab room shop is often far less chaotic a process than retraining and upgrading tab room personnel. Frequently, the user must recruit personnel outside of his organization and to enter this brave new world requires considerable courage and a substantial down payment.

Overbuying is a third problem and one which has become increasingly common. The additional cost for faster, larger memories, added tape drives, and other peripheral equipment may not seem significant at the time of contract signing, particularly for companies projecting expansion. However, much of this added potential may, in fact, be outdated and uneconomical when the organization eventually finds adequate use for it and, of course, initial problems and cost of installation are magnified.

Since most small businesses have not experienced a major changeover in automated office equipment for at least a decade or two, the problems inherent in planning a computer installation are generally of far greater consequence than one might normally expect. In scientific computing, changeovers are often two or three years apart and the comparative smoothness of such operations has often lulled the business executive into an unwarranted state of bliss. Awakening can prove financially traumatic.

New applications in the business field frequently discussed in the press are generally still experimental in most installations and when a computer is purchased to be used for management games, for example, disenchantment is likely to follow. Removal of "middle management" chores is also many years removed from realistic accomplishment, assuming one can adequately define this area. More important perhaps, is recognition of the present limitations implicit in a computing installation such as the fact that a seemingly simple inventory control problem can prove an enormous headache.

Professional leadership in business data processing has also lagged far behind the rate of installations. The Data Processing Management Association (DPMA) and Business Equipment Manufacturers Association (BEMA) are the principal organizations indicating strong interest in this field, the latter being concerned primarily with the entanglements of standardization. The more venerable Association for Computing Machinery (ACM) has only recently evidenced moderate concern for business applications and the American Management Association (AMA) has accomplished virtually nothing which might resemble sustained leadership. Of the groups users should look toward, DPMA has provided the most practical, early assistance in upgrading its members thereby offering a potentially substantial contribution to the industry. Its Certificate program, plans for high school education in computing and numerous other activities indicate an active leadership cognizant of the enormity of the job which must be accomplished.

Answers to the problems of this field will not be found in high priced, "quickie" seminars, commiseration from automated accountants or contemplated retrenchment to the days of adding machines and calculators. Some measure of stumbling is inevitable but permanent injury can be avoided by taking several somewhat obvious but practical precautions prior to installing a computer:

1. Determine present costs of bookkeeping and accounting procedures as precisely as manufacturing costs are controlled.
2. Review present bookkeeping and accounting procedures and be certain they are all documented *including exceptions*.
3. After reaching a decision on the computer to be leased, purchase a sizeable amount of time on this machine at a service bureau, thereby testing the manufacturer's claims, appraising the programming problem, and determining the calibre and size of staff required to operate the installation. During this period, many of the problems to be tackled after installation should be coded and checked out.
4. Based on the results of the preceding studies, revise your schedule and delivery date. ■

Once upon a time there was an emperor named Dod, richer and more powerful than any before him. And merchants came from the remote corners of the earth, from Poughkeepsie and Minneapolis and far Camden, to spread their goods and rich embroideries at his feet. And because he was easily beguiled, he patronized many of them. But the women of the palace murmured, for much he bought appeared as the veriest shoddy under the embroidery, and crumbled beneath the cutting and stitching. And the rascally merchants lost favor.

Then did they severally petition him, wailing "Dood Dod, what I do now?" in the phrases immemorably prescribed, but the Emperor answered them not. So they came to his Chamberlain of the Robes and in secret audience begged for assistance. "The old coot is catching on, Charlie!" they muttered.

"Yea, verily, the day of the whole cloth is sped," said the Chamberlain. "But take shears and needle and make for Dod finished garments, such as he may don at once. For the fingers of his women are not sure—too many young chicks in the pad, lad!" And the merchants agreed.

Now did these men press the Chamberlain to reveal the Emperor's preferences. But the Chamberlain knew the great man had few, for none in the court dared to outshine Dod, and he read little save the worn copies of *Playboy* at the Officers' Club. So the Chamberlain ordered instead that each merchant send his tailors, and when these wretches appeared, the guards of the palace seized them, and locked them all in a vast bare room with slate walls. And the Chamberlain tortured the tailors, withholding chalk from them, until they consented to design new clothes for the Emperor. And they agreed to do his will, as aforesaid men had determined the height of the King of Siam.

But lo! when these poor unfortunates set to, it became evident that the embroideries would not cut and stitch well. And some of the tailors had made only veils aforesaid, or academic robes, or codpieces. So did their tempers rise, and they needed only one another, and the precious chalk was trampled.

One day a great thought came to these beleaguered folk. And it is even to this hour a secret whence it came—from the tailors themselves, from the merchants, or even from the august Chamberlain. But from that time the work flourished, and the merchants were again in favor with Dod and his dodderers. And the word spread throughout the empire and far abroad that the Emperor's new robes were so rich, so handsome, so easily donned and doffed, indeed so new and unusual in all ways that none would ever again want ordinary clothes, but would insist on off-the-rack copies of the *nouvelle vague*.

Proudly did the merchants announce their success. And they and their henchmen set forth a rich feast, and proclaimed the Emperor's intention to attend. And there was a great parade, with the Emperor in the van, and the merchants following after on elephants, and the tailors on asses, as was meet.

And the parade came past the bazaars, and the tradesmen cheered. And it came past the mosque, and the learned men of the town bowed low. And it came past the great armory, and cannons were fired, and muskets. But as the procession turned again toward the palace, it passed into a poorer part where dwelt the scavengers and the uncleaned and the inner-directed.

Then did a few of these ghetto dwellers, having little to lose, call out against the procession. And they pointed at the great Emperor, and they jeered, for truly he was as **NAKED AS A JAYBIRD** in their eyes. But Dod made as if he heard not, and continued on his stately way. And the merchants turned their elephants against the little huddle of disloyal ones, and trampled them into the mud, and there were few who survived, and those fled away beyond the ocean.

So did the tailors prosper, and the merchants, and the Chamberlain withal. And the Emperor shivered in his new garments, as did the others at court who emulated him. But the wise men of the mosque took a pavilion near the palace, and flew from it a great banner saying "Pneumonia we can cure," and they also prospered, exceedingly. And almost everyone lived happily thereafter.

MAGIC LANGUAGES

debugged

by H. R. J. GROSCH, Contributing Editor



Americans are supposed to be informal, frank, vigorous. But in our field the honors lie elsewhere, at least as regards professional publication. Everyone interested in the continuing debate on programming languages should read the papers and most especially the discussions in the July and October (1962) *British Computer Society Journal*, and the report in the September BCS *Bulletin*. Not only are our UK friends more literate and more informative—they're more lively! Sure, for slang and rough talk the RAND thing in the October and November issues of *Datamation* is way out; it's also confused and undisciplined.

With our fantastic proliferation of meetings and user groups and publications, it shouldn't be necessary to turn to the BCS to get the real feel of the battle. It isn't a matter of commercialism, either; the boys from Ferranti and ICT and English Electric are in there plugging just

as hard as Clippinger and Bromberg.

All this is a preliminary to my topic for this issue: current feelings about what Opler rightly calls "magic languages." I want to boil down the recent discussions, add a little bile and venom for seasoning, and serve bite-size. One major agreement, for instance, is on the original concept of commonality: American and British, commercial and scientific, manufacturer and user, large machine owner and small, all agree that magic languages do not—repeat, *not*—make it possible to transfer work from one machine to another. I have worded that clause carefully; many of the academics still feel that programs should be written in machine-independent form for ease of human comprehension and comparison, with the sometimes tacit but usually frank admission that additional manipulation (especially in the input-output area) is required before such programs can actually be run. And some optimists—McCracken, for one—still feel that work can be put on a successor machine of somewhat similar characteristics but increased power, more cheaply and quickly if a

magic language has been used originally.

Two powerful answers have appeared in the last months. On the general question of intellectual gain Barry Gordon (to whom the above fable is dedicated—watch out for those elephants, man!) has replied that a language designed to cover the whole spectrum of applications, the whole range of machine capabilities, and the whole gamut of programmer skills cannot possibly do anything outstandingly well. Indeed, I would point out that ALGOL is being used only by those of an academic quality of mind, on very small machines (X 1, Z23, GIER), for numerical analysis problems. But in this well-trodden region the supposed power and generality of ALGOL becomes trivial: about equivalent to transforming a conventional algebraic expression into one of the Polish notations.

On the question of economics many voices are raised: Patrick in the opening sentences at RAND; Gruenberger and Gordon later; Paine and Glennie in the Northampton College (BCS) discussions. All point to the hidden costs of the magic language: long compile times, repeated recompilation during debugging, longer running times, and—surprise, surprise!—higher prices on the machines to cover the manufacturers' software investment.

These inefficiencies are enormous on a 1401-size machine using a 7094-size programming language. They are of course much less on the big machines. But on the big machines the ratio of machine costs per hour to programmer ditto are much higher—of the order of fifty—so that even slight inefficiencies are uneconomic. Clippinger gives an example of a FACT customer payroll application. In three or four man-months "18 integrated programs . . . roughly equivalent to 80 or 90,000 single address instructions" were written. From his general description I've made a rough guess that the daily, weekly, monthly, and yearly runs might total 300 hours a year, or 1200 hours in the life of the program (three years on an 800, three years on an 1800). Let's say \$500,000 in machine time and associated overhead, shall we? Now how long would it have taken to write that same complex of programs in the commercial equivalent of SAP, with sort subroutines and report generators? Three times as long? Five times as long? Ten times? I doubt that latter one very much; say five, although three is probably closer. Then the programmer saving was about 1.2 man years, or about \$20,000 including applicable overhead.

If the machine utilization, then, is more than *four* per cent less efficient with FACT, the customer loses. And in a typical 1401-size installation, although the ratio of machine to programmer hourly costs is perhaps ten, instead of the forty used in the 800 example, inefficiencies from using COBOL may easily run several *hundred* per cent, counting compiling and recompiling and poor operation on debugging, as well as wasteful running.

I've said this many times already, in *Datamation* and elsewhere: the costs of COBOL and FACT and future commercial language are tremendous—hidden, yes, but tremendous. Elaborate record keeping and analysis do not provide the control that management demands, and thinks it has. The vast inefficiencies of open-shop operation are an intangible; the payroll figures show a reduction in number of programmers. The increased running time of object programs is hidden; the operations report shows spectacular increases in number of machine instructions generated per programmer. The higher rental of the new machine, and the cost of those gay GUIDE meetings, is masked by the fact that the "other" manufacturers and the other customers have to do the same. The boys up top are being hornswoggled magnificently; only occasionally does one hear a benumbed newcomer mutter, "If we're so smart, why ain't we rich?"

If there were *one* honest computer manufacturer, he could undoubtedly get the others in very serious trouble with, for instance, the FTC; misleading advertising would be merely the first and most obvious charge. What do you think the other heavy-construction outfits would do if

a maverick began advertising, "You're reading the only language you need to know to operate a Hokus-Pokus-built oil refinery?"

There is another point that recurs in the British articles and in some of the Munich discussions now in press. Frank Engel and I had it in print back at the second Armour meeting, and it was certainly not a novel concept even then. The costs of coding are only a very small part of the total explicit costs of a computer center, and a still smaller part of a total which includes hidden costs, study and staff costs, startup and changeover costs, and settlements with the union. The costs of problem analysis and of systems design, the cost of debugging, the costs of keeping abreast of a fantastically proliferating discipline, are so much greater than the cost of routine COBOL table coding that even complete elimination of the latter is not really much of an advantage. The reduction in key-punching costs may be almost as important!

I could go through an analysis: machine costs and associated overhead are half the explicit total; of the other, human, part overhead is again half (secretaries, key punchers, floor space costs, trips to SHARE, and standing at the Coke machine); of the remaining 25 per cent, at least four-fifths is spent in understanding the problem, developing the general framework of the attack, debugging the program, and defending the results. But a much more convincing argument is to review the number of workable COBOL statements produced in a reasonably efficient shop, per programmer, per day. One hundred, perhaps? That would be one every five minutes. Must be more than that, even allowing for mistakes and restarts; two hundred or so, maybe? Actually, as experienced hands know already, the true figure is—hold your hats, youngsters—*four!* And I don't mean four *hundred*. You see, it only takes a few minutes to write down a chain of machine instructions, or the equivalent magic words of FACT or FORTRAN. But it takes hours and hours of the hardest kind of thinking to understand the problem and to outline, flow chart, design the solution. Hence the apparently microscopic production, and hence my claim that considerably less than .five per cent of the total cost of a computer center is in the coding. If COBOL reduces this by a factor of three (highly debatable, in my view), the total saving is—three per cent!

Finally, one idea of my own: at least, one I haven't seen in print or heard from anyone else; it is good, *not* bad, to have to reprogram your problems whenever you change machines. The greatest gain in running a big job on a better machine is that you are forced, by the nature of the programming process and by the nature of human customers and programmers, to reconsider, restudy, replan as well as recode your problem. The GE group doing jet engine performance calculations in Evendale from 1953 to 1956 gained as much in speed going from the 701 to the 704 as they had in going from the CPC II to the 701; they understood so much more about the nature of a 700-series machine with a generous memory, *and so much more about the problem*, that the many man-years of reprogramming were paid for over and over again in increased efficiency before the 704 in turn was replaced. I understand the same argument applies to the nuclear work which has been improved through many computer generations, from 701 to STRETCH, at Los Alamos.


In other words, there isn't much short-term gain to be realized, COBOL does not realize it anyhow, and if it did the long-term effect would be stultifying rather than beneficial.

Add to that the intellectual objections I developed earlier, the agreement on both sides of the Atlantic that it also takes expert programmers to use COBOL or FACT or FORTRAN, and the moral deterioration among the manufacturers—well, you can see why my motto for the season is:

*Spray that crabgrass!
Silent Spring, come soon!!*

A TIME BUYERS' SHOPPING GUIDE

less optional goodies

 Shopping for computer time might be compared to buying an automobile: the Flashfin 8 carries the same "manufacturer's suggested list price" in every dealer's showroom but it's the extra goodies and discounts that vary from one outlet to the next that help close the sale.

In examining prime shift charges posted by independent data processing service bureaus, manufacturers' computing centers, and users with open time for sale, a wide range of computing equipment was surveyed, by machine type rather than source or geographic location, in order to present as broad a cross-section possible of what has been made available to the computer time buyer. Most computer centers offer time at both prime time and off time (with corresponding reduced rates), while only a few sources have one rate for all shifts. Three exceptions to this shift-by-shift variance are General Electric, which bases equipment charges at its Information Processing Centers on a sliding usage scale, depending on the total hours used within a calendar month; Computer Usage Co., for the use of 1401 configurations, and Computer Sciences Corp. which has recently introduced a sliding scale based on the amount of time purchased as well as scheduling convenience on its 1107. (See *Business & Science*, page 21).

Rates were readily available from most firms contacted. However, in the service organization category, which is the most active in the scramble for the computer-time buyer's dollar, a number of firms flatly refused to participate, or ignored correspondence. (One Los Angeles company agreed to furnish prices, but only if its identity was not disclosed.)

Hourly rates for the utilization of a 7090/1401 configuration ranged through a cost differential of as much as

22% higher than the lowest rate quoted. C-E-I-R and IBM's Service Bureau Corporation both charge \$550 for prime shift time. In the center of the scale, Computer Usage, which serves as a broker between installations having idle time and clients wishing processing service, does not make a distinction between prime shift or off shift in its rate structure. The quoted figure of \$500 is for 7090 time only, and a \$50 charge is added for the use of a 1401 peripheral to a larger main frame, bringing the total fee in line with that of C-E-I-R and SBC.

(It might be pointed out that SBC, like its parent company, is loath to release any information contrary to company policy. The figure shown was not obtained through an informant, but was gleaned from an SBC news release.)

Computer Concepts, occupying the low-rung on the 7090 ladder, includes one hour of 1401 time at no charge for each hour of 7090 time utilized for both commercial (\$475) and government contract (\$450) work.

Other large-scale systems available are the Control Data 1604, and the Philco 2000-210 and 211. Of this group, only C-E-I-R's 1604 in Los Angeles is offered by a service-type organization, and stands about eight per cent higher than what is charged by Control Data at its computer centers. (The C-E-I-R 1604 will soon be removed.)

In the area of medium-scale equipment, the buyer can select from Computer Usage's 7070, at \$170, the Bendix G-20, available at \$180 from the Reaction Motors Division of Thiokol Chemical Corp., Denville, N.J., Honeywell's 800, \$245, and the RCA 501, operated by C-E-I-R in Hartford, Conn., and at RCA Data Processing Centers, at \$250 per hour.

The ubiquitous 1401 dominates the small-scale computer time availability market, with prices generally dependent on the number of tape units in the configuration, and to

an extent, what the traffic will bear and the prevailing state of economic conditions from one service organization to the next.

Computer Usage, which charges a flat \$50 per hour for what is termed "normal" service, recently initiated a new schedule for a 1401 four-tape configuration based on guaranteed pre-scheduled availability. These rates run from \$1,000 per month, for an average daily use of one hour, 22 hours use during the month, to \$3,100 for four hours average daily use, 88 average monthly hours. Per hour, the highest cost stands at \$45, while the lowest breaks down to \$35, a considerable difference compared to the industry's "going" rate.

1620 time, offered at ComputerMat, Los Angeles, and C-E-I-R, Salt Lake City, stands at \$50 and \$45, respectively, while the Control Data 160 takes the tail-end position at \$25, at Control Data Computer Centers.

Vacuum-tube equipment is still available to the time-buyer, with prices competitive with medium-scale, second-generation equipment. Litton Industries, Canoga Park, California, has 704 time open at \$275 per hour, as does General Electric's Santa Barbara, California, facility, which charges \$200. Again, Computer Concepts leads the pack, selling 704 time for \$130, with Computer Usage a close second at \$135.

Other first-generation computers which turned up in the survey were operated at UNIVAC Service Centers, and included the 1103A (\$350), UNIVAC II (\$550), and UNIVAC I (\$380). Computer Usage lists 705 II time at \$245 per hour.

To borrow a much-abused line, the prices shown on these pages are subject to change without notice, and do not include the cost of optional equipment and/or services. ■

PRIME SHIFT CHARGES

UNIVAC 1107

Computer Sciences Corp., Los Angeles, Calif.\$450¹

IBM 7090

C-E-I-R, Inc.\$550

Service Bureau Corp., NYC. 550

Computer Usage Co., NYC* 500²

Computer Concepts, Washington, D.C. 475³

Computer Concepts, Washington, D.C. 450⁴

CONTROL DATA 1604

C-E-I-R, Inc., Los Angeles\$255

Control Data Computer Centers 300

PHILCO 2000-211

Philco Service Bureau, Willow Grove, Pa.**\$500

PHILCO 2000-210

Philco Service Bureau, Philadelphia\$375

IBM 7070

Computer Usage Co., NYC*\$170⁵

HONEYWELL 800

Honeywell EDP Service Bureaus***\$245

BENDIX G-20

Data Processing Center, Thiokol Chemical Corp., Reaction

Motors Div., Denville, N.J.***\$180

RCA 501

C-E-I-R, Inc., Hartford, Conn.\$250

RCA Data Processing Centers*** 250

NCR 304

NCR Data Processing Centers\$200

HONEYWELL 400

Honeywell EDP Service Bureaus***\$135

NCR 315

NCR Data Processing Centers\$150

UNIVAC SS 80/90 (TAPE)

UNIVAC Service Centers***\$150

UNIVAC SS 80/90 (CARD)

UNIVAC Service Centers***\$100

GE 225

GE Information Processing Centers

0-10 hours\$150

11-40 hours 130

41 or more hours 120

IBM 1401 (4 TAPES)

XYZ Service Co., Los Angeles⁶\$105

Computer Usage Co., NYC

Guaranteed pre-scheduled availability:

Average Daily Use	Total Average Monthly Hours	Monthly Charge
1 hour	22	\$1,000
2 hours	44	1,800
3 hours	66	2,500
4 hours	88	3,100

"Normal" service: \$50/hour

IBM 1401 (2 TAPES)

C-E-I-R, Inc.\$ 75

IBM 1401 (1 TAPE)

C-E-I-R, Inc.\$ 60

Computer Concepts 50

RCA 301

RCA Data Processing Centers***\$125

Tabulating Consultants, Inc., Los Angeles 100

CONTROL DATA 160A

Control Data Computer Centers\$ 35

IBM 1401 (CARD)

XYZ Service Co., Los Angeles⁶\$ 65

C-E-I-R, Inc. 45

IBM 1620

ComputerMat, Los Angeles\$ 50

C-E-I-R, Inc., Salt Lake City 45

CONTROL DATA 160

Control Data Computer Centers\$ 25

UNIVAC 1103A

UNIVAC Service Centers***\$350

IBM 704

Litton Industries, Canoga Park, Calif.\$275

C-E-I-R, Inc., Los Angeles 250

General Electric Co., Santa Barbara, Calif. 200

Computer Usage Co., NYC* 135

Computer Concepts, Washington, D.C. 130

IBM 705 II (TRC)

Computer Usage Co., NYC*\$245

UNIVAC II

UNIVAC Service Centers***\$550

UNIVAC I

UNIVAC Service Centers***\$380

NOTES:

* One rate for all shifts; no charge for set-up or occupancy time

** Night and weekend time only

*** One rate for all shifts

¹ Base rate-charge for overnight jobs. Rates range from \$360-\$625 depending on scheduling convenience and quantity of work

² \$50 extra for 1401 utilization peripheral to larger main frame

³ Commercial contracts; includes one hour of 1401 time at no charge for each 7090 hour used

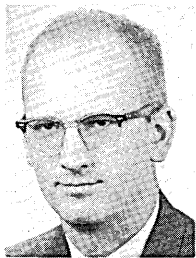
⁴ Government contracts; includes one hour of 1401 time at no charge for each 7090 hour used

⁵ Discount after 50 hours of monthly usage with a minimum charge of \$100/hour

⁶ Fictitious name

SOURCE PROGRAM EFFICIENCY*

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



"COBOL for the X turns out object programs that are only Y% as efficient as assembly language programs, and the fault is all the compiler's." Next to ALGOL recursiveness, this is probably the most frequently heard lament in the software fraternity. Passing delicately over the slightly confused question of what a precise definition of "efficiency" might be, let us admit briefly that the contention is partially true, then see whether it is a valid basis for black despair.

There can be little doubt that some compilers do indeed turn out awful coding. One hears too many stories of graduate students speeding up standard compilers by factors of five or ten, to believe that the art of compiler writing has reached its peak of perfection. It may well be that some compilers are so bad that the wise user will refuse to waste his time and money on them until they are improved. To the extent that today's favorite complaint about compilers is true, I can suggest only an organized campaign of harassment of the manufacturers, to get them to do the job right.

The trouble, however, is that this complaint is being used as an excuse for users' troubles that cannot properly be laid at the manufacturer's doorstep at all, in the time-honored tradition of instantly blaming the machine at the slightest indication of programming error. The intent of this article, therefore, is to suggest some things that can be done to make the best use of any compiler, whether it is superb, just adequate, or barely acceptable. As my title indicates, I choose for now to take compilers as they are, and point out how the *source* programmer can improve the efficiency of the object programs his compiler turns out for him.

I must apologize to any experienced programmers who may read this. Nothing I will say is original or, for that matter, less than ten years old. Some of the ideas were old when 17th century clerks were blaming Pascal's desk calculator for their own mistakes. Too many of these

a restatement of basic principles

principles, however, have been omitted from training courses and have become obscured by the more fanciful claims for current compiler languages.

I shall phrase my restatement of these ideas as a checklist of 18 *Do's* and *Don'ts*. The bulk of them apply to any programming language, including octal absolute; the last half-dozen are devoted to COBOL, which is currently the target of the most virulent attacks.

1. *Don't* do anything twice if you can avoid it. If you have to compute an expression such as

$$Y = (A + B)^3 - (A + B)^2 + \frac{7}{A + B}$$

don't add A and B three times. In FORTRAN notation, the proper way looks like this:

$$T = A + B$$

$$Y = T**3 - T**2 + 7/T$$

This example is almost trivial, but the principle is not: shrewd use of intermediate variables can save bundles of time. Items 2, 6, and 13 are essentially corollaries of it.

2. *Don't* compute anything in a loop that can be computed in advance. If you must form the sum

$$\sum_{n=1}^{6000} e^{-n^2 \pi^2 x^2}$$

please don't evaluate $\pi^2 x^2$ six thousand times. I exaggerate, but not much. Careful consideration of this factor can save major amounts of time, especially in heavily-used loops.

3. *Do* arrange branch tests so that the most likely outcome is tested first. No use looking first at something you don't expect to happen.

4. *Do* try to equalize input/output time with internal compute time. (This statement assumes only one I/O channel.) In an extreme case, this can save 50% of the total job time, over a run in which the two are equal but there is no overlap of I/O and compute.

This point has several corollaries. If you have a run that is badly tape-limited, you can forget about the ef-

* This article is based in part on "A Guide to COBOL Programming," authored by Mr. McCracken and scheduled for May publication by John Wiley and Sons, Inc., New York.

iciency of internal processing: nothing you save there will make a bit of difference. If you have a tape-limited run preceded or followed by a run that is compute-limited, try to reorganize the runs to shift some of the computing to the tape-limited run. The total job time will be reduced by precisely the amount of computing moved, until the tape-limited run becomes compute-limited.

5. *Don't* split items across words in a fixed word-length machine any more than you have to. Consider these two data arrangements, where AAAA stands for the four characters of an item named A, etc., and assume that there are six characters in a word.

```
AAAABB BBCCDD DDEEFF  
AAAACC BBBBEE DDDFFF
```

Both layouts contain exactly the same information, but the first will slow down the object program uselessly, since items B and D must be assembled from two words each. The object program must still break apart items from within one word, but at least each item is in only one word. If time is much more important than space, and especially if the run is compute-limited anyway, it would pay to waste a little space by putting each item in a separate word (using the SYNCHRONIZED option, in COBOL).

This is an excellent example of the pitfalls awaiting the credulous, i.e., those who innocently believe that you don't have to know anything about the machine to use a Magic Language. The compiler can certainly produce an object program to handle the first arrangement, and it will never put out a diagnostic saying, "You've done something stupid." The COBOL example I described in "Object Program Efficiency Revisited" (*Datamation*, June, 1962), was slowed down by a factor of *ten* by several such stupidities.

6. *Do* use your knowledge of the problem area to avoid obvious wastes. For instance, if you have a lot of hyperbolic sines to compute and your compiler doesn't have a subroutine for it, you are perfectly free to write

$$\sin(x) = \frac{1}{2}(e^x - e^{-x}).$$

but why compute two exponentials when a single division will replace one of them? Write

$$t = e^x$$

$$\sinh(x) = \frac{1}{2}(t - 1/t).$$

Any moderately experienced programmer can devise dozens of such examples. Much can be saved by the virtually trivial use of ten or fifteen basic mathematical identities.

7. *Don't* use fanciness just for the fun of it, or because it saves you a little pencil lead. Some scientific compilers, for instance, allow subscript expressions to be any expression, including floating point. Unless there is some really good reason for using this flexibility, which there sometimes is, stick to very simple fixed point expressions. Complicated subscripts have to be evaluated every time the array is referred to, which can cost a lot of time.

8. *Do* use blocking of tape records to save tape space and therefore time. Most commercial compilers make the processing of such blocks so automatic that the source programmer hardly need know what a blocking factor is; the savings can be appreciable.

9. *Do* write everything possible on tape, rather than printing or punching on-line.

10. *Do* arrange your runs so that as much as possible of the set-up (tape mounting, paper changing, etc.) can be done while the other parts of the system are productively occupied.

11. *Do* check input extensively for erroneous data, such as month 17, age 137, code 9 where there should only be 7, etc. The time it takes will generally be more than saved by not having to rerun the bad data and by avoiding the messes that such data can create with marvelous ease.

But don't put these checks into the working loop!

12. *Don't* stop the computer to let the operator make manual corrections to bad data, unless there is absolutely no way to proceed otherwise—and even then it is usually better to remove the run entirely than to try to make the corrections under the pressure of having a \$200-per-hour system stand idle.

for COBOL

13. *Do* use working storage to avoid duplication of time-consuming operations. If you have a tape record that unavoidably has several items in a word, or items split across two words, don't process the items from the input record area. Instead, move the heavily-used items to a working storage area that has each item in a word (or words) by itself. Such working storage locations are easily established with the COBOL data division.

This, however, brings up a corollary to item 1: don't do anything *once* if it needn't be done at all. Suppose you are processing a master tape with a very low activity ratio, which means that for most records you will simply look at the key, decide that you don't have to process this record, and write it to the output. In such a case, it makes no sense to go through the motions of breaking up the record into working storage locations where they can be processed easily; wait until you know that you are going to process it.

14. *Don't* do any unnecessary conversions between the DISPLAY and COMPUTATIONAL forms of representation. This, of course, applies only to a machine where there are two different forms, such as binary vs. BCD, or one digit vs. two-digit, but there are quite a few of those. Study your reference manual assiduously, know the difference between the two, and know when to use which: sometimes the choice is forced and sometimes it is optional. Worse, if you don't state which of the two you want, DISPLAY is assumed; arithmetic on DISPLAY items is permitted, with the necessary conversions supplied "automatically" by the compiler. *Sure* they're automatic. And what happens when you set up a heavily-used program counter in BCD, with the four digits split across two words? Answer: every time you add 1 to that counter, the object program must execute several *hundred* instructions to extract the four digits from the two words, convert from BCD to binary, add 1, convert back to BCD, and put the four digits back into two words, leaving the other contents of those two words unchanged.

No programmer in command of his faculties would ever do this but there are many other examples of the principle. In general, if you must do extensive arithmetic on data that comes to you in DISPLAY form, convert it to COMPUTATIONAL *once*, in a working storage location.

15. *Don't* insert unnecessary gimmicks. If you are adding two four-digit numbers and storing the result in a five-digit location, you *know* that overflow can never occur. Therefore, don't use the ON SIZE ERROR option; its use takes both time and space in the object program, even when overflow has not happened.

(Needless to say, careless assumptions about data item sizes are risky; I stated my conditions cautiously. It would not be wise, for instance, to leave out the ON SIZE ERROR option on the assumption that a time card would never show more than 16 hours worked in one day, or, for that matter, that it would never show more than 24. Unusual circumstances could invalidate the first assumption, and bad data the second.)

16. *Don't* make rash use of source program features that may be extremely costly in your system. This of course depends on the machine and the compiler, but three to watch out for are editing, the EXAMINE verb, and subscripting. It may be hoped that the manufacturers

A HORRIBLE EXAMPLE . . .

The kinds of things under discussion can make a *lot* of difference in the running time of a program. To demonstrate this graphically, I ran the two versions of one of the case studies in my FORTRAN and ALGOL books.

The problem, which involves heat transfer, requires the evaluation of the following infinite series:

$$T(\rho, \theta) = \frac{800}{\pi^2} \left[\left(\frac{\rho}{10} \right) \sin \theta - \frac{1}{3^2} \left(\frac{\rho}{10} \right)^3 \sin 3\theta + \frac{1}{5^2} \left(\frac{\rho}{10} \right)^5 \sin 5\theta - + \dots \right]$$

In the first version, I took 40 terms of the series, being temporarily too lazy to try to figure out how many terms would give the required accuracy of about 10^{-4} . Furthermore, I took the straightforward (stupid) approach of evaluating each term just as it stands, which amounts to rewriting the formula as:

$$T(\rho, \theta) = \frac{800}{\pi^2} \sum_{i=1}^{40} \frac{(-1)^{i+1}}{(2i-1)^2} \left(\frac{\rho}{10} \right)^{2i-1} \sin [(2i-1)\theta]$$

I ran this version on a Philco 2000, Model 212, with two loops that ran through 110 combinations of

values of ρ and θ . The program took 2.065 seconds, including output; during this time the 212 executed a little over a million instructions.

In the second version, I inserted a test to stop computing terms after reaching one that was less than 10^{-4} in absolute value (not including the sine, which could give a false indication of convergence). Furthermore, I took advantage of the fact that each term contains factors that are easily derived from the same factors in the previous term. For instance, raising $\left(\frac{\rho}{10} \right)$ to a power can be done much more speedily by multiplying this factor from the previous term by $\left(\frac{\rho}{10} \right)^2$ and similar devices

get most of the rest of the factors. (As a matter of fact, even the sine can be obtained from addition formulas, but I did not do this.)

This version, which gave answers that were precisely the same to the accuracy required, took 0.407 seconds, during which time the 212 executed 244,915 instructions. That's just about five times faster, with little extra programming effort.

Naturally, nobody cares about speeding up a program that takes only two seconds total. But five-to-one time ratios are worth working for, or even two-to-one, or even 30%. Brains can replace money.

will quietly distribute little memos suggesting what's fast and what's not so fast in their systems.

The last two items are not really COBOL source programming matters at all, but nevertheless, are probably the most important in the list.

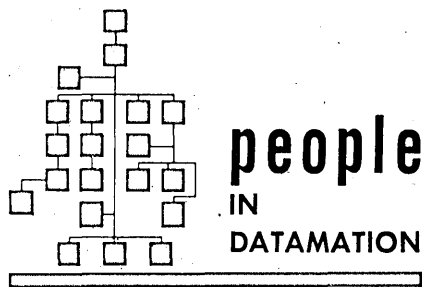
17. *Don't* believe it when you hear that a COBOL programmer needs to know nothing about the machine itself. COBOL and languages like it do *reduce* the amount of machine knowledge necessary, and more important, in my opinion, make it possible to set up a more meaningful training program, but they do not *eliminate* the need for machine knowledge. I have already given several examples of things that COBOL permits, with no warning of disaster, which can make a program prohibitively expensive to run.

It is time a fundamental fact was accepted: production

programming is done by programmers, not by stock clerks or vice presidents. This axiom, if universally accepted, could have a profound influence on the publicity for new languages, and, in the fullness of time, might even influence their design.

18. (To the programming supervisor.) *Do* assign your best programmers to lay out the data division for the main files, well in advance of actual programming. With careful attention to system design problems, computer characteristics, and object program efficiency, the people writing the procedure divisions that process these files will be relieved of many of the worries suggested earlier.

Programming should be done by programmers, and those programmers should know that whether their compiler is good or bad, object program efficiency depends largely on what they write in the source program. ■



■ Virgil S. Thurlow, formerly with Systems Development Corp., has joined Systems Programming Corp., Inglewood, Calif., as senior scientist. He will be responsible for work on computer software for military command and control systems.

■ The Department of Defense announces Walter M. Carlson as defense director of technical information in

the office of the Director of Defense Research and Engineering. His office will serve as the focal point in developing and recommending policy for the review and coordination of DOD scientific and technical information activities.

■ John S. McKay is now projects director, Programming and Applications Division of Computer Dynamics Corp., Silver Spring, Md. A specialist in multi-computer problems requiring extensive systems analysis and design planning, he is responsible for development of complex dp applications on a wide range of hardware.

■ Maughan S. Mason, head of Thiol Chemical Corp.'s Wasatch Division analog simulation office, was named chairman of the board for

Simulation Council, Inc., the national professional and technical society for analog simulation and computer scientists. He serves a one-year term.

■ Joseph D. Grandine II has joined Data Processing, Inc., computer consulting firm of Waltham, Mass., as VP and senior analyst. He was formerly director, Computer Applications Division, United Research, Inc.

■ Jack Laderman has been named technical director of operations research and applied mathematics for The Service Bureau Corporation, NYC. Formerly a mathematician with the Office of Naval Research, Laderman, in his new post, will be responsible for the development and application of computer techniques in business and science problems.

PREDICTING CLERICAL ERROR

in an edp environment

by GARY CARLSON, Advanced Information Systems,
Los Angeles, Calif.



Very little is known about error in any precise manner, but everyone seems to know that it is always present and that it is usually bothersome. A review of the enormous literature reveals that philosophers have thoroughly discussed error; scientists have tried to control error by creating greater precision instruments, and plain, old humans have been left to cope with error as best they can. The high accuracy of EDP equipment requires that a closer look be taken at the accuracy of the input data. Since errors of input are propagated through the system, total system accuracy necessitates a reduction of input error. Intensive analysis of input error in a highly automated bank central office is the focus of this study.

Since error is almost always present in any operation, one has a wide selection of behavior to choose from to study the problem. Since most of the prior work done on error has been very fuzzy in nature, it was felt best to study some situation where error could be precisely defined and treated. Another condition had to be met. With regard to the bulk of behavior, error is a rather infrequent occurrence. A great deal of behavior would have to be examined in order to acquire sufficient data to study error. This problem makes a laboratory approach economically prohibitive. The solution to this problem is to locate a large amount of historical data of recorded error. Even though accountants and bankers may not want to talk about it, a bank central office is an ideal location because of the very large volume of work processed and the precise historical record maintained. For the bankers' sake, I must say that most of the errors are located within their system, with only an occasional rare instance of an error being passed on to a customer!

The particular problem studied was the ability to predict or simulate human error. When an error is made in the listing of checks, predictions based on the correct list can be made at three different levels of complexity:

First, when the total of a list of items is out of balance, a good predictive routine would process the correct listing to pinpoint what item had been listed in error.

The next simpler level would require that the item which has been listed in error be indicated; the routine would predict from the correct list where an error has oc-

curred, that is, what digit or digits have been listed in error.

The third and most basic type of prediction requires that the item listed in error be indicated *and* the location within the item, such as the last digit or the first two digits, etc. Prediction in this case would predict the precise change made.

Rather successful predictive routines have been developed for the third and most basic level. Some start has been made on the next or second level of complexity.

The setting for this study is a large bank central office, a location where checks from outlying branches and banks are brought at the end of the day's work to be listed and then sorted to the maker's branch or bank. In the central office studied, the daily volume of checks listed is between 1.6 to 1.9 million per day. Even though much of the check processing is now mechanized and uses MICR (Magnetic Ink Character Recognition) for sorting and ultimate processing, considerable hand work remains. The dollar amount is MICR encoded by a clerk at an early stage in processing. Nothing on the horizon suggests a change in this manual input operation.

The equipment used is the IBM 803 and 1201 check proof machines. These machines have a nine key and zero bar numerical keyboard and a 32 key sorting keyboard. The operator detects an error by noticing a discrepancy between the incoming tape total and her current master tape total. About 30% of differences at this point are due to the incoming listing being in error, and the remaining 70% are due to the central office operator making an error. The operators (all women) must select the proper sort key and list the dollar amount for each item. In the central office studied, there are about 300 women operators and approximately 100 male clerks. The women make the errors and the men correct them.

Most individuals who have studied error fall into one of two groups. One group wants to control error; the other searches for interesting correlations or classifications. Control has been attempted by training, establishing quality control charts, human engineering the input device, or by eliminating the human from the operation. Control has had some success, but most of the claims are poorly documented.

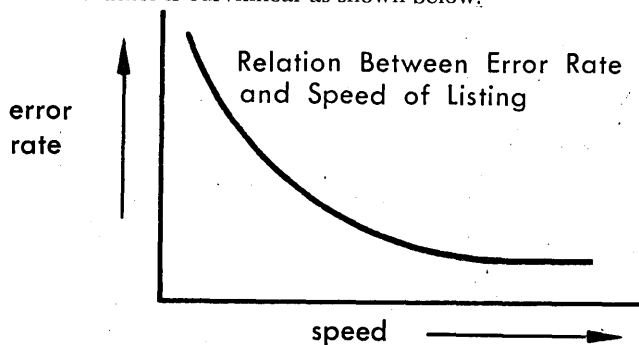
The correlation and classification of error has done very little to increase our understanding of how or when errors

occur. These approaches were applied to the present data with remarkably worthless results. There were a few interesting tidbits, such as the fact that Tuesday is the highest error day, as shown in Table 1.

Day of week	Errors per 1,000 items listed	Volume (000) (54 operators)
Monday	1.138	370
Tuesday	1.203	283
Wednesday	1.165	236
Thursday	1.023	232
Friday	1.002	385

The error rate has no clear relationship to the volume of checks processed. IBM has a report which shows the same result; namely, that Tuesday is the highest error day of the week. Similarly, some accident statistics show the same phenomenon of Tuesday being the highest accident day of the week. Now this is very interesting, but it provides no understanding of why or how errors occur. "Obviously" someone else can make something of this but, for the present, this is too typical of work in the behavioral sciences—an interesting but sterile tidbit.

One other interesting item can put an end to many arguments concerning the relationship between speed and accuracy. At least in this situation, there is a very strong and consistent relationship between speed and error. The fastest operators make the least errors. The fastest operator's number of errors per thousand is significantly less than the average operator or the slow operator, and often the total number of errors of the fastest operators is less than the total number of errors of the slower operators. The relationship between speed and errors is not a linear one but rather is curvilinear as shown below.



Another approach is by classification of the kinds of errors made. This analysis had a surprise in store. Most discussions of classes of error are concerned with transpositions. This occurs when two digits are interchanged in their relative positions. Since most general discussion

	Percentage	Example
Substitution	62.4%	126.32 → 123.32
Omission	20.7	10.28 → 1.28
Insertion	6.0	54.33 → 541.33
Transposition	1.5	86.27 → 68.27
Double substitution	2.1	22.16 → 55.16
Double omission	2.3	368.00 → 3.68
Double insertion	1.1	4.56 → 456.00
Miscellaneous	3.9	127.34 → 38.46
	100.0%	

of error by bankers and accountants deal with transpositions, it has often been assumed that transpositions form a large part of all errors made. Yet, it will be noted in Table 2 that only 1-2% of all errors made in the bank central office are transpositions. A similar low percentage was found in most other studies of listing operations.

Again, this is interesting but does not lead to an understanding of why nor how errors occur. Statistical data of this sort is of no assistance in prediction of what errors occur.

After several years of massaging the data in this fashion, it was suggested that the heuristic approach of Newell, Shaw and Simon might be of some use. This approach was most useful in finding a solution to developing predictive routines. The goal, then, became to create a binary decision tree which would have the end nodes stating what change should be made to coincide with human behavior. This binary tree was created by laborious, subjective analysis of individual errors. The analytic process is still very much of a subjective matter and, in many cases, consists merely of staring at a list of errors until some common feature pops into mind.

Once this common feature was hypothesized, the errors in question were categorized by this common feature. The items which had been placed in one category were then analyzed and the process continued until most of the items in the category represented a common change made. Two thousand one hundred and 10 errors (representing over 2,000,000 checks listed) were analyzed to develop the predictive routines. The routines were then used to predict 4,155 new errors not used in the development process. Over 4,000,000 checks were listed to produce these errors. A brief example of a portion of the tree is given in Figure 1. (see pg. 36) The first number under each terminal node gives the number of errors covered by this branch. The second number is the percent of errors correctly predicted. A few representative examples are also given for each end node.

Forty-six percent of the 4,155 new errors studied are correctly predicted by this set of routines. Let's compare this with other possible approaches, one a chance prediction and the other a stochastic prediction. A straight chance prediction could predict one of the other nine digits or that the digit was omitted. This would give a 10% correct prediction. But certainly we can do better than this, since a 3 is more often changed to an 8 than to a 1. The conditional probabilities can be readily computed, representing this kind of change. This type of analysis gave 20% correct prediction. Again this may be contrasted with the developed routines which predict 46% correctly.

It was most encouraging when it first became possible to do this with one operator, but it was assumed to represent the unique operating mode of one operator. Much to my surprise, when routines were developed for a second operator, the only routines which were consistent in good predictive power were almost identical with those routines developed for the first operator! Subsequent study has conclusively demonstrated that the routines are consistent over eight different experienced operators and two trainees. In addition, the routines are consistent on work done by the same operators one year earlier, and again on work done five years earlier.

The developed routines therefore seem to be independent of the operator, of the type of work, and of the time the operation is performed. For the first time we have been able to take the study of error out of the realm of the mysterious, of the supposed random behavior, and describe error in terms of consistent behavior. Further, even though this is only a slight step in predicting errors, it is a definite step forward. Prediction and understanding come close together and both of these can hopefully soon

be followed by control. This poses somewhat of a paradox for those who have attempted to control human error by eliminating the human. We may now have the key to control error—through intensive study of the error process itself.

A further implication of the study is that success at the most basic level is most encouraging for success at the next two levels of complexity. Indeed, further work has already shown that, for certain conditions, the second level of prediction can be achieved. ■

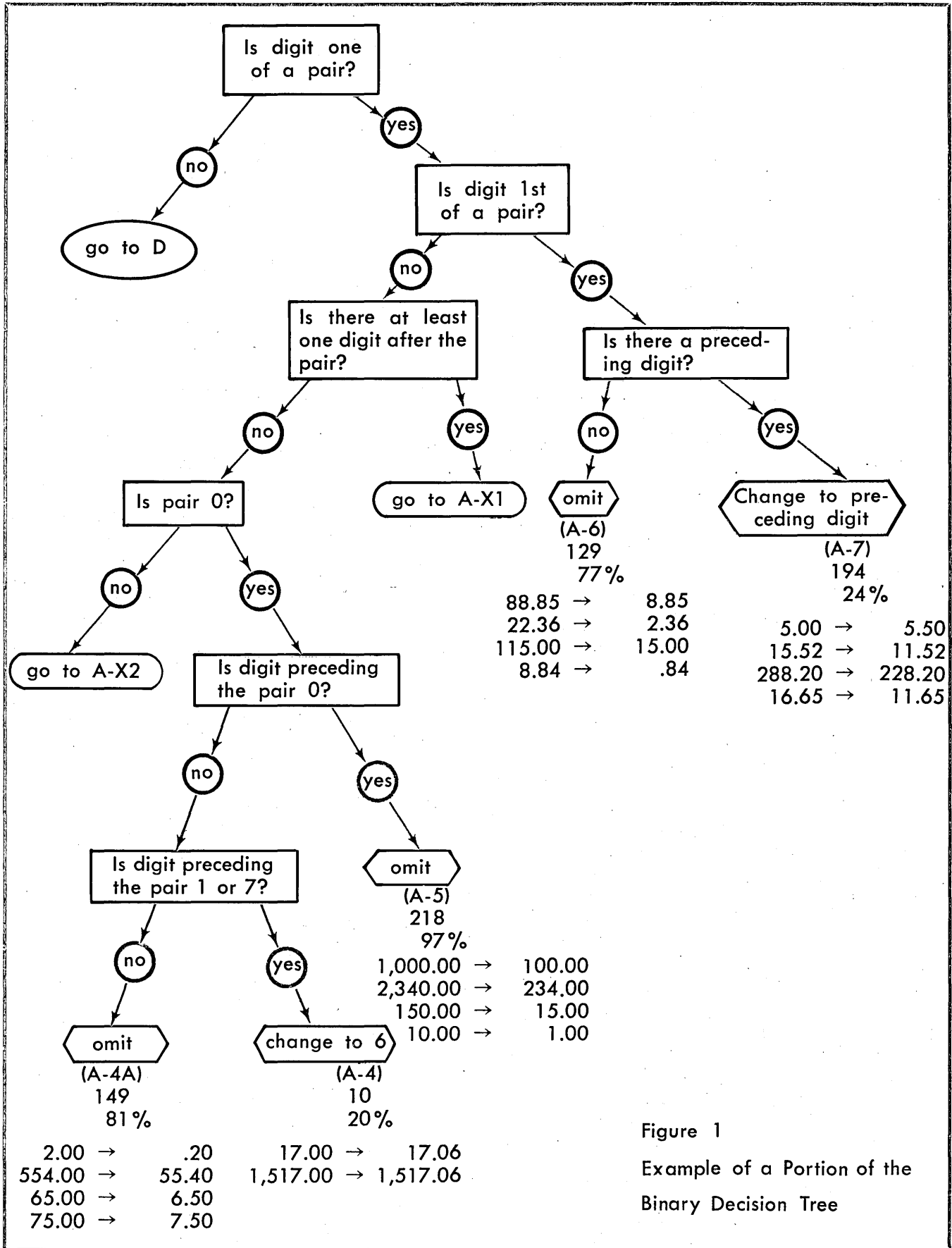


Figure 1
Example of a Portion of the
Binary Decision Tree

the SON of IN and OUT

returns to meet
frankenstein
who gives up drinking

By TONI SCHUMAN



After two years it has become apparent that the computing field has shifted its emphasis once again and those things which are IN and OUT need redefining. As a first approximation we can abide by the original rules which stated that anything formerly IN is now OUT, but some new crises are developing, and several old ones require reemphasis.



Big Brother will always and forever be OUT
 Caroline Kennedy, however, is IN
 Little Brothers who should be OUT but insist on staying
 IN are therefore OUT

Consultants with fancy offices are especially OUT
 Consultants with plain offices are also OUT
 Consultants with no offices are IN
 Jackson Granholm is where he belongs

FACT, COMTRAN and OCTAL ABSOLUTE are OUT
 Jokes about FACT are OUT
 There are no jokes about COMTRAN
 When FORTRAN II is checked OUT it will be IN, hopefully

Bob Bemer, Dick Clippinger and Alice in Wonderland are IN
 Julius LaRosa is OUT

Hypertape, UltraSupertape, and Captain Marvel are OUT
 Consoles are OUT

More than ever, flesh peddlers are OUT; sincere ones are even further OUT
 Command and Control is IN big, unfortunately

Salesmen may be coming back IN; if they carry Discpaks they have a better chance
 Backus notation will only be IN a short while longer

The next permute algorithm will positively be OUT
 Dick Nixon is OUT for good

Standardization is IN at the moment; don't look for it next year
 AFIPS is IN but no one knows why
 The term "egghead" is OUT, but eggheads themselves are actually IN

AIEE, IRE and the American Medical Association are OUT
 Medical applications are IN
 The government says expense accounts are OUT

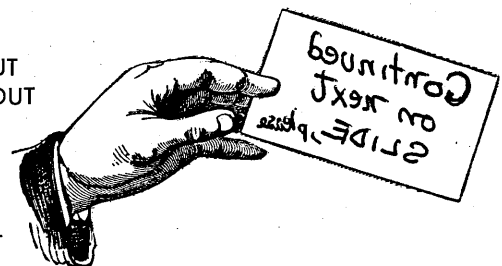
"Recursive" is an OUT word
 Stored logic is almost IN, but OUT people don't think so

Gigantic computers are definitely OUT (ask Big Brother)

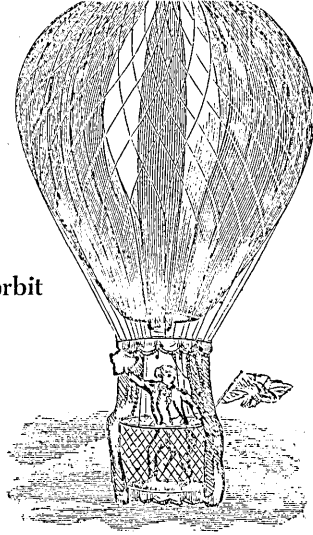
Field engineers are the INest of all people
 Compilers are definitely on the way OUT
 Compiler controversies are especially OUT
 Even the word "compiler" is OUT

The only IN language is Kludgetran
 Bullpens are OUT

Priority interrupts are usually IN
 Programmers who don't bathe are OUT



still in orbit

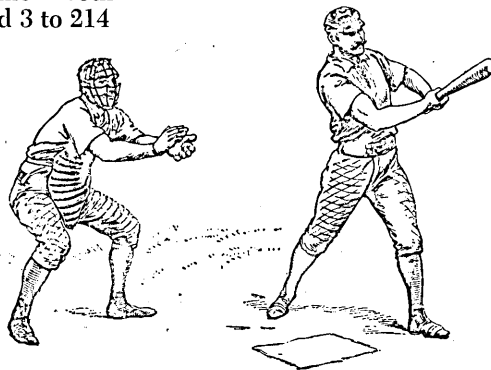


"Modular" is IN with IN people and OUT with OUT people, and if you can figure this OUT you're IN

Minneapolis is OUT unless you move to the suburbs
Some people think it is IN to knock the ACM. This is not so. OUT people just don't know any better. The IN people may not believe in the ACM (Santa Claus and the Easter Bunny are IN), but they don't talk about it

Therefore, Al Perlis and Myrtle Kellington are IN
Post offices are also IN

same old ball game — 79th
inning. Score tied 3 to 214



The following terms are IN:

cpff
associative
microminiaturization
money

while these are currently OUT:

throughput
solid-state
simultaneity

Anything-morphic is OUT

Conventions in Detroit are unequivocally OUT,
unless they are automobile conventions,
in which case they will probably be held in Las Vegas

Being unemployed is OUT unless you live in Monte Carlo

Profits are IN, and profits before 1980 are especially IN although unlikely

Gaudy displays at conferences will cause the offending company to be OUT for one year

It is becoming IN to listen to papers at computer conferences,
although increasingly painful

Anyone who can invent a past tense for "output" will be IN for life

Spooing the field is obviously IN, I hope.

out in



line to be discontinued — take Bayonne cars starting tomorrow

THE PROGRAMMING GAP IN REAL-TIME SYSTEMS

a new challenge:
commercial applications

by R. V. HEAD, IBM Systems Research Institute,
New York, N.Y.



The past five years has seen the rapid evolution, within the organization of each major computer manufacturer, of a professional programming group whose mission is to supply programs to support usage of the manufacturer's products. The present output of these groups, designated variously as Applied Programming, Programming Systems, Systems Support, etc., consists of programs which fall into several rather distinct categories:

Assemblers and Compilers. These cover a broad gamut of processors capable of dealing with numerous programming languages, ranging from the relatively primitive, machine-oriented, one-for-one pseudo-codes up through the sleek, high-powered COBOL and ALGOL dialects.

Monitors. Monitors are provided to aid the user, especially the scientific user, in scheduling jobs such as assemblies, test shots, and production runs through his computer.

Generalized Routines. Included here are programs which can be made part of the user's operating system. Generalized sorts and merges, report generators, and input/output control systems provide examples of such routines.

Utility Routines. These are programs which, while not part of the operating system, help to keep the system running. Loaders, analyzers, comparators, and the like come under this general heading.

Anyone conversant with the programming systems field can readily see that this list contains no surprises. It has come to be generally expected that a manufacturer will provide a generous helping of all these items, well-adapted to each of his announced products.

However, the advent of real-time systems for commercial applications threatens to upset the neat categories into which applied programs now fit, and to alter significantly a great deal of the work-in-progress in many applied programming lofts and factories. The number of real-time systems-in-being increases with each passing month and the ultimate rôle of such systems cannot yet be accurately gauged. A conservative prognosis, however, would indicate that these systems will eventually take their place somewhere midway between the old and the new technology, displacing some presently-existing non-real-time systems on the one hand and, on the other, extending

the stored-program computer into application areas hitherto untouched. Certainly, the demonstrated preference for real-time systems by such important users as savings banks and airlines¹ demands a careful analysis of the adequacy of currently-available applied programming support for such systems.

Even the most preliminary and superficial scrutiny of this support in the light of real-time requirements reveals three major sources of difficulty. The first of these has to do with programming languages, the second with control programs, and the third with system testing. The purpose of this paper is to identify some of the problems which real-time system implementers have been grappling with in each of these areas.

programming language limitations

In certain respects, commercial real-time systems represent a sort of "cultural lag" when compared to more conventional systems. How else can one account for their inability to make use of higher-level, problem-oriented languages such as COBOL? To the writer's knowledge, no commercial real-time system has been implemented to date using such a language. Instead, these systems have resorted to usage of assemblers of archaic design and almost laughable simplicity. While on the surface it may seem incongruous that real-time systems people are not relying on the labor-saving programming languages in which manufacturers have invested so dutifully, further examination reveals good reasons for this contradictory state of affairs. It's not (as some may suspect) that real-time systems men have, in a mood of pique, perversely and ungratefully spurned these languages; it's simply that they can't quite figure out how to use them in their present form. Consider the following problems, characteristic of real-time systems:

Program Read-In

When it is learned that the number of real-time instruction steps will exceed the capacity of high-speed memory, the system designer is confronted with a most troublesome situation. Assuming that extra core can't be added, the solution involves developing a program read-in scheme of some kind, usually necessitating the ability to relocate, in real-time, programs from an external file into whatever portion of core memory happens to be available. Often such read-in and relocation schemes divide core

memory into fixed blocks which form a repository for programs of a standard size. This, of course, forces the programmer to make a rigid segmentation of his program into one or more chunks which will fit into the arbitrarily-defined core blocks at read-in time. In a higher-level language, each statement written by a programmer will produce a fairly large yet unknown number of actual machine instructions. This is almost certain to (1) aggravate the read-in problem by producing a greater total number of instructions than would one-for-one machine coding, and (2) prevent the pre-planned division of programs into relocatable segments of standard length. Thus, in attempting to work with a language which produces more than one machine instruction per statement, the system designer is thwarted in pursuing the twin goals of minimum overall program size and standard program segment length. In most cases, he can ill-afford to relinquish this control over program development.

Object Program Efficiency

Because many programs in a real-time system may be clamoring for a chance to use available core memory to process their transactions, an important system design objective is minimum running time for each routine. With this in mind, the system designer must decide between expending the man years required to program at the machine level in order to obtain highly efficient running programs and saving on program preparation time by using a higher-level language with a resultant decline in object program efficiency. The realistic systems man, while lamenting the fate which forces him to make such choices, must of necessity favor the approach which minimizes execution time for each program.

File Organization

Although some real-time systems rely on magnetic tape as an auxiliary storage device, there is far greater emphasis on drums and disk files as storage media. The notion of random access storage and the idea of updating records in real-time just naturally go hand-in-hand. It is, therefore, regrettable from the standpoint of the emerging real-time systems that languages like COBOL are so heavily oriented towards processing of sequential tape file data. The entire concept, for instance, of proceeding to Open an Input File, Read Records one-by-one into an area set aside for this File, then Close the File when processing is complete is alien to real-time processing. The normal real-time storage media of drum and disk are seldom if ever "opened" or "closed" and a given record or set of records is called for in response to external demand rather than in a pre-defined sequence. Now the COBOL manuals don't come right out and say that you can't have randomly-stored disk records reachable by first consulting an index kept on drum, if that's the kind of set-up you really want; but they do couch their definitions and examples in the parlance of sequential tape file processing.²

There is doubtless room for honest dispute over the merits of the case being brought by real-time systems people against the higher-level languages. But what is really needed is not so much a "great debate" as an "agonizing reappraisal" by applied programmers of the suitability of such languages in their present form for use in real-time system efforts.

need for control program development

Most real-time systems, and particularly those which possess mass storage devices such as drums or disks, require a control program to supervise work in various stages of completion inside the processor. This control program—a relatively new phenomenon—may be defined as a collection of routines needed to (1) coordinate and service the machine components of the real-time system, and (2) coordinate and

service the processing programs and the data which these programs require. Although it is not the purpose here to expand the functions of a control program, a few typical operations should at least be noted:

- Handle all input and output messages.
- Determine processing priority of each input.
- Maintain queues of data awaiting processing.
- Read in programs and file records needed for processing.
- Perform switchover in a duplex system.
- Accomplish fallback to a degraded level of service.

With the emergence of requirements for such control programs, queries arise as to who shall write them and how they can best be written. The argument has been advanced that these programs are really vastly-glorified extensions of present-day input/output control systems and should, therefore, be supplied by the equipment manufacturers. If this point of view gains acceptance, it appears certain that manufacturers will be reluctant to supply control programs especially written for each individual customer and will instead call upon their applied programming groups to "generalize" such routines. Experience now available, while limited, certainly indicates that control programs can be generalized and standardized within machine lines and within application areas such as stock brokerage and airline reservations.

The situation seems to call for an intensive look by the applied programming groups into the problems of generalizing control programs. And problems there are indeed, which must be overcome before these programs will fall into place as smoothly as do other generalized programs today. Take, for instance, the little matter of the effect of generalizing upon system efficiency. A control program, general or otherwise, really represents non-productive housekeeping "overhead," and should take up as little space and time as possible. Many of the generalized programs produced by applied programmers today must be viewed more as effort savers for the customer than as paragons of efficiency. An attempt to generalize control programs cannot be based upon this philosophy.

demands of system testing

Certain attributes of real-time systems tend to make them significantly more difficult to check out than conventional systems. Among the more troublesome problems encountered in real-time testing are:

Complexity of Interfaces

All systems must achieve that classical interface between hardware and program which has caused such endless (and often ugly) controversy during testing as to whether trouble lies in the equipment or the program. In real-time systems there are additional interfaces which must be contended with—equipment/control program, equipment/processing program, and control program/processing program. Development of a generalized, pre-tested control program will no doubt alleviate this problem, but in the meantime there remain two programming subsystems rather than one to be tested.

Repeatability of Errors

It is almost a truism among real-time programmers that errors cannot be depended upon to repeat when desired. Unless the real-time system is a very limited one processing but a single transaction at a time in fixed sequence (much like a garden variety batch processing system), the testing group will face the discouraging task of trying to reset input conditions and restore pre-error status inside the processor and in the files in order to make an error repeat. Only with data logging and tracing of a rather sophisticated kind can this problem be even partially overcome.

Consequences of Errors

The effects of errors in a working real-time system are

usually so horrendous from an operational standpoint that a more intensive pre-cutover testing phase becomes a must. Testing of many non-real-time systems—even large ones—has all too often been ill-planned and haphazard with numerous errors discovered only after cutover. In systems that do not have to provide an instantaneous real-time response, such a desultory approach could be tolerated. In most real-time systems, the prevalence of errors after cutover, any one of which could force the system to go down, is intolerable.

Because of these requirements for a more thoroughgoing approach to system testing, demand is arising for program packages which will ease the real-time checkout burden. Granted that better test planning and methodology are sorely needed, there remains this urgent need for more and better programs in support of system test. A list of such support programs would include:

Simulators—to permit testing of individual programs before they are placed in the real-time environment. Such simulators may, during the early phases of testing, take the place of both the real-time equipment and the control program.

Data Generators—to produce massive amounts of input and file data in order to flood the system with transactions prior to cutover.

Data Reduction Programs—to aid in rapid and meaningful analysis of test results when the system is inundated with large quantities of test data.

Data Logging Programs—to facilitate rerun when an error occurs either because of program or equipment malfunction. Such programs will be useful as diagnostics even beyond the final testing phase.

Snapshots and Macro Traces—to capture the status of a given processing program (or all processing programs) at various critical junctures in its execution, such as upon a request to the control program for a file record.

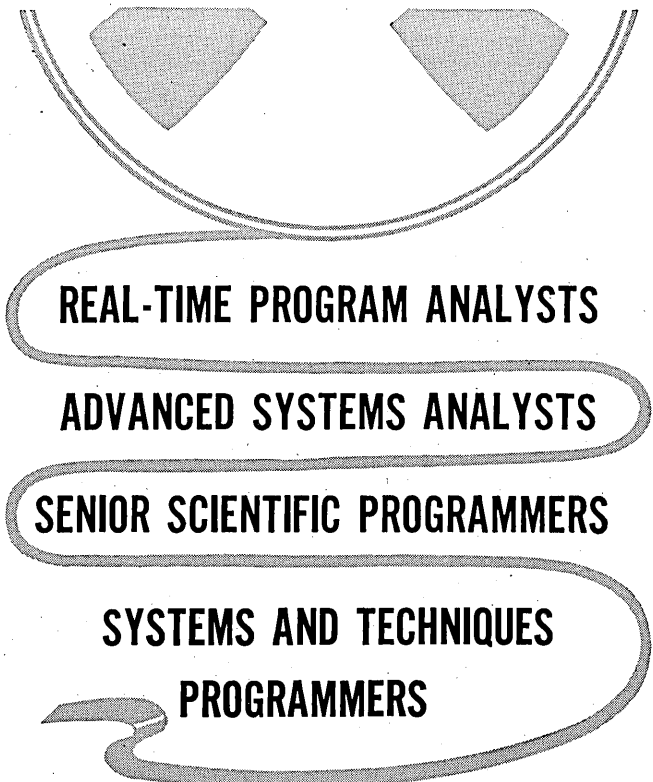
These are illustrative of the kinds of programs needed to support system testing adequately. Many of them have been used in the past in testing non-real-time systems. The point is not that they are new; it is rather that their availability is vital to the conduct of a well-conceived real-time system testing effort.

Some of these testing aids will doubtless have to be tailor-made for each installation, as has been largely the case up to now; there is reason to hope, however, that many of them can be generalized and made available to all real-time users. Once again, the question comes down to consideration of whether this is a good investment of applied programming dollars.

This somewhat cursory survey of real-time system requirements has sought to show that increasing demand may be expected for some additional outputs from applied programming groups. Some new programming products must be added to the line and some old ones restyled in order to accommodate the burgeoning real-time systems field. While the writer does not fully share the enthusiasm of those real-time partisans who are confident that "by 1970 all electronic data processing systems will be of the on-line-real-time variety,"³ he is willing to go sufficiently far out on a limb to predict a "real-time revolution" within applied programming organizations over the next year or two. ■

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2. General Information Manual—COBOL, IBM Form F28-8053-1, 1961.
3. Richard E. Sprague. Electronic Business Systems, Ronald Press, N.Y., 1962, p. iv.



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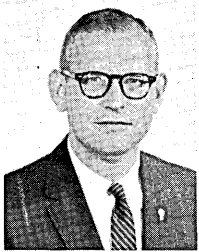
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PROGRAMMING CONTROL BY PROJECT SCHEDULE

to induce savings
in accurate planning

by R. R. FAIR, Transformer Division, Westinghouse Electric,
Sharon, Pa.



As is the case with most medium-to-large-scale computer users, the Westinghouse transformer divisions in Sharon, Pa., have been concerned with how to plan and control the efforts of its systems and programming personnel. Beginning in 1959, the transformer divisions instituted a project schedule concept that has permitted the development of a more comprehensive plan, and to measure performance against this plan. The project schedule program has not only provided the individual control, but has also greatly improved communications throughout the divisions. The system is now being installed in many other divisions of the company.

The computer project schedule concept has provided both an element of control and a communication medium which is unique. It has expedited systems analysis, methods and procedures effort, and programming and coding techniques to the point which allows planning with reasonable accuracy. This plan is communicated to all levels of supervision, and it is controlled throughout the schedule period.

In the computer project schedule system, anyone can originate a project simply by filling in a form and sending it to the manager of systems development, business systems department. Many of the projects are submitted by systems analysts and computer programmers to those connected with the business systems department or other departments whose programs are run on the IBM 705. These projects are solicited from all departments in late August of each year to tie in with the divisions' annual fall profit planning program for the coming year.

The manager of systems development reviews all project schedules for accuracy and completeness. He checks with the originators on estimates of analyses, programming time and savings. When this review is completed, all projects are segregated by the department; summaries are then made, and the first review with department management is held. In a large organization like the transformer divisions, projects originated by technicians, such as a systems

analyst or a programmer, may be completely unknown to a subdepartment head or to the department manager. For this reason, these reviews are invaluable. At each review, the originator, or his supervisor, presents his project. He reviews where the project fits into an over-all program and its justification. If management agrees, the form is signed and submitted to the next higher organizational level.

As all projects are reviewed, approved and summarized, several important advantages develop. First, the projects are sifted for those having the largest short or long range payoff. With the facts available and an agreed plan of action, decisions can then be made. Since this program is circulated within the functional department—with the business systems department management present for guidance—department heads not only become familiar with what is to be accomplished over the next year, but they also develop the feeling that it is "their" program and not one of the central staff. Simultaneously they see (by business systems) how their programs can integrate with other departments toward some over-all goal.

After the series of reviews are complete, the divisions' program takes final form and is presented to the vice president and general manager through a steering committee. This committee is comprised of the vice president, his immediate staff, and the manager of business systems. The review meeting is held in the late fall after each staff member has reviewed his department's program. The line managers again describe and try to sell their programs. This is preferred over the staff manager's attempt to present an over-all program unknown to those who have to approve it.

While the above procedure is time consuming, the communications aspects are worth it. After three years, it is safe to say that all department management are familiar with and approve the annual programs in the computer area. Moreover, since all programs have been evaluated, the best are being followed. In addition, proper integration is apparent and approved.

the business systems project schedule form
The business systems project schedule form (see illustra-

1961 - BUSINESS SYSTEMS PROJECT SUMMARY

Department Power
Reference Chart I & II

Fourth Quarter Report

Area Of Responsibility	Description Of Project	Development Costs			Annual Savings	Comments
		Forecast	Actual 4th Qtr.	Actual Yr. To Date		
Production & Material Control Integrated Control System	Develop a completely integrated system covering all phases from order entry to shipment of power transformers. Work will be concentrated in the production control area during 1961 and will encompass other functions as part of a three-year program designed to reduce annual costs.	M/P 48,800	M/P 7,806	M/P 34,954	(6) 1,165 (7) 6,295 (9) 20,925 (10) 4,930	Present phase of Shop scheduling complete. Material forecasting programmed and being implemented. Accuracy check of productive ratio complete. Copper activity summary by

Muncie-Sharon Tie-in	Develop procedures to handle Muncie M.I. Processing Also Muncie Main Stores.
Industrial Engineering	Determine operation sequence and calculate time values in Sections E-20 (brush copper), Z-7 (tank braces), I-40 (paper taping), I-40 (space miser), Z-8 (tank components). Direct savings in 1961 will be modest. However, the I.E. program support, and are necessary to accomplish, total systems integration outlined above.
Manufacturing Information	Install the dictation to key punch for engineered orders, extend programs to include writing miscellaneous orders such as KX, LX, Muncie orders, etc.
Marketing	Assist in the consolidation of the marketing functions and conduct functional studies to determine manpower requirement consistent with the work load. Develop methods and procedures for executing the work as required by the new organization plan.
POWER	TOTAL

- M/P - Methods and Programming
CT - Computer Testing
- (1) Expense avoided at Muncie
(2) Expense avoided at Muncie
(Note: - Both above figures c
(3) Reduction of 1 Industrial
(4) Reduction of 5 Production
(5) Personnel Reduction.
(6) Reduction in cost of suppl
(7) Stocking of repetitive par

PROJECT SCHEDULE - 1961

PROJECT		SCHEDULE												STATUS	NOTES	PROJECT TEAM	
NO.	DEPT.	TITLE	DESCRIPTION	1960	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT				OCT
17-01	I.E.	TIME VALUE APPLICATION	BRUSH COPPER SECTION	PROG													
17-02	"	TIME VALUE APPLICATION	TANK BRACE SECTION	PROG													
17-03	"	TIME VALUE APPLICATION	PAPER TAPING SECTION I-40	PROG													
17-04	"	TIME VALUE APPLICATION	SPACE MISER SECTION Z-8	PROG													
17-05	"	TIME VALUE APPLICATION	BRUSH COPPER SECTION	PROG													
17-06	"	TIME VALUE AT MODIFIED P.E.		PROG													
17-07	"	DEVELOP SHOP ORGANIZATION		PROG													

WESTINGHOUSE FORM 33485 BUSINESS SYSTEMS PROJECT SCHEDULE

PROJECT TITLE: Complete Mechanization of Cost Department Operations as a part of a completely Integrated Mechanical Accounting System. PROJECT NO. 61-16-10

DESCRIPTION OF PROJECT: To produce or have produced necessary mechanical outputs and inputs from Manufacturing Information, Factory Accounting and other areas which can be processed through the computer by prepared programs which will automatically produce accurate and complete cost data and records.

OBJECTIVES: To furnish costs on single items, component parts and complete apparatus, and also to furnish management with accurate and useful information for future planning.

DEPARTMENT (S): Factory Accounting - Cost REQUESTED BY & DATE: John Jones 9-9-59 PRELIMINARY SURVEY AUTHORIZED BY & DATE: James Smith 9-12-59

PLANNED STARTING DATE: 1-2-60 ESTIMATED COMPLETION DATE: 6-1-61 ESTIMATED MAN - WEEKS: 10 MONTHS ESTIMATED COSTS: \$ 10,212 ESTIMATED SAVINGS: \$ 90,720 gross \$ 54,720 net

APPROVALS TO PROCEED WITH PROJECT (NAME & DATE): Ira Bosse 9-15-59 Ole Chief 9-16-59 Computer Test Hours: 37 Estimated Costs (B): \$ 8,000 (C) TOTAL COST (A) + (B): \$ 18,212

PLAN OF ACTION	SCHEDULE BY MONTH												TOTAL				
	1960	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV		DEC	1961		
1. Cost Master Tape - Raw Material Self-Mfg. Parts	PROG. SCHED.	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
2. Cost Master Tape - (Sub-Stores) Bought Outside	PROG. SCHED.																
3. Cost Master Tape - Parts - (LG21) Correct Material Identification on Mfg. Information Master Tape.	PROG. SCHED.																
4. Correct Style Identification on Mfg. Information Master Tape. Material Card Output	PROG. SCHED.																
5. Mfg. Information Master Tape. Labor Card Output	PROG. SCHED.																
6. Mfg. Information Program	PROG. SCHED.																
7. Payroll Program	PROG. SCHED.																

REPORT ON JOB COMPLETED (SEE REVERSE SIDE FOR DETAILED COST/SAVINGS ANALYSIS)

DATE OF COMPLETION: _____ ACTUAL MAN - WEEKS REQUIRED: _____ COST/SAVINGS RATIO: _____

COMMENTS: _____

HAVE ALL NECESSARY APPROVALS BEEN OBTAINED? AFFECTED BUDGETS BEEN ADJUSTED? IS SUBSEQUENT FOLLOW - UP PLANNED? WHEN?

(Foreground: Business systems project schedule.)
(Middle: Project schedule - 1961.)
(Background: 1961 business systems project summary.)

tion) is rather all inclusive and can be used in whole or in part as the situation dictates. In every case the name, description, and objectives of the project must be listed. Further, there must be estimates of costs, savings and/or other benefits, and the person's signature who has prepared or originated the project. If during the year a specific time requires that the project must be worked on, or completed, in order to fit into an over-all program, it can be shown. If not, the manager of systems development will schedule the project and fill in the plan of action and schedule by month section.

One of the keys to successful use of the project schedule system is the degree of accuracy attained in both the estimates of savings and estimates of programming and debugging time. These estimates have to be approved first by responsible department supervision, where the savings are to be obtained. Furthermore, business systems must approve the programming and debugging time. To a degree, savings can be planned and ways of calculating these savings on the reverse side of the form can be incorporated. Of course, these savings receive considerable attention, as the project is circulated to department management. Programming estimates are based on cursory analysis at the job content to which previous time experience is applied. The conservative side is always chosen. This presents a real incentive to the programmer and a challenge to the whole organization. In the beginning, these estimates varied; now they are realistic.

In any one year, about 120 project schedules are received. Of these, about 60 per cent or 70 projects survive the reviews and are incorporated into the annual program. Theoretically, more could be accepted if they justified increased effort. On the other hand, only 40 or 50 projects could qualify. In either case, the central systems and the programming staff would have to be adjusted. Minor staffing adjustments are always made year to year,

depending on the project load. Major adjustments would have to be carefully considered since this type of technical personnel is highly qualified and not easy to replace or hire.

controlling by project schedule

Since the delivery of the IBM 705 computer in August 1956, main frame usage by job in decimal hours has been recorded. Since 1958 all main frame expense to the user on a costing rate basis has been charged out. The costing rate is set so that the computer operations budget will end the year, with all services charged out resulting in zero expense, budget and variance. All development or debugging time is charged to the central programming staff until the program goes operational; then it is charged to the customer department.

Since mid-1958, all systems and programming personnel have accounted for all their time on a weekly basis. Their time is fully reported regardless of their activity.

All times (both machine and personnel) are being reported against project number. These times are accumulated, multiplied by a costing rate, and charged to the specific project. This program is run each week on the 1401 computer.

Each project is summarized monthly on program versus plan. Expenditures are also itemized. Quarterly progress is reported to top management together with reproductions of Gantt charts on each project (see illustration). The Gantt charts are maintained weekly and are used for a visual progress record.

When a project is closed and savings are apparent, the functional department representative prepares a cost reduction docket which is processed through the divisions' official cost reduction program. These docketed savings, when approved, are filed together with the completed project for final reporting.

Aided by this planning and progress control system, savings approach \$1,000,000 a year.

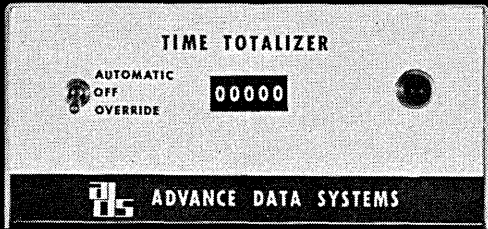
operational considerations

Several operational considerations should be mentioned in connection with the project schedule system. One of these is, "What to do about new projects which are developed during the year?" When it seems desirable to adjust the annual program, a new project schedule form is completed in the same manner as those incorporated in the annual program. The same department reviews are held to determine what original project should be eliminated, or if the new one should be added over and above all those previously approved. If it is a substitution, this can be handled with some ease. If it is an addition, other departments may have to review their programs for possible reschedule to make room for the new project. If the new project is significant, additional programming assistance may be requested.

The project schedule system is primarily designed for major development projects; however, it is used for other activities also. Recently, when converting from tab equipment to the 1401 computer, several over-all projects were originated with minor subdivisions for all the various program conversions that had to be made. Another example is in the area of maintaining productive programs combining many extension maintenance subprojects into one over-all project and make the usual estimates on effort and savings.

Finally, since all time is reported, project schedules are available for training, customer meetings, etc. These are not expected to develop tangible savings, of course, but they do serve the useful purpose of letting management know just how much training does cost and the real expense for attending customer and society meetings. ■

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CIRCLE 22 ON READER CARD

A MULTI-LANGUAGE SYSTEM FOR COMMAND & CONTROL

a proposal to counter inadequacy

by SAUL ROSEN, Purdue University,
Lafayette, Indiana



In a recent test run involving a Volkswagen, an Oldsmobile, and a Greyhound bus, it was proved that the VW provides better gasoline economy than the Olds, which in turn is far more economical than the Greyhound. The driver of the Greyhound bus suggested that another test be run in which each vehicle would be required to carry forty passengers.

This rather heavy flight of fancy is inspired by a number of recent compiler speed tests reported in *Datamation*, October, 1962.

The same problem was programmed in a variety of languages for which compilers now exist. It was compiled and the object program was run, and the compilation times and object program running times were duly recorded, and eventually found their way into print.

These tests were designed, at least in one case, to aid in the selection of a language which would be the standard language for programs in the area of command and control in one of the armed services.

No one can argue against the use of compile time and run time as important criteria in the selection of a language. However, it can be extremely misleading to compare compile time and run time of compilers that were built to handle quite different classes of problems.

The tests under consideration compared compilers like NELIAC, and MAD with JOVIAL and CL-I. The latter two were very much slower. If the assumption is made that all four languages are equally suitable for use in large command and control systems, then the choice is clear. There would also exist a clear implication that the military procurement personnel who authorized the development of JOVIAL and CL-I, and the programming groups that developed these languages and compilers were, at best, incompetent.

A comparative analysis of these languages will not be attempted in this paper. It is clear that JOVIAL and CL-I provide features in the area of data handling and data description that are not present in the faster NELIAC and MAD compilers. A compiler language that provides the ability to describe files and tables of information of great variety and complexity, and that provides convenient formats for the description of such files, must consume considerable compiling time in handling and interpreting this information. If it further attempts to organize the information in these files so as to produce efficient storage utilization, and also attempts to produce relatively good running programs it will take still more compiling time.

It has been proposed from a number of sources that what is needed is a very general language and a very general compiler for the language that will operate at high

speed where appropriate, and will move more slowly when necessary. When a program uses a subset of the language that does not require elaborate compiling techniques, or when a programmer indicates that he will be satisfied with an object code that is far from the optimum, the compiler will operate at very high speed. For more complex programs, and programs in which extensive optimization is desirable, more complicated subroutines of the compiling system would be used.

An adequate system of this type does not exist. An adequate language for command and control does not exist.* The fact that these do not exist in spite of the huge total effort that has been expended in the field of programming systems is an indication of the extent to which this effort has been misapplied. An attempt to develop a new system of this type on a crash project basis for use in currently planned command and control centers would almost certainly result in still another inadequate system.

The large computing systems that are going into operation in 1963-1964 have only two alternatives. They can adopt one of the existing inadequate languages as a standard or they can operate as multi-language systems. It is here proposed that operating in a multi-language environment provides the more reasonable approach.

A multi-language system can be used most effectively only if the translators for the various languages produce uniform standard outputs. It is reasonable to require that any translator that will be used must be modified if necessary to produce running codes that look the same to the loader as running codes produced by any other translator in the system. Such running codes would be in a standard relocatable form and would contain symbolic information to aid in setting up links with other programs produced by the same translator or by other translators.

The use of more than one language implies that programmers must be trained in a number of languages. In very large programming activities like those associated with command and control systems, individual programmers and programming groups will in general use only one language for their class of problems. Only a few systems programmers would have to be multilingual.

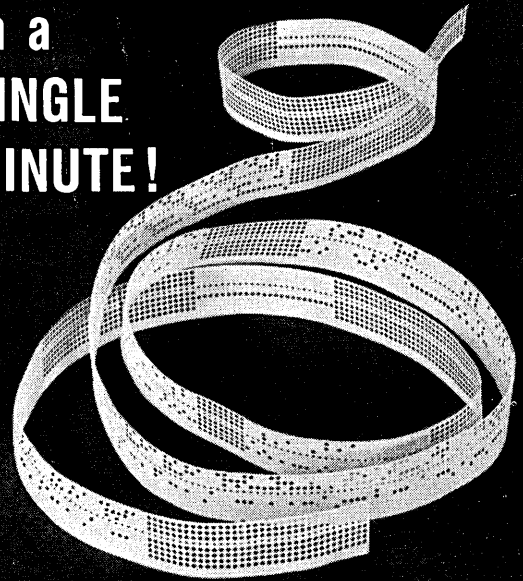
The multi-language approach will have the advantage that it will permit the use of new compilers in new and more powerful languages. In particular, it is hard to imagine that the new COBOL compilers will not find many uses in military command and control applications. They are going to be slow and they will not be applicable to all areas of computing, but they will probably supply the best available programming system for a large class of problems.

A multi-language system could also make use of FORTRAN which has become in many respects a universal language and a standard in the scientific computing field. There exist many thousands of trained FORTRAN programmers, and many thousands of FORTRAN programs.

A multi-language operating system would have under its control an assembly language system, a very fast compiler like MAD or NELIAC, a FORTRAN language compiler, a compiler in the JOVIAL-CL-I class, and a COBOL compiler. This is not proposed as an attractive solution, but rather as a practical approach to early effective utilization of the huge multi-purpose, multi-computer installations that are being developed. ■

* See W. H. Wattenberg. "The Programming Problem in Command and Control," *Datamation*, September 1962.

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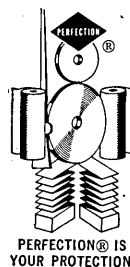


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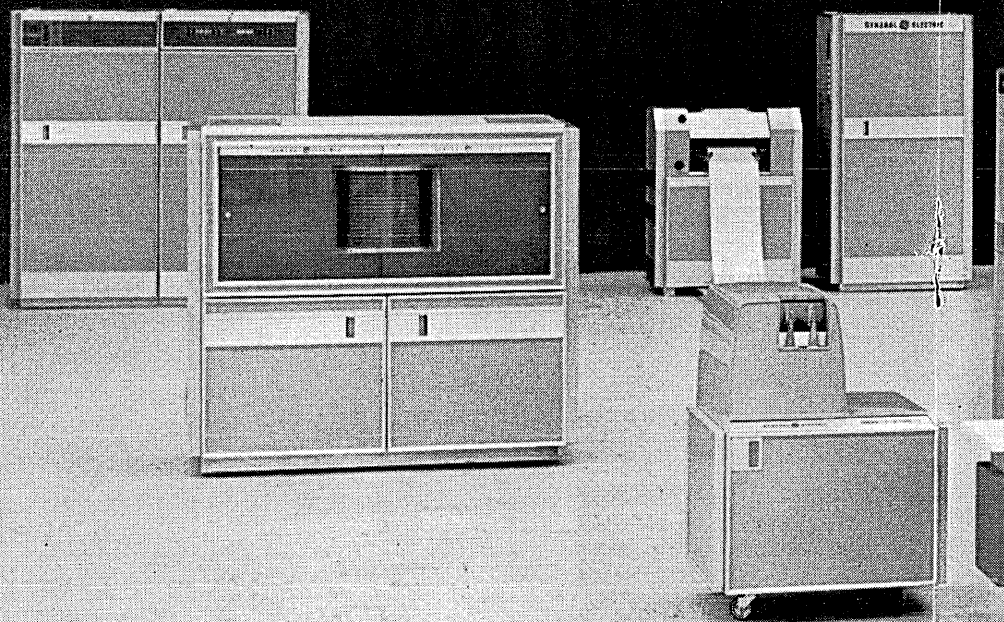
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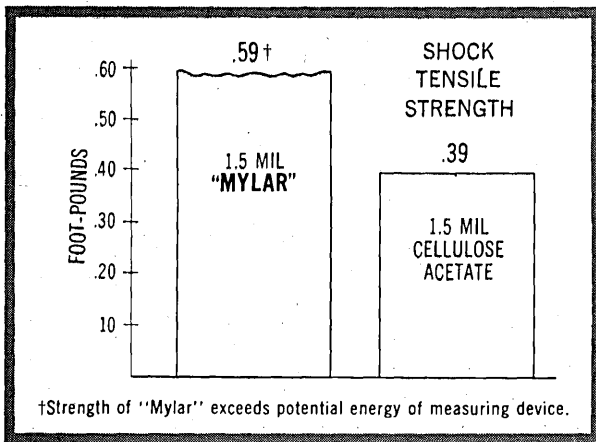
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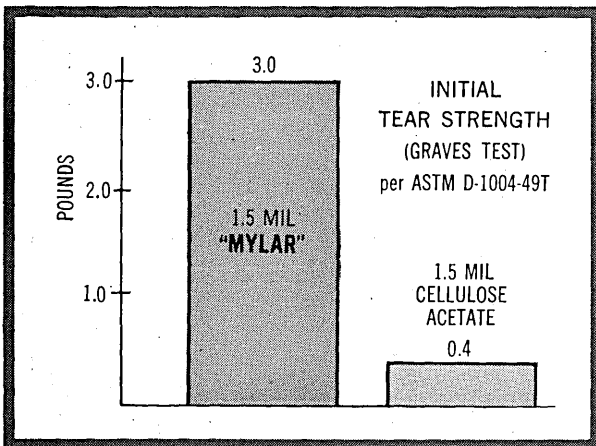
CIRCLE 24 ON READER CARD

GUARD AGAINST DOWNTIME WITH RELIABLE TAPES OF MYLAR®



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

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

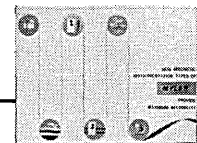


The cost of the data . . . the cost of the equipment . . . the cost of time *all* demand reliability. Get it with tapes of "Mylar". Send coupon for free booklet of comparative test data and judge for yourself. Du Pont Company, Film Department, Wilmington 98, Delaware.

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



Better Things for Better Living . . . through Chemistry



E. I. du Pont de Nemours & Co. (Inc.)
Film Department, Room #12, Wilmington 98, Delaware

Please send free, 12-page booklet of comparative test data to help me evaluate magnetic-tape reliability.

Name _____ Position _____

Company _____

Address _____

City _____ Zone _____ State _____

CIRCLE 25 ON READER CARD

DATAMATION'S QUARTERLY INDEX OF COMPUTING

With the inclusion of initial installations of the large scale 1107 plus the typical growth rate experienced over the past year, the computing index for the fourth quarter of 1962 resumed its upward trend.

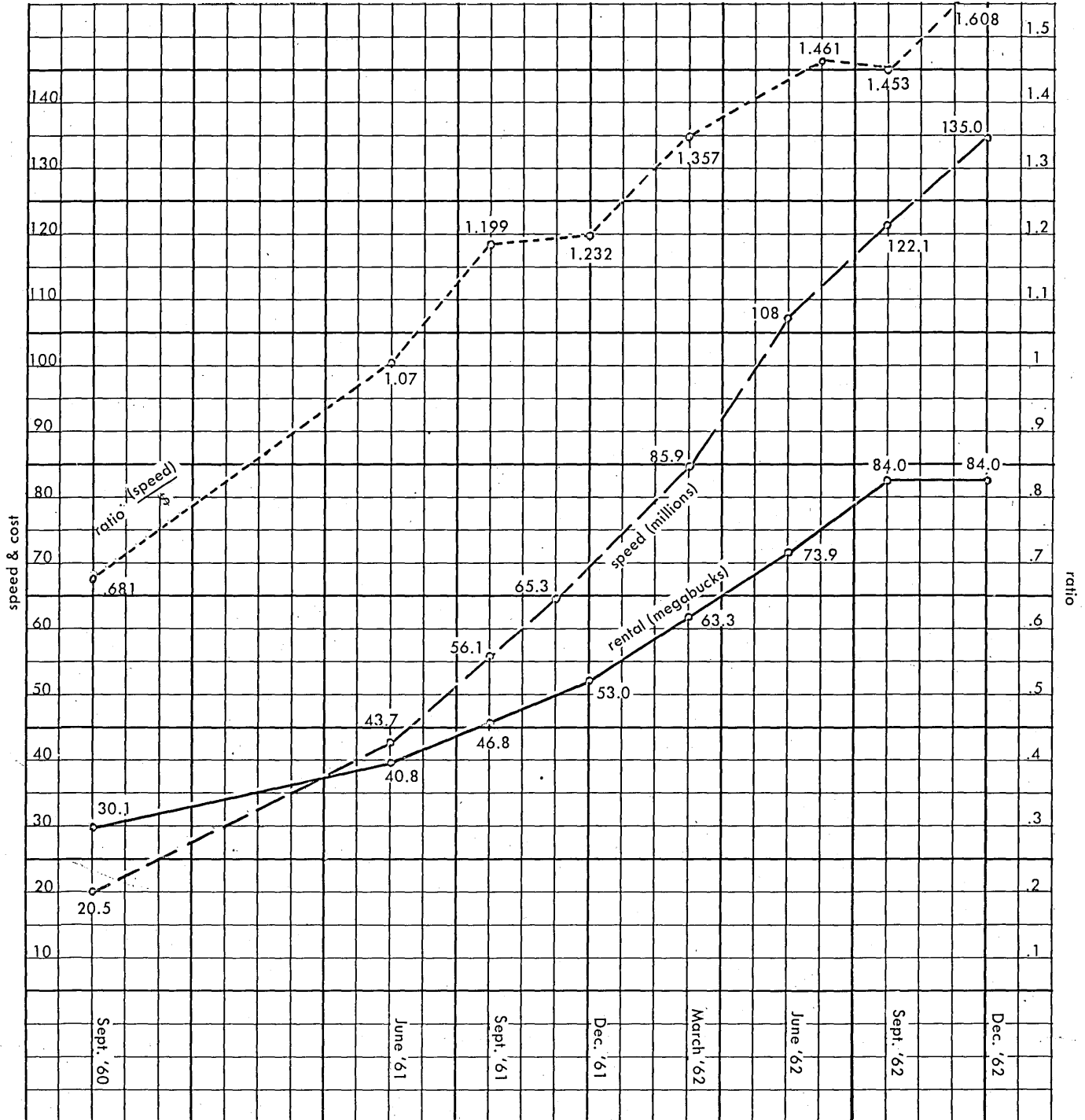
The number of ops/sec rose to 135 million, a gain of slightly more than 10% over the third quarter's figure of 122 million. Continuing installations of large scale systems in the 7000 class plus small scale computers such as the 1401 contributed to this gain. (It might be noted that 1401 installations have tapered off slightly during the past three months, for the first time during the year.)

Monthly rentals show a total of 84 megabucks, or approximately the same as in the previous quarter. Again,

the slight drop-off of 1401s affected this figure.

The ratio of computing power per dollar represents the quotient of the Speed Index and Operations per Dollar Index. Since the Ratio Index represents a measure of a condition, the units (operations per second) ÷ (dollars per month) need not be meaningfully related to provide an intelligible result.

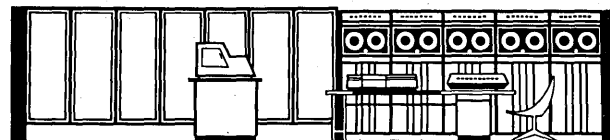
This ratio reversed itself during the fourth quarter as compared to the previous period, moving upward to 1.608, a gain of 10%. It is felt that the number of small scale installations, with high throughput cost as compared to large scale systems, tends to offset the lower operation/cost balance achieved by the larger machines. ■



There is a Honeywell magnetic tape unit that is just your speed

One of the key features of Honeywell's line of high-speed computers is the broad selection of magnetic tape units. The newest addition is called the Super Density system. It might also be called Super Speed, with its transfer rate of 186,000 decimal digits per second. Other models in the line include the High Density system which has a transfer rate of 133,000 digits per second, the Standard system at 96,000 digits per second, and the Economy system at 48,000. With a speed for every need, you can select the combination of computer and magnetic tape system that will assure maximum efficiency and economy for the job you have at hand.

With the compatibility of this line of magnetic tape systems, you also have added flexibility, when it comes time to expand. You can move up to higher speed units without need for reprogramming or other costly changeover operations. Tapes written at one speed can be read at other speeds on other units.



Super Density gives higher speed, takes less tape

The Super Density magnetic tape units achieve their high data transfer rate by packing information more compactly on tape. The 775 bits-per-channel-inch density of the Super Density unit compares, for example, to the 397 bits-per-inch of the Standard unit. In addition to higher speeds, this also means that more data is recorded on a reel of tape which, in turn, means fewer reels, less tape changing.

Table talk

	Economy Tape Unit	Standard Tape Unit	High Density Tape Unit	Super Density Tape Unit
DENSITY OF DATA ON TAPE				
Decimal digits per inch of tape	794	794	1,111	1,550
Pulses (bits) per channel inch	397	397	555	775
TRANSFER RATES				
Decimal digits per second	48,000	96,000	133,000	186,000
Alphanumeric characters per second	32,000	64,000	89,000	124,000
MEAN TRANSFER RATE				
Characters per second	40,000	80,000	111,000	155,000
SYSTEM APPLICABILITY				
	H400 H800	H400 H800	H400 H800 H1800	H800 H1800

Automatic error correction across the board

All Honeywell magnetic tape units feature Orthotronic Control, a unique method of automatically detecting and correcting errors. This technique, developed and perfected by Honeywell, minimizes the cost of maintaining accuracy and saves time otherwise required by human intervention or rerunning of programs.

Transports that treat their tape tenderly

All Honeywell tape units utilize vacuum capstans to produce and control the motion of tape past the read/write head. Vacuum is used to grip the tape to one of two counter-rotating capstans, depending on the direction of motion called for. Air pressure serves as a low-friction bearing to float the tape over the surface of the opposite capstan. The course of tape travel from reel to reel is designed in such a way that the oxide surface of the tape is untouched by any portion of the unit except the read/write head. Also, there are no pinch rollers to imbed dirt or dust into the tape or cause excessive wear. No other tape units treat their tape so gently or transport it so precisely.

Even a novice can change Honeywell tapes in seconds

Honeywell tape units and tape reels are designed for fast, safe changing. Reels are locked in place and the tape leader is threaded with the aid of vacuum. There are no openings in the reel flanges to catch fingers or foul the tape. Tapes can be changed in less than 25 seconds with a minimum of practice.

Write for more information

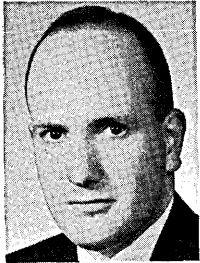
If you would like more information, write to Honeywell EDP Division, Wellesley Hills 81, Massachusetts. In Canada, Honeywell Controls Limited, Vanderhoof Avenue, Toronto 17, Ontario.

Honeywell
ELECTRONIC DATA PROCESSING

DATA COLLECTION FOR BUSINESS INFORMATION PROCESSING

a survey of
hardware and applications

by JUSTIN A. PERLMAN, Product/Market Developers, Pacific Palisades, Calif.



The use of computers has developed mightily since the first major product of the industry was installed at the Bureau of the Census in 1951. For many of the intervening years, the prime focus of computer manufacturer and user was placed on enlarging the power (speed, flexibility, etc.) of the central processor. In recent years, however, as more and more emphasis has come to be placed on what is frequently called the "total system concept" it has been recognized that the central processor is merely one part of the hardware complex.

To perform the job being cast for it in the total system concept, the functions of the hardware complex are being enlarged in two directions: to encompass entry of source data into the system, and to provide selected output directly to the using executive in a form usable to him.

This discussion of data collection will focus on the entry of source data into a business data processing system. Within this area we will survey some of the broad needs, general types of equipment available and their functions,¹ how these equipments are being used today and are planned to be used in the near future, and finally some considerations in selecting and installing data collection equipment.

needs

It has been recognized for many years that reducing the number of times and number of points at which "source data" must be originated, transcribed, and entered into a processing system (computer or manual) both decreases paperwork costs and improves reliability of the output developed from the source data. Progress along these lines led to the realization that as the number of originating points was reduced, steps could more easily be taken to organize the input data such that processing effort, time, and cost could also be reduced. With the widespread use of small and large-scale computers for the processing task, this organization of input into formats readily ingestible at high speeds into the computer has become a necessity rather than just desirable.

Another requirement is system response time. This is important even in primarily manual systems. In the last few years information management specialists in several large companies have been talking in terms of eventually implementing real-time control of manufacturing and other operations. Such control or the approximations to it which a few advanced organizations are making today require a high degree of mechanized data collection: full information must be put in machinable form at the earliest possible time, and this data must reach the processing center as soon as possible after key events occur. This can provide the distinction between decision outputs which can be used with current effect vs. after-the-fact statistics whose control value is diminished.

These broad needs, of course, must be met at minimum cost and with minimum upset to ongoing operations. Data collection equipment and techniques, properly applied, may meet these requirements.

equipment available now

Most data collection equipment manufacturers are now installing their first or second generation of equipment. (The reader can make his own comparison to the stage of development of central processors.) Today's equipment allows several functions to be performed; it:

- a. Identifies an individual
- b. Identifies a job or order
- c. Identifies a location
- d. Identifies charging and charged parties
- e. Identifies non-normal conditions
- f. Specifies quantitative information
- g. Specifies time
- h. Can provide conversion from one data medium to another
- i. Conveys the information to a central point, usually the computer center.
- j. Formats the information, and checks it for completeness and "obvious" errors.

These functions are accomplished by having the equipment "read" cards, plates, badges, tags, etc., accept information entered via dials, buttons, levers, slides, and so forth, and in some cases ingest data directly from productive machines, test equipment, and the like. Many equipments then transmit the data over wire to a collection point. The many different pieces of hardware now available essentially differ in type rather than being different in kind. One device will accept seven digits of manually entered variables, another will accept twelve digits; one transmits at thirty characters per second, another at sixty. This is not to say that for a specific application one device may not be more suitable than another (e.g., in some uses it may be desirable to pay a premium for extensive error-checking circuitry whereas in another application the information system itself has been designed so that most of the very small percentage of errors are automatically detected).

how DC is being used

As in the case of early edp installations, mechanized data collection is frequently finding its first uses in mirror-image automating of manual systems. The improved speed and reliability of information handling (and in some cases reduced cost) has been gratifying to these users, but as in the case of early computer applications the conversion of manual systems is usually a sub-optimum usage. Data collection equipment, like computers but to a lesser degree, opens avenues to completely new ways of managing and controlling a business. Not that the potential was not present before the advent of this gear, but data collection hardware properly employed can facilitate realization of this potential. With the recent advances in information

systems technology and the hardware now available to implement them, it is possible to plan operations in detail for a multi-hundred man or a multi-thousand man organization, to control to this plan by collecting data only on deviations to the plan, and then to issue a fully updated plan — on as frequent a basis as desired. This approach will become more economical as the years pass, such that both large companies with their own processing centers and small firms utilizing service bureaus will be able to derive full benefit. Among the many discrete applications for which mechanized data collection is being used today are those shown in Figure 1.

Some of these applications are overlapping, and undoubtedly several have been overlooked. As a matter of fact, one purpose of this list is to stimulate the reader to a realization of the many potential uses to which data collection equipment has *not* been put.

Since considerable literature already exists on such "standard" applications as order location, labor distribution, attendance reporting, etc., we will say only a brief word about a few of the less publicized applications.

In-process inspection has been implemented in an interesting way in a plant manufacturing electric typewriters. Here, inspection results are manually recorded via the data collection equipment as they occur and analyzed at frequent intervals. When necessary, corrective action can be taken rapidly. Another example where a much longer response time is set as a goal, is the assembly of submarine cable repeaters. In this instance, inspection information is automatically read and recorded from electronic test equipment together with identification of the unit under test from cards. This data is "stored" until malfunctions occur in the underwater cable, at which time the original test data is analyzed for possible clues in diagnosing the trouble.

Intercompany ordering is being utilized by a stationery supply firm as both a sales tool and an efficient ordering method. This firm negotiates blanket purchase orders with its customers, normally covering a one-year period. The customers are then supplied with cards for each of the items covered by the P.O., and can order simply by inserting the appropriate cards in a data collecting and transmitting device together with information as to quantity, distribution code, and delivery information (if required). The stationery supply firm uses the received information to produce the order, shipping list, and an acknowledgment, and to update inventory, sales, and accounts receivable records. This is all done on punched card equipment. Advantages claimed for this ordering system include a sharp reduction in paperwork, lowered customer inventory levels, and a shortened response time. Since this entire system is on tab equipment, the customers can be supplied with a variety of usage and cost distribution reports suited to their needs.

The stationery firm is going one step further with this system to bring some of these advantages to its smaller customers and to decrease its own operating costs. Data collecting and transmitting devices are being placed in the homes of its salesmen so that orders taken during the day can be entered each evening directly with the company's central office in machine language.

Several of the other applications listed under Marketing and Distribution are similar to this intercompany ordering example.

Vehicle dispatching and charging is an application found in companies with sizable administrative fleets, in some trucking companies, and recently in a TV home service firm. In this last case the repairmen call in when they finish a job and give the home-office operator information as to time spent, parts used, type of trouble corrected, etc., and the operator uses a data collecting unit to enter this information into the billing and analysis system. Re-

pairmen efficiency is one of several analytical outputs.

Use as a conversion device is illustrated by an application where machine-tool control tapes are prepared via a data collection device. Selection is made from an inventory of operation cards of those cards pertinent to a particular job. These are then placed in the data collection device in proper sequence and combined with a minimum of manually entered variable data to produce a paper tape. In effect, the data collection equipment is being used in place of more usual paper tape generating equipment. In this and other conversion applications the advantage stems from maximum use of pre-punched pre-checked input, no need for a skilled operator, and, normally, availability of data collection equipment which has been installed for other purposes.

Figure 1.

Product oriented	Material oriented
Order location	Receiving
Degree of completion	Receiving inspection
In-process inspection	Stores receipts and issues
Lot sampling	Stores adjustments and transfers
Design change control	Periodic inventory
Individual operation time	Marketing and Distribution oriented
Employee oriented	Shipment to customers
Attendance	Regional warehouse inventory control and ordering
Location and control of roving personnel	Intercompany ordering
Labor reporting, including Job time	Field ordering
Operation time	Retail catalog store ordering
Unproductive time and cause	Mail order filing
Indirect time and type	Administrative and "other"
Overtime authorization and reporting	Overhead projects status and costs
Scrap and rework by employee	Document control
Incentive payroll	Computer time utilization
Payroll deductions	Cash reporting (payments received by utilities, insurance and mortgage companies)
Performance efficiency	Billing for professionals (doctors, etc.)
Workplace oriented	Film processing control
Scheduling, and schedule deviations	Vehicle dispatching and charging
Past-due orders	School student assignment and control
Parts shortages	Hospital patient charging
Machine loading and unloading lineup	Hotel charging
Machine utilization measurement	Railroad train accounting
Leadtime analysis	Railroad car sorting
Rework control	Credit card accounting
Scrap reporting	Physical security control
Set-up	Use as a conversion device (manual or machine data into another machinable medium)
Downtime	
Tool control	
Tool usage measurement	

selecting and installing equipment

In surveying the feasibility of a data collection installation several caveats should be firmly kept in mind. The only justifications for new equipment or changed operating procedures are lower cost or tangible improved service. There are no prizes offered for merely being "first" with a new application. The preparatory study, systems work, and programming required for a profitable installation are themselves time consuming and costly, and as in the case of other such activities in the computer field make up a large portion of the cost of a successful installation. As noted earlier, merely converting a manual system to a mirror-image mechanized data collection system does not usually yield significant advantage.

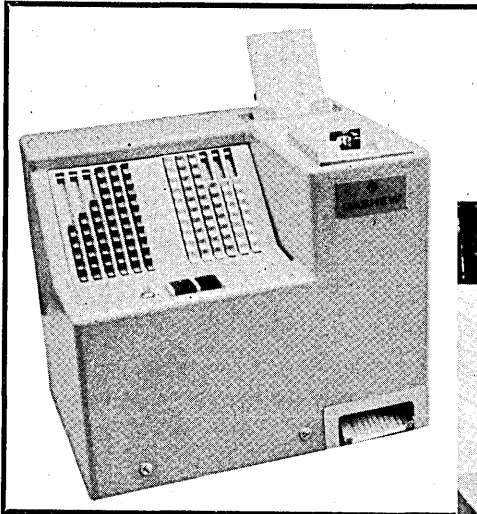
The hardware selected, while important, will be less significant to the success of an application than the system work accomplished by your organization and the hardware supplier's personnel. Most important, however, in selecting a supplier is the service he will provide and the inherent reliability of his equipment. The best way of checking on these factors is to contact several of his current customers. Most equipment now being installed is

well-engineered and the suppliers are extremely conscious of the importance to them of excellent service. There are existing cases, however, where 25 to 50% of the installed units must be pulled each week for unscheduled maintenance, and other instances where service personnel and arrangements are far from adequate. On early equipments the need for frequent preventive maintenance was usually grossly underestimated, particularly in installations with substantial usage seven days a week, three shifts a

day. This appears to have been corrected somewhat in the modified and new units now available.

Figure 2 lists some comparative characteristics of data collection equipment manufactured by a number of suppliers. The chart is based on information furnished by the manufacturers. The significance of some of these characteristics (and others) is described briefly below.

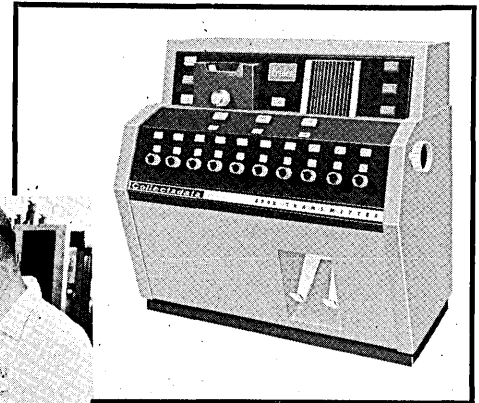
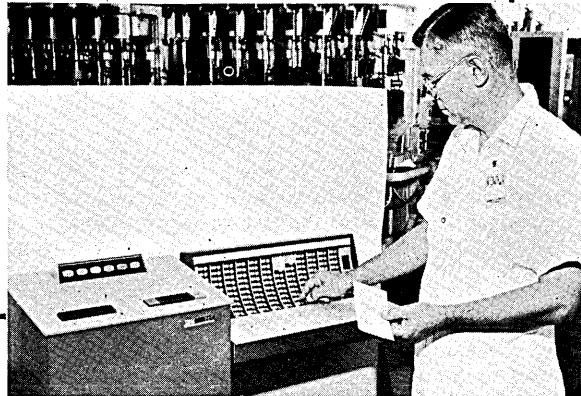
Sequential or Parallel Set-up. This is of interest normally in transmitting systems. Parallel set-up implies



Left: The Dashew DashaRecorder DC-4020

Below: The IBM 357 Input Station

Right: The Friden Collectadata 3002



DATA COLLECTION EQUIPMENT COMPARISON CHART	CONTROL DATA 180	DASHEW DashaRecorder DC-4020	FRIDEN Collectadata Model 30, & 12	GENERAL ELECTRIC Datamet GE-3101
INPUT				
Fixed Input—Type	IBM cards, stubs; alphanumeric	IBM card, embossed punched plate; alphanumeric	IBM cards, punched embossed badge; alphanumeric	IBM cards, stubs; alphanumeric
Fixed Input—Quant ^a Set-Up and Insertion	80 ^c Sequential; horizontal slot	90 Parallel; vertical slot	192 Parallel; vertical feed-thru (card)	80 ^e Sequential; vertical slot
Variable Input—Type	Dials	Slides	Dials	Dials
Variable Input—Quant	10	12	10	10
TRANSMISSION				
Cabling Speed	No NA ^d 16 c/s	Yes 40-wire, or 2-wire 0-20 c/s	Yes 7-wire, or 2-wire 30 c/s	Yes 33-wire 60c/s (fixed), 110c/s (var)
OUTPUT	Punched paper tape	Punched paper tape, or IBM card	Punched paper tape, or buffer to computer	Punched paper tape
GENERAL				
Interlock and Format Control on Input	1-4 dials may be interlocked to any transaction codes. 1-3 cards may be sequence controlled and counted.	Card and plate must be inserted	Fixed and variable interlocked to any transaction codes	Single card, var. only, cards plus var., etc.
Output Error Detection	Vertical parity, end of msg, start & end codes	Vertical parity, length of msg.	Vertical parity, length of msg, start & end codes	Vertical parity, digit count (must be even)
Remote/Central Ratio (mgx)	NA	20:1	20:1	10:1
INSTALLATIONS^b				
Remote Stations ^b	0-20 50-250	0-20 0-50	50-200 Over 1000	50-200 50-250
COST				
Remote Station ^f Central Station ^f	\$115/mo NA	\$55— /mo \$106— /mo	\$40-\$70/mo \$46— /mo	\$61-\$72/mo \$75/mo

NOTES a Characters, with single insertion of documents.
b Numbers of installations and remote stations are given in classes to avoid disclosing proprietary information.

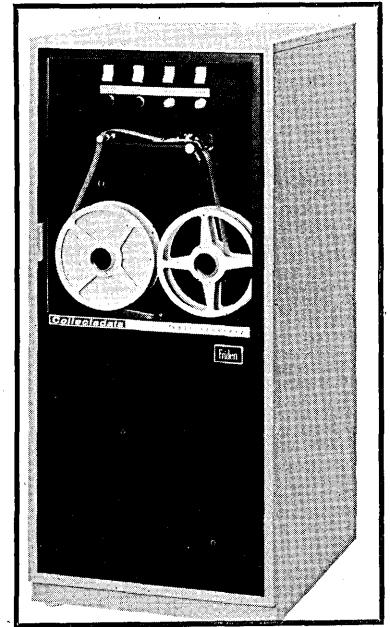
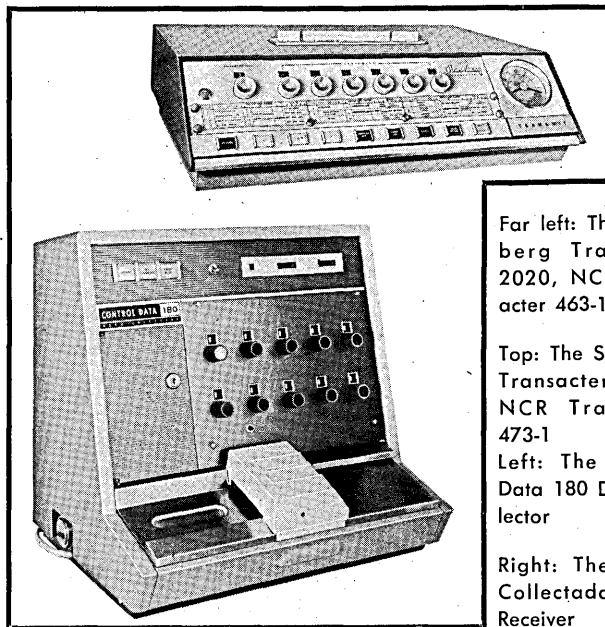
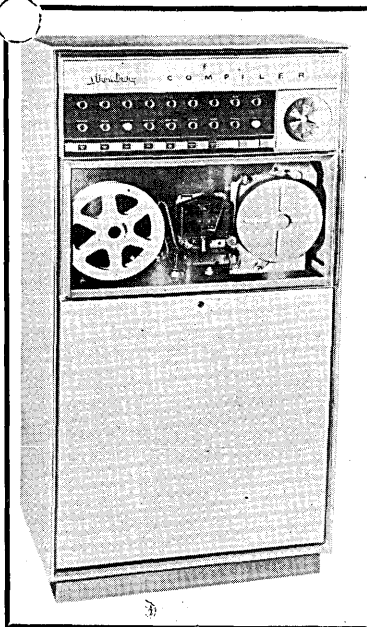
c Up to three cards per recording, for maximum of 240 characters.
d Not applicable.
e Unlimited number of additional cards.

setting up the full transaction (inserting all cards, stubs, badges, and the variable data) before the remote station is connected to the central station. If there is not a major cost advantage to sequential hardware, the wasted time during which the operator accomplishes one portion of the transaction after another (or fails to complete it properly) can degrade the overall performance of a system.

Transmission. Most of the units listed are capable of

transmitting data from a remote location in a plant to a processing center located in the same plant. Some can transmit economically over short interplant distances, and a few can transmit nationwide over telephone lines.

Speed and Cabling. Speed and the type of cabling required are dependent variables. Two-wire transmission can provide roughly 30 characters per second in current equipments while multiconductor cable in some cases provides 60 characters per second. Speed is desirable in reducing



Far left: The Stromberg Transacter 2020, NCR Transacter 463-1

Top: The Stromberg Transacter 1010c, NCR Transacter 473-1

Left: The Control Data 180 Data Collector

Right: The Friden Collectadata 3031 Receiver

IBM 357	IBM 1001	NATIONAL CASH REGISTER Transacter ^f 473-1, 463-1	RCA EDGE	STANDARD REGISTER DataRay 401	STROMBERG TIME Transacter 1010c, 2020
IBM cards, punched badge; alphanumeric	IBM cards, stubs; alphanumeric	IBM or RR card, stubs; alphanumeric	IBM card, stub, punched badge	IBM cards, stubs; alphanumeric	IBM or RR card, stubs; alphanumeric
90 ^e Sequential; vertical feed-thru (card)	36 ^e Sequential; horizontal carriage	131 Parallel; vertical slot	114 Parallel; vertical 'slot' (card)	51 ^e Sequential; horizontal carriage	131 Parallel; vertical slot
Slides	10-key keyboard	Dials	Lever	10-key keyboard	Dials
12	—	7	10	—	7
Yes	Yes	Yes	Yes	Yes	Yes
39-wire, or 2-wire 20c/s	2-wire 12 c/s	18-wire, or 2-wire 60 c/s	2-wire 28 c/s	2-wire 12 c/s	18-wire, or 2-wire 60 c/s
IBM card, or to computer	IBM card	Punched paper tape	Punched paper tape, or to computer	IBM card	Punched paper tape
Via coding in cards	Controlled by program card of output punch	Fixed & var. interlocked to any transaction codes	Transaction codes specify type and number of docs and var. (inclusive/exclusive)	Controlled by program card of output punch	Fixed & var. interlocked to any transaction codes
Length of msg.	Length of msg., vertical parity, invalid char., self-check number	Vertical parity, length of msg.	Vertical parity, start and end codes	Length of msg., vertical parity, invalid char., self-check number	Vertical parity, length of msg.
20:1	Unlimited ^g	25:1	25:1	Unlimited ^g	25:1
Over 200	Over 200	20-50	0-20	20-50	20-50
Over 1000	Over 1000	Over 1000	250-1000	250-1000	Over 1000
\$29-\$72/mo \$114-\$265/mo	\$15-\$23/mo \$135/mo	\$78/mo \$375/mo	\$69-\$74/mo \$705/mo ^h	\$15-\$25/mo \$45-\$65/mo ⁱ	\$54-\$78/mo \$270-\$365/mo

f Telephone company data transmission subsets additional, where necessary.
g Unlimited, since only one connected via telephone line at any one time.
h Includes two paper tape punches at central.

i NCR has obtained distribution rights for the Stromberg Transacter. The equipment is identical.
j Plus keypunch.

the number of data collection stations necessary for a specified station queueing time; but many applications and combinations of applications do not require high speed. Speed costs money, primarily in forcing the use of multiconductor cabling. This is both expensive to install initially, and costly when location of stations must be changed. However, there is still a further trade-off involved in cabling: one manufacturer states that by designing his equipment to use multiconductor cable (and thus not having to go through a data conversion stage for transmission) his error checking capability is both enhanced and less expensive.

Cabling or any wiring presents an important point to clarify early in your investigation: does your local municipal code require that the cabling be installed in conduit? If forced to use conduit, the initial cost will jump substantially.

Output Medium. Output media currently available are punched paper tape, punched cards, printed cards, and direct input to a computer. In the past, several varieties of printed coded tape or fanfold forms were offered as was a non-computer magnetic tape. The output medium is important to you in several ways. Depending on how you will use the collected information there will be a definite cost involved in converting from the output medium of the collection equipment to the input medium of your processor if they are not the same. In addition to the conversion cost, the time required for the conversion and the way this will affect the response time of your system is of key importance. By careful design of his information system and output and input media, one successful user is now operating a system with roughly a 15-minute response time. This is accomplished without the use of costly real-time hardware. The output medium may also imply additional programming and processing cost for a central processor if the organization of the information in the output medium is not optimum for input to the processor.

Feedback. There is at present no integrated inexpensive equipment available from data collection manufacturers to provide inquiry from a remote data collection station with answerback to the remote location, or a hot message capability such that certain types of transactions (or portions of them) transmitted to the central collection point also simultaneously become messages to one or more other points in the plant. Several improvised installations of standard page-printer hardware have been made to approximate a "feedback" capability. If imaginatively utilized, this capability may offer one of the prime advantages of a data collection system.

Interlock and Format Provisions on Input. Several of the devices listed provide for different "transaction codes" which when set, force the operator to insert specific types of documents and a specified number of variable digits for each different type of transaction before the equipment will recognize the entry as complete and accept it. This type of capability raises the price of the equipment but in many installations saves more than its cost by forcing proper entry of data and eliminating "garbage."

Output Error Detection. Error detection comes in "many sizes to fit different pockets." Among the techniques available are vertical parity checks (character by character), length of message checks for each type of transaction, start and end of message symbols, etc. Again, the more comprehensive the check, the greater the cost in hardware and to some extent in operating time. Type of usage should be the guide to the degree of sophistication needed. Experience at one installation using equipment with error detection capability of a lower order of sophistication indicates a retransmission rate (error detected while the operator is still at the remote station) of around 0.5 per cent, and an undetected error rate (detected by processing

equipment subsequent to the central collection gear) of less than 0.1 per cent. Bad cards accounted for many of the undetected errors. Another installation using data collection devices of a higher order of sophistication has been operating for some time with an undetected error rate of only one in several hundred thousand characters. This is obviously far superior to tab equipment specifications.

Remote/Central Ratio. This figure needs to be taken with a grain of salt. Most installations operating today have less than the maximum number of remote stations hooked to a central collection station. This is a function of queueing time specified by the user. An important figure here is the cost of the central equipment. Several of the devices listed have inexpensive central units such that an installation of only a few remote units to one central is feasible for small applications.

Special Capabilities. Some of the equipments have provision for hooking test equipment, automatic scales, counters, data reduction equipment, etc., directly into the data collection gear.

Mixed Installations. With the availability of devices capable of transmitting via telephone circuits over long distances, several installations are now using a combination of in-plant and out-of-plant data collection, all feeding to a central location. The ability of the device selected for in-plant use to operate compatibly with out-of-plant should be evaluated if applicable to current or future needs.

Message Verification and Error Notification. The remote equipment should have some means of determining or being notified that a transaction has been accepted at the central station. If not accepted by the format provisions of the remote unit, or by the central station, it is desirable to indicate to the operator just what portion of the input information is unacceptable.

Physical Characteristics. The hardware, naturally, should be capable of operating in the environment in which it must be used. Future problems may be avoided if included in the selection process is the factor of actual temperature and humidity extremes in the facility, and the worst-case situation of voltage regulation. Regulation can be corrected, of course, but the cost can be substantial. Also to be considered are mechanical reliability, ease of maintenance, simplicity of pulling one unit and replacing it with another, movability, reasonably jamproof and tamperproof, and other physical characteristics one would expect in equipment to be placed in the type of service an installation implies (e.g., wall mounting, outdoor use, etc.).

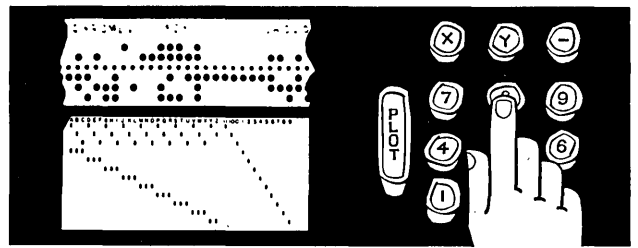
and tomorrow

Future trends in data collection will see the planning of these installations being a part of the conception of total information systems or their overhaul. Data collection devices are actually the conversion point for human-sensible data to machinable data, and this point is being pushed farther and farther back from the central processor. Future systems will probably call for increasingly larger numbers of collection devices with sharply lowered complexity and cost. Just as the telephone is an accepted unit in large quantities throughout business and industry, collection units will someday be nearly as ubiquitous, as inexpensive, and as reliable. This time will be hastened by progress in the information and management control technologies to the end that the differences between planned performance and actual performance of an organization are encompassable by acceptably priced real-time processing equipment. At that point data processing activities will be supplying high quality information on which effective decisions can be solidly based, rather than furnishing management the ingredients for educated guesswork. ■

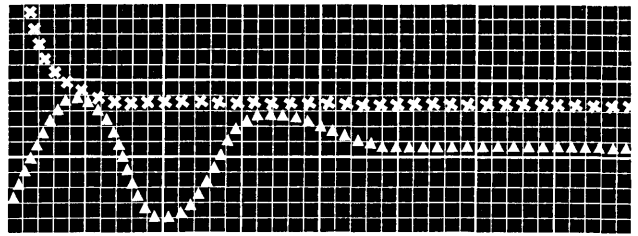
PLOT FOR ECONOMY

**SAVE
TIME...
SAVE
MONEY...**

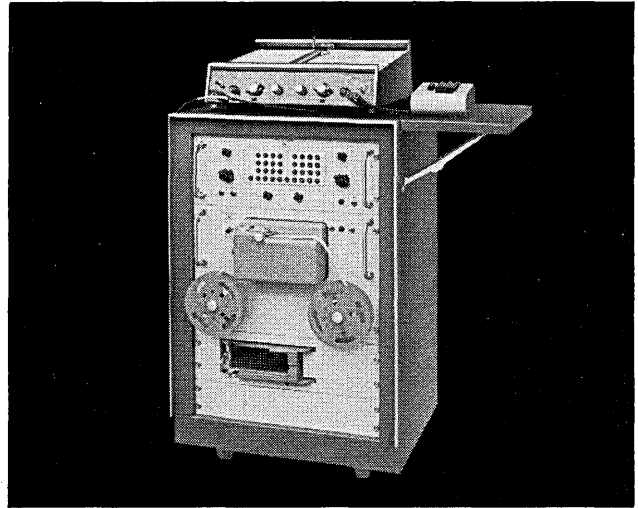
CONVERT
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TO
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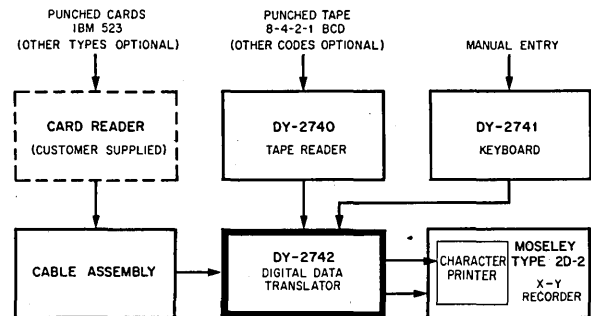
WITH
THIS



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

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

Here's the DY-6242 System:



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

Write or call your nearest Dymec/Hewlett-Packard representative or Dymec for full information.

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A DIVISION OF HEWLETT-PACKARD COMPANY

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7688

CIRCLE 49 ON READER CARD

CODASYL, COBOL & DETAB-X

a status report

by SOLOMON L. POLLACK, Systems Group Chairman,
CODASYL Development Committee



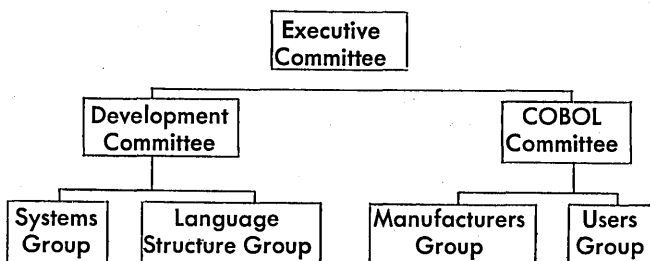
DETAB-X (Decision Tables, Experimental) was introduced to the data processing world on September 20, 1962 at a Decision-Table Symposium in New York sponsored by the Systems Group of the CODASYL Development Committee and by the Joint Users' Group (JUG) of ACM.

DETAB-X is thus a recent product of activities set in motion some time ago by CODASYL (The Conference on Data Systems Languages). In its early days (1959) CODASYL was comprised of three committees reporting to an Executive Committee: a Short Range, Intermediate Range, and Long-Range Committee. After the Short Range Committee produced COBOL, the CODASYL organization evolved into that shown in Fig. 1.

The Development Committee's broad charter was to "consider the next generation of computer languages and to augment the Short Range Committee's undertakings."¹ To do this the Committee created two groups. The Language Structures Group concentrated on the development of business language structures; the Systems Group set out to develop a machine-independent, systems-oriented language.

The Systems Group investigated several techniques for describing business problems, and in early 1960 focused its attention on decision tables² as a possible foundation for a business language. The Systems Group was fortunate in being able to draw heavily on the experience of two of its members, Orren Y. Evans and Burton Grad, who had done extensive pioneering work in applying decision tables to operational business situations.

Fig. 1—Organization of CODASYL as of December 31, 1962



Decision tables in general are set up in a tabular format containing a set of decision rules based on a given set of conditions; each decision rule describes the sets of conditions that must be satisfied in order for a given sequence of actions to be taken. The language used within the table to state the conditions can be "pure English," FORTRAN, COBOL, or modified versions of any one of these or other languages. The CODASYL Systems Group developed specifications for DETAB-X — a decision-table structure using modified COBOL-61 for business-problem description. They chose modified COBOL-61 because most computers for business data processing were expected to have COBOL-61 compilers by the end of 1962.

DETAB-X was labeled experimental in order to encourage data processing specialists to experiment with it and to provide feedback to the Systems Group by answering the following questions:

1. Is the decision-table format useful as an additional form to the Procedure Division of COBOL?
2. Can the decision-table format be useful for problem analysis?
3. Within what range of complexity are decision tables effective?
4. Do decision tables serve as an effective tool in the area of documentation and man-to-man communications?

It is important to note that the modifications to COBOL in DETAB-X enable people or computers to readily translate the decision rules contained within each decision table to official COBOL-61 sections, paragraphs, and statements. The modifications were considered necessary for efficiently

Fig. 2—Sample DETAB-X Procedure

NOTE: TABLE 3 is an emergency-order routine
TABLE 4 is a secondary-supply routine

	Rule 1	Rule 2	Rule 3
STOCK-ON-HAND LR CURRENT ORDER	Y	Y	N
CURRENT-ORDER GR SECONDARY-SUPPLY GO TO	Y	N	—
	TABLE 3	TABLE 4	
SUBTRACT CURRENT-ORDER FORM	—	—	Stock on- Hand

describing decision rules within the decision-table format.

As an illustration of a DETAB-X decision table, the following COBOL-61 PROCEDURE DIVISION statement³ is shown in DETAB-X form in Fig. 2.

IF STOCK-ON-HAND IS LESS THAN CURRENT-ORDER THEN IF CURRENT-ORDER IS GREATER THAN SECONDARY-SUPPLY GO TO EMERGENCY-ORDER-ROUTINE; OTHERWISE PERFORM SECONDARY-SUPPLY ROUTINE; OTHERWISE SUBTRACT CURRENT-ORDER FROM STOCK-ON-HAND.

In addition to its presentation before an audience of over 450 data system designers and computer programmers at the aforementioned Decision-Table Symposium, DETAB-X was presented to over 500 members of Guide at its Philadelphia meeting in November, 1962. Both audiences were encouraged to experiment with DETAB-X and provide feedback to the CODASYL Systems Group; those interested in doing so were provided with the DETAB-X Specifications Manual and Decision Table Tutorial Manual.

The CODASYL Systems Group is just beginning to receive some feedback from users; their remarks indicate that DETAB-X is a significant development in data proces-

sing and would be a valuable addition to COBOL. The following are two examples of the many comments received:

"DETAB-X certainly aids the problem of man-to-man communication. We believe that continuity of documentation is extremely important for program maintenance and programmer replacement purposes."

"DETAB-X would be a very valuable addition to the Procedures Division of COBOL. We hope that it would be a 'required' versus an 'elective' addition to COBOL. As an elective we would be afraid to use it due to the potential lack of compatibility between various manufacturers."

The Systems Group had originally planned to evaluate all feedbacks from the experimental use of DETAB-X with a view towards making a recommendation on decision tables to the CODASYL Executive Committee. If the feedback continues in the same vein as above, it is reasonable to expect that the CODASYL Systems Group will probably propose to the CODASYL Executive Committee, probably by mid-1963, that DETAB-X be adopted as an addition to COBOL. ■

Members of the CODASYL Systems Group and Task Force who Participated In the Development of DETAB-X

Carl L. Byham
Continental Can Co.
I. M. Brown
Insurance Co. of North America
Les W. Calkins
United States Steel Corporation
Systems Group chairman 1959-1962
Charles Cooper
Standard Pressed Steel Company
Leonard P. Chamberlain
The Provident Institution for Savings
Orren Y. Evans
IBM Corporation
John J. Feldman
The Howard Savings Institute
Kenneth A. Foster
Sylvania
Burton Grad
IBM Corporation
Howard T. Hallowell, III
Standard Pressed Steel Company

Mary K. Hawes
Radio Corporation of America
Charles Katz
General Electric Computer Department
Harry Lex
Standard Pressed Steel Company
Hans Nickel
Standard Pressed Steel Company
Solomon L. Pollack
The RAND Corporation
John R. Smith
Malcolm D. Smith
Minneapolis-Honeywell Company
Jack A. Strong
Computer Sciences Corporation
Richard Sullivan
General Motors Research Laboratories
Richard E. Utman
BEMA
Kendall Wright
The Church of Jesus Christ of
Latter-Day Saints

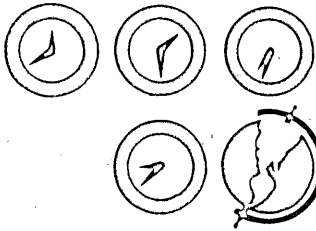
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1. For a fuller description of CODASYL's early history, see Howard Bromberg's "COBOL and Compatibility," *Datamation*, February, 1961.
2. For a full discussion of decision tables see Burton Grad, "Tabular Form in Decision Logic," *Datamation*, July, 1962.
3. Borrowed from Jean Sammet's article, "Basic Elements of COBOL-61," *Communications of the ACM*, May, 1962.

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NEWS BRIEFS

CUC SALES, INCOME AT NEW HIGHS

Computer Usage Co. reported record sales and income for the year ending September 30, 1962. Total sales from services reached \$2,022,156, up 55% from 1961's \$1,299,700, while net income after taxes totaled \$61,421, a 65% increase over the previous year. Earnings per share amounted to .30 on the average number outstanding, against .19 for 1961.

CUC's backlog for services, according to Elmer C. Kubie, president, was approximately \$1,342,000 on September 30, compared with \$669,000 the year before.

WDPC ANNOUNCES 1ST EDUCATIONAL LINK

UCLA's Western Data Processing Center announces the nation's first educational computer telephone network. Hooked up to UCLA's IBM 7090 through 1009 transmission units are the Air Force Academy, CalTech, Stanford, USC, Utah, and UC (San Diego).

CalTech, Stanford, USC, and UC (San Diego) have hardware of their own, but benefit from additional machine time, according to George W. Brown, director.

Although WDPC is oriented toward business research, the cooperating schools use the network for teaching and research in other fields as well, including military and physical sci-

ences. Serving 77 other colleges and universities in 12 western states by mail, the center plans to include 10 or 12 schools in its telephone network during 1963.

RAND SEMINAR FOR BEHAVIORAL SCIENTISTS

A Research Training Institute in the Simulation of Cognitive Processes will be held at The RAND Corp., Santa Monica, Calif., from June 17-July 26.

Sponsored by the Social Science Research Council and The RAND Corp. under a grant from the National Science Foundation, the institute will cover recent developments in constructing computer programs that serve as models of such complex human processes as problem-solving, concept formation, rote memory, decision-making, and verbal communication. It is intended primarily for post-doctoral behavioral scientists who are affiliated with universities. Completed applications must be in by March 15.

For information contact Bert F. Green Jr., Department of Psychology, Carnegie Institute of Technology, Pittsburgh 13, Penna.

GE ANNOUNCES 215

General Electric's newest entry in the general purpose field was announced early this month as the 215, a lower level complement to the 225.

Aimed at the burgeoning 1401 market, the 215 features a core memory

of 4-8K with a 20 bit word length as well as double precision 40 bit words. The new machine is compatible with the 225 as software may be used interchangeably.

Instruction time is 36.5 usec, with add time of 71.2 usec; subtract time, 89 usec; multiply, 307 usec, and divide, 510 usec. Average through-put however, is claimed to be 65-75 per cent of the 225. Monthly rental for a typical configuration will range from \$4-10K.

CIRCLE 101 ON READER CARD

NEW HONEYWELL CENTER FOR PROCESS CONTROL

An analog-digital systems simulation facility has been opened by Minneapolis-Honeywell at its Special Systems Division in Pottstown, Penna. The center, capable of simulating the operation and control of complex industrial processes, has a Honeywell 290 and two 231R analog computers built by Electronic Associates, modified to include special design features. Hardware may be operated separately or together.

The facility enables control analysts to determine whether a manufacturing process should be controlled by computer systems or other means of instrumentation, and to familiarize and train user personnel in systems operation prior to installation.

IEEE SPONSORS COMPUTER CONFERENCE

The Pacific Computer Conference, sponsored by the Institute of Electrical and Electronic Engineers (IEEE), will be held at CalTech on March 15 and 16.

Sessions will include topics on nano-second computer devices and circuits, optical and electrical signal transmission considerations, tutorial sessions in cryogenics, magnetic thin films and optical computer techniques, and informal panel discussion groups.

For information contact Dr. E. Schubert, Conference Chairman, Systems Division of Beckman Instrument, Inc., 2400 Harbor Blvd., Fullerton, Calif.

● Artificial intelligence and automated design of apparatus were two features of the recent IEEE Winter

ATLAS ON THE AIR AT MANCHESTER UNIVERSITY

The Ferranti Atlas, world's genuinely largest commercially-available computer, is now on the air at England's Manchester University.

The Manchester configuration has 16K core storage, 8K fixed store, 1K subsidiary store, and 98K on four drums. Addition time is from 1-2 usec. Peripheral equipment consists of eight mag tape drives, four paper tape punches and four readers, two teleprinters, one line printer, one card reader, and one card punch. Software for the Atlas includes FORTRAN, COBOL, ALGOL and the Mercury Autocode. The price is from 2-3.5 "megaquid" (5.6-9.8 megabucks.)

In addition to interpreting data re-

ceived from the Mk. 2 radio telescope which is to be installed at Jodrell Bank, the Atlas will be engaged in work on modular structure, linguistic analysis and literary criticism, and in cosmology, meteorology, astrophysics, and stellar evolution.

The second Atlas is scheduled for London University this autumn, and the third for the National Institute for Research in Nuclear Science at Harwell in the summer of 1964.

In addition to the Atlas, other Ferranti machines installed and on order include the Apollo (1), Argus (5), Mercury (19), Orion (15), Pegasus 1 and 2 (38), Perseus (2), and Sirius (16).

General Meeting in New York City. Covered were approaches and physical techniques in artificial intelligence, and steps toward the solution of artificial intelligence problems. Among design papers presented were those for dental prosthetics and small power transformers and inductors.

DISC FILE SYMPOSIUM SET FOR MARCH

A Disc File Symposium, sponsored by Informatics, Inc., Culver City, Calif., is scheduled for March 6-7 at the Thunderbird Inn, Hollywood, Calif. Topics for the Symposium include applications, programming, analysis and techniques, and file characteristics—programmer and user aspects of IBM 1301 and 1311, Data Products dp/f-5020, Bryant 4000 Series, and future disc files.

Registration fee is \$75. Additional information and final program are available from Informatics, Inc., 8535 Warner Drive, Culver City, Calif.

● Westinghouse is using a UNIVAC 490 to automatically route Teletype messages from one company location to another. The computer determines the message destination by a code at the beginning of the message, and automatically switches the incoming information to the proper location. If the Teletype lines to that location are in use, the 490 will store the message until a line is free, and then send the Teletype to the proper plant or office.

CIRCLE 100 ON READER CARD

● The Weizmann Institute of Science in Rehovoth, Israel, is scheduled to receive a Control Data 1604-A/160-A computer complex this month. Peripheral equipment includes 12, 606 mag tape units, a 1,000 lpm printer, card-reader and card-punch system, and additional magnetic core memory and arithmetic units. The system, to be used in scientific research, is valued at more than one megabuck.

● The U.S. Army's Logistics Management Center, Fort Lee, Va., is using an RCA 501 to simulate conditions in the Army supply system, and teach military and civilian students to cope with routine and emergency materiel problems. Condensing four years of operations into three days, 501 reports such specific errors as ordering more stock than is available, failure to allow sufficient lead time, and the reduction of inventory below a predetermined safety level. Name of the game is CALOGISM.

ANOTHER CASE HISTORY FROM GKI

MEMO TO: Users of computer tape
FROM: General Kinetics Incorporated
SUBJECT: Pre-testing tape to ensure perfect data recording in Saturn booster test program

Here is how a tape reliability problem is being solved at NASA's Marshall Space Flight Center, Huntsville, Alabama:

PROBLEM: To assure 100 per cent reliability in digital recording of Saturn booster test firing data.

SOLUTION: Digital magnetic tapes to be used in the Saturn test program are now pre-tested on GKI's Tape Preventive Maintenance (TPM) system to guarantee reliability in the data reduction process. Before every static firing, each digital tape to be used is cleaned and error-tested on GKI equipment.

The GKI KINESONIC Tape Cleaner and Model 7 Tape Tester installed at the George C. Marshall Space Flight Center's Computation Division are employed routinely to assure digital tape quality and to repair used tapes for reliable re-use.

Individual units of the GKI system are available separately, including Tape Testers, KINESONIC Tape Cleaners, Programmed Tension Tape Winders and Bulk Tape Erasers.

Write or call today.



GENERAL KINETICS INCORPORATED
2611 Shirlington Road, Arlington, Va.
Phone: (703) 671-4500

Breakthrough in Ferroelectrics

The spirit of science is tentative, experimental, skeptical. Thus we have been cautioned by our research colleagues here at the Laboratories of the naiveté of pinning a "breakthrough" label on a discovery they made in ferroelectric materials. We're not convinced.

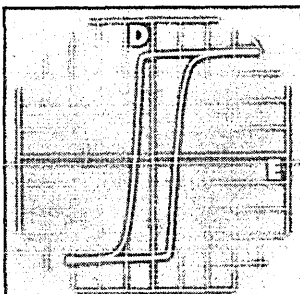
Ferroelectrics have remained on the scientist's workshelf as curious crystal analogs of ferromagnetic materials . . . as intriguing insulators whose dielectric "constant" isn't, but varies with changes in electric field intensity much in the hysteresis loop fashion of magnetic materials.

Recently, two members of our research staff reported they had observed ferroelectric behavior *at room temperature* in a polycrystalline form of ordinary saltpeter. Furthermore, this ferroelectric phase in potassium nitrate has nearly ideal electrical characteristics. Apparent true coercivity. Dielectric hysteresis loops that are really square (ratios of 600:1 and more). Here then is an inexpensive, easily prepared material that may perform the much sought after memory and switching functions in capacitive circuits—functions similar to those handled by their ferromagnetic brethren in inductive circuits.

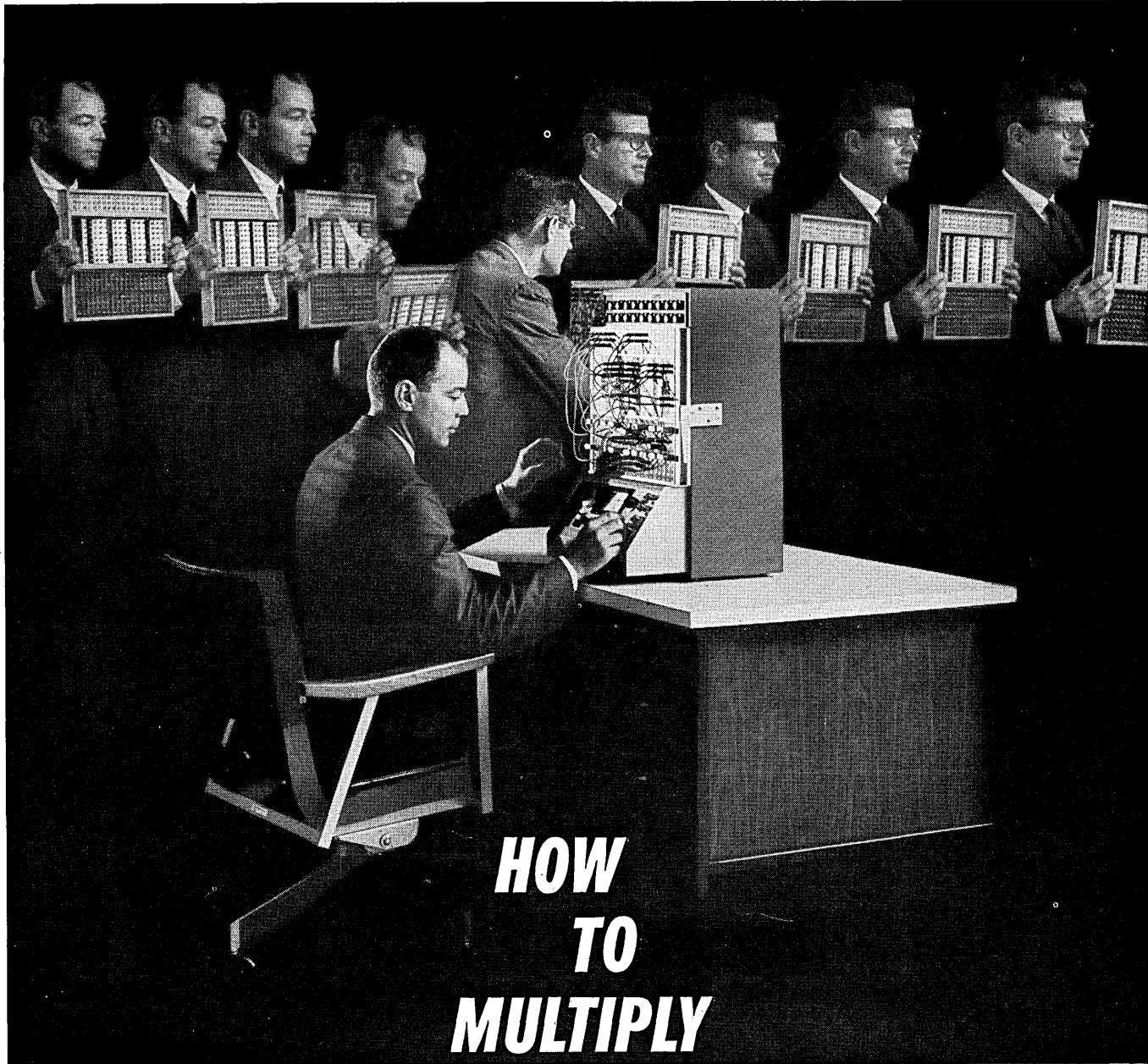
This discovery is expected to stimulate the development of practical, compact electronic devices of interest to the computer, control, and communication sciences. It is only one of the avenues of science and engineering being opened by GM's research in depth.

General Motors Research Laboratories

Warren, Michigan



Room temperature 60-cps hysteresis loop (above) of KNO_3 melted on copper substrate with the simplest of tools (left).



HOW TO MULTIPLY ENGINEERS

One engineer and an EAI PACE® TR-10 transistorized desktop analog computer can be the equal of several men limited to conventional design tools. The TR-10 multiplies the design capabilities of the most able engineer. One TR-10, equipped with a removable patch panel, will serve the needs of a roomful of engineers. This new patch panel permits pre-patching of programs away from the computer. It plugs into the computer instantly — valuable computation time is conserved. ■ Versatility of the TR-10 is unequalled. Unique simplicity makes it excellent for students or engineers unfamiliar with analog techniques. Accurate to a tenth of one percent, the TR-10 performs admirably for the experienced user in 95% of routine engineering problems. And with High-Speed Repetitive Operation added, or with several units slaved to operate as one, the TR-10 meets the demands of many advanced applications. ■ For technical data on this almost infinitely versatile computer, write for Bulletin No. AC 934.

EAI

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Penelope, I'll have you know there's a Computape type compatible with most of the major computers in the field, including the IBM 704, 705 III, 7070, 7080, 1410, the GE 225 and the RCA 301, 501. And each tape type guarantees up to 800 bits per inch with no dropout in severest applications.

Computape, are you the compatible type?

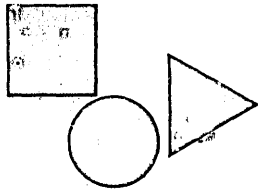


TODAY'S COMPUTAPE IS BETTER THAN EVER — AND IT HASN'T EVER CHANGED A BIT. 556 or 800 bits per inch. No dropout. That's a real guarantee of reliability. *That's a reel of Computape* — product of the first company to manufacture computer and instrumentation tape *exclusively*. Investigate new Computape today. Better still — *immediately*.



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122 Calvary Street, Waltham, Massachusetts

CIRCLE 30 ON READER CARD



NEW PRODUCTS

mass storage

The 490 Fastrand Mass Storage Subsystem has a capacity of 65 million characters and a retrieval time of 92 usec. It rents for \$3,300 per month, sells for \$160K. The Fastrand Control Synchronizer rents for \$2,750 per month, sells for \$135K. Delivery in six to nine months from contract date. UNIVAC DIV. OF SPERRY RAND CORP., 315 Park Ave. South, New York 10, N.Y. For information:

CIRCLE 200 ON READER CARD

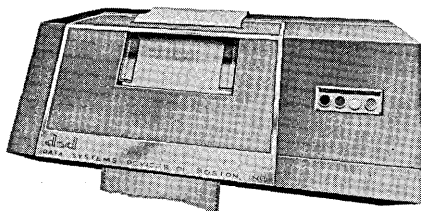
random access drum

The 7320 is a random access magnetic drum with storage for 1.1 million characters, and access time of 8.6 ms. It can move alpha-numeric information sequentially into a computer at 203K cps. It will rent for \$2.3K monthly, and sell for \$124K. IBM DATA PROCESSING DIV., 112 E. Post Road, White Plains, N. Y. For information:

CIRCLE 201 ON READER CARD

drum-type printer

Model 1-132 has a speed of 1.2K lpm with 132 printing positions and 64 characters per position. It has a two-speed paper advance, a maximum single-line advance time of 15 ms, and



a minimum multi-line advance rate of 25 ips. It takes forms from 3" to 22" wide. DATA SYSTEMS DEVICES OF BOSTON, INC., 343 Western Ave., Boston, Mass. For information:

CIRCLE 202 ON READER CARD

print reader

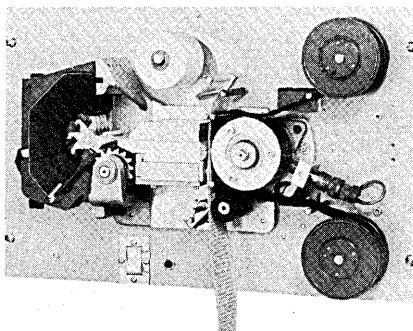
This new multi-font reader converts printed or typewritten material into data on punched cards or tape at 700 cps, with 20K cps said to be feasible. It reads up to 20 different type faces from 1/12" to 1/2" in height, either printed or typewritten. The recognition process requires less than 50 usec. SYLVANIA ELECTRIC PRODUCTS, INC., 730 Third

Ave., New York 17, N. Y. For information:

CIRCLE 203 ON READER CARD

strip printer

The Data/Log MC 10-40 is a solid-state, 4-line, coded input strip printer. It prints 1K lines per minute, is available with 4, 8, 12, or 16 printing positions, each position capable of printing



0 through 9, five symbols, plus, minus, decimal, A and B standard. Price is \$1,570 for the 4 columns, and up to \$2,140 for the 16 columns. MONROE CALCULATING MACHINE CO., ELECTRONIC COMPONENTS DIV., 60 Main St., San Francisco 5, Calif. For information:

CIRCLE 204 ON READER CARD

clock for 7090

This programmable real time clock and interval timer uses five machine cycles access time and operates independently of 7090 power. DELCO RADIO DIV., GENERAL MOTORS CORP., Kokomo, Ind. For information:

CIRCLE 205 ON READER CARD

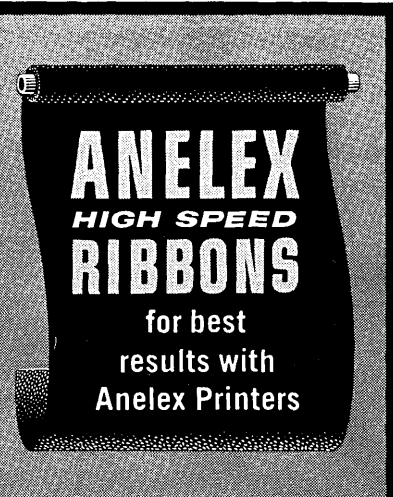
clock/calendar

The 729 programmable clock/calendar system is able to read the date and time under program control into any IBM computer using 729, II, IV, or VI tape drives. The system is priced at \$4,800 to \$5,500. CHRONO-LOG CORP., 2583 West Chester Pike, Broomall, Penna. For information:

CIRCLE 206 ON READER CARD

datachron clock

The Datachron operates under computer program control without involving permanent connection with the computer. Real time data, either on a 24-hour (Model 790) or elapsed time (Model 791) is interrogated from the

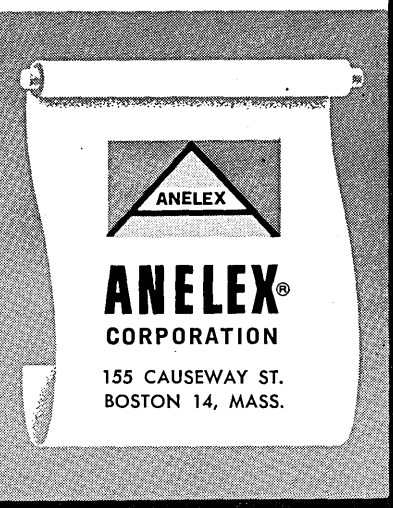


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Analex High Speed Ribbons cost no more, yet give greater value . . . clear, clean printing, long life and accurate winding. That's because they are made especially for Analex High Speed Printer Systems...made for trouble-free operation on heavy duty, long runs.

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CIRCLE 31 ON READER CARD

FALL IN!

New-type recorder assembles slow or random data, spaces it uniformly on tape for computers

If your digital computer is as finicky as most, it won't listen to a magnetic tape that

t a l k s l i k e t h i s

It will insist on characters uniformly spaced on the tape

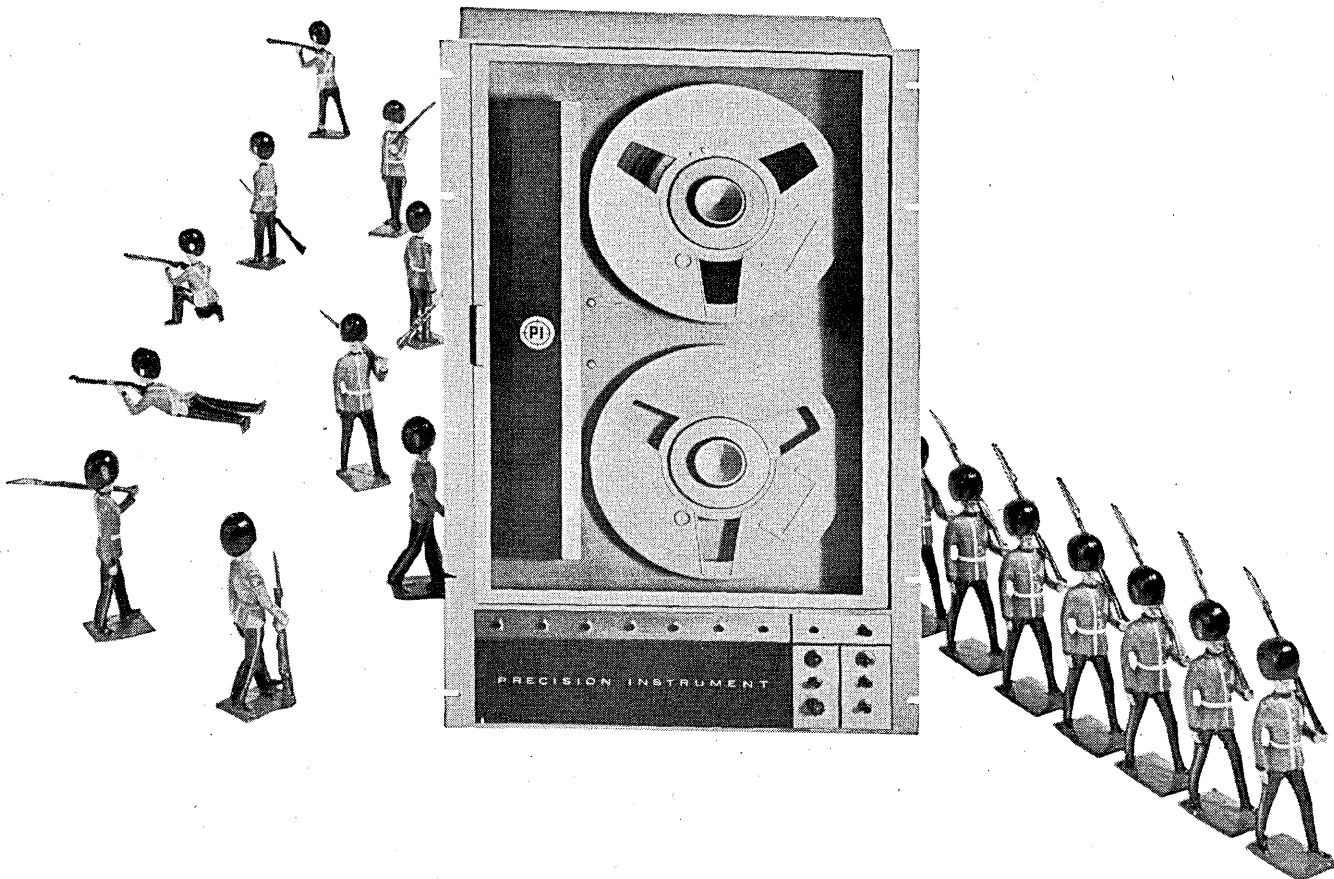
like this
.....

Which means that life can be difficult for people who have data that is otherwise perfectly reputable, but just doesn't happen to occur at the right time intervals to suit the computer.

Now comes a wonderful device that will gladly accept irregular data — such as the output of a teletypewriter or an analog-to-digital converter — and put it on mag-

netic tape just the way the computer wants it. The secret is incremental tape motion. Our new recorder stands still awaiting each character, records it, then moves the tape a uniform distance to await the next. As a result, whether characters arrive 100 per second or 1 per month, they are recorded in a proper, uniform packing density.

The PI incremental recorder shown here records 200 bits per inch (556 BPI optional), a recording fully compatible with the input requirements of IBM computers. To tell you more, we've put together a brochure fully compatible with the input requirements of discriminating users. Send for bulletin #73; address us at Stanford Industrial Park, **PRECISION INSTRUMENT** Palo Alto 13, California.



NEW PRODUCTS . . .

Datachron and sent to storage. Accumulated BCD coded time is referenced to 60 cps AC power frequency. Interrogation time is approximately 10 ms. Price is \$2.5K. ELECTRONIC ENGINEERING CO., P.O. Box 58, Santa Ana, Calif. For information: **CIRCLE 207 ON READER CARD**

timing generator

The 1500G generator is the basic unit of the 1500 series timing and counting systems. The count may be started from any pre-selected point and may be held or started at any point in the count by means of panel or remote controls. EDP CORPORATION, 3501 S. Orange Blossom Trail, Orlando, Fla. For information: **CIRCLE 208 ON READER CARD**

data converter

The SC-332 is able to operate at the rate of 500 cps in the magnetic tape mode; and at 250 cps when converting data to paper tape form. It automatically performs code translation, formatting and error-checking. GENERAL DYNAMICS/ELECTRONICS, 1400 N. Goodman St., Rochester 1, N. Y. For information: **CIRCLE 209 ON READER CARD**

binary to decimal converter

Model S44 features a speed of 6000, 11 bit conversions per second. The binary input signal is in time parallel form. The converter is priced at \$4,035. NON-LINEAR SYSTEMS, INC., Del Mar, Calif. For information: **CIRCLE 210 ON READER CARD**

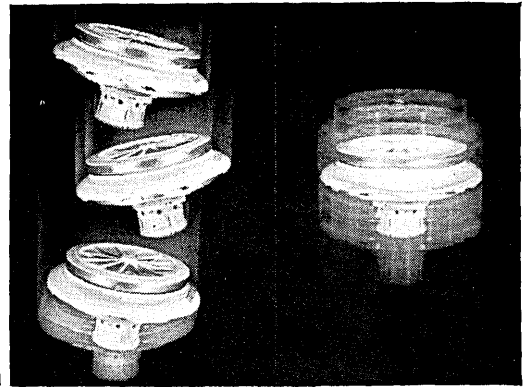
data acquisition

The DY-2010A consists of a DY-2901 input scanner/programmer, 562A digital recorder and a DY-2401A integrating digital voltmeter. The system provides five digit in-line visual readout and a printed paper strip output which includes numerical data, polarity, decimal location and channel identification. The DY-2010A is priced at \$8,675. DYMEC, 395 Page Mill Rd., Palo Alto, Calif. For information: **CIRCLE 211 ON READER CARD**

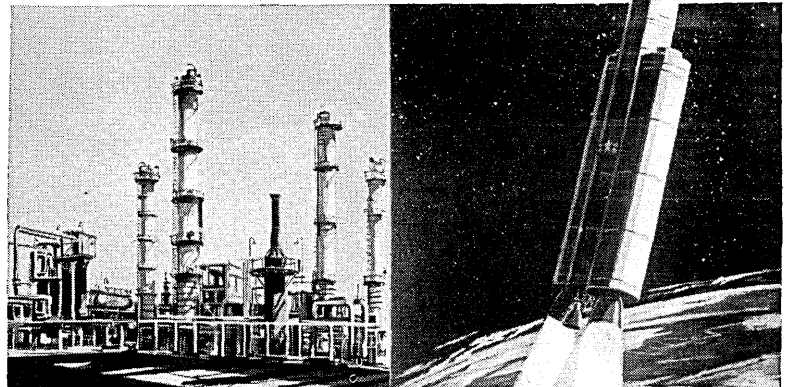
alphanumeric dialing

Data Ray units for transmitting punched card data over ordinary telephone lines now operate with alphanumeric data. Rental for the card reader begins at \$23 per month, is priced from \$880. The translator unit will rent for \$65 per month, and sells for \$2,665. RAYTHEON CO., Lexington 73, Mass. For information: **CIRCLE 212 ON READER CARD**

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memory devices
or complete
memory systems
customized
for you*



*...ideal for environments of shock--
vibration--altitude--temperature
and humidity*

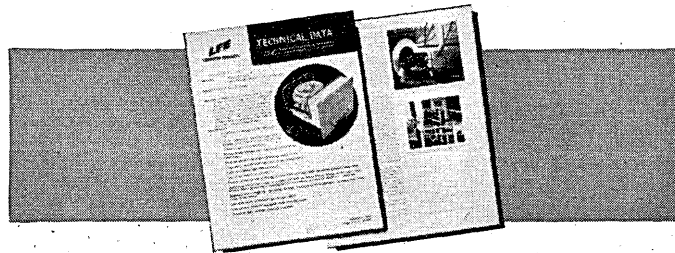


Their ruggedness, simplicity and low mass qualify Bernoulli memory devices for a wide range of aircraft, missile, spacecraft, shipboard and commercial applications. They are dust proof and moisture-resistant, as well.

And these versatile, economical, reliable Disks more than pay their way in fixed digital computer and process control applications.

Best of all: now you can buy COMPLETE MEMORY SYSTEMS OFF-THE-SHELF, matched to your requirements — with all the inherent advantages of the Bernoulli Disk principle: performance on a par with military requirements, but at competitive, commercial costs! Complete compatibility is the concept: standard card cages, standard printed circuit modules, standard recirculating registers, pre-written clocks and index markers — plus the ability to interface with any standard logic level.

Storage capacities per disk: from 10,000 to 777,200 bits.



Send for this authoritative technical article on the development of the Flexible-Disk Magnetic Recorder — and for this comprehensive technical data bulletin on Bernoulli Disks and complete systems.

And remember that LFE is your single source for the most advanced components and systems in the memory field.



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LFE ELECTRONICS

A DIVISION OF LABORATORY FOR ELECTRONICS, INC.
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Memory Systems, Devices and Components including: Bernoulli Disks, HD File Drums, Circuit Modules, and Read-Write Heads.

CIRCLE 33 ON READER CARD

we really weren't trying to obsolete other paper-tape readers...

... only to build the most stable, most versatile, most easily applied photoreader in the low-price field.

As it happens, though, the new OMNI-DATA PTR-80, priced at only \$1385*, has actually done just that—obsoleted all previous photoelectric tape readers for synchronous speeds up to 500 characters a second and asynchronous speeds up to 200 characters a second.

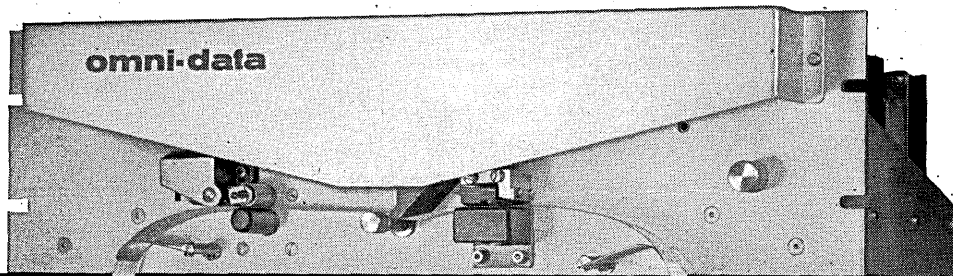
Using the exclusive Omnitronics principle of *reflected light*, the PTR-80 can read any type, any width, any color, any thickness of tape without amplifier adjustment or regard to varying tape opacities. So stable and reliable is this instrument that not a single variable electrical component or mechanical adjustment is required.

Its bidirectional counterpart, Model PTR-81, is also attractively priced—\$1635*.

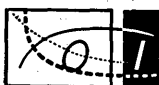
For tape-reading speeds up to 500 characters a second, there's no other photoreader in the industry to compare with the new OMNI-DATA PTR-80 and 81. For speeds up to 1,000 characters a second, we recommend our Models PTR-7 and 71.

Call or write for Bulletin PTR-80/81.

*PTR-80 (unidirectional) with RS-200 Reeler, \$2050. PTR-81 (bidirectional) with RS-300 Reeler, \$2400



<p>Reads all types, colors, widths, thicknesses of tape</p>	<p>Reading speeds to 500 char./sec. synchronously, 200 char./sec. asynchronously</p>	<p>No variable electrical components or mechanical adjustments</p>	<p>Prices: \$1385 (unidirectional) \$1635 (bidirectional)</p>
--	---	---	--



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CIRCLE 34 ON READER CARD

NEW PRODUCTS . . .

binary digit dialing

The 401E and F are transmitter and receiver for one-way transmission of low-speed data over regular telephone lines. They can accommodate 99 possible characters at up to 20 cps. AMERICAN TELEPHONE & TELEGRAPH CO., 195 Broadway, New York 7, N. Y. For information: **CIRCLE 213 ON READER CARD**

7710 communicator

The 7710 data communication unit transmits information between the magnetic core memories of two 1401 computers at all speeds for which broad-band common carrier equipment is available, up to 5.1K cps. At lower speeds, a Teleprocessing terminal utilizes lower-cost, standard telephone lines. Monthly rental is \$1,575, and price is \$83K. IBM DATA PROCESSING DIV., 112 E. Post Rd., White Plains, N. Y. For information: **CIRCLE 214 ON READER CARD**

mag tape eraser

An automatic, self-contained mag tape bulk eraser, the K-80 has a complete erasure cycle of one minute per reel, will handle any standard reel diameter from 3" to 15", and can accommodate tape widths up to 2". GENERAL KINETICS, INC., 2611 Shirlington Rd., Arlington 6, Va. For information: **CIRCLE 215 ON READER CARD**

magnetic coating

A homogeneous, metallic, magnetic coating has been developed for use on disc and drum files. It has been demonstrated to pack from 200 to 1.5K bits per inch. It reportedly has replacement value for oxide-coated drums or discs. CAMBRIDGE LABORATORIES, INC., 681 Oxford Ave., Venice, Calif. For information: **CIRCLE 216 ON READER CARD**

mag tape preserver

The Netic Co-Netic mag tape shielding container has the hinge along the container's upper edge, allowing access to tapes when box is flush against a wall. PERFECTION MICA CO., MAGNETIC SHIELD DIV., 1322 No. Elston Ave., Chicago 22, Ill. For information: **CIRCLE 217 ON READER CARD**

input aids

Two units, an unwind can and winder may be used to wind tape on computer reels and is able to operate at 200 ft. per minute. DRESSER PRODUCTS INC., P. O. Box 2035, Providence 5, R. I. For information: **CIRCLE 218 ON READER CARD**

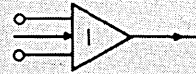
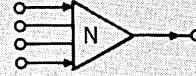

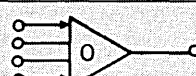
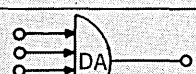

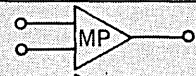
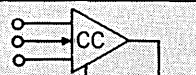
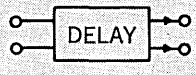
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The all welded construction of Kearfott's MicroFunction Circuits, in Standard TO-5 cases, permits 16:1 volumetric reduction of conventional digital circuit design.

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Kearfott's Germanium or Silicon Transistors may be specified; dependent on temperature requirements. Also available are dual matched pairs within a TO-5 case. A number of available circuits can be provided in TO-18 cases on special order.

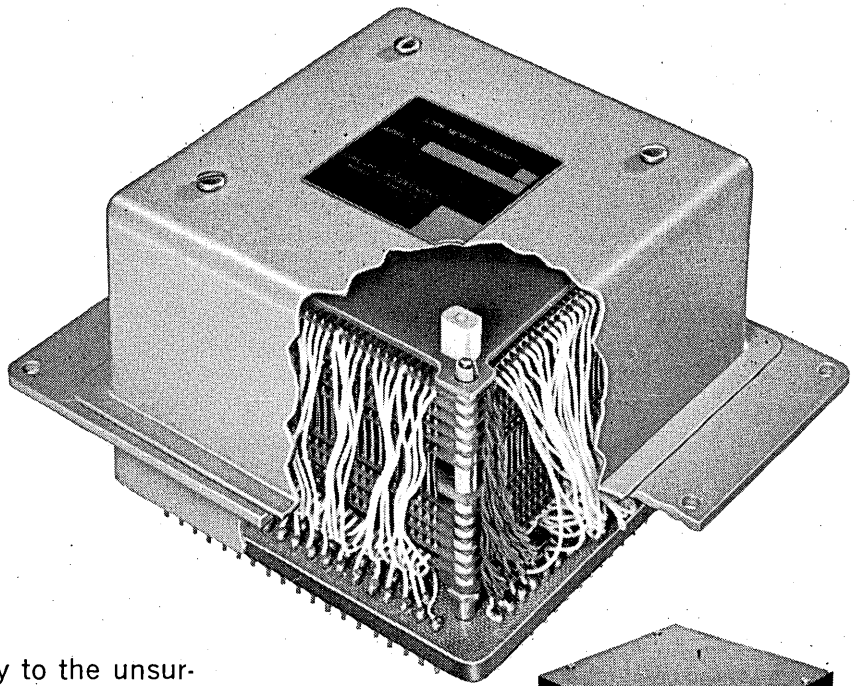
DEVICE	SYMBOL	GERMANIUM	SILICON
INVERTER		11 INVG	11 INVS
NOR		TO 5 21 NRLG	TO 5 21 NRLS FAN IN FAN OUT
EMITTER FOLLOWER (BUFFER)		TO 5 21 EFG	TO 5 21 EFS
OR		TO 5 21 ORG	TO 5 21 ORS
AND		TO 5 TO 18 41 DLG	TO 5 TO 18 41 DLS
FLIP FLOP		2 TO 5 INVERTED 2 TO 5 PIGGY BACK 22 FFG	2 TO 5 INVERTED 2 TO 5 PIGGY BACK 22 FFS
MATCHED PAIRS (TO 5)		TO 5 TO 18 22 MPG	TO 5 TO 18 22 MPS
DARLINGTON		TO 5 TO 18 21 DARG	TO 5 TO 18 21 DARS
DELAY		2 TO 5 INVERTED 2 TO 5 PIGGY BACK 21 DELG	2 TO 5 INVERTED 2 TO 5 PIGGY BACK 21 DELS

For complete data write Kearfott Semiconductor Corp., West Newton, Massachusetts.

GP GENERAL PRECISION AEROSPACE KEARFOTT DIVISION
LITTLE FALLS, NEW JERSEY
GENERAL PRECISION, INC.

CIRCLE 35 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.

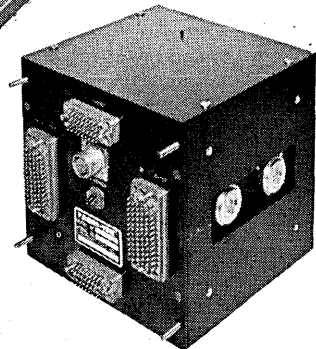
Normal production stacks are rugged, too, withstanding high level shock and vibration.

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?

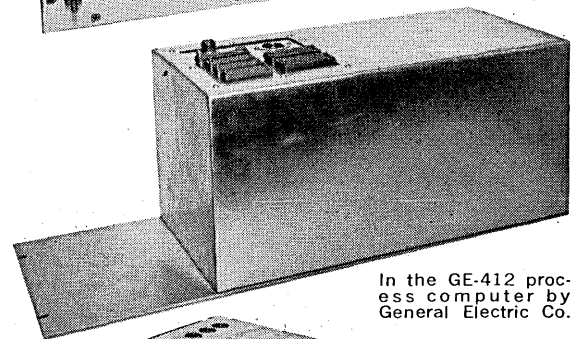
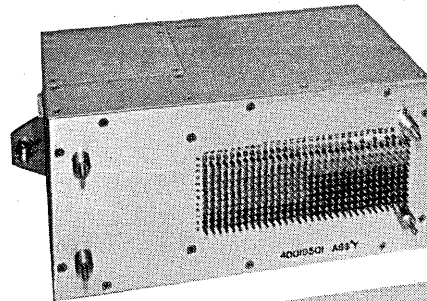
Fabri-Tek, Incorporated, Amery, Wisconsin
Telephone: COngress 8-7155 • TWX: Amery 8931

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

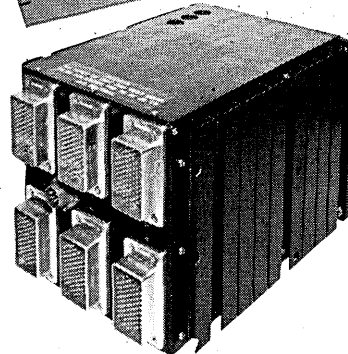


In the 8400 Series computer by Collins Radio

In AN/UJK-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.

FABRI-TEK

NEW PRODUCTS . . .

storage and display system

The SM-IIA is able to generate 500 K cps. The system allows display of any combination of alphanumeric characters, abstract symbols, schematics, logic diagrams, graphs, charts or maps. A Bernoulli Disk memory device is used as the storage element for the SM-IIA. LABORATORY FOR ELECTRONICS, INC., 1079 Commonwealth Ave., Boston 15, Mass. For information:

CIRCLE 219 ON READER CARD

data display

A "picture window" concept for data display systems with cathode ray tubes is being made available on custom versions of the CHARACTRON shaped beam tube. The approach is said to reduce computer time by eliminating the need to program for fixed or infrequently changed data. It also provides for simultaneous observation of displayed data by both human operators and photographic recorders. GENERAL DYNAMICS/ELECTRONICS, P. O. Box 127, San Diego 12, Calif. For information:

CIRCLE 220 ON READER CARD

card punch

Model EP-4 enables recording of data in all hole positions of all standard sized cards at the rate of 720 columns per second. This speed permits perforation of a minimum of 450 fully laced 80 column cards per minute. SOROBAN ENGINEERING, INC., P. O. Box 1717, Melbourne, Fla. For information:

CIRCLE 221 ON READER CARD

edge recorder

This Edge-Interpreting Punched-Tape Recorder is a combination photoelectric tape reader and electrostatic serial printer which adds alphanumeric characters along the edge of previously punched paper tape. OMNITRONICS, INC., 511 N. Broad St., Philadelphia 23, Penn. For information:

CIRCLE 222 ON READER CARD

paper tape reader

A paper tape reader with dielectric reading and transistorized circuitry, the PE 1000 operates at 1K cps. It takes paper, transparent, and plastic tapes of any color, and is convertible for 5, 6, 7, or 8-track punched tape. FACIT ELECTRONICS AB, Fack, Solna 1, Sweden. For information:

CIRCLE 223 ON READER CARD

manual tape punch

The B-V Telepunch is a portable, manually-operated machine to create five-channel, punched paper teletype

Why selecting a scientific or engineering computer without a feasibility study can be a costly error

And the one sure way to find the computer that suits you best

A scientific or engineering computer is a sizeable investment. Selecting one calls for a responsible decision. Far from being alike, computers vary in efficiency and in ways they can be used. They vary, too, in price—and the equipment price tag doesn't always reflect true cost.

Your selection, then, should be based upon a careful study. Concentrate not on details, but on finding the one computer that will best suit your firm's particular needs. You may find your answer in the Recomp® line of solid-state computers, as so many companies have. But two important considerations—total problem-solving time and total cost—best measure a computer's worth.

Which is the fastest computer?

The criterion to use is total problem-solving time. On the average, computing time represents only about 10% of the time required for complete solution of an engineering or scientific problem. Microseconds saved in computing mean nothing if hours are lost in programming, which often is 90% of the total job.

The Recomp line of small and medium-scale computers save programming hours, not just computing microseconds. They are simple to program, easy to operate, and have exceptionally large memories.

Which is the cheapest computer?

Scientific problem-solving computers sell from \$40,000 and up; rent from \$1,000 a month, and up. But in comparing price, remember: 1) Cost figures should cover the entire working system needed to accomplish a job. 2) "Man hours" saved are an important facet of cost. A company which once got 2 proposals a year from a top creative scientist increased this to 3½ with a computer (not Recomp). With Recomp, the company now gets 9 proposals per man a year.

Recomp offers a broad price range. The Recomp III, ideal for small-scale needs, can be leased for \$1,495 per month, complete. For medium-scale needs, Recomp II can be leased beginning at \$2,495. A complete line of peripheral equipment is available for both.

Will special personnel be needed?

Some computers are so complicated that engineers must spend months in learning how to use them. Others require the hiring of trained programming personnel. Both types, therefore, are more expensive than they might appear. Worse, the necessity of a programmer doubles the communication time between scientist and machine, thereby off-setting the value of the computer as a quick problem-solving device.

Recomp computers are among the easiest of all to operate and program. Engineers with less than eight hours instruction have had no problem using them profitably.

The one sure way to select a computer

The computer requirements of your company are unique. Only by conducting a feasibility study can you be sure of which computer suits you best.

Put Recomp side by side with comparable computers, and some solid facts will speak for themselves. You'll see why no computer feasibility study is complete without Recomp. As a study guide, send today for a copy of "Management Guide to a Computer Feasibility Study."

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Autonetics is a Division of North American Aviation

Recomp

Dept. 52, 3400 East 70th St., Long Beach, Calif.

Please send me "Management Guide to a Computer Feasibility Study."

Name _____

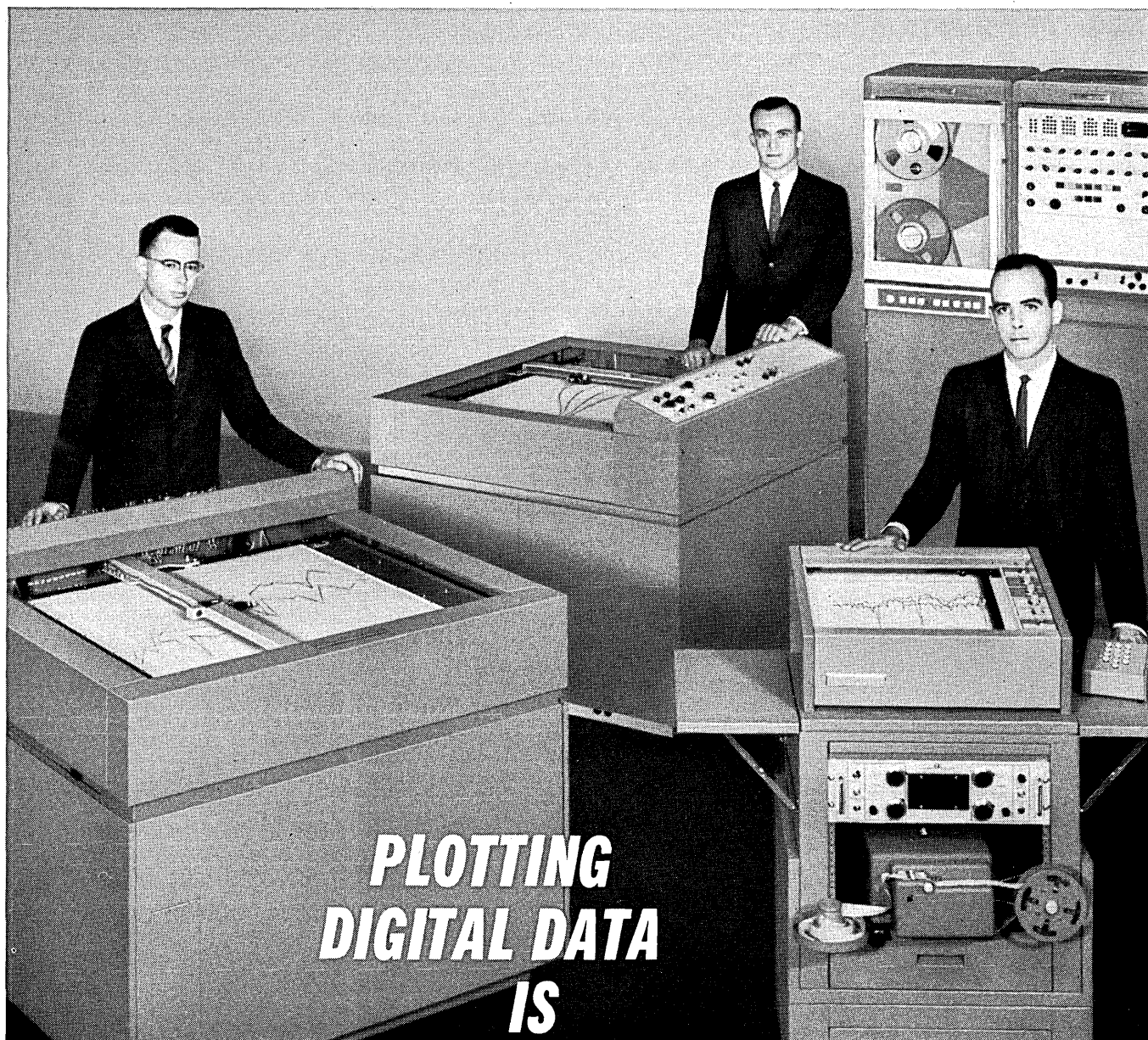
Position _____

Company _____

Address _____

City _____ Zone _____ State _____

CIRCLE 37 ON READER CARD



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EAI

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

CIRCLE 38 ON READER CARD

NEW PRODUCTS . . .

or transmission tapes. Manual coding (punching) is with stylus against a drilled drum. BONNAR-VAWTER, INC., 96 Dunbar St., Keene, N. H. For information:

CIRCLE 224 ON READER CARD

panel tape minders

These panel tape minders can be adapted to any type of perforated tape installation and can be positioned for right or left feeding, as well as from above or below. Speeds up to 15 and 20 inches per second are available. CYCLE EQUIPMENT CO., 17480 Shelburne Way, Los Gatos, Calif. For information:

CIRCLE 225 ON READER CARD

plotting system

This mag tape-Controlled Plotting System has a plotting area of 12' x 6', draws lines in four colors, types and scribes information at up to 500 ipm. It may be operated manually or automatically from its computer. GERBER SCIENTIFIC INSTRUMENT CO., P. O. Box 305, Hartford, Conn. For information:

CIRCLE 226 ON READER CARD

G-20 accessories

The LP-13 is a new buffered, 120-position, line printer which prints at

the rate of 300 lpm and is priced at \$49,800. Also available is the MT-9, a mag tape module that performs all the standard functions of the IBM 729 model IV tape transports. The MT-9 is priced at \$103,300. BENDIX CORP., COMPUTER DIV., 5630 Arbor Vitae St., Los Angeles 45, Calif. For information:

CIRCLE 227 ON READER CARD

TR-48 periquip

An integral repetitive operation display and a solid-state comparator expand the repetitive computational capabilities of the TR-48 analog computer. They display up to four variables simultaneously, eliminating the need for an external oscilloscope. ELECTRONIC ASSOCIATES, INC., Long Branch, N. J. For information:

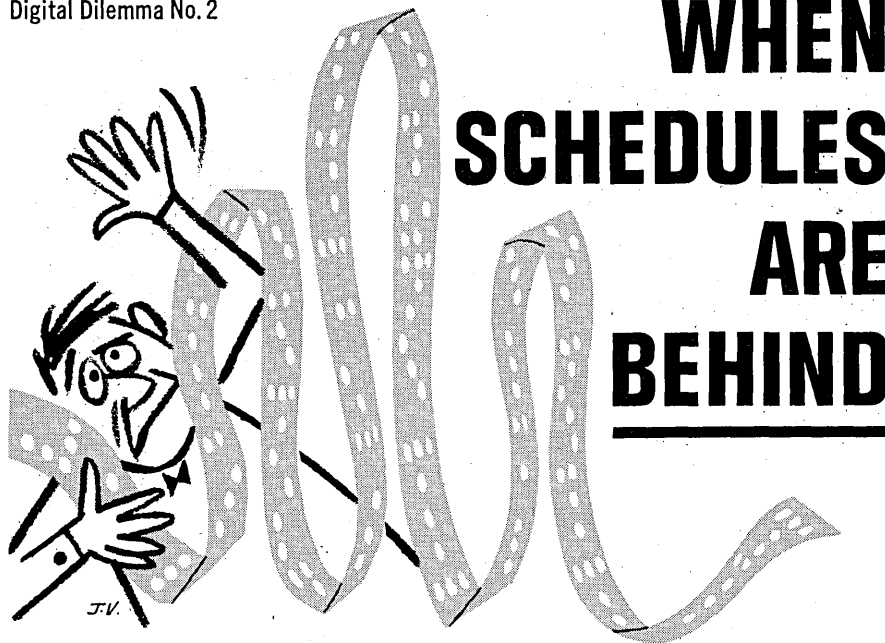
CIRCLE 228 ON READER CARD

analog computer

The AD-2-64PB is a 64-amplifier, tabletop, analog computer with removable, color-coded patchboard. It is modular, and can be slaved to other computers with a ± 100 volt reference. Delivery time is 60 days, with prices beginning at \$7K. APPLIED DYNAMICS, INC., 2275 Platt Rd., Ann Arbor, Mich. For information:

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CIRCLE 92 ON READER CARD

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

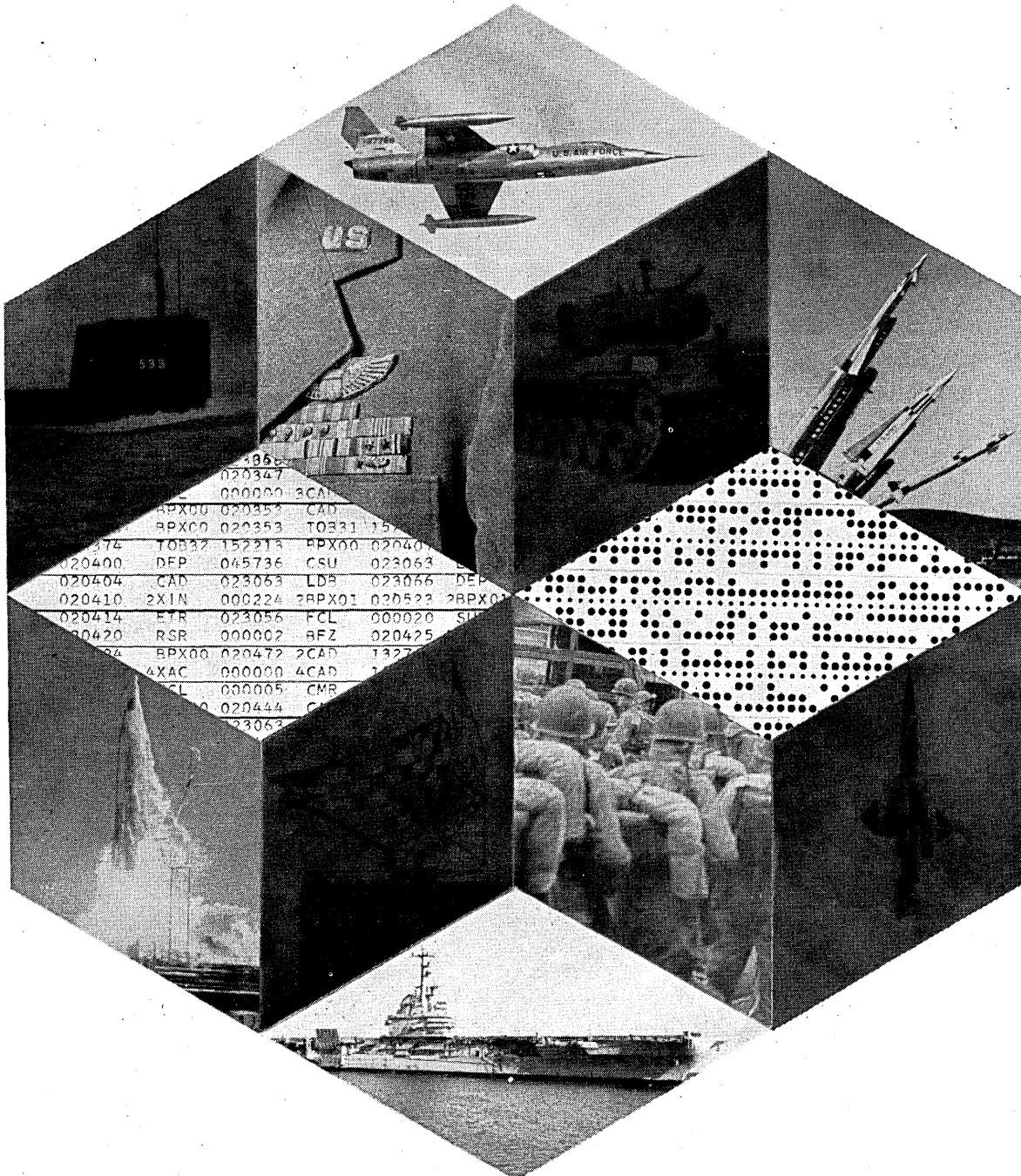
The costly, complex weapons systems of today make such a decision far more difficult than in the past. World-wide forces and events are frequently involved. The time for decision has been compressed, the information on which it must be based has been multiplied in volume, variables, interrelationships. 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."



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Systems that help men make decisions and exercise control



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Backed by the Honeywell Corporation's 75 years of technical management experience, we've created and produced a growing line of business and scientific digital computer systems that include the H800, H400 and H290. Earlier this year our powerful new computer system, the H1800 was announced. Compatible with the H800 and H400, it has broadened and deepened the software production requirements of our Programming staff and has helped create many new additional career opportunities for Honeywell Programmers.

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Systems Service Representatives

Will assist in sales effort by contributing technical systems design support and will aid Honeywell customers in planning, programming and installing systems. Should have programming and systems analysis experience on magnetic tape computers.

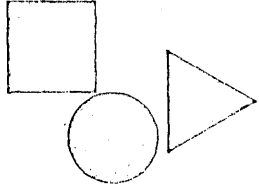
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Opportunities also exist in other Honeywell Divisions coast to coast. Send resume to H. E. Eckstrom, Minneapolis Honeywell, Minneapolis 8, Minnesota. An equal opportunity employer.



COMPONENT PRODUCTS

converter module

The Digi-Card D-to-A has an analog output which varies between zero and 15 volts; for AC operation, between zero and nine volts RMS, and in either case, has an output impedance of 5000 ohms. Price of the converter is \$90.20. SANDERS ASSOCIATES,

INC., 95 Canal St., Nashua, N.H. For information:

CIRCLE 230 ON READER CARD

digital converter

This transistorized two digit analog to digital converter, offered with power supplies has a basic price of \$850. The system is able to perform 200 conversions per second and has an input voltage range of .01 volts to 99 volts with an input impedance of 50K ohms /volt. ESS GEE, INC., 15 Havens St., Elmsford, N.Y. For information:

CIRCLE 231 ON READER CARD

magnetics testers

Two programmed magnetics testers are models 150 and 102. They have interchangeable modules: negative drivers, positive drivers, current calibrator, and program generator. Model 150 has front-panel control of pro-

grams, and model 102 is for static requirements. Price for 150 is \$6.1K, for 102 is \$4.6K. ELECTRONIC MEMORIES, INC., 9430 Bellanca Ave., Los Angeles 45, Calif. For information:

CIRCLE 232 ON READER CARD

switching diodes

Designed for use in diode logic circuits and for transistor coupling in other high-speed circuits, the 1N994 has a reverse recovery time of two nanoseconds the 1N995 is rated at six nanoseconds or less. This is measured when switching from a forward current of 10 milliamperes to a reverse voltage of six volts with a 120 ohm resistive load. RAYTHEON CO., SEMICONDUCTOR DIV., 900 Chelmsford St., Lowell, Mass. For information:

CIRCLE 233 ON READER CARD

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The AM600 with a switching speed of 100 nanoseconds, is designed for computer switching applications. It is a 600 volt, 300 megamp device with a capacitance of two picofarads. Price, depending on quantity, is \$7. AMERICAN MICRO DEVICES, INC., 10888 N. 19th Ave., Phoenix, Ariz. For information:

CIRCLE 234 ON READER CARD

dc amplifier

Model 361, designed for data acquisition, is a low-level dc amplifier with choppers. It is solid state, and has its own power unit. Gain accuracy is 10 to 1K \pm .02%, and gain linearity is 10 to 1K \pm .01%. REDCOR CORP., 7760 Deering Ave., Canoga Park, Calif. For information:

CIRCLE 235 ON READER CARD

Model 371 is a DC Differential amplifier, with recovery from differential and common mode overload of 80 usec, high cmr with wide band width of 50 kc. REDCOR CORP., 7760 Deering Ave., P. O. Box 1031, Canoga Park, Calif. For information:

CIRCLE 236 ON READER CARD

10-bit encoder

Model 4020 is a 10-bit photoelectric shaft encoder with all silicon electronics, continuous readout, and 0.1 gm-cm torque. Maximum slew is 6K rpm, and it can be read up to 4K rpm. No brushes or slip-rings are used. Price is \$321. DIGINAMICS CORP., 2525 E. Franklin Ave., Minneapolis 6, Minn. For information:

CIRCLE 237 ON READER CARD

computer amplifiers

This new series includes models 113 and 114, which are unity gain amplifiers with a bandwidth from dc to one megacycle; model 115, which has a

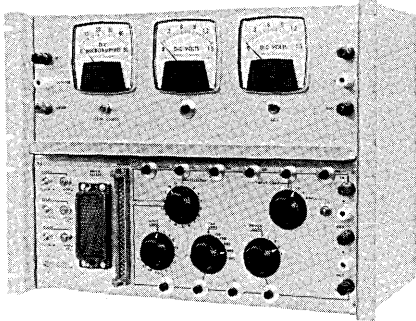
COMPONENT PRODUCTS . . .

bandwidth from dc to 150 kc with gain adjustable from one to 200; and model 116, which is a narrow band, fixed gain amplifier. ASTRODATA INC., 240 E. Palais Rd., Anaheim, Calif. For information:

CIRCLE 238 ON READER CARD

module tester

Module tester, JX10, is two units in one case. One unit measures the voltage/current parameters of switching and Zener diodes while they are installed in a circuit. The other tests



complete cards under various conditions of loading, both resistive and capacitive, plus degradation of clock amplitude and width. Price is \$3K. SCIENTIFIC DATA SYSTEMS, INC., 1542 Fifteenth St., Santa Monica, Calif. For information:

CIRCLE 239 ON READER CARD

d-a converter

This digital to analog converter uses constant current generator method in modular construction. Accuracy claimed is $\pm .01\%$. Digital word length is from two to 13 bits (with sign bit optional). Price with two bit cards is \$1.5K. Additional cards cost \$100 each. GENERAL AUTOMATION, INC., 8 E. Butler Ave., Amble, Penna. For information:

CIRCLE 240 ON READER CARD

potentiometers

This series of subminiature trimming potentiometers for computer circuits has a range of 10 ohms to 50 kilohms, operating temperature range of -55° to $+175^{\circ}$ C, and a power rating of one watt in still air. DAYSTROM, INC., POTENTIOMETER DIV., Archbald Penna. For information:

CIRCLE 241 ON READER CARD

programmable digital system

The PE1-101 has been developed for testing designing, simulation and training in digital systems. Features include dc to 2.0 megacycle static logic circuits with a choice of diode or transistor gating and 28 standard panels from which to select specific

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CIRCLE 91 ON READER CARD

IBM asks basic questions in character recognition

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5 6 7 8 9 a b c d e

u v w x y z , 2 3 4
5 6 7 8 9 a b c d e

**The experimental
system can also**

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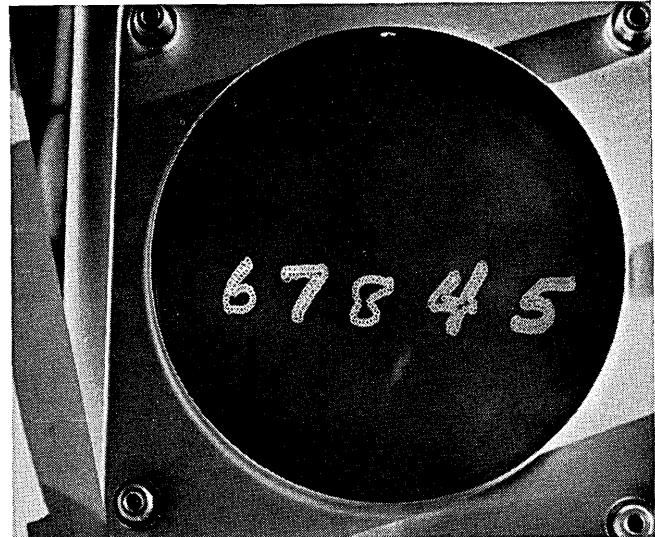
Первая серия проводи

Upper or lower case, typewritten or printed, good registration or bad, these letters are all recognizable to IBM's experimental multi-font reader.

Transforming source information into machine codes is the slowest step in data processing. To make it possible to enter data directly, optical-scanning and magnetic character-sensing devices have been developed. However, most of these machines have been able to read only specially designed type faces. Now IBM has built experimental devices for optically reading a wide variety of printed and typewritten material—and even handwritten numbers.

The chief obstacle to automatic print reading is the variation in type styles found in printed and typewritten information. To overcome this obstacle, IBM scientists have developed an experimental character recognition system which can accept many different type fonts, sizes, and printing qualities in both the Cyrillic and the Latin alphabets. The system determines its own criteria for distinguishing among characters. As it identifies characters, it estimates the reliability of its recognition. After a few minutes it can read text in type styles for which it had not previously been adjusted.

The experimental character recognition system is a form of self-organizing machine. It works out its own methods of distinguishing one character from another in each alphabet it encounters by deriving 96 unique reference measurements which are used to identify each character. The computer programs which aided in the design of this machine represent an advance in character recognition research.



Written in different styles, these numbers can be recognized by an experimental reader whose scanning beam detects line edges by traveling a circular path around the characters.

An equally important step toward more direct entry of data has been the development of an experimental system which recognizes handwritten numbers despite variations in individual writing styles. This system thus solves one of the most difficult problems in character recognition. It differs in its optical reading technique from the multi-font reader, making use of "recognition logic" derived from statistical summaries of the contours of sample handwritten characters. These samples were collected under uncontrolled writing conditions. The scanner in this experimental system generates voltage wave forms analogous to character outlines. The system analyzes these wave forms and records its identification on IBM cards. In a recent test at Tufts University, 200 people, after brief instruction on avoiding excessive distortion in their writing, submitted more than 100,000 numerals to the system. It recognized 98.5% of them correctly, indicating that it may possess the flexibility required to sense large volumes of handwritten numerals in computer systems of the future.

If you have been searching for an opportunity to make important contributions in character recognition, programming systems, space, or any of the other fields in which IBM scientists and engineers are finding answers to basic questions, please contact us. IBM is an Equal Opportunity Employer. Write to: Manager of Professional Employment, IBM Corporation, Dept. 701B, 590 Madison Ave., N.Y. 22, N.Y.

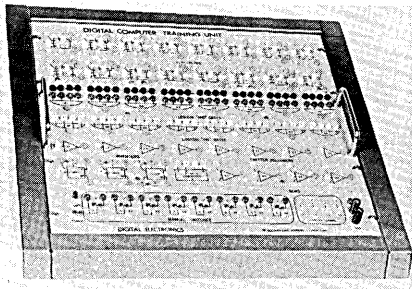
COMPONENT PRODUCTS . . .

requirements. CONTROL LOGIC, INC., 11 Mercer Rd., Natick, Mass. For information:

CIRCLE 242 ON READER CARD

training unit

The 3010 is a computer training unit for lab experiments in digital logic. Complete bread boards may be constructed and the unit features its own internal power supply, with in-



indicator lights that show the status of each flip flop. Price is \$695. DIGITAL ELECTRONICS, 2200 Shames Dr., Westbury, L. I., N. Y. For information:

CIRCLE 243 ON READER CARD

memories

These new BIAX ferrite memories are capable of two megacycle continuous

readout with access time of .25 usec. Standard memory sizes range from 128 words to 1K, with word lengths up to 48 bits. FORD MOTOR CO., AERONUTRONIC DIV., Ford Road, Newport Beach, Calif. For information:

CIRCLE 244 ON READER CARD

These medium temperature range ferrite cores are available in 30 mil (Type 34-100) and 50 mil (54-100) sizes. Full Drive for 34-100 is 550maT; for the 54-100, 800maT. ELEC-TRONIC MEMORIES, INC., 9430 Bellanca Ave., Los Angeles 45, Calif. For information:

CIRCLE 245 ON READER CARD

These 30 mil word select core memory stacks are available in units of 2, 4 and 8K words, each of 56 bits, with complete cycle times of 1.0, 1.25 and 1.25 microseconds respectively. AMPEX CORP., 934 Charter St., Redwood City, Calif. For information:

CIRCLE 246 ON READER CARD

The MS-1 is a pair of memory planes arranged in a word-organized array consisting of 64 words of 18 bits each. Continuous sheets of thin magnetic film deposited on aluminum substrates are used as the storage medium. When used in combination

with conventional electronic components, the MS-1 memory stack is reputed to yield a small memory capable of 0.2 usec cycle time. TEXAS INSTRUMENTS, INC., P.O. Box 5012, Dallas 22, Tex. For information:

CIRCLE 247 ON READER CARD

bcd decoder card

These cards can be used from dc to five mcps and are designed to decode binary-coded-decimal inputs and generate 10 separate output gates. The card accepts either a 1-2-4-8 or a 1-2-4-2 code, and the output is a standard voltage level which can drive additional logic. GENERAL APPLIED SCIENCE LABORATORIES, INC., Merrick & Stewart Aves., Westbury, L. I., N. Y. For information:

CIRCLE 248 ON READER CARD

pcm decoder

Model PCMD-1000 features completely transistorized circuitry with 0.1% accuracy over the temperature range of 0°C to 50°C. Conversion capability is at 5, 6, 7, 8, 9, or 10 bit levels. Basic prices range from \$2900 to \$5500. CORRELATED DATA SYSTEMS CORP., 1007 Air Way, Glendale, Calif. For information:

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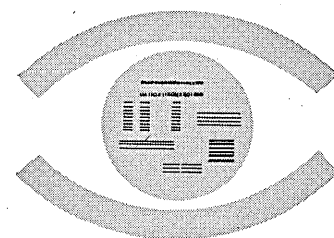
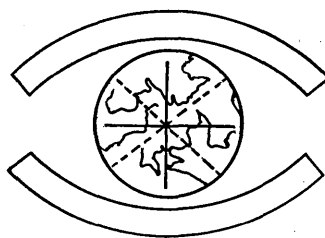
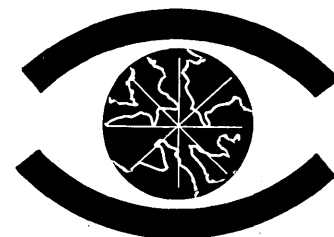
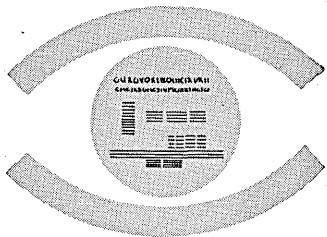
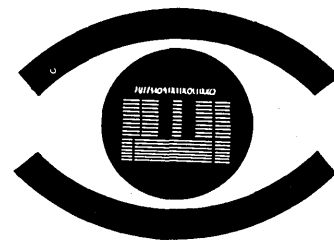
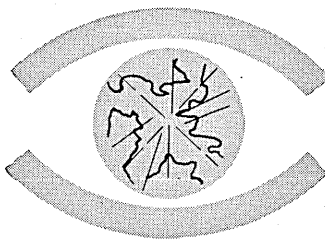
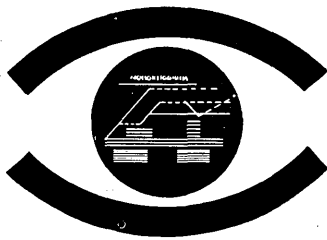
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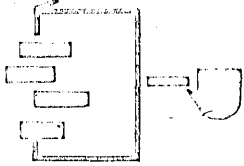
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DATAMATION



NEW LITERATURE

TELEMETRY SYSTEM: This 12-page illustrated brochure, "Spacecraft PCM Telemetry Systems," explains engineering and production problem-solving techniques used in the development of missile and satellite electronics. RADIATION, INC., Melbourne, Fla. For copy:

CIRCLE 130 ON READER CARD

THIN FILM MEMORY UNITS: A 12-page booklet contains an explanation of the behavior and operation of these units and includes diagrams, photographs and charts showing operating characteristics. BURROUGHS CORP., ELECTRONIC COMPONENTS DIV., Plainfield, N. J. For copy:

CIRCLE 131 ON READER CARD

LOGIC MODULES: An illustrated brochure on the DM-1000 series includes features, design philosophy, mechanical characteristics, and descriptions. SOLID STATE ELECTRONICS CORP., 15321 Rayen St., Sepulveda, Calif. For copy:

CIRCLE 132 ON READER CARD

225 SOFTWARE: This brochure lists the features as well as output options for Symmetric Linear Programming. The concept of modular programming is discussed. GENERAL ELECTRIC CO., COMPUTER DEPT., Phoenix, Ariz. For copy:

CIRCLE 133 ON READER CARD

D2020 MAG TAPE UNIT: A 12-page booklet offers listings of physical and performance characteristics of the D2020, in addition to a detailed product description and photographic illustrations of special features. DATA-MEC CORP., 345 Middlefield Rd., Mountain View, Calif. For copy:

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SYSTEMS INSTRUCTION: A 24-page prospectus outlines dates, enrollment procedures and course descriptions for nine educational programs totaling over 100 courses to be given this year. FRIDEN, INC., PROMOTION

PLANNING DEPT., 97 Humboldt St., Rochester, N. Y. For copy:
CIRCLE 135 ON READER CARD

HYDAPT: Basic elements, theory of operation and features of the Hybrid Digital Analog Pulse Time technique

are described in this 16 page brochure. GENERAL ELECTRIC CO., 600 Main St., Johnson City, N. Y. For copy:

CIRCLE 136 ON READER CARD

210 DATA SYSTEM: This revised brochure features new applications of the

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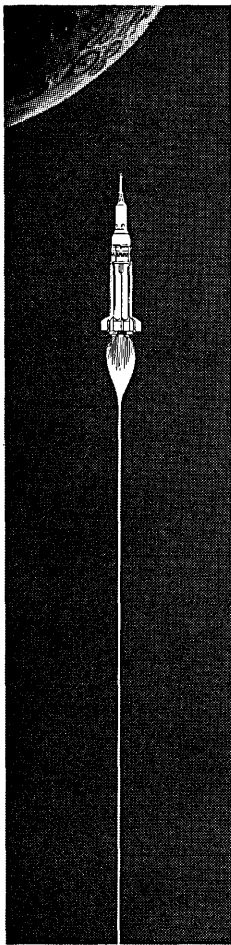
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(Above programmers will utilize NASA central computer facilities. Equipment includes IBM 7090 and 1401, Honeywell H-800 and H-400, and GE-225)

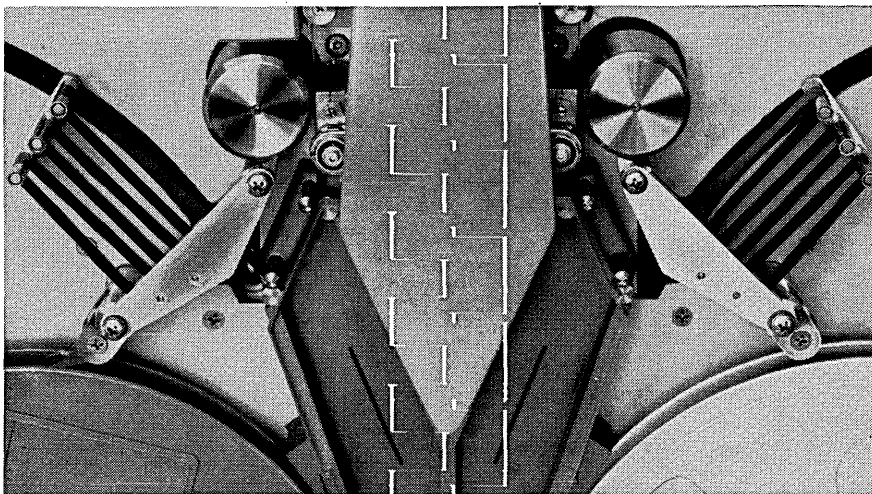
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 engineer
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NEW LITERATURE . . .

210 in conjunction with the EASE analog computer and error control translator. Accessories and optional peripheral equipment are also described. **BECKMAN INSTRUMENTS, INC., SYSTEMS DIV.,** 2400 Harbor Blvd., Fullerton, Calif. For copy:
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BERNOULLI DISC MEMORIES: Series 2200 bulletins describe specifications and applications for this rotating storage device. Also included is a technical article on "The Development of the Flexible-Disk Magnetic Recorder." **LABORATORY FOR ELECTRONICS, INC.,** 1079 Commonwealth Ave., Boston 15, Mass. For copy:
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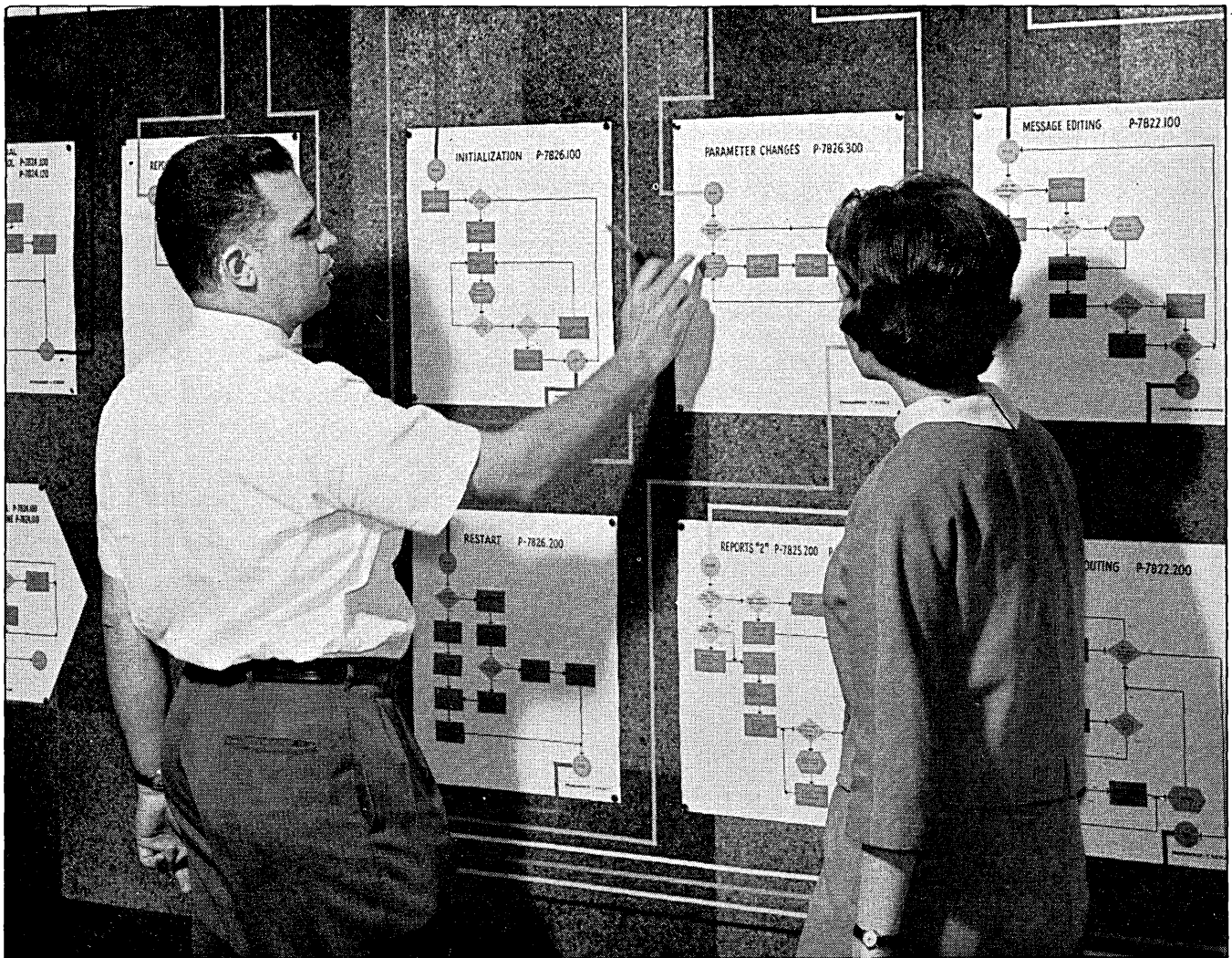
MAG TAPE EQUIPMENT: This brochure highlights the models A-11 and A-12 tape units which have been developed for use with the 210 and 420 computing systems. **ADVANCED SCIENTIFIC INSTRUMENTS, INC.,** 5249 Hanson Ct., Minneapolis 29, Minn. For copy:
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DIGITAL LOGIC KIT: A variety of classroom demonstrations and laboratory experiments which may be performed with the kit are described in this folder. **DIGITAL EQUIPMENT CORP.,** Maynard, Mass. For copy:
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1401 PLOTTING: This four-page brochure details the uses of digital plotters for graphing data output of 1401s. **CALIFORNIA COMPUTER PRODUCTS, INC.,** 305 Muller Ave., Anaheim, Calif. For copy:
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ANALOG DESIGN: "Analogic" includes sections on uses of simulators, dc operational amplifiers and their use in operational circuits, diagrams, design of integrator-summers, special analog circuits and wiring techniques. For a copy of this 50 page book send \$2 to **EMBREE ELECTRONICS CORP.,** 10 N. Main St., West Hartford, Conn.
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ENCODER PACKAGE: A comprehensive portfolio on the 3C Dicotron optical shaft angle encoders includes information on the multiple slit technique, specifications on standard models, series T miniature optical encoders, environmental specifications, power supplies and read out amplifiers. **COMPUTER CONTROL CO., INC.,**



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MANUAL CORE TEST JIGS: This two-page bulletin illustrates model 4021B, a two conductor probe jig that tests miniature ferrite cores. Other available models are also described. Specifications and schematic drawings are included. COMPUTER INSTRUMENTATION CORP., Route 38 & Longwood Ave., Cherry Hill, N. J. For copy:

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MAGNETICS TEST EQUIPMENT: Described in this catalog is equipment for testing and handling miniature ferrite and tape wound bobbin cores, equipment for testing magnetic core memory planes and stacks, and system exercisers for simulating computer environments for testing complete memory systems. COMPUTER INSTRUMENTATION CORP., Route 38 and Longwood Ave., Cherry Hill, N.J. For copy:

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26-PAGE GLOSSARY: Over 400 computer-language words and phrases are

contained in this, newly released glossary, CPB-93BP. GENERAL ELECTRIC CO., COMPUTER DEPT., 13430 N. Black Canyon Highway, Phoenix, Ariz. For copy:

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PLOTTING BROCHURE: This four page booklet details the use of digital incremental plotters for graphing data output of 1401s. The brochure, "Digital Plotting with the IBM 1401," describes the method of connecting the plotter to either the 1401 or to an IBM 1407 inquiry station. CALIFORNIA COMPUTER PRODUCTS, INC., 305 Mulder Ave., Anaheim, Calif. For copy:

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FORTRAN DIAGNOSTIC LOADER: This 14-page brochure presents a general description, operating procedures and instructions, format statement errors, arithmetic statement errors, design considerations and methodology for this program which was written to diagnose FORTRAN statements during the normal card-to-tape loading pass on the 1401. Tables and charts are included. DATATROL CORP., 8113A Fenton St., Silver Spring, Md. For copy:

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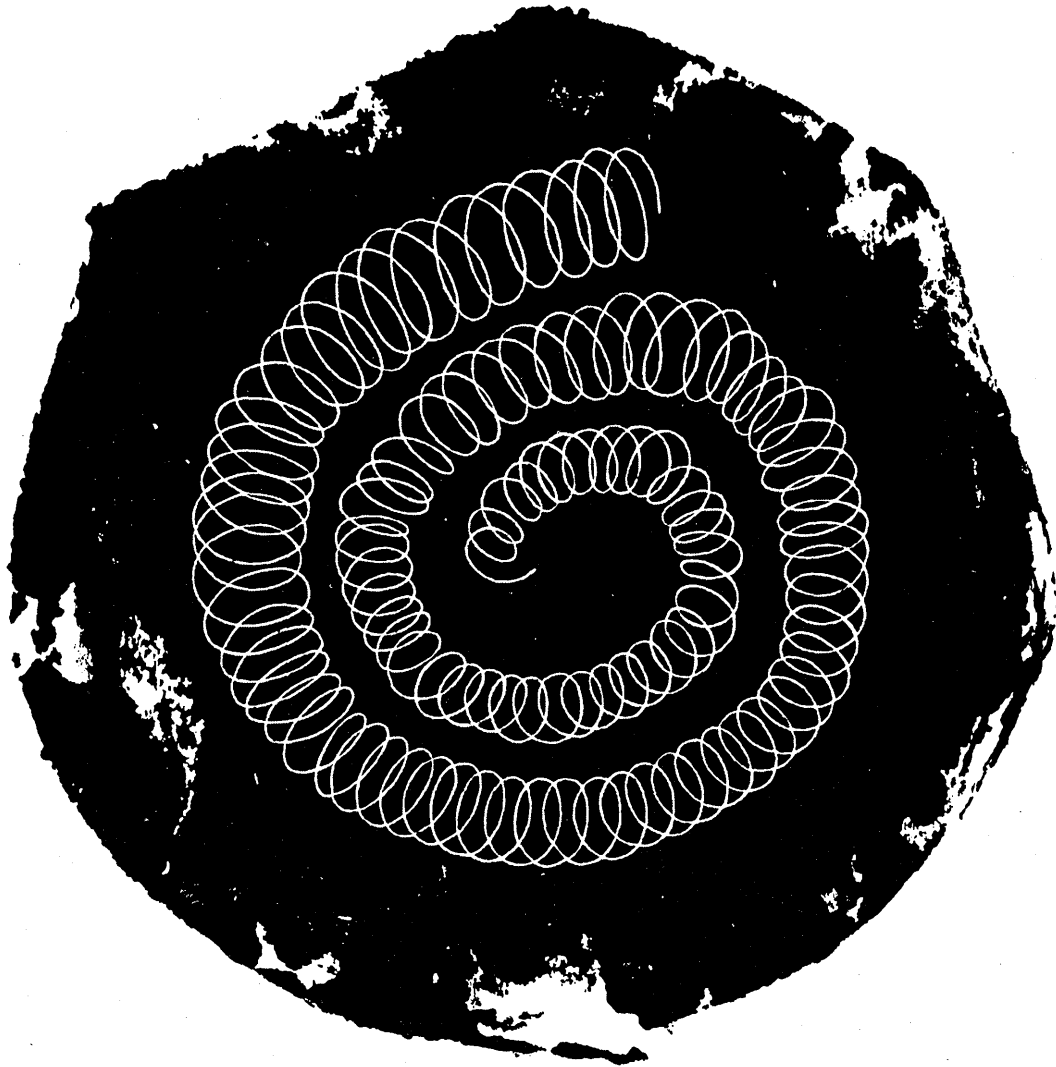
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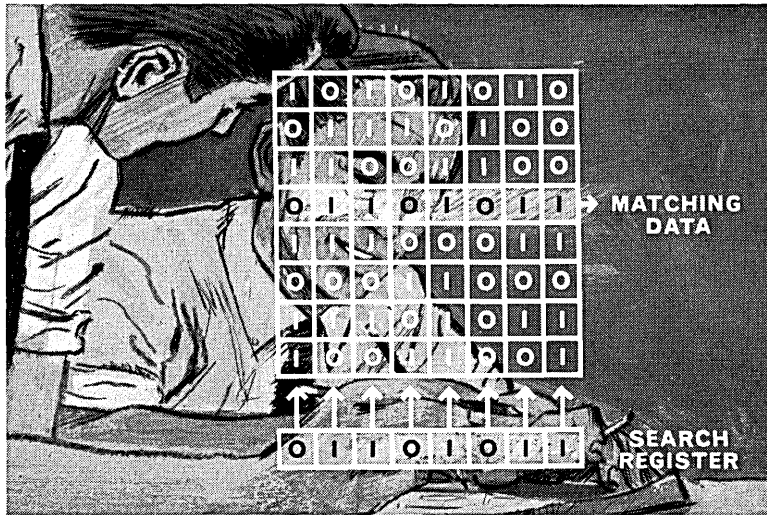
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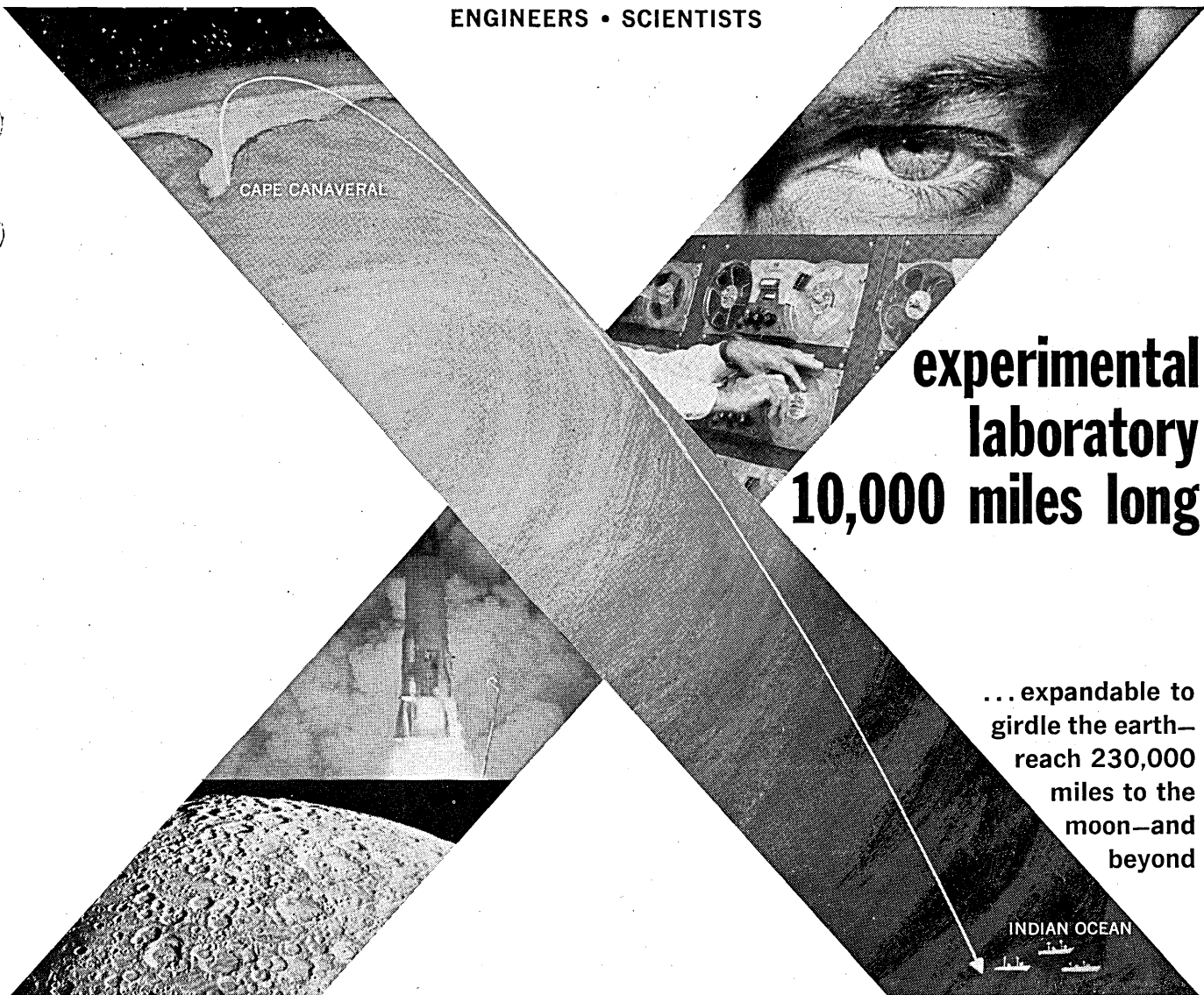


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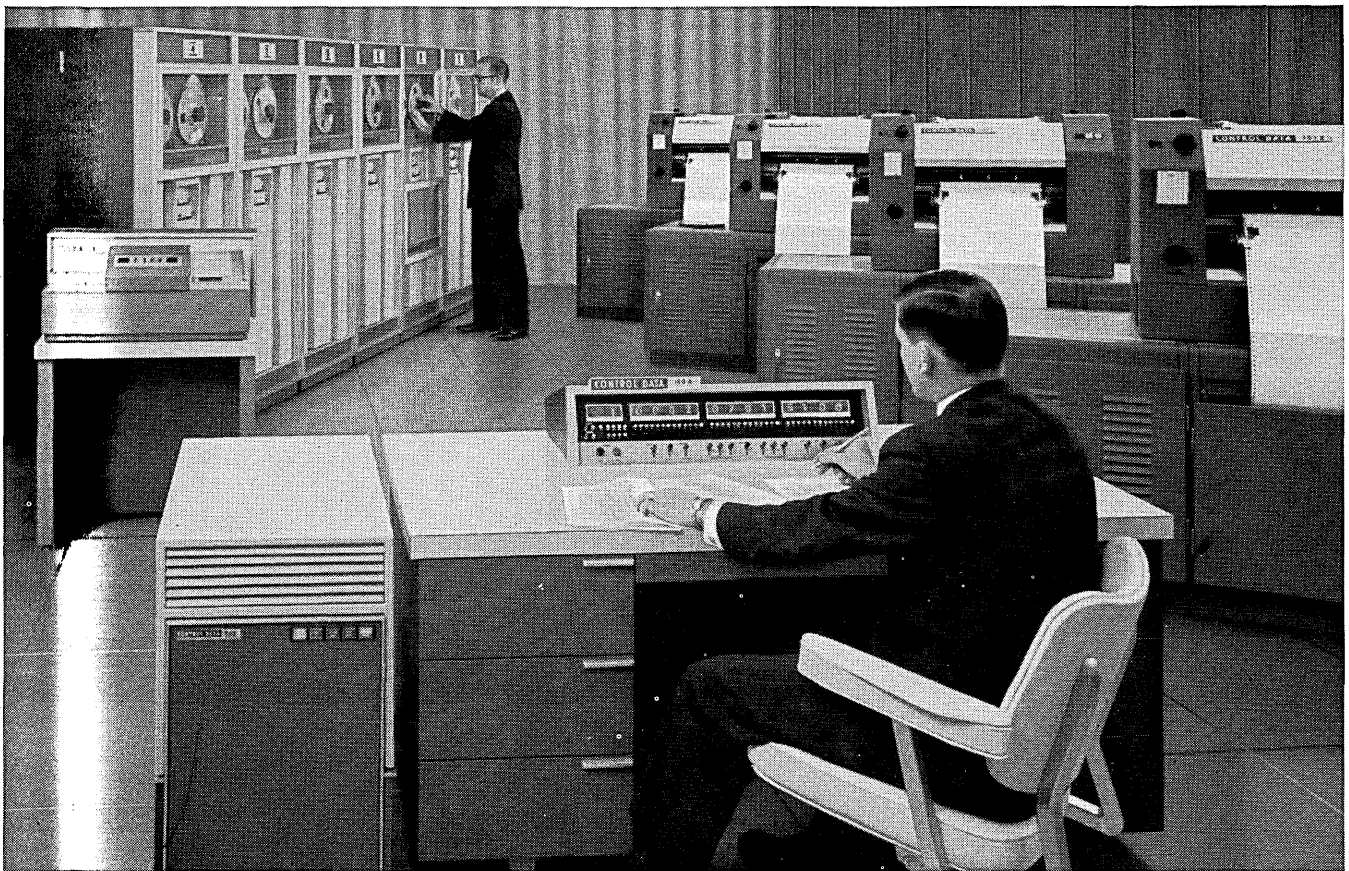
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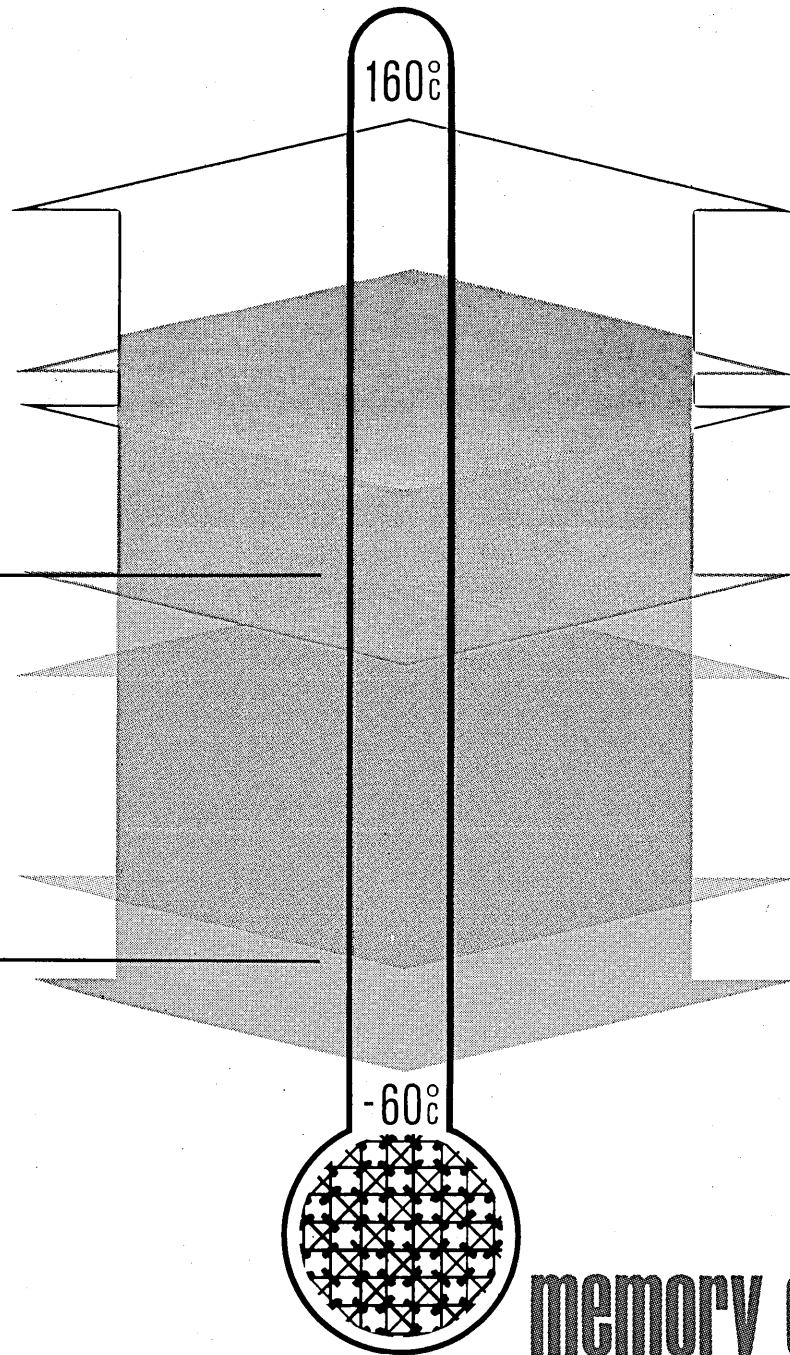
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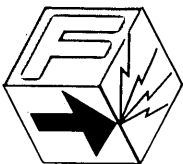
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