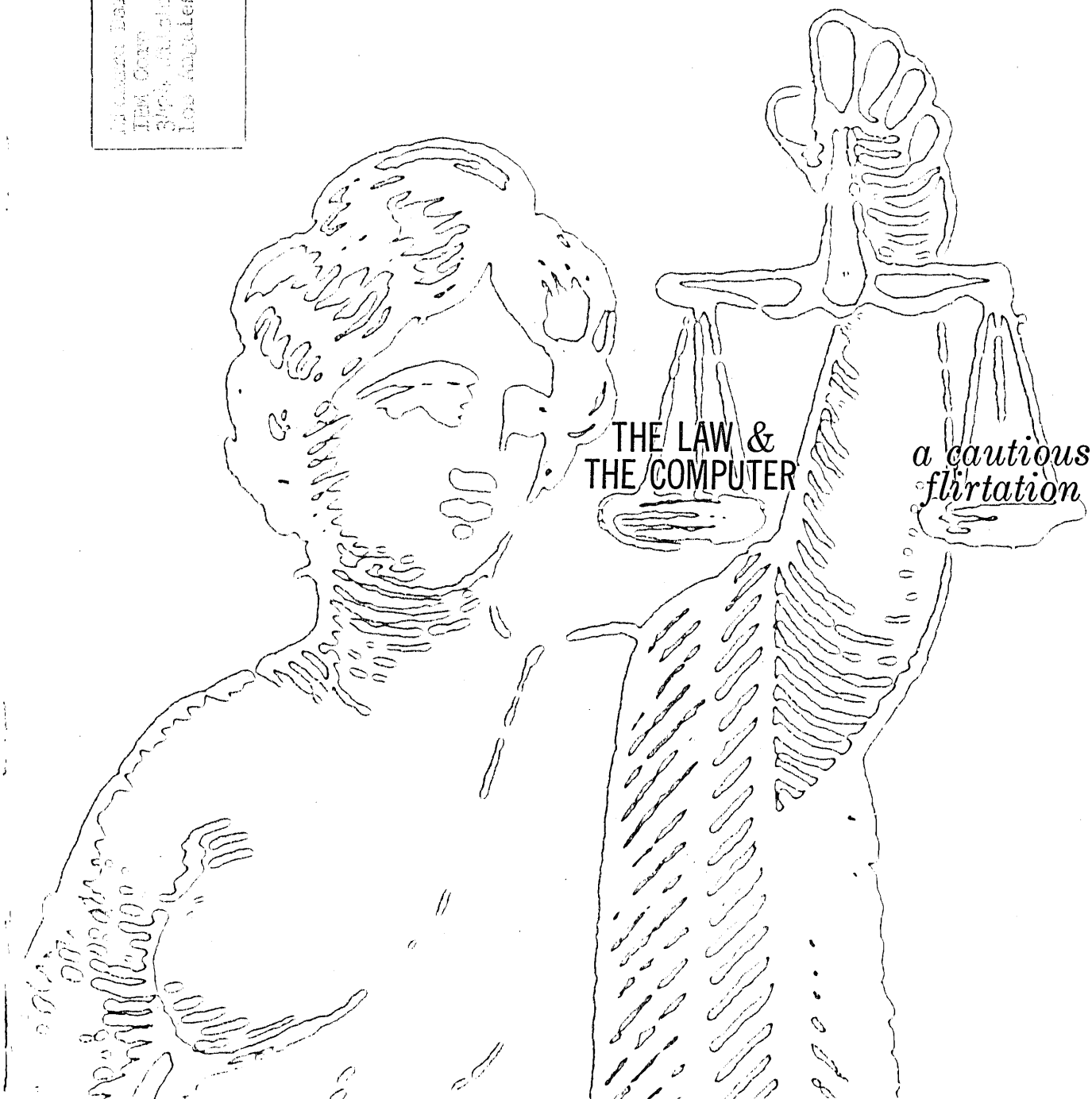
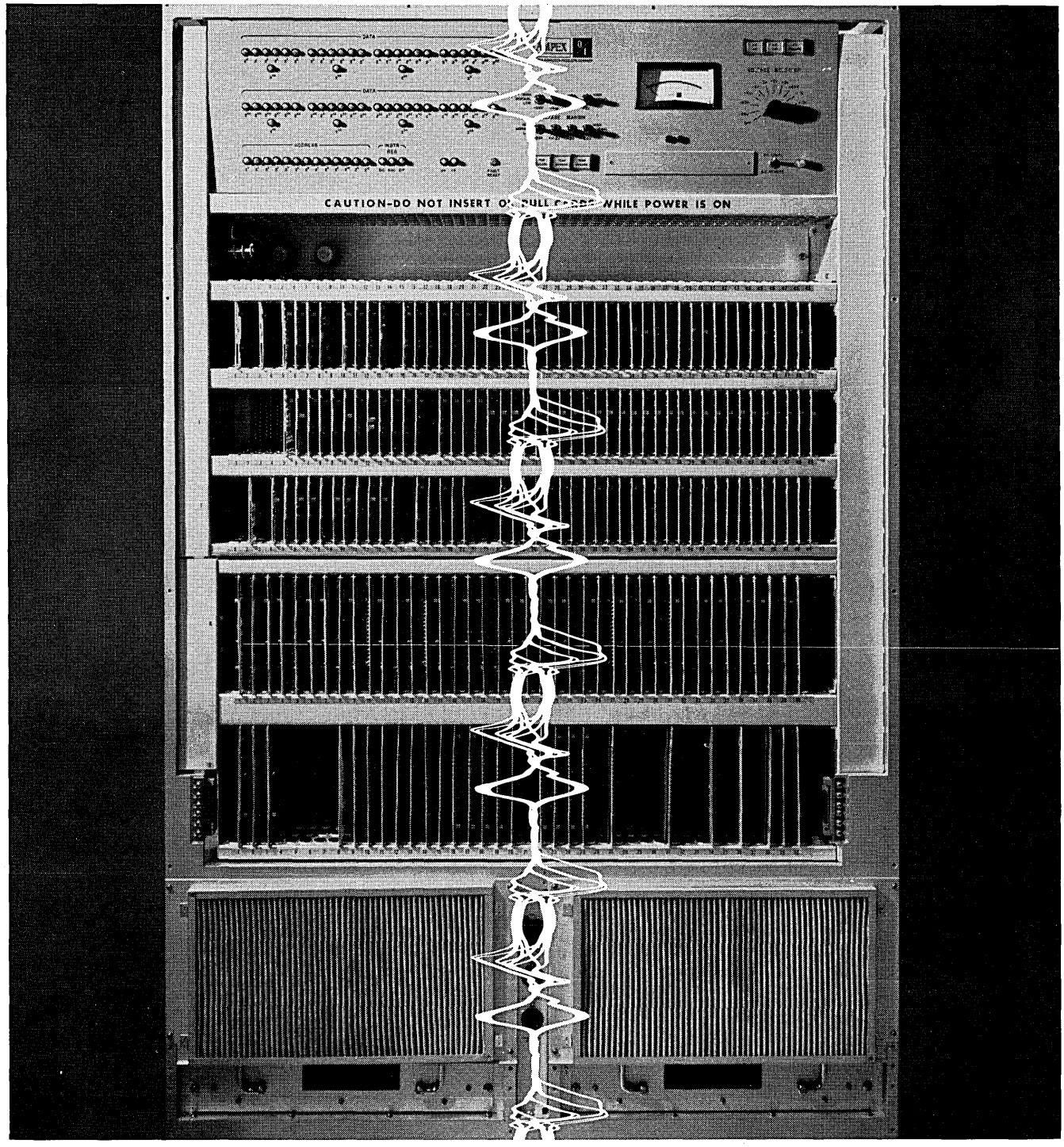
DATAMATION 62 ®

July

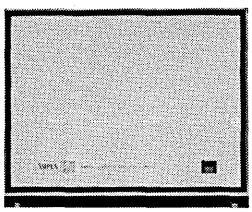
[illegible] Barnell, Sys Engr
IBM Corp
3[illegible] Wilshire Blvd
Los Angeles Calif
13-16


THE LAW &
THE COMPUTER
a cautious
flirtation



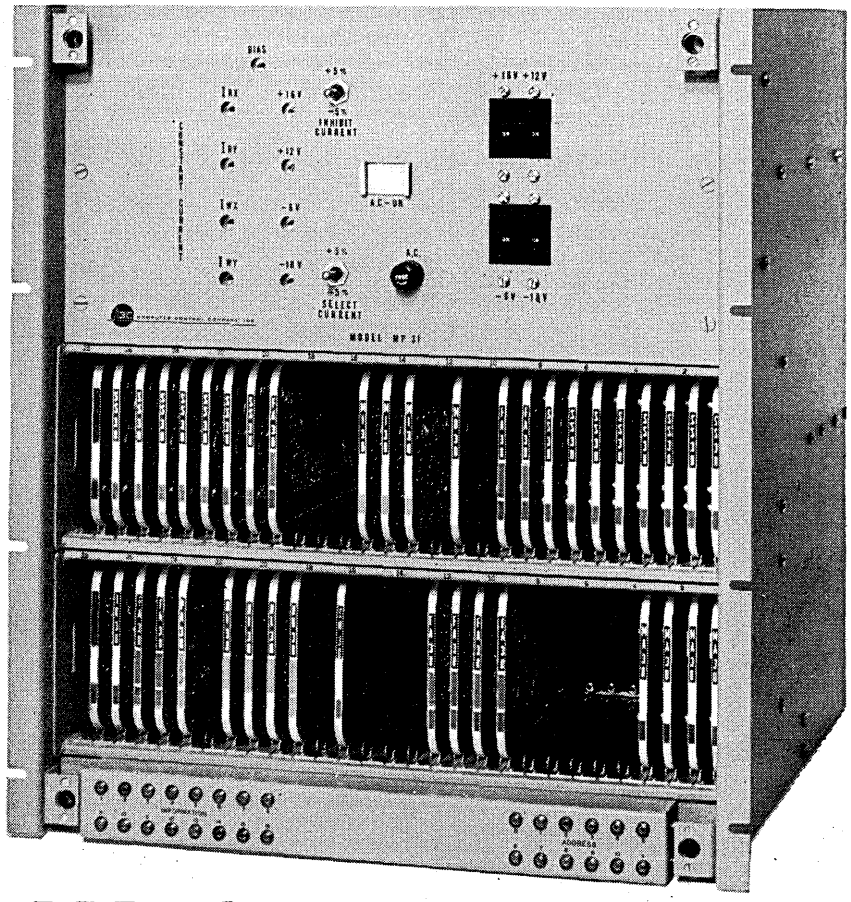

**Who knows enough about memories to make this and 39 other models? AMPEX.**

Only Ampex brings you such a wide range of core memories—with cycle times from 24 to 1.5 microseconds and capacities from 128 to 32,000 words. These memories have the flexibility needed for random access applications or high speed sequential or buffer operation. Examples? The RB with a capacity of 1024 words and a memory cycle in 8 microseconds. The RVQ with a capacity of 4096 words and memory cycle in 6 microseconds. The RQL, RQA and LQ each with a 32,768 word capacity and memory cycles in 6, 5 and 1.5 microseconds respectively. These are only five of the 40 models of memories from Ampex. And still more are yet to come. For data write the only company providing tape and recorders for every application: Ampex Corp., 934 Charter St., Redwood City, Calif. Sales, service engineers throughout the world.



CIRCLE 1 ON READER CARD

QUALITY GOES DEEP



# CORE MEMORIES with unique logic flexibility

Coincident current 3C Core Memories are all solid state, have true logic flexibility. They mate well in a system because they are tailored from an extensive line of standard 3C modules. Operating margins are broad. Model pictured stores up to 130,000 bits, with word lengths of 6 to 40 bits. Read-write cycles are 5 to 10 μsecs. You select features. Example: 3½ to 6 μsec split-cycle operation. Another: power supply test switch marginal checking. No extra charge for these features. Memory self-checking is extra, but not much. Other features, other capacities available. Experience? Three and one-half years. Quality? It goes deep.

3C

**COMPUTER CONTROL COMPANY, INC.**

983 CONCORD ST., FRAMINGHAM, MASSACHUSETTS • 2251 BARRY AVENUE, LOS ANGELES 64, CALIFORNIA

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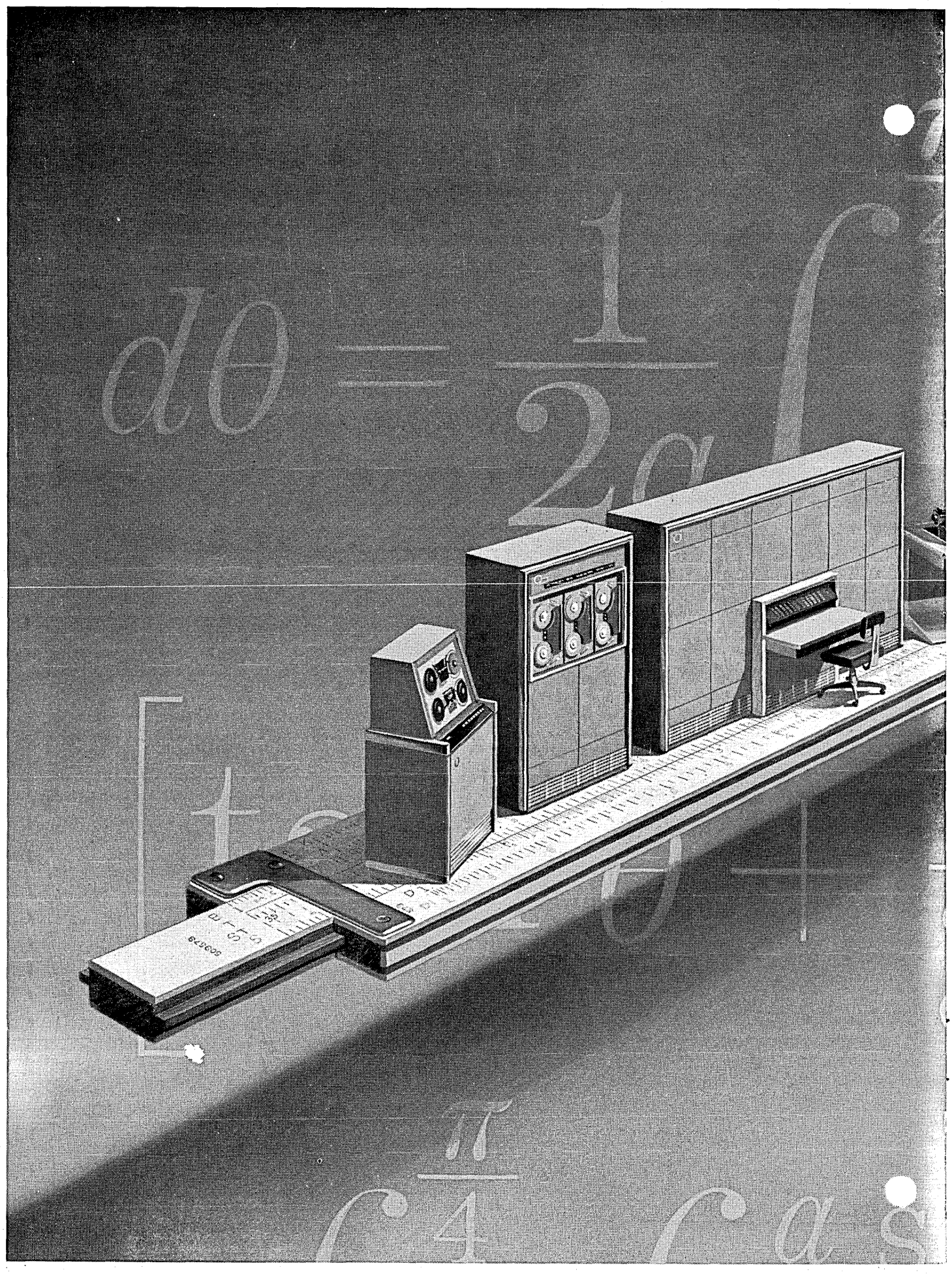
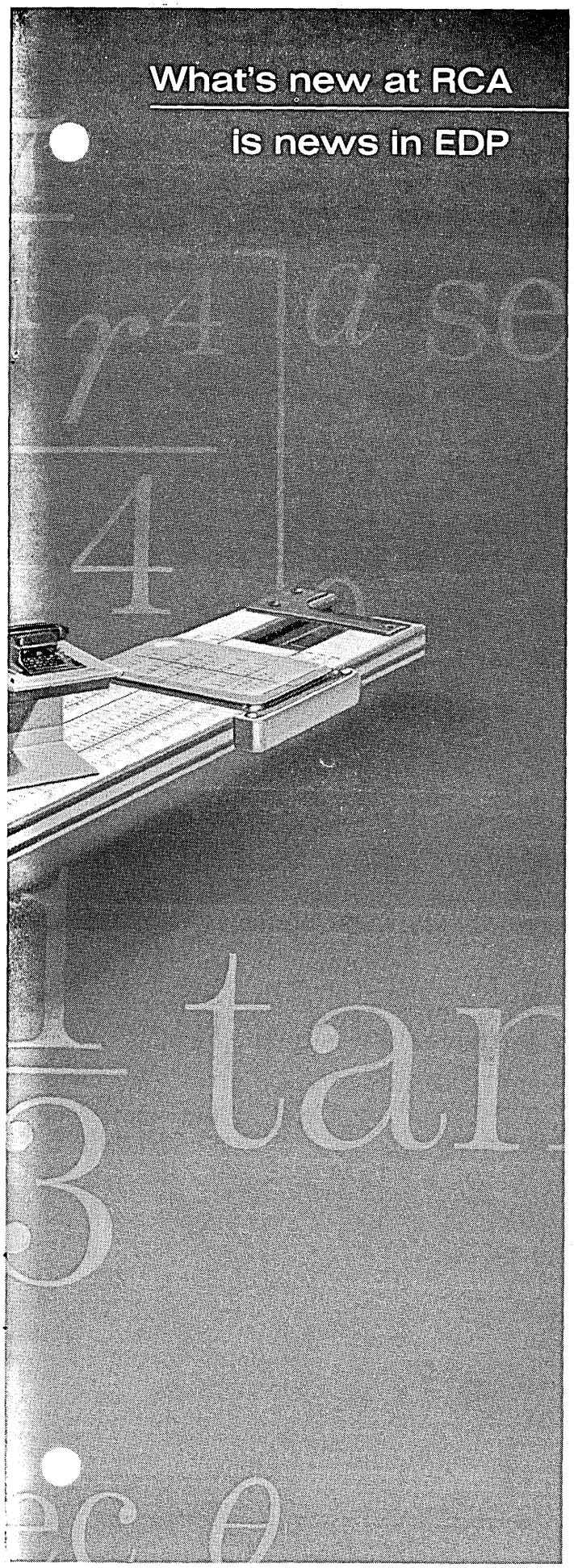





# RCA ADDS NEW SCIENTIFIC CAPABILITY TO THE LOW COST, HIGH CAPACITY 301

RCA's 301, today's best investment in low-cost commercial EDP, is now the best buy for commercial *and* scientific computer power at low cost.

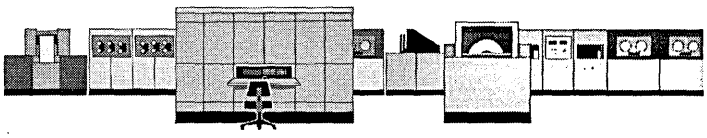
**TOTAL EDP CAPABILITY.** The new RCA 301 gives you *total EDP capability*. With this capability you get greater efficiency for your rental dollars, can schedule time for *both* technical and business assignments. Use the 301 for all your routine EDP business accounting needs. And use it for statistical, analytical and control problems. Assign mathematical tasks to the new 301 and free professional time for creative work.

**MANY NEW WAYS TO USE RCA 301.** Open up new possibilities in your day-to-day data processing with this new 301. For instance—replace several smaller, less efficient computers with one 301. Or—if you have conflicts with time-sharing a large computer, give critical departments their own 301. Or—if you have an outdated computer that's slowing down work, replace it with a 301. You may well save half the cost to do the same job!

**EXTENSIVE SOFTWARE COVERAGE.** RCA makes available a variety of scientific sub-routines—for matrix operations, linear programming, statistical analysis, curve-fitting, double precision floating point, etc., plus Scientific and Bell Interpreter systems and UMAC (an Algebraic Compiler which employs Fortran mathematical statements).

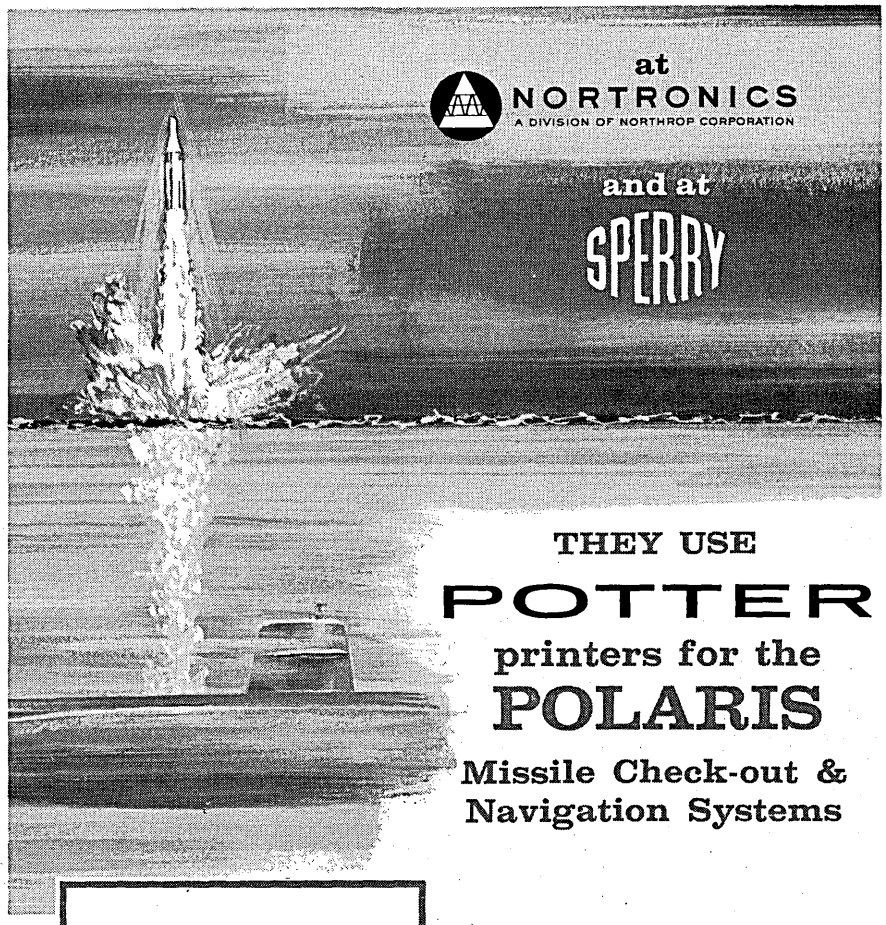
Check the specifications below and find out what the new 301 features can do for you. Then contact RCA Electronic Data Processing, Cherry Hill, Camden 8, N.J.

- An entire family of new fast circuitry arithmetic instructions, including:
  - fixed point
  - floating point
  - 16 digit accumulator manipulation and shifting facilities
- This new instruction format allows the use of bit indicators for storage of operands and for address field modification.
- Approximately 6000 floating or fixed point eight digit add/subtract and 2000 floating or fixed point multiply/divide operations per second. (With 2 digit exponent in floating point.)
- Three index fields for address modification.



**The Most Trusted Name in Electronics**

CIRCLE 5 ON READER CARD



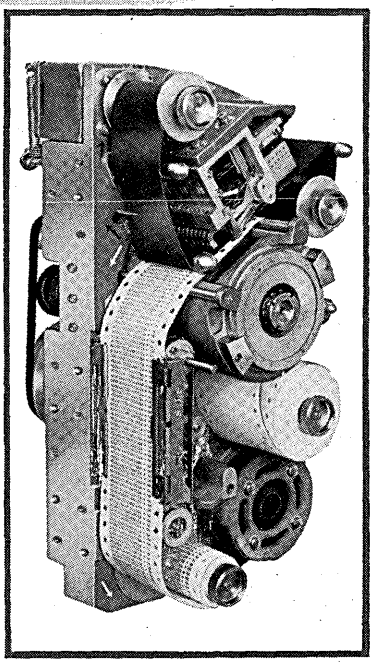

THEY USE

# POTTER

**printers for the**

# POLARIS

**Missile Check-out & Navigation Systems**



The Polaris missile tactical and readiness check-out system and the navigation system operate on a round - the - clock schedule to achieve extreme accuracy.

Potter M3366 high speed printers and associated electronics were chosen for these demanding systems to provide fast, accurate print-out of computer data.

These rugged militarized printers provide optimum reliability at rates exceeding 300 lines per minute in 20-column format.

Potter produces a variety of printers with speeds up to 1000 alpha numeric lines per minute and a range of 20 to 160 columns. Information and specifications on a model for your particular application are available on request. *Write today.*

**POTTER INSTRUMENT CO., INC.**
*Sunnyside Boulevard • Plainview, New York*

T.M.

CIRCLE 6 ON READER CARD

# DATAMATION 62

*the automatic handling of information*

*volume 8, number* 7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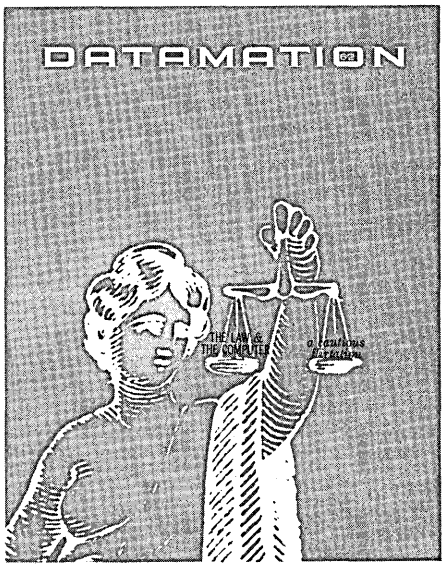


While contradicting leading prognostication, the present inbalance between data processing and the legal profession is substantiated by a report of a major conference on the law and computing beginning on page 25, and visually interpreted by this month's cover, designed by Art Director Cleve Boutell.


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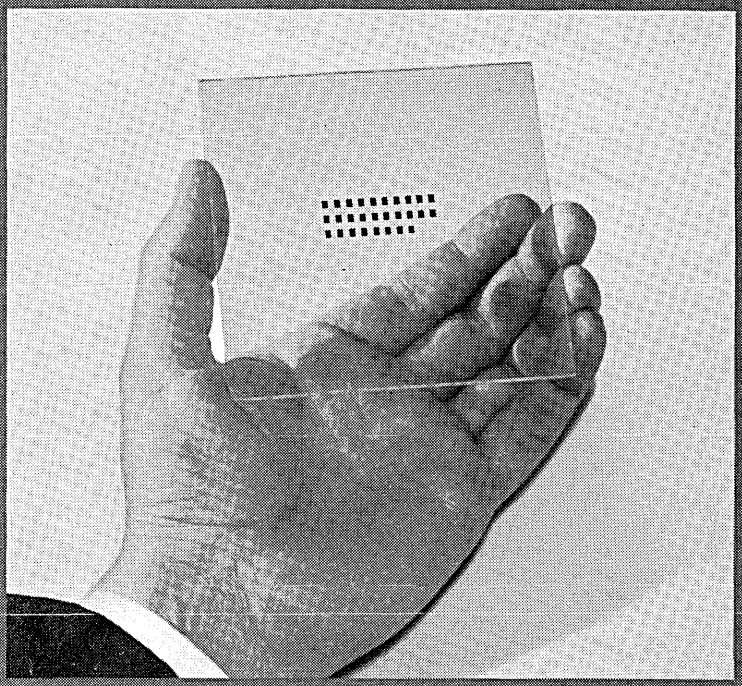


# An entire metropolitan newspaper could be recorded in the tiny dots above!

Every page, every word, every picture in an entire edition of a metropolitan newspaper could be recorded and reduced to microscopic proportions, thanks to an amazing new photochromic micro-image technique developed by NCR Research.

Using a photochromic material consisting of molecules of light-sensitive dyes, it makes possible completely grain-free clear reductions far finer than those achieved with the finest micro-film.

Actually, the little plate above is big enough to record 1,312 newspaper pages . . . micro-images that can be enlarged to almost perfect copies of the original documents.

To put it another way . . . this new NCR development makes it possible to store the entire contents of a 400 page book on one square inch. Thus the library of the future could store all its volumes on small, expendable memory cards. The cards could be read at home with viewers which magnify the image for easy reading.

Or, put another way, documents that now require 250,000 square feet of filing space can be stored in 6¼ square feet. Think of what this will mean to business concerns in the years to come, as space becomes more and more valuable.

The point is . . . this is only one of the many new and exciting projects at NCR's Research and Development Division, whose major objective is . . .

***To provide the finest total business systems—from original entry to final report—through NCR accounting machines, cash registers or adding machines, and electronic data processing.***

NCR

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

CIRCLE 7 ON READER CARD

# important DATES

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

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

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

- The 1962 Symposium on Ballistic Missile and Space Technology sponsored by USAF and Aerospace Corp. will be held at the Statler Hilton, Los Angeles, Aug. 27-29.

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

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

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

- The AIEE/IRE International Conference on Nonlinear Magnetics will be held at the Shoreham Hotel, Washington, D.C., April 17-19, 1963.

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

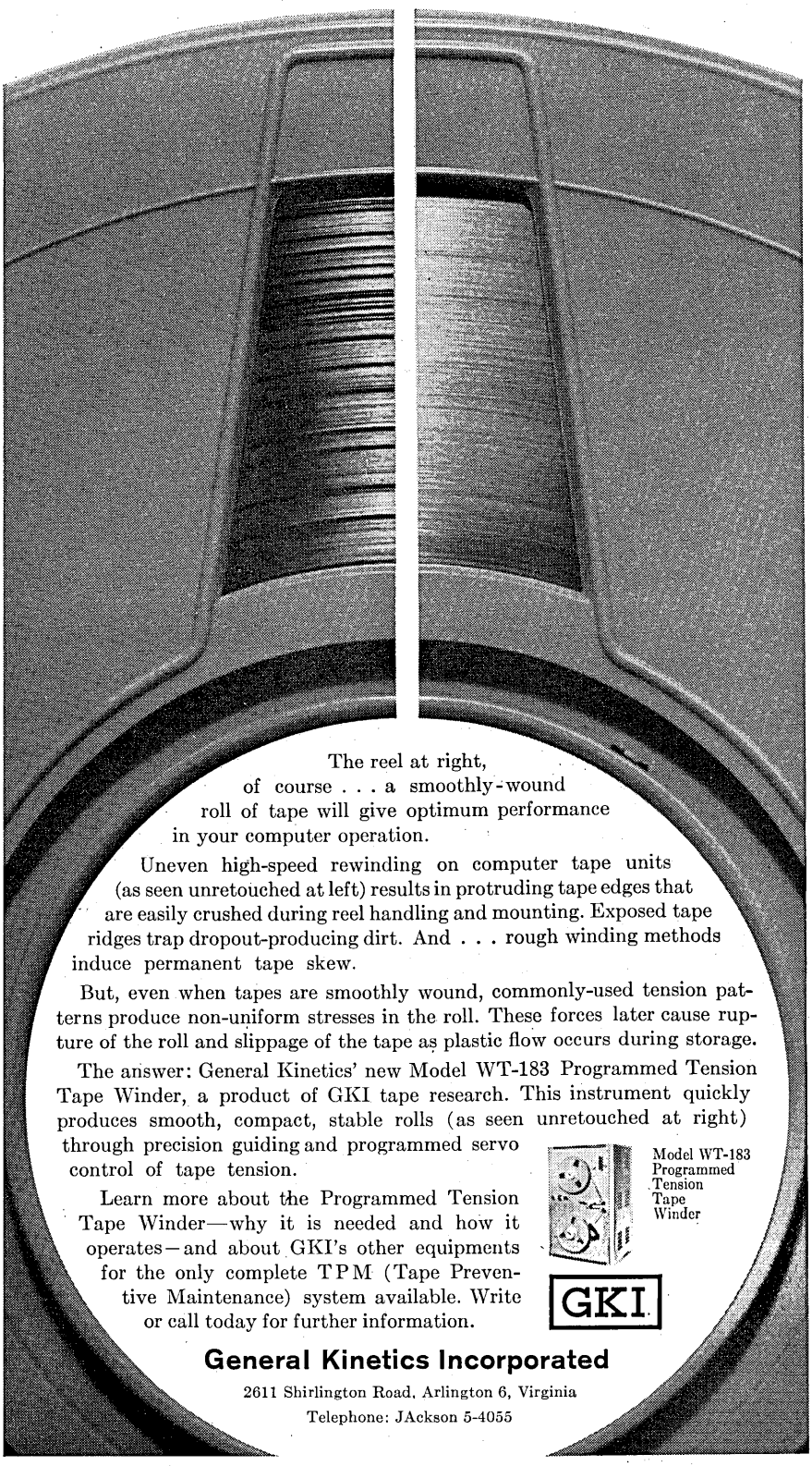
- The 1963 ACM National Conference will be held Aug. 28, 29, and 30th in Denver, Colorado.

- The 1963 Fall Joint Computer Conference will be held in Los Angeles, Calif., Nov. 12-14, 1963.

- The 1964 ACM National Conference will be held in Philadelphia, Penna., Aug. 25-28, 1964.

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


## Which tape will produce more reliable data?



The reel at right, of course . . . a smoothly-wound roll of tape will give optimum performance in your computer operation.

Uneven high-speed rewinding on computer tape units (as seen unretouched at left) results in protruding tape edges that are easily crushed during reel handling and mounting. Exposed tape ridges trap dropout-producing dirt. And . . . rough winding methods induce permanent tape skew.

But, even when tapes are smoothly wound, commonly-used tension patterns produce non-uniform stresses in the roll. These forces later cause rupture of the roll and slippage of the tape as plastic flow occurs during storage.

The answer: General Kinetics' new Model WT-183 Programmed Tension Tape Winder, a product of GKI tape research. This instrument quickly produces smooth, compact, stable rolls (as seen unretouched at right) through precision guiding and programmed servo control of tape tension.



Model WT-183 Programmed Tension Tape Winder

Learn more about the Programmed Tension Tape Winder—why it is needed and how it operates—and about GKI's other equipments for the only complete TPM (Tape Preventive Maintenance) system available. Write or call today for further information.

GKI

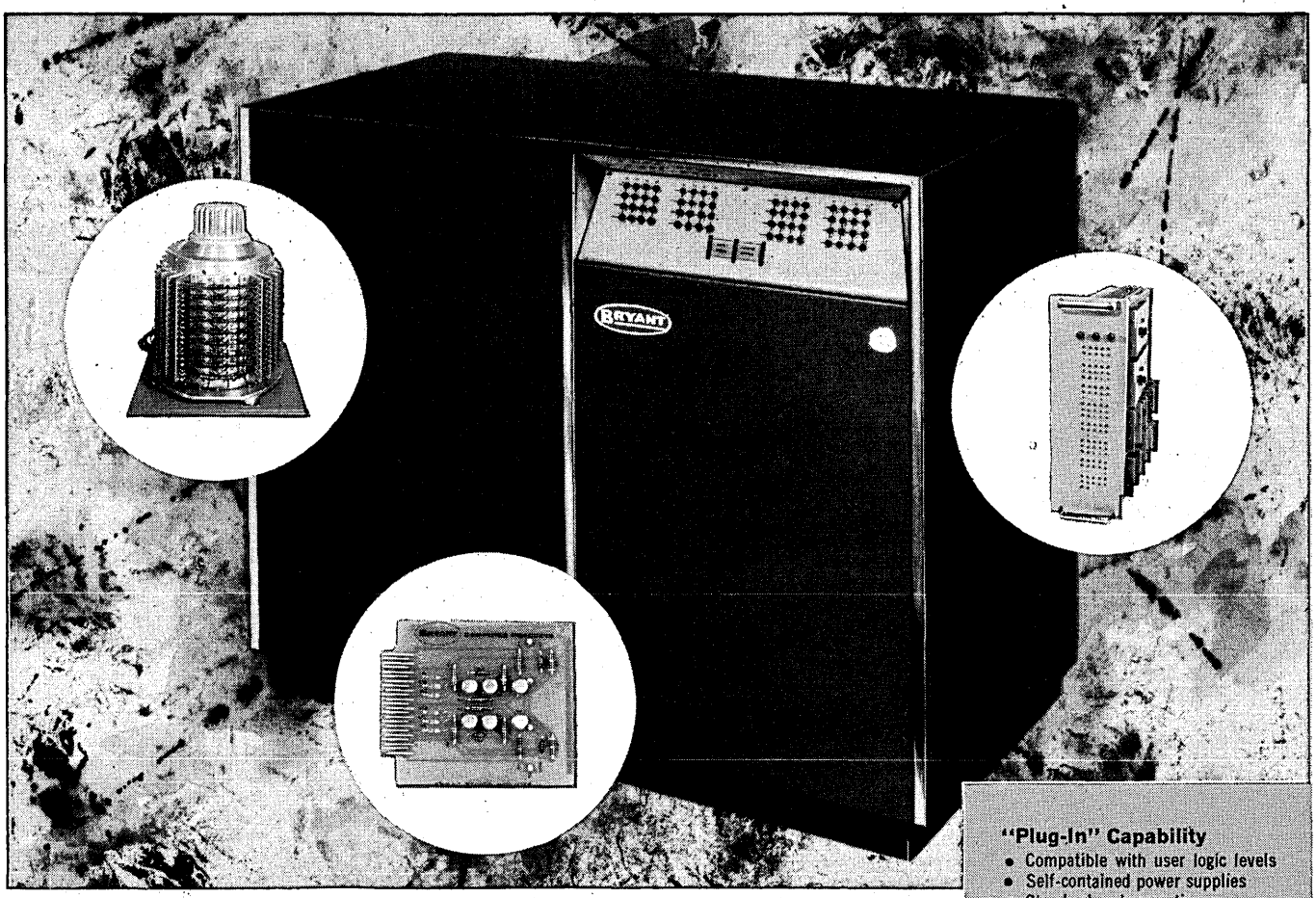
**General Kinetics Incorporated**

2611 Shirlington Road, Arlington 6, Virginia

Telephone: JAckson 5-4055

CIRCLE 8 ON READER CARD

# BRYANT SYSTEMS AND CIRCUITS REDUCE DATA STORAGE COSTS




Whatever your data storage requirements, investigate Bryant's drum and disc file memory systems, and full line of modular read, write, selection, and interface circuitry. For details contact your local Bryant representative, or write direct to: 852 Ladd Road, Walled Lake, Michigan, MArket 4-4571.

**Typical Specifications** (Read Amplifier Model 6002)

| | |
|---|---|
| No. of Circuits per board | 1 |
| Frequency of operation | DC min.; 500 KC max. |
| Input signal required | 10 MV to 500 MV |
| Output drive capabilities | 20 MA "And" current; 7 MA "Or" current |
| Current requirements per board @ − 20 V | 30 M.A. |
| @ + 7V | 30 M.A. |
| @ − 7V (Clamp) | 10 M.A. |
| Output wave form rise time | less than .1 usec |
| Output wave form fall time | less than .1 usec |
| Logic Levels | Ov and −7v |
| Temperature Range | 0°C to +55°C |

**"Plug-In" Capability**
- Compatible with user logic levels
- Self-contained power supplies
- Standard rack mounting
- Choice of recording modes

**Design Flexibility**
- Frequencies to 1 MC
- Serial and parallel operation
- Selective alteration of data
- Custom units for every requirement

**Built-In Reliability**
- Complete solid state designs
- Derated components, Mil-approved connectors
- Glass epoxy printed boards
- Overload protection

**Circuit Availability**
- Individual circuits available include: read, write, selection, clock read, driver, inverter, flip flop, multiple gate, and power supply modules.

62-42CP

BRYANT

**COMPUTER PRODUCTS**

Disc File and Magnetic Drum Memories for Every Storage Application

*A DIVISION OF EX-CELL-O CORPORATION* XLO

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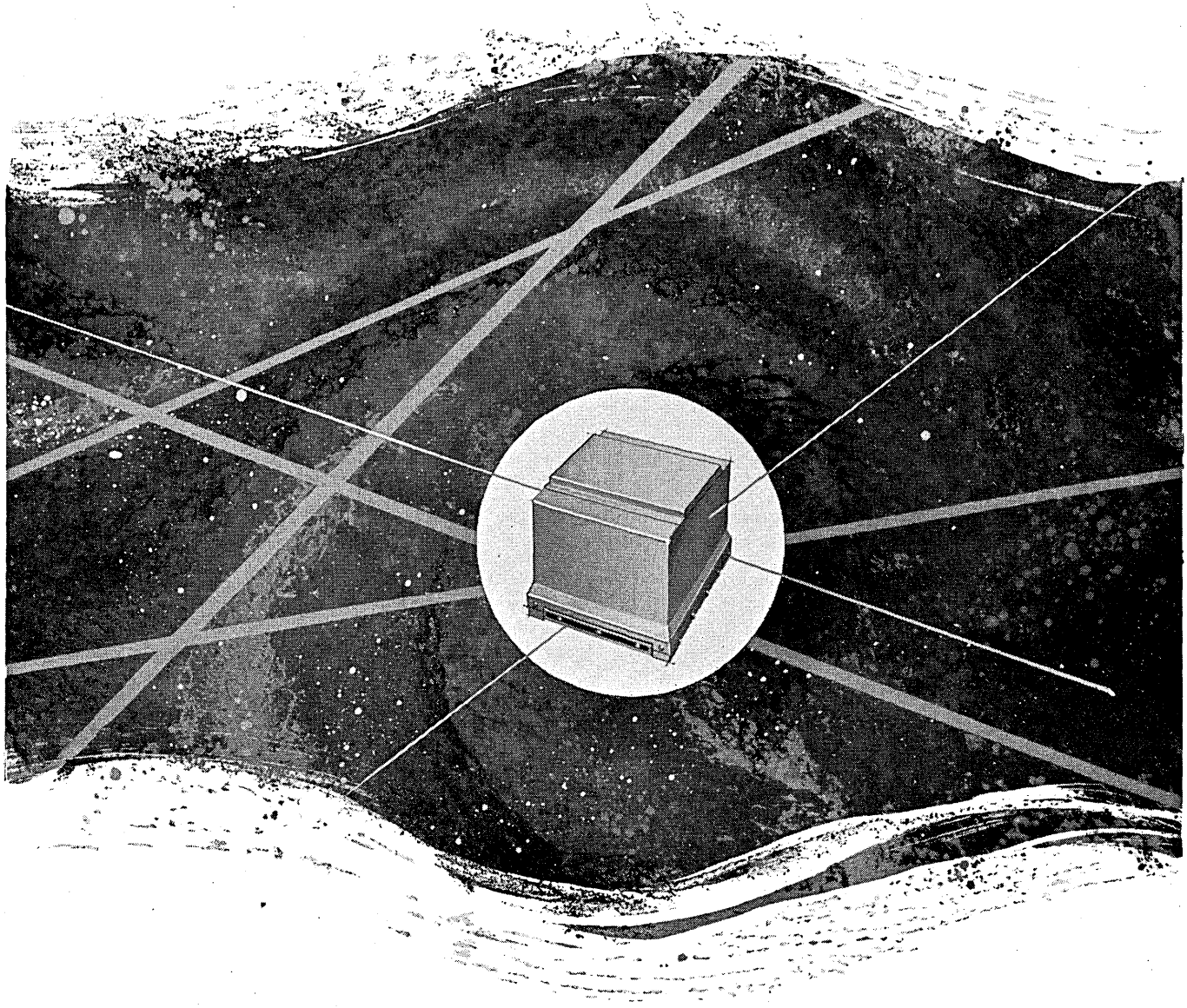


## this computer withstands space age punishment

**. . . thanks to IGC memory products** — Indiana General memory, switching and multi-aperture cores help the MAGLOC I computer meet extreme reliability and maintenance requirements of long duration interplanetary missions. MAGLOC I, developed by Sperry Gyroscope Co., utilizes IGC ferrites for logic, drive and memory circuits. Life expectancy of the ferrites is 1,000 times that of the components they replace and the ferrites cost 1/10 as much. In some circuits, a single IGC ferrite replaces as many as 24 semiconductor elements. Besides long service life, little power requirement, and low cost, the ferrites are up to 100,000 times more resistant to radiation damage. MAGLOC I logic and memory circuits have been successfully tested to MIL-E-5400, class 4 specifications and beyond. ■ **Magnetic storage systems are our business** Whatever your computer requirements, you can count on Indiana General's experience to save you time, materials, man power and money. **Call or write today for Engineering Data File** to Indiana General Corporation, Electronics Division, Keasbey, New Jersey.

# INDIANA GENERAL IGC

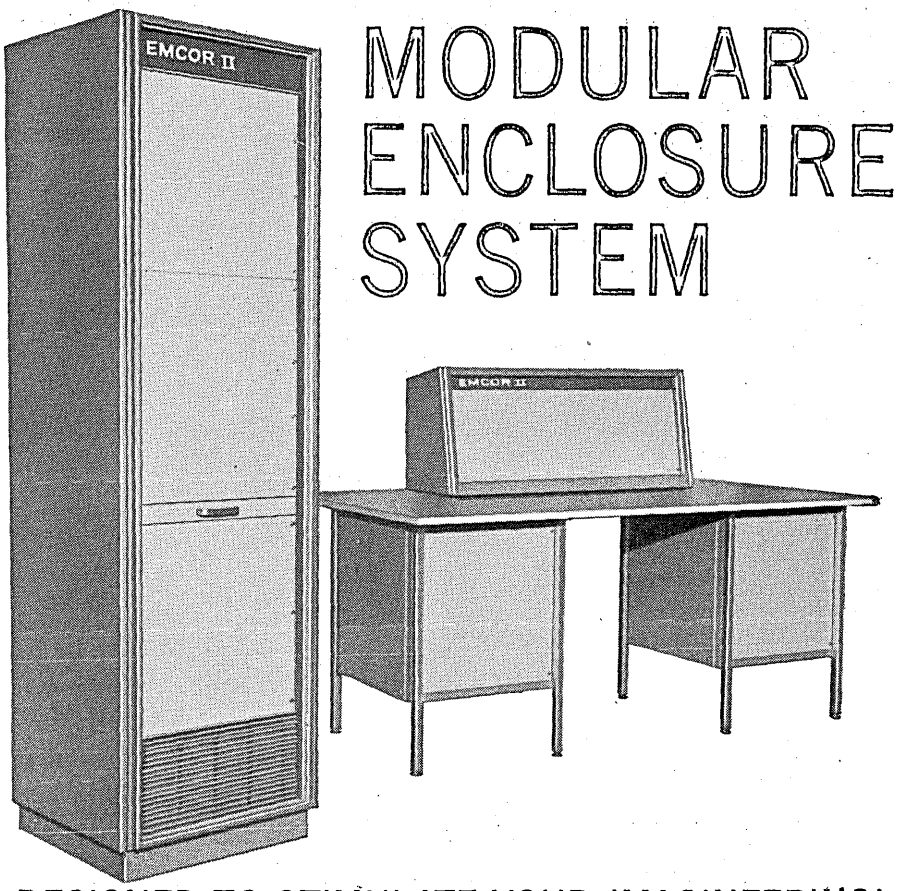
| MEMORY SYSTEMS | FERRITES | TC CORES | PLANES | STACKS |
|---|---|---|---|---|

CIRCLE 10 ON READER CARD

ALL NEW
from Ingersoll Products

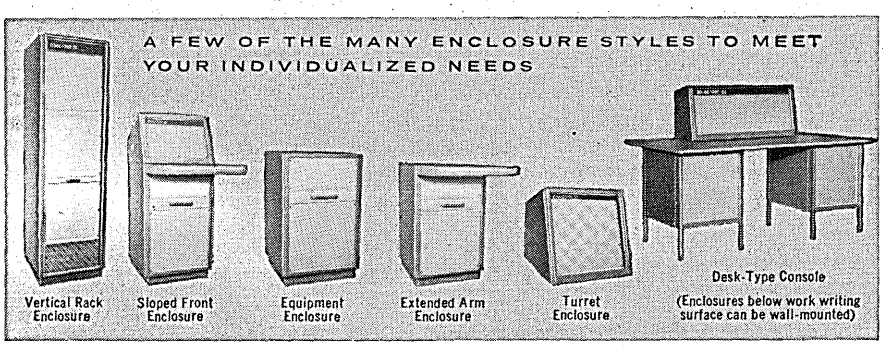
Emcor III

MODULAR ENCLOSURE SYSTEM




DESIGNED TO STIMULATE YOUR IMAGINEERING!

EMCOR II Modular Enclosure System provides an exclusive combination of appearance and structural features for distinct, individualized customer identity. Recessed, flush or extended panel mountings; choice of aluminum trim or grillwork extrusions, an assortment of customer nameplate styles, double width frames, pontoon bases and side panels, multi-function enclosures; superior structural strength second to none; externally removable side panels; 1¾" pull-out Work Writing Surfaces plus many more features designed to stimulate your imagineering. Your investigation of the EMCOR II Line will be rewarded by virtually unlimited application possibilities.

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CIRCLE 11 ON READER CARD

# letters

## compiler comparison

Sir:

In May, *Datamation* published a Lockheed comparison of FORTRAN compilers on several machines, including the Honeywell 800. Compilation and running time are such complex functions of the problem being run that a one-problem sample is meaningless. The Lockheed problem emphasized output edit time rather than computation time, and required ten times as much time on the 800 as on the 7090. We immediately wrote a FORTRAN program which emphasizes tape motion and optimizes features that will run at about the same speed on both machines. Neither comparison is typical . . .

Speed ratios are not the only measures of compiler value. Other important measures are total cost per job, jobs per day, checkout ease. New and extended compilers are being prepared for both the H 800-1800 and the 7090-7094. We will achieve a throughput of 600-800 jobs per day at a cost of about $1.70 per job. These are the measures that count.

RICHARD F. CLIPPINGER
*Technical Advisor,*
*Automatic Programming,*
*Minneapolis-Honeywell EDP Div.,*
*Wellesley Hills, Mass.*

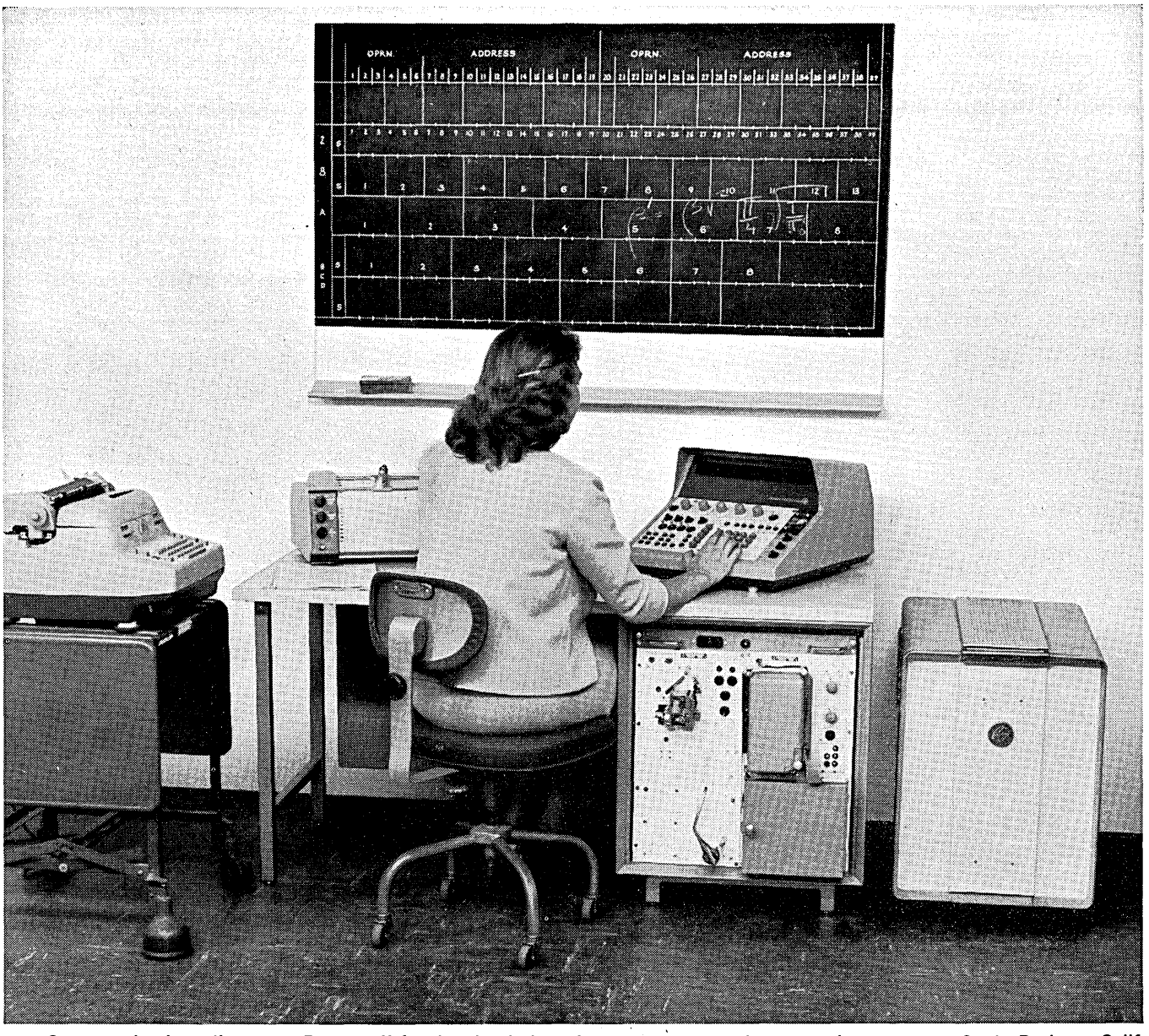
## Kludge comments

Sir:

Your three successive articles on Kludges should really make a user laugh, but there is so much veiled truth in them that I almost cried. After drying my tears, I was sufficiently moved to write the following article on "How To Use A Kludge:"

Don't tell the boss you've got one. Surreptitiously buy an abacus, dust off your slide rule, hire a coolie to run both, set up a closed shop (preferably closed-door) operation and pray that you can exchange machines for a lower order Kludge before anyone debugs a program. As a hedge against getting caught, place a "Situations Wanted" ad in a leading computer journal (if you can find one). You're worth more money anyway!

R. L. MORRIS
*Cincinnati, Ohio*




Servomechanisms/Inc. uses Recomp II for the simulation of space systems at its research center near Santa Barbara, Calif.

# How to lease a physical laboratory for $2,495 a month.

It weighs a little more than 500 pounds. It's just a bit larger than a desk. And it goes to work when you plug it in.

It can work as a flight test facility, a microscope, an electronics test bench, an environmental test chamber, a space system simulator. And that's just the start.

This particular laboratory is called Recomp.® It is an advanced, solid-state digital computer.

It's amazing the number of things Recomp can do. One big asset is the way it frees technical personnel for creative work.

For example, a company that used to get 2 proposals a year from a top creative scientist, was able to increase this figure to 3½ with a computer (not Recomp). But with Recomp this company is now able to get nine proposals per man each year.

Recomp's accessory line and software advantages are the most up-to-date in the computer industry (they now include an xy graph plotter and card reader capability). And an extensive programming library is available without charge.

There is a Recomp to fit your needs (and budget). For medium-scale needs, Recomp II starts at $2,495 and with a complete line of peripheral equipment goes up to $4,500. Recomp III is perfect for small-scale needs. You can lease one for $1,495, complete.

There is only one way to know exactly what computer suits you best. That's through your own feasibility study. And no computer feasibility study is complete without Recomp. Put Recomp side by side with any comparable computer on the market. Let the facts speak for themselves.

We'll be glad to help you get all the facts. Write today for a helpful guide: "How to Conduct a Computer Feasibility Study."

Write: Recomp, Department 67, 3400 East 70th Street, Long Beach, California.

# Recomp

Recomp is a product of Autonetics Industrial Products Autonetics is a Division of North American Aviation

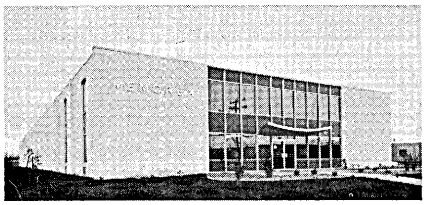
CIRCLE 12 ON READER CARD

# Memorex scientific approach to magnetic tape making benefits users

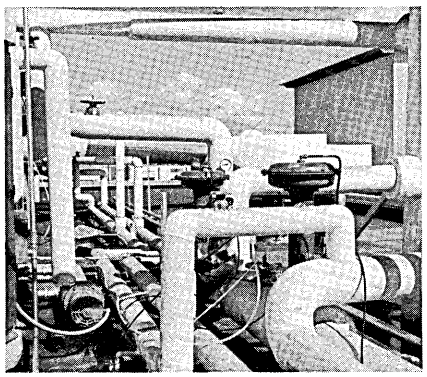
Too frequently, the best available magnetic tapes have not been good enough for many tape users. The reason: lack of consistent quality and reliability — the result of tape-making practiced as an uncertain art.

Memorex approaches tape-making as a science. Manufacturing processes and techniques uncommon in the industry have eliminated the uncertainties in tape-making and their consequent distressing effects. The result: Memorex magnetic tapes not merely incrementally better than products available to date, but materially better in important parameters.

In early 1961, Memorex Corporation undertook to turn the art of tape-making into a science. It put together a team of highly qualified people affording a diversity of talent and breadth of experience unique in the industry. Significantly, the group possesses unusual depth in chemistry, process engineering and automation, as well as in magnetic recording technology and data processing.



*Within the white walls of the plant, which bespeak Memorex emphasis on cleanliness, are the most advanced tape manufacturing facilities in the United States. A conspicuous feature of the plant is its control and elimination of dust and other possible contaminants of production. Extreme emphasis upon freedom from airborne dust particles provides for Memorex tape users a like freedom from incipient drop-outs which could otherwise result from encaptured dust. Memorex uses dust filtration equipment similar to that employed in atomic energy facilities to prevent the escape of radioactive particles. The photo below shows a portion of the complex system of air filtration, humidification, de-humidification, heating, and cooling which provide the special environment for Memorex tape manufacture.*



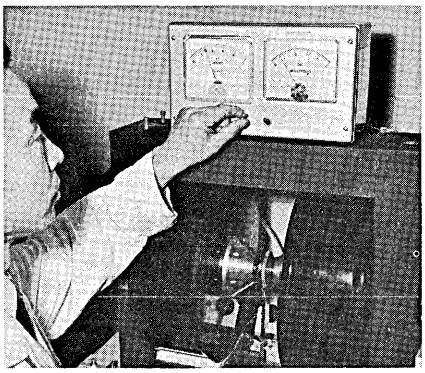
### *Memorex Research*

Acute awareness of tape users' problems is one key to product development at Memorex; deeper understanding of the many parameters of tape is another.

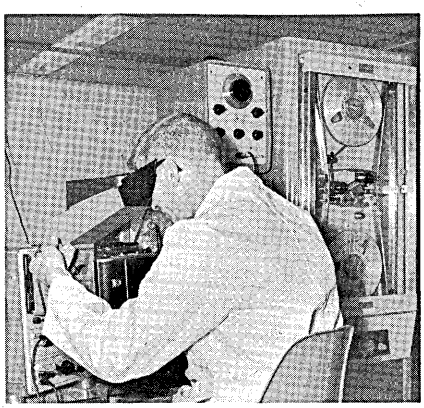
Knowledge of tape users' problems — tape wear, oxide shed, head contamination, head wear, and obtaining better short wavelength performance and pulse response — derives from earlier experience of many Memorex researchers. Working with equipment manufacturers and sophisticated tape users, they obtained insights useful in developing meaningful solutions to many tape problems.

The aim of much Memorex research is to develop vital fundamental knowledge, lack of which continues to limit product improvement in the magnetic tape industry. The research staff has extensively investigated the problem of tape wear and the exact way in which wear influences tape reliability. Basic causes of different types of drop-outs have also been determined. Factors affecting the response at very short wavelengths and high packing densities are under study. Other study areas include the significance of the condition of tape edges and the electrostatic behavior of tape.

To establish a true technological basis for magnetic tape development and improvement, it is also essential to obtain critical measurements of the electrical, chemical, and physical properties of tape. Memorex, therefore, has set up one of the most thorough and accurate testing facilities in the world for tape analysis. It encompasses a number of new tests and techniques, which go well beyond the specifications of the most critical commercial and military users, and it utilizes advanced Memorex-developed test instruments, which achieve a degree of sensitivity and precision otherwise unobtainable.



*An unusual degree of accuracy in measurements on magnetic materials is made possible with the use of a vibrating sample magnetometer, designed by Memorex research engineers. Below, as a part of a durability test which Memorex makes on every production run, a performance check on a digital tape handler provides the permanent photographic record of a computer tape's pulse output.*

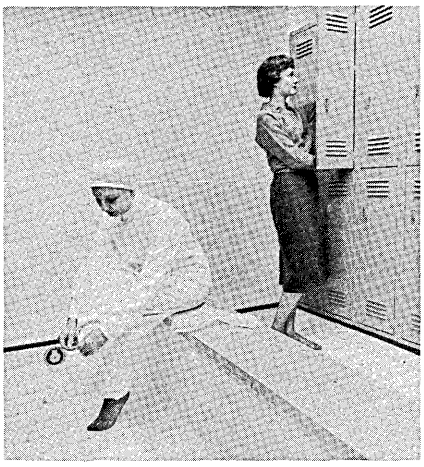


### *Memorex Manufacturing*

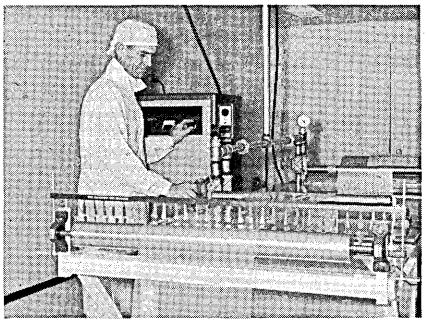
The strength of Memorex manufacturing people derives from their extensive experience in process engineering and chemical and pharmaceutical production. This background has enabled them to obtain for Memorex the consistency and reliability of quality production which is its objective.

Throughout the manufacture of Memorex tape are employed the principles and techniques of automation, production-line monitoring, and process control. As a consequence, you will find extreme consistency in the quality of Memorex tape, both within-a-reel and reel-to-reel. Also borrowed from the pharmaceutical industry are the standards of cleanliness and the techniques of sterile-room manufacturing which help insure consistency and freedom from drop-outs.

The Memorex manufacturing process incorporates many innovations, in the areas of formulation dispersing, treatment of backing material, coating, drying and curing, slitting, and even in packaging. Traditional processing methods were held suspect, not because of any desire to be different, but because innovation was considered essential to overcome quality limitations inherent in commonly used methods.



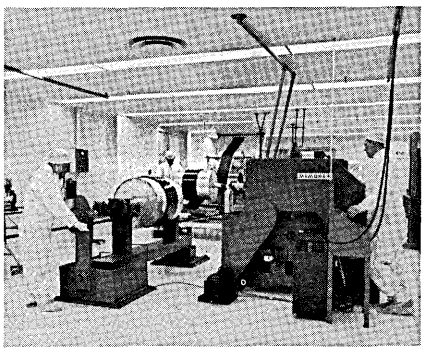
*Access to clean room areas is through change rooms where street dress, jewelry, and cosmetics are removed. Lint-free clothing, caps, and boots are donned from another locker across the barrier-bench. Below, an ultrasonic cleaning system, designed by Memorex engineers, removes foreign matter from film base material prior to coating.*



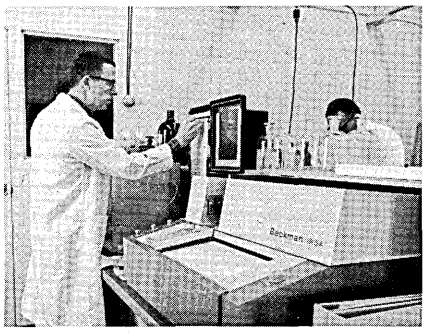
### *Memorex Quality Assurance*

Memorex standards of quality, which exceed the specifications of commercial and military users, are established by its Quality Assurance Laboratory, an independently constituted function which cannot be subjected to delivery schedules and other pressures of a manufacturing operation. The Lab also has the responsibility for continuous audit and enforcement of its standards in the drop-out checking and other quality control activities of manufacturing. At least one tape slit from each production run is comprehensively tested.

It is not necessary for Memorex customers to engage in extensive and costly testing of Memorex products, because of this high order of quality control and this quality assurance philosophy. We conceive it to be our responsibility to know and to certify the quality of Memorex products without reservation. Our warranties reflect our integrity in practicing what we preach.



*Slitting of rolls of the coated web into narrow tape widths is one of the several operations carried out in a completely controlled environment. Below, infra-red spectrophotometer and gas chromatograph analyses are used to monitor the resin binder systems used in coatings.*



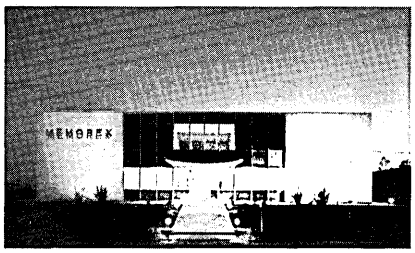
### *Type 22 Computer Tape and Type 33 Instrumentation Tape*

Memorex manufactures only precision magnetic tapes for computers, data acquisition and analysis systems, telemetry and instrumentation recording systems, and exacting audio frequency applications. Memorex precision tapes are now available in widths, lengths, and reel sizes for all commercial tape drives.

Type 22 Computer Tape sets new standards of wear and durability. Users will find Type 22 gives performance comparable to premium tapes at substantial savings.

Type 33 Instrumentation Tape offers performance and cost advantages to analog recording users.

Write for comprehensive specification sheets. Upon request, we shall also send you literature describing Memorex research and manufacturing capabilities.




**MEMOREX CORPORATION**

PRECISION MAGNETIC TAPE

SANTA CLARA, CALIFORNIA

# IF

- *you're weary of matching one assembler instruction per one machine language instruction*
- *you're spending half of your machine time translating compiler programs into machine language programs of questionable efficiency*
- *you're using up time and money with hunt-and-peck machine language debugging and reprogramming*
- *you're tired of seeking, teaching or even becoming a bilingual programmer—fluent in both problem and machine languages*
- *you're fed up with programming methods that are cumbersome, time-consuming and costly*

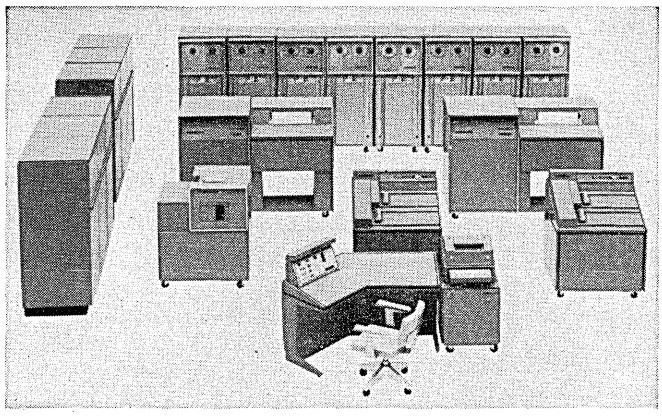
Then, you'll be interested in Burroughs B 5000, a new kind of information processing system which is the result of a total departure from traditional computer design concepts. A system in which *software* dictates equipment designs and specifications to bridge the communication gap between man and machine.

As a problem oriented system, its software capabilities accept ALGOL and COBOL statements directly because its logic matches the logic of problem-language programming. Instead of an instruction-address-instruction-address sequence, there's a continuous flow of instructions with table references when addresses are required. Addresses are independent of instructions.

The system language is designed to implement the problem language for extremely rapid translations allowing program translation each run. Object programs, as efficient as those written in machine language, can be created far faster than with the most advanced conventional computers.

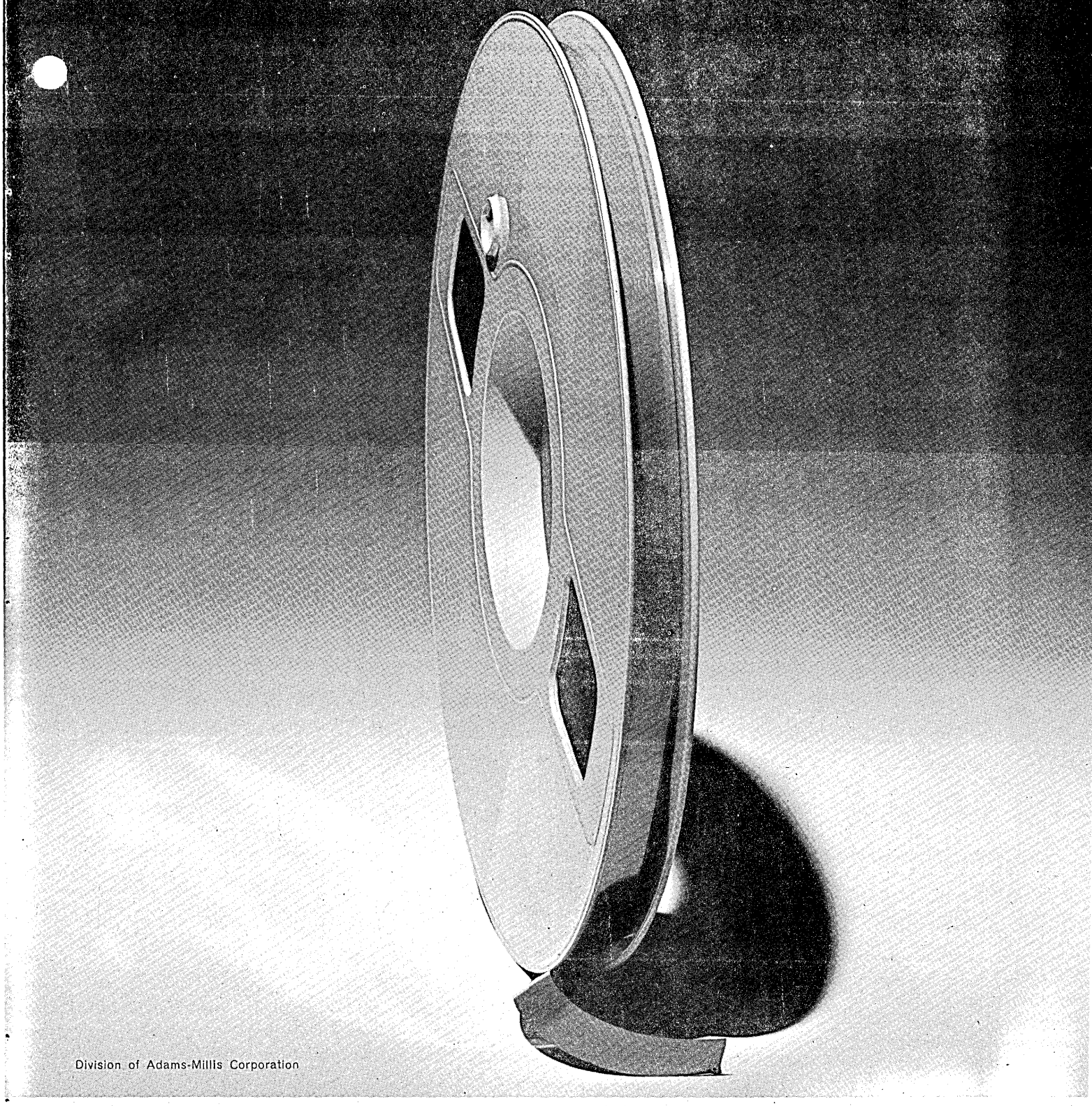
The need for the programmer to know both problem and machine languages is eliminated. Now for the first time, the programmer is free to concentrate on the processing problem itself. Free of the gymnastics he used to employ to make his problem acceptable to the machine, he merely states the problem and the Burroughs B 5000 provides an efficient, rapid solution. Burroughs—TM

*Burroughs Corporation, Detroit 32, Michigan*



**Burroughs Corporation**

# MAC PANEL *computer tape* . . . ASSURED PERFORMANCE



Division of Adams-Millis Corporation

MAC Panel Computer Tape is produced under rigidly controlled, scientific conditions to give you assured tape performance. *Manufactured for Performance* through the use of an improved oxide formulation that insures the presence and retention of the most critical magnetic properties as well as the prime physical characteristics: permanent coating adhesion . . . hard shell toughness . . . and flexibility under all conditions. *Tested for Performance* using procedures that far exceed the normal criterion for attention to detail. Every element in the new oxide formulation is tested before and after blending . . . every reel of tape produced is subjected to thorough tests which insure the quality of MAC Panel Computer Tape. *Packaged for Performance* in clean, dust-proof containers hermetically sealed inside a plastic envelope. This entire unit is shipped to you in a specially designed, shock absorbing package that features a "handy-handle" for carrying convenience. *Write for Free Booklet:* "MAC Panel Computer Tape . . . Assured Performance."

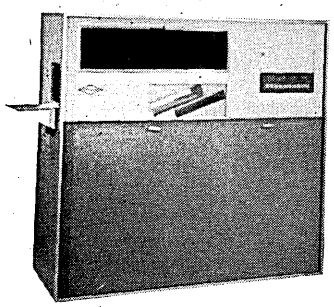
**MAC PANEL COMPANY ■ High Point, North Carolina** MAC PANEL

CIRCLE 15 ON READER CARD

# Send me a machine that can read!

A machine that can read source documents and be on the job everyday. The pile of documents mounts higher and all have to be read and translated into computer language. **PROBLEM:** How to eliminate the input bottleneck and tell the computer *quickly, most economically,* and *100% accurately,* what it must know?

**SOLUTION:** The Farrington Optical Scanner, such as the Model 1P below, the machine that reads pages, up to legal size and translates the data *fast* into computer language: punched cards, punched tape, or magnetic tape. Farrington Optical Scanners are now solving this every-day problem every day for TIME INC., U. S. AIR FORCE, and others.



*for further information, write Farrington Electronics Inc.*

7019 Edsall Road, Alexandria, Virginia

**16 out of every 17 reading machines in use today are by** FARRINGTON®

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Outstanding opportunities for:

APPLIED MATHEMATICIANS

Atomics International offers experienced mathematicians the opportunity to work on the application of computers to complex numerical problems arising from the theoretical study and design of nuclear reactors. Two current openings are described below:

1. To develop large scale nuclear codes as well as the logical integration of existing codes to form nuclear design systems. Must have degree in Mathematics with several years experience in the use of FORTRAN.
2. To develop logical digital programs for analysis of problems in the fields of heat transfer, ballistics and trajectories, chemical kinetics and thermodynamics. An advanced degree in Mathematics is preferred.

U.S. Citizenship required.

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

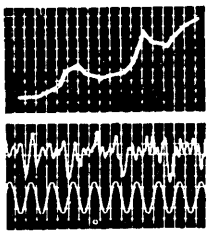
**For specific details write: Mr. H. T. Newton, Personnel Office, Atomics International, 8900 DeSoto Avenue, Canoga Park, California.**

Atomics International

Division of North American Aviation

CIRCLE 79 ON READER CARD





# BUSINESS & SCIENCE

## MID-YEAR: THE STATE OF THE BUSINESS

The economic health of computing's sundry manufacturers may now be given the hindsight of a mid-year look. Contrary to continued prognostication of a major drop-out in the bottom ranks, no one has left the field although some financial bones have been severely rattled.

Meriting principal attention has been the shake-up of top management at RCA, Philco, RemRand, Bendix, Packard Bell, Ramo Wooldridge and Royal McBee. And as of late last month, the turbulence has shown little signs of subsiding (See People in Datamation, page 57).

In most instances sales and rentals have been improving substantially although they are still below expectations. A sharply reduced r&d effort in many quarters has been replaced by even stiffer costs for the softer wearables and expanded marketing efforts. Break-even points are still two years distant, and public acknowledgment of this fact has been increasingly common.

Earlier philosophies of long range investments have been shifted toward more immediate profits from existing hardware. Refinements in peripheral gear have included faster tapes, disc files, and for the main frame, higher speed memories. The coming of third generation equipment appears further removed than ever before with the outlook for true nanosecond hardware pushed as far ahead as late 1964 by many firms.

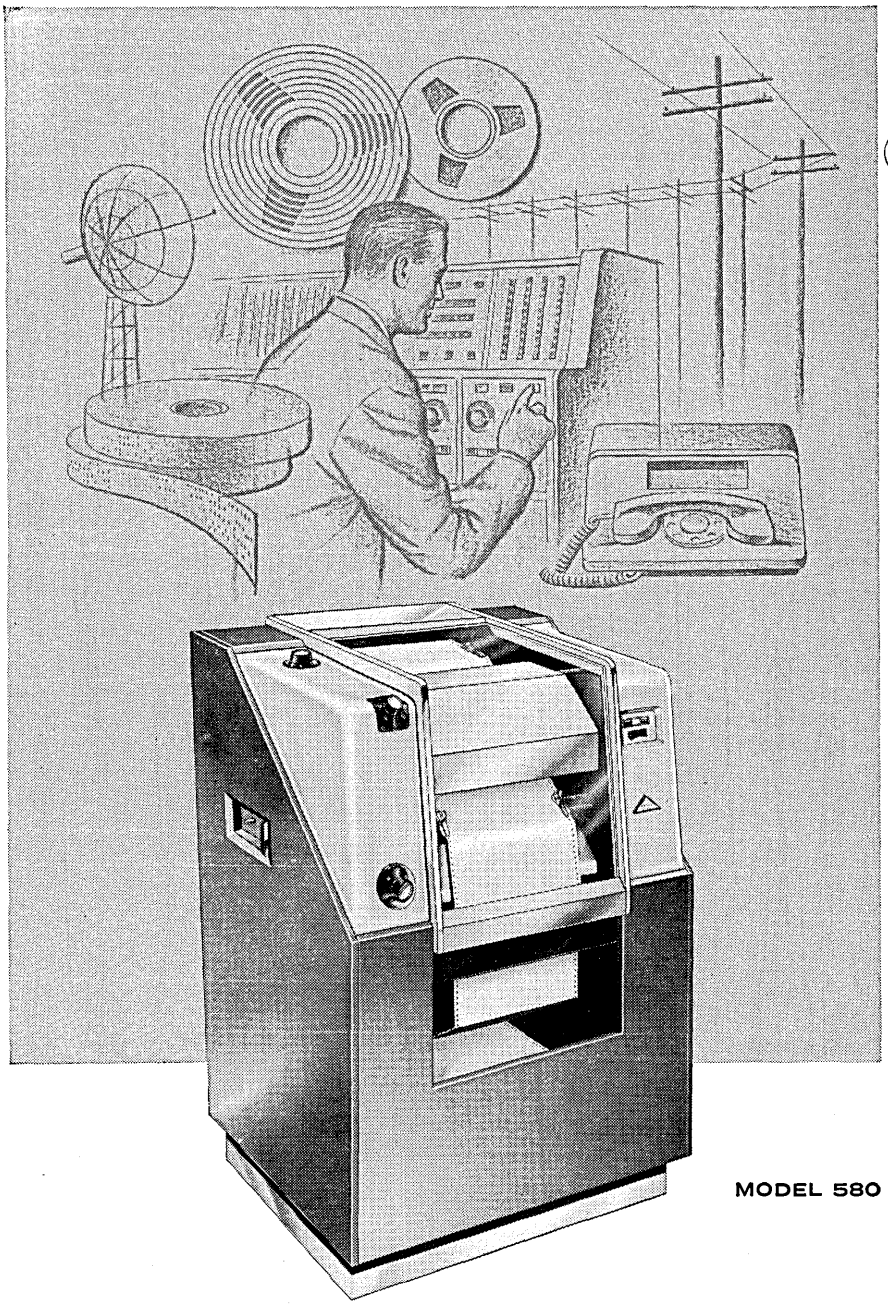
New hardware announced this year included the IBM 7040, 44 and 94; UNIVAC 1004, Honeywell 1800, CDC 3600, and the contributions of newcomers SDS (910,920) and ASI (210,420). While numerically the total is equal to the announcement rate in '60 and '61, the concepts are hardly revolutionary with compatibility to FORTRAN and existing systems as the basic theme of invention.

## THE MONEYMAKERS

By far the most prominent growth pattern in the industry may be viewed in the accession of the computer consultant. Possesed of a variety of faces and comparatively flexible at shifting postures, the range of consultant services is virtually infinite in nature.

It is estimated that gross output for consulting will climb over 78 megabucks this year. Included in this estimate are time sales, programming on and off the shelf, marketing counsel, government contracts for realistic and grande schemes, etc.

Most astonishing is the fact that during the first six months of '62, 114 new consultant firms were an-



MODEL 580

# HIGH SPEED PRINTER SYSTEM FOR COMMERCIAL, "SATELLITE" AND DATA-COMMUNICATIONS USE

Compatible with any computer in "satellite" applications . . . with Bell Telephone's Data-Phone . . . with programmed systems using coaxial cables or microwave transmission. Prints 80 columns at rates up to 1000 lines per minute . . . full alphanumeric character array for civilian use or FIELData code for the Military. Provides all the features and controls of larger Anelex Printer Systems.

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Write for complete Brochure Model 580

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# COMPUTER RESEARCH ENGINEERS & LOGICAL DESIGNERS

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

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

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

These professional assignments involve such R & D areas as:

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

Located in Southern California's Orange County (the nation's fastest growing electronics center), Hughes-Fullerton offers you: a stimulating working environment; private or semi-private offices; long-term stability.

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For complete information on these challenging assignments, call us collect **today!** Ask for:

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CIRCLE 78 ON READER CARD

nounced: 32 in programming, 19 in engineering, and 63 in what may be classed as general purpose infinitum. Financing may vary from an ink blotter and a PO box to several K and a firm contract. Talent may or may not exist in both categories and unfortunately, there are no statistics on the number of deaths.

## THE G.E. MARKET WITHIN A MARKET

The requirements for computing power within the General Electric Co. would probably be sufficient to sustain the growth of a small to moderately sized manufacturer. More than 20-megabucks are expended annually for the rental of over 100 systems. While IBM remains an important supplier to this market within a market with its 1401 and 7090, GE's computer division has established a much firmer base of 210 and 225 sales to the company's other divisions.

At present there are 55 225 installations with 20 of that number internal at GE. A backlog of 90 225s with 26 internal orders provides further indication of the initial success of the machine regardless of its corporate destination.

For the more venerable 210, 50 have been installed with only two machines within GE. Twenty 210s are on order with one scheduled for internal use.

## CDC SURVIVES A RUGGED WINTER

Despite one of the midwest's fiercest winters, Minneapolis' Control Data Corp. managed to survive and has thawed out to the tune of 123 new installations of the 160/160A within the last eight months. The total now stands at 195 machines on the air with a production rate for the 160A of 3.5 per day. Fifty-five orders are reported.

As for the large scale 1604, 36 machines are on the air, an increase of 11 since the first of the year or an average of almost two produced per month. There are 12 1604 orders in the house and one for the 3600. Livermore's order for the super-scale 6600 is reported as firm.

## RCA READIES 301 SCIENTIFIC

The engineering sores are presently in the healing stage on RCA's large scale 601 which is scheduled for internal operation and display next month at Cherry Hill. On the lower scale of the scientific market, RCA has entered the stiffening competition with fixed and floating point options for its 301. Models 354 and 355 processors will be offered with 20 and 40K characters of core memory and will be dubbed the 301 Scientific.

Parameters for the new system may be indicated by its ability to perform 6K separate floating point additions or subtractions per second and 2K multiplications or divisions per second. A basic system including paper tape I/O and monitor printer rents for $4,495 per month.

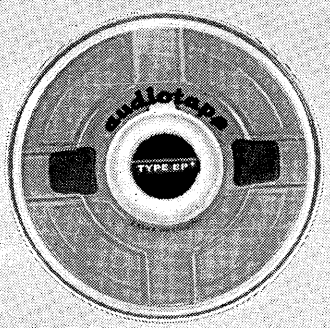
For software, RCA is offering UMAC, a FORTRAN-like compiler from the University of Miami.

At present, RCA has 330 orders for the 301 system with about 125 of that number for overseas commitments with Bull of France (50), ICT of England (50), and Hitachi of Japan (25). There are 77 501 installations with 8 orders in the house.

# WHAT GOES INTO A SUPERIOR COMPUTER TAPE?

Many things, tangible and intangible, go into the making of EP Computer Audiotape. On the tangible side, only the finest materials and equipment—meticulously selected and constantly tested—are used in producing this extra precision computer tape. In addition, every reel is 100% checked on specially-designed Automatic Certifiers to insure that each of the 112 million test pulses (161 million on high density tapes) reproduce properly . . . Less tangible but just as important are our years of experience in this exacting field. Experience that tells you Extra Precision Computer Audiotape consistently lives up to its name. Once you try this superior computer tape, we're certain that you'll agree.

**EP COMPUTER AUDIOTAPE / AUDIO DEVICES INC., 444 MADISON AVE., N. Y.**




CIRCLE 18 ON READER CARD

(Advertisement)

# Computer Maker Challenges Cliché

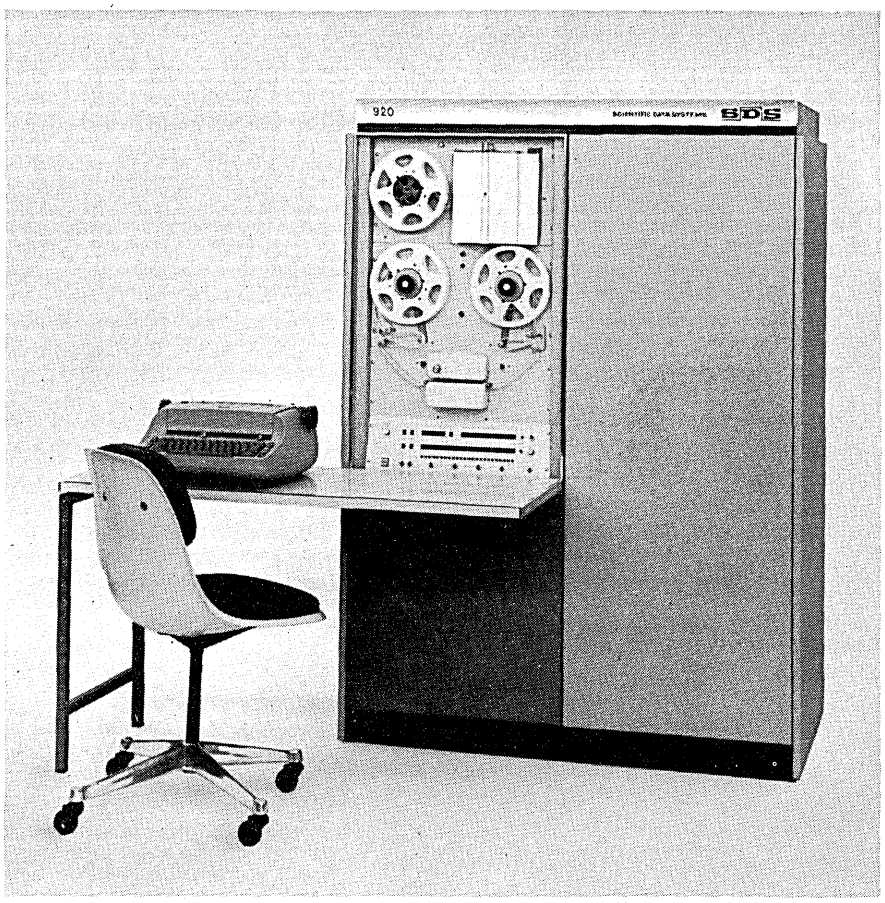
Los Angeles — "There haven't been any really new small digital computers for general purpose use since those conceived around 1953-54," according to Max Palevsky, President of Scientific Data Systems, Inc. "Because small computer technology has remained static relative to the rapid evolution of large-scale computers, an erroneous cliché — that the cost per computed answer is inversely proportional to the size of the computer — has become widespread."

PALEVSKY

Palevsky continued, "Our new 900 Series prove that small computers can be extremely economical in both original cost and in operation. They are the only small G.P.'s in which an extensive input/output system has been integrated into the basic design. This allows us to take advantage of a high speed arithmetic unit without requiring extensive coupling units for peripheral equipment. Further, unlike other small computers, the 900 Series is easy to program. And, we have a complete software package."

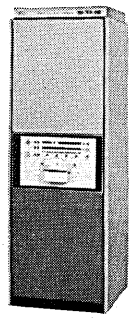
**$82,000 combination.** To emphasize the low cost of an SDS installation, Palevsky pointed out that, "SDS can provide a complete core memory computer with a 16 microsecond, 24-bit add time — including all access and indexing — together with two 15 kc IBM compatible magnetic tape units and IBM compatible FORTRAN II, for only $82,000.

**Other features revealed.** Palevsky reported that the new SDS computers utilize silicon semiconductors for wide operating temperatures and increased reliability. Buffered input/output rates exceed 50,000 characters/second and a built-in memory interlace operates at rates up to 200,000 characters/second. An SDS innovation, called "programmed operator," allows complete program interchangeability between all models of SDS 900 Series computers.




# cost carver

**The new SDS 920 General Purpose, Solid State Digital Computer** cuts both the original cost and the operating costs of scientific/engineering computation and systems integration. It has all the speed (16 μsec. add — 32 μsec. multiply) and operating features found only in much more expensive equipment. This single address, core memory computer has five distinct built-in input/output systems, including a high speed buffer. A comprehensive software package, including FORTRAN II with magnetic tape statements is available. The 920 is priced at only $89,000.



**The SDS 910, a smaller computer,** costs only $41,000 (half the price of comparable machines) yet shares the principal features of the 920. The 910 is designed for on-line control and real time systems work, as well as general purpose computing.

**The SDS 910 and 920 computers and their optional peripheral equipment are described in the SDS 900 Series brochure. Request your copy today.**

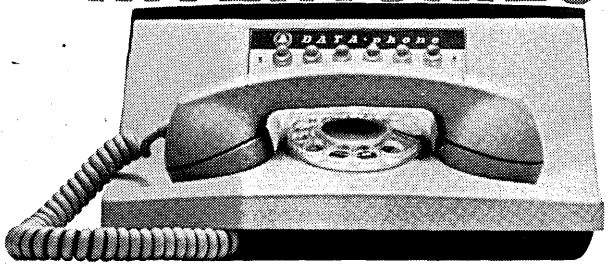
SCIENTIFIC DATA SYSTEMS

SDS

1542 FIFTEENTH STREET • SANTA MONICA, CALIFORNIA

CIRCLE 19 ON READER CARD

# PAYROLLS
# INVOICES
# RESERVATIONS
# ORDERS
# SCHEDULES
# REPORTS
# PRODUCTION
# MINUTES
# TICKETS
# PURCHASING
# TELEMETERING
# ACCOUNTING
# SALES DATA
# INVENTORIES




## SEND IT ALL BY TELEPHONE.

Data processing has a new dimension. It's called DATA-PHONE service. It lets business machines talk over regular telephone lines... at regular telephone rates... and at great speeds.

It means you can transmit operating data of all kinds between your headquarters and outlying addresses in a fraction of the time it takes you now.

Call your Bell Telephone Business Office and ask for one of our Communications Consultants. He'll study your operation, then tell you how this new service can work efficiently and profitably for you.

BELL TELEPHONE SYSTEM

CIRCLE 20 ON READER CARD

# EDITOR'S READOUT

## FODDER AT THE WATER COOLER

After being plagued for years with "electronic brain"-type feature articles, it has been a welcome relief to see a few responsible media emerge from the sensational, headline-grabbing stage to the presentation of the important facets of computing.

There still remains, unforunately, several sore spots one of which is the quality of reporting (or lack) at computer conferences and other computer-related professional meetings.

While these conferences do not provide all the material for the public press during the course of a year, the surface implications drawn from the technical sessions do provide fodder for many of the irresponsible articles which endure until the next conference, whereupon new grist is is processed through the mill.

At the recent SJCC, members of the public relations committee did their best to answer questions posed to them by the local press, and attempted to place the contents of the technical sessions at the layman's level. All was for naught, as the usual claptrap about computers that think and decimation of the work force, appeared in print. The least said about the press's treatment of the subject of cryogenics the better, but it provided the basis for this gem which appeared in Herb Caen's column, a widely-read San Francisco observer:

*"Computers have been big-big-BIG in the news the past few days. There are computers that work more efficiently in the cold. Others like warm weather and stand around the water cooler with their buddies, talking about a trip to the Caribbean . . ."*

Surely, there was nothing in the information provided by the Conference's public relations staff that would prompt such nonsense. Or was there? Public relations as practiced today is a highly-skilled profession, best left in the hands of those who are adept in the art of influencing public opinion and when possible, also versed in the computing sciences. Amateurs who attempt to deal with the press on technical matters often find their well-intentioned remarks painfully backfiring.

There is an answer to this problem. Many business, labor and professional organizations maintain full-time public relations staffs, as employees of the particular group. As for the computer industry, the absence of such a facility has proven to be a serious handicap, leaving the accurate presentation of data processing information much to chance and part time, uninformed counsel.

It was suggested in DATAMATION about a year ago that to combat irresponsible reporting, computer people should abstain from any interviews or furnish information to representatives of some of the mass-circulation publications that have consistently demonstrated their irresponsibility. Whether this self-imposed censorship has worked to any great extent is a matter of conjecture. Too often, refusing to "cooperate" with the press can be as harmful as being misquoted. If the reporter cannot get his information, he must either use previously printed material, or rely on his imagination. It boils down to a case of "heads I win, tails you lose."

AFIPS, as the national voice for information processing, should take it upon itself to provide competent, authoritative communications with the press. This can best be accomplished through the means of a full-time, experienced public relations staff, whose only function would be to provide objective information, devoid of any intra-industry partisanship.

In the area of public enlightenment, where adequate communication

from the sacrosanct world of computing to "outsiders" has been sadly wanting in the past, a multi-level national education program would be an influential tool in helping to shape the public's view of data processing to achieve a more positive form.

The scope of activities might be organized along the following lines:

- A Speakers Bureau should be organized on a national basis with regional and local offices where industry spokesmen would be available to address business and professional groups, civic and fraternal organizations, and students at high schools and universities.
- Educational material should be provided to schools and libraries, including bibliographies on various aspects of computing, and audio/visual aids.
- Seminars should be conducted in data processing, similar to the special sessions held at the SJCC, which would discuss both the basics of computing and specific applications. Programs of this nature could be directed toward business and professional societies, local newspapers and radio and TV outlets.
- Courses should be sponsored in high schools and adult education centers, with provision for counselling services for students interested in pursuing a career in computing.
- Exhibits should be prepared for libraries, including a selected list of books and periodicals, and exhibits for trade fairs and business shows.

These projects are hardly alien to AFIPS The awareness that a problem exists is evident in the organization's charter, which, in a similar fashion, sets forth these goals. All that remains, it appears, is the means for implementation. If apathy stands in the way of a voluntary participation and solicitation of funds, then conscience-examination should be encouraged on an industry-wide scale.

The primary member organizations within AFIPS: ACM, AIEE, and IRE, should however, provide the impetus and firmly establish the groundwork for the senior body. All of these groups and their local chapters have expended some effort in this direction but at present, accomplishments are largely uncoordinated and lacking in direction and vigor.

Without a definitive, forceful public information and education program, data processing will continue to remain obscured behind a cloud of half-truths and awe-inspiring mystery, detrimental to both the industry and the people who are devoted to their profession. ■

# 16 U. S. PAPERS SET FOR IFIP CONGRESS

## 4,000 delegates to attend

Sixteen papers by American authors will be presented at the six-day meeting of the IFIP Congress 62, which will convene on August 27 and continue through September 1. In addition, seven symposia will be conducted by American participants.

Nearly 4,000 delegates from 21 countries are expected to attend the Congress, which consists of three main areas of interest: the Scientific Program, IFIP Interdata, and Plant Tours.

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

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

Sixteen American firms will be among the exhibitors: Ampex International; Beckman Instruments; Bureau of National Affairs; Control Data; Datamation; Electronic Engineers International; Friden; Hewlett-Packard; Honeywell; IBM; ITT; National Cash Register; Potter Instrument; UNIVAC; and Telex Inc., Data Systems Division.

Five plant tours will be held for limited groups, during and following the Congress. There will be no charge for the tours, and transportation will be provided by the firms conducting the visitations. Tour participants, however, will pay for their own food and lodging. Applications for the plant tours must be made when registering for the Congress, and will be consdered in order of receipt. ■

# THE LAW & THE COMPUTER

## a cautious flirtation

by IRWIN SCHORR, Assistant Editor

"The legal profession has had previous flirtations with psychologists and sociologists, and now the computing sciences. The first two did not contribute anything of great value, and I don't think the last named will do much better."

This strongly-worded opinion was handed down by Richard C. Maxwell, Dean of the Law School, University of California, Los Angeles, at the second National Law and Electronics Conference, held recently at Lake Arrowhead, California.

Dean Maxwell's skepticism was a reflection of the attitude shared by some of his colleagues toward the recognition of data processing as a potential tool to aid the legal profession. These pockets of resistance tend to point out that the only position the law has taken toward computing has been isolated attempts to improve information retrieval techniques.

This rejection of the computing art is not manifest throughout the law, however, as there are some members of the legal profession who have assumed a more open-minded view toward computing. However, even this faction's outlook tends to be clouded by a "let's wait and see, and we shouldn't run into this blind" type of conviction.

Taking strong exception to this stand is a recently-formed group, the "Special Committee on Automation of the Los Angeles Superior Court," which will attempt to determine whether computers can assist in the "improvement of administration of justice."

Although regional in nature, the committee's work will have national implications, as it is the first serious move by any group toward investigating possible application of computers in the legal profession.

In specific terms, the committee will "examine the workings of the court to see what, if any, benefits could be achieved in economy, efficiency, improved judicial performance, behavioral science research or other areas by the use of information processing systems and equipment in recording, storing, and searching the data collected by the court."

The committee is comprised of seven judges from the Los Angeles Superior Court, Eldridge Adams, System Development Corp., and Professor Edgar A. Jones, of the UCLA Law School. Judge Richard F. C. Hayden is chairman.

When the committee arrives at concrete recommendations, the suggested program will be presented to the 120 judges of the Superior Court. If the program is approved, funds will be allocated by SDC to follow-up the recommendations.

The two-day Conference, jointly sponsored by UCLA and SDC, attracted nearly 100 attendees, including jurists, practicing attorneys, deans of law schools, professors of law, and information processing specialists.

SDC's Tom Rowan, co-chairman of the Conference, along with Professor Jones, stated that the acceptance of computing by the law parallels that of medicine. Both professions, he said, have a "public trust," but deeply ingrained is the suspicion of "people who bring in solutions from outside the legal and medical professions."

"We have shown, however," he added, "that data processing would relieve the medical profession of much of its routine work. We want to illustrate the same thing to lawyers."

Although the American Bar Association has had a long-standing committee to study information retrieval, Rowan noted that "the Superior Court's committee is the first formal effort by both 'sides' to do something."

One of the objectives of the Law and Electronics Conference is to increase the awareness of data processing's inherent benefits as could be applied in the legal field, said Rowan. "You'll notice that one-third of the people at this Conference are law professors. This is one way of getting the awareness to law students, who will be our future attorneys and judges."

The problems confronting the law's acceptance of computing are numerous, Prof. Jones pointed out, but perhaps one of the most serious is the "juke box complex." Legal practitioners have a distorted view of computing, which frustrates any potential understanding. "The committee we have formed intends to break through this caricature," he said.

In discussing the implications of information retrieval to the preservation of a free society, Carl F. Stover, Center for the Study of Democratic Institutions, was fearful that due to a greater accessibility of information, the technological unemployment of law clerks was foreseeable.

He admitted that the use of data processing might show gaps and inconsistencies in legislation and might lead to rewriting the law and eventual law reform, but "the law has to consider whether electronic refinement is for its benefit. To use a computer, one has to think like a computer. Electronic systems may qualify the mediocre and

discourage thinking, caused by following set routines."

Stover predicted that the ultimate subjugation of law by technology will be decision by computer. Therefore, "law and members of the law must insure that the technology will serve good ends."

Rising in defense of data processing was Roy Freed, practicing attorney from Philadelphia, and a well-known advocate of computing in the law field. He said that a careful study of computing feasibility is overdue. The study should show how a data processing system could operate practically and economically, and could stand on its own feet. He admitted that a dp system is expensive, and therefore fees for services must cover expenses at the very least, plus provide a profit to the user.

George W. Brown, Professor of Business Administration and Professor of Engineering, UCLA, and Director of the Western Data Processing Center, traced "where computing has been, where we are now, and where we're going."

Brown said there are "standard fears" about computing, one of which is that people concerned with substance are fearful that programmers will make all the decisions. "This is ridiculous – and a bad lack of understanding. The head of the computing department should not report directly to the president or the chairman of the board, any more than the switchboard operator should. The ultimate responsibility for analysis and decision making has to rest with the user."

While information retrieval is the most obvious utilization of computers, Brown acknowledged that the technique is far from simple, and one outstanding problem that exists is the lack of an IR theory.

In enumerating the benefits computers can provide in the legal field, Eldridge Adams, SDC, said that clerical tasks will be made easier; less fatigue in legal library research will lead to error reduction; and an aura of detachment will be attained, eliminating emotional involvement.

Using the computer will provide certain benefits at various levels of judgment, he said, and when coupled with the users' abilities by means of appropriate development, creative abilities will be extended.

An experiment in applying mathematics and computers to law was described by Reed C. Lawlor, chairman of the American Bar Association's Data Retrieval Committee. Lawlor developed a mathematical model, using Boolean algebra, to predict future decisions of the U.S. Supreme Court. His model was based on the past decisions of the Supreme Court justices in ruling on 39 cases.

The research, said Lawlor, was an example of how lawyers can use mathematics which computers can use. He urged the legal profession to give computer people a chance to be of assistance, and added that because "you don't know how a problem can be solved, it doesn't mean the problem is insolvable."

In discussing Lawlor's presentation, William Cohen, Professor of Law, UCLA, said that the research had some merits, possibly in helping lawyers, and judges in lower courts, to gain some insight on how higher courts might decide on a case. Dissenting was Vern Countryman, Dean, School of Law, University of New Mexico, who said that Lawlor didn't take into account the justices' previous opinions on similar cases which were not included in the 39 cases used in the model. Both discussants agreed that any model must be consistent.

A third participant, Victor H. Yngve, MIT, asked the conference to consider four aspects of Lawlor's work: 1. The use of scientific methods in a legal question. 2. The use of a computer in a legal question. 3. The prediction of decisions. 4. The method of prediction.

He said he had no quarrel with Lawlor's approach, but added that one must use scientific accuracy if a scientific method is to be used. Yngve stressed that Lawlor's work should be taken as an example, rather than as a proven scientific method.

Progress reports on information retrieval projects were presented by John Horty, Health Law Center, University of Pittsburgh; Robert A. Wilson, Southwestern Legal Foundation, Southern Methodist University, Dallas; and Robert T. Morgan, Assistant Professor of Business Law, Oklahoma State University.

Horty reported that his group had prepared a list of 112 "common words," using natural text, with no indexing, before the information was placed in memory. Input was from Flexowriter tape with conversion to punched cards.

The full text material was sorted, and each word given a location. The output on mag tape consisted of full text of relevant sections, and was printed out.

Material on tape now includes the Pennsylvania statutes, representing a total of 611,000 cards containing 6 million words, broken down into 31,000 sections. Other projects at the Health Law Center will cover the health statutes of 15 states; New Jersey Rules, Court Rules, and Constitution; and rulings of the Pennsylvania Attorney General.

The program developed by the Southwestern Legal Foundation, said Wilson, is a system for computer storage and retrieval of lengthy technical documents, such as legal precedents and articles in technical publications. The system is characterized by full text English language input and output.

Walter E. Craig, American Bar Assn., Phoenix; Felix F. Stumpf, University of California, Berkeley; Reed C. Lawlor, Chairman, ABA Special Committee on Data Retrieval.

A dual indexing system, comprising two reciprocally coordinated mag tape files – a master word file and a root index file – permits, if desired, a word-by-word machine search through the natural text of documents retrieved by a preliminary machine search. It also permits ease of entering new documents into the system at frequent intervals, and eliminates the need for synthetic search terms, or for digesting, coding or editing of documents before coding.

Wilson said that "it isn't a question of whether we want to go into modern data processing techniques – we have to develop a high-speed system to meet the needs of clients for fast answers to complex legal questions. The computer gives us the ability to animate an index and make it move, and it also gives us the power to search with many index terms simultaneously."

The two factors, he said, "allow us to make each search

on our individual needs, rather than on the restrictions of a printed index; the computer index conforms to us, rather than we to the index."

One of the projects at Oklahoma, said Morgan, was to put all the words of the recently-adopted Uniform Commercial Code on punched cards, which required, when finished, over 10,000 cards. The language of the old Oklahoma law will be compared with the new law, to see whether it is really new or merely a rewritten version of the previous legislation.

Another IR project centered around portions of the gift tax code and regulations, in addition to 18 cases decided under the law. Morgan said that a system called "Point of Law" is used. This approach to electronic legal research "is one in a series of systems attempting to develop an accurate, fast and economical method of searching legal literature. The fact that one-tenth of the entire body of Federal gift tax case law, plus all appropriate regulations and code sections in the area of Federal gift taxation, can be searched, selected and printed out in approximately two minutes, makes the computer a very desireable tool for legal research."

From the standpoint of the jurist, some of the most pressing problems are those involved in establishing accessibility to trial court data. These problems, reported Judge Hayden to the Conference, are generated by the "staggering" numbers of words and figures on paper which are the output of "courts of record."

Four types of data are maintained: a case file; an index to all cases by the names of the parties; a docket, which lists all court transactions; and a minute book, comparable to the journal in an accounting system.

Don Madden, Director of Information Processing, SDC; Robert Kingsley, Dean, School of Law, University of Southern California; Richard C. Maxwell, Dean, School of Law, UCLA.

Said Judge Hayden: "I would not venture to guess as to the number of millions of words that are preserved by our (Los Angeles) County Clerk nor as to the number of new words added to his store every day."

In order to obtain information about a specific case, if the name and number are known, about 20 minutes are involved in walking, searching docket volumes and waiting at file counters. To be certain of each court action, nearly an hour might be spent in hunting through minute books.

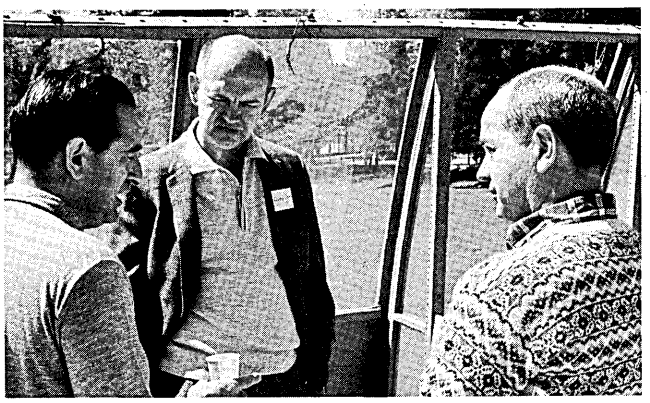
This, he pointed out, is a typical access time to the records of a particular case when the full address (case number) is known. It may be half again as long if only one party is known. However, if the names of one or more parties, or the file number is not known there is *no* way to get access to the file. It does not help if the court personnel and attorneys are known, or where the accident happened, or what the lawsuit was about. "Unless I find someone who can say, 'Oh yes, that was Smith vs. Jones,' I will never find the file or its contents."

Material presently being collected by the trial court could be indexed on a variety of different dimensions, Judge Hayden explained. For instance, in addition to the individual parties to litigation, the names of witnesses, attorneys, jurors, the judges, receivers, executors, and any other name which appeared in the file could be indexed. Similarly, an index by types of persons could be maintained.

"It would be interesting to know," he said, "some of the characteristics of the parties to litigation, and certainly of jurors, and there might well be similar areas of interest relating to witnesses, lawyers and judges.

He cited the example of the Probate Court of St. Louis County, Missouri, which is presently making all minute entries by pre-punched cards, and are coded to punch out, not only the text of the minute order, but the fee involved in that proceeding. The purpose for which they have adopted this practice is primarily an accounting one, but it would appear, said Judge Hayden, that it problably simplifies the clerk's function, if anything. "Manifestly, if this aggregate detail can be placed in machine readable form, virtually every step of the court's activities could be made accessible."

One of the possible products of such accessibility could be information about the individual members of a jury panel. The court itself could collect this kind of information automatically if it recorded in machine readable form the names of trial jurors on cases. These jury "books" typically contain a small amount of background information on the individual juries, and a record of the cases on which they have acted; occasionally, they contain specific items of information which have come to the attention of the lawyers which tend to disclose a specific bias.



Myron Tribus, Dean, Thayer School of Engineering, Dartmouth College; Quentin Ogren, Professor of Law, Loyola University, Los Angeles; Richard F. C. Hayden, Judge, Los Angeles Superior Court.

If the desirability of a jury "book" is assumed, there might be an equal need for a judge's "book." It is impossible for any attorney to have detailed knowledge from first-hand experience about each of the 120 judges who regularly sit in Superior Court, and some estimation of how a judge would be likely to perform in a given case can be made with equal reliability based on years of recorded performance as can be done for a juror based on only a handful of trials.

Many courts keep records of the productivity of the individual judges, and this could be done in much more detailed fashion and with greater ease by data processing

procedures. One benefit would be that it might be possible to evaluate the effectiveness of individual judges in particular kinds of proceedings, such as pretrial.

But if the individual judges are to be revealed in the light of subsequent analysis, is it not equally fair that attorneys be similarly treated? Judge Hayden asked. Conceivably, the statistical analysis of the judgments obtained by individual lawyers might destroy some now impressive representations. By being able to get access to the files in which an opposing counsel had been involved, an attorney might be able to obtain some valuable insights as to the likely strategy of his opponent.

One important court record is the shorthand report of the courtroom proceedings. In typical cases, the reporter does not transcribe the words he has recorded except on special order of one or both of the attorneys, and more often than not, this is only after the case is concluded for the purpose of appeal.

There are, however, instances when because of the complexity of the case, the attorneys will order a daily transcript, which involves the reporters working in shifts and delivering a typed copy of the transcript to the attorneys on the evening of the day the hearing is held.

The use of a Flexowriter, or similar tape-producing typewriter would enable the generation of machine-readable tapes of the words spoken in the courtroom. It should then be possible to produce by suitable programs a machine generated index to the transcript.

While there are other benefits which might be derived from increasing the accessibility to trial court data, the problems involved in attaining these benefits could be divided into two parts: one, the problems to be solved in order to establish accessibility, and two, the problems created by establishing accessibility.

Although the costs of machine-readable court records would be substantial, said Judge Hayden, and as with most newly-created processing systems, the choice would be whether to incorporate old records into the new system or simply pick an arbitrary date and start with new material only. The latter choice would be cheaper but it injects the problem that the indexing and similar research would have to be conducted by two different methods.

The question of security of information presents itself in at least two possible forms, he said. The first is the question of making available for analysis records which are treated by the court as confidential, such as Juvenile Court records, adopton records and Conciliation Court records.

The second problem is the question of to whom should statistical studies growing out of non-confidential data be revealed. Clearly, studies which result in comparison of individuals, whether they be lawyers or judges or other, "are susceptible to invidious interpretation and some standards would have to be established with respect to both of these problems. There is always a problem of any public agency maintaining confidential its internal administrative analysis."

There are certain limiting conditions which complicate the problem of establishing accessibility to trial court data. One is the establishment and production of techniques for the exploitation of the data. For instance, the program for generating the value of a personal injury case in advance of trial is at present an unsolved problem, and similarly the development of the daily transcript has not yet been accomplished.

A problem created by too great accessibility to trial court records is that of the invasion of the privacy of the individual. At the present time, although court records are normally public and available for examination, the cumbersomeness of searching them affords a great deal of privacy to persons whose names appear in the court records so that after awhile, one's court activities become almost confidential. "There is a serious question in my mind as we approach 1984 to what extent we wish to fulfill Mr. Orwell's predictions."

A related problem is the question of to what extent would the conduct of the participants in the judicial process be affected by their knowledge that their conduct was being analyzed. Asked Judge Hayden: "Would judges change their conduct in the management of the trial and in their giving of judgment if they knew that their performance was being accumulated and compared to that of other judges?

"Similarly, if the 'jury value' of a case were known, what effect would this have on the conduct of a judge trying the case without the jury? Would he be tempted to abdicate to a machine in the interest of uniformity? I suspect that there would be some tendancy in this direction on the part of at least some of the judges."

There is also the problem of too much information. If the record were readily available in tape form and each attorney could have a copy of the tape for the simple cost of machine duplicating, it's conceivable that this burden would be placed on attorneys in virtually every case that extended over a number of days.

Judge Hayden said he felt that the problems seem either solvable or manageable and "certainly the list of possible benefits cannot be considered to be either complete or reliable in the absence of much more detailed studies of the actual court situation in a given court. It is for this reason that I look forward with enthusiasm to seeing the results of the initial survey to be conducted in the Los Angeles Superior Court."

Maurice Rosenberg, Professor of Law, Columbia University, in a review of the Conference activities, noted that missionary work was needed to make known computer technology, as a means of aiding the law in knowledge gathering. In this light, he suggested that the goal of law and the goal of computing should be matched in order to reach reasoned judgments for the common good.

He cautioned, however, that "we need restraint as we play with 'dangerous' tools as a guard against displacing thought and conscience."

As for the conference itself – "we should move the ball a yard at a time—and not try to run for a touchdown every time we get the ball." ■

A partial list of the conference attendees includes Arnold I. Dumey, Data Sciences, Inc., Great Neck, N.Y.; Alfred C. Emery, Dean, College of Law, University of Utah; Vernon W. Hunt, Judge of Municipal Court, Los Angeles; J. D. Madden, System Development Corp.; Richard C. Maxwell, Dean, School of Law, UCLA; Philbrick McCoy, Judge, the Superior Court, Los Angeles; Mrs. Jessica S. Melton, Center for Documentation and Communication Research, Western Reserve University; Joseph O'Mera, Dean, Notre Dame Law School; Martin Shubik, Thomas J. Watson Research Center, Yorktown Heights, N.Y.; Frank R. Strong, Dean, College of Law, Ohio State University; Charles B. Tompkins, Professor of Mathematics and Director, Computer Facility, UCLA; Myron Tribus, Dean, Thayer School of Engineering, Dartmouth College; Heinz Von Foerster, Professor of Electrical Engineering, University of Illinois, and Mrs. Helen L. Brownson, Program Director of Documentation Research, Office of Science Information Services, National Science Foundation.

# A SURVEY OF COMPUTER FACILITY MANAGEMENT

**30 Southern California users interviewed in depth**

by CHARLES M. LAWSON, System Development Corporation, Santa Monica, California

Few will argue the point that the electronic digital computer is one of the most sophisticated tools, if not the prime tool employed in business management today. A fair estimate places about 8,000 such computers in use throughout the United States, with a reasonable forecast of growth to some 15,000 by 1965. The market value of the hardware alone is upward of 2 billion dollars, and many millions are paid out monthly by industry for rental service. This is indeed big business.

To properly focus on the management of these installations, the System Development Corp. of Santa Monica, California, recently undertook a survey pertaining to computing practices. Its purpose was to gather data in order to develop some yardsticks for comparison and self-evaluation.

The survey was conducted by the personal interview technique. This in itself raised the age-old problem of communication and interpretation, and as proved to be the case, enough difference in terminology existed to rule out the possibility of the survey being conducted by mail, telephone, or any other medium.

Furthermore, the job was the responsibility of one investigator, and thus presented some limiting factors. It was to be confined to the Southern California area. Although geographically limited, the quality, rather than quantity, approach was adopted.

### designing and testing the questionnaire

The questionnaire set was developed by an iterative process. Each category was designed to provide responses germane to a general area of concern, with specific questions therein. Many of them called for a "Yes—No" type of answer such as: "DO YOU HAVE ANY RECIPROCAL OR MUTUAL ASSISTANCE COMPUTER USE AGREEMENT WITH ANY OTHER COMPANY?" Others were seeking quantitative data. As an example, "HOW MANY PERSONNEL ARE EMPLOYED IN THE COMPUTING FACILITY?" Also posed were ten topics soliciting opinions on subjects of current interest, "WHAT METHODS DO YOU USE TO KEEP UP WITH AND EVALUATE NEW COMPUTING EQUIPMENT?"

Altogether 120 questions were drafted, captioned by the following eleven categories:

General Specifications, Selection of the Computer, Personnel Roster, Personnel Selection, Personnel Opportunity, Computer Usage, Computer Services, Operational Procedures, Control Procedures, Systems Procedures, and Management Observations and Opinions.

Before proceeding into the field, the questions were sample-tested in the home office. This afforded an opportunity to gauge the length of time needed for each interview (which turned out to be three hours) and to clarify as much as possible the ambiguities which were bound to exist with terminology and question intent.

### sample and component classifications

In addition to the major category breakdown, the survey incorporated two other control features. For management purposes it seemed appropriate to sub-divide answers by types of facility (Scientific or Business) and by size of primary computer (Large or Medium).

Of the thirty respondents, 14 classified themselves as a Scientific EDPM facility, 12 as a Business data processing facility, and four as included in both categories.

Several installations reported more than one type of pri-

mary computer, in which case a choice was made at the beginning of the interview as to what machine would be considered "primary" in the interest of the survey.

### the participants and their EDPM

Reaching from Los Angeles into industrial San Diego, the thirty participating firms included major aircraft and missile manufacturers, petroleum producers and distributors, insurance and title companies, banking institutions, and educational centers.

Each industry was contacted ahead of time and made aware of the nature of the Computing Facility Management Survey. Throughout the entire investigation, answers were recorded to 96 percent of all questions asked. The 4 percent represented questions which were not applicable or for which data was not available. Of those individuals interviewed, 80 percent held positions of managerial rank wherein all aspects of the computing complex – normally consisting of systems, programming and computing operations – reported directly to them. The remaining 20 percent held supervisory responsibility in one of the aforementioned areas.

A variety of computers were reported as primary equipment, with the IBM 7090 being the major choice of the users. Of all participants the 7090 was utilized by 43 percent as their main computer. Of the support computers, used primarily for input-output off-line operations, the IBM 1401 was by far the front runner. According to "Large Scale" computer users, the number of on-line Magnetic Tape Units averaged 12.4 per machine system, while the "Medium Scale" system required an average of 4.6 tape units.

Other primary computers reported were:

Bendix G-20, Burroughs 205, CDC 1604, GE 210, IBM 704, IBM 705-1, IBM 709, IBM 7070, IBM 7080, IBM 1401, IBM AN/FSQ-7, Honeywell 800 and UNIVAC II.

### how the computers are applied

The series of questions under the broad category of General Specifications elicited the following answers. To the query, "WHAT WOULD BE CONSIDERED THE PRIMARY APPLICATION?" the replies leaned toward Engineering (23 percent), Administrative and Accounting (23 percent), with Billing, Production Control, Research, and Data Reduction in lesser percentages. Other applications were: Information Retrieval, Marketing, Manufacturing Control, Model Simulation, Program System Development, Scientific Mathematical Analysis, and Provisioning.

To a question regarding the organization of the computing services within the corporate structure, 59 percent indicated they operated as a separate and distinct entity with full control and responsibility, such as a data processing department or computing center. Thirty-one percent viewed their role as more task-oriented, being primarily concerned with one particular department or division within the company and reporting to that area. These results, plus opinions offered throughout the survey, tended to support the view that corporations are moving more toward the centralization of computing services.

On the question of open shop programming, 39 percent of those installations in the Scientific category reported "open shop" as their modus operandi. As for the computer time spent on checking code for future applications as opposed to time used by the computer for the operation of checked-out programs, Scientific users spent about an equal amount of time on each. Business users spent only half the time on developing new applications or modifying present programs as they did in using the computer for standard production runs.

### acquisition of the computer

Most companies (79 percent) stated that a special appointed study group led to the recommendation and acquisition of the computer. Composition of the study group was worthy of note. To the questions:

"DID THE TOP MANAGEMENT OF THE COMPANY HAVE A REPRESENTATIVE ON THE COMPUTER STUDY GROUP TEAMS?"

and

"WERE ANY MEMBERS OF THE STUDY GROUP TEAM REPRESENTATIVES OF AREAS WHOSE FIELD WAS NOT DIRECTLY DATA PROCESSING?"

the affirmatives and negatives were about equally divided. The same equal division applied to the query "TO YOUR KNOWLEDGE, HAVE ANY OF THE EXECUTIVES OR KEY PERSONNEL OF YOUR COMPANY TAKEN ANY EDP ORIENTATION COURSES?" These results only help substantiate that high level corporate management is becoming serious in its cognizance of the computer as a practical and essential tool.

Another interesting statistic resulted in questions pertaining to length of experience. Of all surveyed, 31 percent have used data processing equipment of some form or another for more than 10 years. Sixty-five percent of Scientific and 27 percent of Business users have employed internally stored program digital computers for more than five years. It can be seen that relative to the total data processing spectrum, the participants represented some real veterans.

When asked whether or not the present computer was the first one operated by the facility, 83 percent replied "No." To the followup question, "IF NOT, IS THE PRESENT COMPUTER MANUFACTURED BY THE SAME COMPANY AS THE FIRST COMPUTER USED BY THE COMPUTING FACILITY?" ninety-two percent replied "Yes" – a point for manufacturers to digest.

### composition of the computing facility

Depending on the application, size of the corporation, responsibilities involved etc., a significant variance was exhibited in the size of the personnel rosters. Excluding those on either end of the spectrum, the average count was 104 per facility.

Matching Scientific against Business classification in the matter of personnel composition revealed the following statistics.

| | Scientific 100% | Business 100% | Both 100% |
|---|---|---|---|
| Administrative Supervision | 8.8 | 9.5 | 9.5 |
| Programmers | 33.2 | 24.0 | 30.6 |
| Data Processing Operators | 21.6 | 28.4 | 23.9 |
| Key Punch Operators | 14.2 | 23.0 | 17.3 |

The above data was further processed through an IBM 7090 to provide groupings of overall similarity of percentage distributions. Interestingly enough, there were 12 cases, predominantly in the Business category, which were *average* in Supervision, *low* in Programmers, and *high* in Data Processing and Key Punch Operators. And there were eight cases, predominantly in the Scientific category, which were *average* in Supervision, *high* in Programmers, and *low* in Data Processing and Key Punch Operators.

### personnel selection, training and recruiting

When questioned on methods for personnel selection, 70 percent used some form of aptitude test for hiring programmers, and 55 percent employed similar techniques for

hiring operators. As for "trainees," 87 percent frankly reported they hired programmers and operators in this beginning capacity. As more than one participant put it — "Where else do you find programmers?"

To the query "IS A COLLEGE DEGREE A PREREQUISITE FOR PROGRAMMER APPLICANTS WITHIN THE COMPUTING FACILITY?" the Scientific category diverged sharply from the Business: 72 percent of the former said a degree was necessary while only 19 percent of the latter indicated an affirmative.

Fifty-eight percent of both Scientific and Business facilities reported that given the choice, they preferred to hire personnel with experience in the appropriate line of endeavor and train them as programmers, rather than the reverse approach of hiring personnel with programming skill and teaching them the necessary trade or business techniques. An analysis of responses from "purely commercial" industries (such as an insurance company) indicated that the trend was more pronounced. Sixty-three percent favored hiring personnel with business experience and training for the programming skills.

Statistics on personnel turnover should be an eye-opener to management. Scientific facilities averaged 26 percent total annual turnover of personnel; Business reported 20 percent. Within the context of this question, turnover meant any personnel losses suffered by the computing facility for any reason within the past year. It would include, for example, transfers from the computing facility to other areas within the corporation — certainly a major consideration for advance planning.

### computer usage

Sixty-three percent of the respondents reported working a three-shift operation, some installation running on a six-day, even seven-day schedule. The average monthly computer time, however, ranging from 176 to 550 hours, amounted to 334 hours monthly for both Scientific and Business facilities. Regularly scheduled preventive maintenance time averaged 12.3 percent of the total hourly usage. A similar statistic for unscheduled maintenance showed an average of 5.3 percent of total hourly usage. Unscheduled maintenance was defined as time, not previously planned, needed for maintenance because of computer malfunction.

As for questions on methods employed by survey participants for computer time-sharing, specifically where conflicting demands for service exist, Business facilities preferred to adhere to recognized schedules. Scientific installations were more prone to introduce emergency measures such as priorities for work, reservation of time periods for specific computer processing (block time), and other similar approaches, in an effort to solve the overload dilemma and satisfy the "customer."

When questioned on the amount of elapsed time required by computer operations for code check turn-around (program check-out and debugging), the Scientific facilities claimed an average of 6.6 hours, whereas Business facilities reported 11.5 hours as average elapsed time needed.

Both Scientific and Business facilities ranked in the same order of importance these criteria for evaluating the effectiveness of their operations: technical competence, response time, flexibility of service, liaison and goodwill.

### procedures—operational, control and systems

Three out of four respondents stated that they maintained and published Standard Operating Procedures for their computing facility. Answers to a series of questions about communications between operator and maintenance engineer, between operator and programmer, between programmer and maintenance engineer indicated a growing tendency to document the exchange, however informally, over verbal instructions.

An awareness by those contracting for computing service within the corporation is indicated by the reported statistic that 70 percent require cost estimates before proceedings begin and 50 percent of customer users (those areas receiving computing services) are provided reports from the computing facility indicating machine usage and expended dollar amounts.

Questions on the size of computer programs were difficult to tie down, due to differences within installations as to what constitutes the program. Indications from this survey did reveal, however, that in general, programs written for use by the Scientific facilities were larger than those needed by the Business groups.

Virtually none of the firms queried had developed any quantitative methods for assessing programmer capability. Several expressed the opinion that effort in this direction was not necessary and were doubtful that any existing criteria could be justifiably applied. Others thought differently, and 35 percent of Scientific and 56 percent of Business facilities believed that such measures should be developed. Ninety percent of those interviewed reported they had not developed any reliable methods for estimating programmer manpower requirements for work assignments, other than those attributed to experience and intuition.

When questioned as to computer and manpower time budgeted for the development and maintenance of programs or program systems which may be used for general application or system control within the facility, 66 percent felt that not enough of such time was made available to accomplish the job to their satisfaction.

### views and opinions

The personal interview technique provided an excellent opportunity to solicit opinions and attitudes toward topics of general interest and concern. A question related to top management's perception of the importance of computing services could thus be summarized. Unlike the situation a decade ago, business leaders today neither shy away from EDP for lack of understanding nor embrace every electronic gadget for fear of missing something. They seem better adjusted to the phenomenon, and willing to learn more about it.

By far, the majority of respondents indicated that corporate management was very cognizant of the need for high-speed computing service in today's business and scientific applications. True, not everyone shared this view. Some felt that top management lacked a basic comprehension of the potentialities of the computer as a management tool. Yet comments did suggest that management was becoming more open-minded toward this viewpoint.

"HOW DOES EDPM SUPERVISION KEEP UP WITH LATEST ADVANCES IN COMPUTING EQUIPMENT?" One of the biggest problems facing the supervisor of a data processing facility lies in the selection of his tools. The very dynamic nature of today's technological environment tends to make the task more difficult, more complex. The survey demonstrated that in many cases, the responsibility was delegated to certain people within the facility; in others, special corporate functions assumed the job of computer evaluation. Only one company reported the development of a computer program technique for hardware evaluation.

Most respondents of managerial rank expressed a continuing need for programming research of some nature. With few exceptions, participants indicated that they look

to the manufacturer to supply a comprehensive package of program systems with the hardware. They see their responsibility as modifying delivered software to meet their own specific needs.

To the query about space allocation for "your computing facility hardware," the consensus seemed to be expressed as follows:

"As computers attain more industry-wide acceptance, the day of the showplace installation is on the wane. Nevertheless, most computing facilities report that adequate provisions have been made by the companies for hardware, permitting good operating and maintenance practices, ofttimes with built-in growth potential. The main concern appears to be for lack of space for personnel directly connected with the computing complex, such as programmers and systems people. The point is that such people are not apt to apply themselves as well under overcrowded conditions."

As for the issue "centralization versus decentralization" of computers within a company, two to one predicted a trend toward consolidation of hardware. Several respondents predicted the growth of the satellite concept, wherein small-scale computers communicated with a larger centralized system.

"AS A MANAGER OF A COMPUTING FACILITY, WHAT PROFESSIONS, SKILLS, AND AREAS OF RESPONSIBILITY DO YOU DEEM NECESSARY FOR THE MOST EFFECTIVE ORGANIZATION?" Most organizations begin with a nucleus of personnel directly oriented toward a particular task. In the case of a computing facility, this normally consists of systems personnel, programmers and operators, with clerical and managerial support. As the organization grows, the need for broadening its base often arises. To cope with growth, some advocated that on-going training under a professional instructor would be desirable. Public relations were generally considered the responsibility of all personnel, although some managers were of the opinion that a computing facility of any reasonable size should regard it as a specific function. Other necessary roles and responsibilities extended to Technical Consultants, Technical Writers, Mathematical Analysts, and Engineers. One respondent raised a flag of caution in this area. He felt that in the recent past, Parkinson's Law had been exploited to the fullest by many computing facilities. He opined that such proliferation often resulted in losing sight of the main objective – the use of the computer as a tool, nothing else. Before long, the tail was wagging the dog – another point of view.

"WHEN A PROGRAMMING GROUP EXISTS FOR THE EXPRESS PURPOSE OF WRITING ALL PROGRAMS FOR THE PRIMARY COMPUTER, IT IS CONSIDERED CLOSED SHOP PROGRAMMING. WHEN PROGRAMS FOR THE PRIMARY COMPUTER ARE WRITTEN BY PERSONNEL THROUGHOUT THE COMPANY, PROFESSIONAL PROGRAMMERS OR OTHERWISE, IT IS CONSIDERED OPEN SHOP PROGRAMMING." "WHEN THE COMPUTER IS OPERATED ONLY BY PROFESSIONAL OPERATORS OF ONE GROUP, IT IS CONSIDERED CLOSED SHOP COMPUTER OPERATIONS. WHEN PERSONNEL THROUGHOUT THE COMPANY, PROFESSIONAL OPERATORS OR OTHERWISE, ARE AT LIBERTY TO PROCESS THEIR OWN WORK ON THE COMPUTER, IT IS CONSIDERED OPEN SHOP COMPUTER OPERATIONS." "FOR YOUR COMPUTING FACILITY, WHICH APPROACHES DO YOU FAVOR?" This well-bandied question was included as it affords an opportunity to record the opinions from a segment of the computing industry. No one favored open shop operations. As for programming, it was 3 to 1 in favor of closed shop. There were some reversals; that is, current "Programming open shoppers" advocated closed shop, and vice versa. All agreed, of course, that further development of higher level languages makes open shop more applicable. It was further agreed that the question was only relevant to Scientific facilities, although all were polled.

A sampling of comments is as follows:

"Open shop programming opens the door for duplication of effort."

"We were open shop programming and operations. We closed operations first and do subscribe to closed shop programming."

"Open shop programming should be controlled."

"Provisions should be made for some special FORTRAN programming on an open shop basis."

"Controlled open shop programming for engineering."

"Business – closed programming. Technical – open shop programming."

One of the major problems facing a manager, particularly where the computing services are diversified, is in turn-around – the amount of elapsed time from receipt of the work to the return of the processed results to the customer-user. Often, as the load increases, turn-around service decreases, schedules begin to slip and measures are implemented to process work under a more closely controlled plan, such as a work priority system. On the other hand, it may be argued that priorities can do more over-all harm than good, unless rigidly controlled, and are really only necessary when adequate scheduling has not been planned. As one participant put it, "Priorities! – over my dead body." Comments in answer to the query, "WHAT METHODS OF COMPUTER USE CONTROL DO YOU ADVOCATE FOR EFFECTIVE RESPONSE TIME?" only pointed up the variety of methods employed to overcome a complex problem. "Establish maximum limits for code checks." "All work scheduled through the Operations Manager." "Develop sophisticated scheduling practices." "Establish time blocks."

Admittedly, asking the question, "WHAT DO YOU CONSIDER TO BE THE MAJOR PROBLEM AREA IN COMPUTING FACILITY MANAGEMENT?" is something like asking "What is the most important part of a wrist watch?" All parts are essential for smooth running. Similarly, it is difficult to identify any single problem facing the facility manager as being more major than others. However, as an attempt to categorize thoughts on such a broad question, each participant was allowed only one response. It should be noted that of the thirty participants, two-thirds of them identified their major problem as being in one of four areas:

Finding competent people
Liaison and communications
Educating the users
Keeping management aware of your role and
"On your side!" ■

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The System Development Corporation has made TM (Technical Memorandum) 704 "Computing Facility Management Survey" (C. M. Lawson) available to firms who actively participated. Readers interested in obtaining copies may do so, under letterhead of their respective companies, by writing to System Development Corporation, 2500 Colorado Avenue, Santa Monica, California, ATTN.: Document Distribution.

With little expectation of a private unveiling of IBM's five-year plan for painless profit in computing, DATAMATION nevertheless felt that a brief exposure to top management thinking at White Plains would constitute a highly palatable, feature-length offering.

No constraints on subject areas were imposed for the following interview, and with several hours of available time and tape, conversations ranged from ALGOL and COBOL to the Consent Decree and STRETCH. Principal participants were WARREN C. HUME, president of IBM's Data Processing Division and A. L. HARMON, the Division's manager of product marketing.

HUME joined IBM in 1939 and has been branch manager at Lansing, Detroit and Milwaukee. In 1957 he was promoted to manager of Midwest sales and in 1960 received a divisional vice presidency. He became president in May, 1961.

HARMON has been with IBM for nine years. His background is in sales and systems engineering and he was formerly manager of applied programming in the Data Processing and Data Systems divisions.

# A PROFILE OF NO. 1

## IBM's Hume and Harmon view problems, progress and professional criticism

based on a taped interview
by HAROLD BERGSTEIN, Editor

**Q.** Despite IBM's position of prominence in the industry, there is criticism frequently voiced that you have not been a leader in technological progress. In support of this argument, the comparison is frequently made with other manufacturers in the general purpose field, for example: UNIVAC's 1107, Burroughs' B5000 and Philco's 2000. Would you care to comment?

**HUME:** I don't think we have to take a back seat to anyone and I don't think anybody has scooped us. We're not going to be first in everything, but one of the things you missed in your question of great significance is random access. This was a tremendous breakthrough with the various approaches we've had to it. A large volume solution where there were literally hundreds of machines performing random access functions and applications is a tremendous and significant breakthrough. I honestly think that random access, as a philosophy, has not been extended to the degree that we will see in the future.

We can talk about how fast we can sort, as a case in point, but if you can get a fast enough random access, you may not have to sort. As you look at systems like SABRE and at other on-line systems, you are going to find that random access is a real key to the future.

**Q:** A specific criticism of technological progress is that you still retain a 600-line-per-minute printer even for STRETCH and that the 1,000-line-per-minute printer has been widely accepted by users and competitive vendors. Would you comment on this?

**HUME:** We're all constantly looking at the market place and we're looking at our capability to provide the best answer at the lowest possible price. I don't think there is any question that we can produce a 1000-line-per-minute printer or that we can make it even faster than 1000. The point is to bring a solution at a level which is to the best advantage of the customer. I think, though, that you find the present cost of the throughput of our machines is a relatively good one.

**Q:** What recent factors would you consider important in the accession of IBM to its present position in the industry?

**HUME:** There is a basic premise here and, operating upon it, we literally turned our company around in the market place, so to speak, within the last two to three years. As simple or as much of a cliché at it sounds, we stepped back for a moment and took a look-see and decided that we couldn't find a businessman — a top businessman — who wanted to buy a microsecond. What he was really looking for was a solution to a problem.

Therefore, it seemed logical that if we were to provide a solution we had to have the technical competence in not just hardware, but in his business — industry competence, if you will — to define the problem. In order to define it, we had to know this man's industry.

Consequently, we took experienced people who had been working in a particular industry and sent them to postgraduate schools. For example, we took our banking people and did two things. We sent them to postgraduate school at Rutgers, which included a combination of the academic approach that they had, plus bringing in a lot of outside talent. NYU made facilities available for a

retailing school and we had such outside speakers as Bernard Gimbel. We went to the University of Connecticut for insurance and so on down the line.

The other thing we did was to reorient many of our branch offices from a geographical arrangement to coverage of specific industries. Historically, if the size of the territory was too big, it had seemed logical to cut the area in half and put in two offices. We revised this.

For instance, in Chicago we have five offices and each one covered a certain amount of geography. Under the new concept, we took one office and made it responsible for the financial industry, so that in this particular IBM office, all considerations, everything, pertained to finance. They lived like bankers, so to speak; they ate like bankers, and they thought like bankers. They were in it all day long. They weren't thinking about manufacturing control in the Chicago financial office. They were thinking about finance, brokerage firms and banks.

Now, that to me, is a significant change and I think it has had a significant bearing on our sales volume.

**Q:** What were some of the important factors in the mid-50s responsible for the growth of IBM?

**HUME:** There really wasn't a large volume of people with pieces of hardware in the field at that time . . . we got into the business with what we thought was a machine that could solve a problem, and we tried to demonstrate to the customer how we could solve his particular problem with that machine.

As you look back, the problems then were much different than today's. Then, you could take some top specialists, train them on the machines, train them on the applications, but the scope of the market was limited enough that you could use these people in those few spots.

Today, the whole market has changed with the 1401, the 1410 and some of our competitors' machines. It's a very broad market and consequently, we have to serve it on a very broad base with specialized knowledge.

In the 50s, there was one difference, too, which prompted a basic decision. I don't know what it amounted to in terms of dollars, but it was a sizeable investment.

We realized that historically, just having specialists go from one location to another to analyze the problem and recommend a solution was not the long-term solution. Any time someone put one of these machines in, we had learned from the unit record field that it was a day-to-day proposition and therefore, we set up a tremendous educational program so that we could have at the local level, top answers, specialized answers, so that the businessman was as close to a solution as his phone with a representative ten minutes away.

I can simplify the answer by saying that we had to make a basic decision: one choice was the task-force approach and the other was to take a broad educational approach, accept that it's going to be a broad market, invest heavily in education and beef up systems engineering – which we did, and put it at the local level. And this we also did.

We think this has a significant meaning. We take a great deal of pride today in the capability at the branch office level, not that we don't have consulting available to these people, but we think that we have a tremendous amount of technical competence, both industrywise and machinewise, at the branch level.

**Q:** Regarding present-day industry problems, the American Standards Association, the Association for Computing Machinery, and the International Federation of Information Processing Societies, as well as several other manufacturers, have advocated the implementation of ALGOL. What is IBM's position?

**HUME:** May I ask a question? What's the stand of GUIDE and SHARE who are the major machine users?

**Q:** In support of FORTRAN.

**HUME:** And logically, because they have a tremendous investment. I think one of the successes of IBM has been based on the fact that we try and service the investment of our customers. That's number one. These are the major users of the machines.

Secondly, I somehow feel that there is a wrong impression as to our support of ALGOL. We are not ignoring ALGOL. We're really taking a look at it and, over and above a look, we're putting a tremendous investment in ALGOL.

Some people have the feeling that just because we're continuing FORTRAN with the investment that our customers have in it and since GUIDE and SHARE have come out for FORTRAN, that we're against ALGOL. We're not against it. We're simply saying that we have to support FORTRAN.

**Q:** By investing in ALGOL, do you mean research into the development of an ALGOL processor?

**HUME:** Yes.

**Q:** Will it be anounced soon?

**HARMON:** As you know, ALGOL and its specifications are still under development and we have submitted an experimental ALGOL processor to the SHARE ALGOL committee for further development and work. We like to make sure that things are reasonably cleaned up before significant assets are poured into any program.

**Q:** Regardless of an announcement date of an ALGOL processor, would this signify the end of FORTRAN maintenance and development?

**HUME:** It would not.

**Q:** With this fact in mind, would you be able to provide a prediction as to when an ALGOL processor might be forthcoming from IBM?

**HARMON:** You're in an area where you're almost asking when will something be invented. In a development program, it's extremely difficult to forecast even close to when something will be specified to the level where it can be properly implemented.

My guess would be that the next five years will show significant changes, not only in the ALGOL effort, but also in the FORTRAN language itself. It's conceivable that these two will marry.

**Q:** In your support of COBOL and compatibility, this effort would seem to run diametrically opposed to IBM's best interests in maintaining customers and sales since compatibility implies that a user may transfer his work without major reprogramming between machines of different manufacturers.

**HUME:** Naturally, we intend to keep our sales up. I, in particular, intend to keep our sales up, since this is my job. However, regarding COBOL, I don't think that our support is so unique.

I think every man who ordered his computer in the first place made a decision. At that point, he had no investment in programming. Later when COBOL came along, he had to make another decision. So these decisions have been made thousands of times across the country, and I don't think that there is a major difference between the first time and the second time they are made.

I think that as we gain experience we have a better appreciation of the man's business and his problems and therefore are in a better position to offer a solution.

**Q:** Would you comment on the general direction and progress which IBM has made in the COBOL movement?

**HUME:** Let us say that because of our early entry into

this particular game that we had the opportunity, through experience, to learn that there was no Utopia and while progress would be made in these things, that it takes time.

There has been tremendous medical progress made in the last fifty years, probably as much as in the previous ten million and yet, the gestation period of a baby is identical with what it was. So, I think that we're saying we recognize there are certain things that you just can't solve by waving a wand. The only way you learn these things is by doing them.

**Q:** Mr. Harmon, would you rate the general progress which the industry has made in the COBOL effort?

**HARMON:** All the votes aren't in on COBOL yet. In dealing with anything as major as a new language like COBOL or any commercial translators for the business world — it takes a period of time to really shake down your own opinions as to whether or not the benefits originally forecast are realized. I would point to our experience with FORTRAN. It was several years before this was really accepted by the scientific computing community.

Admittedly there were two things going on — the acceptance of a philosophy of a higher-level language and the acceptance of FORTRAN. But I don't think we have to go through the acceptance of the philosophy again.

My guess would be that this will take something of the order of another year of user experience with COBOL to decide whether or not significant benefits will be realized.

**Q:** Still on the matter of standards, but shifting tracks slightly, would the entire standards movement in this country become a rather impractical force without the agreement of IBM?

**HARMON:** Definitely not. The desire for standardization is strong enough today so that efforts would continue with or without the support of any single company. However, IBM believes strongly in the benefits of standardization for data processing users and is participating in these efforts in a number of areas.

**Q:** Is there a single professional problem in the industry that you would consider as the most pressing?

**HUME:** The answer to that question can be pretty well defined by the want ads in the newspapers. Take the N. Y. Times as a case in point. You find a myriad of ads for programmers. Someone said there is an obvious demand for some 10,000 programmers.

**Q:** When do you feel the problem will smooth itself out?

**HUME:** I haven't thought out an answer but to take one off the top of my head, I would say that with the machines going into colleges and universities, there should be an increased capability coming out of the schools within two to three years.

Many colleges and universities are actually putting in programs of programming as accredited courses and in some cases, they're making it virtually mandatory in the engineering school particularly, and in the areas of mathematics, physics and chemistry.

**Q:** At the opposite end of the spectrum, is there a single technical problem such as the study of thin films, cryogenics, tunnel diodes, etc., that seems of primary importance?

**HUME:** No, although these certainly are areas that are being explored, and there's a great deal of technical emphasis on them by all the manufacturers.

While I'm not trying to minimize the fact that they're exploring great areas, I honestly think that history will prove that the technologies have exceeded the present capability, not of any individual company but in toto. They have exceeded the potential to adequately use that capability which is already in existence.

To put it another way, I think you will find that with the machines that are available today, people will be discovering new ways of using them and will be using them on a much more sophisticated basis five years from now. The machines basically won't change, but the people's capability of using them will change.

**Q:** Do you believe that within the coming five years, programming may become of equal or greater importance than engineering of hardware?

**HUME:** Your question leads me to think that possibly one can have some type of system — perhaps a complete building block, and therefore it's the programming that would tend to put these pieces together. Incidentally, I believe that the term software — as a catchall word — is going to become less and less meaningful as time goes on.

The present ratio of applied programming and applications programming to hardware is becoming greater because of the greater flexibility of the hardware. As you get more flexibility, it may be compared to an airplane that can go through more maneuvers and the pilot has to be more capable to take it through these new maneuvers.

**Q:** The opinion of many users is that the programming

of their machines is costing more than the machines themselves. Has this been your experience?

**HUME:** I think there's a tremendous investment in programming. There's no question of it.

**Q:** It has even been suggested that hardware development be frozen for a period of years so that applications and programming can catch up to the microsecond speed. Would you agree?

**HUME:** You've got too many people in the market place who are developing hardware with improvements over their previous hardware and curtailment of this progress simply can't be done. I can't see how competition would allow it to happen. Even if the government were to edict it, which I don't see happening, you'd just be opening yourself and the whole industry to an attitude of saying, "Let's sit with less than the best."

**Q:** In the move toward third generation technology, would you hazard a guess as to which direction the industry will take?

**HUME:** You hear about thin films, cryogenics, all kinds of things. I don't think any manufacturer has frozen his specifications to the point where he knows which one or which blend of these things he will use. I'm not too sure that there aren't certain things that might be developed within the next year or two which might even obsolete these.

**Q:** When can we expect a successfully operating multiprogramming system for a machine in the STRETCH class?

**HARMON:** I think the remarks we made concerning development programs as they relate to new programming systems, apply here. When you speak of a solution, you imply a total solution, and in the field of programming, I don't think you can forecast a total solution. What you do is solve a problem such as compiling speeds versus object program efficiency, multiprogramming, etc.—you solve these incrementally.

**Q:** Speaking about STRETCH, has CEIR officially concluded its negotiations with IBM on a penalty for cancellation of the STRETCH machines?

**HUME:** No, they have not. I believe you used the plural, however, in referring to STRETCH *machines*. They did not have two machines on order. They had placed one order and a letter of intent. As far as an order to build, they had only one machine.

**Q:** What are your plans for the cancelled STRETCH?

**HUME:** There are two basic things we can do. First, if some agency had an interest in it, we would consider completing the machine. The other course would be to use it for spare parts. There is a third possibility that we might set up a usage within our own company. I'm not saying that this is planned, but it is a possibility.

**Q:** Why doesn't IBM announce the number and location of its machine installations?

**HUME:** I honestly think that this is a personal thing. It's just like asking you how much you earn.

**Q:** But you detail your earnings in your annual report.

**HUME:** Yes, this we do, but I don't think that you necessarily expound the sources from which you earn it. If you would allow me the same analogy, I could say what my income was last year, or I might even put it on a credit report as many of us do, but I don't have to describe what investments I've got.

**Q:** Since other manufacturers provide installation figures to the public, there has been speculation that this particular IBM policy might be attributed to the Consent Decree and the desire of your company not to pinpoint its financial status to the Justice Department.

**HUME:** I could see where someone might have this opinion, but it is not the real reason. My answer is that we have always considered such figures proprietary and have rarely divulged them, either before or after the Consent Decree.

**Q:** There is also the impression that the Consent Decree has actually been of far greater benefit to IBM than if it had not existed, since the credibility attributed to your announcements may be somewhat higher because of these publicly reported restrictions. Would you agree?

**HUME:** I don't think that the Consent Decree changed any of the basic policies of the IBM Company. You can say that there are some differences. For example, since the signing of the Consent Decree, our machines are now offered for sale.

However, there haven't really been any basic policy changes from what we did prior to that in the announcement of our hardware. I can remember participating in the announcement of the 407, for example. When we announced it, I had one on the stage showing it running. As a matter of fact, that's how it was announced. At the same time, we announced the key punch and the new proof machine. I think we also announced the 101 statistical sorting machine on the same day.

I can say categorically that if the Consent Decree were to expire tomorrow, you wouldn't see any change in the IBM Company. There are some practices on which the limitations have been lifted and we have not changed these practices whatsoever.

**Q:** American Airlines has informed us that the SABRE system will not be on the air as per its originally scheduled installation date. What are the reasons for its lateness?

**HUME:** First of all, you have to define "the scheduled installation date" but let me tell you the whole story rather than to try and explain that.

As you know, when you put any of these systems together, you've got the system, the control program, the operations program and a myriad of people operating with the controls, operations and hardware.

Under the original plan, there were certain layouts and simulations that were scheduled to shake down the hardware, the control program and operations program, and then a city was to have been placed on line, using this technique as a shakedown.

As we got into the total program, it became clear that we would be better off setting up a simulation laboratory, shaking down the programs to a far greater degree than we had originally anticipated. At present, we're actually having a simulation of a small airline and using actual data. Therefore, this means that the date of the original city which was really part of the shakedown, is being deferred.

This does not mean, however, that if the first city in the shakedown is moved back, that the installation of the total system is deferred for a similar period of time, because if you take the bugs out of your programs as you place these various cities on line, you can expedite this schedule.

In these large systems where you have tremendous programming involved, we feel that there is more shakedown on the simulation basis to be accomplished prior to the time that you use a live example. We believe it will conserve more over-all time than would be required by going the other route. It's that simple. I don't think we know the exact date that this is going to be concluded. This doesn't mean that we're afraid that it's going to be moved way back, but a program like this is brand new so it could vary plus or minus a limited amount of time.

**Q:** Do you feel that the influence of SHARE and GUIDE which we discussed earlier with regard to FORTRAN,

has stayed the same or increased over the past few years? I refer to its influence in prompting IBM to make changes in its equipment, add or subtract black boxes, etc.?

**HARMON:** I think the big value of SHARE and GUIDE is to themselves. Of course, this value is growing in importance to the new people joining these groups. As far as IBM is concerned, we have always enjoyed an input from these organizations as far as market requirements are concerned.

**Q:** Looking to the future again, do you expect there will be fewer or a larger number of firms in the computing field?

**HUME:** It's impossible for me to really know. I think there might be more changes such as Ford and Philco, for instance, but I don't expect any major drop out. My guess would be that the number of firms in the business will increase although whether the new companies will make complete machines is another question. I think you'll see more and more people becoming suppliers.

In the automobile business we think in terms of three or four or five companies and yet, my guess would be that there are literally hundreds which, if you ask them, would say that they're in the automobile business. It is likely that suppliers in computing will feel the same way.

**Q:** Would you venture an opinion on centralized versus decentralized computing (or large versus small systems) and whether a trend might be forthcoming?

**HUME:** It almost gets back down to the argument that's been going on in business ever since business began, on the merits and demerits of centralization versus decentralization. The economics in both directions are going to be such that the decision will be based largely on an organizational desire rather than on the computer.

There are certain areas and types of applications where the centralization of the data is logical but basically, it would have been logical before. For example, we were talking about the SABRE system and when you got to the end result, there was a centralized spot at which the inventory of seats available on these flights was maintained. It was sent out in blocks so they could be properly sold. I visualize this sort of application being placed more on an on-line basis than we have ever done before.

**Q:** It was pointed out recently by several leaders in the industry that the design of the computer has changed only insignificantly since von Neumann and that aside from a brute force increase in speed, there have been only five or six real improvements in logical design. Do you agree?

**HUME:** Is it really important? That's the question I'd like to ask. The point is can you get the solutions to the problems that you want to get at the cost and speed that you want to get them? I tried to bring this out earlier, but it merits repeating; the businessman really isn't interested in a nanosecond or microsecond or logic or a doggone thing. All he wants to see is how to get the solution to his problem and couldn't care less basically, whether it's air conditioning, solid-state, or if it looks like an airplane or a match box.

Of course, I'm drawing ridiculous extremes but I think the emphasis in a lot of these cases is put on the wrong spot.

**Q:** What efforts has IBM put forth in the matter of automation and displacement of the working force?

**HUME:** Perhaps my definition of automation is different than yours.

**Q:** May we have your definition?

**HUME:** I think the concept that most people have of automation is one of a production line which is creating, as you say, the unemployment or displacement. I don't see this as the same thing. We're comparing apples with oranges when we're talking data processing and automation. There's a distinct difference between an automatic production machine and a data processing machine.

I don't know this to be a fact, but I will venture a guess that the number of people involved in operating, manufacturing and servicing data processing equipment is greater than the number who have been displaced by data processing equipment including unit record.

**Q:** One final question which concerns the professional's view of IBM. Since most individuals are almost intuitively opposed to a consistent winner, IBM is frequently the butt of much industry laughter. For example, at one professional society meeting, someone mentioned IBM and was greeted by "Oh, you mean International *Bailing* Machines." The result was laughter from 500 attendees. Would you care to comment?

**HUME:** The IBM Company can laugh at itself just as well as any other company can laugh at itself. Are we aware of our position? The answer is that we are aware of our position and we try to walk the line — and it's a difficult line — between confidence and smugness.

We are confident that we have the best people — a collection of the best people — in the field in this particular area. We are far from smug. We make mistakes. We hope we learn by our mistakes. ■

# GROSCH'S LAW REPEALED

**replacing the square by the square root**

by CHARLES W. ADAMS, Charles W. Adams Assoc., Bedford, Mass.

Less than four years ago, Philco delivered the first transistorized electronic data processing system to be manufactured as a commercial product. Since then, more than 50 different solid-state systems have been announced, and first deliveries made on about 40 of them.

(The salient features of all these systems have been tabulated in the *Computer Characteristics Quarterly*. Published by Adams Associates, the Quarterly is updated every three months in an attempt to keep it abreast of the rising tide of new systems.)

The six-dimensional chart appearing on the opposite page graphically depicts: storage access time in $\mu$sec by the ordinate; "typical" monthly rental by the abscissa; number base by the shape of the point; word size (in bits, with character-addressable machines such as #33, the IBM 1401, shown as having a five-character and therefore a 30-bit word) by the height of the box enclosing the point; number of words by the horizontal cross section of the box (so that the volume of the box represents the total storage capacity); and the year of the first delivery by the shading of the box.

The computing capacity of a given system depends on *all* its characteristics and on the way it then happens to fit the job it is to do. But raw internal speed depends greatly on storage access time, and the almost universal use of magnetic core storage has consequently markedly changed the relationship between speed and storage.

A few years ago, Herb Grosch asserted that empirically the ratio of speeds of two competitive computers could be expected to be directly proportional to the square of their costs, that is, for ten times the money one could expect a hundred times the speed. Grosch's law has been repealed; one can no longer expect even a linear increase. Indeed, a case can be made for replacing square by square root, and the popularity of the six-microsecond core memory introduces a special situation, represented by the 6-$\mu$sec law above.

The author sincerely hopes that, having taken note of the results here published for the first time, the reader will proceed to forget them — for the author is of no mind to defend them! ■

## COMPUTER REFERENCES — See Corresponding Number References on Chart at Right

1. IBM 7030 STRETCH
2. UNIVAC LARC
3. IBM 7090
4. PHILCO 2000 MODEL 212
5. IBM 7080
6. RW 400
7. UNIVAC 1107
8. CONTROL DATA 1604
9. RCA 601
10. PHILCO 2000 MODEL 210,211
11. IBM 7074
12. UNIVAC 490
13. IBM 7070
14. IBM 7044
15. UNIVAC III
16. HONEYWELL 800
17. BENDIX G-20
18. BURROUGHS B 5000
19. RCA 501
20. IBM 7072
21. NCR 304
22. GENERAL ELECTRIC 210
23. IBM 7040
24. UNIVAC 1206
25. CONTROL DATA 924
26. IBM 1410
27. NCR 315
28. HONEYWELL 400
29. UNIVAC SS 80/90 MODEL I, MODEL II
30. PHILCO 2400
31. GENERAL ELECTRIC 225
32. BURROUGHS B280 & B270
33. IBM 1401 (TAPE)
34. RCA 301
35. RPC 9000
36. CONTROL DATA 160A

36a. BURROUGHS B260

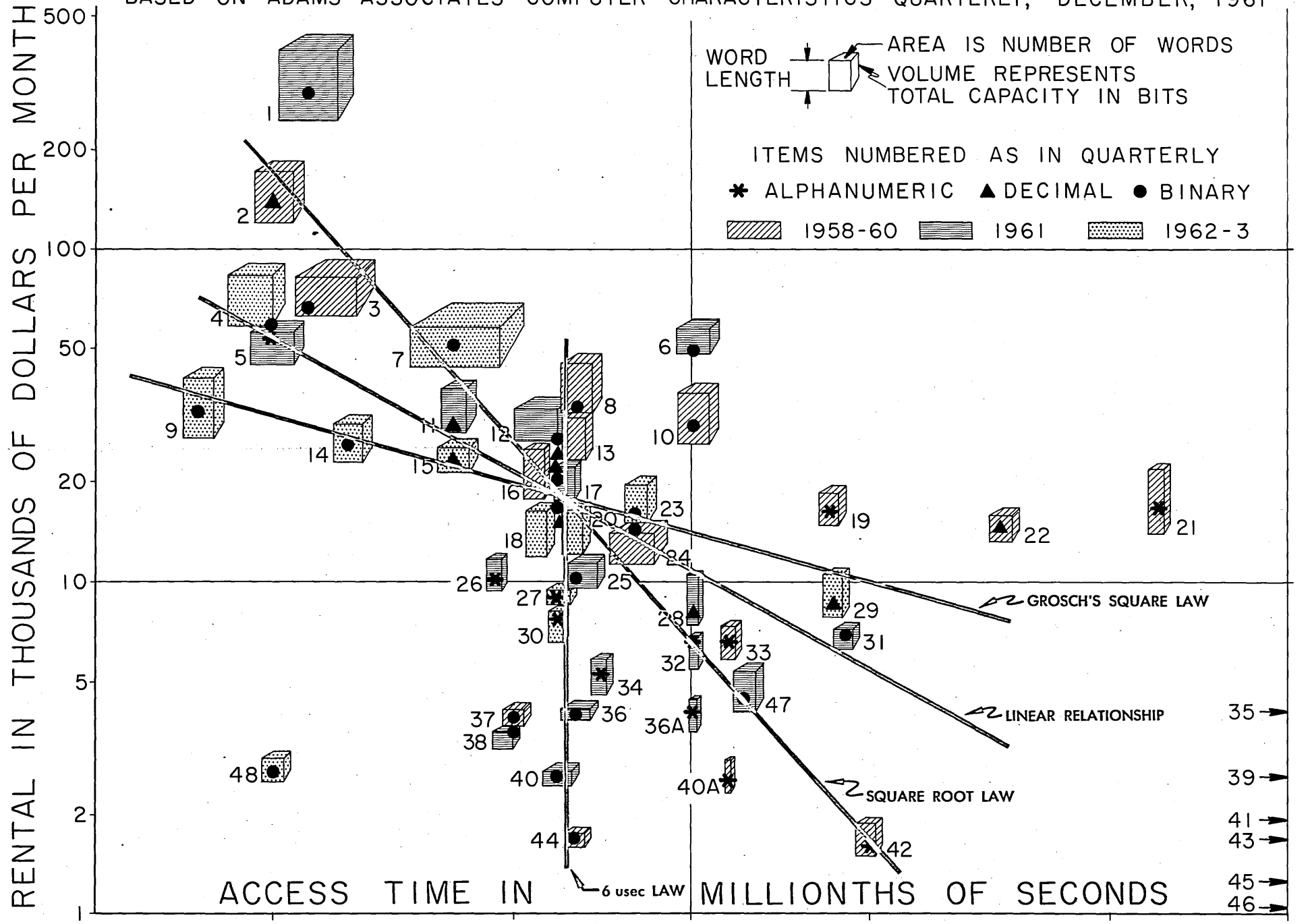
37. DEC PDP-1
38. COMPUTER CONTROL DDP-19
39. AUTONETICS RECOMP II
40. RW 530

40a. IBM 1401 (CARD)

41. RPC 4000
42. IBM 1620
43. AUTONETICS RECOMP III
44. CONTROL DATA 160
45. PACKARD BELL PB 250
46. MONROBOT XI
47. GENERAL MILLS AD/ECS-37
48. ADVANCED SCIENTIFIC ASI-210

# SOLID-STATE DIGITAL COMPUTERS — COST vs. MEMORY SPEED

BASED ON ADAMS ASSOCIATES COMPUTER CHARACTERISTICS QUARTERLY, DECEMBER, 1961



# QUARTERLY INDEX OF COMPUTING

## Ops/sec rise to 108 million over first quarter

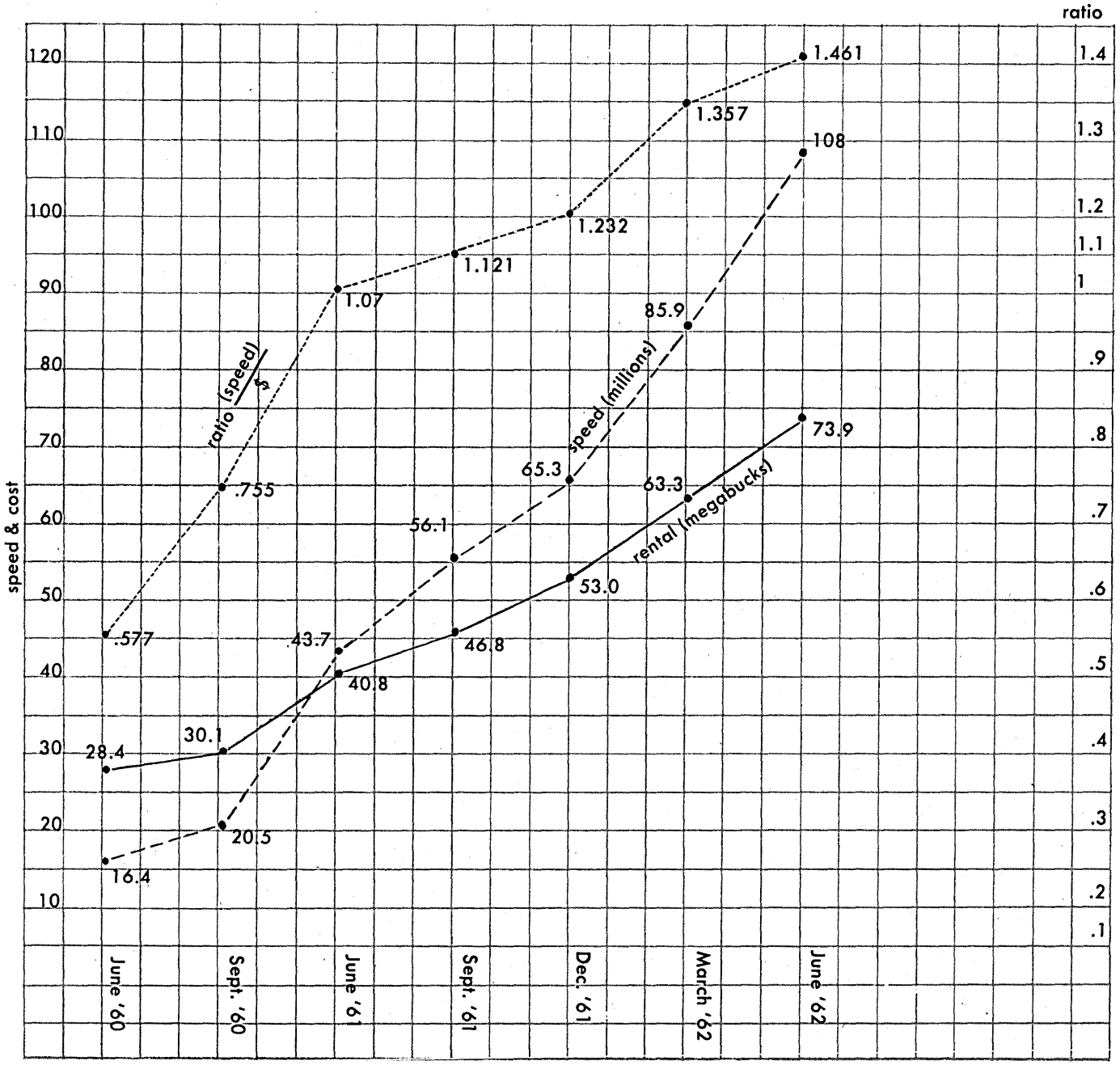
Based on information presently available to *Datamation*, estimates as shown below are offered as reasonable approximations derived from the specifications of larger systems and selected small scale systems such as the 1401.

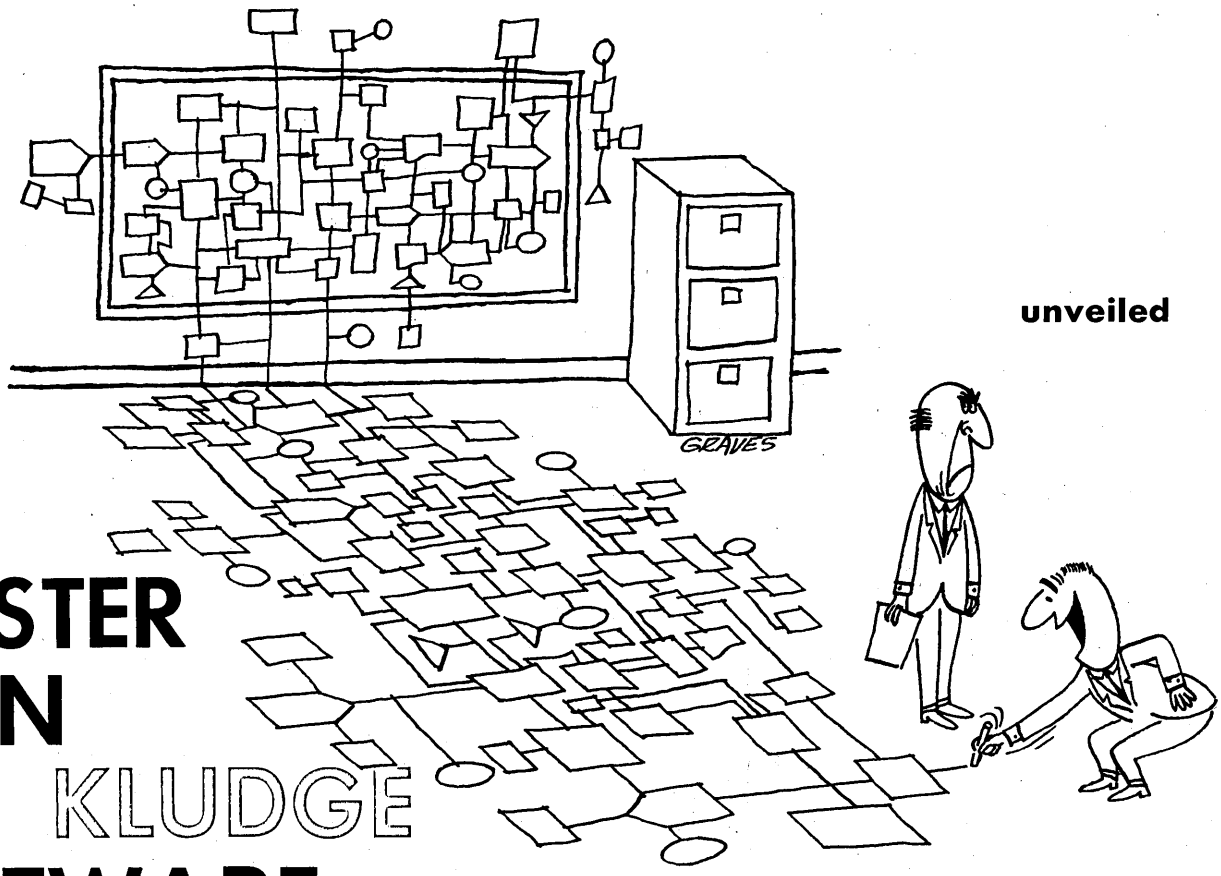
The ratio of computing power per dollar represents the quotient of the Speed Index and Operations per Dollar Index. Since the Radio Index represents an indicator or measure of a condition, the units (operations per second) ÷ (dollars per month) need not be meaningfully related to provide an intelligible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

The number of ops/sec during the second quarter of 1962 continued to show an upward trend, rising to 108 million ops/sec, a gain of 25.7 over the first quarter's mark of 85.9 million. This is attributed largely to the growing number of 7090, 7070, 1401 and 1620 installations. The latter two now are estimated to total 2.75K and 1K, respectively.

As far as monthly rentals are concerned, the total of 73.9 megabucks represents an increase of 16.7% over 63.3 megabucks, the estimated machine rental figure for the first quarter of 1962.

The ratio of computer power per dollar registered an increase of from 1.357, the first quarter's figure, to 1.461, a gain of 7.66%. It is felt that the mounting number of 1401 installations, with high throughput cost as compared to large-scale systems, tends to offset the lower operation/cost balance achieved by systems in the 7070-7090 range. ■






# THE MASTER PLAN FOR KLUDGE SOFTWARE

by Dr. MORRIS L. MORRIS & Dr. AUSTIN O. ARTHUR, Kludge Komputer Korp.

Previous writers in this series have attempted to show how the road to non-computing can be fostered at its foundations by:

(1) Engineering glitches into the hardware. With suitable ingenuity, these can be either new botches (discovered after the prototype is constructed, usually, and then firmly cast in concrete) or loving repetitions of what never did work right.

(2) Marketing the resulting Kludge with the same techniques used to peddle deodorants and cigarettes. The analogy is painfully accurate.

(3) Applying time-tested rules for maintenance which operate faithfully to minimize uptime. These rules are a sort of check list for the Kludge Fixer so he can save time by listing excuses by the numbers.

Now, brief reflection quickly reveals that the above approaches are *only* the foundation. The real approach today has far greater scope, since it strikes at the heart of the matter – software. Everyone knows that software is *the* thing. The planners at Kludge Komputer Korporation are keenly aware of this trend. Having pioneered so well in the fundamentals, they can be expected to excel here too. What follows is the basic outline followed at KKK. The Master Plan is the result of years of study and represents the ultimate in software systems for users of the famous line of Kludge hardware.

### Kludge software master plan

The cardinal Commandment of any software development program is "Announce it first, worry about producing it later."

The first and most important Edict is, "Always start with fresh programmers." This is a simple rule and its raison d'être is obvious. Any programmer who has used or designed another system has been adulterated or biased and such bias (sometimes referred to as experience) may well influence him in the task he is to perform.

*Edict 2.* "Never let your fresh programmers talk to the programmers who designed the last software package, if this can be avoided – but at all costs never let any software programmers talk to the people who design, sell or maintain the hardware." This rule needs no explanation.

*Edict 3.* "Never let the software specifiers talk to the software implementers." This form of warping young programmers' minds is to be avoided like the plague. Software designers always seem to have the weird idea that they better than anyone else, know how to implement their designs.

*Edict 4.* "Never let a software group know that there are other groups." A weaker form of this rule is also useful, "Never let one software group know what the others are doing." The stronger form of this rule tends to create very high morale or esprit de corps brought about by a feeling of exclusiveness. In the weaker, but more pragmatic form, the effect is acquired by implanting the idea that all of the people in all of the other groups are a bunch of inexperienced poopheads.

*Edict 5.* "If you must document the software, be sure that the documentation is done by a wholly separate group, preferably technical writers who are not too knowledgeable about computers and programming." Many benefits accrue from this approach, but the greatest one is the high regard with which your documents will be copied. Worry not about their accuracy; users are more adaptable than you think. The proof of this is found in the great number of installations still operating Kludges with *no* documentation.

Turning our attention now to the design phase of software (predicated of course upon the above personal practices) the following rules have served not only the Kludge

Komputer Korporation but many of its fellow companies for many years.

*Rule 1.* "Every software package must have a monitor, irrespective of the size of the Kludge." Without a monitor to occupy between 25 and 50% of the available fast store (and at least ¼ of the backup storage) the users' programmers will become careless. They will eventually discover that one can trade time for space – which leads to reduced utilization and thus, rental income. An appropriately designed monitor on the other hand can be depended upon to *waste* a minimum of 10% of the available time just searching the system tapes.

*Rule 2.* "All error messages must be as coy and ambiguous as possible." The object here is to make the console operator (and, later, the programmer) unstable. For example, what could be simpler than "AN IMPOSSIBLE ERROR HAS OCCURRED ON AN UNSPECIFIED UNIT WHILE EXECUTING AN UNIDENTIFIABLE PROGRAM." It should be pointed out that the creative souls who can compose such wonderful phrases are rare beasts, indeed, and when found should be coveted and nurtured.

*Rule 3.* "There should be more phases in the monitor than there are jobs or programmers in a given shop." This is the only realistic settlement to the ever raging argument between the one-phase and three-phase proponents. Besides, how else can you provide the capability for clobbering programmer A's phase p results while running programmer B's phase q interlude if everyone knows what is to happen in each phase? And what better way to keep an operator guessing – you see he is much less likely to call for the KF's under these circumstances – another form of saving not to be discounted.

*Rule 4.* "Every software routine should have a snappy acronymic name." For instance, we at Kludge Korporation called our Kludge Monitor System KLUMSY; the Kludge assembler, KLAP; and the alternate version, KLAPTRAP, required for a Kludge with traps (working or not).

*Rule 5.* "Before letting pragmatic aspects interfere, be sure that the things that count are taken care of. SEE THE SALES DEPARTMENT FIRST AND THE COPY WRITERS IMMEDIATELY." As we all know, if a Kludge can't be sold on its hardware merits alone, (and it can't) the software must carry the burden.

A Kludge cannot subsist on a monitor alone. Thus it behooves the Kludge software suppliers to provide working languages for the Kludge. The more the merrier. Since the list of OK languages changes from season to season, and position within the list is not constant (or computable), one had best consult one's marketing people to find out which ones have strongest current motivational appeal. Within these bounds, the guiding principles of Kludge languages follow.

*Principle 1.* "Hop aboard all of the current band wagons." If FORTRAN is the current best selling gee-wiz, write (promise) a better one. Change the name slightly so that you don't lose your identity, but not so much so that you can't tell who whelped it. Thus, Kludge Korporation's version of FORTRAN will be called KLUDGTRAN.

*Principle 2.* "Always release preliminary undebugged versions of the translators, compilers, generators, assemblers, etc." Why NOT? Let your customers debug the things. Why should you spend your programmers' time and operate a machine with all that awful overhead? If your customers want it badly enough, they'll check it out for you. (Unfortunately, the day is gone when you could get him to design and implement it, too.)

*Principle 3.* "No 'preliminary' or 'field test' version of any translator should be compatible with the monitor or any other translator." The savings realized by the elimination of coordination and liaison would amaze you. This also prevents future coordination and liaison because each "field test" version gets too deeply imbedded for anyone ever to want the final version anyway.

*Principle 4.* "Join and actively support any and all government sponsored and international magic language generation efforts." This lets you know what the opposition is thinking. But be careful: contribute only those ideas which you know are impossible to implement on the competitors' hardware, or will at least make it look bad. Always be ready with a claim to have a working version of whatever language is the current vogue.

*Principle 5.* "Never, NEVer, NEVER write a decent or useful training manual for any system." Remember, you may be taking the bread out of the mouth of some striving young author.

*Principle 6.* "If you must supply an assembler, do it uder duress." The best ploy to use to get out of this one is to tell the customer he never ever needs to know the basic language of the machine. All of his problems can be solved with the New International Magic Language Number 6.5. Well, our version of it anyway. As we all know, magic languages are the thing, and you can't sell a Kludge without magic.

We must now turn our attention to software maintenance; an area too often ignored.

*Tenet 1.* "Each program should be on a separate tape with its own unique format." This is logical. You wouldn't want the corrections for one system to be acceptable to another, would you?

*Tenet 2.* "Corrections should be distributed at such a rate (empirically determined) as to keep the users from inundating you with requests for additions and changes to the system." It seems best to protect our programmers as much as possible from new and different ideas. Besides, we've always done business this way.

*Tenet 3.* "Distribute new versions of each system as soon as the previous one is showing signs of being checked-out." This guarantees job security for a very large segment of the programmer community known as "System Programmers."

*Tenet 4.* "Whenever a new system is proposed or implemented, refuse to continue maintenance on some other (any other) existing system." How far can *you* make a rubber band stretch? We've already provided for keeping our programmers busy!

*Tenet 5.* "Never let the programmers who implemented the system maintain it." It has been found over the years that many system programmers acquire a certain attachment for their own code and refuse to consider sullying it with corrections. Thus, the only solution is to have some other programmer do the appropriate surgery (preferably a brand new one, fresh from the university) in the form of absolute binary patches.

In closing, we should like to point out that we of the Kludge Komputer Korporation have managed to keep abreast of the competition in software as well as hardware by having a loyal claque. Which brings us to the last Commandment:

"FORM A USERS GROUP," whence springeth all that is worthwhile. Wine and dine them, buy their loyalty and in every way possible make sure that *your* users are satisfied and happy. Channel their desires appropriately. Hold meetings at least twice a year and see that all of the attendees get smashed (we at KKK sometimes pick up the tab) and go home generally feeling loved, wanted and appreciated by all.

the bitter end

# GIGAHERTZ COMPUTER CIRCUITRY

**a state-of-the-art survey**

by GERHARD L. HOLLANDER, Hollander Associates, Fullerton, Calif.

Gigahertz* computers operate roughly a thousand times faster than present computers. If gigahertz computers were to have the same configuration as megahertz computers, straight scaling up would imply the following approximate characteristics:

(1) Memory cycle: 10 nanoseconds
(2) Gate delay: 0.3 nanoseconds

Though these high speeds may dictate unconventional computer configurations, the circuit speed would not be much lower.

Gigahertz computers should provide two advantages — faster computation and greater economy. While few problems have been identified that require faster computation per se, the eventual economy, the performance per unit cost, promises to be the main attraction. Fast computation per se is needed only if the problem cannot be solved by paralleling several megahertz computers. It is the economy of the gigahertz computers that should bring some of the larger problems into reach. In general, speeding up the circuitry by a factor of 1,000 increases the cost of the computer less than a factor of 100. Even tasks presently on parallel megahertz computers can be performed more efficiently on serial gigahertz hardware.

## gigahertz devices

Gigahertz computer circuits depend on fast devices that provide three basic functions:

(1) Non-linearity: to perform logical operations.
(2) Gain: to restore amplitude and rise time of signals.
(3) Memory: to store data for later use.

As memory can be obtained by properly connecting several logic circuits, this paper is devoted to logic circuitry satisfying the requirements of non-linearity and gain.

A brainstorming session would generate several pages of devices possibly useful for gigahertz circuitry. Exploratory research has narrowed such lists to the following candidates:

| | Typical GB in gigahertz | No. of Ports |
|---|---|---|
| Tunnel Diodes | 10 | 1 |
| Cryotrons | 0.1 | 2 |
| Thin Magnetic Films | | 2 |
| Fast Transistors | 2 | 2 |
| Parametrons, especially variable-capacitance diodes | 3 | 1 |
| Travelling Wave Tubes | 150 | 2 |

Gates with sufficient fan-out and the 0.3-nanosecond switching time, require a gain-bandwidth (GB) product of about 6 gigahertz. The preceding listing shows that some of the devices have this already and that others, particularly variable-capacity diodes and cryotrons, should achieve it in the near future.

One distinction between devices is the separation of inputs and outputs. In two-port devices, the input controls the ouput by a field through the geometry of the device, but the output has no first-order effect on the input. In single-port devices, input and output are connected to the same device terminal, and isolation of directionality must be provided by the circuit.

Size and speed are interrelated at gigahertz frequencies. One inch of wire represents approximately 0.15 nanoseconds time delay. Furthermore, most devices are limited by their distributed capacitances and inductances. The travelling wave tubes (TWT) appear to be the best candidates on Table I but are eliminated by cost, by their relatively large size, and by their inherent time delay as high gain-bandwidth products.

## scope of report

The gigahertz computer field is making rapid progress, and available reports and publications cover research performed until early 1960. Except for some more recent personal communications, techniques and experimental results reflect the status 18 months ago.

At this fluid stage it appears futile to dwell on details almost two years old. Instead, this paper classifies various approaches by fundamental characteristics that determine their usefulness for computer systems. The single-port circuits are critically compared and a new system organization for cryotrons is described.

Figure 1 is the family tree of gigahertz circuitry. The devices are classed by the number of ports. All circuits that have been described fall in these classifications.

## two-port devices

Two-port devices include the multi-layer films, thin magnetic films and cryotrons; transistors; and travelling-wave tubes. Travelling-wave tubes show less promise because of their large size and inherent time delay. Until now, thin magnetic films have not achieved the speed of competitive devices. Cryotrons, now barely in the 0.1-gigahertz range, should eventually reach the 10-gigahertz range.

Though less exotic, transistors quietly keep up with existing gigahertz technology. Speeds of 50 to 100 megahertz, using conventional transistor circuitry and tunnel diode gates have been achieved at M.I.T. Flip-flops;

*Gigahertz is a contraction of the prefix "giga" meaning $10^9$, and "hertz" meaning cycles per second. These international standards adopted also as U.S. standards, replace the more cumbersome and less precise term "kilomegacycle."

operating at 200 megahertz have been reported by Philco.

On the whole, two-port devices, in particular cryotrons and transistors, are strong contenders because they provide the directionality with simple circuitry.

### single-port devices

Currently, single-port devices are closest to gigahertz speed. Of the four circuit functions:

(1) Gain
(2) Non-linearity
(3) Directionality: to transfer information in one direction only
(4) Inversion: to provide logical negation

A single-port device can furnish only the first two; the other two must be provided by the circuit. Differences in the circuitry are fundamentally how they achieve these functions.

*Parametrons.* Parametrons are devices that achieve gain by varying a parameter of the device. They include variable-inductance thin films and variable-capacitance diodes. In a capacitor, gain is obtained by charging it at high capacitance and discharging it at low capacitance. Magnetic thin-film parametrons have been found wanting because they require excessive power at gigahertz frequencies.

Great strides have been made in variable-capacity diodes for phase-locked oscillators and modulator-demodulator configurations. The modulator-demodulator system is essentially a conventional radio-frequency system in which a high-Q variable-capacitance diode modulates a high-frequency (20-40 gigahertz) pump signal, and a demodulator restores it to baseband. The modulator exhibits gain; a modulator-demodulator pair has shown gains of 6.5 db with rise times of 0.4 nanoseconds. Several stages of the modulator-demodulators can be cascaded for a greater gain-bandwidth product at the cost of some delay. However, greater promise of other devices have led to the abandonment of this approach.

In the phase-locked oscillator, the parametric device generates signals at one-half of the pump frequency, and the relative phase of the subharmonic contains the signal. As with any carrier system, the rise time of the signal is at least 10 cycles of the carrier so that pump frequencies on the order of 34 gigahertz would allow operation in the 1-gigahertz signal range. Sufficient gain can be achieved at this band-width by tight tolerances. Requirements imposed by the majority logic operation has led to the abandonment of PLOs for the early gigahertz computers. Tolerance difficulties arose in the pump circuits, the signal circuits, and in the logic modules.

*Tunnel Diode Circuitry.* Tunnel diode circuits can be divided into two classes. In the level class, the output is a function of the present input. In the threshold class, an input pulse triggers the circuit; and, once triggered, the output is independent of the input. In the monostable threshold circuitry, the circuit resets itself; the bistable threshold circuitry requires an external reset, either by turning off the power supply or by an external reset pulse. The bistable group can be subdivided further into the locked and cocked circuits. Locked circuits can be triggered only at a brief instant of time, generally when power is first applied. Cocked circuits can be triggered any time between reset pulses, and then remain in the fired position until reset.

Figure 2 shows the static characteristic of a tunnel diode. The different load lines determine the operation of the circuit. Load line (a) represents a resistance approximately equal to the negative resistance of the diode.

Fig. 1. Classifications of gigahertz circuitry.

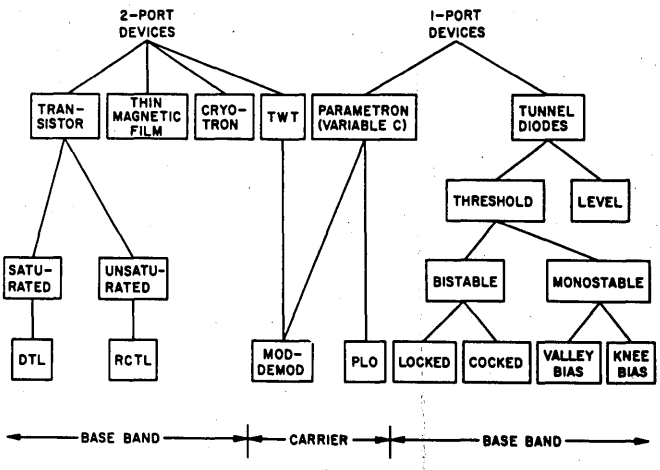



Table I. Characteristics of single-port circuits.

| | CIRCUIT CLASS | RESET MECHANISM | PERIOD OF INPUT SENSITIVITY | SYSTEM USAGE | DIRECTIONALITY MECHANISM | INVERSION MECHANISM | STORAGE (1 BIT) | PRINCIPAL LIMITATION |
|---|---|---|---|---|---|---|---|---|
| TUNNEL DIODE | LEVEL | INPUT | CONTINUOUS | ASYNCH | 1a+1b+2a | FLIP-FLOP | FLIP-FLOP | COMPONENT TOLERANCES LIMITED GAIN |
| THRESHOLD | MONOSTABLE | STORED ENERGY | AFTER RECOVERY OF PRIOR CYCLE | SEMI-SYNCH | 1a+1b | TRANSFORMER INVERTED INHIBIT PULSE | DYNAMIC | LONG RECOVERY TIME, CRITICAL INTERCONN. LENGTH |
| | BISTABLE COCKED | RESET PULSE | AFTER RESET | BOTH | 1a+1b+2a | TEST BEFORE RESET (NOR CIRCUIT) | | COMPONENT TOLERANCES |
| | BISTABLE LOCKED | DEENERGIZE | SET INSTANT ONLY | SYNCH | 2b+2c | INHERENT | DYNAMIC | CRITICAL P. S. TIMING, CRITICAL INTERCONNECTION LENGTH, MATCHING C OF DIODES |
| PARAMETRON | PLO | DEENERGIZE | SET INSTANT ONLY | SYNC | 2b+2c | COUPLING ELEMENT DELAY | DYNAMIC | CRITICAL P. S. TIMING CRITICAL INTERCONNECTIONS |

There is only one stable point regardless of how the load line is shifted. This load line is the basis for an asynchronous level logic.

Load line (b), (c) and (d) represent the threshold circuits; load lines (b) and (d), the monostable; and load line (c), the bistable. When power is applied, the threshold tunnel-diode circuits will assume an initial quiescent state at points B, C, and D, respectively. For the bistable circuit, a positive input pulse will temporarily raise characteristic load line (c) above the knee and the diode will assume its higher-voltage stable point. Similarly, a positive input current on load line (b) or a negative input on load line (d) will move the characteristics above the knee or below the valley respectively, and cause a switch to the higher or lower voltage state temporarily until the circuit returns to its quiescent point after removal of the input pulse.

Bistable circuits have gain in that a small amount of current can move the diode beyond its knee while a large load can be controlled in the valley. Monostable circuits have no gain unless they contain a reactive element, usually an inductor. The inductor increases the recovery time so that while monostable circuits will switch faster than a bistable, their repetition rate is lower. The monostable threshold circuits can be divided into knee-biased (load line b) and valley-biased (load line d). The knee-biased switches faster but has a longer recovery time than the valley-biased circuit. Most work has been done on knee-biased circuits.

A bistable circuit, as represented by load line (c), remains cocked below the knee until triggered by a pulse into the high-voltage position. Two bistable devices can be connected so that one must always be in the high-voltage and the other in the low-voltage position as soon as power is applied. Such circuit will assume one or the other position during the time that power is turned on and will remain locked until de-energized. The circuit is locked because it takes much more power to move a bistable tunnel diode from the high-voltage to the low-voltage position than vice versa, and the trigger voltages are designed to be smaller than the necessary reset pulse. Thus, the state of a locked circuit is determined by the input at the instant when the power applied to the stage goes to its steady state value.

## comparison of single-port circuits

Table I compares the characteristics of the main contenders containing a single-port device, especially the circuit's ability to provide inversion, directionality, and storage of a bit. The table also includes the principal limitations, which turn out to be related to the fundamental operation of the circuit.

As most of the circuits are threshold devices, the reset mechanism is important. For the level-logic circuit, the output is strictly a function of the input. The monostable circuit resets to its quiescent point when the triggering voltage is removed. To speed up the operation and provide gain in the circuit, additional energy is usually stored in the inductance; but even without the inductive element, the trigger has moved the circuit to a higher energy point from which it will return. Both bistable circuits and the PLO can be reset either by turning off the power supply or by a reset signal. The reset signal must contain enough energy to change the device in the attenuation (negative gain) direction. Although both methods are theoretically possible, the PLO and the locked bistable circuits are locked so solidly that it is easiest to turn off the power supply. The cocked bistable circuit can usually be reset with a d.c. pulse, thus simplifying the power supply.

The setting and resetting mechanisms determine when a circuit can be set. Obviously the level gate can be set at all times. Similarly, the monostable circuit can be triggered at all times except during a recovery cycle. The cocked bistable circuit can be triggered any time after it has been reset, but then it remains in the high voltage condition, insensitive to any further triggers. The locked circuits, bistable and PLO, can only be triggered at the very instant the power supply is turned on.

The system usage of the circuits is strictly a function of the input timing. The level circuits can be used completely asynchronously. Theoretically, the monostable circuits could be used asynchronously too, except that for AND or INVERT operations the inputs must overlap. For an OR operation, the inputs should not be separated by more than the recovery cycle to prevent duplicate triggering. The cocked bistable circuit may have several asynchronous levels within a reset cycle, but is obviously reset synchronously. The locked circuits, bistable and PLO, are of course absolutely synchronous.

Directionality can be achieved by various means, each one independent of the circuits. In general, information can be transferred from one tunnel diode gate to another unilaterally if either of the following conditions, through one of its subconditions, holds:

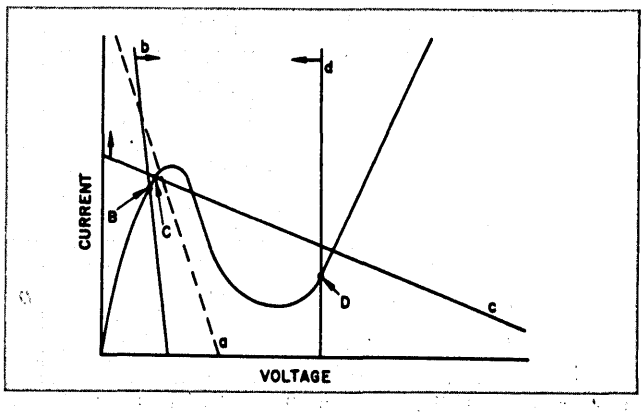
(1) Current through coupling element can exist in one direction only.
  (a) Coupled by a non-linear element;
  (b) Potential difference across element
(2) If a reverse current can exist, the first circuit is insensitive to it and does not change its state.
  (a) It is already in the state to which the current might switch it.
  (b) The power supply to the first circuit is de-energized.
  (c) Circuit is locked in initial state.

Column 4 shows the possible mechanisms for achieving

Table II. Status of most promising gigahertz circuits (1961).

| CIRCUIT FAMILIES | POWER SUPPLY | METHOD FOR ATTAINING: DIRECTIVITY | INVERSION | 1-BIT STORE | MAXIMUM SPEEDS ACHIEVED: SINGLE ADJUSTED CIRCUIT: SWITCH TIME NS | SINGLE ADJUSTED CIRCUIT: REPET. INTERVAL NS | MULTI-CIRCUIT BREAD-BOARD: SWITCH NS | MULTI-CIRCUIT BREAD-BOARD: REP. INT NS | FAN OUT |
|---|---|---|---|---|---|---|---|---|---|
| BALANCED PAIR | 3 ø SINE | TIMING | CIRCUIT | DYNAMIC | 0.3 | 0.9 | 0.7 | 2.2 | 2-4 |
| MONO & BISTABLE | D.C. & RESET PULSES | TUNNEL-RECTIFIER | BISTABLE | FF | 0.3 | 1.5 | 1.0 | 3.5 | 2 |

Fig. 2. Load lines for different tunnel-diode circuits. (a) Level circuit. (b) Monostable, knee-biased. (c) Bistable. (d) Monostable, valley-biased.



directionality for each of these circuits. For the locked circuits, it is usually a combination of 2b and 2c. The system is energized by a 3-phase power supply whereby the driving stage is energized while the next stage is sensitive (2c), and the following stage has its power turned off (2b). The other circuits depend either on unidirectional current flow in the coupling element, or occasionally on combinations that will prevent feedback.

Inversion, necessary for logical negation, is usually difficult to obtain with a logic that depends on the presence and absence of pulses. The level and the locked circuits actually operate like level rather than pulse logic. The level gates do not provide inversion by themselves and thus the family must be supplemented with a flip-flop. Bistable locked circuits have a positive and negative output from the two tunnel diodes. In the PLO, the phase can be shifted by 180° through lengthening the lead slightly. In the monostable circuitry, an inhibit pulse must be applied to a stage simultaneously with another pulse. In the cocked system, a pulse can test the condition of the circuit after it would have been triggered, had there been a ONE input. Another cocked circuit is a NOR circuit which has inherent inversion.

The principal limitations of these circuits are directly tied to their method of operation. The locked circuits and some of the monostable circuits demand that input signals arrive simultaneously, making the inter-connection lengths critical. Furthermore, the locked circuits must time their power supply as it must turn on a stage when the input signals are there. The other circuits depend more on the tolerances of the individual components, particularly the level circuits. In fact, the level circuit has so little gain that a fan-in of two is tops.

### gigahertz cryotrons

The switching time of cryotrons is determined by build-up of an external field and by the switching time of the superconducting material itself. The build-up of the field is limited by the inductance of the circuit, or, more precisely, its L/R time constant. The internal switching time of the superconducting material consists of:

(1) Eddy current damping of the magnetic field propagating into the normal portion of the specimen.
(2) Thermal effects (absorption of the latent heat and generation of ohmic heat) occuring during the transition.

The electromagnetic switching time is expected to vary approximately with the square of the film thickness and inversely with the resistivity.

Although present samples exhibit experimental time constants on the order of 5 nanoseconds, eventual switching speeds of 0.1 nanosecond or less are expected with 5,000 Angstrom films.

A paper study, using cryotrons with assumed characteristics commensurate with the experimental 5-nanosecond rise time showed that a 3-bit ripple-carry adder executes an addition in 100 to 400 nanoseconds. This speed is scarcely competitive with present megahertz computers. However, it leads one to think about entirely different computer organizations.

In cryogenics one of the main problems is the time delay along the interconnecting line, not the switching time of the device itself. Remember it is the inductance that limits the operation. Can we take advantage of this delay in some other fashion?

One way to speed up operations is to make a computer parallel. Although parallelism implies only that many processing elements operate concurrently, it is generally assumed that they execute the *same* operation concurrently on *different* bits of the same sequence (word). Another form of parallelism would be to have many elements perform *different* operations sequentially on all bits of the sequence. Now the delay between elements does not reduce the processing rate, but merely introduces a constant delay time into the totality of all operations. This super-serial approach could be likened to the operation of the early digital differential analyzers that performed one operation after the other concurrently but on different bits of a word. Some preliminary analysis shows that this system may make cryogenics far superior to any other device, especially when cryotrons achieve the higher speeds.

Cryotrons can be manufactured as integrated assemblies. By elimination of all assembly labor and testing, costs will be very low, once appropriate yield can be achieved. Cryostats are available commercially now and greater usage should reduce their cost. The remaining cooling problem is the heat losses through the leads of the cryotrons.

### the state today (1961)

For practical computers, some circuit techniques can be combined. Table II shows those that promise early results. The balanced pair, a locked bistable circuit timed by the 3-phase power supply, switches in about 0.7 nanoseconds. The low repetition interval is due to the 3-phase clock, not any circuit limitation. Fan-outs of two to four appear reasonable. Fan-outs of two can be attained without difficulty; fan-out of three require adjusting individual components. Single circuits, properly adjusted with knobs, are switching at 0.3 nanoseconds.

Mono- and bistable circuits can be combined as a practical family. Such family, powered by direct current and separate reset pulses with directivity supplied by tunnel-diode rectifiers, exhibited switching times of 1 nanosecond and recovery times of 2.5 nanoseconds with a fan-out of two and a fan-in of two to three in experimental multiple-circuit breadboards. Single circuits with knob adjustments can be made to switch at 0.3 nanoseconds with a recovery time of 1.2 nanoseconds.

### and tomorrow (?)

Until late 1959, phase-locked oscillators (PLO) employing variable-capacitance diodes appeared to be the leading contenders for gigahertz computers. Limitations in PLOs and rapid advances in tunnel diodes have advanced the latter into the lead now, and the first computer approaching gigahertz speeds will probably use tunnel-diode circuits.

From a cost viewpoint, cryotons should eventually take the lead, unless integrated circuits with tunnel diodes can be plated or evaporated economically. While the cryogenic technology has not quite reached the speed of tunnel diodes, and though cryotrons will demand an entirely new computer organization, within a few years they should cost one to two orders of magnitude less than competitive tunnel-diode circuitry. ■

This paper is based on a presentation at the 1961 AIEE winter meeting in New York City during the course of which special sessions were held on gigacycle computing systems. The proceedings of these sessions may be obtained from the AIEE, 345 E. 47th St., N.Y.C. 17, at $3 per copy.

Readers desiring a bibliography and reference sources should

CIRCLE 102 ON READER CARD

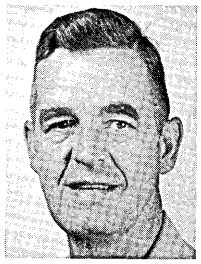


FOR GENERAL DYNAMICS CIRCLE 23 ON READER CARD →

despite intuition

# PROGRAMMING TALENT CAN BE MEASURED

by LT. COL. RAY V. JORDAN, Chief, Data Processing Branch, Comptroller, Hq. SAC, Offutt AFB, Nebraska



This is a difficult thesis to maintain because most discussions on the subject usually equate programmer measurement to a function of experience. However, even the most vocal of the intuitive measurement school agree that there is a need for the development of some objective criteria which can portray to management the relative worth of their programming staff.

The objectives of a programmer measurement system include minimizing elapsed run time, promoting programmer efficiency, identifying the quality of the programmers, and executive benefits from group adherence to a set of standards. With these purposes in mind we have established a coefficient of effectiveness which we call the Programmer Proficiency Profile. The plan envisages a scoring period covering three months of activity.

All programming effort is broadly directed toward current and future projects. Therefore the major divisions of the profile scoring system are based on present performance and projected performance. The scoring has been built around data and statistics that are reasonably available. To place the system in a reasonable environment, we have attempted to include as much objective evaluation as possible. However, we have also included some elements which are basically lead programmer evaluation of their subordinates. These subjective areas are discussed under the "Programmer Excellence" portion of the profile. Briefly stated, the full profile is based on the following factors:

| | |
|---|---|
| **Present Proficiency** | |
| 1. Effective Rate of Computer Utilization | 25 Points |
| 2. Quality Audit of Documentation | 20 Points |
| 3. Adequacy of Operating Instructions | 15 Points |
| **Projected Proficiency** | |
| 4. Progress Analysis of Programming Plans | 15 Points |
| 5. Number of Assemblies versus Mean Number of Assemblies | 10 Points |
| 6. Number of Debugs versus Mean Number of Debugs | 10 Points |
| 7. Debugging Run Time versus Mean Debugging Time | 5 Points |
| **Programmer Excellence** | |
| A. Optimization of Programs | 5 Points |
| B. Complexity of Programming | 5 Points |
| C. Programming Workload | 5 Points |

PART ONE
PRESENT PROFICIENCY

In considering the current production efforts of a programmer we note three major factors that are capable of evaluation:

1. *Effective Rate of Computer Utilization.* This is a measurement of the programmer's production efforts as related to those programs he has created which fail to run because of program error. The formula for computation:

$$\frac{\text{Programmer's Total Production Time On Computer} - \text{Production Time Lost For Program Error}}{\text{Programmer's Total Production Time on Computer}} \times 100 = \text{Effective Rate of Computer Utilization}$$

The rating score is obtained by multiplying the effective rate times the total points for the item. For example, an 80% rate × 25 points = 20 points.

2. *Quality Audit of the Documentation in the Programmer's Run Book.* The need for adequate documentation is particularly clear in the case of an activity that may have a high turnover of personnel. Self evident is the fact that documentation runs concurrently with programming. In order to prevent documentation at the completion of programming, an audit of the documentation will be made of all programmers on a random basis. The survey will be timed so that one-third of the programming staff is reviewed each month. The entire programming group will be audited in the quarterly period. The tabular scoring for each of the programmers' production items will be as following:

| Item | Rating | | | | |
|---|---|---|---|---|---|
| Zero | Poor | Fair | Good | Excellent | Superior |
| 0 | 1 | 2 | 3 | 4 | 5 |

a. Program Narrative
b. General Flow Chart
c. Input and Output Format
d. Memory Layout
e. Detailed Language Bubble Chart
f. Program Header
g. Data Defining Sheet
h. File Specification Sheet — if applicable
i. Coding Sheet
j. Test Data and Conversion Program — if applicable

The maximum evaluation obtainable for a single program

is 10 items × Superior (5) = 50 rating score. The formula for computation:

$$\frac{\text{Total Score Attained}}{\text{(50) Rating Score x Number of Programs Scored}} \times 100 = \text{Precent of Maximum Score}$$

The percent of maximum score times the point available for the item (20), equals the individual's score.

3. *Adequacy of Operating Instructions.* Operating instruction can factually be validated only if they accurately instruct the operator. However, there are tangible benefits that accrue from the standard submission of operating instructions. The purpose in measuring the programmer's operating instructions is to prevent reruns that may be attributed to poor operating instructions. It is apparent that since the programmer converses with the operator through operating instructions the recording must be legible, complete, and specific. As a measurement of the operator's instruction sheet the following factors are included:

| | Poor | Good | Outstanding |
|---|---|---|---|
| | 0 | 1 | 2 |
| a. Legible | | | |
| b. Entries Complete | | | |
| c. Remarks Cover | | | |
| 1. Starting Address | | | |
| 2. Correction | | | |
| 3. Input | | | |
| 4. Typeouts | | | |
| 5. Restarts | | | |

The maximum evaluation obtainable for a single program is seven items × outstanding (2) = 14 rating score. The formula for computation:

$$\frac{\text{Total Score Attained}}{\text{(14) Rating Score x Number of Programs Scored}} \times 100 = \text{Percent of Maximum Score}$$

The percent of maximum score times the points available for the item (10) equals the individual's score. However, since some well written operating instructions fail to do the job in actual production, a penalty demerit of one point is assessed against each program which fails because of a mis-instruction of the programmer. For example, the programmer specifies the wrong file designator.

## PART TWO
## PROJECTED PROFICIENCY

4. *Progress Analysis of Programming Plans.* The delays for program implementation are most often traceable to the procrastination which was allowed to consume time in the preparatory stage. To provide personal progress checkpoints each programmer will establish his dated milestones which will permit program production within the established production date. The dates forecasted for projected performance include the following elements:

a. Systems Design
b. General Flow Charting
c. Detail Flow Charting
d. Coding
e. Assembly
f. Debugging
g. Production

Each program consists of seven elements which have been dated by the programmer for performance. The forecasted and actual dates will be measured for an analysis of progress. Failure to meet a single date negates the scoring for that program. Formula for scoring would be:

$$\frac{\text{Number of Programs Which Met Element Target Dates}}{\text{Number of Programs in Planning State}} \times 100 = \text{Planning Effectiveness Rate}$$

Planning effectiveness rate times points available (15) = total score for item.

5. *Number of Assemblies versus established mean for assembly runs.* Each programmer's efforts in assembling programs will be matched against the average number of assemblies which have been taken by local programmers to date. Any program which uses a number of assemblies which is larger than the mean will be categorized as a sub-standard effort. Formula for scoring will be:

$$\frac{\text{Number of Programs Assembled} - \text{Sub-Standard Assembled Programs}}{\text{Number of Programs Assembled}} \times 100 = \text{Assembly Performance Rate.}$$

Assembly Performance Rate times points available (10) equals attained score for this item.

6. *Number of Debug Runs versus established mean for Debug Run.* Each programmer's efforts in debugging programs will be matched against the average number of debugs which have been taken by the local programmers to date. Any program which uses a number of debugs which is larger than the mean will be categorized as a sub-standard effort. Formula for scoring will be:

$$\frac{\text{Number of Programs Debugged} - \text{Sub-Standard Debugged Programs}}{\text{Number of Programs Debugged}} \times 100 = \text{Debugging Performance Rate.}$$

Debugging Performance Rate times points available (10) equals attained score for this item.

7. *Time Spent Debugging versus Mean Time for Debugging a Program.* An average time has been established for a debug run. It is recognized that some sophisticated programs use more than average time and we would be invoking a penalty for superior work. The offsetting point accumulation would be awarded to this individual under the Programmer Excellence Portion of the profile. For each program that is debugged in the rating period which *exceeds* the mean, a penalty point will be assessed. For example, if a programmer has two debug programs which run for a longer time than our average time then he would be scored: total score (10) minus Penalty Points (2) equals total attained score (8).

## PART THREE
## PROGRAMMER EXCELLENCE

The specific intent of this portion of the profile is to permit supervisors to identify those subordinates whose talents are worthy of merit mention. In as much as 100 points are attainable in Parts One and Two of the profile, the programmer excellence portion may be considered as "bonus

points" to the profile score. This scoring will be done entirely by the supervisory programmer. The distribution of the profile points in this subjective part of the scoring will follow a normal curve pattern. Skewness in the scoring curve is more a reflection of supervisory sympathy than programmer skills.

A. *Optimization of Programs:* Improving an established program is a facet of programming that is given much lip service. In practice, however, it appears as if few programmers deliberately strive for optimization of their efforts. An optimized program is most often that reworked program which uses less computer time than the original effort.

However, we can have contributions to optimization which may be more general in nature in the sense that the first effort was in itself an optimized program. Minimal use of Flexowriter typeouts, efficient use of monitor levels, the rapidity with which a program is written, all contribute to a supervisory estimate of optimization. Item can be scored up to five (5) points. *Integrity in scoring is stressed.*

B. *Complexity of Programs:* As a recognition of a programmer's efforts in writing programs that are intricate in nature there is a provision to add to his profile scores for the complexity of his program. This addendum to the score is a function of the lead programmer. As there is no methodology for determining complexity, the prime consideration is the experience of the supervisor. We suggest attention be given to the nature of the program being programmed, the use of tables, the use of sub-routines, and the type of instruction used. Since complexity is a subjective relationship with all known programs there is little reason for the distribution of points not to follow a normal curve pattern. Maximum score allocated for this item is five points.

C. *Programming Workload:* Comments are often made as to the relative distribution of workload. The subject matter most often decides the size of the workload. The program maintenance workload is in relationship to the number of programs assigned. To provide profile recognition for those programmers who have significant workloads in relationship to other programmers, the lead programmer will award merit points. Maximum score allocated for this item is five points.

## PART FOUR
## SUMMARY

1. *"RE Factor:"* Quantitative arrays of people in terms of their profile scores can be misleading if taken alone. For this reason we have added a qualitative element, or Reasonable Explanation ("RE") of the facts. This permits a narrative explanation of what could be misleading facts. The quality of the explanation will determine its quantitative merit. Scores will be converted based on the subjective weight placed on the "RE Factor."
2. *Conclusion:* The foregoing represents an effort at putting a tangible label on what most people say can only be evaluated by experience. The success of an effort of this nature depends on the spirit with which the supervisors view the project. We stress that lead programmers will never be competitively grouped with subordinates. The success or failure of profiling programmers is not in the writing, but in the doing. ■

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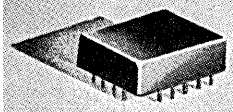

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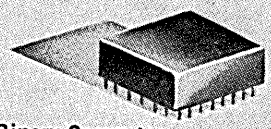

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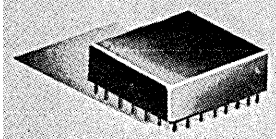

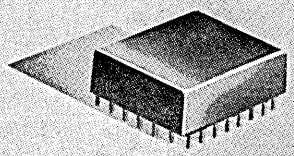

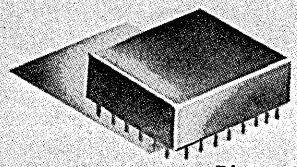

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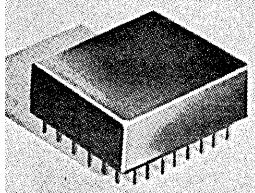

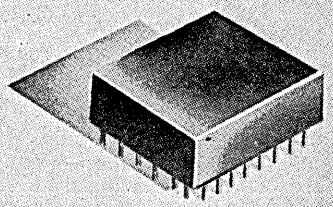

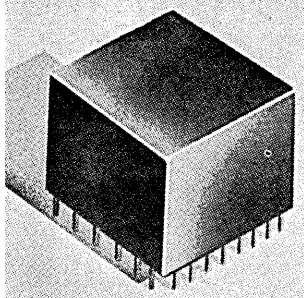

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# NEWS BRIEFS

## NEW ASA GROUP TO STUDY FORTRAN STANDARDS

The Common Programming Languages Subcommitte (X3.4) of American Standards Association Sectional Committee X3 (Computers and Information Processing) is forming a FORTRAN standards group to "develop proposed standards of the FORTRAN language."

W. P. Heising, IBM, has been named chairman of the new group, which is designated X3.4.3-FORTRAN. Manufacturers, as well as users, are anticipated as participants in the group.

## COMPUTERS IN SPACE AGE THEME OF FJCC

"Computers in the Space Age" is the theme selected for the 1962 Fall Joint Computer Conference to be held at the Sheraton Hotel, Philadelphia, December 4-6.

The technical program will include papers in these broad interest areas: information processing in space technology; advanced system organizations; hardware/software relations; new applications of information processing; information processing as a national resource; information communication and display.

Papers will also discuss information retrieval; learning processes; self organization; man/machine interface; speech recognition; cryogenics; programming theory; I/O advances, and multiple computer systems.

General chairman of the 1962 FJCC is J. Wesley Leas, RCA, Camden, N. J.; vice chairman, E. Everet Minett, Univac Div., Sperry Rand Corp., Blue Bell, Pa. Herman A. Affel, Jr., Auerbach Corp., Philadelphia, is finance committee chairman.

## N.W. COMPUTING ASSN. TO MEET IN AUGUST

The Northwest Computing Association will hold its annual summer conference at the Olympic Hotel, Seattle, Washington, on August 9 and 10. Theme of the conference will be "Computer Processes: Education to Research."

Workshops and technical sessions, along with an exhibit of hardware, have been scheduled. Keynote speaker will be Fred Gruenberger of the RAND Corporation. For information and registration, contact Robert Smith, Conference Director, Northwest Computing Association, Box 836, Seahurst, Washington.

## SIMULATION COUNCILS ADMITTED TO AFIPS

Simulation Councils, Inc., has been voted membership in the American Federation of Information Processing Societies, and is the first group to be admitted under the charter opening membership to other than the three original member societies, ACM, AIEE, and IRE. A national analog organization, Simulation Councils was voted to the status of affiliate member.

## LINK DEVELOPS OPTICAL SCANNER

An optical scanner which reads variable type styles at speeds of up to 6,000 wpm has been announced by the Link Division of General Precision, Binghamton, N. Y. Designated the Model X-2, the scanner's input function is being designed to handle all types of documents ranging from card-size records to complete page formats.

Availability date, delivery schedules, and prices were not announced by the manufacturer.

CIRCLE 100 ON READER CARD

## GE DEVELOPS ONE PASS COMPILER-ASSEMBLER

A combination compiler-assembler called ZOOM has been developed by Marshall Johnson, a 24-year-old programmer at General Electric Computer, Phoenix. Basically, ZOOM is a series of generators used to create an assembly input and requires only one pass during compiling.

The program has the characteristics of a general compiler, but is said to be closely related to an assembly program. Designed specifically for the GE-225, ZOOM offers the option of writing statements in compiler language, assembly language, or a combination of the two.

Johnson, who developed the program on his own time over a twelve week period, had been programming only three months when he began work on ZOOM. He has been with GE since June, 1961.

CIRCLE 101 ON READER CARD

## "LANGUAGE OF COMPUTERS"

*The Language of Computers* is a new book by Professor Bernard A. Galler of the University of Michigan intended for high-school seniors and college freshmen. It treats several problems (mostly non-mathematical) from the point of view of discovering for each one an algorithm for its solu-

## UNIVERSITIES TO EXHIBIT AT ACM CONFERENCE

The 1962 ACM National Conference and International Data Processing Exhibit will feature a section in the exhibition hall devoted to university activities in computing. Schools taking part in the exhibit, which will be held in Syracuse, N.Y., Sept. 4-7, are the University of Massachusetts, University of Akron, Southern Illinois University, University of Michigan, University of Pittsburgh, Syracuse University, University of Houston, and Duke University.

Scheduled to be shown is an information retrieval system; a computer facility as used in conjunction with course work in programming; a total systems approach to university administrative, research, and instructional uses of computing equipment; an audio-visual tour of computing center activities; and teaching materials and library programs.

The technical program will offer papers covering automatic programming and computer languages, business information processing, information retrieval, language translation, real time processing, and educational uses of computing techniques.

Technical sessions will be held at the Syracuse Hotel, conference headquarters, and at the War Memorial Auditorium, which will also be the scene of the exhibit.

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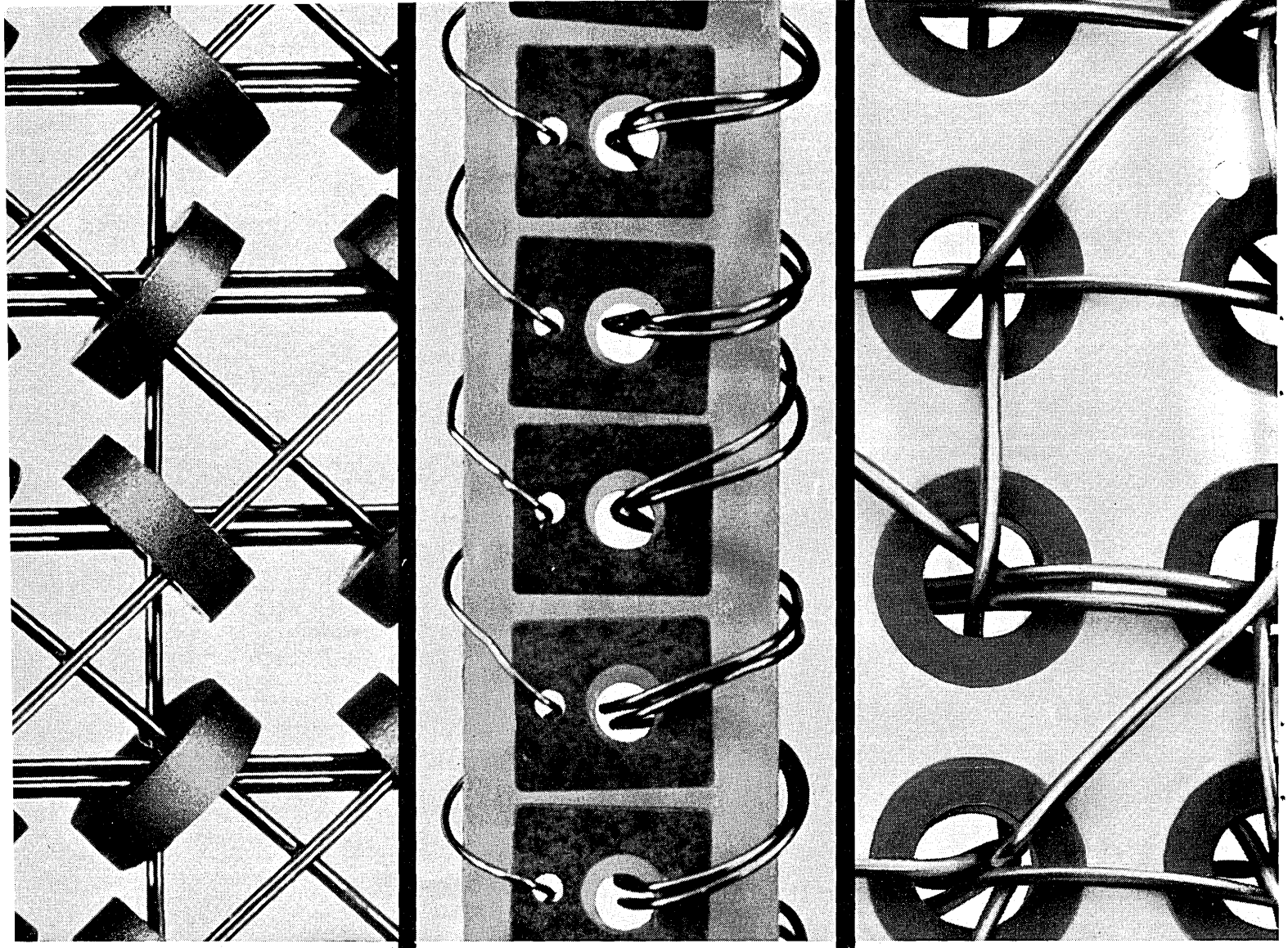

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The enlarged photos above show three of the many types of memory plane assemblies produced by Lockheed Electronics.

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tion, and then asking what features would be desirable in a computer language for communicating the algorithm to a computer.

The language which appears is a subset of MAD (see *Datamation*, December, 1961), with appendices showing how to translate this language into FORTRAN and ALGOL. The McGraw-Hill Book Co. is the publisher.

CIRCLE 103 ON READER CARD

### GLOBAL POWER STRUGGLE PROBED BY COMPUTER MODEL

Raytheon Company's Missile & Space Division, Bedford, Mass., will simulate the international power struggle on a computer, to serve as a model to test arms control plans, limited war capabilities and threats, foreign aid programs and other strategic operations.

The first stage of the model, which is being constructed under Defense Department contract, will consist of Eastern, Western and Neutralist blocs and their interactions. Information on the three blocs, their productivities, ideologies, military strengths and other characteristics have been programmed.

Problems, such as limited wars or famines, can be injected into the simulation, followed by counter moves — deployment of forces, threat of limited or all-out war, or economic aid programs. Future plans call for refinement of the model's three blocs into individual nations.

Heading the project for Raytheon is Clark C. Abt.

### NEXT MONTH IN DATAMATION

For readers unable to attend next month's IFIP Congress in Munich, DATAMATION offers its August issue as a stay-at-home-without-beer-drinking-guide focused on a special IFIP section denoting the conference program, exhibits and field trips. As proper background for this theme, correspondents in England, France and Germany report on computing progress on the continent with an obvious eye directed at U.S. comparisons.

Also on tap is a survey for time buyers, a report on schizophrenic computing at USC, a Granholm guide to hiring programmers, and a taped interview with Bendix general manager Charles Edwards.

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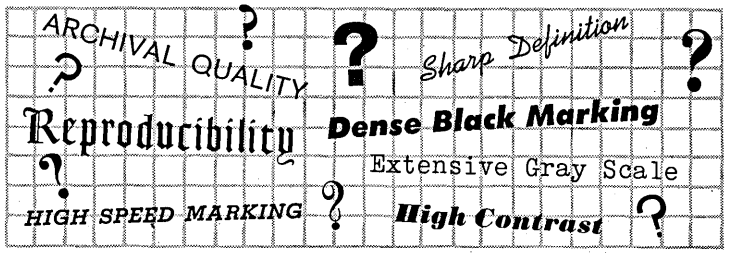


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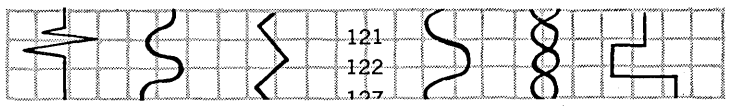


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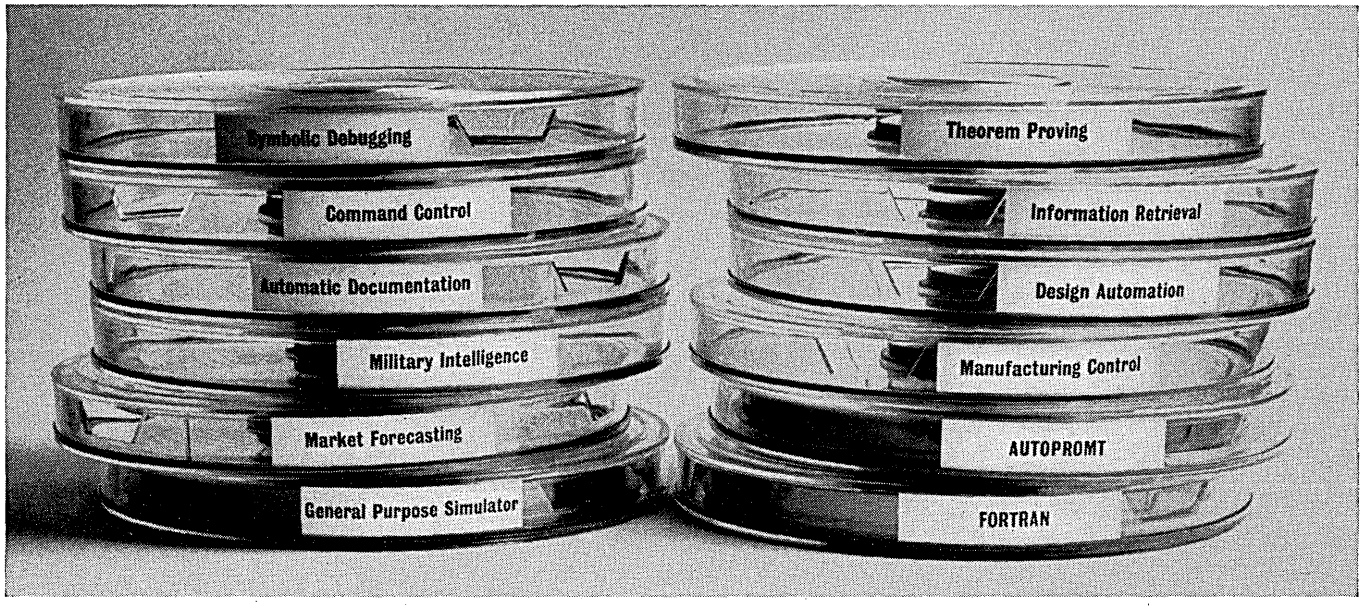
**IBM** extends the range of programming

# Are you interested in exploring the capabilities of the computer?




Some of the most important programming developments are taking place now at IBM.

The broad scope of work underway at IBM offers important advantages to members of our professional programming staff. They have the opportunity to work on projects taken from the broad range of programming. They are face to face with the frontiers of applied, scientific and administrative programming. For example, what advanced programming techniques interest you the most: multiprogramming systems . . . compilers . . . problem-oriented languages and processors? Programmers at IBM are exploring these techniques and many more.

Here are some other areas you might work in if you were a programmer at IBM: theory of computing . . . artificial intelligence . . . simulation systems . . . scheduling methodology . . . communications control systems . . . space systems . . . and the design of total computer systems.

At IBM, you would find yourself in the kind of atmosphere that encourages accomplishment. You would help to design new hardware systems. You would work side by side with men of eminent professional stature: scientists, engineers and mathematicians who pioneer in the research and development that make new computing systems possible.

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The scope of programming at IBM stimulates professional growth. It offers possibilities which merit serious consideration whether you are a master of the skills of programming or a relative newcomer to the field. Salaries and benefits at IBM are excellent. If you have experience in scientific or commercial programming, we would like to acquaint you with the wide range of responsible positions on our programming staff.

Programming facilities are located in San Jose, Calif.; Washington, D. C., area; Lexington, Kentucky; Rochester, Minnesota; Omaha, Nebraska; and New York, Endicott, Kingston, Owego, Poughkeepsie and Yorktown Heights, NewYork. IBM is an Equal Opportunity Employer.

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CIRCLE 28 ON READER CARD


# people IN DATAMATION

■ S. Dean Wanlass, president of Packard Bell Computer, resigned last month to join Philco Computer as vice president and general manager of the division. Succeeding Wanlass at Packard Bell is Dr. Wendell B. Sell, formerly vice president and general manager at Marquardt Corp.'s Pomona division.

■ Dr. Alan J. Perlis, head of the Computation Center and Department of Mathematics, Carnegie Tech, has been elected president of the Association for Computing Machinery for the 1962-1964 term. Elected vice president was Dr. Bruce Gilchrist, director, Systems Engineering Technology, IBM Corporate Staff. Herbert S. Bright, manager, Programming and Planning, Philco Computer Division, was elected secretary.

■ Walter L. Anderson has been named chairman of the Professional Group on Electronic Computers, Institute of Radio Engineers. Anderson, who previously held the position of vice chairman of the Group's Administrative Committee, is vice president of General Kinetics, Inc.

■ Edward K. Blum has resigned as acting director of STL's programming and applied mathematics lab to direct computing at Wesleyan University, Conn. He will also teach mathematics and numerical analysis, and conduct research in programming and automata theory. His replacement is Dr. Eldred Nelson.

■ Dr. C. West Churchman, Professor of Business Administration at the University of California, Berkeley, will assume the duties of Dr. Launor F. Carter as SDC Research Director while Carter serves a one-year term as Air Force Chief Scientist.

■ R. J. Mindlin, of NCR, has been appointed chairman of the International Committee for Character Recognition. At NCR, Mindlin directs the Banks and Financial Systems Section of the company's Product Planning Dept.

# Now see this!

**New Acme Visual Control Panels mastermind electric brains at Department of Defense worldwide general supply center**

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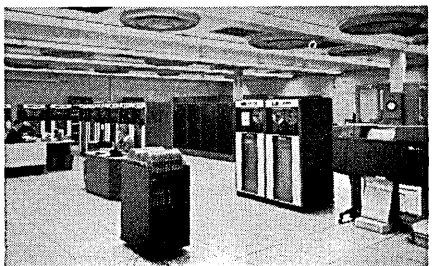

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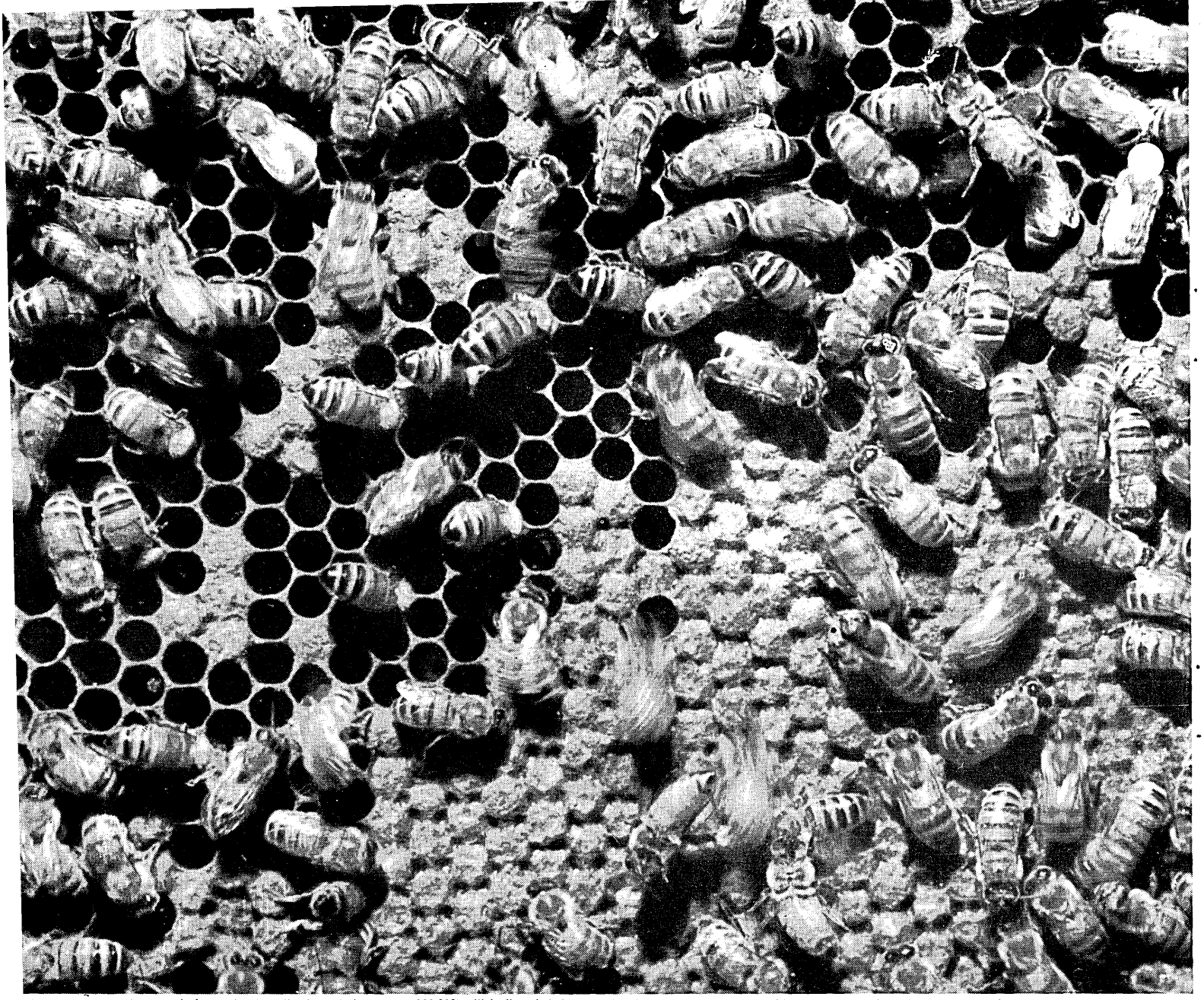

To prevent loss of honey during maturation, the bees (colony pop.: 120,000) will incline their hexagonal, tubular cells at an angle of 5 degrees . . . "The Life of the Bee" by M. Maeterlinck.

# to bee...or not to bee

That is the question which faces many a young programmer in today's mushrooming computer industry . . . whether 'tis more satisfactory to blend one's talents with the mass effort, which, in the case of our worker bees above, can result in one of the most effective organizational efforts known to man . . . Or, whether it better suits the programmer's personality to operate under less confining conditions, feeling free to spread his creative wings in flight over widely divergent terrain . . . Fortunately, both alternatives are still available to qualified programmers . . . For those more comfortable in the mass effort, there is an abundance of opportunity with larger organizations . . . For those who incline to the activities of miniaturized task forces, for those who seek to develop new techniques, to explore new areas of information processing in concert with business, industry and government . . . there is Computer Concepts, Inc., a young organization staffed with seasoned veterans of the computer industry . . . Computer Concepts, an equal opportunity employer, has immediate openings for senior and medium-level programmers with a minimum of 2 years experience on IBM 704/709/7090 computers. Salaries range to $15,000 per year. Relocation expenses are paid. Send resume to—

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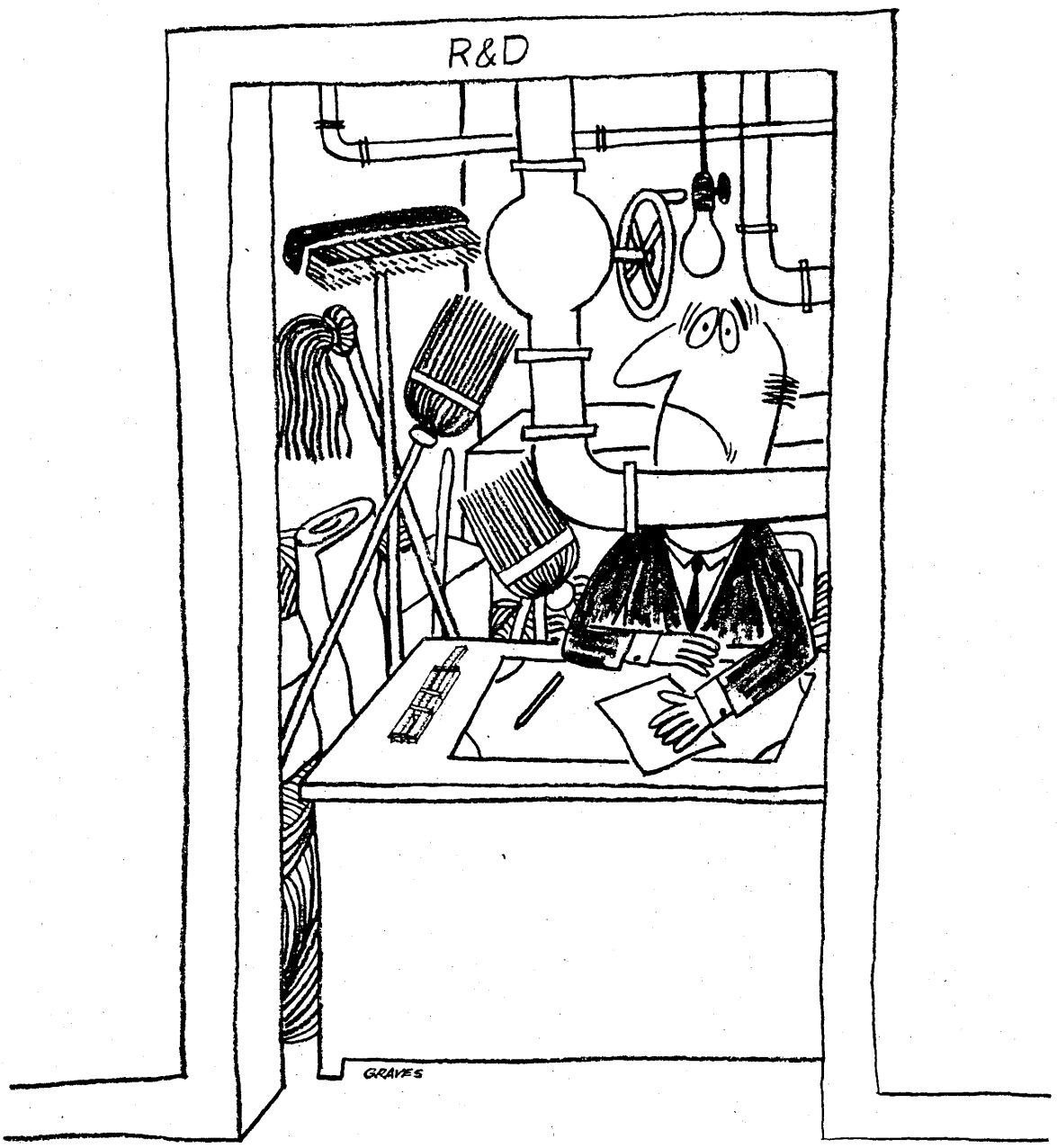


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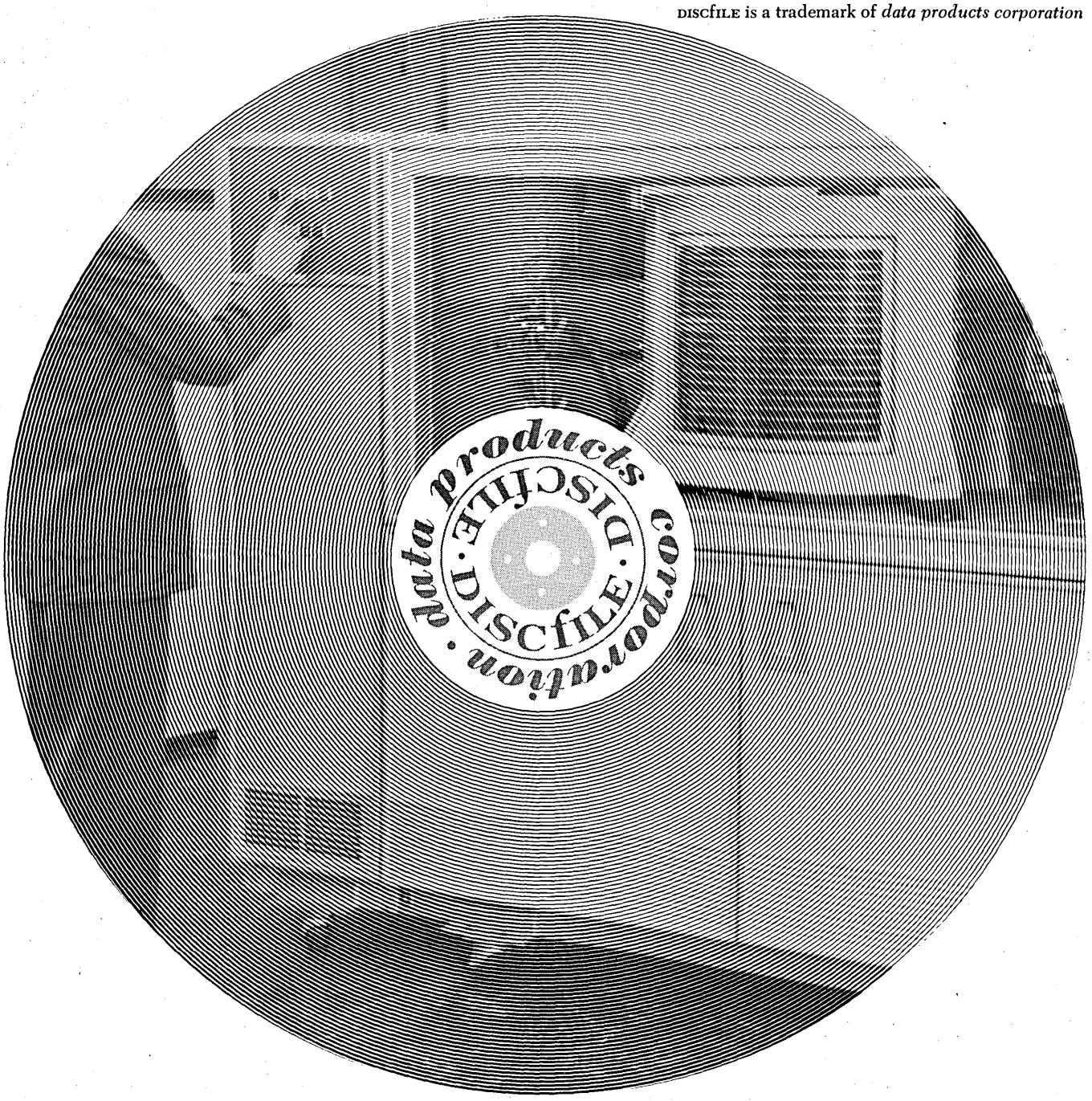


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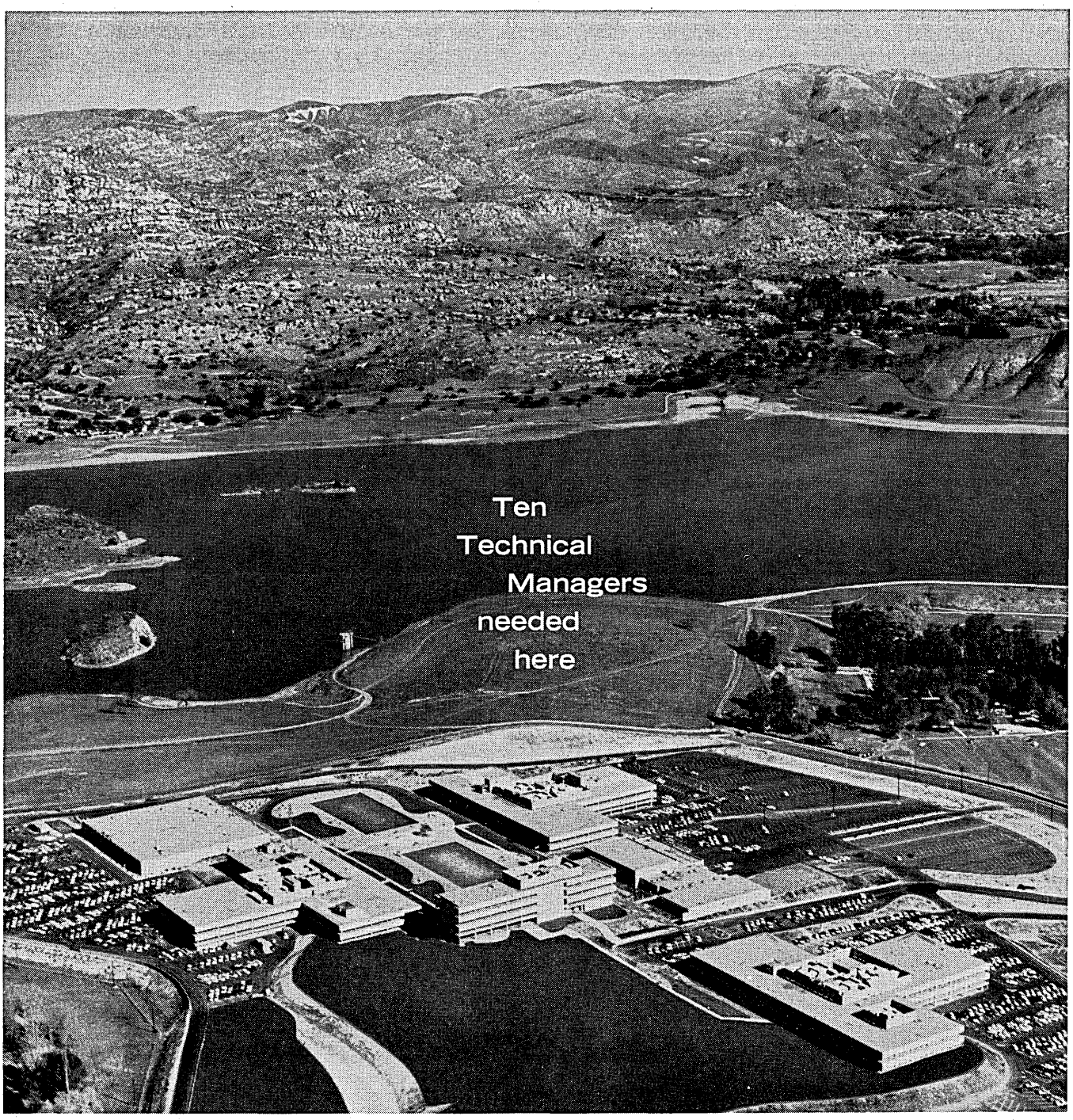


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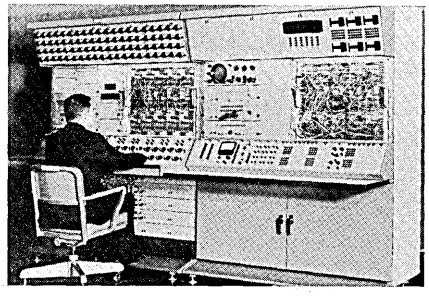

digital memory, analog memory, analog digital conversion and advanced digital arithmetic. It is applicable in the areas of iteration and optimization studies, partial differential equations, simulation of logic functions and auxiliary mathematical functions. ELECTRONIC ASSOC., INC., Long Branch and Naberal Ave., Long Branch, N. J. For information:

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### card readers

CR-1, CR-2 and CR-3 have been designed to accept punched cards, read the information on the cards and transmit the information. The three models differ in the number and variations of codes they can interpret. A-I-D-S DIV. OF EMPCOR, 101 West Verdugo Ave., Burbank, Calif. For information:

CIRCLE 201 ON READER CARD

### 401 data transmission system

The reading capability of this system is up to 51 columns of numeric information on 22, 51 or 80 column cards at a speed of 10 columns per second. The system consists of a card reader and translator. Features include remote control of alternate program, skipping and 11 or 12 punch. THE STANDARD REGISTER CO., Dayton 1, Ohio. For information:

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### precision magnetic tapes

Type 22 and type 33 (especially designed for analog recording use) are said to be error-free at 556 or 800 bits per inch. A new technique, used for these tapes, holds coating thickness within ±10 microinches tolerance and has been specially treated to reduce its resistance to less than 75 megohms per square. MEMOREX CORP., Santa Clara, Calif. For information:

CIRCLE 203 ON READER CARD

### ALTARE

This Automatic Logic Testing And Recording Equipment can complete the functional test of a logic board in 12 minutes. It is tape programmed with all voltage comparisons completed automatically. If a logic board error is found during the test, the error is visually displayed and printed out on paper tape. AUTONETICS, 9150 E. Imperial Highway, Downey, Calif. For information:

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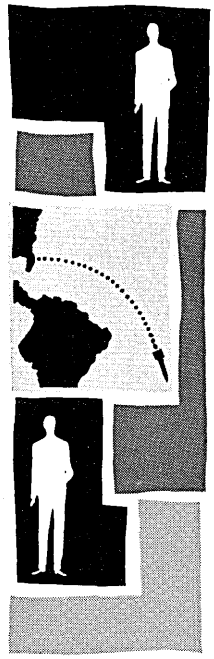
### data communications equipment

The CTDS 2400 has a data rate of 2400 bits per second over a single channel and a maximum probable error rate of one bit in 100K. Five different units are available with standard data rates of 600, 1200, 1300 and 2400 bits per second. The system is compatible with any present digital data acquisition, processing or computing equipment and will operate over commercial quality voice communications channels. List price is $6,600. THE HALLICRAFTERS CO., 4401 W. 5th Ave., Chicago 24, Ill. For information:

CIRCLE 205 ON READER CARD

### reader/handler

This block tape reader and handler, model 623, operates without storage or isolation circuits. Output is read directly from the interlocking reading head which prevents tape movement during opening or closing of the head. Standard EIA 1″ Mylar tape which can be coded by standard 1″ punch units is utilized and is available with transport mechanisms for use either

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# COMPUTER MAINTENANCE ENGINEERS

465-L, the world's largest digital computer-based communications/control system is now being engineered by the International Telephone and Telegraph Corporation.

Federal Electric's role on this global system, designed to transmit, process and display SAC operational data, is the installation design and subsequent installation, check-out and maintenance of headquarters and remote equipments.

Successful applicants will first receive intensive formal training in the theory of the 465-L system, followed by a thorough indoctrination and orientation on the existing prototype system. Then, working with our engineering staff at Paramus, they will participate in the system installation planning phase. After this will come permanent relocation to operational sites, to direct the installation and carry-out continuous maintenance and user training programs.

To engineers with a degree and three to five years' experience in the maintenance of large-scale digital computer or digital data processing systems, we offer the opportunity to join this unique operation.

For consideration, send a detailed resume to Manager, Professional Staffing, Dept. DA-1.

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## NEW PRODUCTS . . .

with AC or DC voltage. The 623 is priced at $1695. CHALCO ENGINEERING CORP., 15126 S. Broadway, Gardena, Calif. For information:

CIRCLE 206 ON READER CARD

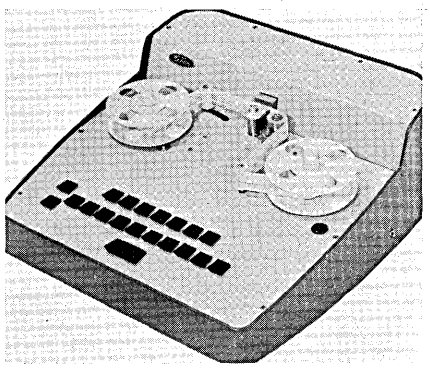
### high speed multiplexer

The EM-3 is available for switching from four to 64 channels and operates with a basic setting time of 20 $\mu$ sec. It will switch a full complement of 64 channels in less than 50 $\mu$ sec. Input and output limits of the EM-3 are $\pm 10$ volts with no inversion and the unit will drive a stable load impedance of 25,000 ohms or more. Price is $2000 plus $210 per pair of channels. PACKARD BELL COMPUTER, 1905 Armacost Ave., Los Angeles 25, Calif. For information:

CIRCLE 207 ON READER CARD

### self-verifying tape punch

Model 1010 verifies the information it punches by printing the character



above the hole code. Any 20 combinations of numbers, letters and symbols for the keys are available. Price is $790. NAVIGATION COMPUTER CORP., Valley Forge Industrial Park, Norristown, Pa. For information:

CIRCLE 208 ON READER CARD

### computo-form

This new form has been designed for use with high speed printers and is particularly applicable to short run reports. Computo-Form features both vertical and horizontal shading and column heading spacing. ALLIED/EGRY BUSINESS SYSTEMS, Dayton 2, Ohio. For information:

CIRCLE 209 ON READER CARD

### multivibrator

Model DCMV1182 consists of an astable multivibrator and output buffer amplifier. The base frequency is set by internal circuitry and is stable to within $\pm 10\%$ over the temperature range from $-40°C.$ to $+100°C.$ SOLID STATE ELECTRONICS CORP., 15321 Rayen St., Sepulveda, Calif. For information:

CIRCLE 210 ON READER CARD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As a principal research, development and manufacturing division of the global International Telephone and Telegraph Corporation, ITT Federal Laboratories is carrying on a long tradition of pioneering in electronics and communications. With principal research facilities on both coasts and in the mid-West, ITT Federal Laboratories is staffed and equipped to undertake a wide range of systems and component projects, from initial research to final production.

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- Electronic Display Equipment
- Technical Writing

Engineers and scientists interested in exploring the broad range of career opportunities offered by these programs are urged to write to Manager, Professional Staff Relations, Dept. DA.

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**New 0.5 μsec Microferrite Word-Address Memory Stacks:** RCA's new Microferrite Memory Stacks make possible complete read/write cycle times of less than 0.5 μsec at driving currents no higher than 350 ma with at least 50 mv output. This revolutionary new stack, designed to meet Military Specifications, is a result of RCA's broad experience in producing thousands of memory planes and stacks in hundreds of configurations.

**Versatile RCA Memory Planes and Stacks:** In addition to the new Microferrite Word-Address Memory Stack, RCA's broad line includes: Wide temperature range stacks incorporating temperature stable, high-temperature ferrite cores...Temperature controlled stacks designed to meet MIL Specifications...Conventional memory stacks without temperature controls for applications requiring high quality at lowest possible price. All RCA planes and stacks are 100% dynamically tested to assure compliance with operating specifications. Planes are available in molded plastic, printed circuit and aluminum frames.

**Wide-Margin Ferrite Cores — High-Speed Transfluxors:** RCA offers one of the industry's most comprehensive lines of memory cores all designed with specified wide operating margins. One of the newest additions to the line is type 233 M1, a high-temperature core having an output variation less than 0.25 mv per °C over a 140°C temperature range. RCA memory transfluxors are available with switching speeds as fast as 1.3 μsec.

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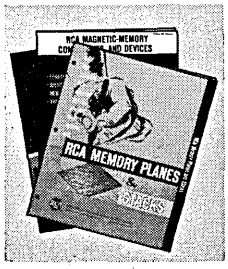


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CIRCLE 33 ON READER CARD

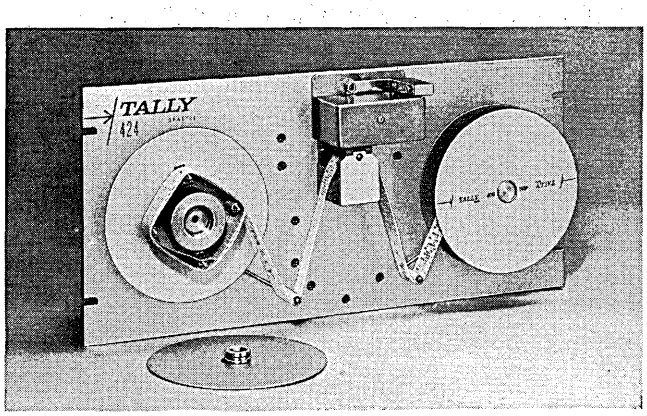
# TALLY TAPE READERS, PERFORATORS AND SYSTEMS

Tally Register offers a complete line of perforated tape readers and perforators. Tally readers feature up to 120 characters per second operation in either direction, instant reverse, triggered tape feed, and full bit accountability with form C switching for positive hole/space identification. Readers will handle 5, 6, 7, or 8 channels of information without modification, up to 16 channels on special order. Reader prices begin at $575.

Tally perforators are self-contained high speed punches which operate at 60 characters per second and accept 5, 6, 7, or 8 channels of paper, foil, or Mylar tape without modification. On special order up to 16 channels are available. Perforator prices start at $1,000.

Both readers and perforators feature asynchronous operation which simplifies control logic and oil mist lubrication for quiet operation.

Peripheral and accessory equipment includes tape handlers, verifier and duplicator control modules, transistor drives, end-of-tape sensors, edge milling, NAB hubs, cables and so forth.



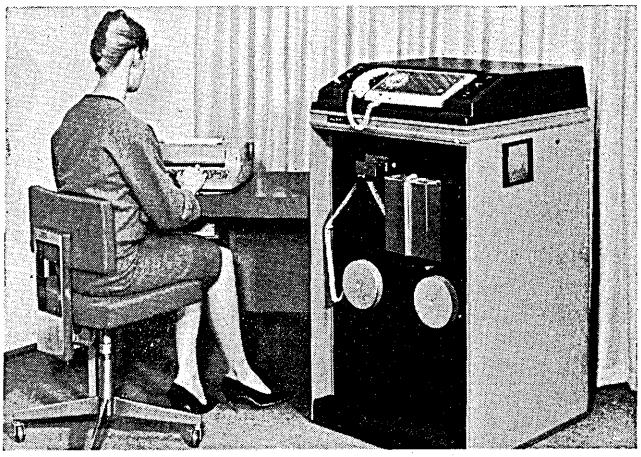

Rack mounted version Model 424PR Tally Reader

## TALLY MARK SYSTEMS

To fill specific perforated tape system needs at a low cost, Tally has structured various groups of standard components plus interconnecting logic.

Mark 1 through 3 systems are data communications systems. Mark 20 through 23 units are standard verification, duplication and preparation systems. Mark 40 series covers tape to typewriter equipment. Mark 60 systems convert paper to magnetic tape.

Tally Mark 1, 2, and 3 systems are used in conjunction with the Bell System's new Parallel Data-phone service to provide a significant breakthrough in the price / performance ratio of data communications. These systems feature unrestricted character transmission rate up to 60 characters per second or 600 words per minute • Unrestricted by tape format or code structure • Variable system transmitting speed • Data remain in parallel form for flow through telephone network, eliminating need for serializing equipment • Simplified operation • Uni-directional or bi-directional communications.



Most sophisticated of the new Tally data systems is the new Tally Mark 50 series. Shown above is the Tally Mark 51 which combines the advantages and features of the data dissemination and point to point communications systems with the high speed hard copy reader to typewriter to perforator systems of the Tally Mark 40 series.

Typical of Tally Mark 40 systems is the new Tally Mark 45 Read/Write Perforated tape system featuring IBM's Selectric typewriter. Data are entered or retrieved at 15½ characters per second. This speed is 25% higher than the earlier IBM Model B electric typewriter and 100 percent faster than other equipment currently on the market.

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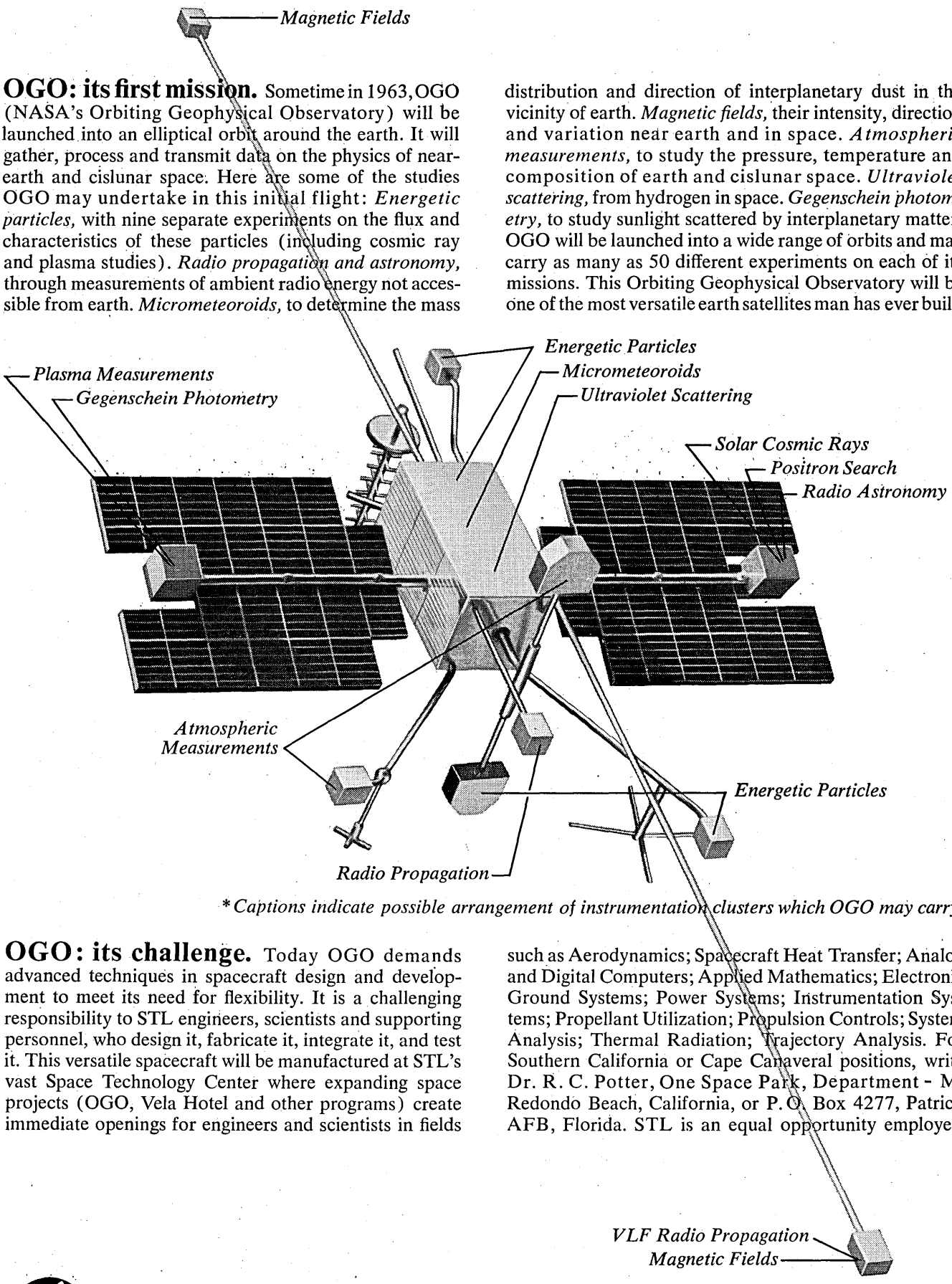
**OGO: its first mission.** Sometime in 1963, OGO (NASA's Orbiting Geophysical Observatory) will be launched into an elliptical orbit around the earth. It will gather, process and transmit data on the physics of near-earth and cislunar space. Here are some of the studies OGO may undertake in this initial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




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

**OGO: its challenge.** Today OGO demands advanced techniques in spacecraft design and development to meet its need for flexibility. It is a challenging responsibility to STL engineers, scientists and supporting personnel, who design it, fabricate it, integrate it, and test it. This versatile spacecraft will be manufactured at STL's vast Space Technology Center where expanding space projects (OGO, Vela Hotel and other programs) create immediate openings for engineers and scientists in fields such as Aerodynamics; Spacecraft Heat Transfer; Analog and Digital Computers; Applied Mathematics; Electronic Ground Systems; Power Systems; Instrumentation Systems; Propellant Utilization; Propulsion Controls; System Analysis; Thermal Radiation; Trajectory Analysis. For Southern California or Cape Canaveral positions, write Dr. R. C. Potter, One Space Park, Department - M, Redondo Beach, California, or P. O. Box 4277, Patrick AFB, Florida. STL is an equal opportunity employer.

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Business Programmers
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PERT System Programmers
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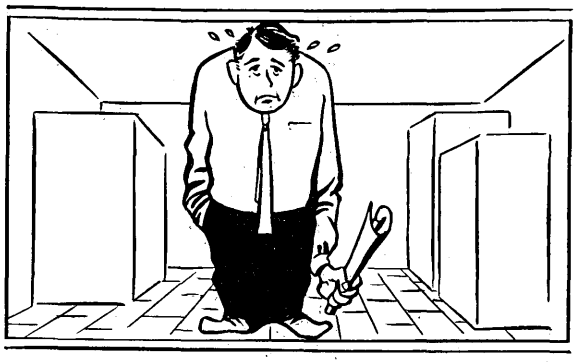

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# NEW LITERATURE

**PLANAR EPITAXIAL DIODES:** A table of electrical specifications showing maximum ratings and a series of 18 application curves are included in this data sheet on the company's line of silicon Planar epitaxial diodes. FAIRCHILD SEMICONDUCTOR, 545 Whisman Rd., Mountain View, Calif. For copy:
CIRCLE 130 ON READER CARD

**DOWN-TIME AND SERVICE CALL REPORT:** This form is offered to all dp machine users to record pertinent information relative to the non-operating time of each piece of equipment in their section. It may also be used for recording operational failures on other machines. AUTOGRAPHIC BUSINESS FORMS, INC., 45 E. Wesley St., South Hackensack, N.J. For copy:
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**ATTENDANCE SYSTEM:** This 16-page booklet presents a general description of a new computer based punched card attendance system being used in the Massachusetts schools. Included are sample punched cards, examples of output, technical operating details and the 1401 and FORTRAN programs which are used. For a copy of this booklet send $1.00 to NEW ENGLAND SCHOOL DEVELOPMENT COUNCIL, 475 Broadway, Cambridge 38, Mass.

**DIGITAL CLOCKS:** This packet contains descriptions of digital clock designs including count-down, count up, time programmer, analog output, multiple display systems and test sequences. PARABAM, 12822 Yukon Ave., Hawthorne, Calif. For copy:
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**DYNAMIC ANALYSIS AND SIMULATION:** This 10-page illustrated pamphlet describes the analog and combined analog/digital capabilities of the mathematics and computing services of this company. RESEARCH LABORATORY, AERONUTRONIC DIV., FORD MOTOR CO., Ford Rd., Newport Beach, Calif. For copy:
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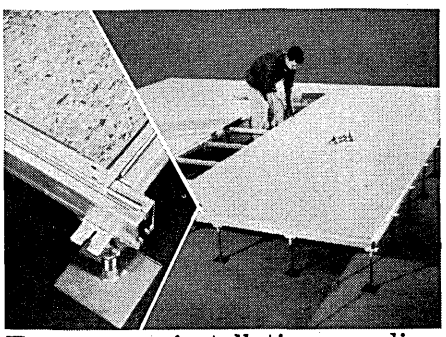

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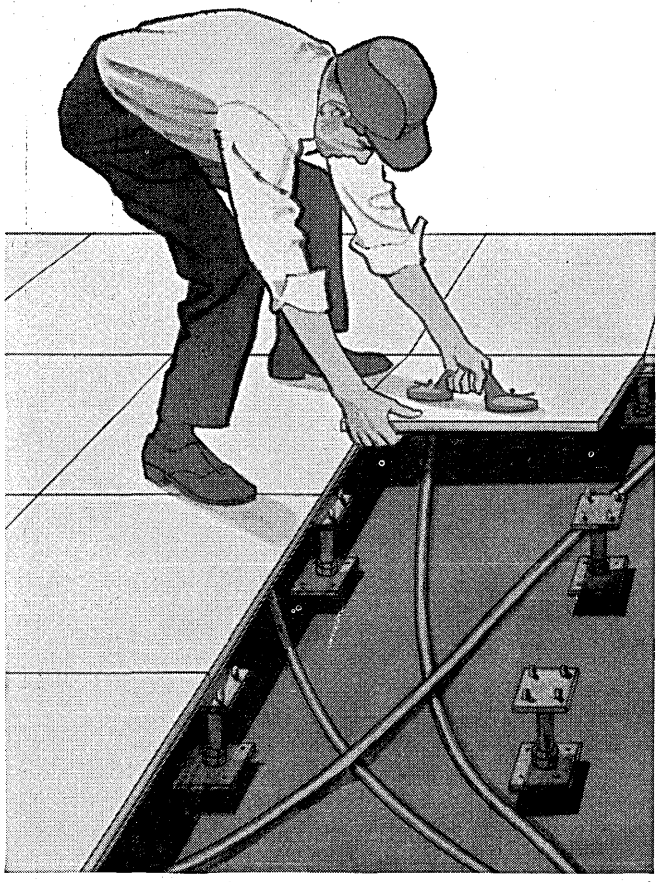

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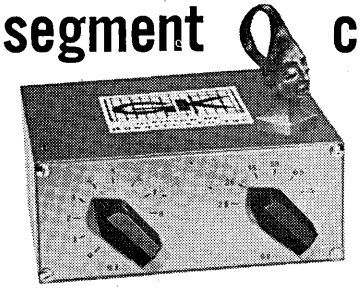

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| Part # | Total Delay μs | Increment Delay | Td/Rt Ratio | Zo | Max. Rt. |
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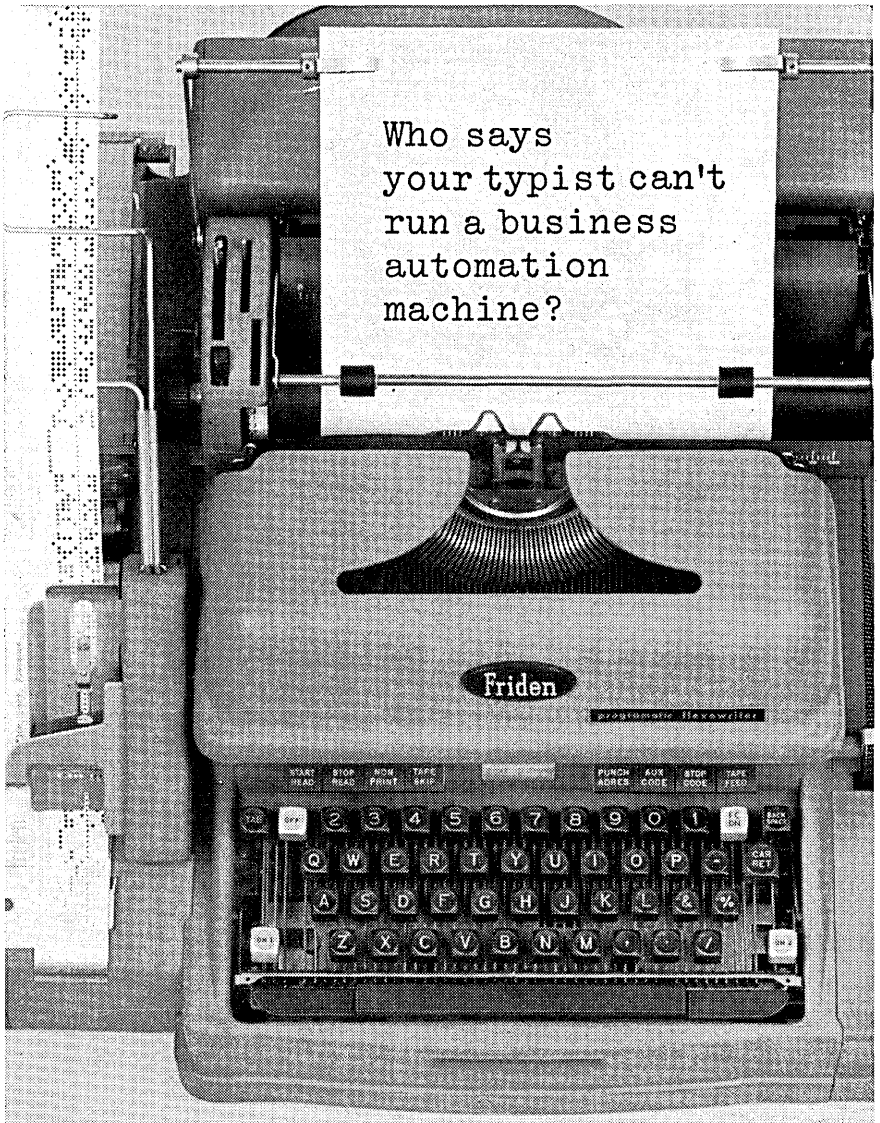


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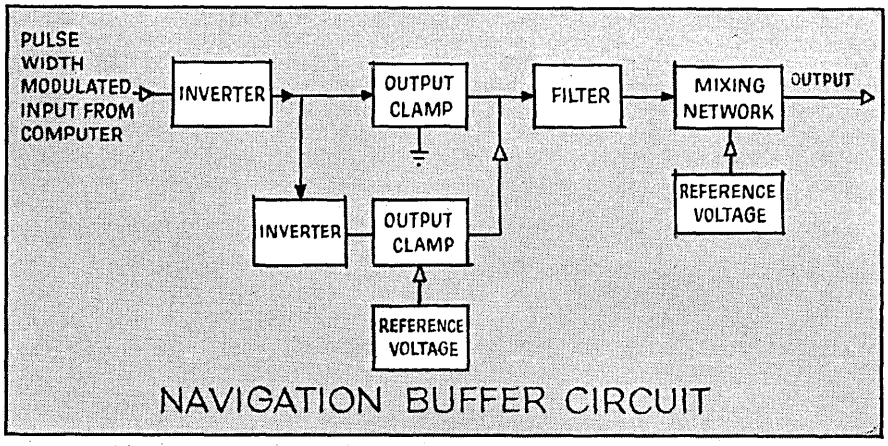

NAVIGATION BUFFER CIRCUIT

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

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

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

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

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

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

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

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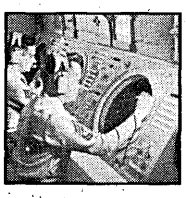
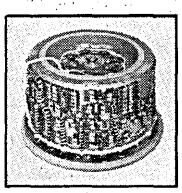
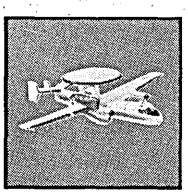

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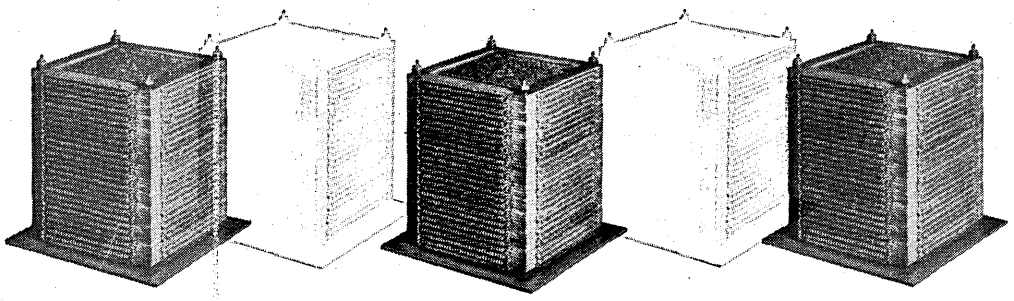

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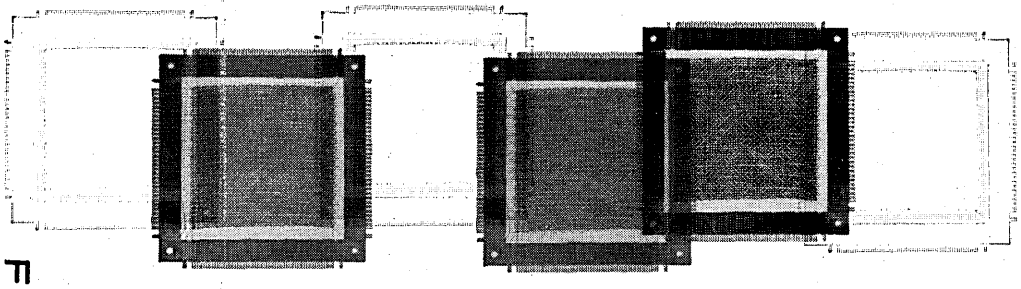

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