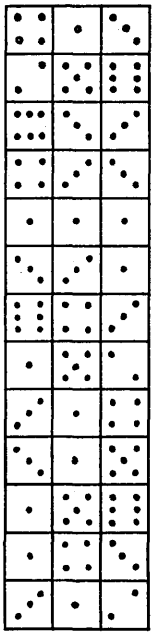
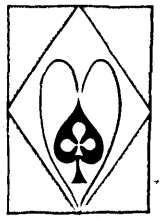
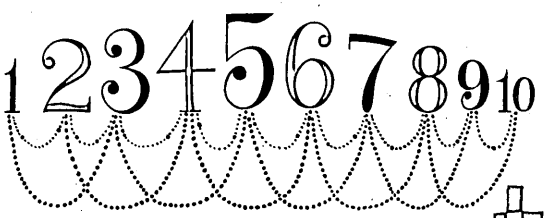
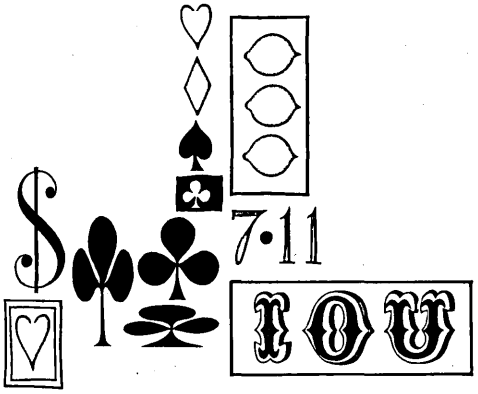
DATAMATION®

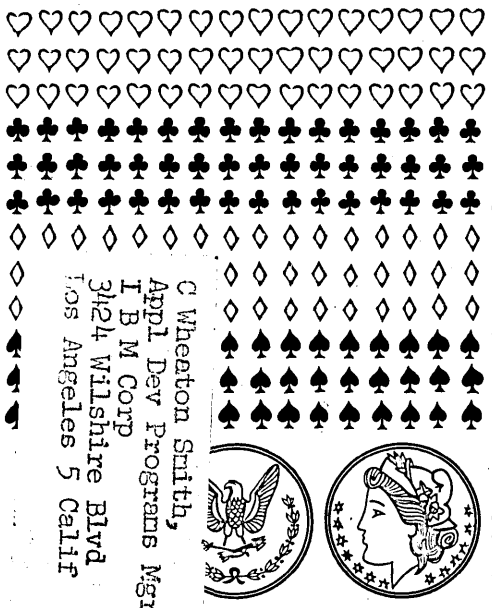
October

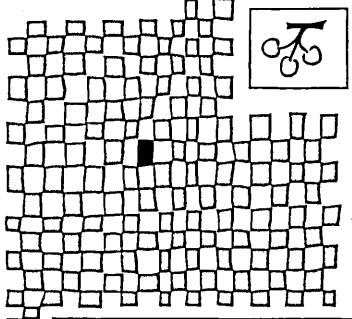


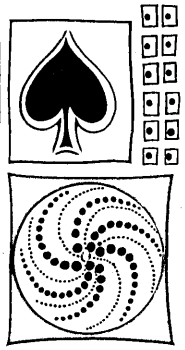


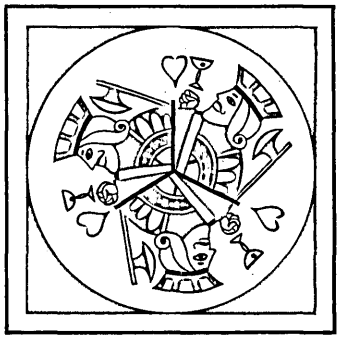












C Wheaton Smith,
Appl Dev Programs Mgr
I B M Corp
3424 Wilshire Blvd
Los Angeles 5 Calif

BF
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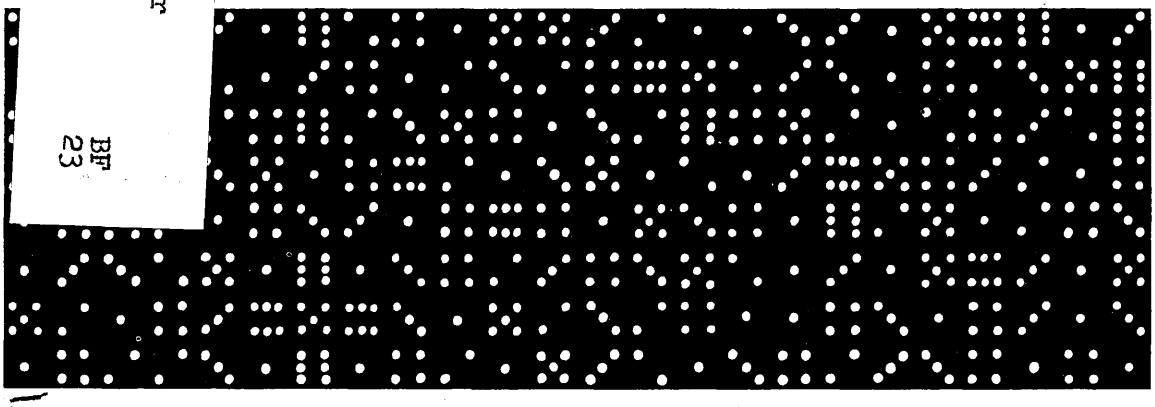
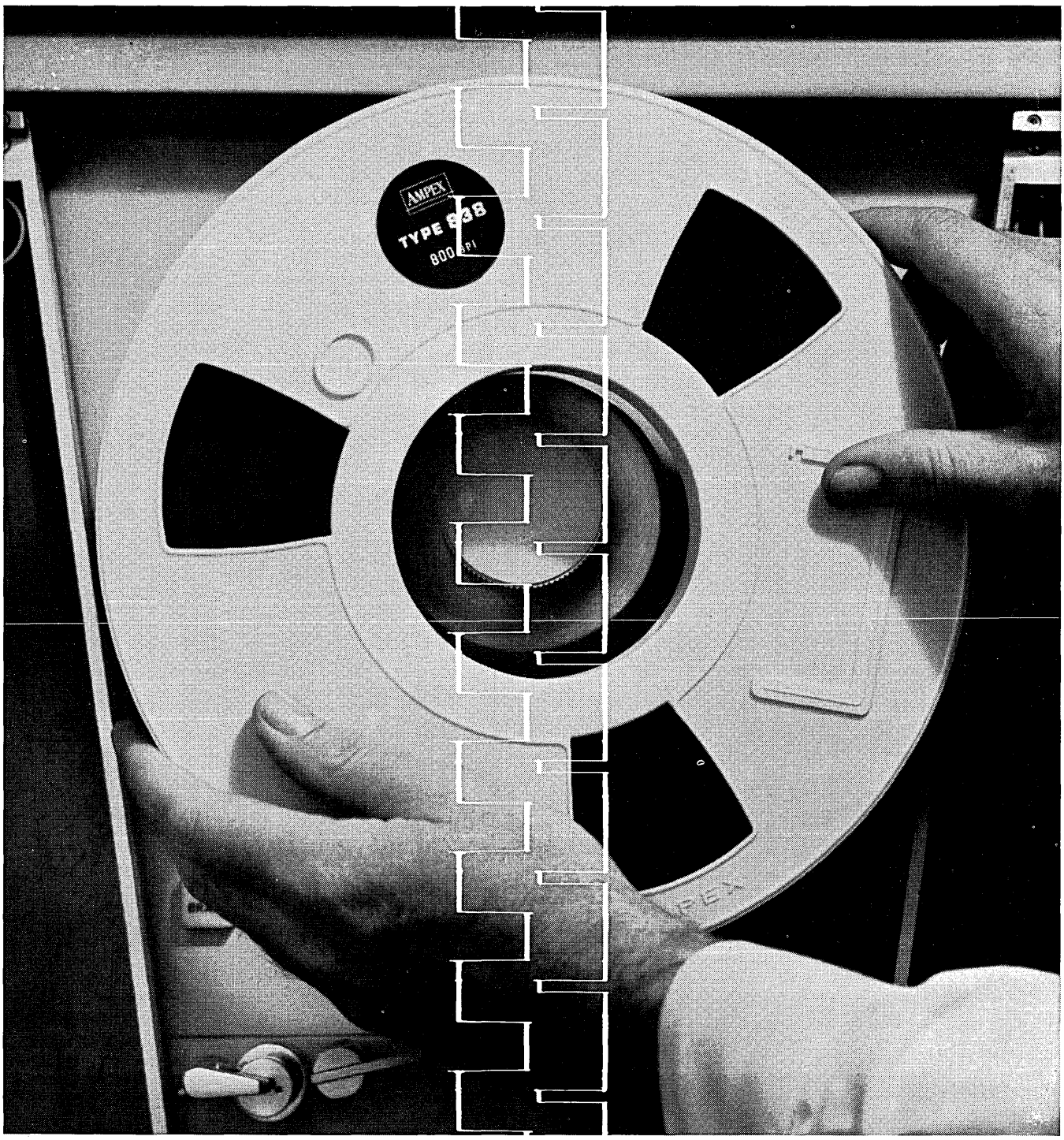


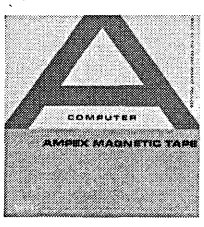
1963 Fall Joint Computer Conference
Las Vegas, Nevada



Who wants you to test their computer tape before you buy it?

AMPEX

We think we've got a computer tape that's next to perfect. And we'd like to prove it. We'll bring you a tape to test out on your own system—at no obligation to you. (All Ampex computer tapes are fully compatible with IBM systems.) And each reel you buy is guaranteed to meet specifications on the first read pass—or we'll replace the tape. Here's why we can be this confident: Before we pack a tape for shipping, we digitally check it from end to end on a system compatible with the one on which it will be used. That way we know it's completely free from even one permanent error. And our tapes stay error-free longer. An exclusive Ferro-Sheen* process, together with an improved binder, keeps the surface smoother; reduces headwear and oxide build-up. For more information write the only company providing recorders, tapes, core memory devices for every application: Ampex Corp., 934 Charter Street, Redwood City, Calif. Worldwide sales and service.

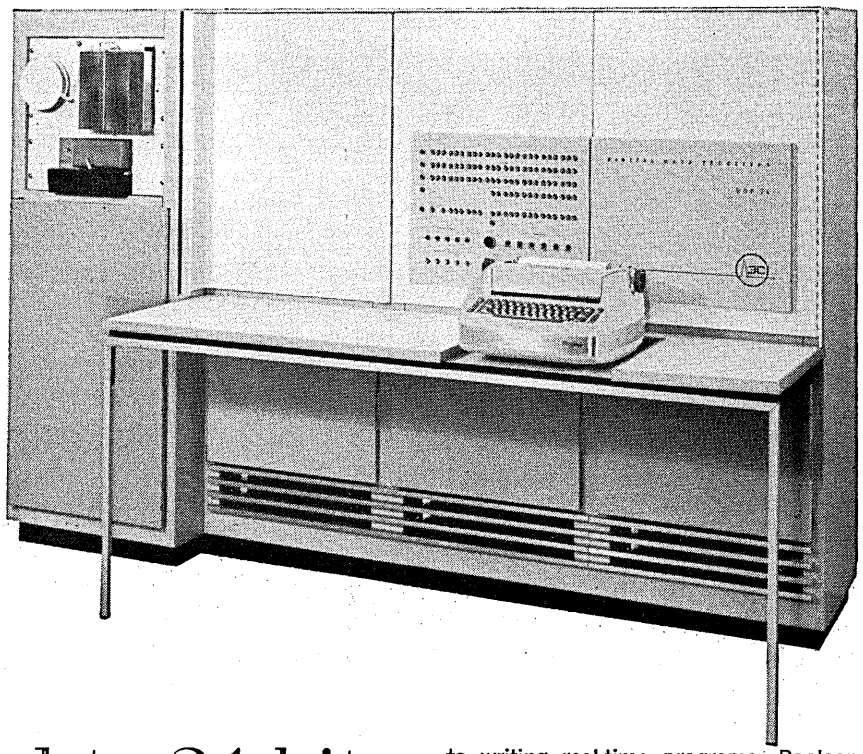


AMPEX

*TM Ampex Corp.

CIRCLE 1 ON READER CARD

$87,000



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

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

DDP expanded to 24 bits Faster arithmetic unit Comprehensive software

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

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

SPEED

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

Add floating point	116μ/secs. max.
Multiply floating point	97μ/secs.
Add double precision fixed	70μ/secs.
Add double precision floating	181μ/secs.
Multiply double precision fixed	204μ/secs.
Multiply double precision floating	371μ/secs.

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

INPUT-OUTPUT

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

SOFTWARE

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

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

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

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

OPTIONS

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

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

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

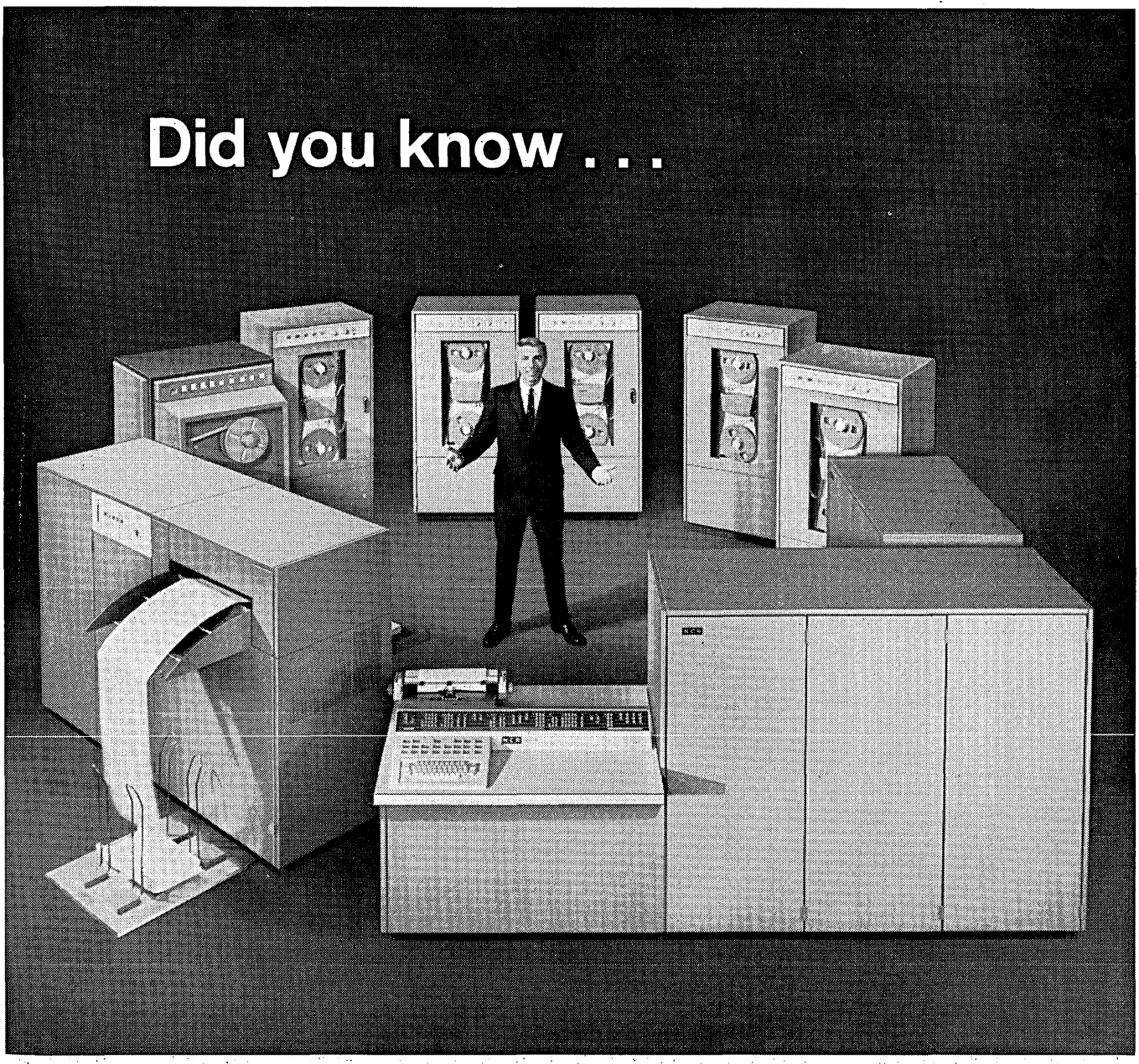
Peripheral equipment optionally available: Magnetic tape control and transport units, A/D, D/A converters, card adapter, high speed line printer and adapter, digital plotter and adapter. Digital Resolver, satellite computer, increases DDP speed up to 10 times for algebraic and trigonometric functions.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

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

COMPUTER CONTROL COMPANY, INC.

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

CIRCLE 4 ON READER CARD



you can get an NCR 315 Computer System for only $3800 per month?

YES . . . five magnetic tape handlers, a punched paper tape reader, a high-speed printer, a console, and a processor containing a 10-thousand character memory for only $3800 per month.

With this NCR 315 computer system more businesses than ever before can enjoy the benefits of electronic data processing. It is a system that is expansible — up to 16 NCR CRAM (Card Random Access Memory) files, up to four magnetic character sorters, up to three more magnetic tape files, and a punched card input/output unit can be added as future requirements dictate.

There's more we could say about this system . . . space does not permit. Give your local NCR Representative a call . . . he has all the facts.

NCR PROVIDES TOTAL SYSTEMS — FROM ORIGINAL ENTRY TO FINAL REPORT — THROUGH ACCOUNTING MACHINES, CASH REGISTERS OR ADDING MACHINES, AND DATA PROCESSING
The National Cash Register Co.-1,133 offices in 120 countries • 79 years of helping business save money

NCR

CIRCLE 5 ON READER CARD

IN COMPUTER APPLICATIONS YOU NEED PRECISION—

AND THAT'S THE WORD FOR ARNOLD BOBBIN CORES

For use in shift registers, coincident current matrix systems, pulse transformers, static magnetic memory elements, harmonic generators and similar equipment, Arnold Bobbin Cores meet the most exacting requirements.

Quality and uniformity? *You'll find them no problem*—because, as a fully integrated producer with highly modern facilities, we're able to maintain close control over every step.

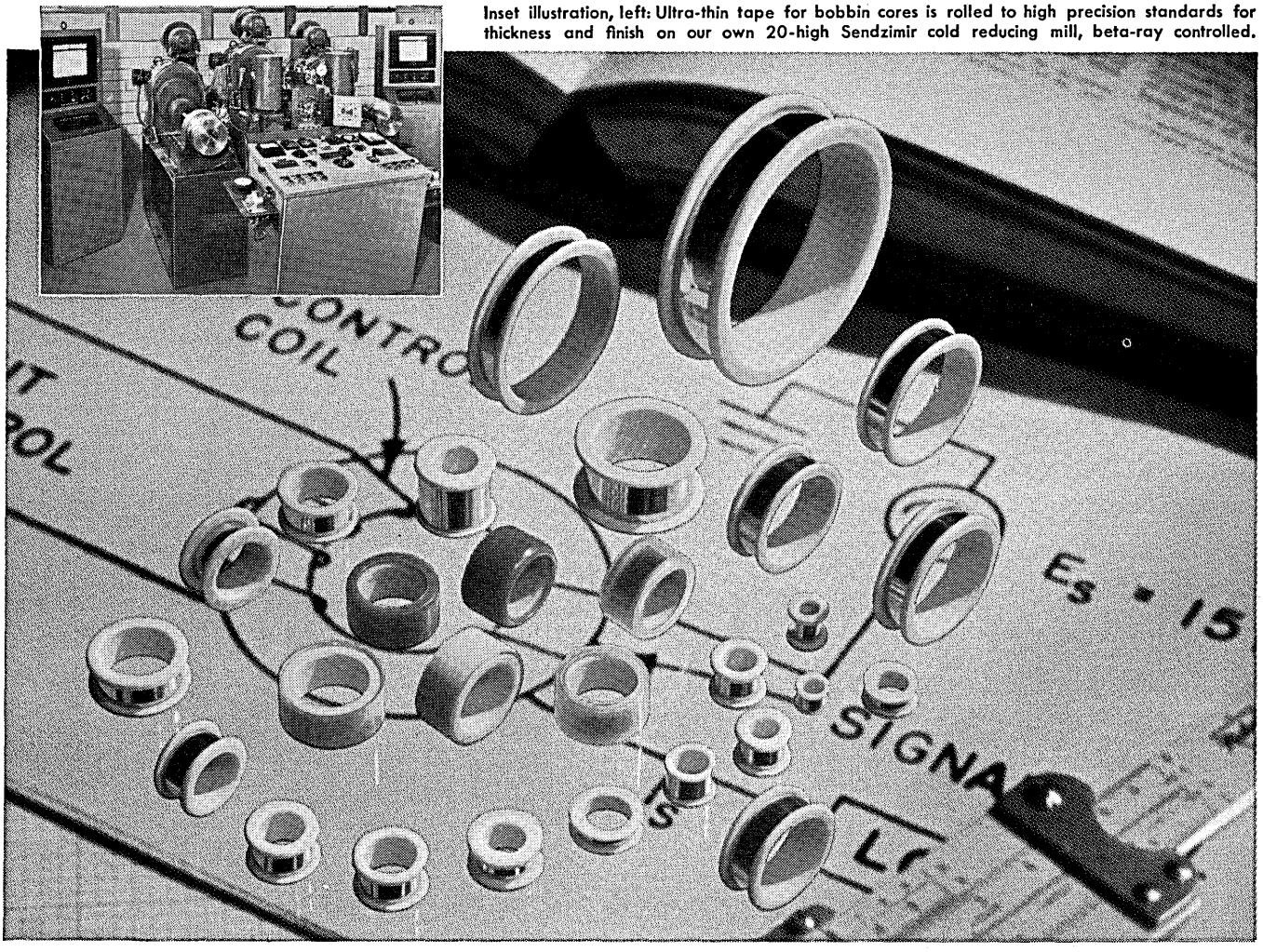
Arnold Bobbin Cores are available in a wide range of sizes, tape thicknesses, widths and number of wraps. Magnetic materials usually employed are Deltamax and Permalloy, in standard gauges of 1, ½, ¼ and ⅛ mil, in widths from 1/32" through ¼". Core properties include quite rectangular hysteresis loops, relatively low coercive values and high saturation densities, plus the ability to shift in a few micro-seconds from negative remanence to positive saturation, and vice versa, under conditions of pulse excitation.

Let Arnold supply your requirements for bobbin cores, other tape-wound cores, powder cores, permanent magnets, etc., from the most complete line of magnetic materials in the industry. • For data on bobbin cores, ask for Bulletin TC-108A. Just write ***The Arnold Engineering Company, Main Offices, Marengo, Ill.***

ADDRESS DEPT. D-9

ARNOLD
SPECIALISTS in MAGNETIC MATERIALS

BRANCH OFFICES and REPRESENTATIVES in PRINCIPAL CITIES • *Find them FAST in the YELLOW PAGES*



Inset illustration, left: Ultra-thin tape for bobbin cores is rolled to high precision standards for thickness and finish on our own 20-high Sendzimir cold reducing mill, beta-ray controlled.

CIRCLE 6 ON READER CARD

I must be getting smarter, Computape. Suddenly, I can see right through you!

It's the Computron people who are getting smarter, Penelope. This new transparent LEXAN* reel is the most sensational, fabulous, and otherwise terrific thing that's ever happened to computer tape!

You'll have to pardon Computape's exuberance, but he's all wound up about his new LEXAN reel—a very important first in the computer tape field. LEXAN reels cost more than conventional polystyrene reels. They are worth it. Much tougher and stronger. Much higher impact strength. Much more resistance to heat distortion and warpage. Extra fire resistance. (LEXAN is self-extinguishing.) *You just don't get this kind of protection with any other reel of tape.* And by the way — what's wound on the reel is still the same Computape. (556 or 800 bits per inch. No drop-out.) Which is to say, the best there is. Investigate today. Better still, *immediately*.

COMPUTRON INC.
122 Calvary Street, Waltham, Massachusetts

*REG. T.M. GENERAL ELECTRIC CO.

CIRCLE 7 ON READER CARD

DATAMATION 63

the automatic handling of information

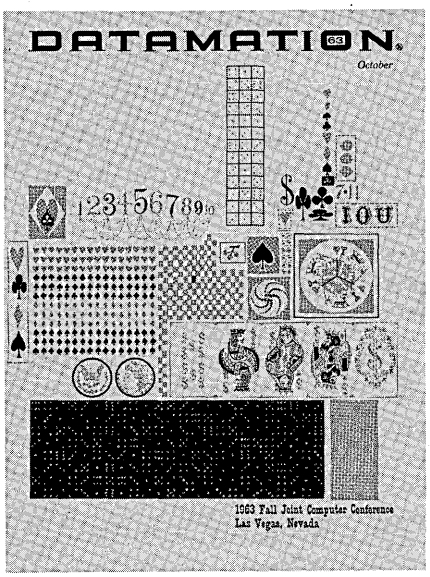
volume 9, number 10

Staff

Feature Articles

Departments

THIS ISSUE — 46,228 COPIES



Cover

This month's mosaic design spotlights the Fall Joint Computer Conference which will be held next month in Las Vegas, where attendees will apply computer-tested probability theories despite long-known odds favoring the house. Beginning on p. 47 is a special section on the conference. Cover design is by David F. Graves.

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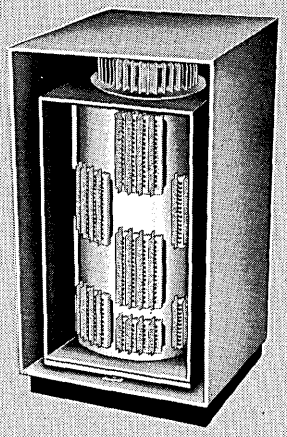
WHAT CAPACITY RANDOM

3″ DIAMETER SERIES A3000
FIXED-HEAD AIRBORNE DRUM



18.5″ DIAMETER MODEL
185900 AUTO-LIFT DRUM

GENERAL SPECIFICATIONS FOR BRYANT FIXED-HEAD DRUMS

Model	Track Capacity (Bits)	No. of Tracks	Drum Capacity (Bits)
3-Inch Diameter (3,600 to 12,000 rpm)			
A3000	1200	85	102,000
5-Inch Diameter (3,600 to 12,000 rpm)			
5005	2048	85	174,080
5008	2048	150	306,200
5014	2048	280	569,344
7.5-Inch Diameter (3,600 to 6,000 rpm)			
7505	3072	85	261,220
7508	3072	150	460,800
7514	3072	280	860,160
10-Inch Diameter (1,800 to 4,800 rpm)			
10005	4096	85	348,160
10008	4096	150	614,400
10014	4096	280	1,146,880
10019	4096	402	1,720,320
12-Inch Diameter (1,800 to 4,800 rpm)			
12005	4800	85	408,000
12008	4800	150	720,000
12014	4800	280	1,344,000
12019	4800	420	2,016,000
18.5-Inch Diameter (1,200 to 3,600 rpm)			
18524	7540	525	3,958,500
18534	7540	825	6,210,500

GENERAL SPECIFICATIONS FOR BRYANT FLYING-HEAD AUTO-LIFT DRUMS

Model	Track Capacity (Bits) at 300 BPI	at 600 BPI	No. of Tracks	Drum Capacity (Bits) at 300 BPI	at 600 BPI
5-Inch Diameter (3,000 to 12,000 rpm)					
5064	4710	9420	86	405,060	810,120
5128	4710	9420	150	706,500	1,413,000
5256	4710	9420	278	1,309,380	2,618,760
7.5-Inch Diameter (3,600 to 6,000 rpm)					
75064	7065	14,130	86	607,590	1,215,180
75128	7065	14,130	150	1,059,750	2,119,500
75256	7065	14,130	278	1,928,745	3,857,490
10-Inch Diameter (1,800 to 4,800 rpm)					
10128	9420	18,840	150	1,413,000	2,826,000
10256	9420	18,840	273	2,571,660	5,143,320
10384	9420	18,840	428	4,031,760	8,063,520
10512	9420	18,840	556	5,237,520	10,475,040
18.5-Inch Diameter (1,200 to 3,600 rpm)					
185128	17,400	34,800	150	2,610,000	5,220,000
185256	17,400	34,800	273	4,750,200	9,500,400
185384	17,400	34,800	428	7,447,200	14,894,400
185512	17,400	34,800	556	9,674,400	19,348,800
185900	17,400	34,800	946	16,460,400	32,920,800

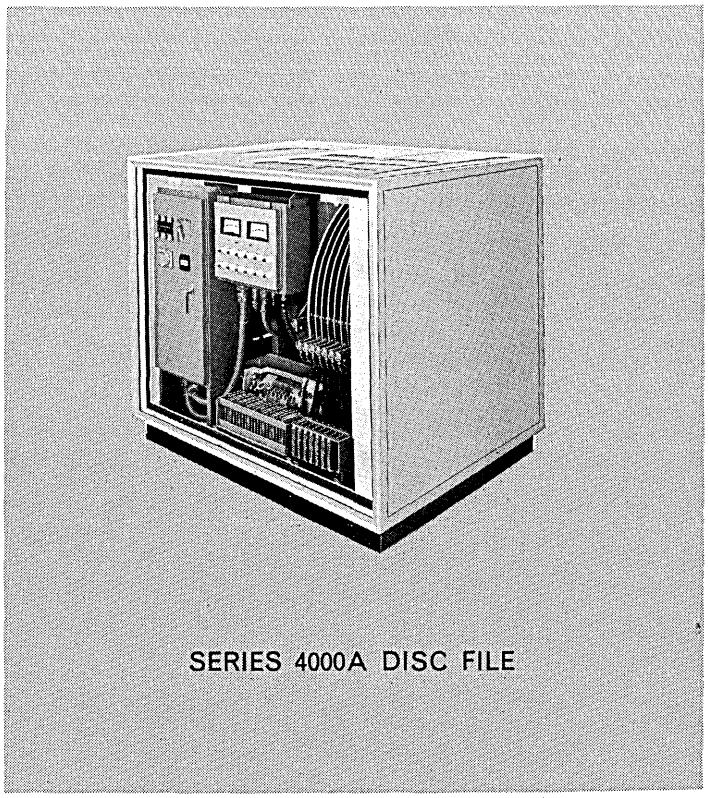
*SEE OUR 4241C DISC FILE IN OPERATION AT BOOTHS
436, 437 and 438 DURING THE FJCC IN LAS VEGAS, NOV. 12-14

ACCESS MEMORY DO YOU NEED?

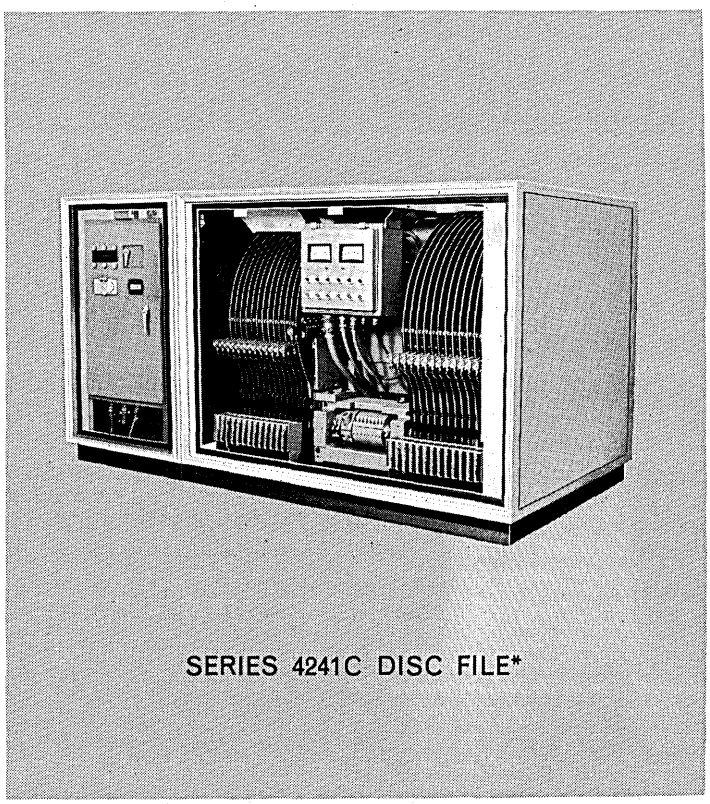
Does your storage application call for a lightweight, compact memory with a 100,000-bit capacity—like the tiny Bryant Model A3000 drum which is only three inches in diameter? Or does it require a memory with a capacity 16,000 times as large—like the Bryant Series 4000C Disc File?

Most capacity needs fall within these widely varying extremes. And only Bryant Computer Products offers you a complete family of random access memories designed to cover the whole range—from 100,000 to 1,600,000,000 bits!

For capacities up to 30,000,000 bits, a whole spectrum of fixed and flying head Bryant drums are available. For capacities between 30,000,000 and 1,600,000,000 bits, Bryant provides a choice of three Series 4000 Disc Files, each modularly constructed to permit optimization of machine size for maximum economy. This flexibility means the user of Bryant random access memories gets the lowest cost/bit storage possible.



SERIES 4000A DISC FILE



SERIES 4241C DISC FILE*

GENERAL SPECIFICATIONS FOR BRYANT SERIES 4000 DISC FILES WITH SIX-ZONE FORMAT*

Characteristic	Self-Clocking Block-Format Recording		Single-Bit Alternation Recording	
Track Capacity (Maximum)				
Zone 1	23,580 Bits		11,200 Bits	
Zone 2	31,140 Bits		14,800 Bits	
Zone 3	38,640 Bits		18,354 Bits	
Zone 4	46,200 Bits		22,400 Bits	
Zone 5	53,700 Bits		25,507 Bits	
Zone 6	61,260 Bits		29,098 Bits	
Disc Capacity (Maximum)	65 x 10^6 Bits		31 x 10^6 Bits	
File Capacity (Maximum)	1625 x 10^6 Bits		775 x 10^6 Bits	
Frequency at Maximum Capacity	900 rpm	1200 rpm	900 rpm	1200 rpm
Zone 1	354 KC	472 KC	168 KC	224 KC
Zone 2	468 KC	623 KC	222 KC	296 KC
Zone 3	579 KC	773 KC	276 KC	367 KC
Zone 4	693 KC	924 KC	336 KC	448 KC
Zone 5	806 KC	1.074 MC	383 KC	510 KC
Zone 6	923 KC	1.230 MC	437 KC	582 KC
Recording Density	600 BPI, maximum		285 BPI, maximum	
Disc Dropouts	Zero		5 Maximum, per Disc	
Operating Temperature	50°F to 90°F		60°F to 80°F	

*All Bryant files use six data heads per disc surface, contain 39-inch diameter discs, have a track density of 64 tracks per inch, and can be purchased with rotational speeds of 900 to 1,200 rpm. There are 768 tracks per disc side. Files with six-zone formating have 128 tracks per zone.

BRYANT COMPUTER PRODUCTS

850 Ladd Road, Walled Lake, Michigan • U.S.A. • TEL. 624-4571, TWX. 810-231-7190

A DIVISION OF EX-CELL-O CORPORATION XLO

CIRCLE 8 ON READER CARD

DATAMATION calendar

- The BEMA (Business Equipment Manufacturers Assn.) Exposition/Conference will be held Oct. 28 to Nov. 1 at the Coliseum, New York, N.Y.
- The Kansas City Management Symposium, sponsored by ADAPSO (Association of Data Processing Service Organizations, Inc.) will be held Oct. 28-29 at the Muehlebach Hotel in Kansas City.
- The 6th annual ACM Technical Symposium will be held Oct. 29 at the Disneyland Hotel, Anaheim, Calif. Theme of the event is "Creativity in Computers."
- The third annual symposium sponsored by the San Francisco Bay area ACM chapter will be held Nov. 1 at the Jack Tar Hotel in San Francisco. Theme of the all-day meeting, which begins at 9 a.m., is "Formalized Systems Analysis and Design Techniques."
- A conference on civil engineering problem-oriented programming languages will be held at M.I.T., by the Department of Civil Engineering, Nov. 4-6. Workshops and demonstrations of COGO and STRESS will be included.
- The DPMA International Electronic Business Systems Conference will be held in Phoenix Nov. 7-8.
- The 1963 Fall Joint Computer Conference will be held in the Las Vegas, Nev., Convention Center, Nov. 12-14.
- The American Bankers Assoc. first national Automation Conference will be held in Chicago Nov. 13-15.
- The annual meeting of the Digital Equipment Users Society (DECUS), will be held Nov. 18-19 at Lawrence Radiation Laboratories in Livermore, Calif.
- The 11th Annual Electronics Seminar, co-sponsored by the EDP committees of the American Gas Assoc. and the Edison Electric Institute, takes place Nov. 18-20 in Chicago.
- The annual meeting of the American Mathematical Society will be held January 20-24, 1964, in Miami, Fla.
- The annual Computer Applications Symposium, sponsored by ITT Research Institute, will be held at the LaSalle Hotel in Chicago, Jan. 30-31.

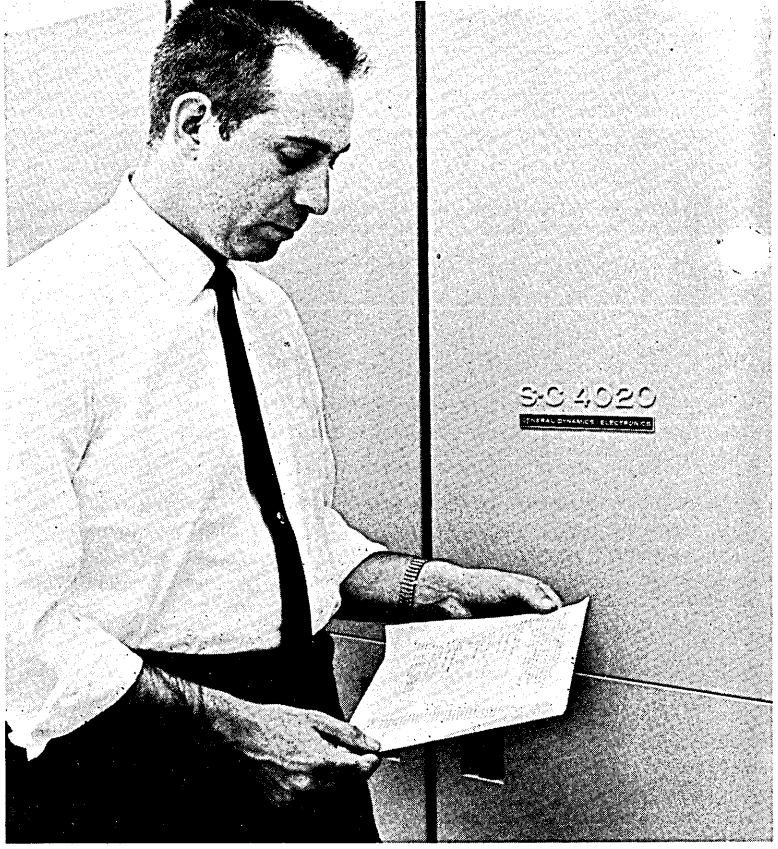
CONTINUANCE OF LEADERSHIP

The New EAI 231R-V Analog Computer

...Dramatically new
ANALOG MEMORY AND LOGIC SYSTEM.
High-speed iterative calculations
without sacrificing real-time accuracy.
The only analog computer
designed for Hybrid Simulation.
Most complete line of wide-band-width
computing components and accessories.
Backed by the world's largest
analog computer applications and
service engineering organization.
Write for the facts.

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

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



One computer output device now gives you all three... a fast glance,

Already proven to be the most versatile computer output device available in terms of what it will produce—the S-C 4020 Computer Recorder is now equally as versatile in terms of how it will produce these outputs.

For example, the new *quick look* capability allows an operator to check any selected page of a program in seconds without the normal turn-around time associated with developing microfilm or photo-recording paper. This new option employs a compact automatic developer together with a mechanical paper-cutting and stacking unit.

After the operator has produced selected *quick look* paper copies for program evaluation the entire program may be run through a regular developing cycle where high-quality pages are printed for use in report distribution or paper records. In addition, the same computer output can be recorded automatically on microfilm by the S-C 4020 for permanent storage and rapid retrieval.

GRAPHIC OUTPUT

The S-C 4020 not only records alphanumeric printing, it also converts and records digital output in combinations of curves, straight lines and characters. To convert digital codes into more easily interpreted graphics, tapes from a large-scale computer (typically a 7090 or 7094) are fed through the S-C 4020. The numerical language is translated and displayed on an improved CHARACTRON® Shaped Beam Tube where it is transferred optically to page-size photosensitive paper and/or microfilm.

SPEED

The S-C 4020 will accept data from magnetic tape at input rates up to 62,500 six-bit characters per second. The S-C 4020 will record this data on film at speeds in excess of 17,000 alphanumeric or symbolic characters per second. Frames combining characters, vectors and curves vary with the complexity of the drawing, but an average annotated graph can be recorded in less than a second.

ECONOMICS

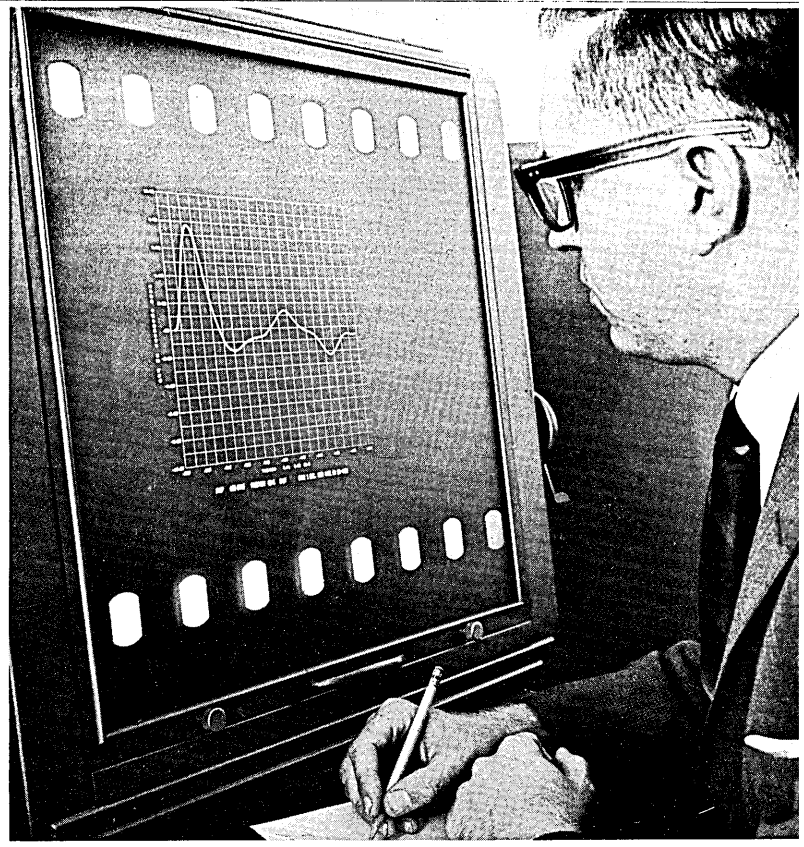
The S-C 4020 can be leased or purchased. Also, service bureaus are in operation on east and west coasts where you can lease 4020 time and try some of your own problems on the machine for evaluation. The S-C 4020 is paying its way many times over in more than a score of major computer labs. For example, one user performs a complex plotting job for an engineering analysis group which was previously done in several days by 100 draftsmen. The S-C 4020 produces the same annotated curves, complete with grids, axis lines and titles in minutes at considerably less cost. The equipment's high density input tape adapter results in minimum use of valuable computer time for tape preparation. Part of the lease or sales price includes trained customer engineers to install and maintain the S-C 4020 at the user's facility.

APPLICATIONS

The S-C 4020 can be used to record tabular and other alphanumeric information such as stock catalogs, program listings, cost records and other statistical data.

SCIENTIFIC CURVES

In many scientific computer labs the S-C 4020 plots highly accurate curves involving one or more parameters. All axis and grid lines, annotations and titles are



a long hard look, permanent film record

included. Curves include flight tests, engine performance, trajectory simulation, hydrodynamic design, etc.

BUSINESS GRAPHS

The recorder proves its usefulness daily by plotting curves and other business charts for cost analysis, production control, manpower forecasts, projected sales and other administrative tasks. PERT and other critical path diagrams can be produced and updated in seconds.

TOOL PATH DRAWINGS

Magnetic tapes programmed in APT language to guide machine tools can first be played on the S-C 4020 which makes a drawing of the part. The drawing can be checked for errors prior to making the part. In addition, the S-C 4020 can be used for such computer drafting applications as logic and flow diagrams, ship and missile design.

MAPPING

The S-C 4020 produces maps for such uses as weather patterns, satellite tracking and population studies. The map itself may be superimposed by a slide projector option. The CHARACTRON Shaped Beam Tube then displays the variable information, or the entire map may be drawn by the tube, allowing expansion of details.

USERS SOCIETY

To achieve maximum benefit from the versatile recorder, users of the S-C 4020 share their ideas, applications and programming techniques. To do this, they have formed a society of users of the S-C 4020 named UAIDE for "Users of Automatic Information Display Equipment." UAIDE has set up a software library to exchange programming and applications data.

SEQUENTIAL EVENTS

One of the more interesting uses of the S-C 4020 is the production of a series of drawings where each succeeding film frame is slightly changed. In this manner the programmer, using the machine as a cartoon animator, can produce sequential events. The S-C 4020 film frames can then be projected as a computer generated movie showing such things as a satellite tumbling in space or a dynamically changing graph. The resulting movie gives the viewer a realistic time-scale sequence of events invaluable as a laboratory tool.

WRITE FOR INFORMATION

To learn how the S-C 4020 can help programmers, engineers and managers to utilize your digital computer more fully, write to Dept. D-45, General Dynamics | Electronics-San Diego, P. O. Box 127, San Diego 12, Calif.

GENERAL DYNAMICS | ELECTRONICS GIIIIIIID SAN DIEGO

An S-C 4020 will be shown in Booths 300-303 at the Fall Joint Computer Conference

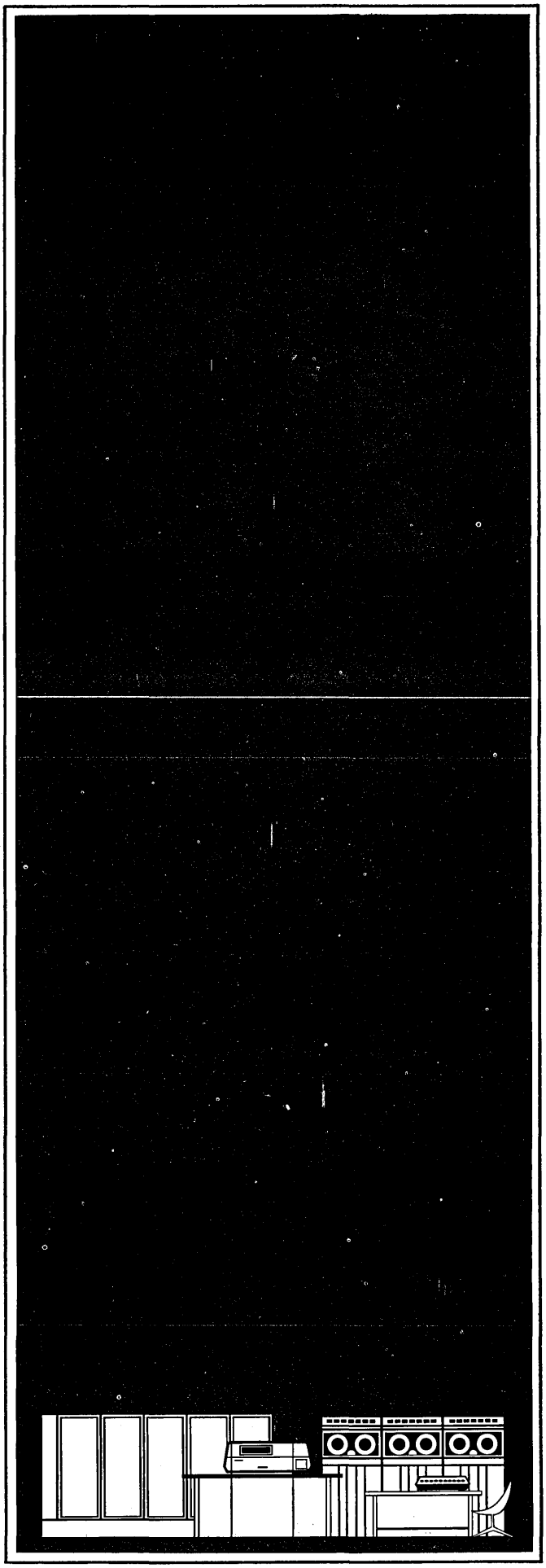
Honeywell 1400- your best buy in real time business data processing

Honeywell's new medium-scale computer, the H-1400, has the unique combination of speed, simultaneity, priority interrupt facility, memory capacity, peripheral flexibility, communications capability and competitive pricing to make it the outstanding candidate for real time business applications.

What do we mean by real time?

At Honeywell, we define real time as immediate and direct command-response communication between a central computer and remote locations.

In business applications, the remote locations can be branch offices, production reporting stations, warehouses, executive suites, subsidiary plants, even customer offices. Information is transmitted between such locations and the central computer via public or private communications lines and each transaction is handled individually and immediately, rather than being batched and stored for subsequent processing.



Versatility – the key to real time efficiency

The Honeywell 1400 is a fast, multi-purpose computer. Its average access time per character is 1.6 microseconds. The ability to work with binary, decimal or alphanumeric data plus a floating-point hardware option, makes it proficient at scientific as well as business data processing tasks. Core memory is expandable up to 32,768 48-bit words, and random access storage is available up to 600-million digits. Its peripheral complement includes the full line of Honeywell magnetic tape units, card equipment, high-speed printers, paper tape units, random access units, character and code scanning devices and communications control units, plus two types of real time clocks. Full buffering permits a high degree of simultaneity. The H-1400 can, for example, read one tape while writing another, read cards, and operate one or two printers, all at the same time.

Complete communications capability

Three types of communications control units give the H-1400 the ability to tie-in to any communications facility, public or private, and the capacity to handle up to 280 individual lines. In addition to other computers and conventional peripheral units, most any device that can be connected to a communications circuit can now be tied-in to a Honeywell 1400 computer. As optional equipment, this communications capability can be added to a conventional H-1400 business data processing system. Consequently a user can start with a low cost business configuration and expand in economical steps to a complete real time network.

When real time processing is a part time job . . .

A key facility of the Honeywell 1400 is an automatic interrupt and priority establishing feature that permits two or more independent programs to be handled simultaneously. This means that real time processing requirements can be dove-tailed with conventional processing runs. There's no need to have the computer standing idly by waiting for contacts, or to limit real time processing to selected time periods.

The final payoff is in dollars

The following table was compiled by Honeywell on the basis of published information and is believed to be a fair and accurate comparison of the three leading computer systems currently being marketed in real time configurations.

Computers		Honeywell 1400	IBM 1410	Univac 490
MEMORY SPEED (cycle time in microseconds)	Published Specification	6.5 (per 24 bits)	4.5 (per 6 bits)	6 (per 30 bits)
	Adjusted to one 6-bit Character	1.6	4.5	1.2
SMALL REAL TIME SYSTEM CONFIGURATION	Memory Size (6-bit Characters)	32,768	20,000	81,920*
Processor, card reader and punch, printer, 4 tape units, facility to handle one (1) two-way communication line.	Approx. Monthly Rental	$11,970	$12,055	$18,500
STANDARD REAL TIME SYSTEM CONFIGURATION	Memory Size (6-bit Characters)	98,304	80,000**	81,920
Same as Small Real-Time System except facility to handle seven (7) two-way communication lines.	Approx. Monthly Rental	$15,990	$19,535†	$18,895
EXPANDED REAL TIME SYSTEM CONFIGURATION	Memory Size (6-bit Characters)	163,840 core 50,000,000 disc	80,000** core 56,000,000 disc	163,840 core 65,000,000 drum
Same as Standard Real Time System except random access storage, facility to handle fourteen (14) two-way communication lines.	Approx. Monthly Rental	$23,200	$24,145†	$29,460

*Smallest Memory Size Available **Largest Memory Size Available
†Includes 7740

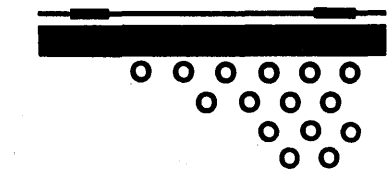
Now let's get down to business

When it comes to picking a real time computer, this information obviously is only a start. It should serve, however, to make you want to know all there is to know about the H-1400, and we'd like to help. Also, if your real time computer considerations have been along more modest lines, you may want to consider the Honeywell 400 which has significant real time capabilities in a lower price range. For more information on either or both systems, write: Honeywell EDP, Wellesley Hills 81, Mass.

Honeywell
ELECTRONIC DATA PROCESSING

CIRCLE 12 ON READER CARD

letters



baudot & ascii

Sir:

Since publication of the first part of my article on the ASCII (August, p. 32), I have had a letter from Walter Zenner, vice president for Research and Development at the Teletype Corp. He draws attention to the fact that wear on punch dies was a minor and perhaps non-contributory reason for the design of the Baudot code. He states the real reason was that Baudot did his work about 1875, at which time electric utilities did not exist; in fact, electric light was not invented until about 1879. Baudot's power source was model 1875 batteries, and his need to conserve power was very real, the marking pulses requiring the operation of an electromagnet. The code was therefore based upon the frequency of the letters as found in French text, which differs slightly from English.

I am glad to have this opportunity to indicate more sympathetic treatment of Baudot, as requested by Mr. Zenner. For my own part, I was very much surprised when I was unable to find entries on Baudot in several encyclopedias and in the biographical section of Webster's Unabridged. I would have thought also that Baudot's work was of considerably more importance to human communication than many of the minor writers whose names can be found in these sources.

R. W. Bemer
Univac Div. of Sperry Rand Corp.
New York, New York

voice from europe

Sir:

Much more familiarity with the British, rather than the Continental, scene was demonstrated by A. S. Douglas ("The European Computer Scene: 1963," August, p. 24). The German manufacturers who "have not really got going yet" have installed about 110 computers, or 16 per cent of some 700 delivered systems, according to our April 1963 German Computer Census.

Telefunken's TR 4, "due for delivery shortly," delivered its third in June 1963; the first was installed in 1962. Siemens, who "will come into the field soon," claims it installed the first gp, transistorized computer, the 2002, in late 1958; since then, it has installed some 30 2002's, and has about 10 orders for its 3003, announced this past spring. Bull's "new machine the Gamma 300," is probably the Gamma 10; its 300's were first delivered in the spring of 1961, and the Gamma 60 is not a "vacuum tube machine", but, rather, solid state.

Zuse, which stands second to IBM in number of deliveries in Germany, announced and demonstrated its new Z 25 in May 1963, and has four systems on order to date.

F. J. Lesh
John Diebold & Assoc. Deutschland GMBH
Frankfurt/Main, Germany

Dr. Douglas replies: It is true that my article was based on less recent information than that available to Mr. Lesh, and I am glad to hear of the recent progress made in Germany. Nevertheless, I believe my remark that the German manufacturers "have not really got going yet" is entirely substantiated by the figures above. I am sure that they have the technical capacity to fill a much larger share of the market there, and will, no doubt, do so over the next few years. The Bull Gamma 300 should indeed be the Gamma 10, a slip for which I apologize.

need for warm bodies

Sir:

As long as I have been programming, I have heard about this "extreme shortage of programmers" (see January Editor's Readout). But what is being done about it?

My husband has received a high B on the IBM aptitude test, has completed some home study manuals, written small programs, and read of data flow and other deeper texts. His problem is this: no one wants trainees. I realize there are many people in the same predicament. How does a person in this situation get into programming and/or how does he get past the screening question on personnel forms, "How much experience?" I don't think most dp departments are aware of the amount of good people turned away as a result of poor communications.

Peggy Randall
Redwood City, California

rca & base numbers

Sir:

At first glance, I was inclined to agree with your tongue-in-cheek query (August, p. 19) about whether the name of the RCA 3301 might have been chosen to suggest that the new machine was "three times as fast as the 301." But then I overheard myself sub-vocalizing. Surely, the *Thirty-three*-Oh-One ought to be 11 times as fast as the *Three*-Oh-One. Even if we divide, we get $3301/301=10.967$, which is equivalent to 11 for many practical purposes . . .

These figures assume, of course, that RCA is using the decimal system. Since we have no proof of this, perhaps we should give them the benefit of the doubt and consider whether they might be making a more modest suggestion in another number system. The existence of the RCA 601 implies that they are using at least a septimal system; and since $33_{(7)}=24_{(10)}$, they might be hinting at only an eight-fold increase. For the octal or novenary systems, the hints would be of only nine- or 10-fold increases. Of course, if they are using a base greater than 10, the sky's the limit.

Ronald E. Wyllys
Chatsworth, California

red punch tape

Sir:

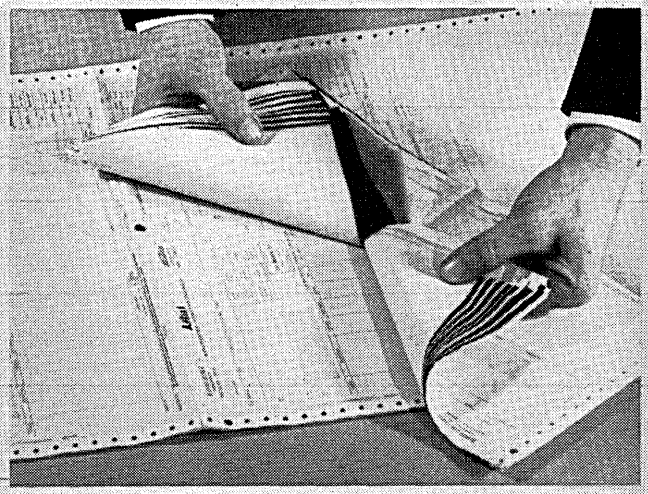
Comrade Gukov (August, p. 29) seems to think that the glorious promise of the proletarian October revolution is at long last on the threshold of realization, now that the decadent capitalists have invented computing machinery. The era of total centralized planning (and total regimentation) apparently will be ushered in just as soon as the Marxists can get their hands on a few megabucks' worth of degenerate imperialist engineering know-how and/or hardware.

The collectivists sound quite confident that they will then be able to deal effectively with all of those cosmopolitan saboteurs and enemies of the working class who persist in inventing color television, rotary lawn mowers, zippers, and other bourgeois gadgets that are not listed in the Kremlin master diskfile which controls the "clockwork economy" (as Academician Glushkov so colorfully terms it).

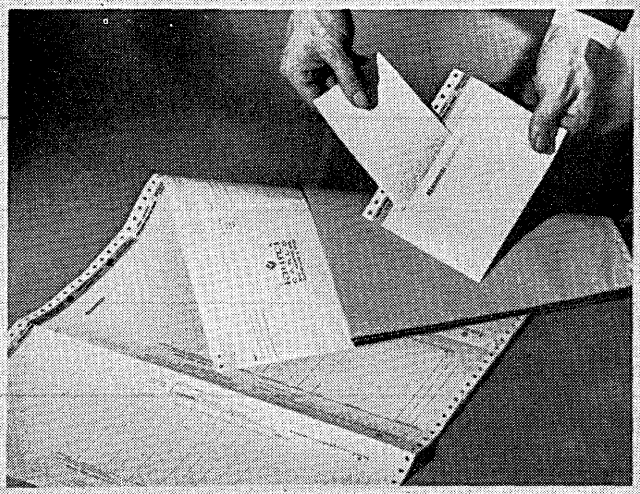
The chief remaining task will then be to develop a machine to read weather reports and, using a modified PERT analysis, punch out a master plan for manufacturing the bullets that will be needed for educating the luckless Ivans whose cabbage crop doesn't quite meet the planners' cybernetically-generated quota.

Paul Stout
Lombard, Illinois

Special for you...

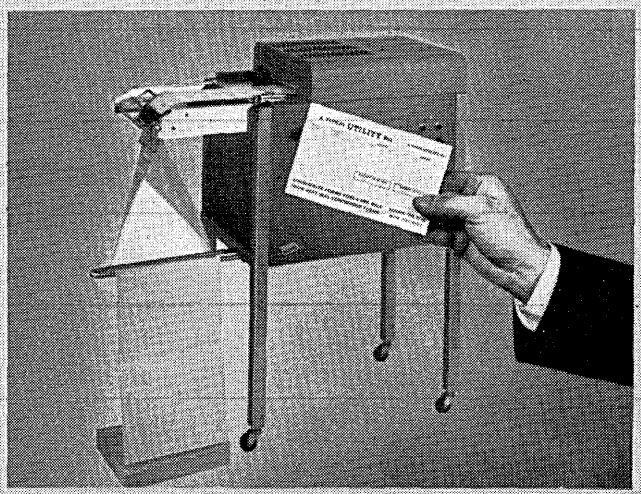


FUNCTIONAL DESIGN is incorporated in this Speediflex form, printed side-by-side sections, each with carbon-extraction features built in.



CONSTRUCTION FLEXIBILITY- This Speediflex statement features pasted pocket envelope with pressure sensitive tape for sealing envelope.

MOORE MANIFOLD BOOKS are handsome and functional, serving many uses, with a variety of handsome litho art effects always available.



FRONT AND BACK information is printed side by side. The form is then machine-folded and sealed, ready to mail as post card utility bill.

Moore custom forms

These are four examples of how Moore has built special forms to accommodate the special needs of customers. Each involves advanced features of construction and, to be done flawlessly, calls for a large measure of design sense, forms know-how and manufacturing flexibility.

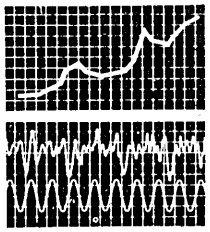
The results unfailingly justify the extra effort and the demands made on creativity, in terms of advantages the customer realizes. You can expect such fundamental benefits as system integration, maximum service from the form, maximum use of your present equipment. Have you a special problem? Try us. If you work with forms we can show how to make forms work for you.

'The right business form for every form of business'

NIAGARA FALLS, NEW YORK · PARK RIDGE, ILLINOIS · DENTON, TEXAS
EMERYVILLE, CALIF. · OVER 500 OFFICES AND FACTORIES IN NORTH AMERICA

MOORE BUSINESS FORMS INC

CIRCLE 14 ON READER CARD



BUSINESS & SCIENCE

THE D825: MILITARY COMAND/CONTROL DARK HORSE?

Silently gaining ground in the specialized market for military control computers is the not-too-widely publicized Burroughs D825. The binary, solid-state, multiple computer system (up to four processors can share 65K 48-bit words), has a three-megacycle clock and 128-word thin-film scratch-pad memory in each processor. Average memory cycle time is 4.3 usec; add time is 1.67 usec. The D825 can have up to 20 I/O channels.

A reported extension of the AF BUIC (BackUp Interceptor Command) contract adds another 17 systems to that order, brings the total installation/order picture to 38, with systems already installed at MITRE and SDC. The Naval Research Lab has had one going for over a year, and the Army has selected the D825 for its Ft. Ritchie, Md., switching system.

CSC WELCOMED TO COMPARISONVILLE

With the filing of a registration statement with the SEC, CSC moves into the magic land of public accountability and financial comparison with other software houses. First glance at the company's books in the prospectus shows net earnings for FY '63 of $391,962 (61¢ a share), compared to $129,966 (20¢) for the previous year. The offering of 200,000 shares (25K from CSC's Fletcher Jones and Roy Nutt) came out at $12½ on Sept. 19.

CDC 3200 SLATED FOR FALL JOINT DEBUT

Control Data, beginning to resemble a computer cornucopia, will unveil its recently-announced 3200 at the FJCC. A 24-bit machine (either 24 bits or four characters) with four parity bits per word, the 3200 has a 1.25 usec cycle time which is asynchronous, allowing overlapping of 8K memory banks. Each of a maximum 32K words or 128K characters is directly addressable. Each memory has two accesses; I/O can take place with store at the rate of one 24-bit word every 1.25 usec. A 64-word core scratchpad memory has a 500 nanosecond cycle time.

Using 3600 hardware, the 3200 is available in four processor models: basic, scientific (floating point), data processing (bcd adder), and general (both bcd and f.p.). Some typical times: f.p. 48-bit multiply --29 usec; f.p. add (48-bit)--12 usec; bcd add (12 plus 12 digits)--20 usec.

Software includes compact COBOL and FORTRAN (subsets of 3600 counterparts), a monitor and comprehensive assembly program.

--continued on page 19

CDC claims its new machine to be a bit faster and a little cheaper than the 7040, and hopes that people who can't make the jump from the 1620 to the 40 will lean toward the 3200. Its I/O (not machine-language) compatibility with the 3600 makes CDC believe it will be a popular 3600 satellite (nine of them have already been ordered by Australia for this role). Prices range from $5-15K/month, making it competitive with the 1410 and the GE 225 at the lower end. Deliveries--hardware and software--are scheduled to begin in May.

FEDERAL EDP: REPORTS AND RESOLUTIONS

EDP continues to attract attention on Capitol Hill. After several hearings with beaucoup testimony (577 pages worth), Tom Murray's House Committee on Post Office and Civil Service produced an interim report on federal agency use of edp gear. In essence, it "recommends that the President authorize the Director of the Bureau of the Budget to evaluate the present EDP policies and practices in the Federal agencies and to develop guidelines for future policy on EDP."

More specifically, the report pinpoints five major problem areas: "lack of communication between agencies on EDP matters generally," specifically on manpower and staffing problems; the need for standardized auditing and reporting of agency edp use and performance; a suggestion that edp systems management might sometimes "be placed higher in the organizational structure;" and the lack of satisfactory information about defense contractors' policies and practices: "Since the taxpayer pays for these costly machines, the Department of Defense should maintain strict control over contractors' acquisition and use of EDP."

NEW LOOK FOR JUG?

JUG (Joint Users' Group), originally formed as a friendly, leisurely club for the exchange of ideas, is evidently going to try to get something done. New Chairman Howard Bromberg says the group will sponsor a program exchange service for present and potential computer users. Currently subcommittees representing both users and manufacturers are being formed to establish operating procedures and to recommend documentation standards for such a program. The users will determine minimum specs to be included in program abstracts, will assume responsibility for all submitted programs, and will develop algorithms for the search and retrieval of programs and abstracts. Further information can be obtained from Mandalay Grems of Univac.

BECKMAN SILENTLY ENTERS HYBRID RACE

The hybrid race is on full tilt. While digital-analog pacts have been signed (between EAI and Computer Controls Co.; between Packard Bell and Computer Products, Inc.), two divisions of Beckman Instruments have quietly been pursuing the same route.

Beckman's Berkeley Division will team its medium-scale analog 2100 series with the digital 420 produced by the company's System Division. The 420, not yet announced, has existed in prototype form since last

December. It features a 5 megacycle logic with a 3.2 usec memory cycle, 32K core memory, and eight I/O channels with a transfer rate of 104K words-per-second. Word length is 18 bits. Selling for around $115K, the 420 will not be pushed independently, but as part of a hybrid system.

NEW GROUND RULES FOR AN OLD COMPUTER GUESSING GAME

Control Data president Bill Norris offered crystal ball gazers at the ACM conference five new criteria for guessing which six out of today's 12 major computer manufacturers will still be around five to 10 years hence: singleness of purpose, top management dedication and depth of understanding, world-wide marketing strength, and manufacturing competence. The criteria look innocent, but singleness of purpose is, it seems, the opposite of "diversification," and could mean that companies manufacturing TV sets, ovens and the like may drop by the wayside, using Norris' yardstick.

Adding rumbles of a forthcoming order in India to recent orders for 3600's in Australia, France and Norway, CDC would seem to be on its way to demonstrating world-wide marketing strength. Financially, the Minneapolis-based firm says in its latest annual report that '63 earnings were up 54% (from $41 million to $63.1 million) over '62. Net profits were up 99% over last year. Public confidence is reflected in CDC's stock price which, last month, ranged from 83¾ to 104-7/8. The latter is an all-time high. Year's low: 36½. P.S. Don't cry, we don't own any either.

RUMBLES, RUMORS AND RANDOM RAW DATA

B 5000 users have pressured Burroughs into unlocking its software and providing the documentation necessary to make changes in the compilers and executive routine. Look for a rash of university orders for the B 5000 once Burroughs solves its software problems... Rumbles are that IBM is coming out with a new disc file and processor...GD/E will demonstrate a new "quick-look" copy option for its S-C 4020 at the FJCC along with a high-density tape adapter option. ... Look for Packard Bell to make a deal with a leading business machines maker to market its dual-memory, stored-logic PB 440. ... IBM is putting clocks on its systems. Best guess, now that they'll be getting an honest 176 hours: first shift will stretch to 200 hrs. ... Three major manufacturers besides IBM will announce new systems within the next two to six months. ...A new mag tape device development team at IBM's Data Systems Div. (large systems manufacturing & engineering HQ) reflects "recognition of the high potential" of new mag tape I/O devices.

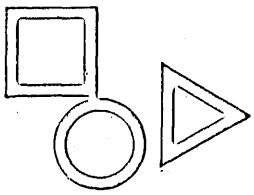
Orders filled in 36 hours, instead of 14 days. Paperwork time and expense reduced by two-thirds. That's how Bell System DATA-PHONE service has helped Whirlpool Corporation speed parts order processing—from receipt to ship-out. Used with data equipment, DATA-PHONE service enables Whirlpool to receive card-punched data sent over regular telephone lines to its La Porte, Indiana, service center from 120 supply points across the country.

At left, above, orders from Whirlpool distribution outlets are received by phone via DATA-PHONE service, then punched on cards for fast checking, clearing and processing for shipment.

Are you transmitting your business data as quickly and profitably as you might be? Talk with one of our Communications Consultants and find out. Just ask your Bell Telephone Business Office to have him contact you.

Bell Telephone System

CIRCLE 18 ON READER CARD



EDITOR'S READOUT

THE COST OF PROFESSIONALISM

The recent decision of the Association for Computing Machinery to raise its dues from $10 to $18 will put to a rather real test the loyalty of its some 13,000 members. They've got to decide whether it's worth that much to belong to an organization which many feel has been dominated by—and catered pretty much to—Ph.D. mathematicians.

Some observers feel that the organization overlooks the needs and interests of the guy running the shop who has to get out x number of reports to v.p. Zilch by Friday noon *or else*. The emphasis, they say, has been overwhelmingly slanted toward scientific computation. And this wouldn't be so bad, but the Association tends to look down its nose at business data processing types while claiming to represent the whole wide, wide wonderful world of computing. That's one view.

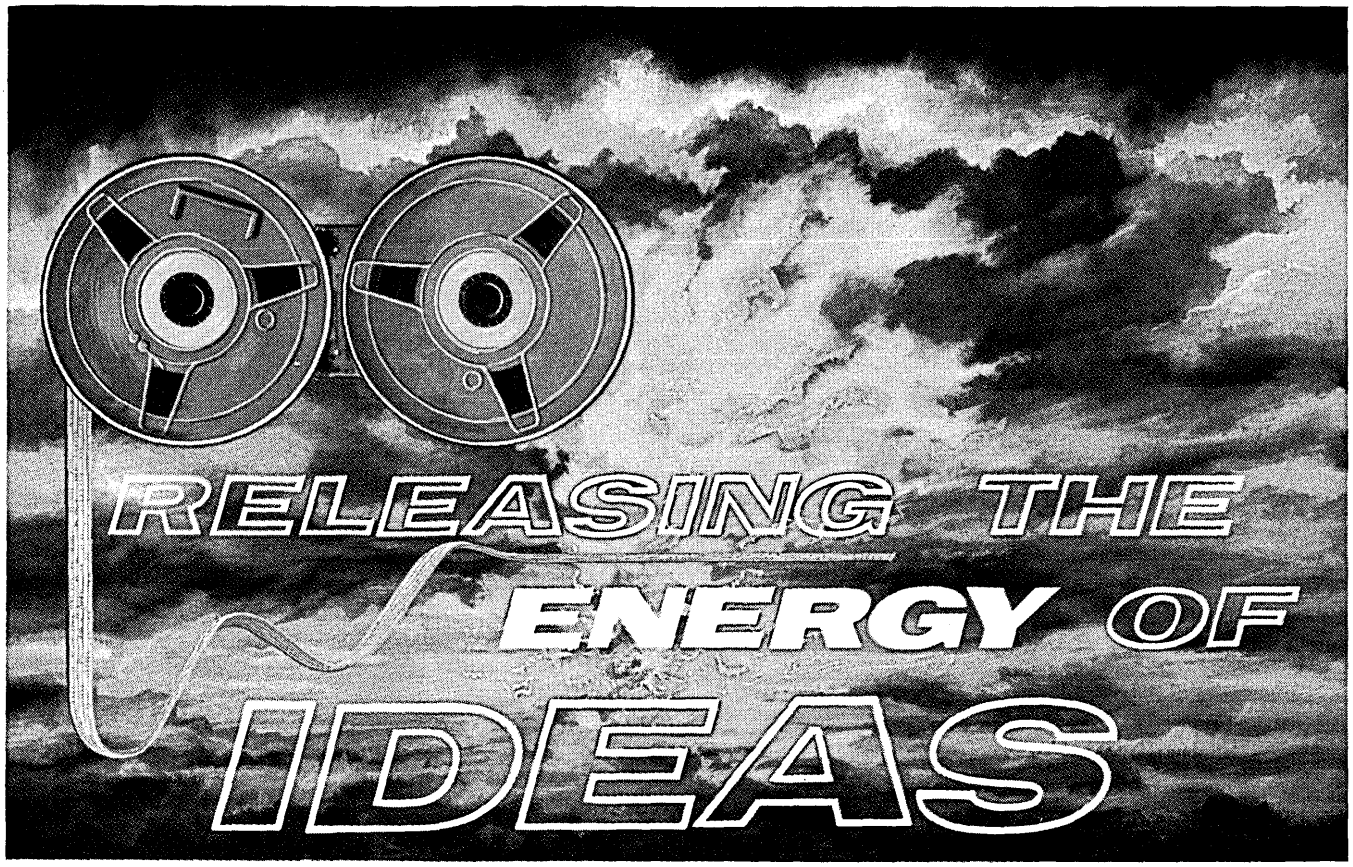
ACM President Al Perlis admits that the ACM has tended to neglect business data processing. "But all that is going to change," he says. And he hastens to add that one reason business-oriented papers have not had a bigger play in the Association's publications is that there have been few good papers.

But whether or not ACM widens the door for business edp, it remains as a vital source of solid technical information interchange for serious practitioners of a tremendously complex craft. Those members of ACM who criticize it have two choices: get out . . . or work harder to see that it does a better job of representing their interests.

The first alternative means that one is saying in essence that he will not support serious, advanced work and publication. "Let George do it." This is not only a selfish point of view, but plain shortsighted. Without broad support, ACM would become even more ingrown, shrinking to a small group of theorists talking in an incomprehensible language about an ever narrowing world. And whether you understand these people or not, they have been the heart of computing, the driving force which has elevated it to a profession. We need them.

The second alternative would seem to be a healthier one. And while our critic is working to help ACM broaden its scope, he gets for $18—roughly equivalent to the cost of three fifths of decent bourbon—a year's supply of technical literature and a chance to write nasty letters to the editor. So he throws the *Quarterly* away. The monthly *Communications* and the bi-monthly *Computing Reviews* would seem to be worth a buck apiece.

Our hesitant friend might also do well to check the dues of other associations. Comparison proves. One of them charges $27 a year . . . plus a national conference registration fee of $75. But costs aside, there's only one ACM. Whether anything comes of current investigations of the possibility of a merger with the DPMA or not, ACM must remain as *the* vital voice of true computing professionalism.



Toss an idea onto the flat surface of business routine and the tide begins to run. One business . . . yours . . . sets a new pace that affects an industry.

But the instant the energy of an idea is released on this otherwise tranquil scene, it begins to run into opposition. It upsets the pattern. It disturbs the routine. It outdates accepted procedures. Your business just isn't the same anymore.

Often, ideas encounter so much resistance from the natural reluctance to "do things differently" they wither and die. Their energy is sapped. They become outdated before they can be put into effect.

Like the nucleus of an atom, an idea is surrounded by problems, all soaking up its energy and containing it. Solving the problems that surround ideas is our job. McDonnell's experienced consultants review procedures and organization, find ways to speed the flow of information, of paperwork and reports. They recommend and conduct research into the effective application of your ideas. They turn to data processing to digest analyses, plans and schedules. They uncover needed extensions of work plans, raw material orders and manpower scheduling. They deliver projected results of idea application and let you make the decision about when and where to put the idea to work.

Ideas can make your company grow. McDonnell Automation Center consultants analyze and strip away the resistance to that growth by the effective application of automation techniques. Call or write us for a brochure or preliminary analysis of your needs, without obligation.

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CIRCLE 19 ON READER CARD

SO YOU WANT TO GO ON-LINE

a trade of $ for time

by ROBERT L. PATRICK

The adolescence of the computer field is clearly shown in our addiction to fads. We went through the freckled face, buck teeth stage where everyone had to have his own unique operating system. We then entered into the gangling, rapidly growing limbs stage when a significant portion of our high level technical manpower was tied up developing new languages and in quasi-learned debates over their relative merits. We are now in the shy and demure stage where we titter to each other about on-line systems. A significant chunk of Federal developmental money is being directed (rightly so) toward the ardent pursuit of on-line systems. Following in the wake of this money is the new cult of adolescents who are happy to be associated with what may be the latest fad.

It should be clearly understood that *some* of the individuals interested in on-line systems are sincere, professional developers in the pursuit of a solution to a very difficult information processing problem. Unfortunately, few of these people have bothered to crisply state their objectives, so that we can differentiate between the professionals and the adolescents. The following chart will allow one to differentiate between these two types.

Fig. 1

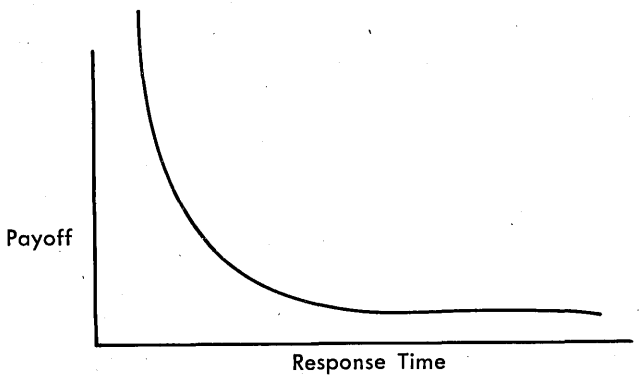

Fig. 1 schematically shows a payoff function plotted against response time. Payoff may be measured in dollars for the case of an economic opportunity successfully exploited, or in defense where the penalty for tardy information may well be destruction. In these cases there is an extremely strong motivation towards reducing the response time (the elapsed time from when the stimulus is first recognized until the resultant action is initiated) and thereby achieving a much higher payoff. For people working in such an applications area the unsolved technical problems are difficult, challenging, and well salted with Federal funds.

Unfortunately, this group is obscured by the previously mentioned adolescents. These practitioners are interested in anything new and stimulating, but do not always contribute in direct proportion to their experience and expense. Some of this latter group could be characterized by their anti-batching motivation. These people do not fully understand the batch mode of information processing although it has been around for several years. With the recent advent of reliable bulk storage devices this latter group are prophesying the early demise of all batch processing with the concomitant assumption of on-line operation and consoles for everybody.

In an effort to supply the doers of the field with the facts necessary to refute the dreamers of the field, some fundamentals must be isolated and crisply stated for all to see. Lest these statements be taken out of context, it must be understood that they apply to the generation of machines circa 1963. It is generally recognized by the more knowledgeable men in this field that present hardware designs preclude the "consoles for everybody" approach. Project MAC (cf. *Datamation*, September '63, p. 17) is an attempt to modify this situation. In the establishment of this project it was recognized that the basic hardware organization itself must be altered if on-line operation is ever to be the rule rather than the exception. Some of our benighted individuals are trying to apply on-line operation to processes which have a characteristic payoff function as shown in Fig. 2.

Many processes exist in the commercial area which have the characteristics indicated by Fig. 2. The payoff for an earlier solution is indeed greater than the payoff for a later solution, but only marginally so. In addition, many processes are geared to the pulse of business and the time reduction must be modulo the business day, week, month, or quarter. In an environment such as this, the marginal value of shifting the closing date for the pay period one day either direction is small. The value of shifting one day either direction after a union contract has been negotiated based on a closing sequence is infinitesimal.

Some of our most confused thinking in the area of on-

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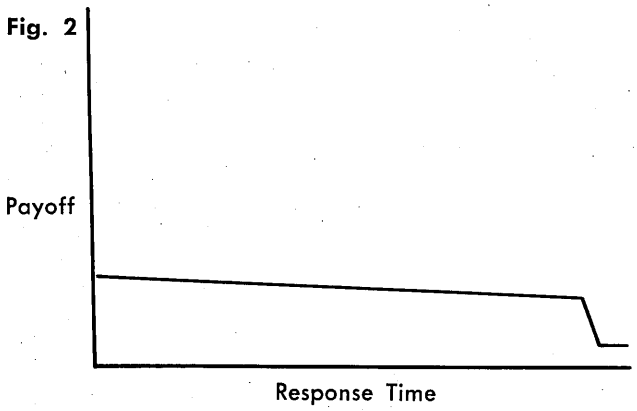
Fig. 2



line systems occurs right in our own computer shops. In a blind attempt to reduce turn-around time, many individuals are considering a liberal sprinkling of disc files, direct connected ancillary computers, on-line remote consoles, and various other combinations of attached hardware. No matter how elated it may make an individual programmer feel, the payoff function for early checkout of his computer program is more like Fig. 2 than it is like Fig. 1.

Each customer tries to impress upon the programmer who is assigned to him that his job is the most important job in the entire plant. Furthermore, the customer tries to get the programmer ego involved so as to raise the quality of the product. The management of the computer shop aids and abets this effort in an attempt to obtain customer satisfaction through the trade of a little employee loyalty. If these two salesmen do well, then the starry eyed programmer gets a mistaken impression of his value to the organization. He starts thinking that HIS PROJECT HAS A PAYOFF FUNCTION SHOWN BY FIG. 1.

As we blow up the programmer's ego, he in turn chides us about long turn-around time. Since we have not yet tried on-line operation, there is some danger that we will jump off the deep end to save face.

Previously it has been reported that seemingly learned individuals are seriously discussing the concept of "consoles for everybody" (cf. *Datamation*, May '63, p. 29; July '63, p. 69). With straight face these reputable people discuss using large computer-based automated files for management analysis and control, merchandizing, and information retrieval. While it's true that the medical value of an additional scrap of information to the physician who is ministering to a dying man may have a payoff function similar to Fig. 1, it is also true that the marginal value of an automated *on-line* legal library is quite small. In every case on-line is the key word. The benefits of automation over present operations are, in the practical cases, economically apparent and justifiable. The benefits of additional response time are, in many cases, sub-marginal.

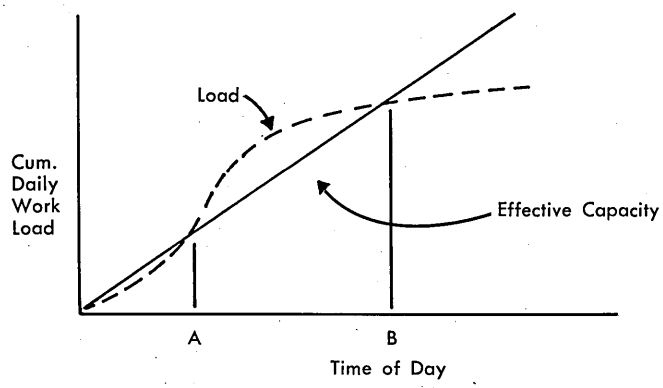
The debate revolves around processing efficiency. In a gross sense a measure of processing efficiency is the number of jobs a computer can handle in a day divided by the cost of handling those jobs. If the programmer payoff function is similar to Fig. 2, then the cost of performing a day's worth of work is proportional to machine time used. Pressed to the extreme, this function will produce the machine time required for a unit of work. From this simple concept it should be readily apparent (but is not to some) that additional cost in machine time used must be balanced by compensating savings in some other portion of the system or the cost per solution goes up.

Some proponents of the consoles-for-everybody approach maintain that major savings result when man-machine interaction is improved. Furthermore, they contend that this improved interaction actually reduces the number of checkout passes to produce a net saving. While this may be true, no observer has ever come forth with a factual report which indicates how many more problems can be solved in a year by the same crew when the mode of operation is changed to on-line. In response to a direct question, one time sharing prophet indicated that the PDP-1 was more accessible and gave quicker solution from analysis to checkout than did a batch operated 7090. He failed to mention that the size of the programs being checked out in the PDP-1 ran from 4,000 words down to minuscule; whereas the size of the programs being checked out on the 7090 were man-sized. Thus the debate continues.

Very few installations have performed a plain old-fashioned time and motion study on the programming process. True, time is lost waiting for machine runs, but the undisciplined programming crew can create peak loads which match exactly other peak loads which are *not* under the installation manager's control. In short, everybody wants to work from 10 a.m. to 3 p.m.! A technique has been devised, known as the Limiting Device Analysis, which allows an installation manager to determine where his delays are occurring. The foundation of such a technique is knowledge of the natural arrival rate of work at the door of the shop. The technique has been found to work successfully on store-and-forward message switching centers, batch operated computational centers, and freeway traffic flow.

The essence of the method is to choose a suitable time period for analysis. In the case of the computer shop, a daily cycle is usually chosen. At the beginning of the day a graphical plot is started. This plot is the accumulated daily work load versus clock time. Thus this plot is a monotone function plotted versus time. Superimposed on this same plot is a line depicting the installed computer capacity. Fig. 3 shows such a typical plot.

Fig. 3



Every time an increment of work load arrives, it is added to the work load which had been accumulated to that time and that new sum is plotted against the time of arrival. On top of this cumulative load distribution, the computer capacity line is plotted. For a typical well-run batch operated shop, 10 per cent of the computer time is wasted due to tape changes, unprogrammed stops, and priority conditions. Therefore the slope of this line is 9 units of capacity versus 10 units of elapsed time. If ever the capacity line cuts the cumulative load line as at point A on Fig. 3, then a backlog results. This backlog will continue to build up as long as the load is arriving at a faster rate than the computer can handle it. This is shown in the time period AB. Finally, at point B, the shop has more capacity than arriving work and the backlog begins to de-

crease. Eventually the backlog will be dissolved and free flow will again occur.

In intermittent processes, such as the operation of a computer job shop, there is a certain amount of overhead associated with initializing the operation. In the case of the computer shop this consists of keypunching and verifying the data cards, selecting the programmer tapes from the library, loading the batch of data onto an input tape, and initializing the beginning of the run. This series of initialization activities (and the companion series of activties which occur at the completion of the batch) are overhead on the entire batch of jobs. The longer the batch, the higher the efficiency. A reasonable batch size results in 15 minutes of computer time. It should be noted that the most inefficient operation possible is running a batch size of one.

It is possible by mediocre design to make operating systems appear to batch input/output and compute while in reality they are internally running batches of one. A true three-phase monitor will obtain the compilers only once and then compile or assemble all jobs before proceeding to execute any of them. One of the most recent "modern" systems released by a major manufacturer appears to batch jobs through the machine when in reality it operates them as batches of one internally. This system is so poorly organized internally that a typical job requires 122,000 words of system program to be handled before the job is ready for execution! These facts are depicted by Fig. 4.

Fig. 4

Fig. 4 shows batch processing time plotted against batch size. The intercept is the overhead for the entire batch, and the incremental execution times are plotted for an average job. Obviously the highest efficiency occurs when the batch size is as long as possible. While this results in the greatest delay for a *single job* in obtaining access to the machine, it can be shown that the turn-around time for a backlog situation is actually minimized by running batches due to the high efficiency involved.

Fig. 4 clearly shows why some knowledgeable people in the field have a strong aversion to on-line processing. With the on-line mode of operation (and current hardware design) each individual application is operated as a batch of one. It has been demonstrated that the efficiency of operation, with a well-trained operation staff, hovers around the 90th percentile when 10 or more jobs are loaded onto a batch. One of our bearded ones has admitted that the efficiency of operation when individual jobs are operated for an arbitrary time slice (one of the on-line gimmicks) is no greater than 80 per cent. If this is truly the case, then this lack of efficiency must be made up elsewhere in the organization. Longer, not shorter, turn-around times will occur when the same load is impressed on a computer and the efficiency is decreased. The time for a day's worth of work will be increased and, furthermore, the peak load problem will be more pronounced due to the 10 to 3 active day phenomena.

Even after machine organizations are adjusted somewhat so that on-line operation can occur with the same efficiency as our batch processing shops, several more major problems remain to be solved. At the present time these problems are not being sincerely treated. With a batch operated computer shop (be this business data processing or scientific checkout and production) the problems of machine reliability are difficult, but not insurmountable. The input data always exists in a hard copy form (punched cards) and if uncertain machine operation is expected, the input tapes can be saved until the run has successfully operated. In the case of the on-line operation where consoles are readily available to all users, the input data will never exist in a hard copy form. Furthermore, current input/output units preclude the computer from typing out the data as it was actually used since a 15 character-a-second console typewriter is death where large data volumes are involved. Thus, such an input mode will place reliability requirements on the remainder of the machine of an order of magnitude greater than those currently available. The possibility of re-running the identical data set (with confidence) in order to determine incipient machine failure will be gone. The problems of diagnostics, audit trails, and automatic logging of intermediate products of computations will set upon the software designers in a very severe way. Unless this problem is faced soon, chaos will result.

In addition, another severe problem which has not been openly discussed is the problem of the keypuncher. Our keypunch girls perform a very high level data editing function. They are capable of observing very complex data patterns and detecting insidious errors or potential errors in those patterns. They are highly trained and extremely competent. In addition, the verifier operators have a very healthy skeptical attitude and, if your input deck is edge notched in column 81, you have a very high assurance that the data that you wrote on the sheet is what was punched in that card. When everyone from the janitor to the corporate vice president has his own private console for on-line interrogation of the computer, our input data quality will decrease remarkably. Most programmers cannot keypunch accurately even the few cards required for patches. To ask that these people accurately key in (type) their programs and/or input data or controls for a run is, to my thinking, out of the question. The only hope is an extremely sophisticated input data editing program which looks at what comes off the other end of the wire. In both of these cases, the additional programs raise the overhead and increase the intercept indicated in Fig. 4. This must be made up somewhere or a less efficient operation will result.

In closing, it appears that on-line operations are no panacea either. If the payoff function for the application is as represented by Fig. 1, then the additional expense for hardware, programming, restarts, and editing is surely justified. If the payoff function is more like Fig. 2, then one can invest manpower and additional equipment without achieving his end. One shop has automated its scheduling, reduced the number of tape changes required (through the use of a disc file), and "decreased turnaround." The average job in this shop has been increased by a minute (from five to six minutes) and the paid-for "during programmed operation" time has increased by five hours per day (300 jobs at one minute each). One marvels at how inefficient this shop was formerly, since five hours per day additional is considered improved operations. ■

TESTING PROGRAMMING APTITUDE

by ASCHER OPLER

As the data processing field continues its rapid growth, the need for recruitment continues to mount. Since prediction of success in programming is difficult and training is expensive, the proper selection of candidates is a problem that concerns many.

Early attempts to identify aptitude used standard tests and correlated the results with actual performance of those tested. Later, written tests aimed at the testing of programming aptitude were specially developed. In 1960, Langmuir[1] described the LAD (Logical Aptitude Device) test which employs operation of a specially constructed machine to test logical aptitude. Although this device has been used for testing electronic technicians and others involved in logical manipulations, it has been primarily applied to testing programming aptitude. Several organizations have made frequent and effective use of the LAD test in programmer selection.

CUCPAT (Computer Usage Company Programming Aptitude Test) developed from an attempt to simulate the LAD equipment on a general-purpose computer. The internal logic proved easy to program, but the console at which communication between man and device takes place proved too difficult to reproduce. This led to the development of a new aptitude test that could be adapted to the console features provided with most computers.

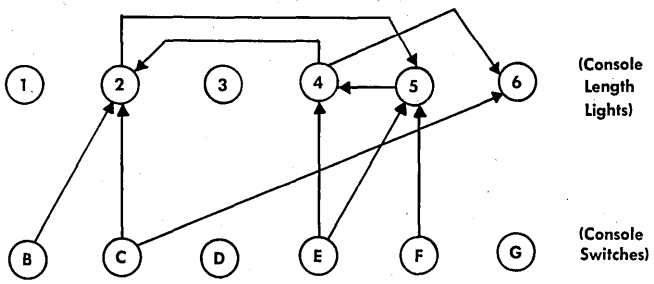
The IBM 1401 was selected as the initial machine on which to develop the test since (a) it is available in several thousand locations and (b) its low hourly rental cost makes it practical for test use.

The test, which will be described in detail below, uses the Sense Switches, the Length indicator lights and the Overflow indicator light on the IBM 1401 console. A mask covers most of the console components not participating in the test. Communication between examinee and computer is greatly simplified by the sparse number of components activated during the test. As later experience demonstrated, this did make it feasible to have non-technical personnel alone in the computer room operating the machine.

In the following sections of this report we give a detailed description of the test, how the test results obtained are to be used in evaluating programming aptitude and how the test was validated. We will also discuss how the test can be modified for use with other computers, how the logic of the test itself may be altered and improved and how the test may form the basis for a wide variety of experiments in man-machine communication.

The problems to be solved by the examinee are represented by two matrices punched on a pair of IBM cards. A single problem set (consisting of one sample problem plus four actual problems of graded difficulty) has been used consistently to date. These problems each have a unique solution which represents a single path from start to finish. In a sense they are equivalent to mazes in which only one traversal path is possible. We have already demonstrated problems with multiple entry and exit points representing mazes of more complex order.

Figure 1: Problem



the test

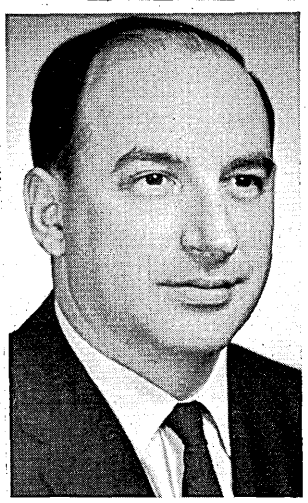
The first element is the configuration of the test machine as operated by the examinee.

Inputs from examinee to machine consist of six sense switches used to make a choice and the START button used to effect the choice.

Outputs consist of six "length lights" used to display the consequences of this choice and the overflow light whose alternation is used to synchronize sequential moves.

An auxiliary element is the 1403 printer which gives the examinee messages regarding the start of each problem and the end of the examination.

The second element is a graduated set of related problems. Each problem is presented to the 1401 as a pair of punched cards and presented to the examinee in the form of a diagram on a 4″ x 6″ card (see Fig. 1). As the examinee passes from problem to problem, additional pairs of cards are read into the computer and the printer



Mr. Opler is vp-director of Programming Systems for Computer Usage Co. Inc., New York City. He joined the firm in 1958 after 11 years with the Dow Chemical Co. He has been associated with various aspects of the computing field since 1947, including the development of numerous computer applications and of automatic programming systems. He is also an associate editor of the Journal of the ACM.

[1] Proceedings, Eastern Joint Computer Conference, New York, N.Y., 1960, p. 1

instructs him to place the corresponding diagram on the deck before him.

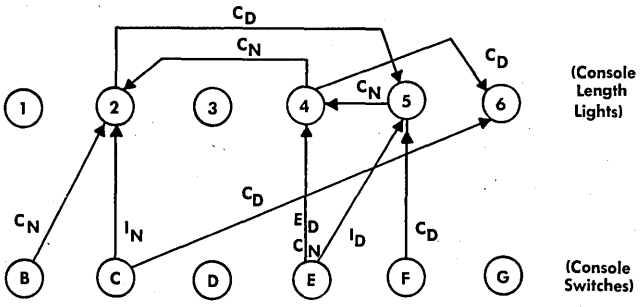
The problems represent a path or maze which must be traversed from the initial condition (no light displayed) to the final condition (light 6 displayed). To proceed from the starting point to the successful light 6 condition the examinee must reference the diagram. This shows, by means of lines connecting points, which console switches and lights must be activated to form the successful path.

But the lines do not indicate which of three actions – effect (activate), co-effect (activate a pair), or inhibit – they represent. Co-effect can result from activating two switches, or a switch and a previously activated light. Also, the lines do not indicate whether the action is to take place during the "day" (overflow light on), or during the "night" (overflow light off).

Thus, the line between Console Switch "B" and Console Length Light "2" in Figure 1 may indicate one of six actions: 1) effect "B" during day or night (E_D or E_N); Inhibit "B" day or night (I_D or I_N); Co-effect "B" or "C" with lighted Console Length Light "4," day or night (C_D or C_N).

Thus, while the examinee has all elements of the path before him, he must apply perceptive analysis and then successful synthesis in order to reach light 6. He must further demonstrate that the path he built is sound by successfully turning on light 6 a second time before the computer will acknowledge this as a successful path (Fig. 2).

Figure 2: Solution



The third element is the set of special actions available to the examinee. By making use of special combinations of the switch settings, he may:

Yield on a problem and pass to the next.

Restart a problem solution from the beginning.

Pass from day to night omitting switch choice.

Explore the problem solution by starting at any selected point. This is accomplished by leaving the "normal" mode for the "explore" mode. A light and a time (day or night) desired for initiating the exploration may be selected. Now the examinee may proceed from this point in the problem toward its solution. Naturally, reaching the goal under these circumstances does not count toward success. The "explore" mode is terminated after each trial and the "normal" mode is automatically restored.

The fourth element is the test record that is made concurrently with the test. This is generally not visible to the examinee. Each choice, the time, the mode and the effect are recorded along with trial and step number. At the conclusion of each problem, a summary is printed. At the conclusion of each examination, summary cards are punched for use with the evaluation program.

CUCPAT is an IBM 1401 program written in Autocoder. It will operate on a 4K IBM 1401 and it required no magnetic tape units.

administration of the test

The test is given in two stages. In the first, the examinee is seated in a quiet room. A short statement about CUCPAT is read by a proctor who then hands the briefing manual to the examinee. The latter is left alone in the room for 45 minutes while he studies the manual. This is a simple, profusely illustrated booklet describing the nature of the test and instructions for manipulating the console switches. A sample problem is worked out in detail. At the end of the period, the proctor returns, answers any questions and leads the examinee into the computer room. The examinee may bring his manual and notes with him.

In the computer room, the proctor shows the examinee the parts of the computer used in the test, seats him at the console (with paper and pencil) and loads the IBM 1401 with the CUCPAT program, which first produces the message "START PROBLEM 01." The examinee places the problem diagram (mounted on cardboard) before him and, with liberal help from the proctor, proceeds to the solution of the first problem. This is identical to the sample problem worked on in detail in the manual. (The performance of this sample problem counts very little in the final evaluation.) After this has been solved, the printer announces the next problem to be tried and so on. The proctor now leaves the examinee alone in the computer room but remains within call. There are four problems (excluding the sample) of graded difficulty in a set. The examinee has up to 45 minutes to solve all four. If he solves them in less, his actual time is noted.

At this point, the examinee is dismissed and the evaluation program is run, producing a one-page summary and rating of the examinee's performance.

evaluating test results

The best way to evaluate the performance of an examinee is to have his complete work observed by a competent, trained psychologist thoroughly familiar with the test and its basis and who will, after the examination period, exhaustively analyze the printout produced during the test.

A less satisfactory method is to have the test perform-

"Hands-on" testing for programmer aptitude is demonstrated by an examinee at the masked-off 1401 console.

ance automatically evaluated. Since trained psychologists will not be generally available to administer and evaluate this test, this latter method is the one that will probably be most used.

The automatic evaluation program receives as input the following information:

1. The time of duration of the test in minutes. (In the event that all four problems are not completed, the total time is still used in the calculation.)
2. The number of problems solved (excluding the sample).
3. The number of Trials, Explores and Gaps for each of the problems.[2]

Figure 3: Relative Factor Weights

CUCPAT Score	CUCPAT Rank	Supervisors' Mean Rank	Staff Position
1.00	1	2	Senior Programmer
1.12	2	4	Senior Analyst
1.71	3	7	Analyst
1.87	4	17	Secretary
2.05	5	13	Analyst
2.12	6	8	Manager
2.14	7	10	Technical Writer
2.20	8	5	Senior Programmer
2.20	8	13	Typist
2.24	10	12	Programmer
2.32	11	9	Programmer
2.53	12	1	Manager
2.70	13	3	Manager
2.90	14	6	Programmer
3.31	15	6	Programmer
3.53	16	20	Clerk
3.56	17	15	Operator
3.78	18	19	Secretary
4.07	19	18	Secretary
4.67	20	19	Secretary

The first step in the calculations is the normalization of the raw counts on Trials, Explores and Gaps. This is obtained by dividing by the means obtained with a base validation group.

Based primarily on intuitive considerations, six factors of possible significance were selected. These factors are computed using the following formulae:

$$\text{Factor 1} = n/t$$

$$\text{Factor 2} = \overline{T}/T$$

$$\text{Factor 3} = (\overline{T}_1 + \overline{T}_2)/(T_1 + T_2)$$

$$\text{Factor 4} = \left(\sum_{t=3}^{n} \overline{T}i\right)/\left(\sum_{t=3}^{n} Ti\right)$$

$$\text{Factor 5} = 1 - (G/\overline{G})$$

$$\text{Factor 6} = E/\overline{E}$$

Where n = total number of problems solved including the sample

t = total test time in minutes

T, E, G = as described on the previous page.

$\overline{T}$, $\overline{E}$, $\overline{G}$ = means for the validation group.

The factors are calculated in such a manner that an increasing value is indicative of increasing excellence of performance except in the "Use of the Explore Mode." At the present time, the significance of this (Factor 6) is not understood and it is not considered further here.

In order to produce a single weighted indicator of aptitude, the five factors were associated with five aspects of programmer performance. Four Computer Usage Company supervisors were asked to indicate the relative weight they placed upon these performance factors. Fig. 3 shows the factors and the weights as indicated by the supervisors. However, before making the final weighting, the effect of the number of problems solved was taken into consideration. This was given a weight of .2 against a weight of 1.0 for the five factors.

A sample of the evaluation sheet is shown in Fig. 4.

validating the test

An attempt has been made to find to what extent the test correlates with programming aptitude and with other factors that might be unintentionally measured. A group of 20 examinees was studied intensively.

Figure 4: Evaluation Sheet

CUC PROGRAMMING APTITUDE TEST

JOHN EXAMINEE

50. MIN. PERFORMANCE

PROBLEM	1	21	38	55	82
TRIALS	7.	14.	8.	9.	24.
EXPLORES	2.	6.	1.	5.	13.
GAPS	0.	0.	0.	0.	0.

RATINGS

PROBLEMS SOLVED - EXCLUDING SAMPLE-	4.	
SOLUTIONS/MINUTE	0.080	3
TOTAL PROBLEM SOLVING	1.076	3
LEARNING FROM BOOK	0.610	5
LEARNING FROM TEST	1.315	2
CONSISTENCY OF SOLUTION	1.000	1
USE OF EXPLORE MODE	1.724	
WEIGHTED AVERAGE	2.55	

COMMENTS

E S.

DATE 2/8/63 PROCTOR

1#A 2#B 3#C 4#D 5#E 353NRW

The composition of the base group consisted of:

Three	Managers	One	Computer Operator
One	Senior Analyst	One	Technical Writer
One	Analyst	Four	Secretaries
Two	Senior Programmers	One	Typist
Five	Programmers	One	Clerk

The group ranged from 12 to 19 years for highest educational level. Eight had no programming experience, three had one year of programming experience, three managers had been in the field 13 to 14 years and the others ranged between two and eight years.

In Fig. 5 the examinee's weighted test score is used as a basis of CUCPAT ranking. Six CUC supervisors independently ranked the members of the base group according to his opinion of their relative programming aptitude.

A Rank Difference Correlation Co-efficient was computed between the rank determination by CUCPAT and the rank determination by the CUC supervisors. The Pearson Rank Difference Correlation Co-efficient was 0.476

[2] **Definitions:**

(T) Trials—each attempt at solving a problem from the beginning

(E) Explores—each initiation of the explore mode

(G) Gaps—the number of trials intervening between the first and the second trial that turns on light 6 in the normal mode

Figure 5

Factors	Supervisor				Mean
	A	B	C	D	
1. Speed of programming achievement.	40	25	20	25	28
2. Excellence of programming achievement.	40	30	30	25	31
3. Ability to learn from manual.	5	10	15	25	14
4. Ability to learn from experience.	5	20	15	10	12
5. Keeping methodical records.	10	15	20	15	15
	100%	100%	100%	100%	100%

which, for a sample of 20, shows a confidence level of 95 per cent.

To estimate the effect of education and experience, the group was divided into quintiles as determined by their rank in the CUC Programming Aptitude Test. The educational attainment and the years of programming experience for each quintile was averaged. For educational attainment, the results are insignificant because of the high cluster of the professional staff's education near 16 years. What the figures reveal is that there is a sharp break between the fourth and fifth quintile, with all those in the fifth quintile having the least (12 years) education.

The correlation of years of experience with performance is quite high. Two hypotheses that might explain this are: (a) computer experience promotes proficiency in taking CUCPAT and (b) those with good aptitude, as measured by CUCPAT, remain in the field longest. Only longer experience with testing will indicate the relative strength of the two hypotheses.

Three of the examinees also took the LAD test. Their comparative results are as follows:

Examinee	CUCPAT		LAD
	Average	Rank	
16	2.13	11	A
20	2.78	14	B+
1	2.85	15	B+

The most significant aspect, which has not yet been tested, is the success of the test in predicting performance as programmers by examining those who have not yet had experience. A continuing study of this aspect is being initiated.

potential development of the test

At the present time, the CUC Programming Aptitude Test is at a relatively primitive stage with many avenues of development open. Some of the expansions possible and probably desirable are given below.

The important elements of the present test are as follows:

1. The test set-up and administration is given by an IBM 1401 computer program and is thus subject to easy change.
2. The test problems are represented by punches on cards and are thus subject to easy change.
3. The console elements of the IBM 1401 are limited and programming the test on another computer could broaden its scope.

The present test program can be readily modified to allow co-effecting by more than two switches or light-switch combinations. Three switches and one light, for example, could be co-effectors.

The problem-set in the card read hopper could be controlled by actual performance and, by passing over certain problem cards, the program could select one of several graded alternatives as the next problem.

If it is desired to create difficult situations, a dynamic aspect could be introduced that would change the role of a relation in a program. For example, a simple effector might turn into an inhibitor every third time it is applied.

The problem-set, with the existing program, can be made more complicated or simpler. This gives the test the potential of being used with above-average and below-average groups. Current problems have single paths. Problems with branches, crosses and loops can be readily devised.

Regarding the man-computer interface (at the console), a computer with typewriter control or an inquiry station (or at least one with more usable console elements) would be preferred. Type-ins could allow for more choice and control and the type-outs could be far more explicit. It should be pointed out, however, that this very increase in communication facility may be a detriment in many ways since it requires more briefing, easier chance of destroying the program, longer test periods, etc.

In the area of future development also lies the task of improving the evaluation program and obtaining validation on a much broader sample. In particular, the test must be used with potential programming training candidates and the test results correlated with their subsequent experience.

While the test was developed specifically for testing programming aptitude, it is obvious that it may be extended to testing of logical aptitude where similar elements come into play. It would appear to be useful in selecting candidates for training as air traffic controllers, electronics technicians, military command systems operations, etc.

Finally, it should be pointed out that this simple problem-solving situation is one where man and computer are face to face, and since the machine directs the test and "observes" the man's performance, it lends itself to various psychological experiments (stress, frustration, environmental factors). It should also prove interesting as a situation to be explored using "artificial intelligence."

acknowledgment

The development of this test from idea to reality in the short space of three months is the result of the enthusiastic cooperation of many members of the staff of Computer Usage Company. In particular, appreciation is expressed to George Kabouchy for writing the CUCPAT program, to Adrienne Raynes for assistance in validating the test and to Ellen Sonn for her careful and patient work in administering the test.

The test obviously owes its origin to the LAD test, developed by Charles Langmuir of The Psychological Corporation. Periodic consultation with him during the development period gave us much needed direction and assurance. ■

THE OPERATIONS RESEARCH SOCIETY of AMERICA

interview with ORSA's president

by ROBERT B. FOREST, Editor

Q: Would you start by giving us your name and title?
A: I am Alexander M. Mood, vice president of C-E-I-R, Inc., but the relevant title for the purpose of this interview is president of the Operations Research Society of America.
Q: Could you give us a brief general description of operations research?
A: Well, one of the easiest ways to start a fight in the society is to try to get agreement on what operations research really is. Luckily you have come to the one man in the whole organization who can tell you exactly what it is—according to my definition. I see it as primarily a branch of applied mathematics but there are strong overtones of interdisciplinary work in it. It is sort of an unconventional branch of applied mathematics in the sense that often the application is to a situation not generally recognized as suitable for mathematical analysis. It usually involves besides mathematics some combinations of engineering, economics, cost analysis, probability theory, statistics or other fields of knowledge. The word *operations* is a good clue to the work; the application is usually to the study of substantial activities: manufacturing operations, military operations, processing operations, inventory management, transportation systems, communication networks, and so forth.
Q: Perhaps an example or two would be helpful.
A: The management of inventories is a typical operations analysis problem on which a great deal of work has been done. Here you may have a manufacturer of several different products, say radios and TV sets. Counting different furniture styles he may have a hundred products. They are made on one or two assembly lines. His inventory is partly at the manufacturing plant and partly at warehouses scattered over the country. How many of each product should be placed at each warehouse? There are financial factors involved: by tying up a lot of capital in large inventories he can avoid lost sales resulting from being out of stock but capital costs money. One must balance these two costs. There are economic factors involved: fluctuations of demand because of seasonal effects and because of ups and downs in the economic health of the nation must be balanced against the economy of having a fixed labor force. Entering both these balances is the economy of making long runs of a given product on the assembly line. There

Member of the board of ORSA from 1956-59, Mr. Mood was a U.S. delegate to both the 1958 NATO OR Conference and the 1960 and '63 International OR Conferences. He was president of General Analysis Corp. when it merged with CEIR in 1960 and, before that, assistant chief, Mathematics Div. of RAND. This was preceded by a three-year stint as professor of mathematics and statistics at Iowa State College.

The Operations Research Society of America is eleven years old. To become a member, one need only receive the sponsorship of two members who will state that the candidate has performed OR work of a professional caliber for at least two years. Anyone can become an associate member, thereby receive the journal and attend meetings. Membership fee is $10 per year. The 3,300 membership includes associates, who comprise about 60% of the total. There are generally two meetings per year; sometimes ORSA cooperates with other societies to sponsor other meetings. Thus, the two main activities are publishing a journal, Operations Research, *and holding meetings. There is also an education committee which advises on and considers appropriate curricula for training in OR; a committee on national problems advises government agencies, upon request, on the possible benefits of OR in some of their activities.*

ORSA activities are coordinated with a few other organizations: the American Association for the Advancement of Science has an ORSA representative who attends the association's council meetings. A representative is also sent to the National Research Council, the semi-official voice of American science, in Washington. And ORSA is a member of the International Federation of Operations Research Societies (there are about 15 countries with OR societies), which holds an international conference once every three years. The other activity of IFORS is the publication of a journal which abstracts OR papers from all countries; each quarterly issue has about 200 abstracts. ■

are statistical factors involved: Even if one had the average demands for every product pinned down at every warehouse still the actual demand in short periods of time would be affected by random factors. Hence it is necessary to estimate the probability distributions of demand and deal with calculations of the probability of exhausting the supply at a given place. You can see that an operations analyst will get himself involved in some pretty fancy analysis in trying to devise a sensible inventory management policy for this manufacturer.

Q: I take it that operations researchers can solve this particular problem with no difficulty.

A: I am going to try to avoid saying we can't solve problems. For this one, certainly, a competent operations analyst would find a good solution. There is lots of literature on this problem and some of it will be helpful to any specific problem. Every inventory problem is different from all others and therefore a ready made solution is not to be found. Different products have different shipping costs, different storage costs, different shelf lives, different distribution patterns and so on. These all affect inventory management and hence every company must have its tailor-made system.

Q: You said a competent analyst would find a good solution. Is there more than one? Isn't there a best solution?

A: There may be a best solution to every problem but an operations analyst seldom goes after it for the reason that usually the analysis would cost too much money. He has to be a very practical man or he will soon find himself looking for a new connection. Just to pick numbers out of the air: A good solution to the radio manufacturer's inventory problem might save him $100 per day relative to the system he is now using; the best solution might save him $110 per day. But that best solution might require very expensive collection of information and data far out of proportion to the additional savings of $10 per day. Of course this sort of situation generally prevails in the world of practical affairs; the business man tries to make reasonably good quick decisions; he cannot afford the time and resources to search out the best decisions.

Q: Operations research is a fairly new science isn't it?

A: Not really. People have been doing quantitative analysis of practical problems for a long time but the definition of this activity as a specific profession began in World War II when several wartime problems were recognized by the military to be amenable to a mathematical kind of analysis. During the battle of Britain, there was the urgent problem of allocating scarce fighters to heavy German bomber raids. The contribution of scientists to the solution of that problem was widely appreciated and very soon the U. S. Department of Defense obtained a group of scientists to work on some of its military operations problems. One of the first was a very typical operations analysis job: that of finding the best way to convoy materiel to Britain. One has to deal with a great many variables such as shape of the convoy, size of the convoy, spacing between ships, speed of the convoy, disposition of protecting Naval vessels in the convoy, accuracy of torpedo firing by submarines, vulnerability of submarines to Naval defense and other factors having to do with the assembly and disassembly of the convoy. Out of this mess of variables one must find the best operating combination. The way to do it is by constructing a mathematical model of the whole operation and then exploring the model by means of mathematical techniques. That is operations analysis.

Q: Perhaps another typical business application would be helpful.

A: Well, one rapidly proliferating technique is the application of the linear programming model to business operations. The linear programming model is simply a collection of linear equations which can be made to represent almost any operation by appropriate choice of variables and coefficients in the model. Probably the largest user is the petroleum industry. Some oil companies have constructed very large models of their complete operations using hundreds of variables. As these models are used to study company operations and find optimum operating policies they tend to get more and more complicated as people strive to make them more and more realistic. As the models become more realistic, executives have greater confidence in the results obtained from them and tend to make wider use of them. Thus the whole activity of operations analysis is self-generating.

Q: There has been talk of constructing linear programming models of whole economies. Is such a thing feasible?

A: It is, because you can shape the problem to make it feasible. In fact it is feasible to construct a very simple, inexpensive model of the whole U.S. economy. You would do it by using few variables, perhaps ten or so, to describe the entire economy. Each variable would have to measure quite a broad sector of the economy. Possible sectors might be such things as agriculture, manufacturing, construction, retail trade, transportation, services, government, etc. A more elaborate model might use a hundred variables which would describe the economy in more detail. Thus, instead of transportation you might have railroads, trucking, passenger cars, airlines, shipping, pipelines.

To be useful for industry as well as government the model would have to be still more detailed. It might employ a thousand or more variables with every important

industry having a variable to itself.

Q: Does any country now have such a detailed model of its economy?

A: At the moment Russia is the only country with such a model although France is pretty close to it. Russia, of course, for its successive five-year plans has accumulated a great deal of data on the operation of its economy and the interactions of the activities within the economy. This information has enabled Russia to put together a number of different linear programming models of its economy having different levels of detail. Some of the smaller ones are presumed to have been used in drawing up past plans. The largest is not yet on a computer but apparently is now being put on a computer and will be used for continuously updating and revising national plans.

Since the war France has been engaged in fairly comprehensive national planning. This is a voluntary cooperative venture in which all interested parties participate: government, industry, finance, labor and consumers. The plan is formally approved by the government but there is no mechanism for enforcing compliance with the plan. People generally stick to it pretty well partly because they regard it as a matter of patriotism to do so and partly because they know their welfare is closely correlated with the national welfare. That has been well served because the French economy is enjoying the most rapid growth rate of any industrial nation apparently as a result of these plans. In any case this planning activity has given France most of the data necessary to construct a linear programming model of its economy and discussions are presently being held as to the advisability of constructing a linear programming model and putting it on a computer so that plans can be more readily and frequently modified.

Q: Does the successful use of such models require more government control than exists in this country at this time?

A: Not at all. French businessmen are known to be as ruggedly individualistic as anybody but they cooperate willingly in the French voluntary system and support it, by and large, wholeheartedly. One reason they do so is that they get out of it a sound basis for their own planning. Business must do all kinds of planning: two and three year budgets, capital expenditure programs that look several years ahead, research and development programs, diversification programs, long range sales forecasting, growth programs and the like.

Q: Would a model of the U. S. economy be of significant assistance to U.S. business in these planning activities?

A: I am convinced it would be of tremendous assistance if it were a fairly detailed model. Without something like such a model these plans have to be based on rather nebulous statistical information: miscellaneous unrelated projections and extrapolations cluttered up with poorly known cycles and trends not to mention unknown random factors. The basic factors at work in the economy and their interactions are not available to them. A linear programming model would not fully supply these but it would supply a first approximation to them which would be infinitely better than what we now have.

Q: Are present computers large enough to handle a detailed model of the U. S. economy?

A: Oh yes. The largest machines now available could handle a very fine model of the economy—say one with 2,000 to 3,000 variables. STRETCH or the 6600 would do it.

Q: This country would seem to have all the tools and talent required to establish such a model. What stands in the way?

A: A decision to do it. Uncle Sam would likely have to foot the bill, of course. Even his resources are limited and there is no end to things people think he ought to do. The fact is, the job had a chance of getting done on a modest scale as a private venture a few years ago. A group of investment analysts organized a company to construct a fairly aggregated model of the U. S. economy. The idea was to sell information derived from the model to investors. My impression is that they could not persuade investors to put up capital to build the model. That experience doubtless injured their sales forecast.

Q: How vital do you think such a project would be to the United States?

A: Well, I am personally very strong for it. I might even claim it is a necessity. We do not have sufficient understanding of the operation and structure of our economy. Just consider what a disadvantage this puts our decision makers in government and industry relative to their counterparts in France or Russia. If those two countries keep up their elegant growth rates a few more years we shall begin looking harder at what we might do about ours. The model will begin to look like an excellent thing to more influential people than it does now. I am definitely not talking about national plans, mind you; I am talking about a model which will give everyone who influences our economy a better understanding of the implications of his decisions. Business planning would be vastly more effective with this information. I believe that planning by entrepreneurs having good knowledge of the operation of the whole economy would lead this country into faster and healthier growth than national plans would.

Q: Is there such a thing as an operations research specialist or are there just operations research teams . . . combinations of specialists?

A: In the early days there very often were teams. In all the military operations research, there were military people on the team who understood the military weapons systems and who worked in collaboration with people who understood how to construct and analyze mathematical models. So it was a team effort. Most people who presently do operations research were trained originally in some other field—mathematics, economics, statistics, etc. Nowadays there are schools that train people for this work, and these schools have curricula that cover the sort of things I mentioned—a good deal of mathematics, economics, statistics, a certain amount of engineering, sometimes chemistry and physics.

Q: On the surface, it appears that this training might turn out an individual who knows a little about a lot of things. Is this a sufficient base?

A: These people go out with an advanced degree. They do have a sufficiently broad education to go into almost any particular business. They have enough fundamental knowledge to pick up the operations of this business pretty rapidly.

Q: Does this attempt to create a separate special discipline tend to defeat the interdisciplinary goals of operations research? As any field becomes more formalized, develops its own vocabulary and techniques, it can become more difficult for people within that field or specialty to talk to people outside it. Is this a danger or a problem?

A: I don't think so, because operations analysts are service people. They are serving managers in government and industry who have to make decisions. And it is really their responsibility to talk the language of the people they are working for. They get nowhere if they come into the manager and start talking mathematical equations, mathematical symbols or using the language of probability theory. So, if they are going to be useful to the company

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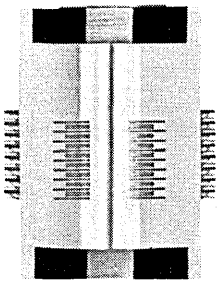

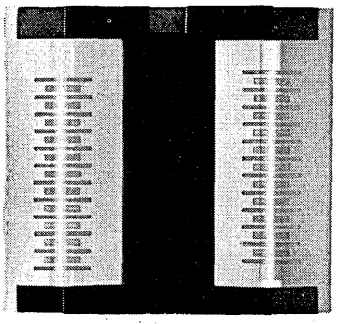

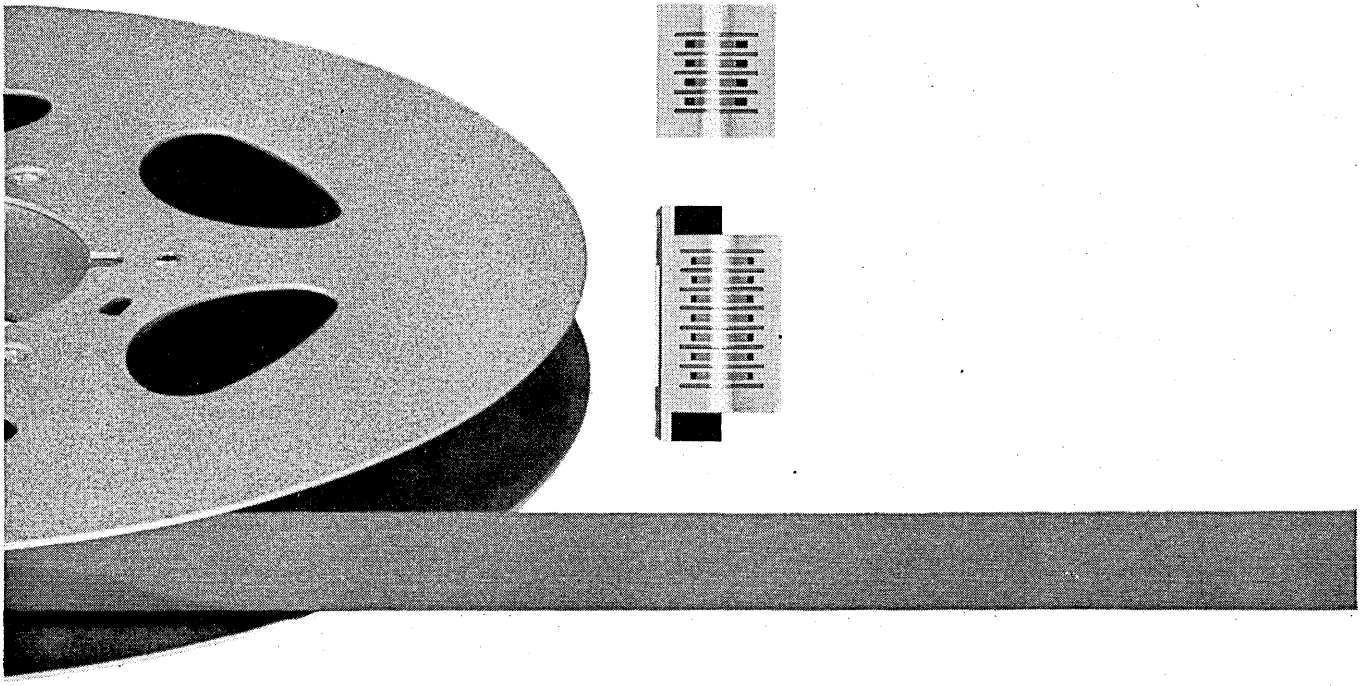

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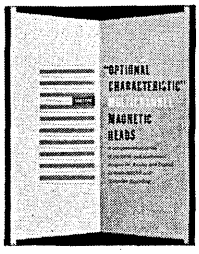

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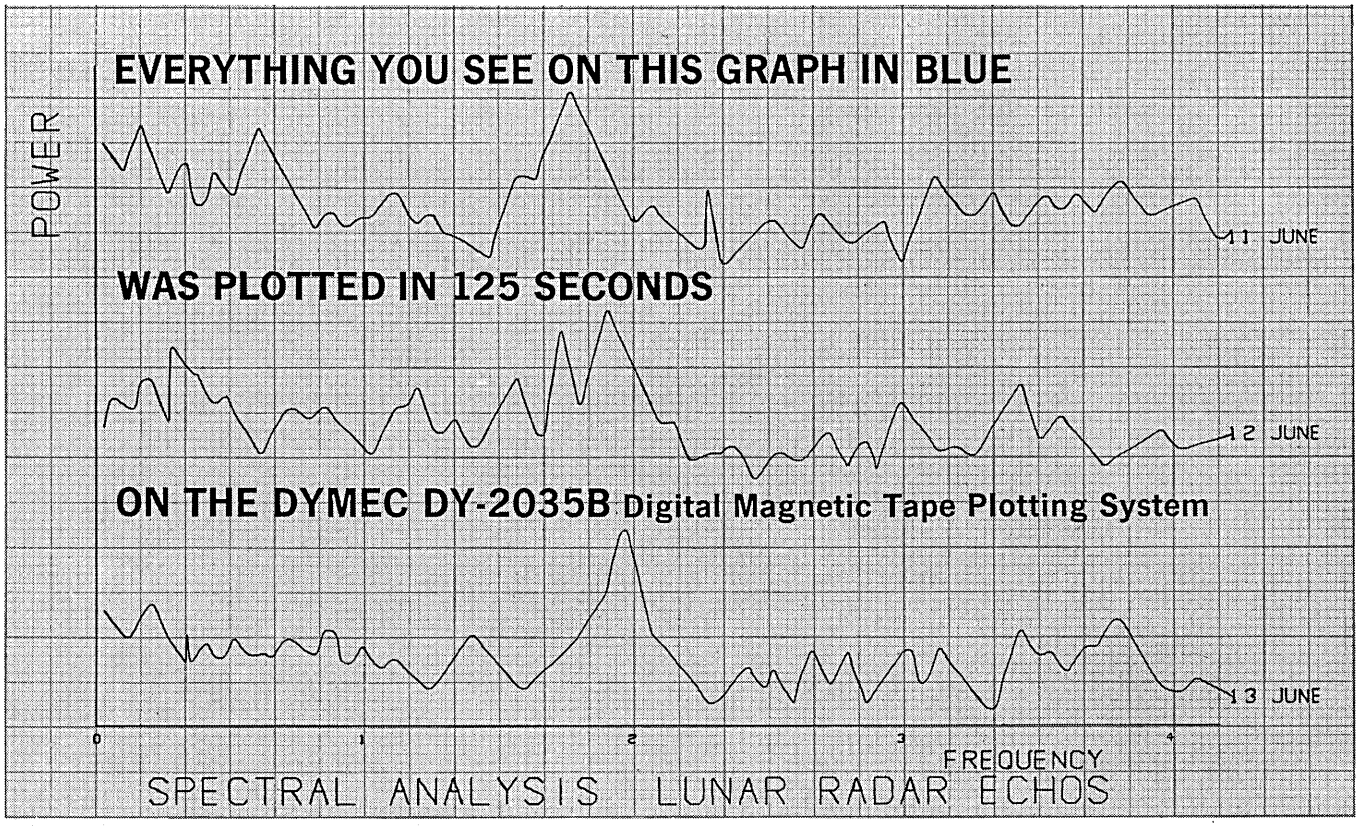

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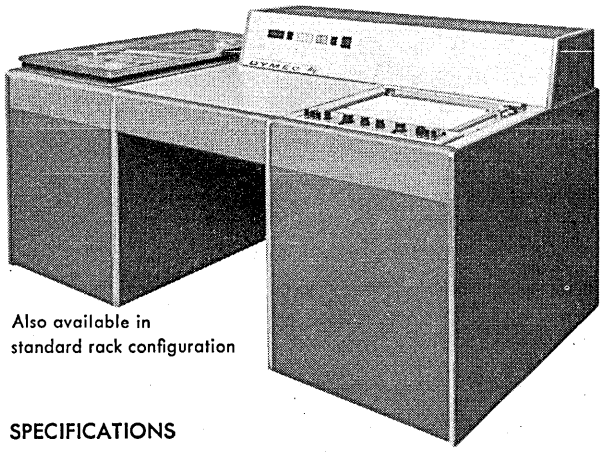

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they must make it their business to speak the language of the customer, understand his problems, and present the solutions and recommendations in a language that the customer will understand.

Q: Generally speaking, some of the things you say seem to be equally true of what might be called a high-level programmer or a systems analyst. What is the distinction between an operations research analyst and a computer systems analyst?

A: There is no difference with respect to this point about communicating to managers. Operations analysts generally talk to managers whereas I suppose computer systems people spend most of their time talking to programmers.

Q: Would you say, perhaps, programmers and systems analysts tend to be more computer oriented whereas operations analysts tend to be more problem oriented?

A: Possibly. Operations analysts are almost entirely problem-oriented.

Q: And whether or not they use the computer as a tool is incidental?

A: Yes. They have no partiality for the back of an envelope, or a slide rule or a computer.

Q: What use of computers is made, generally, in the operations research curriculum of American universities?

A: Well, it is a small part of their education. That is, they would not normally learn how to program a computer. They would know what computers are for and what the general capabilities and costs are. They would usually have some experience using a computer center in the same sense that an engineer might send extensive computations to a computer center.

Q: Would you describe mathematics as the base discipline?

A: It is the basic tool because we are trying to find an optimum combination of factors. And the way to do this is to combine them in some kind of simple mathematical model and analyze the model by mathematical techniques.

Q: How do you assign numerical values to every variable? Is any variable in any kind of a problem always translatable into a numerical value?

A: Well, there are ways, yes. Operations analysts generally deal with problems in which there is not much question about that. They usually deal with obviously measurable things. When they are trying to optimize airlines schedules, for example, there is no problem about variables being measurable. Airplanes carry 119 passengers, it takes them 5 hours to fly between this point and that point, and average traffic flow out of the city is so many passengers per day, crews can fly so many hours per week and so forth. These things are clearly all measurable. Now to things that are not measurable, people assign values anyway. They sometimes assign ranks in market research problems; consumers prefer a certain color, they like this color next, and so on. An analyst would just assign one to the first color, two to the second, and so on. It's possible for these to be satisfactory measures in some kinds of quantitative analysis. There is quite a science of assigning numbers in unmeasurable areas—we call it scaling—which has received a lot of attention, and there are some good techniques for it. It is a mistake to use ranks such as 1, 2, 3, 4, in some situations because that may not portray the proper relationship.

Q: We might gain a clearer picture of OR with this question: To what other organizations might a member of ORSA belong?

A: I belong to the Institute of Mathematical Statistics, as do a number of operations analysts, to the American Statistical Association, the Econometrics Society, (some of them would belong to the American Economics Society) and there are the math societies: American Math Association, American Math Society, along with the Society for Industrial and Applied Math. There is The Institute of Management Sciences, which is very similar to the Operations Research Society. I belong to the Biometric Society and the IRE; a number of people belong to various engineering societies.

Q: You mentioned TIMS as an organization similar to the Operations Research Society and I believe that TIMS and ORSA cooperate. What is the distinction between the two organizations?

A: That is a question often debated between members of the two. Looking at their journals and their meetings, they appear to be very similar organizations. In fact, papers submitted to one could just as well be submitted to the other—at least 90% of the time. The operations research people may be somewhat more analytically or mathematically inclined. TIMS people tend to approach things from the management side, and to ask to what extent the management function can be made scientific. ORSA people tend to think in terms of what management problems are best suited to the analytical approach. Really two sides of the same coin.

Q: How many TIMS members are there?

A: Roughly the same as the Operations Research Society, I believe.

Q: Have the two organizations ever considered merging?

A: Yes, there is talk about it from time to time. And there is always some provincial who says "Why mix wine with dishwater?"

Q: Would you be in favor of such a merger?

A: I think I would.

Q: What is the Society for the Advancement of Management?

A: That group is much more oriented toward traditional management consulting. That is my understanding. It gets involved with problems of organization, with monitoring and control, with personnel selection, typical management consulting activities—generally broader and more nebulous problems than operations analysts like to deal with.

Q: Are there some things that management consultants can do that operations analysts can't?

A: Yes, operations analysts don't deal with personnel selection, control, reorganizations, and systems and procedures. Management consultants usually deal with things that are more matters of judgment than of analysis.

Q: Would you describe the difference between operations analysts and systems and procedures people as one of level?

A: Problems attacked by operations analysis are not much distinguished by level. They are distinguished by their amenability to the application of analytical techniques.

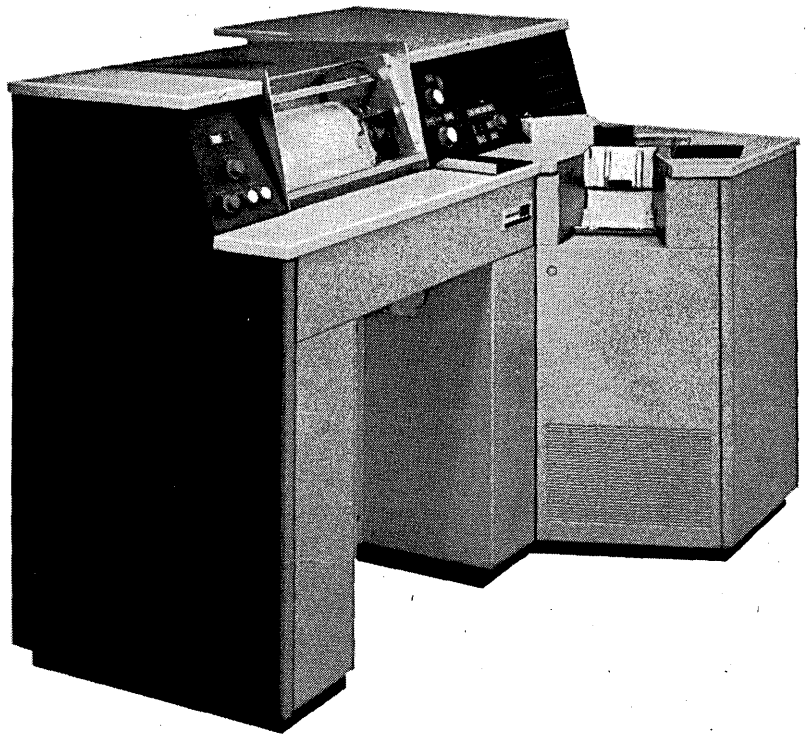
Q: Is the evaluation and selection of a computer system for a specific organization a problem amenable to operations research techniques?

A: Well, operations analysts seldom get into that. It is a problem that is well serviced by experts who deal exclusively with that problem, which is probably one reason operations analysts haven't gotten into it.

Q: Yet these experts, as far as I know, have not generally tended to apply analytical techniques to the problem.

A: No, they make their decisions on the basis of judgment. They know the computer systems. They become familiar with the needs of a particular customer who's looking for a system. I don't think they do a great deal of quantitative analysis . . . they gather information and come to a judgmental decision. It might be a problem which operations analysts ought to take a look at.

Q: When a company has one operations analyst, does he



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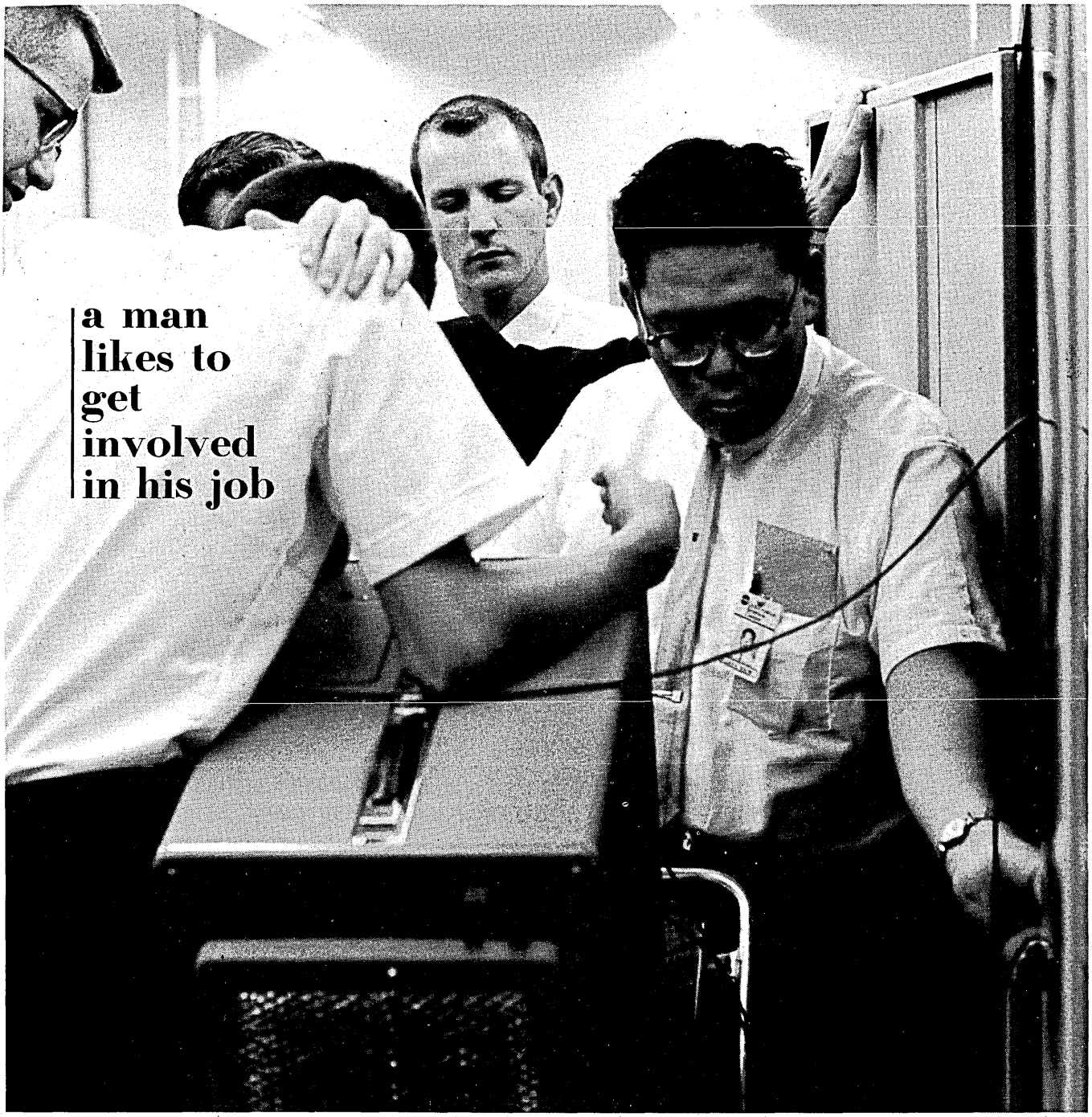
generally report to the president or the general manager?
A: The general manager or the vice president in charge of operations. Only a fair sized company, grossing $15-20 million a year, for example, would have a full time operations analyst.
Q: In a company of this size, does this man tend to supplant or replace more traditionally oriented people such as systems and procedures people, or is he tacked on top of that?
A: He would normally be another overhead item.
Q: Do managers ever resent being told how to do their jobs by operations analysts?
A: They love it. Like cats love mice. No. There is no problem about that. Most managers are accustomed to being assisted by staff studies.
Q: You mentioned, I believe, petroleum as a leading believer and user of operations research methods. What other industries have been aggressive and profited from operations research?
A: Well, the chemistry industry in general uses operations research extensively. Transportation uses OR to a considerable degree, especially airlines and, to a lesser extent, railroads. Most very large manufacturing companies now have operations analysts on their staff.
Q: Could we discuss the relationship of OR to computers?
A: I think the trend of operations research is to make more and more use of the computer. The reason is that areas in which operations analysts work require more and more elaborate models. In the early days they solved their problems with a pencil and paper . . . they used simple approximate models. Now, the more they learn about the operations of the business in which they are working, the fancier their models get; they try to take account of more factors which obviously enter into the problems. It is inevitable in building a model that some less important factors will be omitted and others might be treated in rudimentary fashion. Once that model is working well the analyst naturally wants to make it more realistic by treating those lesser neglected factors more precisely.

Then there are the matters of increasing the scope of a model and of combining models which tends to make models more complicated and hence manipulable only on a computer. A firm may have a production scheduling model and an inventory control model. These two things are closely related and the next step is to combine them into one model which enables analysis of the interactions between these two operations. So operations analysts are using computers to a much larger degree than they have in the past, and they probably will continue that trend for some time. Some problems are already computer-limited . . . there are oil companies I know of that would love to have more detailed models of their companies and their industry but computers are just not big enough to handle them on an economical basis.
Q: What specific hardware developments would you, as an operations research analyst, like most to see in the near future?
A: A big bottleneck is getting the problems onto the hardware. I have no quarrel with hardware except as it might possibly be designed to simplify the software problem. My difficulty is with the software . . . it is such a job to get a mathematical model into a computer.
Q: Even with, say ALGOL and FORTRAN?
A: It's still expensive and time-consuming to get the thing programmed and operating correctly. Another problem is flexibility. Operations analysts are used to juggling models, changing equations; they can do this with a flick of the pencil. But when they want to change the models in a program, the programming seems to have little flexibility. Programmers have to start from scratch all too often when the models have been given some minor revisions; the need is to get a problem programmed in a flexible way so that adjustments and minor changes can be made without wrecking the entire program.
Q: Are there signs of any possible solutions to this last problem?
A: I haven't seen any, but I am not too familiar with current software developments.
Q: Would you describe operations research as acting on the frontiers of computer applications?
A: Very much. Most large computational problems that get on a computer either came through from an engineer or an operations analyst. Of course, business machines are much occupied now by accounting problems, but operations analysts will probably make the bigger contributions to machine utilization in the future. I am thinking of total systems with a mathematical model of the whole company operation and a model of the industry in which that company operates, and perhaps also a model of the segment of the economy in which the industry participates. The import of decisions made within the company, the interaction of those decisions within the industry, can be studied and when those actions have some further ramifications with their segment of the economy they can also be studied. Decision makers in industry have to think of these things in making pricing decisions, for example. Certain pricing decisions bring in substitutes from other industries, so they really can't make those decisions without studying the adjacent areas of the economy.
Q: How far away are we from these levels of models within a company?
A: It will be a slow development. I would guess in five years less than 10 percent of American companies would have total models of their own company operations.
Q: Could operations research, as it is defined today, exist without computers?
A: It couldn't because the present largest activity of operations analysts is in Defense Agencies studying weapon systems which involve large numbers of variables requiring large computers. So the power of these analysts would be severely curtailed if they did not have computers . . . they would have to perform their analyses on a cruder and grosser scale and, therefore, be a lot less useful to their customer because their answers would fail to reflect situations sufficiently realistically.
Q: Is there a lack of cooperation between computer professionals and OR analysts?
A: No, there is good cooperation. Wherever there is a concentration of operations analysts, there is usually a computer facility, and the people are working closely with each other in their daily work. The problems of operations analysts are well known in the computer industry.
Q: You have described two ways of becoming an operations research specialist . . . education in depth and, more recently, a broader educational approach. Is there another way? That is, up through the ranks of, say, the computer profession from programmer to systems analyst and then on up?
A: Certainly, most operations analysts today started out in some other profession.
Q: Then a computer programmer who works very hard and is very able might someday become an operations analyst?
A: (With a laugh) Easily; he might pass through that step on his way to becoming president of the company. ■



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(Cedar Rapids)

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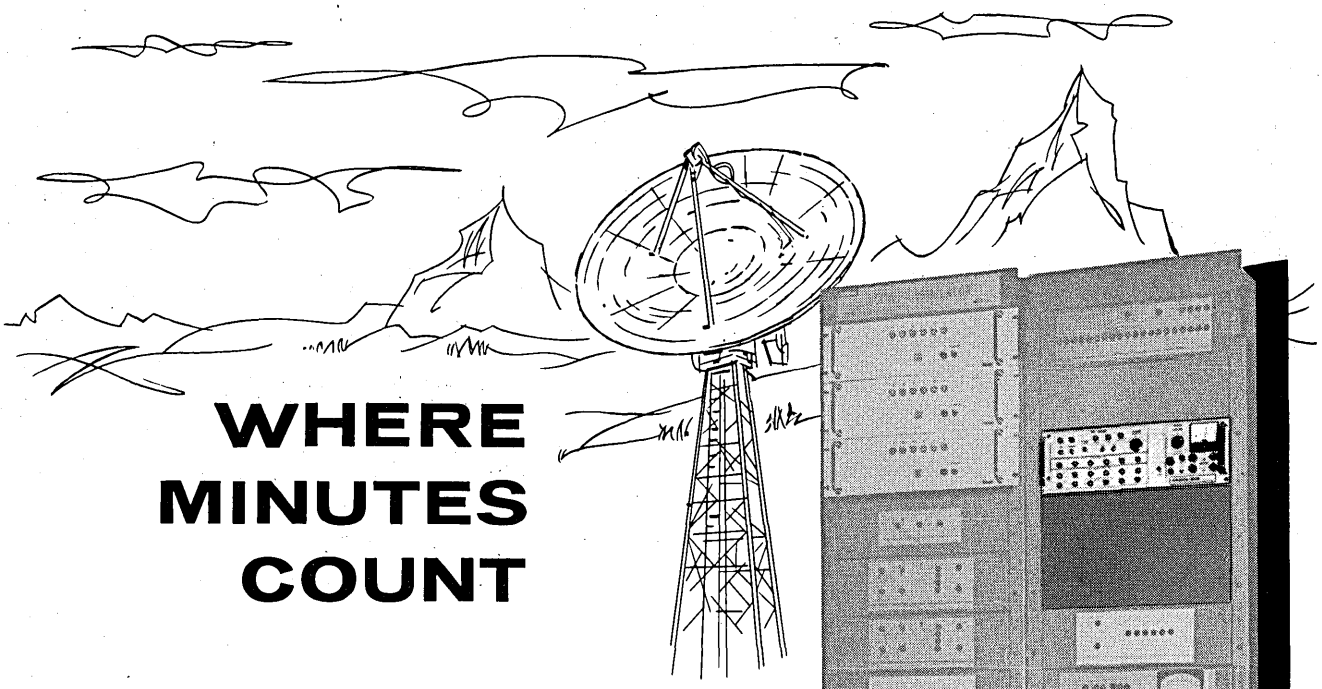

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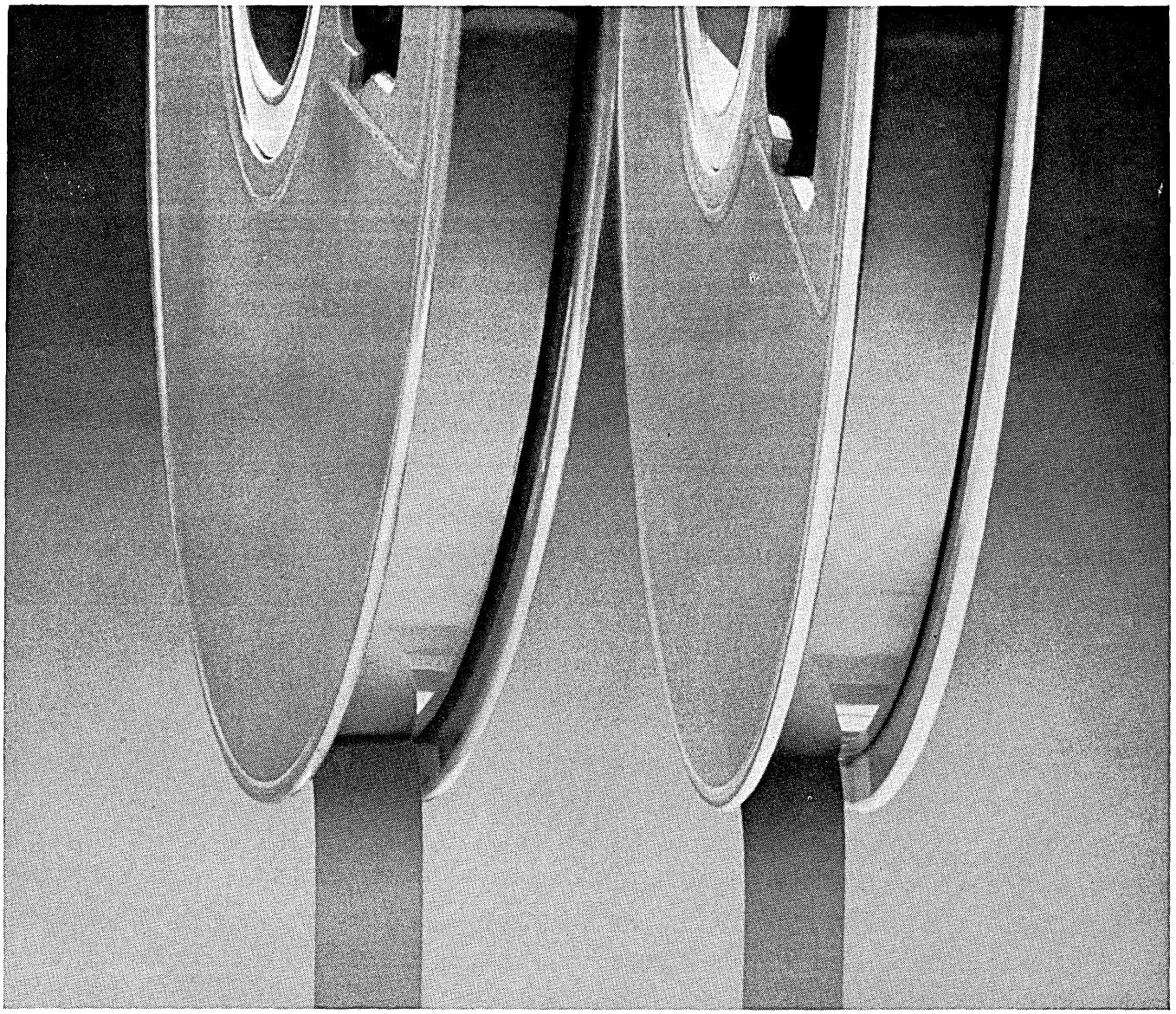

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CIRCLE 23 ON READER CARD

THE CDC 6600 . . .

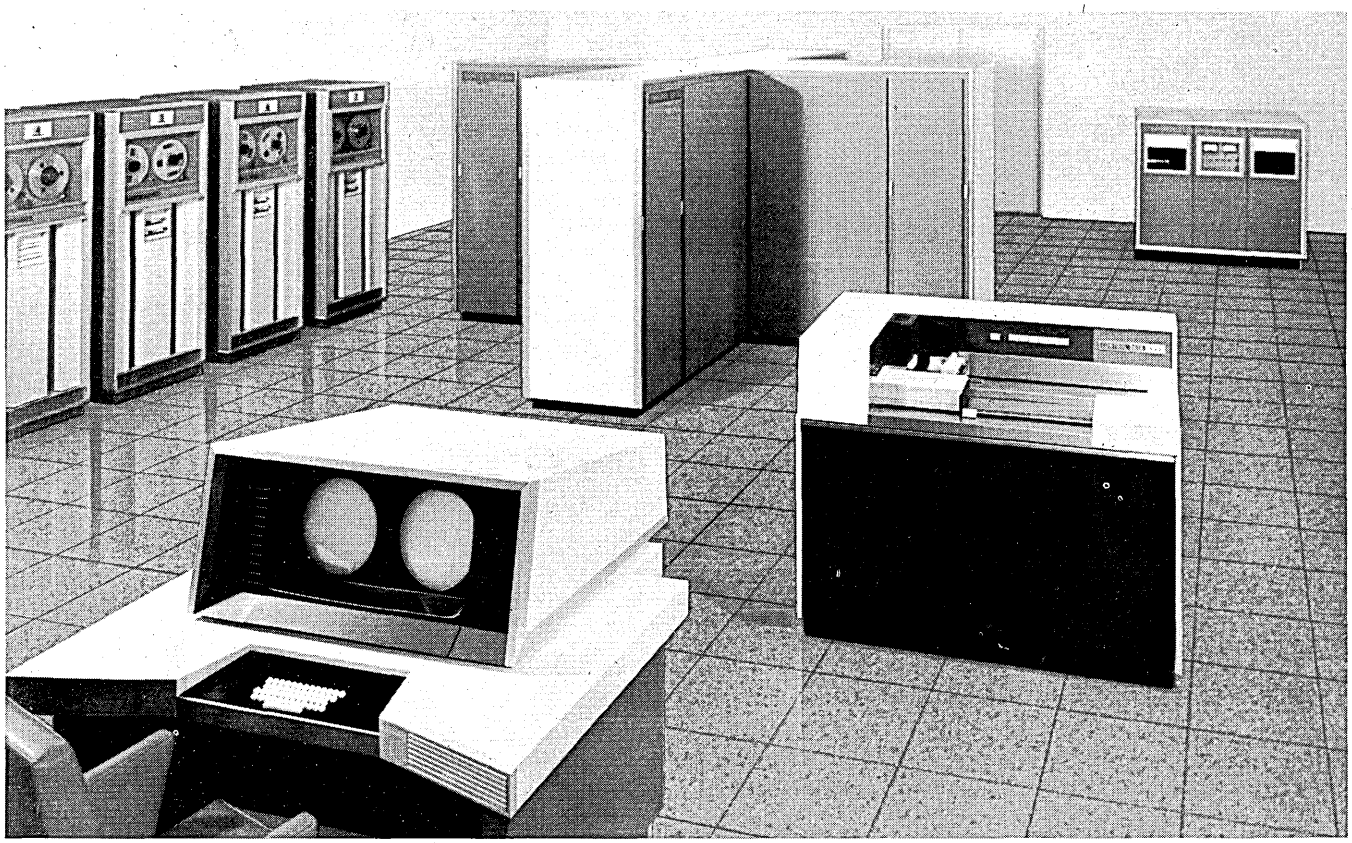
by ED YASAKI, Assistant Editor

The Control Data 6600 is a large-scale, scientific/engineering computer with a memory access time of one usec and add time of 0.3 usec. It is not compatible with any other hardware, and has been stripped of any features which the designers felt would hinder unnecessarily its internal speed. The refrigeration-cooled 6600 has a central memory of 131K (60-bit) words of core in 32 banks of 4K each, connected to a central processor (arithmetic and logical units) and to 10 peripheral-oriented processors, each with an additional 4K (12-bit) words of core. The peripheral processors can execute programs independently of each other or the central processor, although they generally do not solve complex arithmetic and logical problems. Eleven-program simultaneity without time-sharing is said to be possible.

A combination of processors can be involved in one problem whose solution may require a variety of I/O tasks plus use of central memory and the central processor. Each peripheral processor is a stored-program computer with a 4K memory, acting as a system control computer and I/O processor. This permits the central processor to continue high-speed computations while the peripheral processors do the slower I/O supervisory operations. In addition to I/O and logical operations, each peripheral processor is capable of 18-bit add and subtract (fixed point) and indirect addressing. All processors communicate with each other and peripheral devices on 12 independent, bi-directional data channels, using whichever is free. Transfer rate is one 12-bit word per usec. A maximum of six peripheral devices can be used with each channel. Up to four processors may be writing in central memory while another four are simultaneously reading from central memory.

Programs for the central processor are held in central memory. In the interest of speed, memory references are minimized. Twenty-four registers are provided to lower the central memory requirements for arithmetic operands and results. These 24 are divided into eight each of address, increment, and operand registers. To hold instructions, 32 registers are provided, limiting the number of memory reads for repetitive instructions, especially in inner loops. Additionally, 10 arithmetic units with a reservation control are provided to process sequences of unrelated instructions and for partial answers.

The display console consists of only two 10″ CRT display units and a manual keyboard. Typical operation allocates one scope for presentation of operator directives; the other provides the operator with status information on the current problem or other problems being run. None of the registers in the system is displayed automatically; however, a control program can extract register information from the proper memory and send it to a console for viewing. Several consoles can be used in one installation for multi-programming, allowing simultaneous solutions to many unrelated problems. A "potential" for not losing



more than 20 usec in switching between programs is claimed.

Although the 6600 has more parts than the 3600, it is physically smaller. Compactness (and speed) are achieved partly by the "sandwich" packaging of logic modules — components (all silicon) mounted between two circuit cards—each with a capacity for 64 transistors. Within a module, the longest wire is 3½". There are 8,000 modules, more than 200 different types. Wire and cable lengths are further shortened with a main frame consisting of four wings which join to form a cross. The longest wire is thus about eight feet.

The resulting problem of heat-dissipation is handled by freon refrigerant piped past each module row separator and connected to a refrigeration unit—one per main frame wing. Operating temperature is 70° F. Although there is some convection cooling, the majority of the heat is carried off by conduction, going from metal to freon to water, then to the great out-of-doors through a closed cooling system. Yes, the installation must have cold running water.

Arithmetic speeds are listed below in microseconds. There is no difference in speed between floating point and floating double precision operations.

Add	
fixed point	0.3
floating point/double precision	0.4
Subtract	
fixed point	0.3
floating point/double precision	0.4
Multiply	
floating point/double precision	1.0
Divide	
floating point	2.9

Peripheral devices include the 6603 disc file in 500 megabit modules (which is being stressed, over mag tape, as the principal auxiliary storage), the 606 mag tape unit (½" tape, 556 bpi), 626 mag tape unit (1" tape, 800 bpi), 405 card reader (1,200 cpm), and a 1,000 lpm printer.

Price of the 6600 is seven to eight megabucks, and rental is $150-175K. ■

. . . & THE HOUSE THAT SEYMOUR BUILT

Newsmen in Chippewa Falls, Wisc., 100 miles east of Minneapolis, were looking forward equally to seeing the reticent, fabled computer designer, Seymour Cray, as they were to witnessing the official unveiling of Control Data's mighty 6600. The new computer was said to be large and fast; it is, reportedly capable of an average three million operations per second. But Cray, who should've been sporting a three-year growth of beard and wearing a flannel sport shirt, was, instead, clean-shaven, newly-shorn, and attired in a business suit befitting a board meeting (he is, indeed, a member of the CDC board).

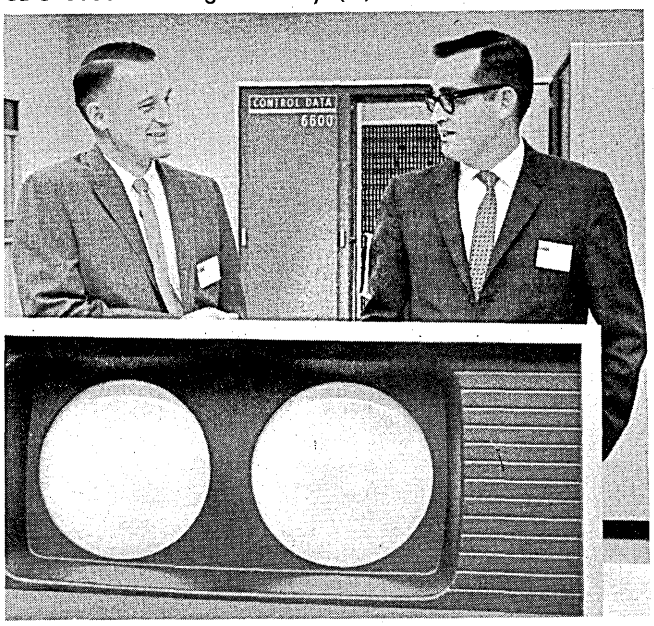
Control Data's Chippewa Falls lab was built for the pre- and post-natal care of the 6600, which was already two years in gestation by the time the engineering staff moved in in July 1962. Only one 6600 presently stands on its floor, but the company is quick to point out that the computer was conceived, planned, and designed as a standard product in its line of hardware (chronologically): 1604, 160, 924, and 3600. The prototype model has been promised for February 1964 delivery to Livermore, complete with an operating FORTRAN II. No other order is in house. Possible application areas include weather research, biomedics, and astronomy, although the first commercial application anticipated by the manufacturer is as a central hardware in a center with many remote computers.

The staff at Chippewa Falls numbers 34, of whom 14 are engineers, four are programmers, and six are "technicians." Production work was by engineers, with assembly executed by local vendors. Work on subsequent 6600's will continue at the House that Seymour Built until it becomes a production item, at which time CDC's production facilities in Minneapolis will be used. The Wisconsin staff will then devote its efforts to the next large-scale system.

Denied by Cray, in a manner befitting a company director, is the supposed inside story of the Chippewa Falls lab. Story has it that Cray approached CDC president William Norris with the necessity for a design lab away from the city, yet not more than an hour's drive away. "Sounds fine," Norris said evasively. "Let's give it some thought." "Well, I've already picked a suitable site," Cray is said to have countered. "All right, we'll present it to the board of directors." "Well . . . " Cray admitted, "they might as well know the truth: I've purchased the land." As it turned out, Cray allegedly had the lab laid out in his mind, the land cleared, and straw strewn on the ground to prevent its being frozen.

Apocryphal or true, construction began in January 1962 and completed in June. A CDC executive admits to driving out to Chippewa Falls to inspect the new facilities, and was unable to find anyone who knew anything about Control Data or its new lab. It wasn't until he mentioned Cray that a member of the local citizenry said, "Oh, you mean Seymour's place! Sure, that's down this road." Cray was born and reared in Chippewa Falls. ■

CDC 6600 co-designers Cray (l.) and James E. Thornton



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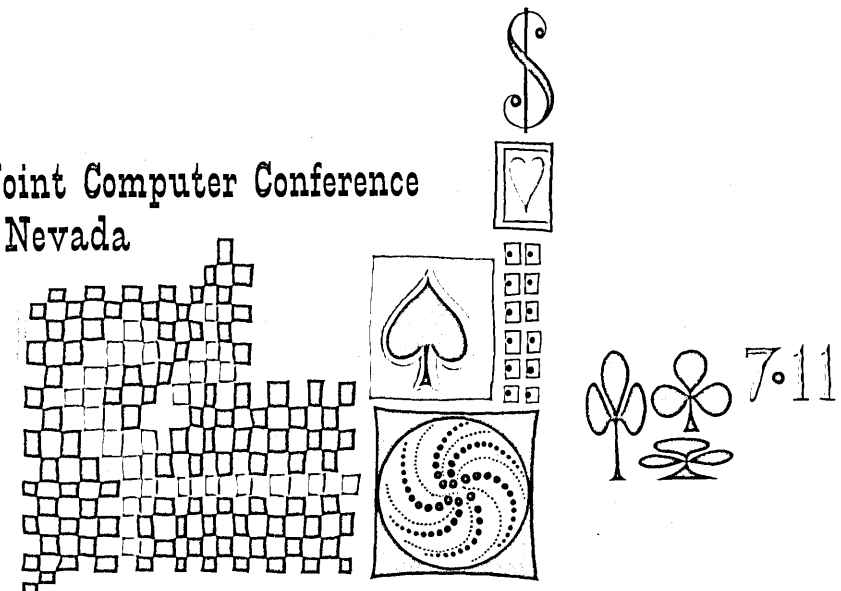
1963 Fall Joint Computer Conference
Las Vegas, Nevada



by James D. Tupac

conference welcome

The 1963 Fall Joint Computer Conference continues the practice started last spring in Detroit of using a large convention center as a setting for the Conference. The Las Vegas Convention Center provides one of the finest facilities in the country for a conference the size of the FJCC. It includes ample meeting and exhibit space as well as spacious and conveniently-located lobby and lounge areas for informal discussions and relaxation.

As usual, the technical program, representing a broad cross-section of the computer field, is of prime significance, complemented by an outstanding technical exhibit. Two prominent speakers have been invited to give major addresses. General Bernard A. Schriever, USAF, commander, Air Force Systems Command, a leader in the research and development management field, will be Keynote Speaker. Dr. A. M. Zarem, president, Electro-Optical Systems, Inc., well-known for his thought-provoking and entertaining speeches, will deliver the luncheon address.

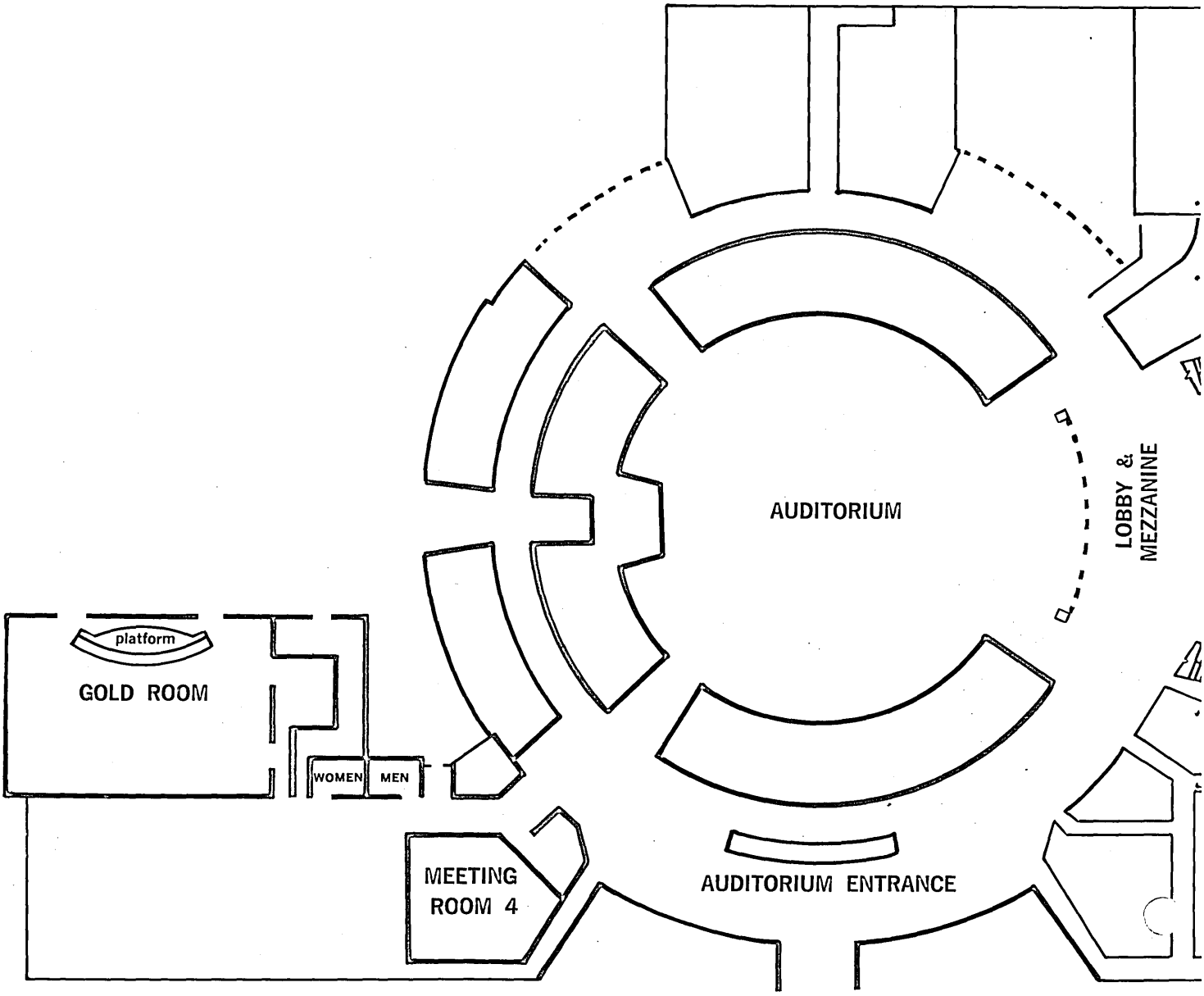
This is the first of the Fall Conferences to be held in the West. The mild desert climate will provide a pleasant contrast to the snow and cold which have typified previous Fall Conferences in the East. The invigorating climate, coupled with stimulating scenery and moments for relaxation, should make the technical exchange more challenging and interesting.

conference particulars

In the midst of the Nevada desert, where the sun supposedly shines 99 days out of 100 . . . where mid-November temperatures range from 40-70 degrees . . . where canvas water bags outnumber goatskin wine flasks, "everyone who is anyone" is expected for the 1963 Fall Joint Computer Conference. It will be held on Tuesday, Wednesday, and Thursday, Nov. 12-14, at the Convention Center in Las Vegas, Nev. Conference headquarters, the Riviera Hotel, is an eight-minute walk from Convention Center. The 24th national conference, the FJCC is sponsored by the American Federation of Information Processing Societies (AFIPS).

Registration fees are $8 for members of sponsoring societies (ACM, IEEE, SCi), $12 for non-members, and $2 for students. With no advance registration taken, attendees will be processed through the registration desk in the main lobby of Convention Center. It will be open on conference eve from 7-10:30 p.m.; on Tuesday, Nov. 12, from 8:30 a.m.-5:30 p.m.; Wednesday, from 9 a.m.-5:30 p.m.; Thursday, 9 a.m.-noon.

The formal program will include informal, evening discussion groups with like-minded people—"birds of a feather" sessions in such areas as IR, multi-processing, and decision tables. These are unscheduled, and will be held as, and if, requested. There will also be a panel discussion on the use of computers to study games of chance and skill, and 15 technical sessions at which 63 papers will be presented. Subject areas of the technical sessions include experimental programming, computer memories, multiprocessor computer systems, information retrieval, computer organization, software for hardware types and hardware for software types, hybrid computation, mass storage systems, natural language processing, real-time simulation, memory oriented computers, applied program-



ming, I O equipment, and computers as a social force.

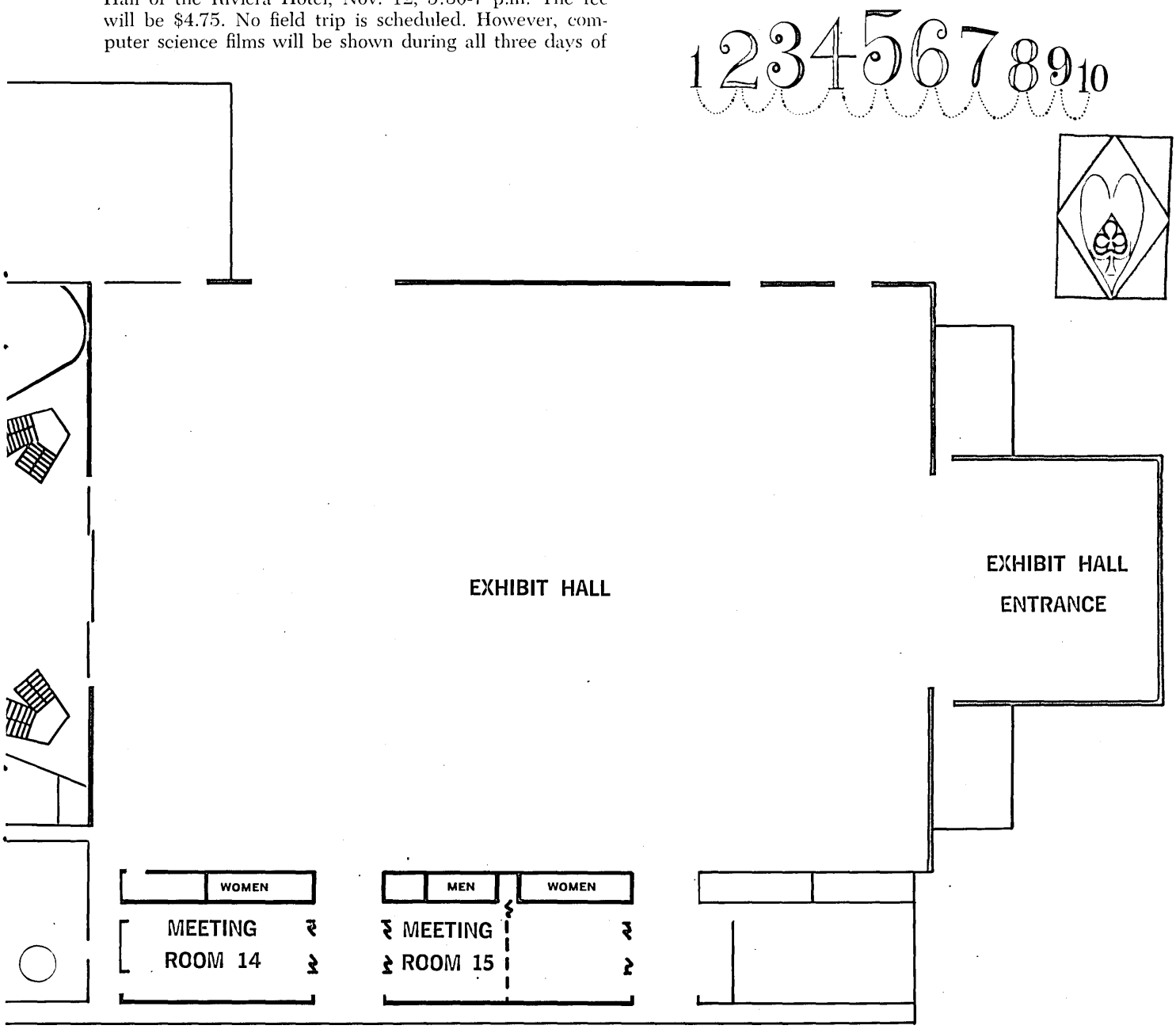
The opening session, at 10 a.m. on Tuesday, will feature keynote speaker Gen. Bernard A. Schriever, commander, U.S. Air Force Systems Command. At the conference luncheon, on the final day, the speaker will be Dr. A. M. Zarem, president of Electro-Optical Systems Inc., Pasadena, Calif.

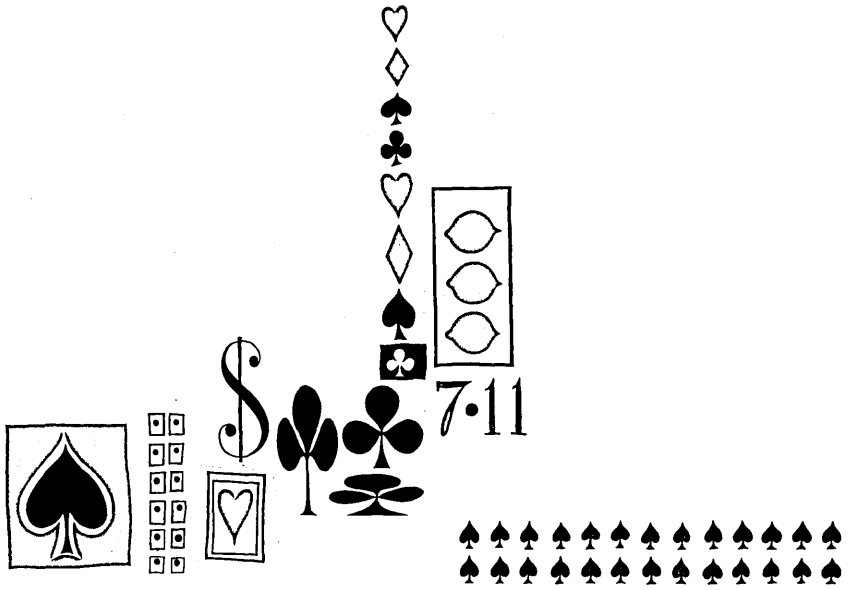
Available at no cost to registrants will be the conference proceedings, to be distributed near the registration desk. Students who wish to obtain copies, however, will be asked to purchase them at the special conference price.

Social events scheduled include the conference luncheon in the Gold Room, tickets for which will be available at $4.50, and the cocktail party to be held at the Convention Hall of the Riviera Hotel, Nov. 12, 5:30-7 p.m. The fee will be $4.75. No field trip is scheduled. However, computer science films will be shown during all three days of the conference, and will include coverage of new developments in computer technology, research, and applications. Films of general interest to conference visitors are scheduled for Wednesday.

More than 60 exhibitors will be on hand at Exhibit Hall, open on Tuesday from 11:30 a.m.-5 p.m.; Wednesday, 10:30 a.m.-6 p.m.; and Thursday, 10 a.m.-5 p.m.

For wives of attendees, a hospitality suite will be open at the Riviera Hotel. Events scheduled include a Tuesday afternoon, non-technical talk on computers, a forum on educational dp and the schoolroom of the future on Wednesday, followed by a trip to Hoover Dam and Lake Mead. A brunch is on the agenda for Thursday, which precedes a tour of one of the casinos. ♣





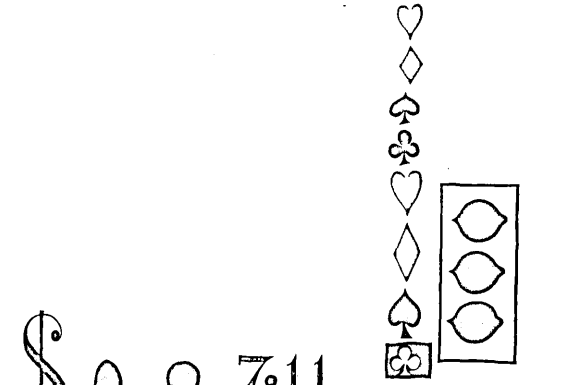
by PAUL M. DAVIES

the technical program

Early in the planning for the 1963 Fall Joint Computer Conference, the Conference Committee set for itself the goal of achieving a balance in the technical program between hardware and software. It was felt that the noticeable trend in recent years toward concentration on software distorted the aim of the Joint Computer Conferences, which is to provide the broadest forum for the entire computer field. Plans were made to redress this imbalance. The Technical Program Committee included a representative from each of the major interest categories: equipment, systems, software and applications, analog and hybrid. Each was responsible for encouraging significant and new contributions in his domain. Two more goals were recognized for the Conference: to improve understanding and communication among the various computer disciplines, and to face the problem of evaluating the profession's contributions and responsibilities to society at large.

The results of the Committee's work were encouraging. Complete drafts of over 200 papers were submitted with good representation in each major interest area. Fifty-three papers were chosen and organized into 15 sessions. We believe that the program outlined in detail on the following pages meets the goals described above. The technical sessions cover a broad spectrum of the field, yet maintain a good balance between hardware and software with a number of significant new developments reported in each area. Additional highlights include two expository sessions, "Hardware for Software Types" and "Software for Hardware Types," and the final plenary session, "Computers as a Social Force," which presents specific proposals for the application of computers to important social problems.

One of the most significant aspects of the program was largely unplanned. Memory development shows itself to be in a virtual renaissance. In session after session, the memory is the dominant force, not only in the hardware sessions but in the systems, software and applications sessions as well. Perhaps it is appropriate that the real theme of the Las Vegas Conference was determined by chance. ♠



7·11 session highlights

Session 1

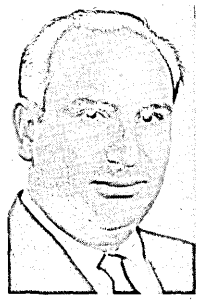
Programming—Experimental

Chairman:
Ascher Opler
Computer Usage Co. Inc.

Programming in 1963 is not fundamentally different from programming in 1958. With intensified requirements for quality and quantity in virtually all areas of computing, it is important to consider current developments in experimental programming.

The four papers to be presented at this session represent interesting examples of advanced development. While the areas to be discussed are far apart, there is a common thread that runs through all. In these experiments, the authors have deliberately sought to explore new techniques by returning to fundamentals.

One paper describes how information algebra was used to describe a program in terms of desired results rather than "how to do it." Another describes the simulation on a 7090 of a collection of nerve cells, while a third describes a pattern recognition system operated by a man seated at a console using a light pen. A final paper, presented by members of the Oregon Primate Research Center, describes a system which allows researchers to devise and experiment with their own Turing machines.



Session 2

Computer Memories

Chairman:
Milton Rosenberg
Electronic Memories Inc.

The Computer Memory session presents six papers covering advanced memory techniques of interest to the computer designer and user. These papers will discuss permanent storage, associative memories, fractional microsecond memory systems, large high-speed mass memories, and memory systems compatible with phase-locked oscillator computers.

Permanent storage memories are presently being used for fixed instruction, function look-up and as system controllers. The principal advantages are simplified logic and circuits combined with high speed. When used in space computers, a permanent memory potentially improves reliability and lowers power consumption. Permanent, or "read only," memories may have significant impact on future computer designs, provided a sufficiently low cost per bit can be achieved.

Two papers discuss associative memories. One describes an approach using thin magnetic films, and the other a system using deposited organic diodes. The two papers describe the feasibility of constructing small associative memories to be used to evaluate associative memories in future computer designs. At the present time, the high cost of the associative memory, compared to a conventionally addressed memory, poses a serious problem to the computer designer; however, both designers and users are intrigued by the impact that associative memories, when economically feasible, would have on future computing systems.

The continuing desire for higher speed computing systems places an important demand on memory designers and manufacturers to provide economic submicrosecond memory systems. Speeds on the order of 5 to 10 megacycle read/restore rates are desired. Techniques to provide economic submicrosecond memories are not yet clearly established. Small memory systems of less than 4,000 words are now technically feasible, but serious investigations must still be completed before it is clear as to the relative advantages of: (a) one or two elements per bit position;

(b) closed or open magnetic path switching; or (c) the choice of ferrite or film elements, or combinations of the two. An approach to high speed design is described.

The information processing industry continues to create demands for larger storage systems. Mass storage requirements of 10^8 or 10^9 bit capacities have been achieved with electro-mechanical techniques. Speed is being accomplished by programming ingenuity and a high degree of information parallelism. Existing high-speed core memories have been limited to approximately one million bits primarily by the total cost of the storage system. The possibility of economic advantages in element cost and addressing technique by use of cryoelectric elements make this approach of interest. The cryoelectric system described in this paper is based on a coincident-current addressing technique combined with evaporated elements and associated drive switches.

The use of the phase-locked oscillator as the basic element in a computer has been hindered by the difficulty of inter-facing with conventional coincident-current memories. One paper discusses a new technique for operating a thin film element in combination with a phase-locked oscillator computer.

Session 3

Multiprocessor Computer Systems

Chairman:
Gerhard L. Hollander
Hollander Associates

Large computers and large problems have brought with them two new approaches to computer design and utilization—multiprogramming and multiprocessing (multiple processor computers). In multiprogramming, *several problems* are executed by a *single computer system* which dynamically interleaves problem components for optimum execution without operator intervention. A multiprocessor system consists of *several processors* that can attack a *single problem* either alone or together under control of a master scheduler. A multiprocessor system must have at least two processors that, alone, could solve every problem assigned to the system. Notice that multiprogramming is a way of using computers; multiprocessing, a way of organizing a computing system. A multiprocessor system can be used for multiprogramming problems. Not included is the trivial case of several processors solving independently several programs, since on failure of one processor the others cannot take up the load.

To a certain point, the faster a processor, the lower the cost per operation. This leads to multiprogramming since many programs can occupy a single processor, thereby loading a fast and economical computer completely. However, the gain must be balanced against the time and cost of the supervisory program and hardware.

At first, multiple-processor systems appear useful only when increasing speed increases the cost per operation, so that several processors in parallel provide a lower cost per operation than a single fast processor. The picture changes, however, when the entire system must be duplicated for reliability. A single large processor must be backed up by another one of the same size, while a multiple-processor system requires only one smaller back-up module for the entire system. Another advantage of multiple processors appears to be better utilization of peripheral equipment.

Though diametrically opposite in application, both techniques depend on dynamic assignment of program segments by an executive program to reduce equipment idle time. Current research and experiments attempt to determine whether the idle-time reduction more than offsets the time and cost of executive programs and equipment.

Papers in this session treat aspects of multiprogramming and multiprocessing. The review paper by Critchlow emphasizes the development of multiprogramming with some trade-offs. Conway describes desirable order structures for efficient program segmentation and control. Aoki, Estrin, and Mandell deal with an analytical technique for computing load assignment in a multiprocessor computer system consisting of an IBM 7090 and a variable-structure computer. Chapin presents results from one of the first operational multiprocessor systems, the Navy NTDS system.

Session 4

Information Retrieval

Chairman:
John Postley
Advanced Information Systems

The management of computer-based files is the basis of a large percentage of applications in business data processing and engineering computing. To perform this file management task, it is necessary to create and maintain files in computer language, to retrieve information selectively from these files, and to prepare appropriate reports.

The usefulness of such an information retrieval system may be limited by the capability of the information retrieval technology it employs or by the complexity of the procedures required for its use. To achieve an appropriate balance between these limiting factors, the technology employed in the operating system must provide the capability to satisfy all reasonable usage requirements and, at the same time, provide efficient operation and ease of use. Similarly, procedures for using the system must be neither so trivial as to fail to make use of the available technology nor so complex as to make the system difficult to employ.

The members of this panel will describe some systems through which they have sought to achieve this balance. In his paper entitled "The Direct Access Search System," I. A. Warheit describes a system which includes an index organized both as an inverted and a serial file. Martin Kosakoff will present his "Experience with a Generalized Information Processing System" to handle a variety of file management functions. Jane Olmer will discuss "A Flexible Direct File Approach to Information Retrieval on a Small to Medium Size Computer," emphasizing sophisticated logical searching and solutions to syntactic problems. And John H. Williams Jr. will describe the results of some experiments on "A Discrimination Method for Automatically Classifying Documents" using frequencies of discriminating words.

This panel will stress some important characteristics common to large classes of information retrieval systems independent of the content of the data in the files. The emergence of an application independent file management technology represents a conceptually new approach to matching system analysis with problem solution. This kind of approach may ultimately prove to be the best solution to the growing backlog in the application of computers to an ever-increasing number of tasks.

Session 5

Computer Organization

Chairman:
D. L. Stevens
TRW Computer Division

This session covers the field of logical design, and emphasizes the development and application of new design concepts at the system and sub-system levels. Basically, this subject relates to the efficiency with which circuits, memory elements, and other components are combined to form an integral computer system. This subject is an important one to all those who are active in the field: the programmer, applications analyst, hardware engineer, to name a few. These individuals are strongly influenced by the activities of logical designers, and by the

concepts which these designers use in the development of their computer organizations.

It has been stated that computer organizations have not changed much since the first principles were developed by John Von Neumann and others more than 15 years ago. Until recently, this may have been true; however, important conceptual refinements are starting to find practical application in today's hardware. These refinements include parallel computer organizations, microprogrammable organizations, search memories, push-down stack memories, etc. Obviously, computer organizations are changing, and future computers may be substantially different from those presently available.

The following papers will be presented in this session: Albert Kaplan's paper reports on the design of a variable field search memory containing 4,096 words of 72 bits each which can be searched in a few microseconds. The paper by E. Boutwell Jr. and E. A. Hoskinson discusses the internal organization of the PB 440, in which the programmer is permitted to direct the computer at a basic level of control by logically manipulating the contents of individual registers and flip flops. James Evey's paper is a theoretical treatment of a class of machines defined by adding counters and push-down stores to finite state machines. There are also two companion papers on the B5000, by C. B. Carlson and R. V. Bock. These treat certain aspects of the design of the B5000 system. The design illuminates the interface between programming and logical design; an attempt was made to produce a machine language using a push-down stack, which more nearly corresponds to a source operator language.

Since the papers will be available in their entirety in the conference proceedings, the authors have been asked to summarize orally and highlight their papers at the session. This will allow ample time for discussion and debate.

Session 6

Expository Session—Software for Hardware Types

Chairman:
W. F. Bauer
Informatics Inc.

The role of programming and the programmer in the computer field is growing rapidly in recognition and importance but is still widely or poorly misunderstood. It is the objective of this session to explain the roles and missions of the programmer as well as the developing structure and current techniques in computer programming. The speakers who have been especially invited to present this information are Walter A. Ramshaw, Thomas B. Steel, Randall E. Porter and John W. Carr, III. They are leaders in the programming field and need no introduction.

Programmers play an important role today in product planning and in technical sales support, in addition to the design and implementation of basic software without which the computer is neither usable nor saleable. The programmer is becoming accepted as an important partner in computer design, and his contributions in design now cover areas of systems organization, instruction repertoire and system analysis as well as marketing and applications studies.

In the past, programmers have suffered under a kind of "second class status" in the computer field as compared with hardware people. Programmers have now reached responsible levels in computer companies and software groups, and programming departments or programming divisions are very often on an organizational par with hardware groups in computer organizations. The emergence of the independent software company with its group of experts and its independence of hardware interests is also especially noteworthy.

Programming is developing rapidly as a technical area both in scope and organization. The structure of programming begins with utility and service routines which are building blocks for assemblers and operating systems. The latter, in turn, are building blocks for sophisticated compilers and monitor systems. An example is the increased emphasis on automatic programming techniques to prepare software such as compiler generators.

Modern compilers such as FORTRAN, ALGOL, COBOL and NELIAC have proliferated in machine versions and dialects. However, common to all is a generalized structure (input translation, syntactical analysis, etc.) and measurement parameters (compiling speed, object program running speed, etc.). Of special interest are the increasing requirements and developing technology in assembler-compiler systems for specialized uses such as numerical control of tools and computer based systems for automatic checkout.

Standardization is certainly a problem for software and software people and the future of software rests heavily on this point. Whatever the uncertainties and vagaries of programming, one thing is certain: the future will bring greater sophistication, complexity and utility in software as well as an increased dependence and respect by the computer industry on the programming profession.

Session 7

Hybrid Analog-Digital Computation

Chairman:
Granino A. Korn
Univ. of Arizona

An increasing number of simulation laboratories combine large general-purpose analog computers with small or large general-purpose digital computers linked by A/D and D/A conversion channels. This technique, which can handle very complicated aerospace and process-control problems, has reached a measure of maturity. Two of the three papers investigate the effects of digital-computer time delays and bandwidth limitations in combined analog-digital computer setups, and suggest extrapolation and correction routines. This topic is of interest in connection with special-purpose computer design as well as for efficient combined simulation.

The third paper describes the first hardware implementation of a Skramstad-type hybrid differential analyzer; each variable in each computing element is represented by a few digital bits plus an analog interpolating voltage, which eliminates DDA truncation errors. An interesting error study employs artificially exaggerated errors.

Session 8

Mass Storage Systems

Chairman:
Irving L. Wieselman
Data Products Corporation

This session explores mass storage systems with emphasis on design parameters, functional properties and their influence on applications. The class of device considered provides fast random-access to a large-capacity erasable store, available on-line to a data processor. Equipment with these properties satisfies the needs of users with business, scientific, and military applications.

The session opens with a survey paper defining the class of equipment to be discussed and then traces the historical development. Storage devices such as magnetic tape units and photographic equipment are not included since they do not satisfy the basic requirements. Next, the application requirements which led to particular design configurations are discussed. Individual characteristics of and comparisons between the following types of devices are examined: moving and fixed head drums and disc files; removable stack disc files; magnetic card memories and static mass memories. In addition, some predictions are made regarding the future dominance of moving media mass storage devices versus static mass memory storage devices.

The paper on the IBM 1311 Disc Storage Drive describes the improvement in technology required to achieve a system which features both high bit densities and the high degree of equipment compatibility needed to permit removable disc packs to be placed on other drive

mechanisms and still maintain reliable operation. Design considerations involving a number of different technologies such as read/write heads, read/write electronics, air bearings and magnetic surfaces are covered in detail.

The paper on the Burroughs Disc File treats a different set of problems in the design of a storage device where access time depends only on rotational latency. In order to achieve large capacities in a fixed-head file, high bit densities are used in conjunction with a multiplicity of heads. The disc itself is metallic coated, using electroplating techniques. The technology describes how several head assemblies are used in a single flying pad. In addition, the data organization, capacity and data rates are discussed. Finally the problem of switching between the heads and the packaging techniques are described.

The paper on the multiple-access disc file describes the Data Products dp/f-5035 DISCfILE system. This is characterized by individual positioners for each disc and their utilization in a system configuration, where simultaneous data transfers may occur on two discs while two other positioners are also being moved to new locations at the same time. The design properties of the disc, heads and positioners are described, as well as the flexibility in operations obtained through the use of the individual positioners. The implication of the design on the performance of the associated data processor is also stressed.

The last paper deals with an approach by Thompson Ramo Wooldridge whereby a plated woven screen is used as the basic storage medium. Access to data is achieved by coincident-current switching. The method of storing with a woven aperture screen plane as well as the improvement in technology of plating to allow for the coincident-current mode will be discussed. The system has been investigated in a laboratory developmental program. The extension of techniques to a mass memory and the economics of the proposed design completes the paper.

In summary, three of the papers are devoted to newly announced equipment configurations utilizing rotating discs for storage, but each having a different design goal and hence utility in different application areas. The fourth paper covers an all solid state approach which has an access time approaching that of core memories but a higher cost-per-bit and is not yet available. The survey paper serves to show relationships, advantages and disadvantages to the various approaches. The session will also stress the relationship between economic factors and performance.

Session 9

Natural Language Processing

Chairman:
Frank N. Marzocco
System Development Corp.

Natural language processing systems are those designed to carry out complex tasks involving unrestricted human language inputs or outputs or both. An ultimate goal is the production of systems that will equal or surpass man in the ability to manipulate language for various purposes, but the goal is far from achievement. Inadequacies in present knowledge are found in the theory available to describe language and its uses and in the technology available to construct working systems. Only isolated, highly constrained tasks are dealt with successfully by existing computer programs, and a great deal of research remains to be done before many of the constraints can be removed.

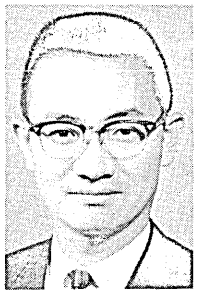
One source of difficulty occurs in extracting the information carried by the syntax of natural language sentences. The paper by Daniel Bobrow, "Syntactic Analysis of English by Computer—a Survey," discusses some of the problems and describes the many grammars that have been invented to deal with these problems. With each type of grammar, Bobrow also gives an account of the computer programs written to perform corresponding syntactic analyses on English sentences.

A serious problem for any natural language processing system is ambiguity. Susumu Kuno and Anthony G. Oettinger, in "Syntactic Structure and Ambiguity of English," review the operation to date of the Harvard multiple path syntactic analyzer, presenting several examples in which alternative structures are produced for the same sentence. They suggest refinements that will eliminate some of the undesirable alternatives, but a disconcertingly large number remain. Another part of the paper proposes a modification to the analyzer which should increase its intuitive appeal and operating economy.

Some of the difficulties inherent in automatic syntactic analysis can be resolved by knowledge about the particular words involved, and such knowledge is also required for specialized applications. The need is met by construction of appropriate dictionaries in machine-usable form. J. L. Dolby, H. L. Resnikoff, and E. MacMurray, in "A Tape Dictionary for Linguistic Experiments," describe such a dictionary and the procedures by which it was constructed and tested.

If completely automatic systems lie far in the future, there are nevertheless possibilities for introducing men only at critical points in otherwise automatic systems. In the fourth paper for the session, "The Computer-Stored Thesaurus and its Use in Concept Processing," Clayton A. Shepherd reports an application utilizing authors to provide indexing terms and conceptual statements as aids for the computer to prepare indexes.

In addition to the technical papers there will be a panel discussion by David Hays, Sydney Lamb, and T. B. Steel. Topics to be considered are the goals of natural language processing research, the adequacy of present approaches, and the requirements for future studies.



Session 10

Expository Session—Hardware for Software Types

Chairman:
Richard I. Tanaka
Lockheed Missiles & Space Co.

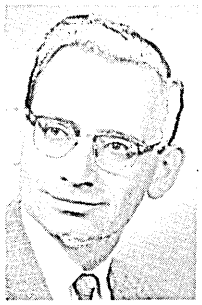
This session was organized to present high-level tutorial descriptions and evaluations of selected topics in the hardware area of computer technology. The title of the session, with what might be misconstrued as an overtone of flippancy, should not obscure the conscientious and serious efforts of each speaker to organize and describe his topic clearly, yet at an advanced technical level. Each speaker has the responsibility for presenting evaluations and opinions. The appraisals, while necessarily subjective, are based on well-recognized technical accomplishments and experience, and hence should be among the most interesting and worthwhile aspects of the presentations.

Developments in hardware, including such items as circuit components, integrated circuits, memory elements and devices, logic elements, and input-output devices, are thoroughly described, documented, and evaluated. Participants in the computer field, regardless of specialty, acquire at least a superficial awareness of the work in the laboratories, and, of course, existing computer hardware is readily available for inspection. Hence, general opinions and conceptions about computer components are easily derived.

What is often difficult to do, however, is to use available information in a meaningful way, since much of what is new or significant cannot be properly evaluated without some depth of understanding of the underlying principles and techniques. The intent of this session is to provide information which may be helpful in this context.

The speakers will present tutorial and expository descriptions about selected hardware topics, with the assumption that the listeners, though not specialists in hardware techniques, are cognizant of the computer field. Unlike most presentations at this conference, the talks are not aimed at discussing only that which is new and different, nor do the speakers plan to confine themselves to surveys of existing devices or tutorial lectures on how available devices work. Rather, emphasis will be given to topics which appear to have relevance and significance in terms of both the present and the future. If common principles underlie apparently different developments, these will be defined

and described. Evaluations and appraisals which stem from the factual information presented will be discussed where appropriate, and attempts will be made to relate this information to the computer user's point of view.



Session 11

Real-Time Simulation

Chairman:
George A. Bekey
Univ. of Southern California

Real-time simulation refers to the construction of a mathematical model of a dynamic system with an overall time scale factor of unity, so that direct communication between the model and the environment is possible. In the past, real-time simulation has depended heavily on the bandwidth and parallel nature of analog computers. In recent years, however, increasing speed and novel design of digital computers have made possible real-time simulation with either hybrid or purely digital computers.

This session presents a wide range of approaches to the simulation problem, from a primarily analog to a completely digital orientation. The problems include requirements for faster than real-time simulation to predict an aircraft trajectory, the interaction of human operators with a computer-driven simulation, and the reconstruction of information presented on radar displays. The final paper presents the design of a digital computer with a command structure which facilitates its use for real-time simulation.

PANEL SESSION

The Use of Computers to Study Games of Chance and Skill

Chairman:
Prof. E. O. Thorp
State Univ. of New Mexico

The analysis of games to determine favorable strategies predates formal statistics, probability, and game theory. Much of the early work in the fields was motivated by such analyses. The effectiveness of these studies was in many cases limited by the amount of computation involved. Today, digital computers serve as a powerful tool for such analyses. We all know of experiments in which computers were programmed to play games such as chess and checkers. This panel session will be concerned with various aspects of using computers to study games such as blackjack, roulette, and Baccarat.

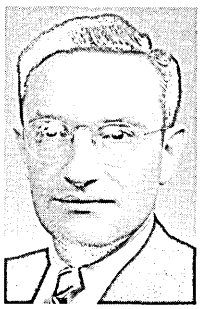
In casino blackjack, it is simple in principle to determine the odds governing any single play. It is difficult, however, to determine the statistical behavior of the odds over many plays and under a variety of conditions. A valid mathematical model of the game must be devised and/or a very large statistical sample must be used. The first important published study of blackjack gave a negative figure for the player's mathematical expectation rather than the correct positive figure. This resulted from computational approximations which for a given strategy were (but are no longer completely) necessary. The exception can be found to be better that 0.1 per cent by playing a large number of hands on a computer.

The computation of the odds in roulette are trivial on any single bet. However, to precisely determine the distribution function of a player's capital, as he follows some prescribed strategy, is generally an enormous computational problem.

A winning bet exists in Las Vegas style Baccarat. The bets on natural-8 and natural-9 are frequently favorable. A detailed winning gambling system, based on the Kelly criterion, was devised with a computer. The gambling system was successfully tested with computer simulation of the game and by playing in the casinos. The analysis brings out the features of the Kelly gambling system and highlights the use of theoretical and computational problems which arise in its application. Details of practical applications to other areas suggest themselves.

Precise values of various quantities in the game were determined with a computer. The analysis settled a long-standing question about Baccarat. It shows that the principal bets in the game, "Banker" and "Players," are occasionally favorable. However, this rarely happens to be of practical interest.

The panel will describe their own efforts and experience in the above areas, and will discuss the techniques and problems involved in studying games with the aid of computers. The problems of selecting a mathematical model and of insuring an adequate statistical test of different strategies will be emphasized. Practical considerations in applying betting systems will also be considered.



Session 12

Memory-Oriented Computers

Chairman:
D. L. Slotnick
Westinghouse Electric Corp.

None will question the profound influence of memory on computer system organization. This session consists of a paper by S. G. Campbell treating the general subject, and three papers dealing with specific, novel memory structures and their system employment. W. T. Comfort describes a Holland structure modified to reduce both hardware complement and programming burden; R. R. Seeber and A. B. Lindquist discuss systems with distributed memory and logic and associated control and programming problems; G. Estrin and R. H. Fuller characterize classes of problems whose solution is enhanced by content-addressable memory, and compare performance with conventional organizations.

Session 13

Programming—Applied

Chairman:
Robert L. Patrick
Consultant

Each of the three papers selected for this session is, in its own way, outstanding. The first two depict the state of the art in applied programming today. One indicates the status of current research in machine systems which reinforce and augment the native abilities of man. The other represents the status of current developments in reducing theoretical operations research to practical application. The third paper in the series concerns a brand new world-wide data processing activity. This is related to the information processing tasks associated with disarmament in a nuclear age. Three outstanding panelists have been chosen. The panelists will have acquainted themselves with the technical material to be presented and can be relied upon to draw out salient points which the speaker may have neglected.

It was only natural that many of the first applications for digital computers involved computation and numerical processing. As we began to understand our equipment better and as our techniques for coping with problems improved, the field has gradually moved the boundaries of applicability out into the domain of non-numerical processing. One significant experiment in this area involves symbol manipulation. The specific activity to be discussed by Messrs. Clapp and Kain will be a

computer program which aids the theoretical physicist or a mathematician in the symbolic manipulation of equations. The stated goal of this system is the elimination of the tedious activities often required in creative scientific work. The systems operational characteristics will be described and the internal aspects of mathematical manipulation systems discussed.

The second paper describes the considerable effort required to reduce theory to practice. The Western Electric Company has 15 separate inventories in the vicinity of Kearny, New Jersey, with a total inventory investment of five million dollars. The corporate operations research team selected this area for detailed investigation and study since the shortage of any one item of inventory could affect several of the manufacturing locations. Effective use of the inventory dollar was the object of the study. It became apparent that the basic fundamental parameters that measured information flow, volume of changes per unit time, inventory activity, and management control were unavailable as the system was constituted. Therefore, an intermediate automation step was initiated wherein the control of the inventory was centralized and the processing was done on a computer. The outgrowth of this intermediate automation step was the fundamental performance of parameters of the system. Given these performance parameters and knowing the volumes of all activities, a proper inventory system, designed to the needs of Western Electric, can be undertaken.

Project Cloudgap is a Department of State activity charged with dealing with arms control and inspection activities related to partial disarmament. The activities involve gathering information from various sources, analyzing this information for meaning and intent, selecting from this mass of incoming information features and situations created by man, and creating an input file. This input file is then compared against a master data file for this geographical area and the changes and exceptions are selected for further processing. In the further processing, an attempt will be made to grasp the significance of these symptoms and relate the symptoms to the environment being inspected. The problem is compounded by the uncertainties basic to the data and its mode of collection, the vagaries of weather, and the insidious but important deviations in instrument calibration and adjustment. The paper discusses a data handling system which allows for the input editing, storage, collation, analysis, and display of pertinent data on which arms control, decisions, and actions can be based.

Session 14

Input-Output Equipment

Chairman:
Howard Gates
Teledyne Systems

One of the major controlling factors in the speed, reliability, and usefulness of a data processing system today is the input-output equipment. In this session are brought together a group of papers which are aimed at presenting solutions to some of the limitations of existing equipment. The first paper describes equipment which can be used for remote entry into a data processing system. The application of this equipment to a manufacturing control operation is described.

A group of three papers describes different approaches to overcoming some of the past limitations of magnetic tape systems. A major emphasis in all of these developments has been an improvement in the system reliability. Each is aimed at a different class of application. The first paper describes a system in which the emphasis has been on very high data rate and data capacity. The second is concerned with the special environmental problems encountered in special military computer systems. The third attacks the problem of reducing the complexity of the magnetic tape handler with the resultant reduction of maintenance and cost. All three of these systems describe unique features not seen in past equipment.

The last paper of the session is on a different topic, but still fits into the general theme of improved system reliability. The paper describes in considerable detail a new development in logical circuitry, which offers an increase in reliability over presently-used techniques.

Session 15

Computers as a Social Force

Chairman:
Frank Wagner
Informatics Inc.

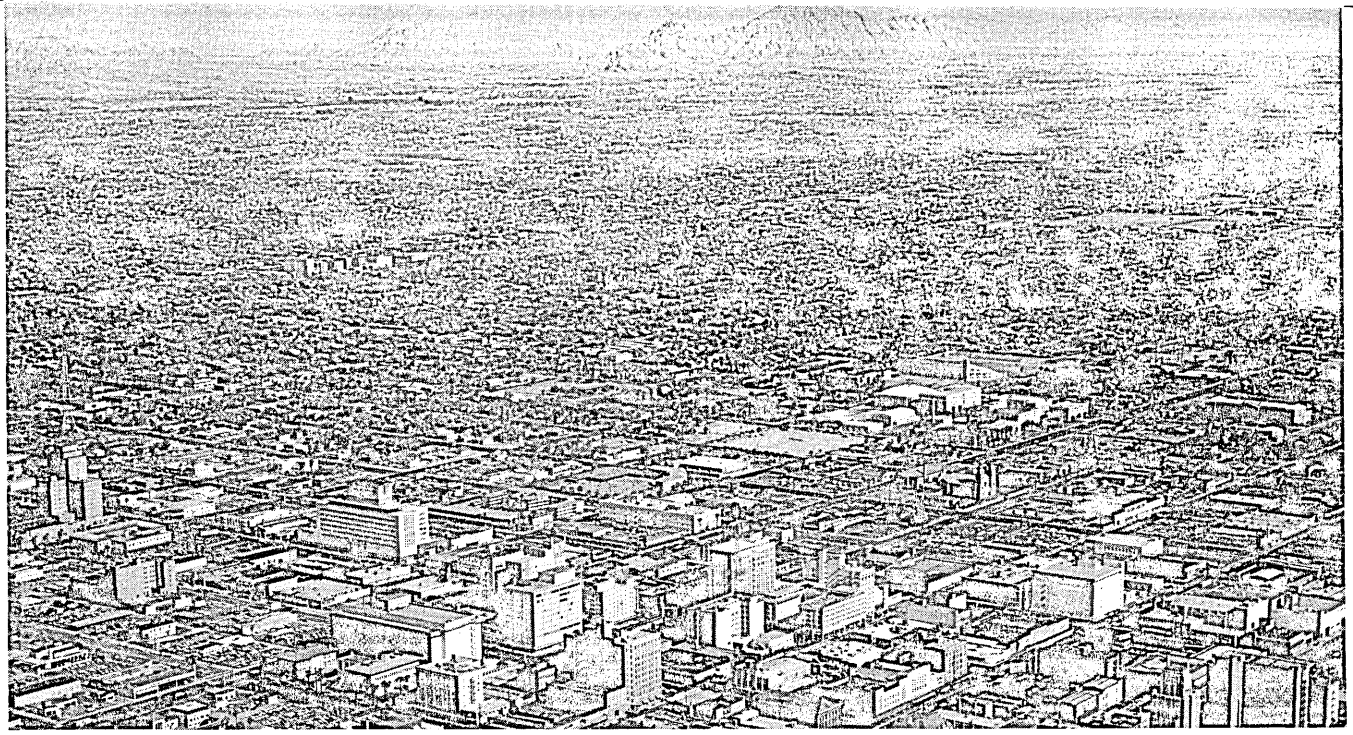
Ten years ago computers began to have an effect in the fields of science and technology. Of those who understand what has happened, few will deny that computers have profoundly influenced the development of many of the activities in those fields. We are now in an era in which the same kind of forces are beginning to be felt in commerce and industry. Most experienced observers will be surprised if computers will not have as great an effect in manufacturing, merchandising, and other commercial activities. This session is devoted to exploring the next step: "Will computers play an equally powerful role in shaping the destinies of man as a social being?"

The world of sociology considers men interacting with one another in numerous ways. It is possible that the computer will have its effect in all of these, perhaps in ways that none of us can conceive today. If this comes to pass, computers will be shaping the lives of individuals. Certainly it is a matter demanding serious attention, if computers have an influence in such fields as politics, social welfare, medicine, law, education, international relations—even conceivably music, art, literature, and religion.

Present state-of-the-art bears a striking parallel to the first tentative penetration of computers into the sciences. This session will explore the current state-of-the-art of computer use in biomedical research, the law, and education. It will venture gingerly into the unexplored realm of international relations.

W. Ross Adey, M. D., Professor of Anatomy and Physiology at the Brain Research of the University of California, will discuss "Computer Applications at the Frontiers of Biomedical Research." Dr. Adey will describe several major developments in his current neurophysiological and psychophysiological research in which computers have played a prominent role. Richard F. C. Hayden, Superior Court Judge of Los Angeles County, will present "A More Rational System of Justice Through Information Processing." On the basis of a serious study performed for the Los Angeles Superior Court, he will show how the administration of justice can be improved in performance by a sizable increment if modern data processing methods are introduced. Partial applications have already been instituted and much greater development seems inevitable. Robert L. Egbert of System Development Corporation will present "The Computer in Education: Malefactor or Benefactor." This is a survey of actual situations in education in which the computer is now or is about to be introduced. In many cases, however, it is not an unmixed blessing. Computers offer a degree of surveillance and control of the individual student, so it will facilitate the school's attempts to help the students progress. But it also is an invasion of privacy and an expropriation of responsibility that may actually hinder achieving the goals of education. Louis Fein, consultant, will speak on "Computer-oriented Peace-Research." As a social goal, the achievement of peace is one of the most important ones facing mankind. This paper subjects the problem to the kind of rational analysis required if the problem is to be attacked by use of computers. A surprising insight into many parts of the problem is thereby gained. It becomes apparent that such an approach, and the actual use of computers, would be most profitable.

The session will attempt to demonstrate that the past is only prologue. Just as computers have profoundly affected the initial areas of their application, so will they penetrate into every domain of human activity, and will influence directly the ways in which our children will live with one another. ♡



WESTERN DPMA MEETING

Phoenix, Nov. 6-8

"Consider, Resolve and Direct" will be the theme of this year's D.P.M.A. International Electronic Business Systems Conference, to be held November 6-8, in Phoenix, Arizona. Conference headquarters will be at the Hotel Westward Ho.

Pre-registration fees for members is $30.00; for non-members, $35.00. Members who are late registrants will be charged $35.00, and non-members, $40.00. A fee of $20.00 will be charged for the ladies for special activities scheduled for three days; $15.00 for two days. All the above fees include the banquet. Special student registration, not including the banquet, will be $5.00.

WEDNESDAY, NOVEMBER 6, three tours have been planned. These include tours of a computers/components facility, and utilities and bank dp facilities. Other tours, which can be arranged on request, will be available in the fields of data processing in schools, wholesale grocers, forest industries, title companies, savings and loan companies, hospitals, insurance companies, department stores, manufacturers, police departments, and city, county and state government.

THURSDAY, NOVEMBER 7, there will be a general assembly, from 9:00 a.m.-noon, in the Thunderbird Room, where the welcoming address will be delivered by Governor Paul Fannin. This will be followed by the keynote speaker, Gerald L. Phillippe, president of General Electric Co., who will discuss the unlimited horizons for the data processing industry as well as several critical management policy questions. The opening address will then be delivered by Leonard Spacek, managing partner of Arthur Andersen & Co., who will speak on the history of electronic tape machines, current problems, improved management understanding, and computer system costs.

At 1:30 p.m., seminars will be held on the topics of: PERT Cost-Critical Path, Airlines and Data Processing, Manufacturings Approach to Data Processing, Banking, and The Auditor's Viewpoint Toward Data Processing. At 3:30 p.m., the seminar on PERT Cost-Critical Path will be repeated, plus sessions on Electronic Data Collection System, Auto Dispatch and Accounting Tele Data in Utilities, Inventory Control, Management Information and Control, and Real Time for Savings and Loan.

The Banquet is scheduled for 7:00 p.m. No speaker is scheduled.

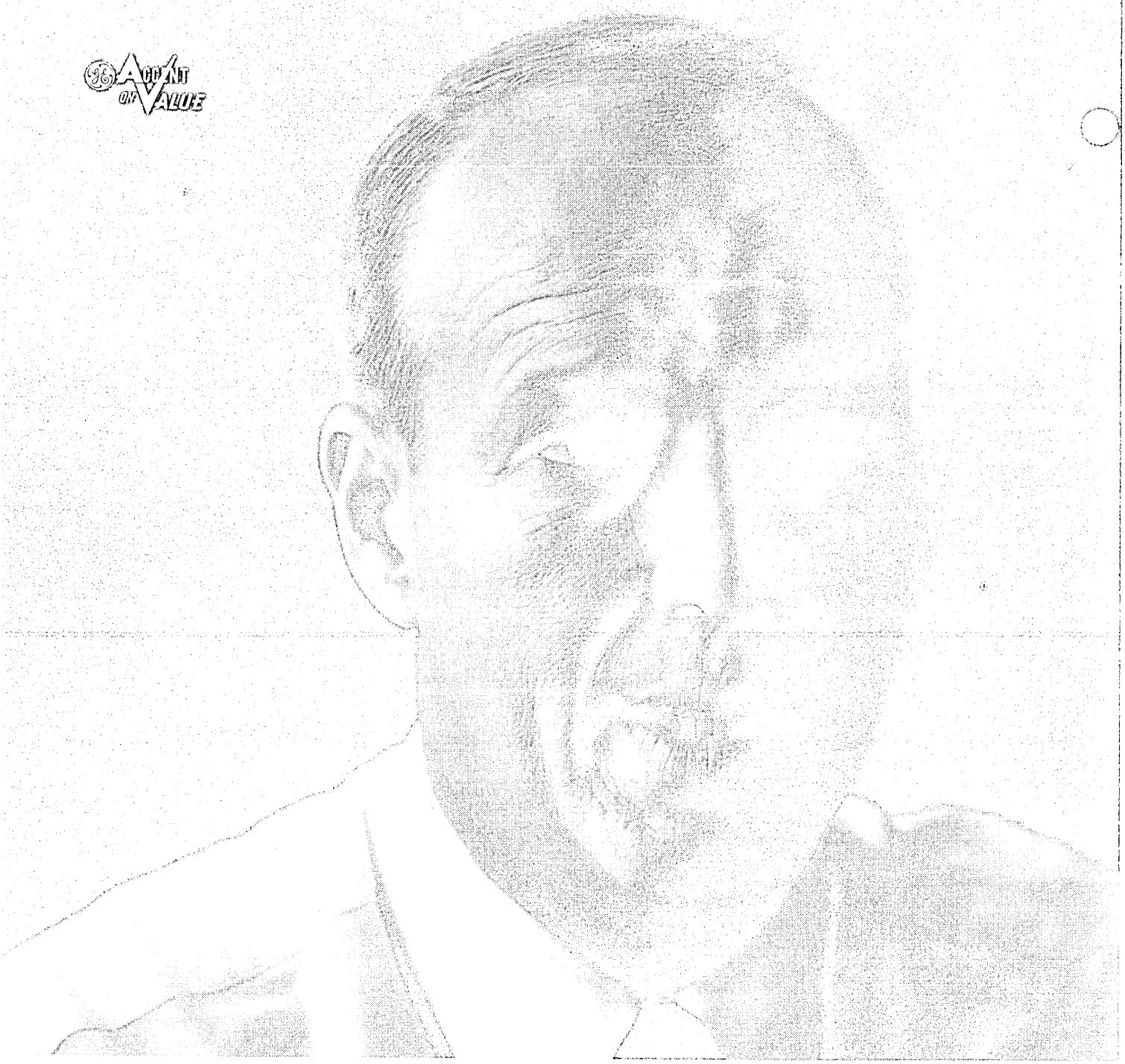
FRIDAY, NOVEMBER 8, seminars scheduled to begin at 8:30 a.m. include: Airlines and Data Processing, Data Processing in Governmental Agencies, Sales Audit and Accounts Receivable, General Ledger on Punch Cards, and Real Time for Savings and Loan. At 10:30 a.m., the sessions on the agenda include: Electronic Data Collection System, Auto Dispatch and Accounting Tele Data in Utilities, Manufacturings Approach to Data Processing, Banking, and The Auditor's Viewpoint toward Data Processing.

The final seminars, to be held at 1:30 p.m., will include: Inventory Control, Management Information and Control, Data Processing in Governmental Agencies, Sales Audit and Accounts Receivable, and General Ledger on Punch Cards.

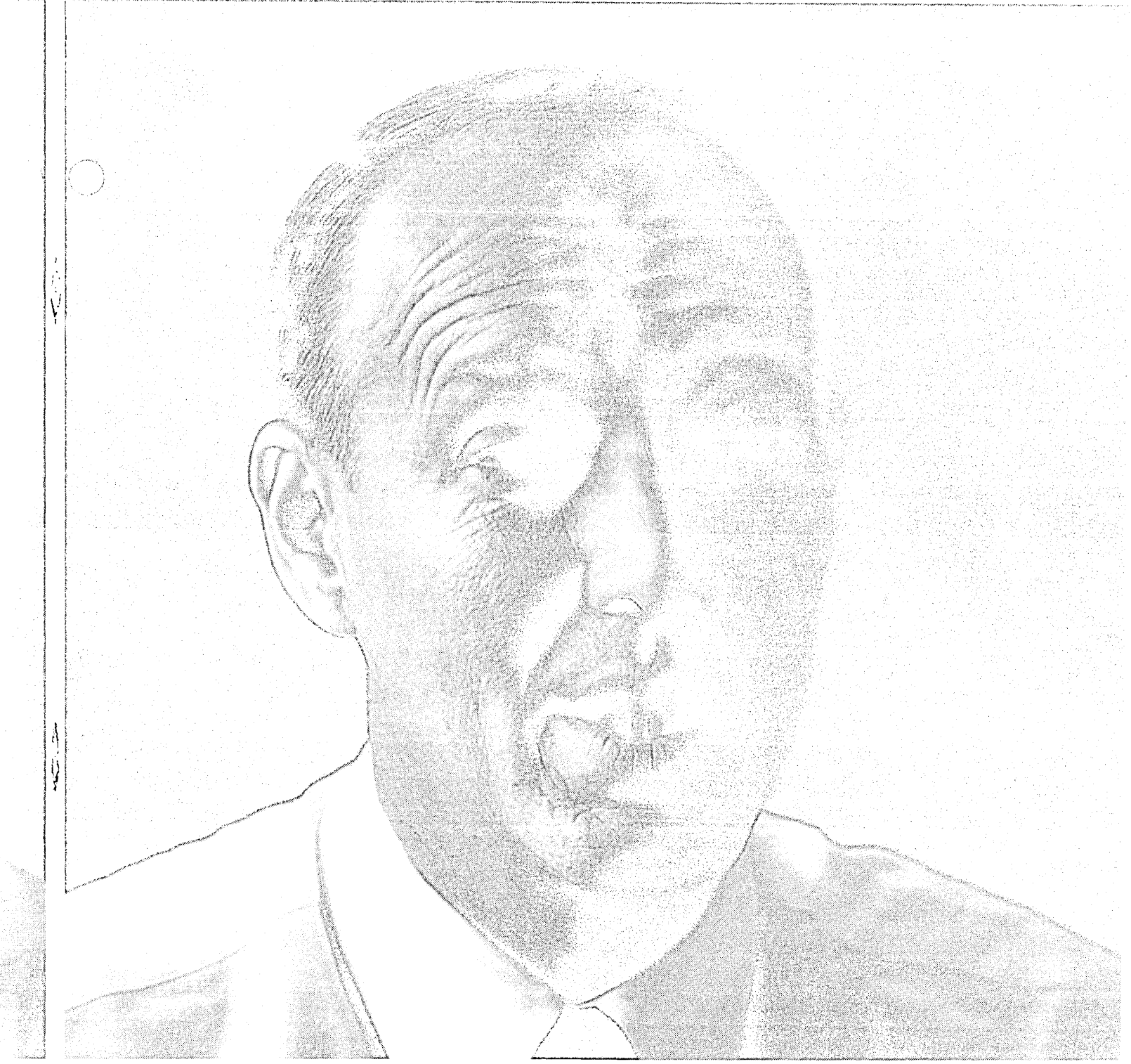
Isaac L. Auerbach, president of the Auerbach Corporation, will adjourn the conference with a talk on "State-of-the-Art Report on Computer Systems" at the closing assembly at 3:30 p.m.

This year's conference chairman is C. Edward Motz of General Electric Co. He is being assisted by Robert L. Tellef, Salt River Power District, who is also acting as program chairman.

Exhibitors for the show, to date, include Allied Egry Forms; Business Forms Printing Co.; Ennis Business Forms; Friden, Inc.; General Electric Co.; Globe Ticket Co.; IBM Corp.; Moore Business Forms; Mountain States Telephone Co.; Peterson, Brook, Steiner and Wist; Remington Rand; Southwest Envelope Co.; Standard Printing Co.; Tab Products; and Vise-Record. Exhibits will be on display in the Turquoise and Colonial Room, and will be open every day from Wednesday, noon, until the conference closes. □



"Our problem was a very big arithmetic load — and a very middle-sized computer budget."



"Then we heard about General Electric's GE-235 computer with AAU." Naturally he's enthusiastic. He discovered that the GE-235's Auxiliary Arithmetic Unit does a floating point addition in a fast 24 μs. He wanted extended numeric precision too. He got it. □ The clincher? A typical GE-235 system with AAU leases for just $7,930/month. An AAU brochure is available. General Electric Computer Department, Section J-10, Phoenix, Arizona. □ Precision equal to 9 decimal digits, with decimal exponent range of ±77. • Two 40 bit registers give 80 bit intermediate result. • Programming in FORTRAN or WIZ. • 3 modes: normalized floating-point; unnormalized floating-point; and fixed point. • Floating-point trapping for automatic checking. • High-speed independent data path to central processor. • All peripherals operate concurrently with AAU. Full peripheral line. • System accepts all programs written for The Compatibles.

Progress Is Our Most Important Product

GENERAL ELECTRIC

CIRCLE 25 ON READER CARD

ACM CONFERENCE REVIEW

dollars, guessing games . . . a philosophy of responsibility

A new computer parlor guessing game and a stiff hike in dues were the biggest news coming out of the recent national conference of the Association for Computing Machinery in mile-high Denver.

Some 1250 members of ACM met not-so-breathlessly there to discuss computers and programming, and to learn that ACM dues are being raised from $10 to $18 a year to meet "a grave financial crisis." (For comment, see Editor's Readout, p. 23).

The guessing game was invented by Control Data president William C. Norris, who gave the opening session his criteria for deciding which six of 12 current major computer manufacturers will still be around in five to 10 years. (See p. 21 for an interpretive list of criteria). Norris said that standardization could help smaller companies, pointing out that CDC had been aided by its early acceptance of IBM standards. His comment that "We need new sources of standards," was applauded. He got in a plug or two for the 6600, noting that it was not a novelty built in the belief that every company has to get one such giant "out of its system."

George Heller reported to the opening session on ACM's educational activities, including a new effort to train the blind as computer programmers, and showed slides of tiny tots getting a computer orientation course.

ACM president Alan Perlis discussed the difficulties of stabilizing a young and busy profession of "intellectual adventurers" and pointed out that the current meeting, held in conjunction with the newly formed Association for Machine Translation and Computational Linguistics (try to make an acronym out of *that* one) presages future ACM meetings held in conjunction with lawyers, physicians, physicists and other groups. ACM, he said, must concentrate on such important problems as "the development of better, faster machines with more memory and flexible input/output, more sophisticated languages, and the solution of the general information retrieval problem."

a compelling responsibility

Feeling "compelled to make a philosophical statement," Perlis wound up by saying he was "bedevilled" by people in the arts who say we are in danger of being split by two cultures. The real danger, he feels, is not the worship of the machine, but the worship of "synthetic mechanisms." "Few have studied the real problem: man's decreasing range of influence, the rapid obsolescence of his patiently acquired techniques, and the substitution by technology of vast numbers of trivial choices for the few really critical to his development. Man is not dehumanized . . . he is in danger of becoming irrelevant."

Speaking of the worship of the machine as "that rational extension of *us* which is most suited for the increasingly tiresome communication and control problems of our frenetic society," Perlis noted the coming invasion and application of computers to problems directly influencing man's social groups. "It will be a tragedy," he said, "if computing people are not aware of their responsibility in these applications . . . and if the political and social scientists do not learn how to properly request and use the results of computer studies."

Noting that computing people have so far been shielded from painful consequences, he concluded that "Someday we may be called upon to accept the consequences of an arrogant mis-use of our wonderful machines. We must understand why, and the responsibility of computing people . . . will be particularly great. We, as computer people, have a most illustrious future, but, alas, an equally disturbing responsibility."

sessions good and bad

The sessions were described by one attendant as "typical: some good papers and some lousy ones." There were no preprints – a condition which is supposed to be corrected beginning next year—and no proceedings. An overflow crowd tried to catch the session on Teaching Machines and Programmer Training, held in a room too small for it. The panel on computers in politics got off to a good start with a talk by Colorado Prof. William McPhee, who reviewed this role of computers to date as "very primitive." He expects solid, unexciting work – interpretation of elections – in the 60's, with models of the political organism available in the 70's. But the session ran overtime. At the business data processing panel, chairman John Postley noted that the software problem was "how to define the problem." Ascher Opler categorized the same problem as that of providing standard software for non-standard configurations.

The panel on multiprocessors and multiprocesses pitted manufacturers Burroughs and IBM against user/Professors John McCarthy (Stanford) and Fernando Corbato (MIT). McCarthy described the ultimate goal of time sharing research as developing computation into a utility. He listed the hardware characteristics vital to time-sharing systems of the future, singling out larger memory and faster swapping between central core and secondary memory as the most important.

Luncheon speaker Dr. Aksel Wiin-Nielsen, Assistant Director for Atmospheric Sciences National Center for Atmospheric Research, summarized the impact of computers on meteorology, noting that machines have taken over most of the mechanics of weather forecasting, leaving more time for research. What is wanted, he said, is longer range forecasts which must take into account more factors and processes than are now considered. And this calls for ever bigger machines.

The 19 exhibitors hiding behind pillars and around corners in the hotel lobby didn't have anything too exciting to show. Ferranti Telexed requests for future population figures of Colorado cities across the Atlantic at Manchester, and Control Data showed off the high school student stars of its modern-day medicine show, reported in last July's *Datamation*. Colorado Instruments showed a $10K gadget which combines radar antenna and radar pencil to allow an estimator to take off electrical requirements from a blueprint.

There didn't seem to be an awful lot of recruiting and/or free booze at the conference. One man whose new company identification was penned in over that of his scratched-out previous affiliation denied that he had changed horses mid-conference. The bulletin board contained the usual employment opportunities, but only one company we know held open house. For their pains, they were mis-named by one man who wanted to taste their hospitality a second night in a row. ◻

convention remuneration assembly program system

7.11

IOU

Las Vegas probabilities

by WILLIAM A. LOGAN

Soon, in Las Vegas, a large group of computer people will be scampering about among the slot machines, crap tables, keno crowds, poker games, chuck-a-luck cages, roulette wheels, etc. The "Disneyland for Big Kids" has devised amusements for all—at a profit to the casinos. A visitor in Las Vegas becomes tired just from carrying silver dollars around instead of paper money—and to relieve this "tired, worn-out feeling," the larger casinos have provided the game of "21." At the "21" table, the conference attendee may relax in a comfortable chair while the dealer reduces his silver dollar burden.

Assuming a basic knowledge of the rules of the game, a player loses at "21" for only three reasons:

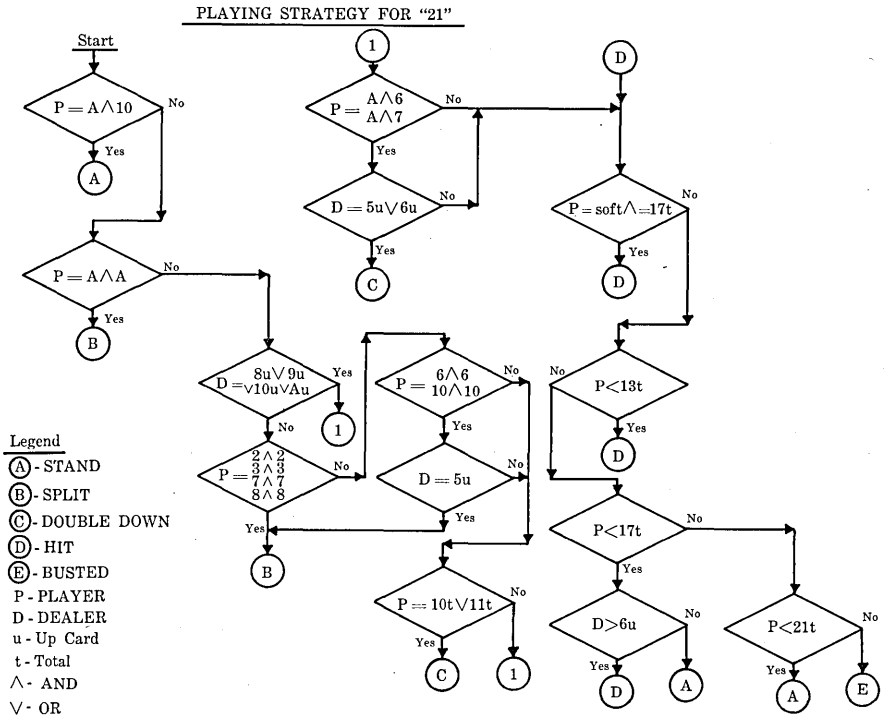
1. The player usually plays with poor strategy.
2. Almost invariably the player does not use proper money management.
3. The player draws cards totaling more than 21.

Both strategy and money management are covered in this article which outlines a system that is largely mechanical. No guarantees are made, but it has been found to annoy pit bosses and their associates while garnering a fair profit to the user.

playing strategy at "21"

The accompanying flow chart (Fig. 1) has no magical elements in it. It merely illustrates the good playing strategy generally agreed upon by the authorities. Succinctly phrased, if the dealer has seven or less up, the world is potentially your oyster. You may split 2's, 3's, 7's or 8's or double down on a total count of 10 or 11. In general, 4's, 5's, 10's or face cards should not be split. Aces should always be

Figure 1



A member of the technical staff of Mesa Scientific Corp., Inglewood, Calif., Mr. Logan has had eight years' experience in programming, development of programming systems, and system design. He has been an operations research analyst, product planning analyst, chief field representative, and senior programmer for such firms as Burroughs Corp. and Teleregister.

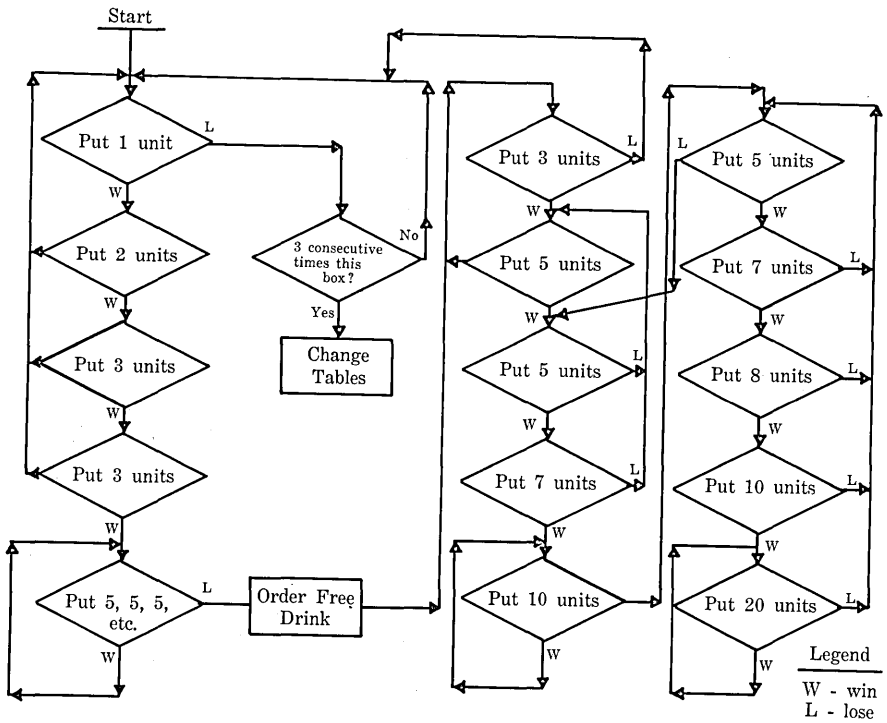
craps...

split. If the dealer has a six or less up, you need have only a total count of 13 or more to have a fair chance of winning. However, if the dealer has 7, 8, 9, 10, face card, or Ace up, you should draw until you have a total count of 17 or more.

Some terms in the play of "21" may need an explanation:

1. Stand—Do not draw another card.
2. Split—If, in the first two cards dealt you, you receive a pair, you may turn both of them face up, double your bet, and play each of them as a separate hand. It is always advisable to do this whenever the strategy allows you to split pairs.
3. Double Down—Before receiving your third card, you may turn both of your cards up, double the bet, and draw one more card. This can be done with any two first cards but is advisable only at the times indicated by the playing strategy flow chart.
4. Hit—Draw another card.
5. Busted—You have drawn a total count in excess of 21. You have lost the hand.
6. Insurance—Whenever the dealer receives an Ace as his up card, he will pause to give the players an opportunity to bet at two to one odds that he, the dealer, has 21. Whether or not to take insurance is a highly moot point. It's usually best not to invest your money betting against yourself.

Figure 2



money management at "21"

The accompanying flow chart (Fig. 2) represents a modified, reverse martingale which has proven successful in the past whenever a game is played at near even odds. Used with the suggested playing strategy, it has scored past wins at "21." Its major advantage is that over any series of bets starting with a one-unit wager, a player will never lose more than a total of one unit per loss, and may gain much more per win. This money management chart is based upon the superstition that luck may run in strings of either wins or losses. A wagering system could be constructed on the alternate superstition that luck does not occur in strings of wins and losses. Such a martingale would probably involve doubling one's wager whenever one lost. While this system can be shown to always yield a one-unit profit for each win encountered, a string of nine or 10 losses increases the wager beyond consideration. Of course, anyone not believing in strings will not find it necessary to consider such a string of losses—until he is penniless.

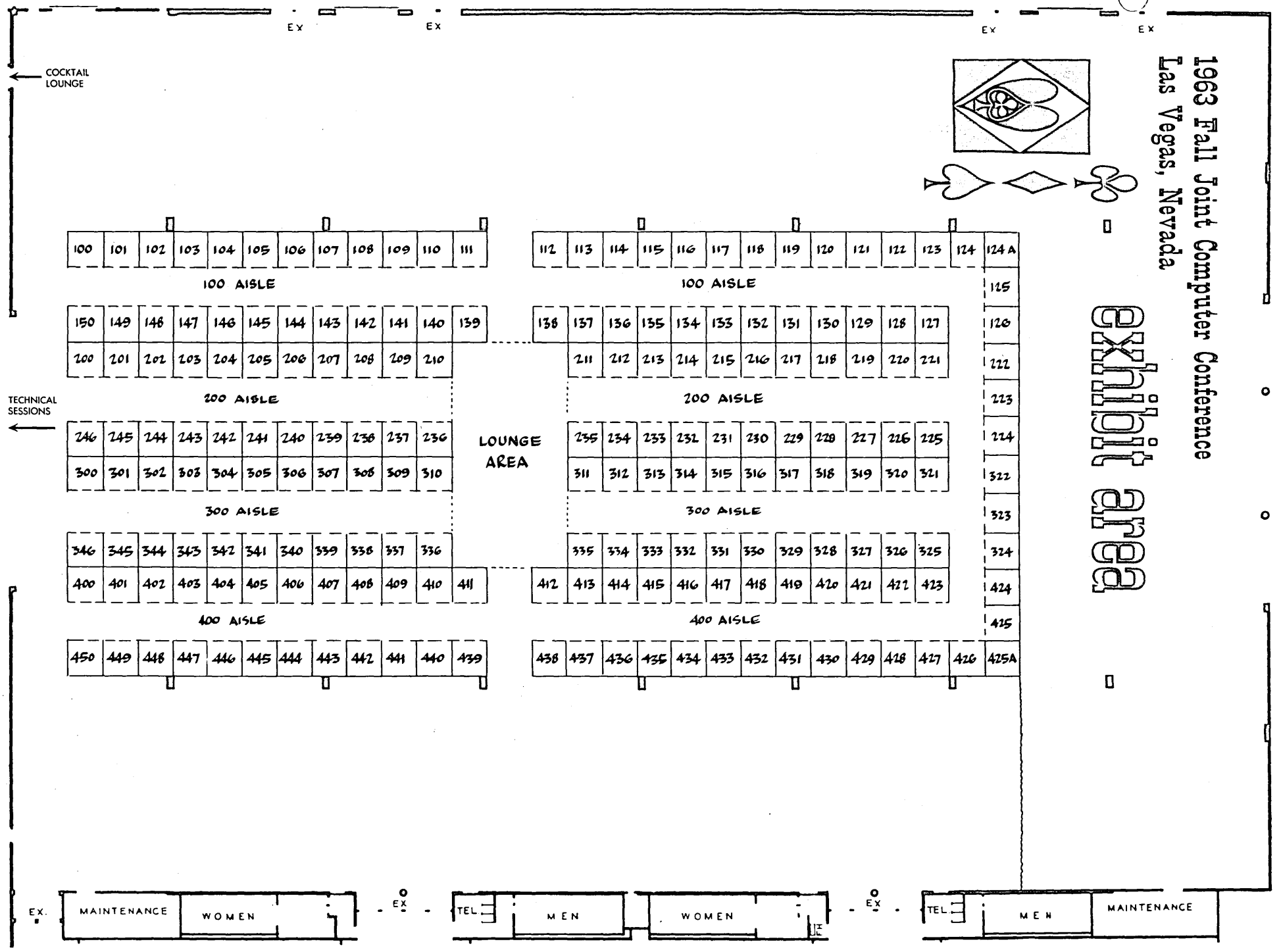
the dealer

Not much has been written about this essential element in the game of "21." He is a man paid by the casino to deal cards and to play his own hand in a completely arbitrary manner. He has no stake in the game. He is dexterous, courteous, and generally willing to help the player in the valuation and play of each hand. He is honest because there is no reason for him not to be. Use him, ask questions, and follow his advice.

The proper use of the dealer, money management and playing strategy may well yield you a profitable Las Vegas conference attendance. ♠

1963 Fall Joint Computer Conference
Las Vegas, Nevada

exhibit area



the exhibitors

the program

OPENING SESSION

Tuesday, Nov. 12, 10 a.m. to Noon Auditorium

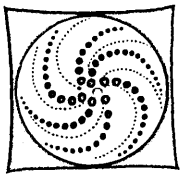
Introduction

Paul M. Davies, Abacus Inc., Santa Monica, Calif.
Program Chairman

Opening Remarks

James D. Tupac, The RAND Corp., Santa Monica, Calif.
Conference Chairman

J. D. Madden, IBM Corp., Poughkeepsie, N.Y.
Chairman, AFIPS Governing Board



Keynote Address

Gen. Bernard A. Schriever, Commander, U.S. Air Force Systems Command, Andrews Air Force Base

SESSION 1

Tuesday, Nov. 12, 2 to 5 p.m., Auditorium

Programming—Experimental

Chairman:
ASCHER OPLER
Computer Usage Co., Inc.
New York, N.Y.

Panelists:
George Ryckman, General Motors Research Laboratories, Warren, Mich.
Fred Scaife, The Martin Co., Denver, Colo.
George Mealy, IBM Corp., Poughkeepsie, N.Y.

1.1: An Experiment in Non-Procedural Programming

J. H. Katz and W. C. McGee
Thompson Ramo Wooldridge, Canoga Park, Calif.

To achieve machine independence, various investigators are turning to non-procedural languages, such as the Information Algebra, developed by the CODASYL Development Committee. This paper describes the application of the Information Algebra to a typical software program—namely, an assembly program. The results indicate that the Information Algebra is applicable to a broad class of computer processes, in particular as a machine-independent language which may be used to minimize the cost of repeated software development. The problem of translating non-procedural specifications into efficient running programs is discussed.

1.2: Simulation of an Assembly of Simplified Nerve Cell Models on a Digital Computer

R. E. Sears and S. M. Khanna
IBM Federal Systems Div., Bethesda, Md.

Experiments made with an assembly of simplified nerve cells, whose properties are based upon selected neurophysiological data, have been performed on an IBM 709. Eight hundred cells were used. Each cell connects to and interacts with 11 cells in the next lower layer. Patterns of impulses were applied to the first layer cells, and the response of the last layer cells, with different cell parameters and input patterns, was investigated. Output firing patterns for several conditions are presented. The programming techniques, which conserve running time of the computer when large assemblies of cells are simulated, are described.

1.3: CYCLOPS-1: A Second Generation Recognition System

T. Marill, A. K. Hartley, D. L. Darley, T. G. Evans, B. H. Bloom, D. M. R. Park, T. P. Hart

Bolt Beranek and Newman Inc., Cambridge, Mass.

This paper describes CYCLOPS-1, a working recognition system with the following capabilities: (1) The system can recognize all hand-printed alphabetic and numeric characters; there are virtually no restrictions on the manner in which the characters may be printed. (2) The system can analyze complex visual inputs consisting of an arbitrary number of characters present simultaneously; the characters may be of different sizes and orientations; they may overlap or be inside of one another; they may be superimposed on arbitrary backgrounds consisting of meaningless lines or spots or geometric shapes. (3) The repertoire of items recognized by the system may readily be enlarged to include shapes other than alphabetic or numeric characters. New items may be added without affecting the recognition of those already in the repertoire.

1.4: Simulation of a Turing Machine on a Digital Computer

R. W. Coffin and W. R. Stahl

Oregon Regional Primate Research Center, Beaverton, Ore.

H. E. Goheen

Oregon State University, Corvallis, Ore.

The authors describe a program for the simulation of a Turing Machine on a digital computer. Essential parameters of the simulation are defined and incorporated into a two-part program. The first is called the "builder," which translates the Turing Machine logic into an operable computer image. The second part of the program, called the "driver," simulates the function of the Turing Machine in solving a particular algorithm. Certain allowable artifacts are introduced to render the simulation more valuable for purposes of instruction and demonstration. Two illustrative examples are given.

SESSION 2

Tuesday, Nov. 12, 2 to 5 p.m., Gold Room

Computer Memories

Chairman:

MILTON ROSENBERG
Electronic Memories Inc.
Hawthorne, Calif.

2.1: The Rope Memory: A Permanent Storage Device

P. Kuttner

Burroughs, Electronic Instrument Div., Philadelphia, Pa.

A powerful way of increasing the capability and flexibility of digital systems is through the use of permanent (read-only) memories. The rope memory is a scheme for realizing permanent storage using standard bobbin or ferrite cores in which each core stores one word. The principle of operation, methods of organizing ropes, operating characteristics, and applications of rope memories are discussed, along with manufacturing concepts, and a comparison with other permanent storage schemes.

2.2: A 300-Nanosecond Search Memory

C. A. Rowland and W. O. Berge

Univac, Div. of Sperry Rand Corp., St. Paul, Minn.

A search or associative memory is one in which an input word is compared with all words in the memory simultaneously to test for equality, greater than, or less than. The 128-word, 24-digit feasibility search memory described employs thin anisotropic magnetic films of cobalt-iron and nickel-iron sandwiched to form BICORE's. The read cycle time is 300 nanoseconds in the worst case with indications that a 100 nsec read cycle time is attainable. The write cycle time of the feasibility model is 100 usec per word. The memory is organized as a complement non-complement memory. The theory of operation, organization and circuits required for reading and writing are described.

2.3: A New Technique for Using Thin Magnetic Films as a Phase Script Memory Element

B. A. Kaufman and E. Ulzurrun

National Cash Register Co., Hawthorne, Calif.

A technique for using a thin magnetic film as a phase-script memory element is described. Rotational switching properties of the film, rather than creeping, are utilized for reading and writing, resulting in speed advantages. Phase-script operation makes the memory ideal for use with parametron logic. Organization of the memory is such that a single cylindrical thin film parametron per digit is required for the digit driver-sense amplifier function. Appropriately timed unipolar pulses are used for word drive. Design of a 512-word, cylindrical thin film memory, based on this technique, is described.

2.4: Laminated Ferrite Memory

R. Shahbender, C. Wentworth, K. Li, S. Hotchkiss, and J. Rajchman

Radio Corporation of America, Princeton, N.J.

The batch fabrication technology and 100 nanosecond cycle operating characteristics of monolithic ferrite sheets with integrated windings are described. The fabrication technology is based on embedding printed conductors in doctor bladed ferrite sheets, laminating and sintering the sheets to form an array. Arrays with 16 x 16 locations have been operated in a word-organized, two crossovers-per-bit mode (128 bits per array). At a 100 nanosecond cycle time, the maximum required read current is 370 ma, the write current is 185 ma, the digit current is 17 ma, and the sense output is ±9 mv. A one usec cycle time array required currents under 50 ma with sense output of 1 mv. These requirements are compatible with integrated semiconductor circuitry and will eventually lead to economic large capacity magnetic memories.

2.5: A Large Capacity Cryoelectric Memory With Cavity Sensing

L. L. Burns, D. A. Christiansen, and R. A. Gange

Radio Corporation of America, Princeton, N. J.

Described is a superconductive memory which lends itself to a storage capacity of billions of bits. The memory consists of a continuous sheet for storage, x-y current coincident access lines driven by cryotron trees, and sensing through a cavity of simple geometry. A single process fabrication technique makes all storing elements, all adding lines and switches, and all connections. This paper reports on a step toward this goal, the working of a 128 x 128 bit plane contained on a 2 x 2" glass substrate. Bit density is 10,000 per square inch.

2.6: Fixed, Associative Memory Using Evaporated Organic Diode Arrays

M. H. Lewin, H. R. Beelitz, and J. Rajchman

Radio Corporation of America, Princeton, N. J.

The associative properties of a symmetrical diode matrix, operating as a fixed memory, are explained. It is shown that all of the basic retrieval functions attributed to a general content-addressed memory, including multiple-match resolution, can be accomplished with this type of array. Further, the retrieval of m words answering a given description always takes exactly 2m-1 memory cycles, independent of the number of bits per word or the number of words in the memory. Experiments with diode arrays, in particular, arrays of diodes fabricated by vacuum deposition of organic films, are described. Circuits designed to operate as either memory drivers or as sense amplifiers, depending on external logic control, are presented. These are part of the electronic mechanization of an automatic interrogation routine which accomplishes the retrieval of stored information.

SESSION 3

Tuesday, Nov. 12, 2 to 5 p.m., Meeting Room 4

Multiprocessor Computer Systems

Chairman:

GERHARD L. HOLLANDER
Hollander Associates
Fullerton, Calif.

3.1: Generalized Multiprocessing and Real-Time Computer Systems

A. J. Critchlow

IBM Corp., San Jose, Calif.

This paper gathers some of the present knowledge in the general use of multiprogramming and multiprocessing. Several of the basic requirements, such as memory protection and allocation, facilities, scheduling interrupt provisions, priority control, prevention of interference between programs, I/O switching and control, are

discussed. Alternative techniques for meeting this requirement are compared on the basis of speed, efficiency, cost and reliability. Analysis of some existing systems illustrates the design trade-off as a function of the design goal dictated by applications. Finally, some extrapolation of presently observable trends is made in an attempt to predict the future use of such systems.

3.2: Organizing and Programming a Shipboard Real-Time Computer

G. G. Chapin

Univac, Div. of Sperry Rand Corp., St. Paul, Minn.

The Naval Tactical Data System is a multi-computer, combat direction system which processes, correlates, and evaluates tactical data in real-time. A basic design principle of NTDS required the use of multiple units of a standard computer for each installation. From two to four AN/USQ-20 are required, depending on the installation. The programs to operate this multi-computer, multi-site, real-time system required several new techniques. Of particular significance are the Executive Control Philosophy and the approaches used to assign and distribute tasks between computers, to organize each program, and to control the overall system as well as the individual programs.

3.3: A Multiprocessor System Design

Lt. M. E. Conway

USAF, Hanscom Field, Directorate of Computers, Bedford, Mass.

Based on the principle that there need not be a fixed relationship between the processors of a multiprocessor system and the parallel paths of a program residing in that system, this paper presents the design of a system which dynamically schedules its processors in order to maximize their use. The system has the following characteristics: (1) There are no inherent limits to the number of processors or memory modules in the system. (2) Knowledge of the number of processors in the system executing a program is not required at programming time. (3) Specification of parallelism is simple and requires two new basic instructions. (4) Interrupt processing is less frequent than with conventional systems; in general, the executive function is simplified. (5) Complete storage protection among concurrently running programs is provided. (6) Storage allocation and scavenging requires no movement of programs already in memory and consumes no memory cycles.

3.4: A Probabilistic Analysis of Computing Load Assignment in a Multiprocessor Computer System

M. Aoki, G. Estrin, and R. Mandell

Univ. of California, Los Angeles, Calif.

This paper describes how a digital computer system with two arithmetic units can be employed to reduce the computation time for bivariate interpolation problems to 35-55 per cent of the time required by a standard parallel computer. The nature of the problem is such that a certain amount of partially processed information needs to be passed between the arithmetic units. The problem of computational load assignment to the two arithmetic units is discussed in some detail. A discrete probability model is used to compute the probability that either computer will stand idle for more than a given time waiting for data from its partner. Some discussions on hardware implementation of the proposed algorithm are also included.

SESSION 4

Wednesday, Nov. 13, 10 a.m. to 1 p.m., Auditorium

Information Retrieval

Chairman:

JOHN POSTLEY
Advanced Information Systems
Los Angeles, Calif.

4.1: A Discrimination Method for Automatically Classifying Documents

J. H. Williams Jr.

IBM Federal Systems Div., Bethesda, Md.

The hypothesis of the discrimination method to automatically index documents is that each subject category can be represented statistically by the theoretical frequencies of its most discriminating words. A document is classified into the appropriate category by comparing the observed frequency of each word in the document with the corresponding theoretical frequencies in the various categories. Multiple classification is made possible through the use of a Relevance Value computed for the document with respect to each category. In the discrimination method, a coefficient is computed for each word for every group of categories. The method provides the basis for a completely automatic system—for the selection of significant words as well as the classification of documents.

4.2: The Direct Access Search System

I. A. Warheit

IBM Corp., San Jose, Calif.

Indexes generally have been organized as either serial or inverted files, each of which has some advantages and some limitations. By including both inverted and serial files, the index organization proposed offers all the advantages of both, and permits selection of the best search strategy for each request. Although, for greatest efficiency the system depends on a random access file for direct access to the items to be retrieved, many of the benefits can be realized with tape systems.

4.3: A Flexible Direct File Approach to Information Retrieval on a Small to Medium Size Computer

Jane Olmer

Applied Physics Laboratory, Johns Hopkins Univ., Silver Spring, Md.

Progress on information storage and retrieval programs now in use is reported, including rather sophisticated logical searches on master files or sub-files to yield a readable output with a reasonable amount of text. Any semantic approach, expressed in an intelligible set of symbols, may be accommodated. The direct file approach avoids sorting and cross referencing. File maintenance and flexibility formatted printing are included.

4.4: Experience with a Generalized Information Processing System

M. Kosakoff and D. L. Buswell

U.S. Naval Ordnance Laboratory, Corona, Calif.

The authors favor a generalized approach to information processing, especially for a small staff serving many customers. Although there are disadvantages, some of them quite serious, the Variable Information Processing System in use at the Laboratory has been by and large successful. The techniques being utilized, expanded, and developed continually permit a flexible design of information systems. The processing system consists of a standardized storage technique and a battery of processor routines which can be linked to perform a variety of functions. The key to its generality is the complete variability in length of all information organizational elements.

SESSION 5

Wednesday, Nov. 13, 10 a.m. to 1 p.m., Gold Room

Computer Organization

Chairman:

D. L. STEVENS
TRW Computer Division
Canoga Park, Calif.

5.1: A Search Memory Subsystem for a General Purpose Computer

A. Kaplan

Univac, Div. of Sperry Rand Corp., St. Paul, Minn.

Presented is a system design utilizing search memory techniques in a general purpose structure. The design has been as general as possible to achieve independence of the memory element used and the particular computer structure. The unit contains 4,096 words of 72 bits each with a typical search time of 12 usec. The search criteria provided are masked equality, greater than or equal, less than or equal, between limits, next higher, next lower, and their negatives. A completely variable field structure is incorporated with the capability to perform a different type of search on each field. The system has been designed for IR, data correlation and statistical analysis applications for which this subsystem can increase the computer's problem-solving rate by several orders of magnitude.

5.2: The Logical Organization of the PB 440 Microprogrammable Computer

E. O. Boutwell Jr. and E. A. Hoskinson

Packard Bell Computer, Anaheim, Calif.

The logical organization of a microprogrammable computer employing parallel bus structure logic is described. Detailed logic of the processing unit, its connection to a modular memory system, and an expandable I/O bus are presented. The machine uses two memory types, one for main instruction storage and a second to hold basic computer logic. Logical operations or micro-orders are stored in this second memory type. This stored logic can be changed under program control, permitting the substitution and modification of command sets. The general programming features resulting from this design approach are discussed.

5.3: Application of Pushdown-Store Machines

R. J. Evey

IBM Corp., Cambridge, Mass.

Six sets of machines are defined by adding pushdown-stores to finite-state machines. Each set is partitioned: (1) into transducers—machines with both domains (inputs) and ranges (outputs) — and accepters, machines with only domains, and (2) into deterministic and non-deterministic machines. Various properties of such machines are demonstrated, and it is shown that: (1) a language is context-free if, and only if, it is the range of a deterministic pushdown-store transducer; (2) only context-free languages can be generated by Yngve's discontinuous grammars; (3) a set of simple computer codes is not context-free; (4) both the Kuno-Oettinger sentence analyzer and the Samelson-Bauer formula translator can be constructed out of certain of the defined machines.

SESSION 6

Wednesday, Nov. 13, 10 a.m. to 1 p.m., Meeting Room 4

Expository Session—Software for Hardware Types

Chairman:

W. F. BAUER

Informatics Inc.

Culver City, Calif.

6.1: The Programmer—Roles and Missions

W. F. Bauer

Informatics Inc., Culver City, Calif.

6.2: Software Today

W. A. Ramshaw

United Aircraft Corp., Hartford, Conn.

6.3: Compilers Today

T. B. Steel Jr.

System Development Corp., Santa Monica, Calif.

6.4: Programmers and Hardware Design

R. E. Porter

Control Data Corp., Los Angeles, Calif.

6.5: The Future of Software

J. W. Carr III

Univ. of Pennsylvania, Philadelphia, Pa.

SESSION 7

Wednesday, Nov. 13, 10 a.m. to 1 p.m., Meeting Room 15

Hybrid Analog-Digital Computation

Chairman:

GRANINO A. KORN

University of Arizona

Tucson, Arizona

7.1: Effects of Digital Execution Time in a Hybrid Computer

T. Miura and J. Iwata

Hitachi Ltd., Central Research Laboratory, Tokyo, Japan

This paper describes theoretical and experimental investigation on two problems in a hybrid computer—assignment between digital and analog parts and effects of digital execution time. Effects of digital execution time for linear differential equations solved with hybrid computer are derived in the form of general formulas. Several methods of compensating for the effects of digital execution time are proposed and their effectiveness verified both theoretically and experimentally.

7.2: Corrected Inputs—A Method for Improving Hybrid Simulation

R. Gelman

General Electric Co., Philadelphia, Pa.

This paper describes a procedure which can be used to circumvent some difficulties generally regarded as basic limitations to hybrid simulation—distortions and time lags in the transfer of data between digital and analog machines. The method of corrected inputs shifts the delay from the data itself to a correction signal, which will not be included in any closed loop of the problem. Closed loop calculations are performed on the analog, with the digital computer supplying a correction signal to compensate for inaccuracies.

7.3: A Hybrid Analog-Digital Differential Analyzer System

J. V. Wait

Univ. of California, Santa Barbara, Calif.

This paper covers the results of theoretical and experimental studies of a parallel analog-digital differential analyzer, differing in several respects from one proposed by H. Skramstad in 1959. It may be regarded as an incremental DDA whose truncation and round-off errors are eliminated through interpolation with repetitive analog computing elements. The prototype system utilizes four digital bits and a one per cent analog channel to achieve a nominal accuracy of approximately 0.1 per cent of half-scale at a maximum full-range computing speed of about 8 cps.

SESSION 8

Wednesday, Nov. 13, 2:30 to 5:30 p.m., Auditorium

Mass Storage Systems

Chairman:

IRVING L. WIESELMAN

Data Products Corp.

Culver City, Calif.

8.1: Review and Survey of Mass Memories

L. C. Hobbs

Hobbs Associates, Corona del Mar, Calif.

This paper traces the history of mass memories, defines the term as it is generally used, discusses major types of applications, compares major types of mass memories, relates their characteristics to applications, and predicts future capabilities and possible limiting conditions. The continued dominance of moving-magnetic-media mass memories until static types are able to compete on a performance vs. cost basis is predicted.

8.2: Investigation of a Woven Screen Mass Memory System

J. S. Davis

Thompson Ramo Wooldridge Computer Div., Canoga Park, Calif.

The design of a 10^8 bit coincident current memory system utilizing woven aperture screen planes is discussed. Memory access time is 10 usec. The switching speed of the magnetic planes coupled with the transmission characteristics of the lines indicate a memory cycle time of 10 usec. Data transfer rate is 5 usec/word, and each word contains 36 bits. Each memory module contains 74 planes and a bit capacity in excess of 4.5×10^6 bits. A single X and Y driver matrix selection is proposed.

8.3: A New High Density Recording System: The IBM 1311 Disk Storage Drive with Interchangeable Disk Packs

J. D. Carothers, R. K. Brunner, J. L. Dawson, M. O. Halfhill, R. E. Kubec

IBM General Products Div., San Jose, Calif.

This paper describes the 1311's read/write heads and electronics, air bearings, and magnetic surfaces as related to design parameters—track registration, signal amplitude, signal-to-noise ratio skew, head-to-disk spacing, etc.

8.4: An Engineering Description of the Burroughs Disk File

R. W. Jack, R. G. Groom, R. A. Gleim

Burroughs Corp., Pasadena, Calif.

This technical description of the Burroughs head-per-track disk file

covers general file characteristics, overall track organization, and data layout. Also described is the technique used in bringing several thousand head connections to the appropriate electronics. A brief summary of disk files is presented and compared qualitatively with the Burroughs unit.

8.5: A Multiple-Access Disc File

I. L. Wieselman, R. Stuart-Williams
Data Products Corp., Culver City, Calif.
D. K. Sampson
Data Products Corp., St. Paul, Minn.

This is a technical description of a recently-announced system with a typical access time of 90 milliseconds, and 130 million or more alphanumeric characters. Independent positioners move each group of heads to access data. Up to four positioners can be moving to different addresses simultaneously, and two data channels can be used for simultaneous reading/writing. A quantitative evaluation is provided to illustrate the structured relationship between data utilization and equipment design parameters.

SESSION 9

Wednesday, Nov. 13, 2:30 to 5:30 p.m., Gold Room

Natural Language Processing

Chairman:
FRANK MARZOCCO
System Development Corp.
Santa Monica, Calif.
Panelists:
Sidney Lamb, Univ. of California, Dept. of Linguistics, Berkeley, Calif.
David G. Hays, The RAND Corp., Santa Monica, Calif.
T. B. Steel, System Development Corp., Santa Monica, Calif.

9.1: Syntactic Analysis of English by Computer — A Survey

D. G. Bobrow
Bolt Beranek & Newman, Cambridge, Mass.

Many theories of grammar have been developed which provide methods for associating some syntactic structure with a sentence of a natural language. This paper reviews those theories which have been used as a basis for a computer program to perform syntactic structuring of English sentences. Among the grammars described are category, dependency, immediate constituent, and phrase structure grammars with discontinuous constituents. Reference is made to computer programs based on each of many grammars, and the goals and relative success of these programs is reviewed.

9.2: The Computer-Stored Thesaurus and its Use in Concept Processing

C. A. Shepherd
Univac, Div. of Sperry Rand Corp., Washington, D.C.

Contributors of papers to a conference of a biomedical society were asked to submit their own indexing terms along with their abstracts. The terms were to be selected from a thesaurus, although additions to the list were allowed. A program compared authors' terms with the thesaurus, validated chosen terms to provide for more complete indexing, and cross-referenced the terms on a concept basis. The computer was able to index documents by accessing the thesaurus of concepts suggested by the authors.

9.3: Syntactic Structure and Ambiguity of English

S. Kuno and A. G. Oettinger
Harvard Univ., Cambridge, Mass.

For any given English sentence, the Harvard multiple-path syntactic analyzer produces all parsings acceptable to a grammar whose rules are in the form of directed productions as defined by Greibach. By revealing the extent and the nature of the ambiguity implicit in a grammar, the analyzer opens the door to systematic investigations of the problems of reducing syntactic ambiguity through better-fitting grammars, through appropriately interspersed human intervention, and perhaps through better understanding of the semantic processes.

9.4: A Tape Dictionary for Linguistic Experiments

J. L. Dolby and H. L. Resnikoff
Lockheed Missiles & Space Co., Palo Alto, Calif.
E. MacMurray
Statistical Tabulating Corp., San Francisco, Calif.

To facilitate certain studies in computational linguistics, a tape dictionary has been prepared using information in standard dictionaries. The initial word list is the 73,000 left-justified, bold-faced words in the Shorter Oxford. Parts of speech and status information are from the Shorter Oxford and Webster's Third New International dictionary. These words were then checked against a tape prepared by Cornell Univ., including an updated listing of Thorndike's 20,000 most-used words. Graphemic syllabification and accent are from Funk and Wagnall's New Practical dictionary. Sublists of the words common to all sources and specific to each were then prepared.

SESSION 10

Wednesday, Nov. 13, 2:30 to 5:30 p.m., Meeting Room 4

Expository Session—Hardware for Software Types

Chairman:
RICHARD I. TANAKA
Lockheed Missiles & Space Co. Research Laboratories
Palo Alto, Calif.

10.1: Physical Realization of Digital Logic Circuits

A. W. Lo
IBM Corp., Poughkeepsie, N.Y.

10.2: Fundamentals and Implications of Integrated Circuits

R. A. Kudlich
AC Spark Plug Div., General Motors Corp., Milwaukee, Wisc.

10.3: Principles, State of the Art, and Future of Computer Memories

J. A. Rajchman
RCA Laboratories, Princeton, N.J.

10.4: Introduction to All-Magnetic Logic

H. D. Crane
Stanford Research Institute, Menlo Park, Calif.

10.5: Interaction-Oriented Input-Output Devices

B. M. Gurley
Information International Inc., Maynard, Mass.

SESSION 11

Wednesday, Nov. 13, 2:30 to 5:30 p.m., Meeting Room 15

Real-Time Simulation

Chairman:
GEORGE A. BEKEY
University of Southern California
Los Angeles, Calif.

11.1: Hybrid Simulation of an Aircraft Adaptive Control System

P. W. Halbert
Electronic Associates Inc., Princeton, N.J.

An adaptive control technique is proposed in which control action is based on predicted and past system performance. Application of the concept to a high performance aircraft permits adaptation to environmental upsets. Analog and digital elements are required in the control system. The simulation imposes requirements of two-speed analog integration of the system equations with iterations of the high speed solution under direction of parallel digital logic elements. These latter are programmed to automatically test and evaluate analog results and execute commands aimed at determining optimum controller parameters.

11:2 A Computer Driven Simulation Environment for Air Traffic Control Studies

E. A. Robin, R. S. Pardee, D. L. Scheffler, F. C. Holland
TRW Computer Division, Atlantic City, N.J.
A. G. Halverson
Federal Aviation Agency, Atlantic City, N.J.

A Computer Driven Simulation Environment (CDSE) to study advanced

air traffic control concepts is described. The environment is built around an IBM 7090, and designed to operate with flexibility in real-time. Keyboards for input and output displays are used by air traffic controllers and simulator pilots to communicate with the real-time programs. The system configuration, role of the gp digital computer, and the program organization are presented.

11.3: Hybrid Techniques for Real-Time Radar Simulation

R. L. Boyell
Pennsylvania Research Associates Inc., Philadelphia, Pa.
H. Ruston
The Moore School of Electrical Engineering, Univ. of Pennsylvania, Philadelphia, Pa.

This paper discusses the results of a study of special purpose computers for the simulation of air-to-ground radars. The computers, in real-time, must generate information for simulating the display of a scanning radar flown at Mach 3 and arbitrary altitude. It can view 10^5 square miles of terrain per second and resolve 60 points per mile in range (five per microsecond). The paper states that a hybrid simulator exploits both the redundance in the terrain and the repetitiveness caused by the radar scan pattern. An overall design is described that affords reduction of 10^3 in storage capacity and computation speed, compared with a straightforward digital approach for generation of profiles from which the data is prepared.

11.4: A Digital Computer for Real-Time Simulation

M. Palevsky and J. V. Howell
Scientific Data Systems Inc., Santa Monica, Calif.

The history of digital differential equation solvers is presented, and the DES-1 is described. The latter is a gp computer with an instruction list oriented toward the solution of analog types of problems, with a software package which permits it to be programmed like an analog device. I/O systems are described as they relate to connecting the DES-1 to various analog and digital devices for large-scale simulation.

PANEL SESSION

Wednesday, Nov. 13, 8 to 10 p.m., Meeting Room 4

The Use of Computers to Study Games of Chance and Skill

Chairman:
PROF. E. O. THORP
State University of New Mexico
University Park, N.M.
Panelists:
Harvey Dubner, Simmond's Precision Products Inc.
Jerry Patterson, Planning Research Corp.
Richard Sprague, Touche, Ross, Bailey and Smart
Allan N. Wilson, General Dynamics/Astronautics
William E. Waldon, Los Alamos Scientific Laboratory
Lt. Anthony A. Colombo, Strategy and Tactics Analysis Group, U.S. Army

SESSION 12

Thursday, Nov. 14, 9:30 a.m. to 12:30 p.m., Auditorium

Memory-Oriented Computers

Chairman:
D. L. SLOTNICK
Westinghouse Electric Corp.
Baltimore, Md.

12.1: Systems Implications of New Memory Developments

S. G. Campbell
Xerox Corp., Rochester, N.Y.

The classical computer problems such as serial vs. parallel, synchronous vs. asynchronous, even decimal vs. binary, as well as the more modern problems such as multi-programming and multi-processing, really relate to ways of exploiting available memories. This paper considers several categories of memories: (1) conventional memories—achievable size and speed, operating characteristics, attempts to combine these into hierarchical memory systems; (2) some sly ways of improving the effective performance of conventional memories; (3) unconventional memories—"active" vs. "passive" memories, special access memories, read-only memories, and forgetful memories.

12.2: A Modified Holland Machine

W. T. Comfort
IBM Corp., Poughkeepsie, N.Y.

In 1958, Dr. John Holland proposed a parallel-network computer with some unique concepts of instruction sequencing and data accessing, and featuring decentralized control. It is characterized by two significant problems—complex programming and the prodigious hardware required. This paper discusses a modified version of that machine, proposing to ease the programming and hardware problems without sacrificing the computing-power capabilities of the Holland machine. Some of the organizational variables which require additional study are indicated as a possible direction for future work.

12.3: Mass Fabrication, Highly Parallel Systems and Associative Logic

R. R. Seeber and A. B. Lindquist
IBM Corp., Poughkeepsie, N.Y.

To take advantage of highly parallel systems, this paper proposes that modular design with low-complexity modules may yield economic mass fabrication in technologies such as cryogenics. To simplify the programming problem, the authors employ modular associative memories and associative controls. An "autonomous" control system permits each processor to proceed on its own, finding work to be done by associative interrogation and then proceeding down a branch of a tree-organized program. At an impasse, it dumps any partial results, with appropriate status symbols, and looks for other work to be done. Examples shown include multidirectional, simultaneous, conditional, and non-conditional branching in a loop.

12.4: Some Applications for Content-Addressable Memories

R. H. Fuller
General Precision Inc., Glendale, Calif.
G. Estrin
Univ. of California, Los Angeles, Calif.

This paper investigates several problem areas in which the distributed logic capability of a content-addressable memory (CAM), used as a component of a gp digital computer, contributes to greater problem-solving efficiency than is available with a gp computer alone. The authors describe some problem characteristics—as found in tasks of function optimization, visual pattern recognition, and solution of elliptic difference equations—in which CAM contributes to efficient problem solution. The efficiency of CAM algorithms is compared to efficiencies for conventional computers and for other related distributed logic machines.

SESSION 13

Thursday, Nov. 14, 9:30 a.m. to 12:30 p.m., Meeting Room 4

Programming—Applied

Chairman:
ROBERT L. PATRICK
Consultant
Northridge, Calif.

13.1: A Computer Aid for Symbolic Mathematics

L. C. Clapp and R. Y. Kain
Bolt Beranek & Newman, Cambridge, Mass.

The authors cover three facets of this area: efficiency of data organization, flexibility, and aspects of the user's communication with the system. A preliminary system designed to study this problem on a medium-scale, time-shared computer has been developed. An ALGOL-like language has been used in programming, facilitating its use on other machines. Functions built in initially include elementary algebraic operations, displaying equations and plotting curves on a scope, and the ability of the user to create new symbols, operations, and functions for his convenience.

13.2: Stock Maintenance by Telephone—One Step Towards Integrated Manufacturing Control in a Multi-Shop Manufacturing Complex

G. P. Lewett and S. Choolfaian
Western Electric Co., Kearny, N.J.

This paper describes a system for controlling inventory in storerooms of various production shops in WE's Kearny Works, based on Data-Phone transmission of store transactions to an IBM 7080 processor. The system was designed as the initial stage in constructing an OR inventory-production control model; flexibility was emphasized to facilitate evolutionary progress towards a complete manufacturing control system. The system is operating in 15 stores, controlling an investment of $5 million in raw material, piece parts, and components.

13.3: Information Handling in an Arms Control Inspection Environment

Lt. Col. L. F. Mathison, USAF
U.S. Arms Control and Inspection Agency, Washington, D.C.

Apart from political considerations, the basic functions of an arms control inspection and verification system are to gather and analyze information, concentrating on features and situations created by man, identify changes from a norm against an established data base, and to grasp the significance of these indicators and their complex interrelationships to the environment being inspected. This paper discusses a data handling systems approach for the agency on which command and control decisions could be based.

SESSION 14

Thursday, Nov. 14, 9:30 a.m. to 12:30 p.m., Meeting Room 15

Input-Output Equipment

Chairman:
HOWARD GATES
Teledyne Systems
Hawthorne, Calif.

14.1: An Approach to Manufacturing Control Using Inexpensive Source to Computer Communications

C .A. R. Kagan and R. Tevonian
Western Electric Co., Princeton, N.J.

This paper describes aspects of two data gathering systems for the improved scheduling and control of manufacturing operations. This includes data from the lowest and most dispersed level of operations, the coverage made economically feasible through the application of a concept of tailor-made systems using a variety of modular subassemblies. Low cost is possible through the use of components and devices mass-produced for other purposes.

14.2: Engineering Characteristics of Cylindrical Thin Film Parametrons for Use in Digital Systems

B. A. Kaufman, W. G. Pfeiffer, V. K. Randery, A. J. Kolk
National Cash Register Co., Hawthorne, Calif.

The operating principles and performance characteristics of a cylindrical thin-film parametron, operating at 10-mc subharmonic (20-mc pump) and capable of logic rates to 300 kc are presented. The thin-film element, a 10-mil Be-Cu wire electroplated with permalloy, is produced in a continuous process. With specified fan-in of seven and a fan-out of 10, these parametrons enable the implementation of complex majority logic networks with minimized parametron count. Twelve parametrons are packaged in a basic module and share a common plated wire, which also serves as the pump current conductor.

14.3: Single Capstan Tape Memory

R. A. Kleist, M. A. Lewis, and B. C. Wang
Ampex Computer Products, Culver City, Calif.

A new development in digital tape drives and its product application in a typical tape memory are described. The drive utilizes a single capstan and a low friction tape path with four guiding elements and no mechanical adjustments. The capstan is servo driven. The application of the tape drive is described in a 556 bpi, 20KC peak character rate, 1 x 4 tape memory.

14.4: The Evolution of an Army-Navy Militarized Digital Magnetic Tape System for Field Computer Applications

D. J. Morrison
Navy Bureau of Ships, Washington, D.C.
D. H. Tyrrell
CCIS70 Systems Office, USAELRDL, Ft. Monmouth, N.J.
J. J. Staller
Sylvania Electronic Systems, Needham, Mass.

This paper covers Army/Navy mag tape systems developed for operation in military environments, with a discussion of the significant technical advances leading to the evolution of the first fully militarized mag tape transport. Areas discussed include tape drive methods, recording and playback techniques, dual tape speed control, automatic threading and cartridge loading, weight reduction, and reliability and maintenance.

14.5: IBM 7340 Hypertape Drive

R. A. Barbeau and J. I. Aweida
IBM Data Systems Div., Poughkeepsie, N.Y.

This paper describes the following aspects of the 7340: the automatic handling of tape, the cartridge, the single fluid coupled capstan which controls the tape motion, the reel drive system including the capacitive method of tape buffer loop sensing, method of recording, and method of error detection and correction.

SESSION 15

Thursday, Nov. 14, 3 p.m., Auditorium

Computers as a Social Force

Chairman:
FRANK WAGNER
Informatics
Culver City, Calif.

15.1: The Computer in Education: Malefactor or Benefactor

R. L. Egbert
System Development Corp., Santa Monica, Calif.

This paper describes recent developments in the use of computers in both the instruction and school organization-administration roles, and the testing of such ideas by educators as the Trump Plan and the Continuous Progress Plan. In command-and-control, student-surveillance, and problem-detection functions of schools, the author feels that computers appear desirable, perhaps essential. Computers, however, offer an unprecedented degree of surveillance and control of the individual student. This will facilitate the school's attempts to help the student's progress, but also presents an invasion of privacy and an expropriation of individual responsibility that may actually hinder achieving the goals of education.

15.2: Computers for Court Records and Administration

R. F. C. Hayden
Superior Court of Los Angeles County, Pasadena, Calif.

This paper describes a study made for the Los Angeles court for the processing of its data. The goal is statistical data of the court's operations, and information of potential value to behavioral science researchers, as well as specific information about parties to adjudication, witnesses, attorneys, judges, jurors, etc., presently unavailable because of indexing limitations. The study is now being considered by the judges, and partial applications have been instituted.

15.3: Computer Applications at the Frontiers of Biomedical Research

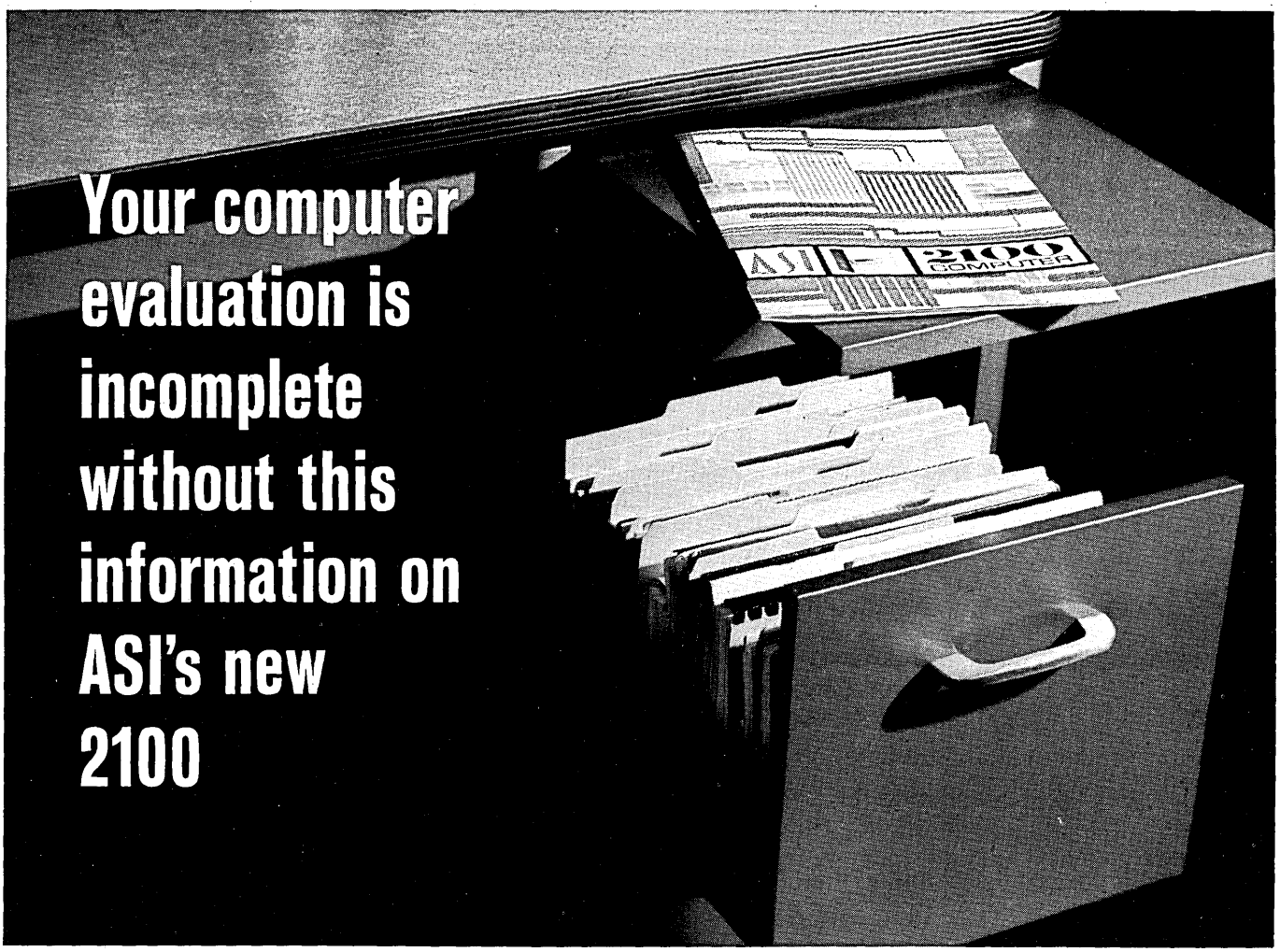
W. R. Adey, M.D.
Brain Research Institute, Univ. of California, Los Angeles, Calif.

In recent years, collaborative research between life scientists and mathematicians in common research programs have been initiated. These ventures in common research offer the prospect of sizable increments in the states of the art of both biological and applied mathematical fields. Such developments, the author states, can be discerned in current neurophysiological and psychophysiological research. Establishment of realistic models of information handling processes in brain systems, for example, may initiate development of distributed memory devices, and lead to a significantly deeper comprehension of processes governing individual interactions in a social environment.

15.4: A Proposal for a Scientific Computer-Oriented Project on World Peace Research

L. Fein
Consultant, Palo Alto, Calif.

The author describes a peace-research program to find both the conditions under which people will live at peace with each other, and feasible ways of attaining those conditions.



These are the basic facts:

SPEED. ASI 2100's balanced-computer design optimizes system performance. It has a 2 microsecond cycle time, 4 microsecond add, 30 microsecond multiply and a 500 KC I/O word rate.

STANDARD FEATURES. Included at no additional cost are double precision hardware, priority interrupts, multiple levels of program execution, three index registers and indirect addressing.

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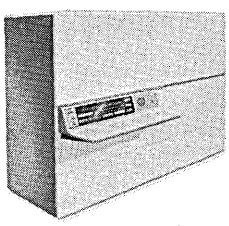
ASI  2100 COMPUTER

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CIRCLE 26 ON READER CARD

New heavy-duty printer for 8-level systems

Here is the new Teletype Model 35 printer. It offers a range of features that will bring new flexibility and improved efficiency to your communications and data handling systems:

☐ 8-level permutation code is compatible with many computers and data handling systems. It also provides extra code combinations for programming purposes.

☐ 4-row keyboard eliminates shifting for figures and common punctuation marks. This saves key strokes, cuts errors, and makes every typist a potential operator.

☐ available automatic character generator can serve as a station identification device—or print out 20 characters of other repetitive data at the touch of a single key.

In addition, the Model 35 is equipped with the Teletype "stunt box," a versatile remote control device. Optional features include a sprocket-feed platen for handling continuous business forms, vertical and horizontal tabulators, automatic feed-out for completed forms, and many others. Speed is 10 char/sec. Input is from local keyboard or line signals.

The "35" is available as a send-receive printer (shown), as a receive-only printer, or as an automatic send-receive set with facilities for punching and reading paper tape.

For additional information, contact: Teletype Corporation, Dept. 81K, 5555 Touhy Avenue, Skokie, Illinois.

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

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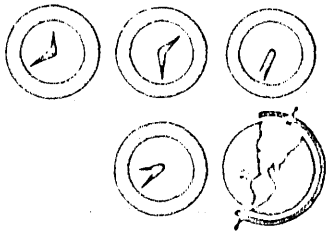
CIRCLE 27 ON READER CARD



NEWS BRIEFS

P-B AND COMPUTER PRODUCTS ANNOUNCE HYBRID PACT

Following closely a similar agreement betwen Electronic Associates Inc. and Computer Controls Co. (see August **Datamation,** p. 67), Packard Bell Computer and Computer Products Inc. have announced an agreement on the joint manufacturing and marketing of hybrid computing systems. Primary emphasis will be placed on the PB 440, a dual-memory, stored logic machine, and the Mark III analog device produced by the South Belmar, N.J. firm. The linkage system will be supplied by Packard Bell.

The firm reports 10 orders in house for the 440, with first delivery scheduled in November. Packard Bell Computer is also scheduled to move into its new headquarters facility in Santa Ana, Calif., before year-end.

RCA SELLS SAN FRANCISCO SERVICE BUREAU TO BANK

The last bank of its size in the state to step into a computerized system took a deep plunge when the First Western Bank and Trust Co., Los Angeles, Calif., purchased RCA's three-year-old San Francisco service bureau. The package deal includes the addition of a 301 to the 501 already there, and the equipping of a mirror installation in Los Angeles in mid-'64. Although no price was announced, equipment value alone was said to exceed 2.5 megabucks.

Both centers will, in time, be handling the bank's own dp, serve its banking customers, and operating a service bureau. The ninth largest bank in California, First Western ranks 49th in the U. S. by deposits. The installation manager in San Francisco is Nicholas Magnis, who headed the center for RCA.

1107-CONTROLLED TRAFFIC SYSTEM ENDS FIRST PHASE

Completion of the first phase of Toronto's traffic control system has been announced by Univac, whose 1107 synchronizes 100 traffic signals in response to vehicle flow. Scheduled for completion by January 1965, the system eventually will control signals at 1,000 intersections in the 13 municipalities which comprise Metropolitan Toronto, Canada.

Using street-imbedded magnetic sensors, on-line with the computer via telephone lines, the result so far has been a reported 28 per cent reduction in congestion in the morning rush hours, and an increase in average auto speeds from 12-13 mph to more than 16 mph. A typical signal-control sequence, from traffic flow data to computer response, is repeated every two seconds.

C.E. & SOFTWEAR SOFTWARE, FLOWCHART DRAWER DEBUT

IBM has announced a program which enables civil engineers to state problems in their own professional language, an inventory control program for apparel manufacturers, and a programming system which enables a 7074 to draw flowcharts. The latter, called AUTOCHART, can include 50 flowchart blocks in 10 rows of five column each, with descriptive material in appropriate blocks. Best available paths for flowlines reportedly are determined by the program, and connectors generated if no clear paths exist.

For the apparel manufacturing business, a software package combines six basic functions – from order entry to inventory control and production scheduling – with a 1440, 1401, or 1410 and random access file.

COGO I (COordinate GeOmetry) is said to enable civil engineers who are unfamiliar with programming languages to solve complex geometry problems on a 1620. It is applicable to most phases of horizontal geometrical design and a range of engineering design problems.

MOVIES BY 20th CENTURY BOX: COMPUTER, OFF-LINE CRT

Animated movies for orbiting satellite research are being made by Bell Telephone Labs with an IBM 7090 and an off-line S-C 4020 recorder. The films are enabling scientists to see both the complex motions of a satellite tumbling through space and results of mathematical research in visual form.

Programmed by Dr. E. E. Zajac of Bell's Mathematics & Mechanics Re-

NATIONAL STUDY PROFILES ACM PROGRAMMERS

A sampling of 549 programmers from among 2,700 selected at random from the ACM files shows that 58 per cent hold bachelors degrees, 30 per cent have masters, and four per cent PhD's. Most of the respondents (54 per cent) are in the $8-12,000 salary range, and the largest group (66 per cent) is in the 26-35 age bracket.

The recently-published study was made by the consultant firm of Deutsch & Shea Inc., New York, which admits that "the sample involved is not representative of the total population in the sense that it is skewed, by virtue of its source, toward programmers with experience in the scientific aspects of programming. For the same reason, the respondents may represent a somewhat more highly motivated group, with regard to their profession, than would programmers who are not members of a professional society."

Most respondents to the questionnaire work in more than one area, such as business and scientific, or systems and applications programming. More than 43 per cent are with firms engaged primarily in scientific-engineering programming, 11 per cent primarily business programming, and 41 per cent doing both. California had the most respondents (164), followed by New York (78), New Jersey (33), and Massachusetts (31).

Almost 45 per cent had worked as a programmer for only one company, and 32 per cent for two companies. Length of service with present company: 49 per cent said one-four years; 23 per cent, four-six years, and 14 per cent, less than one year. Most pressing programming problem in next five years? Applications and techniques, said 53 per cent; personnel, 34 per cent said; languages—25 per cent.

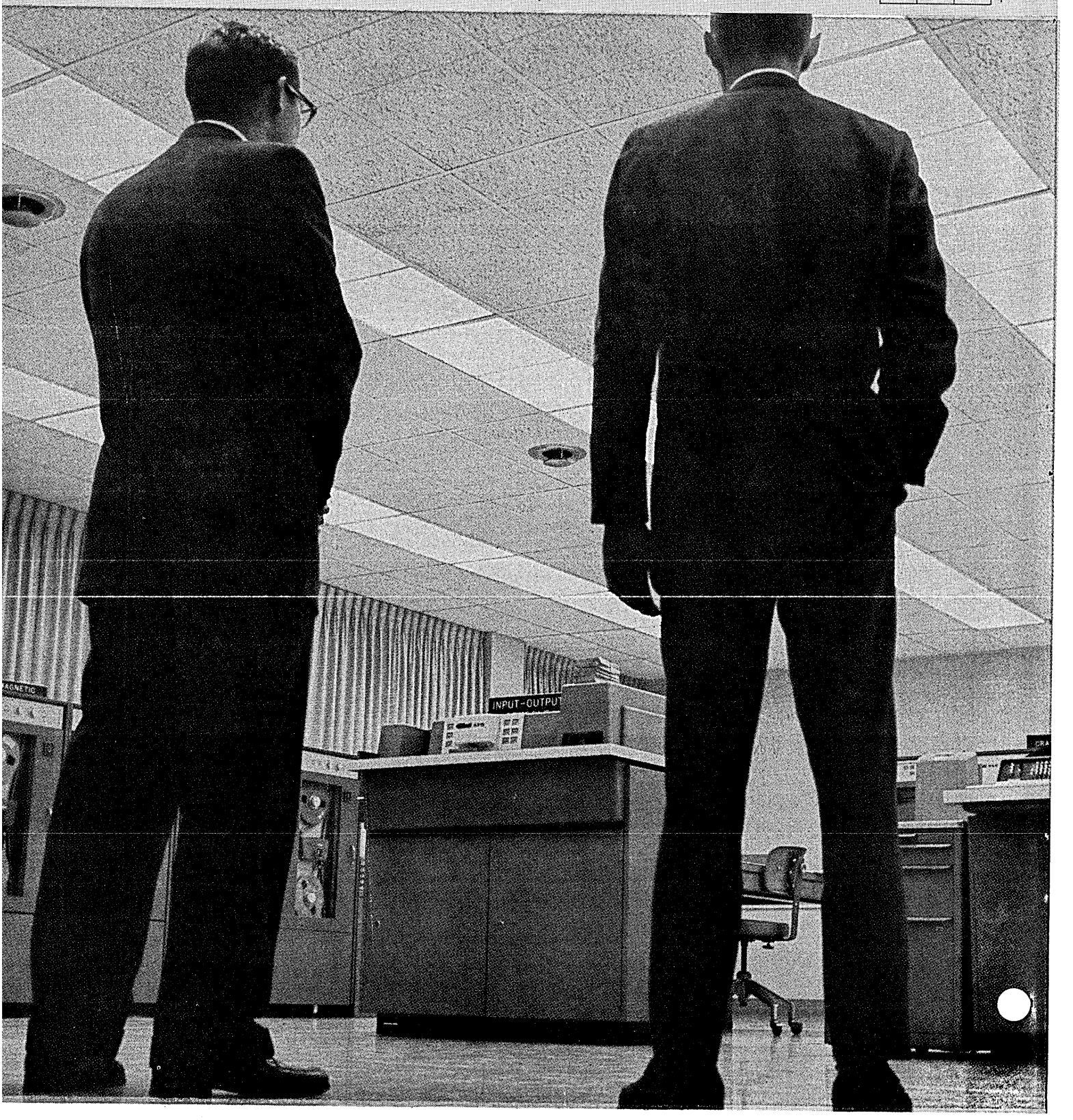
MAKE YOUR NEXT STEP A BIG ONE

STEP INTO WORLDWIDE BUSINESS AUTOMATION WITH NCR, LOS ANGELES

If you want to move ahead in digital systems, go where the footing is solid, the direction forward. Thanks to the success of the NCR 315 Electronic Data Processing System and the CRAM magnetic-card concept in random-access memories, National's Electronics Division has tripled in size in less than three years.

At NCR, you can make original contributions in the most advanced areas of digital technology, creating business systems for use in 120 countries. You can step into a life where independent, searching minds find greater nourishment and reward—where there is no compromise between career values and living values. Why not take that step now?

NCR



search Center, the 90 generates data for describing sequential perspective drawings of a satellite's position and attitude. Line drawings are then projected on the face of the 4020's CRT, and photographed by a movie camera. A simple movie of a satellite required about three-eight minutes of computer time for one minute of movie at 16 frames per second.

Movies made by the 20th century box are applicable to other sequential events, such as simulation of shock waves and explosions, and missile trajectories.

LIVERMORE 3600 INSTALLED, MORE GOING IN ABROAD

A $3-million CDC 3600 has been installed and accepted by the Lawrence Radiation Lab. of the U.S. Atomic Energy Commission. The 3600 joins a 1604-A installed in April; they will be joined in February by a 6600.

Meanwhile, CDC announced that a 3600 system has been ordered by the Institute for Atomenergi and the Norwegian Defence Research Establishment, both in Kjeller, Norway. Another 3600 is scheduled to go on the air at SIA (French management consultant firm, and a subsidiary of SEMA) in November. To be used for a service bureau, the 3600 includes 65K core and 16 tapes.

$500K AUSTRALIAN CONTRACT TO SMITH CORONA MARCHANT

A $500K contract for 100 model 2215 Typetronics has been awarded SCM by the Australian Commonwealth, which will use them at their two CDC 3600-centered dp networks at the Commonwealth Scientific and Industrial Research Organization and at the Bureau of Census and Statistics (see Sept. **Datamation,** p. 19). The order supports rumors that the two 3600 installations will be completely paper tape oriented.

PDP-5 IS THIRD COMPUTER BY DIGITAL EQUIPMENT

The third gp computer by Digital Equipment Corp., Maynard, Mass., is the PDP-5, a small-scale, parallel machine with a six usec memory access time and an 18 usec add time. The basic system consists of a central processor with 1K or 4K (12-bit) words of core, paper tape reader, and I/O control. Other features include indirect addressing and program interrupt.

The memory addressing scheme uses the "page" concept, each page consisting of 128 words. A directly addressed memory reference instruction may refer to either Page 0, or the page on which the instruction is located. Thus, any instruction may directly address 256 words of memory. All other portions of memory are referred to by indirect addressing (a full 12-bit word) which enables access to any cell in memory.

Peripheral devices available include mag tape units, CRT, A-D converter, and plotter. The price of a 1K system with an ASR 33 Teleprinter is $24K; the 4K system sells for $27K.

CIRCLE 100 ON READER CARD

● The National Bureau of Standards has developed a "simple, inexpensive" analog computer which computes the radial characteristics of inhomogenous arcs and flames. Constructed largely from inexpensive commercially available components, the computer is said to be accurate to within five percent.

● Five small Ohio banks with combined assets of $75-million have formed a data processing cooperative, Financial Computer Services, Inc., in Fremont, Ohio. The co-op will install a Burroughs B 270, including sorter, 700 lpm printer, card reader and three tapes, in February, '64. S. N. Woodard, president of the new venture, feels it represents a way for small banks to compete with big city banks.

● Educational institutions can get a reconditioned LGP-30 now for $18,000, under a new plan announced by its manufacturer, General Precision, Inc. Similar machines for non-educational institutions cost $24,500. Thus a school can get an LGP-30 for approximately the same price as an LGP-21.

● "Operations Central," (AN/MSQ-19) – an electronic military command post – has been turned over to the U.S. Army's Fort Monmouth Laboratory for acceptance testing by Philco's Aeronutronic Div., which developed it in conjunction with the Army's Electronic Research and Development Laboratory. The project is under the general management of the Command Control Information System of the U. S. Army Electronics Command.

CIRCLE 76 ON READER CARD →

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

ELECTROCHEMICAL ADDITION

1 + 1 = 2

Electroplating is a well known process [illegible]

[illegible]

to better understand particular [illegible]

[illegible] action of organic addition agents [illegible] an organic leveling agent in a plating bath [illegible]

[illegible] adsorbed on the peaks of the surface [illegible]

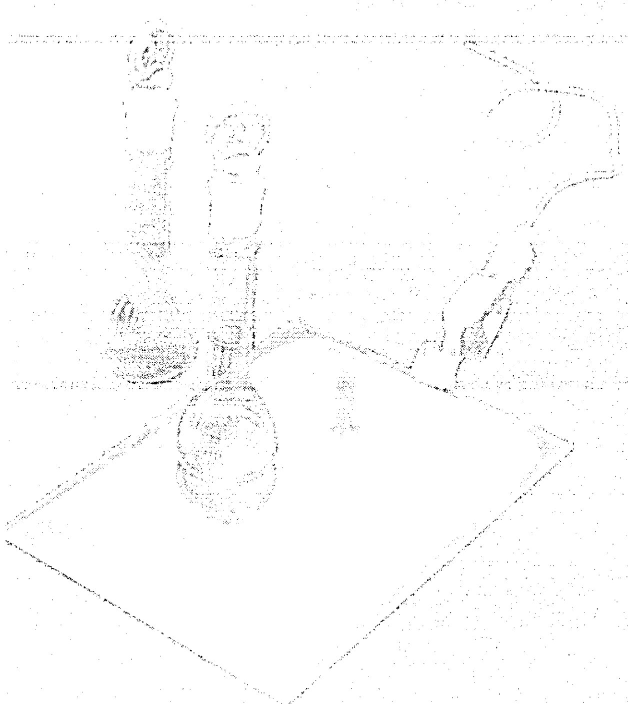
[illegible] Then add another leveling [illegible] even more adsorption [illegible] Most leveling [illegible]

[illegible]

into matters of ion and atom bonding and bond breaking subjects typical of persistent basic research in General Motors

General Motors Research Laboratories

[illegible], Michigan



PROGRAMMERS
SYSTEMS
ANALYSTS

Melpar, a leader in electronics research, development and manufacture is undergoing full scale conversion to EDP which has created openings for Programmers and Systems Analysts for Business and Scientific Systems with experience in the following:

- **Accounting Systems**
- **Production Control Systems**
- **Material Control Systems**
- **Scientific and Research Application**
- **Fortran Machine Language Applications**
- **Real-Time experience for closed loop man-machine system**

Requirements include experience on IBM 1401, 1410, 700, SDC 910, 920, CDC 160, 160-A, PB-250 series equipment and two or more years' experience in analysis of problems, block diagramming, flow charts and checking of coding for reliability. A degree is desired.

Additional experience is desired in the design of clock controlled programs, executive control techniques and minor cycle programming with a basic understanding of computer operations.

For an expense paid visit, send detailed resume to:

JOHN A. HAVERFIELD
Manager—Professional Placement

MELPAR INC

A Subsidiary of
Westinghouse Air Brake Co.

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(a suburb of Washington, D. C.)

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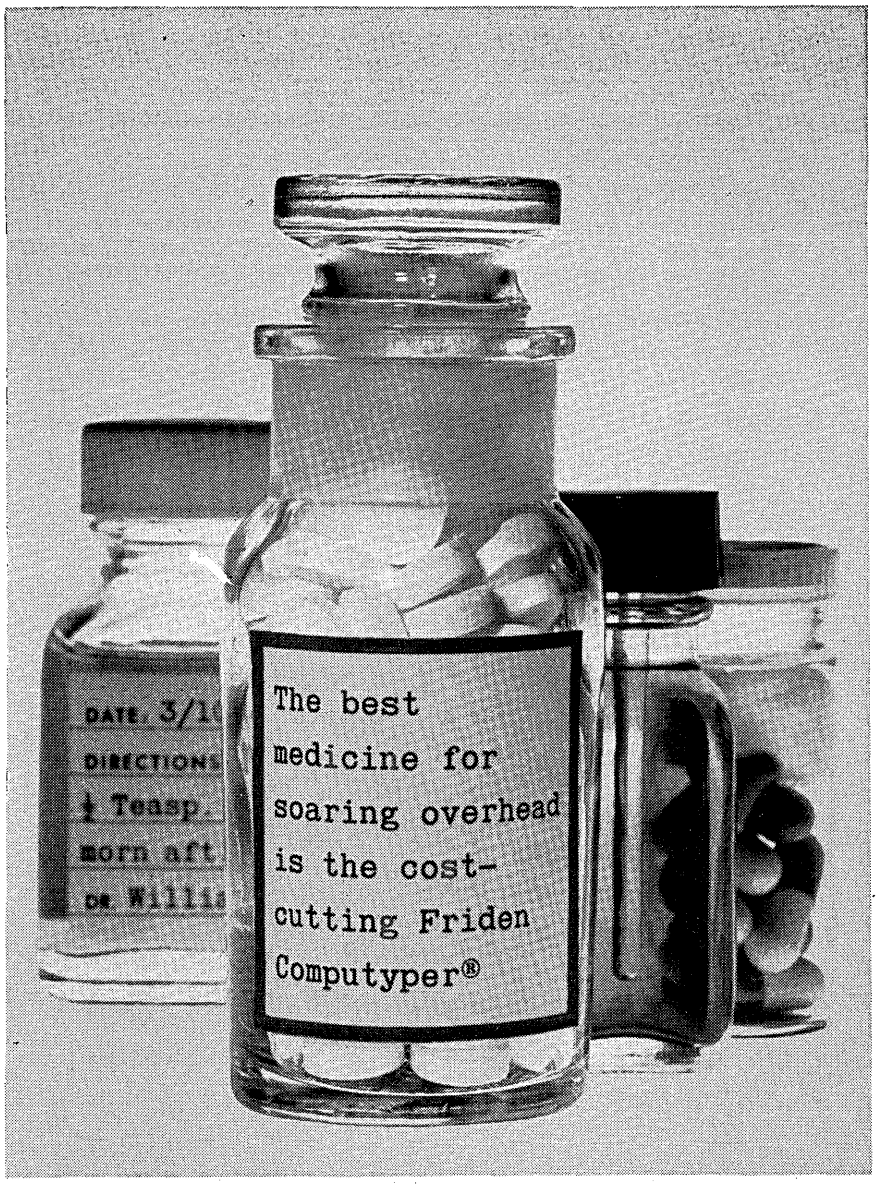

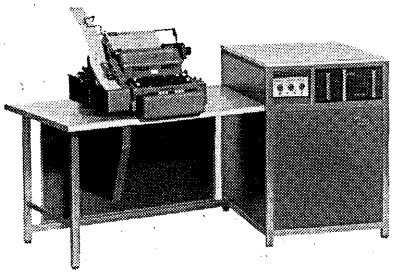

We know what ails many businesses: *the high cost of paperwork.*

The high cost of typing and figuring invoices, purchase orders, sales orders, statements, and similar work.

We know the cure, too: The Friden Computyper, the *automatic* typing and figuring machine.

The Computyper reads data from punched paper tapes, edge-punched cards, or tab cards. Simultaneously it turns this data into complete invoices, purchase orders, or other similar documents. Almost everything is done *automatically.*

The Computyper does more. While it types and computes an invoice, it creates a by-product punched tape that in turn prepares an accounts receivable register. While the Computyper writes purchase orders, it creates a by-product punched tape that will prepare an accounts payable report. While the Computyper automates one office function, its by-product tapes automate others.

That's how to cut costs. Easily. Permanently. The Computyper is inexpensive to own, easy to operate.

For full details on how the Friden Computyper can cut *your* soaring overhead, call your local Friden Systems man. Or write: Friden, Inc., San Leandro, California.

This is practical automation by Friden—for business and industry.

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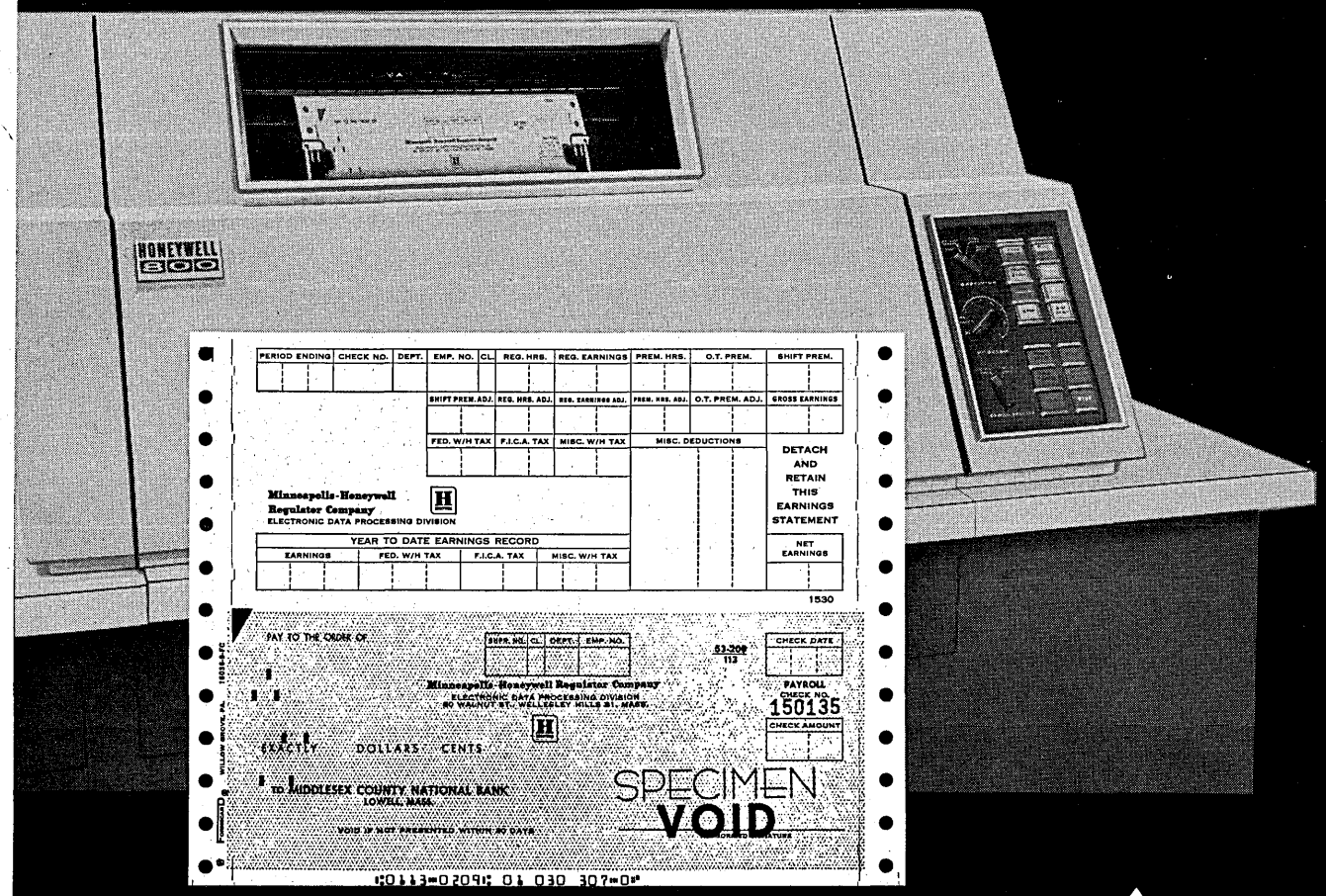
Sales, Service and Instruction Throughout the U. S. and World

CIRCLE 29 ON READER CARD

FOLLOW THE LEADER
with
FORMSCARD®

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

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



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

Forms inc

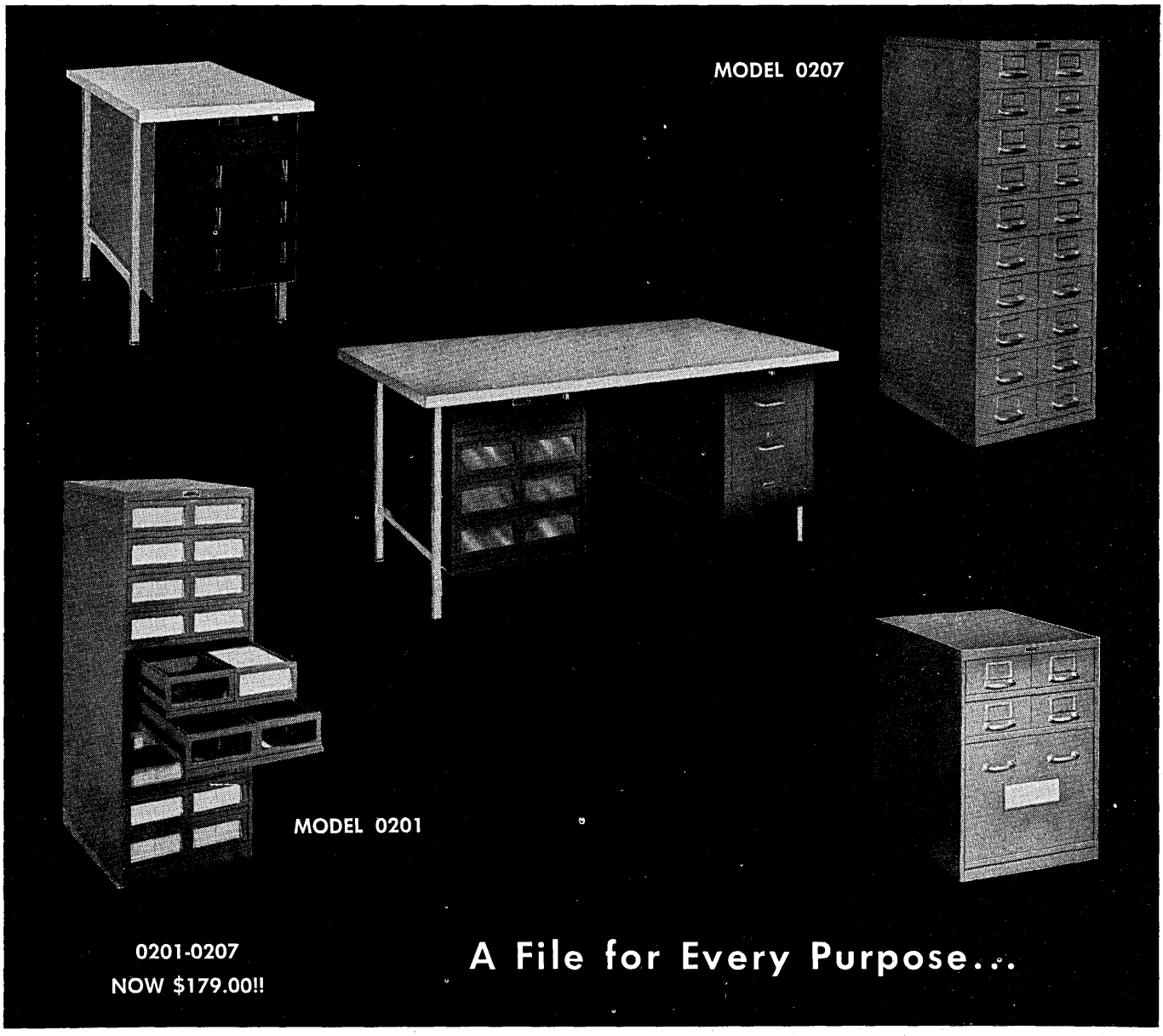
Phone: OLdfield 9-4000/Area Code 215 • Willow Grove, Pa.

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

CIRCLE 30 ON READER CARD

DESIGN

makes the difference*



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

SYSTEMS SALES COMPANY
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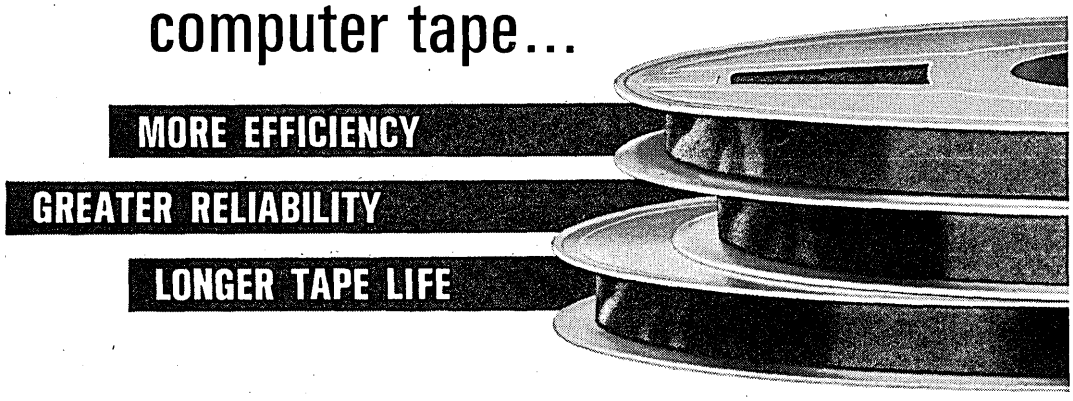
— Finest Quality Data Processing Accessories Since 1945 —

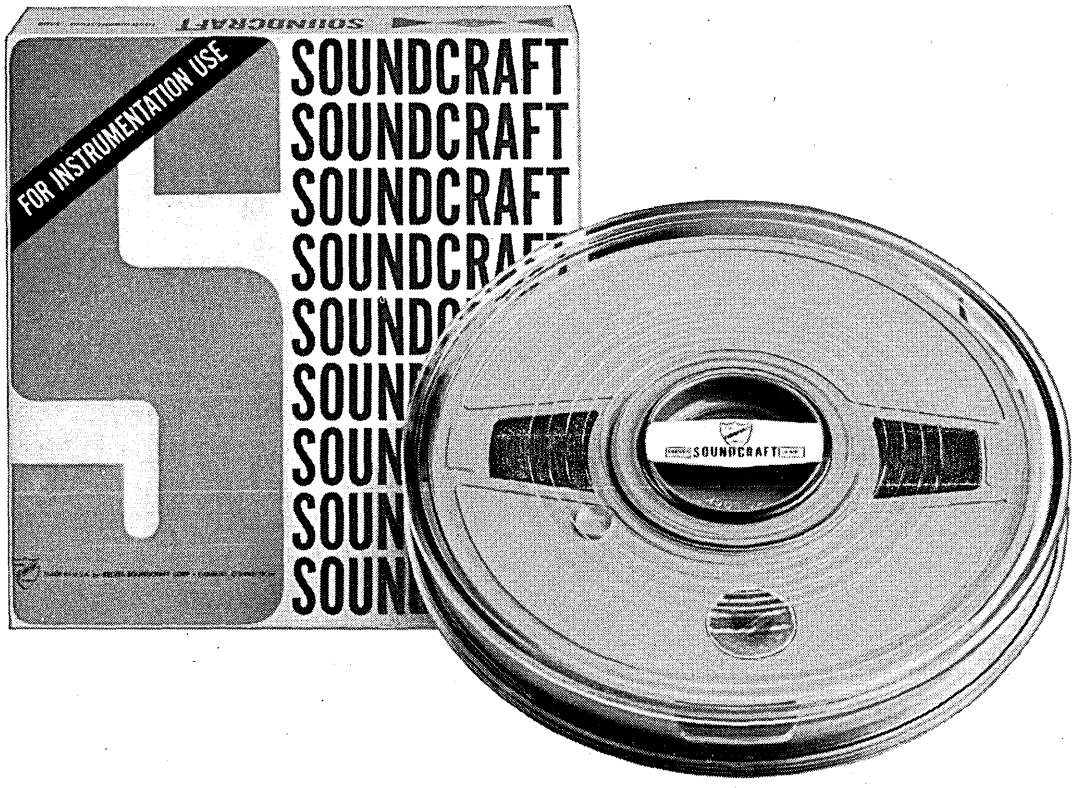
CIRCLE 31 ON READER CARD

R-216

To get all this with your computer tape...



switch to this!



Soundcraft Computer Tape is engineered to give you improved performance in your computer installation. To insure absolute coating depth uniformity, Soundcraft "re-faces" the durable Mylar* base. Micro-plating, an exclusive (*and completely new*) Soundcraft process, produces the smoothest surface found on any tape today. The result: a long-wearing, non-shedding, non-abrasive tape with greatly improved head compliancy—for flawless data recording. Available in Heavy-Duty and Regular Wear, 100% Pre-Tested at 800 or 556 bits per inch. Write for data.

*DuPont T.M.

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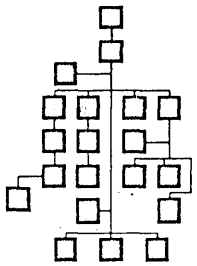
CIRCLE 32 ON READER CARD



people IN DATAMATION

■ Consultant-author-humorist Jackson W. Granholm has joined Informatics Inc., Culver City, Calif., software-systems company, as vp for Technical Communications. He was formerly president of Mellonics A-V Inc., Tucson, Ariz., and an independent consultant. With this newly-created position, the firm will offer audio-visual solutions to technical presentations and reporting.

■ Howard Bromberg has resigned his position as administrator, Advanced Programming Languages at RCA-EDP to join CEIR Inc. as manager of sales to major equipment manufacturers. He was also elected chairman of the Joint Users Group at the recent ACM meeting in Denver.

■ Robert S. Gilmore has been elected international president of the Data Processing Management Assn. He had been a member of the international executive committee for four years. Gilmore is vp and general manager of Information Inc., Torrance, Calif.

■ Announcement has been made of the appointment of Herbert R. Koller, as chairman of the '64 Spring Joint Computer Conference. He is a senior member of the staff of the Office of Research and Development in the Patent Office, where he has been involved in IR research since 1949. Koller was an organizer and past chairman of the ACM's special interest committee on IR, 1962 ACM national lecturer in IR, and 1963 member of the ACM visiting scientists program. He was secretary of the 1961 EJCC.

■ Thomas H. Murray Jr. has been named vp and general sales manager of Dura Business Machines Inc., Madison Hts., Mich. He was previously associated with Friden Inc. and Burroughs Corp.

■ Robert N. Kisch has been elected vp, and retains his position as general manager of the Computer Div. of Control Data Corp., Minneapolis, Minn. He joined the firm in 1957.

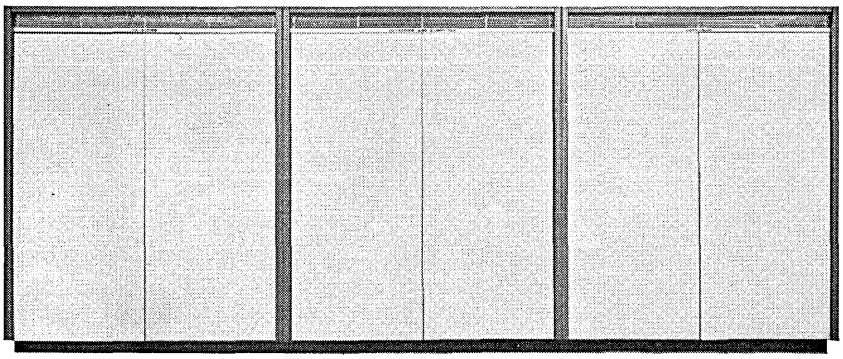
■ John S. Sayer has been elected vp of the Auerbach Corp., Philadelphia, Pa. He is director of the Management Sciences Div. Before joining the firm in 1962, he was executive vp and general manager of Documentation Inc., Washington, D.C.

■ The former director of systems engineering programs for IBM, Dr. Bruce Gilchrist, has been named special assistant to the president of Service Bureau Corp. He joined IBM in 1959.

Henry J. Stewart has been promoted to manager of advanced systems marketing programs for the Federal Systems Div. of IBM.

■ Dr. Abraham Franck has joined Fabri-Tek Inc., Minneapolis, Minn., where he will be responsible for the planning and development of systems applications of memory systems. He was previously associated with Univac and Tronchemics Research Inc.

ANOTHER
NEW
PRODUCT
FROM
DAYSTROM



636

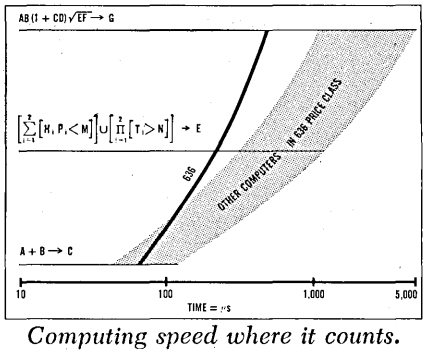
the full-size computer that doesn't limit your problem-solving capability

Here is the general purpose computer specifically designed to meet the challenge of today's complex computing applications. In fact, the more complex the problem – the more you need the 636.

If you have ever outgrown a desk-top or medium-size computer, you already realize how complex even the apparently "simple" jobs can become. A case in point: Daystrom's last 15 on-line computer applications averaged 22,000 words – considerably more than the maximum capacity of smaller computers in the 636 price class. For on-line applications, the 636 can be expanded to 294,912 words, more than ten times this average.

Optimally designed for real-time data acquisition and control, the 636 also has the greatest, most economical expandability for off-line use in its class. Consider the 636 for any of these applications: on-line monitoring and control . . . off-line conversion . . . engineering and scientific problem-solving . . . telemetering . . . any application requiring a full-size computer.

Compare these sample 636 features to any other computer in its price class. ✶ Unlimited number of elapsed time counters. The 636 utilizes any number of memory cells as elapsed time counters without program intervention. ✶ Wide range of instructions – 131 including partial operand, square root, Gray-to-binary, 45 branches, 15 Boolean algebraic logic manipulations. ✶ Direct access to memory. Direct communication between the core memory and peripheral devices gives advantages of multiple computer installations. For example, the following functions can be executed in parallel with the normal program *without any loss of computer time:* random event counting . . . elapsed time counting . . . reading and writing on the auxiliary drum . . . reading and writing on magnetic tape . . . acceptance of digitized data up to 880,000 bits/sec. . . . direct drive of output devices and displays at the same rate. ✶ Ten programmable registers, including two additive index registers and an operand address register. ✶ Sorting of an infinite number of events on a priority interrupt basis. ✶ Expandable memory: core up to 32,768 words – auxiliary drum to 262,144 – tape up to 32 tape handling units. ✶ **Basic 636: $95,000.**



Computing speed where it counts.

Get this comprehensive booklet on the 636 by circling the reader service number, or call your local Daystrom office.

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CONTROL SYSTEMS DIVISION
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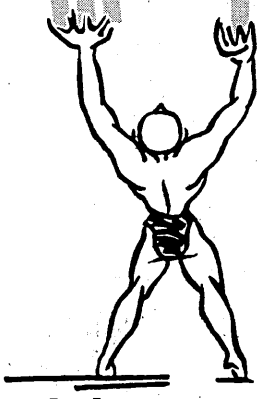
CIRCLE 34 ON READER CARD

PRINTING alignment



with a dsd 1260

HIGH-SPEED PRINTER

No need to shut down this high-speed data processing printer to adjust character-to-character vertical alignment. Alignment is ELECTRONICALLY controlled from the front panel while the printer is operating at a speed which in most applications almost DOUBLES THE DOCUMENT RATE of presently available printers.

PARTIAL SPECIFICATIONS

Printing Speed	1200 lines/min.
Skip Rate	60″/sec.
Form Width . .	3″ minimum
	22″ maximum,
	132 columns

Presently being demonstrated at

dsd DATA SYSTEMS DEVICES OF BOSTON, INC.

342 Western Ave., Boston 35, Massachusetts
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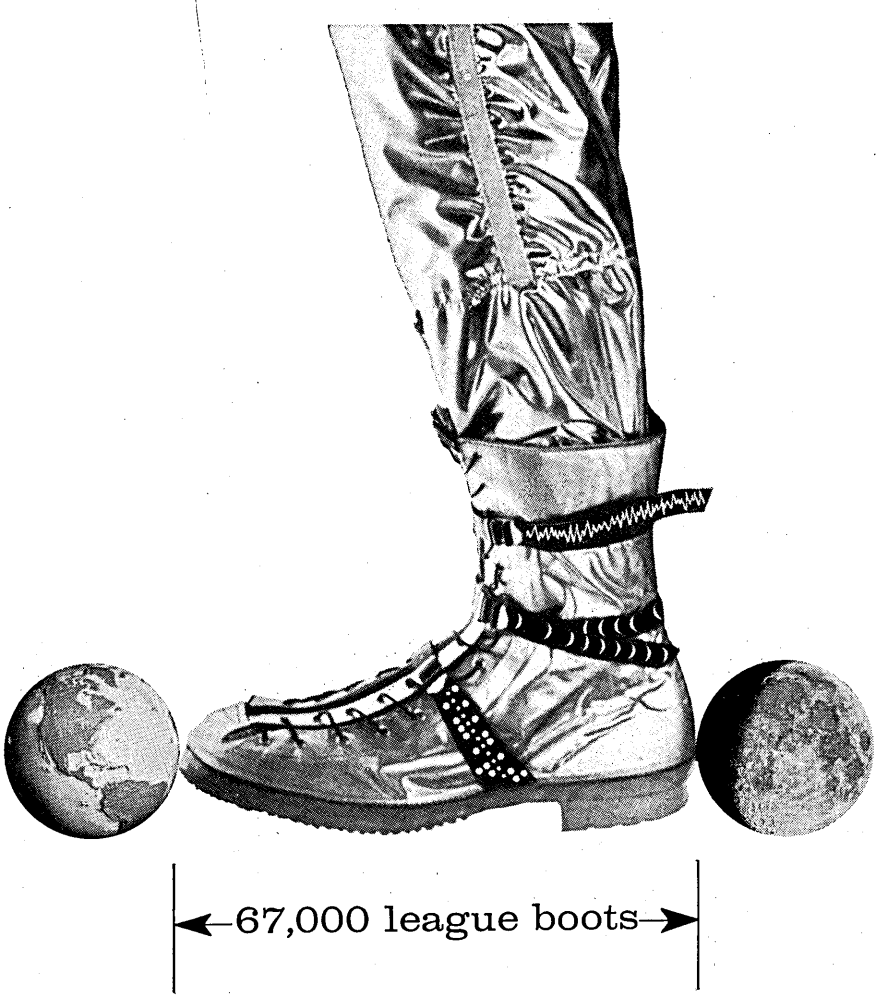
CIRCLE 43 ON READER CARD

DATA HANDLING ENGINEERS



To maximize success of future lunar and space probe flights, in-flight performance data must be conveyed rapidly, accurately, and reliably from vehicle to Flight Control at Cape Canaveral. Planning, systems design, and implementing the required instrumentation systems at range stations and the Cape is the task of Data Handling Engineers with Pan Am's Guided Missiles Range Division.

Prime areas of responsibility are complete systems for data processing and real-time computing, digital data transmission, range safety display, target acquisition, and analog/digital conversion. Engineering study is presently under way on:

- methods of data compaction
- data handling equipment, for radars and telemetry, spanning from Cape Canaveral to the Indian Ocean providing a high-capacity data transmission system with over 3000 bits/sec. and error rate less than 10^{-6} over a 3 kc rf channel
- display systems driven by multiple digital sources for range and missile operations control

If you would like to play an important part in developing this new range technology, write in confidence to Dr. Charles Carroll, Dept. 21-K

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P. O. BOX 4465, PATRICK AIR FORCE BASE, FLORIDA
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CIRCLE 77 ON READER CARD

MAC Panel Heavy-Duty Computer Tape is produced in MAC Panel's own specially constructed research, manufacturing and testing facilities. Every step in the production process is meticulously controlled to assure top quality in every reel. MAGNE-FLO coating, MAC Panel's own gravure process, is just one of these steps developed to give you uniformly consistent signal output and provide superior wear characteristics. Only MAC Panel Computer Tape with MAGNE-FLO coating is produced and thoroughly tested to guarantee a uniformity of signal response from channel to channel, from reel to reel. That's why we can honestly say that MAC Panel Computer Tape is manufactured for performance . . . tested for performance . . . packaged for performance. Ask your MAC Panel representative for the full story, or write for information on how the same high quality standards that made MAC Panel the leading independent manufacturer of control panels have led to the development of computer tape that's guaranteed to give you assured performance every time.

MAC PANEL COMPANY, High Point, North Carolina MAC PANEL
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Representatives throughout the United States, Canada, Latin America and Europe

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Unexcelled Quality in Every Reel

TRW

GIVES YOU

FULL VALUE

SUPPORT SERVICES

An inherently reliable computer
A TRW "Stored Logic" computer has inherently superior reliability because it uses fewer parts. Field experience averages nearly half a year of one-shift operation without trouble of any kind.

Field services
Professional TRW engineers are available for on-call remedial maintenance and regularly scheduled preventive maintenance from regional service centers.

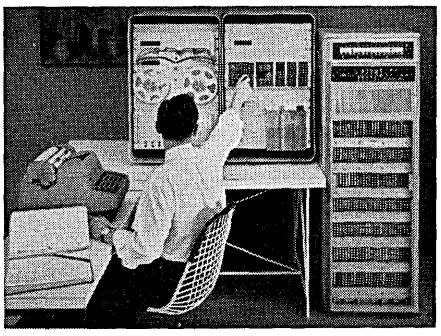
Training and documentation
TRW's training engineers conduct regularly scheduled courses in TRW-230 theory, operation and maintenance. You get expert system applications analysis and full technical manual coverage.

TRW: Dependable excellence
Behind your 230 system is the knowhow and reputation of a respected national corporation dedicated to excellence in advanced technologies and customer services.

TRW-230 "Stored Logic" Multiple Purpose Computer. $2050 per month, including TRW FULL VALUE support services. Full line of peripherals. 60-day delivery.

For details, contact one of our representatives: Atlanta, Boston, Chicago, Cleveland, Houston, Huntsville, Los Angeles, New York City, Rome, N. Y., Washington, D. C.

TRW
230



TRW COMPUTER DIVISION
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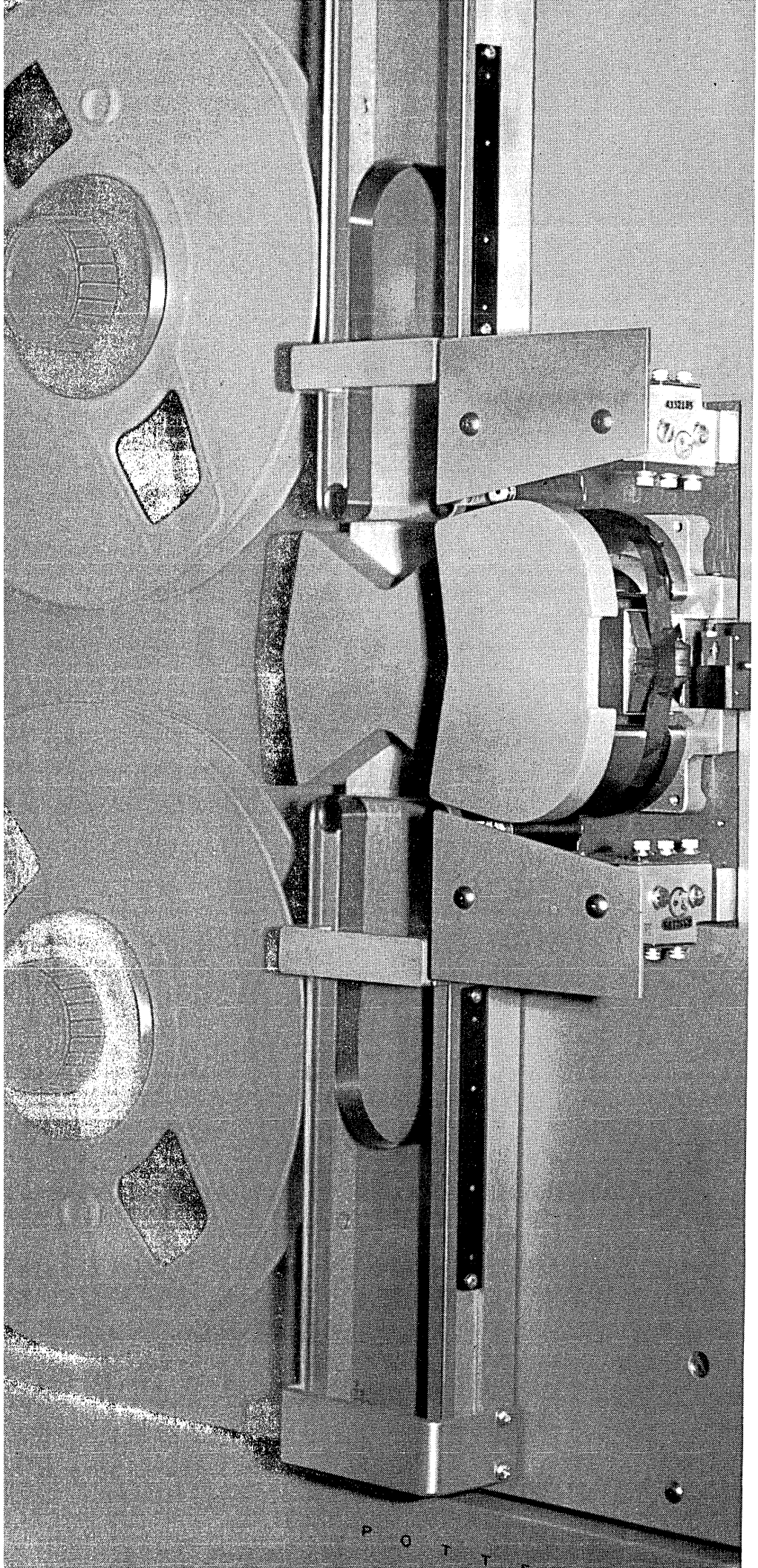
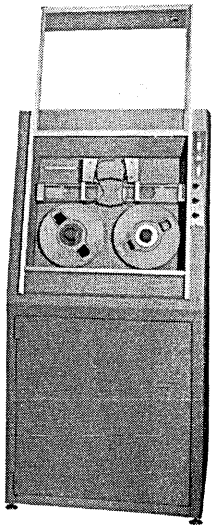
MAC PANEL
←CIRCLE 35 ON READER CARD

CIRCLE 36 ON READER CARD





A very big transport in a 2-foot package

This is Potter's MT-24, a new vacuum column, digital magnetic tape transport which is already proving big in the field. Packed into its mere 24″ height (or length if you prefer to mount it sideways) is all the dependability and performance of tape drives costing over twice as much. Here are the facts:

PERFORMANCE — Read/write tape speeds from 3 to 36 ips, data transfer to 28.8 kc, 200 commands per second. (50 ips and 40 kc performance available in the MT-36 companion unit at very little increase in price!)

RELIABILITY — Use of thoroughly field tested components in combination with new vacuum column construction has resulted in improved transport dependability. Reliability warranted 1 in 10^8 bits read.

COMPATIBILITY — The MT-24 is compatible with IBM's 7330, with packing densities of 200, 556, and 800 bpi. One inch tape and other computer formats are readily accommodated.

ECONOMY — MT-24 (and MT-36) costs less per effective bit transferred than any other transport on the market . . . and with greater operating dependability and data transfer reliability than tape drives costing more than twice as much.

Potter is shipping MT-24's NOW. Delivery within 4 weeks. Want details? Write — Sales Manager.

POTTER
INSTRUMENT CO., INC.
151 Sunnyside Boulevard, Plainview, New York

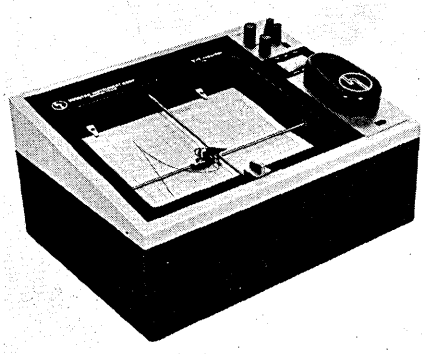
TM.

CIRCLE 37 ON READER CARD

NEW PRODUCTS

t-y servo recorders

These recorders include a null seeking servo which moves an ink pen in proportion to a low level DC signal on the vertical axis and an inexpensive plug-in synchronous timing motor to move the pen from right to left on the vertical or Y axis. Maximum ver-



tical pen speed is 10 inches per second. The HR-80 is designed for 8½ x 11 inch graph paper, and the HR-87 for 11 x 16½ inch paper. HOUSTON INSTRUMENT CORP., 4950 Terminal Ave., Bellaire 101, Texas. For information:

CIRCLE 200 ON READER CARD

random access projector

The 132 is able to locate any requested frame in a 35mm, 100-frame, closed-loop strip film in three seconds or less. The RAP may be operated directly from command inputs including a keyboard, telephone-type dial or rotary switch. MAST DEVELOPMENT CO., 2212 E. 12th St., Davenport, Iowa. For information:

CIRCLE 201 ON READER CARD

scanning and telemetry system

The Fiberscan system features continuous beam control by means of optical fibers. The system can photoelectrically scan aerial films and simultaneously telemeter the information to remote receiver stations in just a few seconds. AEROFLEX LABORATORIES, INC., South Service Rd., Plainview., L.I., N.Y. For information:

CIRCLE 202 ON READER CARD

reader/punch

The 580 and 581 reader/punch stations feature tape tension switches and reverse feed on both reader and punch, tape feed switch on punch, semi-automatic tape loading on the reader. Basic mechanisms share a common housing and motor drive, but are electrically independent. ROYAL MCBEE INDUSTRIAL PRODUCTS DIV., 850 3rd Ave., New York 22, N. Y. For information:

CIRCLE 203 ON READER CARD

portable recorders

The 290 series is a new line of one, two and three-channel portable direct-writing recorders for on-the-spot recording. Using the 290, frequencies of up to 125 cps at pen deflections of 20 chart divisions or more can be precisely recorded. The unit is completely self-contained. AMERICAN OPTICAL CO., INSTRUMENT DIV., Buffalo 15, N.Y. For information:

CIRCLE 204 ON READER CARD

programmer

PLINK is a new computer program for transmitting data over telephone lines in computer-to-computer (1401/1009) link-ups. PLINK has the ability to send both pure binary data and decimal alphanumeric data in binary code in inter-mixed records in the same message. INTERNATIONAL TELEPHONE AND TELEGRAPH CORP., 320 Park Ave., New York 22, N.Y. For information:

CIRCLE 205 ON READER CARD

tape readers

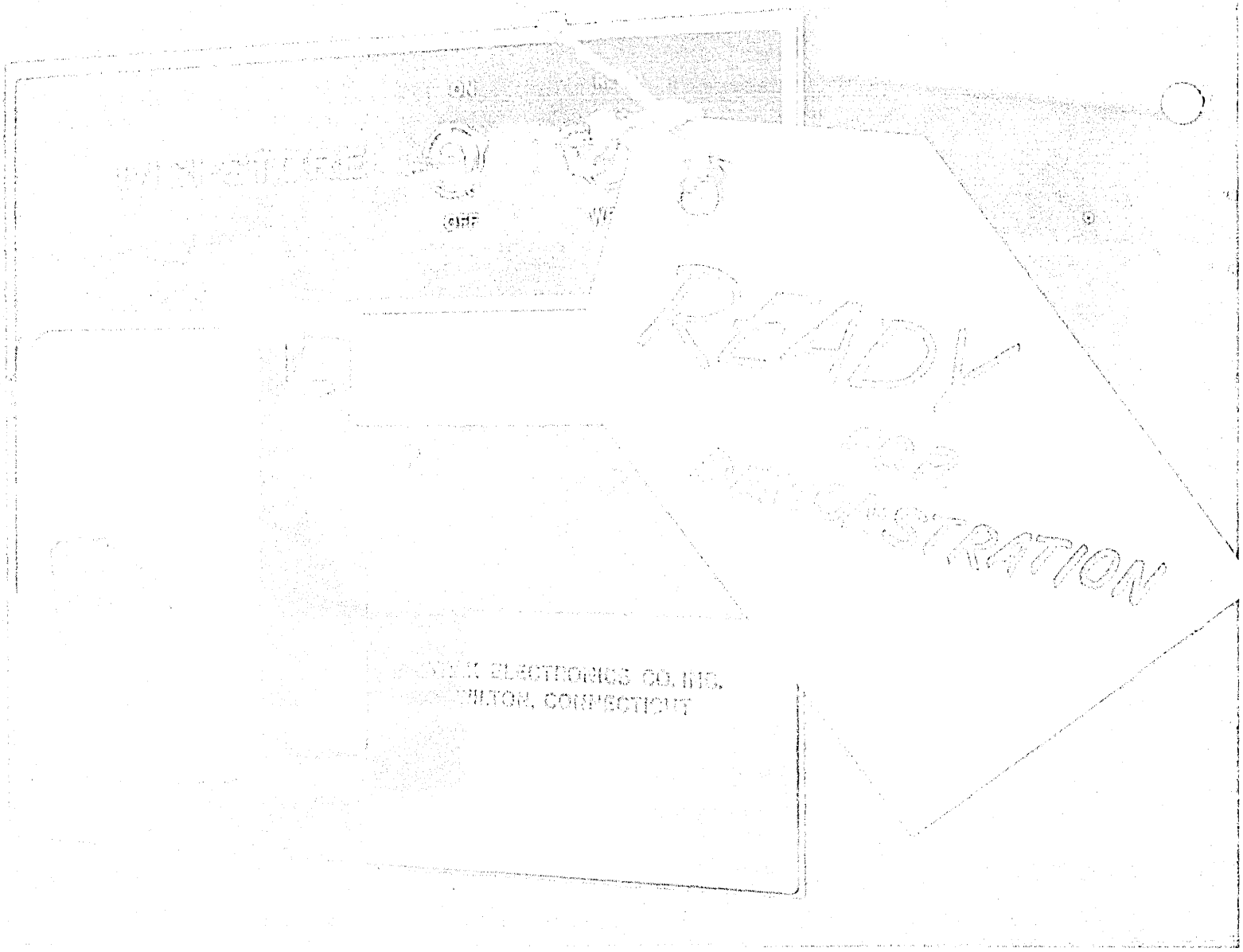
Models PTR-90 and -91 omni-data photoelectric tape readers are able to read all types and colors of paper and plastic tape at speeds up to 1,000 characters per second. The -90 is a

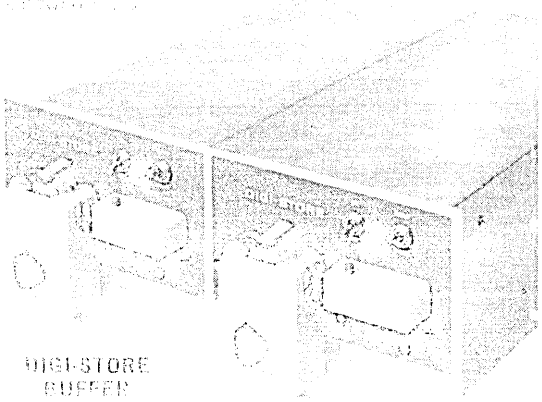
unidirectional reader priced at $1,745; the -91 is a bidirectional reader and is priced at $1,995. OMNITRONICS, INC., 511 N. Broad St., Philadelphia 23, Penna. For information:

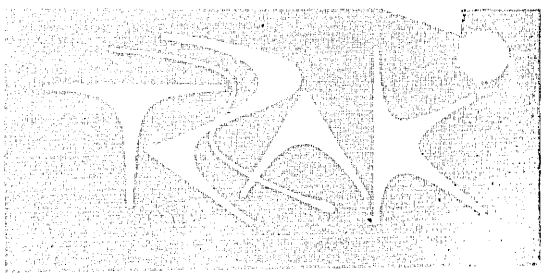
CIRCLE 206 ON READER CARD

software for 400

The PERT 400 for management planning and control and Linear Programming 400 for mathematical computation and analysis have been devised for the 400 computer. HONEY-







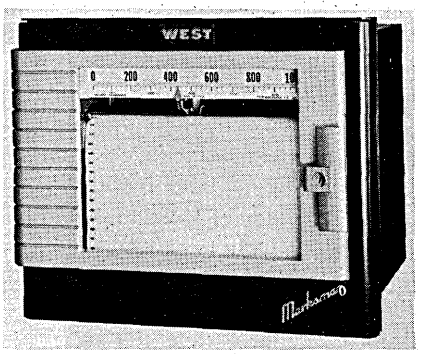
CIRCLE 37 ON READER CARD

NEW PRODUCTS . . .

WELL ELECTRONIC DATA PROCESSING, 60 Walnut St., Wellesley Hills 81, Mass. For information:
CIRCLE 207 ON READER CARD

multipoint recorder

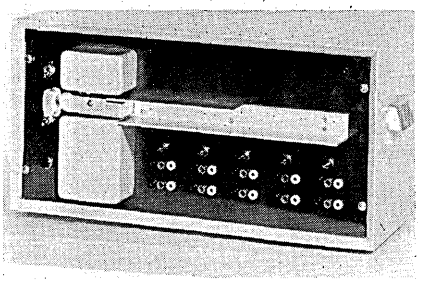
This transistorized universal multipoint recorder, series M2, can record up to 24 points on a 11-inch-wide chart. The M2 can take millivolt or thermocouple inputs and can accom-



modate radiation pyrometers, resistance bulbs, pressure transducers, and thermocouples of any make. WEST INSTRUMENT CORP., Schiller Park, Ill. For information:
CIRCLE 208 ON READER CARD

five channel programmer

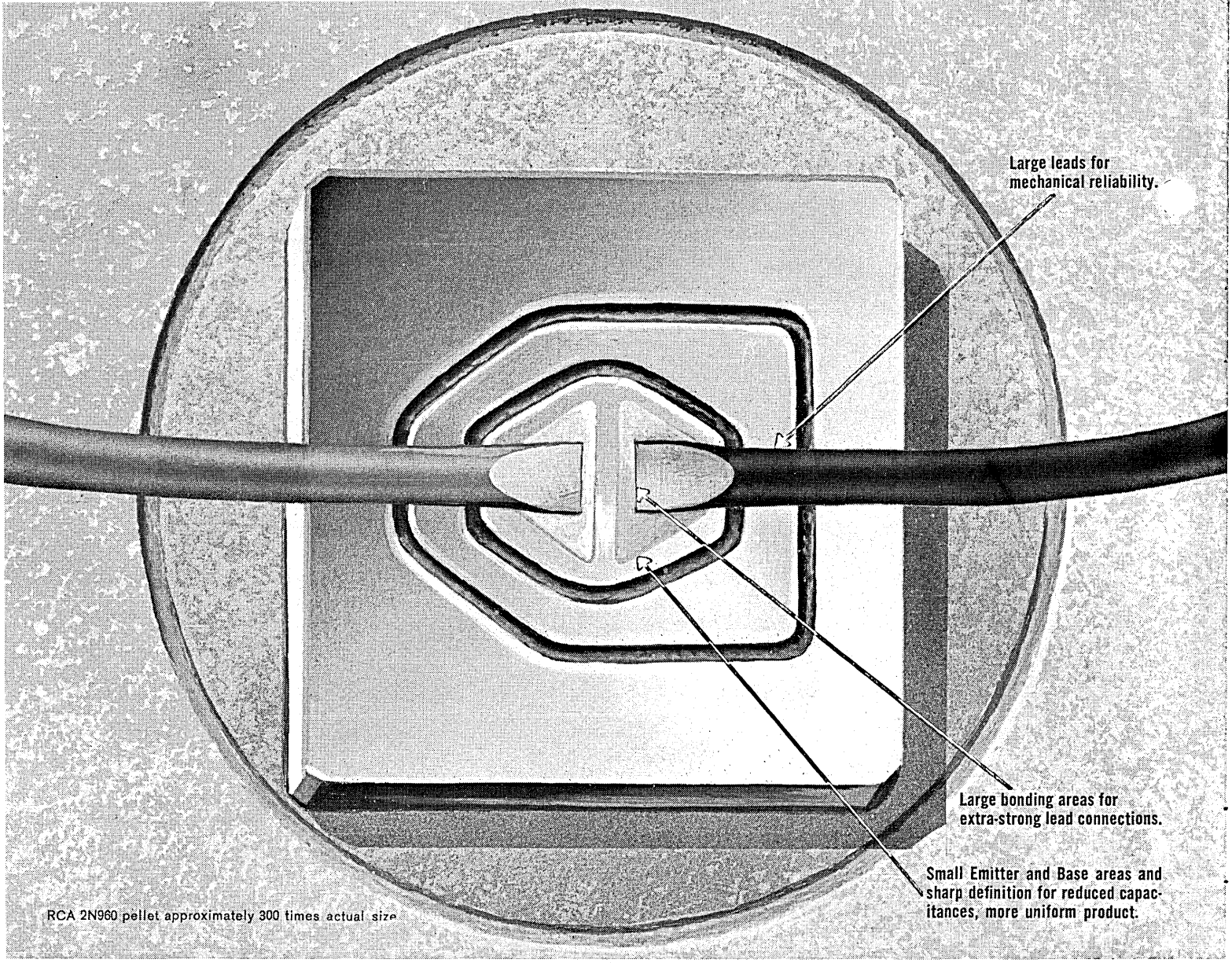
The SM607 is activated by an easily marked, transparent film-loop memory device and can work with all types of equipment and apparatus used in experimental and repetitive testing and process operations. Five separate sets of controls can be op-



erated synchronously with as little as 39 milliseconds between switch activations on each channel. SPACE MECHANISMS, 639 Massachusetts Ave., Cambridge 39, Mass. For information:
CIRCLE 209 ON READER CARD

program for 1410

A PERT time and cost program has been devised for the 1410 which can be used to process networks containing up to 2,000 events. The program is written for a 40K 1410 with on-line card reader-punch and printer with six tape drives. COMPUTER DYNAMICS CORP., MANAGEMENT SYSTEMS DIV., 1104 Spring St., Silver Spring, Md. For information:
CIRCLE 210 ON READER CARD



RCA TRAPEZOID MESA BRINGS NEW RUGGEDNESS TO 2N960 SERIES

RCA develops a new geometry and a new Germanium PNP Epitaxial Mesa Technology for new ruggedness, higher speed and greater unit-to-unit uniformity.

New RCA TRAPEZOID MESAS 2N960-2N967 answer industry's demand for fast and reliable switches. The unique construction developed by RCA increases over-all mechanical and electrical reliability and incorporates all of these design improvements:


TO-18 Package

- Minimum emitter and base area to reduce capacitances
- Minimum distance between base contact and emitter junction to reduce base resistance
- Maximum target bonding area for greater lead size and strength.

All these new design and processing improvements mean improved reliability and better performance. Typical T_{on} values for RCA's 2N960 are 25 nsec (2N960 max. is 50 nsec). For additional information on the new RCA TRAPEZOID MESA family, call your RCA Representative today. Or write: Commercial Engineering, Section CD 10, RCA Electronic Components and Devices, Harrison, N.J.

Available through your RCA Distributor

For a complementary ultra-high-speed NPN type...specify RCA 2N955A

The outstanding features of this 1000-Mc Germanium Epitaxial Mesa Switching Transistor include:

- 6 nsec stage delay in DTL logic circuits...7 nsec stage delay in RCTL circuits...under "worst-case" conditions and with a fan-out of three
- Low stored charge in saturation...45 pC typical
- High dc beta over a broad range of collector currents.

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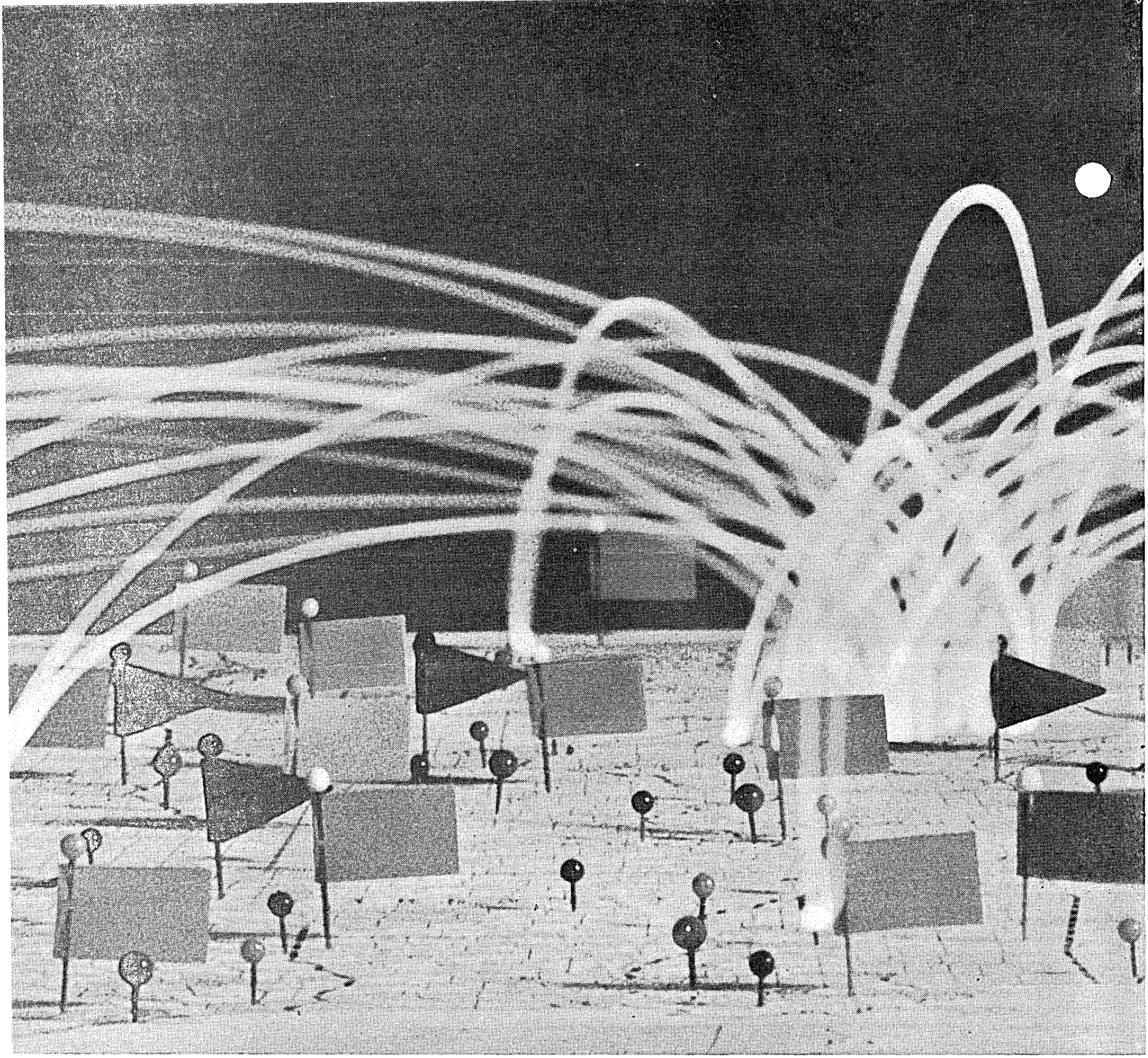
CIRCLE 55 ON READER CARD



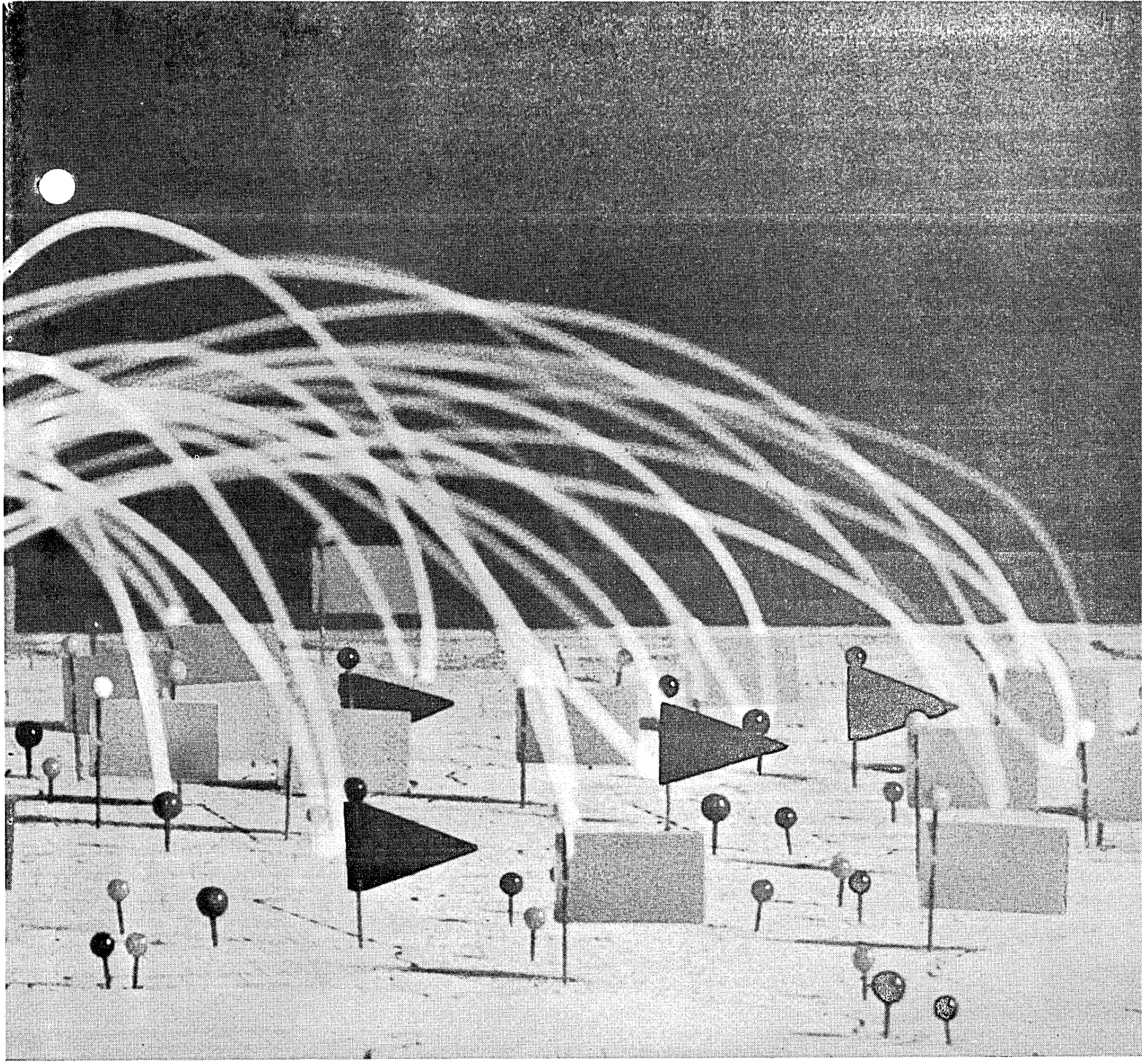
Hot-line for business data – the new IBM 1050 Data

The new IBM 1050 communicates directly with a central computer or with other 1050s over regular communications lines.

It takes punched cards, keyed input, paper tape or edge punched documents...converts to code...transmits 14.8 characters per second. A control unit regulates use of input and output components, provides 2-character address checking, parity checking, longitudinal record checking. The printer used with the 1050 produces a 13-inch line of IBM Selectric® Typewriter quality.

A transmission control unit at the computer sequentially scans up to 112 communications lines, processes high-priority messages immediately.

Write or call any IBM branch office for complete information.



Communications System.

Each 1050 installation may include from one to six input/output devices, including printers, card reader, card punch, paper tape units, keyboard. These easily connected units may be used for local data handling as well as long-distance communication.

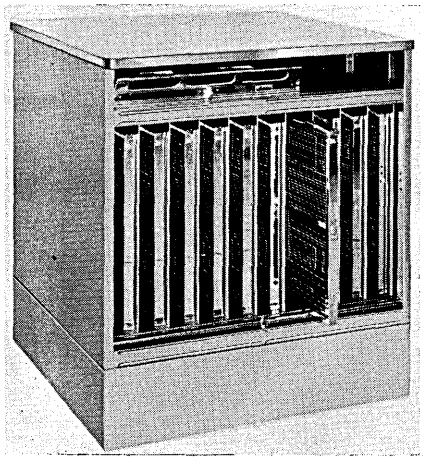
IBM®
DATA PROCESSING

CIRCLE 52 ON READER CARD

COMPONENT PRODUCTS

panel storage cabinet

Model 1155 cabinet has been designed for storage of IBM 407 and Univac 1004 Control Panels. The



panels are stored in a vertical position. SYSTEMS SALES CO., 13 Broad St., Binghamton, N.Y. For information:

CIRCLE 211 ON READER CARD

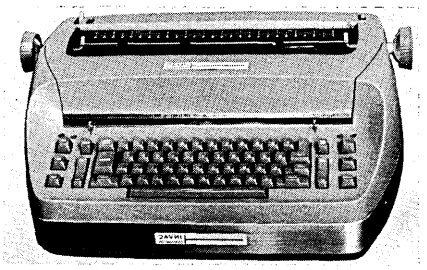
recording-transcribing

This system consists of two special recording machines interconnected to a transcribing control box enabling diversion of incoming recordings to a second machine while simultaneously transcribing previously recorded dictation. DICTAPHONE CORP., 730 3rd Ave., New York, N.Y. For information:

CIRCLE 212 ON READER CARD

typewriter transmitter/ receiver

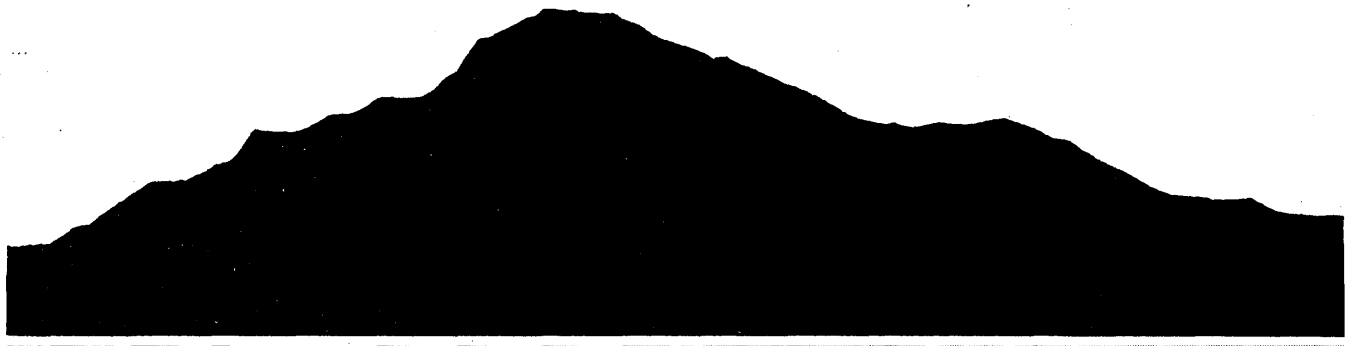
Model TTR-200A is a transistorized, photoelectric, interface typewriter without electrical contacts and equipped with six additional keys integrated with the keyboard. The unit was designed as input/output equip-

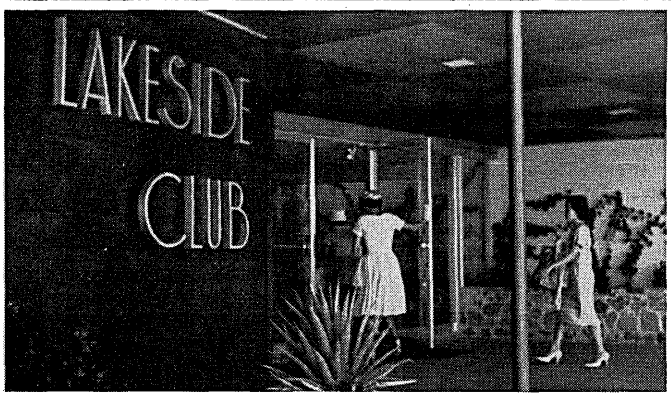


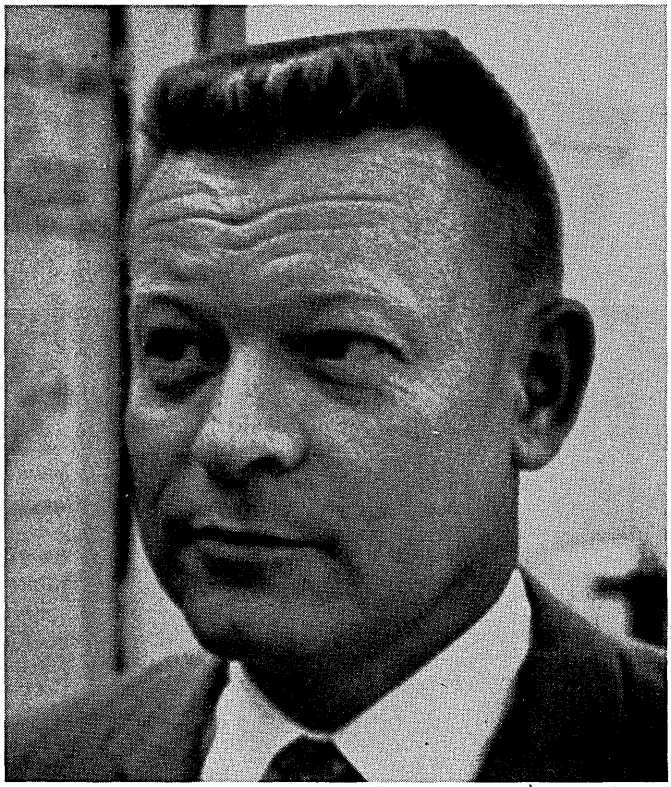
IN THE COOL HIGHLANDS OF SOUTHERN ARIZONA an elite technical team of government and industry specialists is at work applying automatic data processing concepts, techniques and equipment to the needs of the mobile modern Field Army. This program, now beginning its sixth year, is a vital part of the Army's Command Control Information System Project for the 1970's—CCIS-70. TRW has been selected to continue in its role of providing technical assistance to the U.S. Army Materiel Command in support of the CCIS-70 Project at Fort Huachuca, Arizona. Challenging assignments exist in advanced areas such as digital data communications, systems integration, man-machine communications, information retrieval and display, programming techniques and languages, simulation techniques and applications, and integrated system testing under field conditions. Facilities include van-mounted computers developed by the Army for field use, associated system devices, and field communications equipment. We have immediate openings for qualified systems analysts, programmers and test engineers who desire to make a significant contribution to the nation's military capabilities in a stimulating professional environment. At Historic Fort Huachuca and neighboring Sierra Vista, civilian engineers and their families, along with hand-picked Army technical officers and their families, have created an equally stimulating intellectual and social environment. If you would like to join TRW's top-flight technical group at Sierra Vista, contact Robert W. Rogers now at 8433 Fallbrook Avenue, Canoga Park, California. Or phone him collect: Area Code 213, 346-6000. TRW is an equal opportunity employer.

TRW COMPUTER DIVISION

Stimulating!







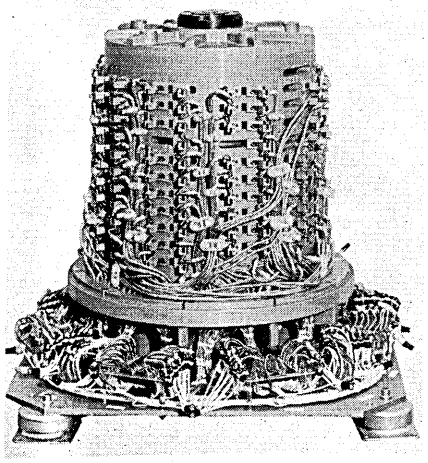
CIRCLE 83 ON READER CARD

COMPONENT PRODUCTS . . .

ment for computers, data logging, plotting and process control. INVAC CORP., 26 Fox Rd., Waltham 54, Mass. For information:
CIRCLE 213 ON READER CARD

memory drums

A new series of metallic-plated memory drums can operate for 40,000 hours at 3,600 rpm, with cylinder concentricities as low as .00008". Storage



capacities range from 50,000 to 3,500,000 bits. METWOOD MANUFACTURING CO., 15029 S. Figueroa St., Gardena, Calif. For information:
CIRCLE 214 ON READER CARD

subminiature memory

This 30,096-bit sequential access coincident-current core memory has internal addressing and counting, but occupies less than 70 cubic inches. Asynchronous input and output can be accomplished at up to 20,000 bits per second. DI/AN CONTROLS INC., 944 Dorchester Ave., Boston, Mass. For information:
CIRCLE 215 ON READER CARD

job recorder

This recorder has been designed to punch Start and Stop time on standard 80-column cards when plugged into any electrical outlet, thus preparing data for automatic processing as a by-product of normal time recording. UNIVERSAL TIME PUNCH, INC., 1559 Crest Road, Cleveland 21, Ohio. For information:
CIRCLE 216 ON READER CARD

tape protection

Tapeguard is a two-in-one safe which provides special protection for storage of data processing tapes. It has been designed to offer protection from fire, smoke and moisture. MOSLER SAFE CO., 320 Park Ave., New York 22, N.Y. For information:
CIRCLE 217 ON READER CARD

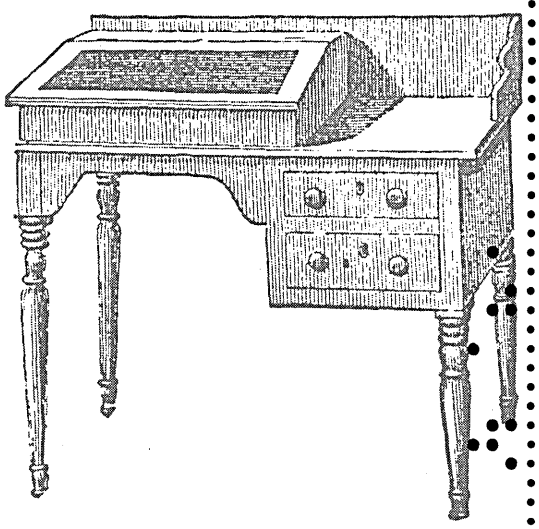
Just what your EDP system has been hoping for

A tape reader that keeps in step with your system. A reader to unflaggingly fulfill the needs of accuracy, reliability and speed. A reader that embodies the most advanced tape controls, with the proved ability to read perforated tapes without adjustment—regardless of color. A Digitronics Model 4500A Photo Electric Bi-Directional Tape Reader. Full servo reel control with speeds up to 1000 cps while handling 1000 feet of 5 to 8 level tape. Captive knob expansion hubs are designed to accommodate standard NAB reels 10½ inches in diameter. It has an integrated electronics chassis, solid state controls and channel amplifiers. Variable tape guides and two speed motors are standard. Be nice to your EDP ... don't keep it *waiting* ... give it what it deserves. Digitronics Model 4500A. Contact your local Digitronics representative or write to Digitronics Corporation, Albertson, New York.

DIGITRONICS

when every bit counts

CIRCLE 42 ON READER CARD



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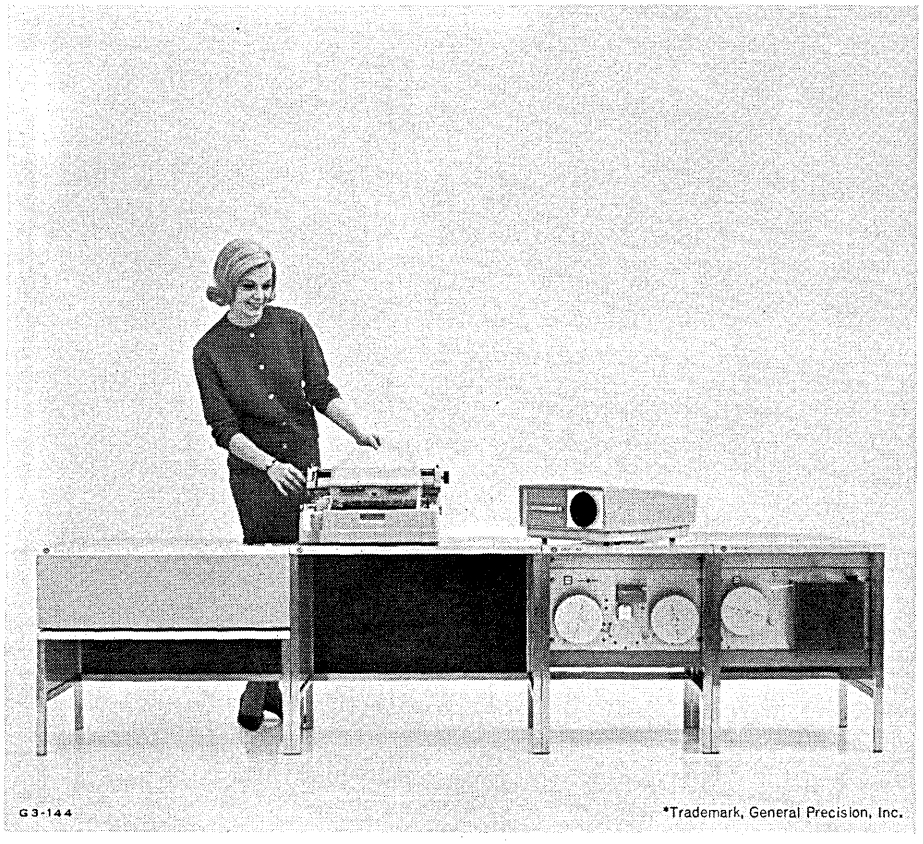

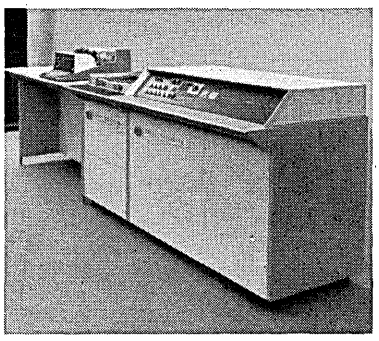

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*Trademark, General Precision, Inc.

CIRCLE 44 ON READER CARD

NEW FIRMS & mergers in DP

Anelex Corp., Boston, Mass., has acquired Franklin Electronics Inc., Philadelphia, Pa., manufacturers of a 2,400 lpm printer and other industrial products. Franklin will continue operations as a wholly-owned subsidiary.

Expansion of operations into Europe has been announced by Auerbach Corp., Philadelphia, Pa., with the formation of Auerbach AG, a subsidiary in Zurich, Switzerland. The office will provide technical services in systems and information management sciences.

The Denver Electronic Computing Service Inc. of Denver, Colo., has been purchased by McDonnell Aircraft, St. Louis, Mo., and renamed Delcos Inc. It will operate as a subsidiary under its founder, Paul W. Fullerton Jr., and continue to function as a consulting, system analysis, programming and computing firm.

The service bureau firm Electronic Business Services Corp. has been acquired by Computer Applications Inc., both of New York City. A software and consulting firm, Computer Applications has elected to its board the president of EBS, Jonathan M. Levine, and acquired a 1410 to supplement the service bureau's 1401.

Information Products Corp., Cambridge, Mass., makers of buffered, desk-unit interrogators and interrogator systems, has been purchased by Renwell Industries Inc., South Hadley Falls, Mass. Renwell produces numerical control machines, and electronic devices and chassis. The IPC facility is being moved to South Hadley Falls.

The expansion of facilities has been announced by the Service Bureau Corp. and Computer Sciences Corp. The latter, headquartered in El Segundo, Calif., has opened its fifth office, sans hardware, in Palo Alto, Calif., staffed with systems analysts and programmers. In the same town, the Service Bureau Corp. has opened a five megabuck computer center equipped with a 7094, two 1401's, and a staff of 100. Locally, SBC also has offices in San Francisco, Oakland, and San Jose.

The NAVY's new civilian/military/computer team streamlines strategic COMMAND, CONTROL and INFORMATION flow through application of advanced edp technology

NAVCOSSACT

Operating directly under the Chief of Naval Operations, NAVCOSSACT—the Naval Command Systems Support Activity—has one of the most significant and far-reaching missions ever assigned a fledgling scientific organization:

". . . support the Chief of Naval Operations, Secretary of the Navy, Secretary of Defense, Joint Chiefs of Staff and Commanders of major commands in the development and implementation of Navy-sponsored command systems, including systems applications, techniques, standardization, evaluation, integration, testing and continuing programming; to provide such support in direct response to requirements determined by the Chief of Naval Operations or higher authority."

The hard core of this provocative mission—**the development and implementation of Navy-sponsored Command systems**—concerns the most advanced—and meaningful—applications of edp technology. In essence, the NAVCOSSACT civilian/military/computer team develops command and control **packages** for on-the-spot use by Navy or Navy supported commands throughout the world.

Thus, NAVCOSSACT scientists and analysts may:

1/ Help CNO and other strategic commanders make best use of computer programming and analysis in their strategic command and control centers.

2/ Explore and exploit new edp developments —including advanced hardware capabilities and analytical techniques—which will make such command control centers more effective.

3/ Making use of operations research, work with operational commanders in developing edp functional requirements and systems concepts . . . and determine operational parameters of edp systems for INTELLIGENCE, OPERATIONS, LOGISTICS, GAMING, COMMUNICATIONS, WEATHER, MANAGEMENT, and ADMINISTRATION.

4/ Design, develop, produce, install, de-bug, test, evaluate and document operational computer programs.

5/ Prepare edp hardware design criteria for future computer centers.

6/ Work in a liaison and advisory capacity for CNO and other commanders both here and abroad to standardize command and control data codes, messages, languages and techniques.

7/ Operate the Navy Information Center (NAVIC) edp facility.

To carry out these and future tasks, NAVCOSSACT needs experienced DIGITAL COMPUTER SYSTEMS ANALYSTS and PROGRAMMERS . . . OPERATIONS RESEARCH ANALYSTS . . . ELECTRONICS ENGINEERS . . . and MATHEMATICIANS mainly here in Washington, but also in military command areas the world over. Not under any one Navy Bureau but reporting only to the Chief of Naval Operations, or "higher authority," means that these positions offer unusual latitude for individual work and coordination with civilians of other services, research groups, and institutions the world over.

Starting salaries range from $8,045 to $14,565 ($8,410 to $15,665 as of January 1st), and offer the exclusive benefits of Career Civil Service. If you qualify, and want continuing assignments of national importance, send your qualifications to Miss D. Burks, Personnel Administrator. Full consideration will be given to all qualified applicants without regard for their race, creed, color, or national origin.

NAVCOSSACT
Naval Command Systems Support Activity
Navy Yard Annex
Washington, D.C. 20390

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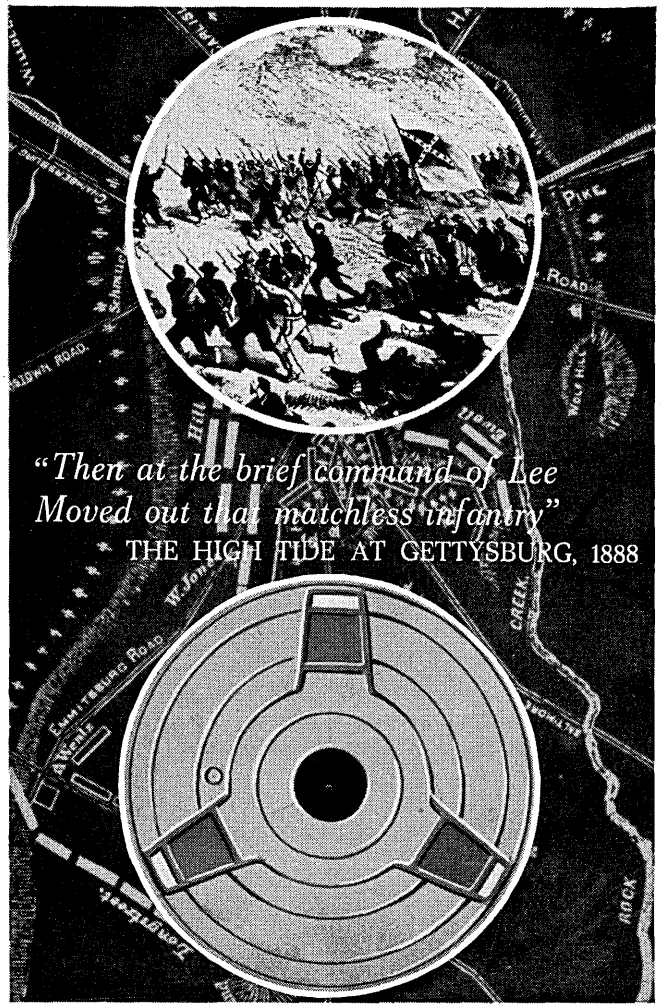

Command Systems profoundly influence the outcome of military missions. Successful operations require systems which provide military leadership with information to make decisions . . . with communications to transmit commands.

The pace of modern warfare . . . vastly different from Gettysburg . . . requires computer controlled systems such as the Air Force Command and Control System 473L. TECH/OPS programmers are playing a key role in providing the complex programs to make this System operational. When completed, 473L will supply Air Force planners and decision makers with vital information needed to make timely and accurate decisions for any military emergency.

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

Positions are available at TECH/OPS in the Washington, D. C. area for experienced Operations Analysts and Computer Programmers.

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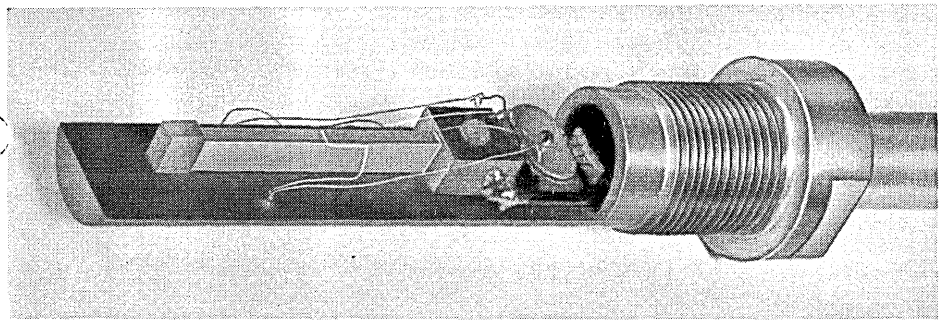

An elegant, but tiny refrigerator, utilizing the Nernst-Ettingshausen effect, has been demonstrated in the Solid State Physics Laboratories at Lockheed Missiles & Space Company. This type of cooling is applicable below 200° Kelvin, where thermoelectric cooling is no longer efficient. It shows particular promise for space application because of the reliability inherent in its all-solid state construction.

In the Nernst-Ettingshausen effect, heat is pumped as a result of an electrical current flowing in a magnetic field. The heart of the present device is a bismuth antimony single crystal. Other crystal systems are also being investigated.

This thermomagnetic cooling device is one of the results of the Lockheed research program in transport phenomena in solids.

Another investigation concerns the quantum theory of the electronic structure of crystals. An ingenious computer program has been devised for determining the essential features of the energy band structure of a wide variety of crystals. Results for a given case can be obtained in an hour or less. Conclusions drawn from the theoretical solution elucidate many of the electronic properties of crystals, and have widespread significance.

Lockheed scientists and engineers are also studying: Electron spin echo phenomena; the interaction of electrons with microwave phonons; coupled traveling waves in crystals; semiconductor lasers; antiserromagnetic resonance; various theoretical and experimental aspects of superconductivity.

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

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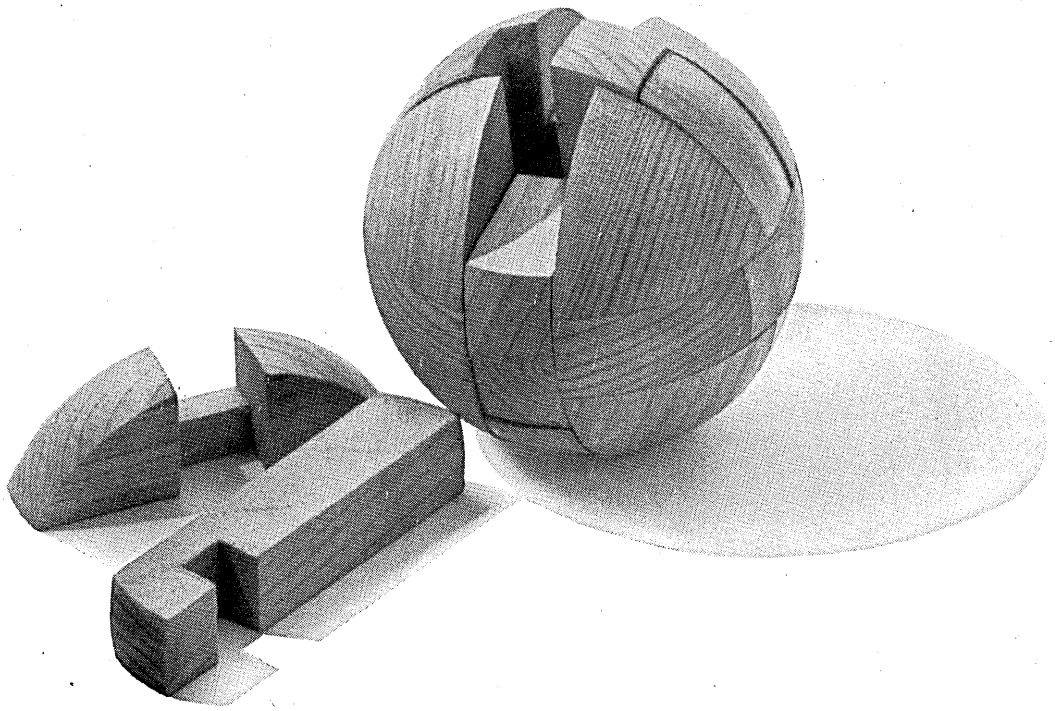
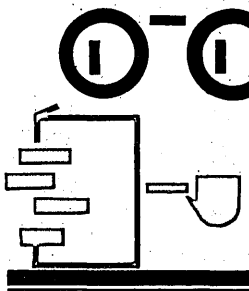
LOOK AT LOCKHEED IN SOLID STATE PHYSICS:

Basic and applied research on the properties of solids





NEW LITERATURE

PROGRAMMED DATA PROCESSOR-5: A 12- page booklet includes a general description of the PDP-5 plus detailed information on the major components of the basic computer, instructions and optional equipment. DIGITAL EQUIPMENT CORP., Maynard, Mass. For copy:
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UNIAC: A four-page brochure on the Universal Insertion and Clinching machines for printed circuit board assembly highlights the pantograph, indexing machine, axial lead components inserters, transistor inserters and features. UNIVERSAL INSTRUMENTS CORP., Binghamton, N.Y. For copy:
CIRCLE 131 ON READER CARD

FLUID CATALYTIC CRACKING: This report presents a summary of technical and economic feasibility of computer control, process description, a description of a control model for the FCC unit, and technical benefits from computer control. A technical and economic evaluation of the application of a computer control system to fluid catalytic cracking is given. TRW COMPUTER DIVISION, 8433 Fallbrook Ave., Canoga Park, Calif. For copy:
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CORPORATION & INDUSTRY INDEX: Over 20,000 companies, basic industries and products are covered in this index which shows where articles have been written on any company, industry or general business subject. Approximately 200 business and trade magazines are indexed, including, as of 1963, Datamation. FUNK & SCOTT, Colonnade Bldg., University Circle, Cleveland 6, Ohio. For copy:
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COMPUTER PROTECTION: Standard No. 75 classifies computers according to their construction, design features and protection needs. Measures needed for the protection of the computer area as well as the computer tapes and records are outlined and emergency fire procedures are detailed. This 30-page booklet is priced at 60¢. NATIONAL FIRE PROTECTION ASSOCIATION, 60 Batterymarch St., Boston, Mass.

DIGITAL CLOCKS: A color bulletin and price list is offered on this company's series 10,000-19,000 solid state digital clocks. Complete details on the units are provided. CHRONO-LOG CORP., 2583 West Chester Pike, Broomall, Penna. For copy:
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IPSO PROGRAM: This literature contains information on the Informational Processing for School Organizations program which covers a four-phase approach to the introduction of dp to school systems. STATISTICAL TABULATING CORP., 100 Church St., New York 7. N.Y. For copy:
CIRCLE 135 ON READER CARD

DISPLAY CONSOLE: This illustrated brochure on the S-C 1090 direct view display console includes operating characteristics and descriptions of the available options which can be used to customize the basic console for specific use. GENERAL DYNAMICS/ELECTRONICS, P. O. Box 127, San Diego 12, Calif. For copy:
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READOUT DISPLAY SELECTOR GUIDE: A pamphlet contains diagrams of this company's various modules, showing principles of operation, complete specifications and prices and a lamp selection and specification chart. INDUSTRIAL ELECTRONIC ENGINEERS, INC., 5528 Vineland Ave., North Hollywood, Calif. For copy:
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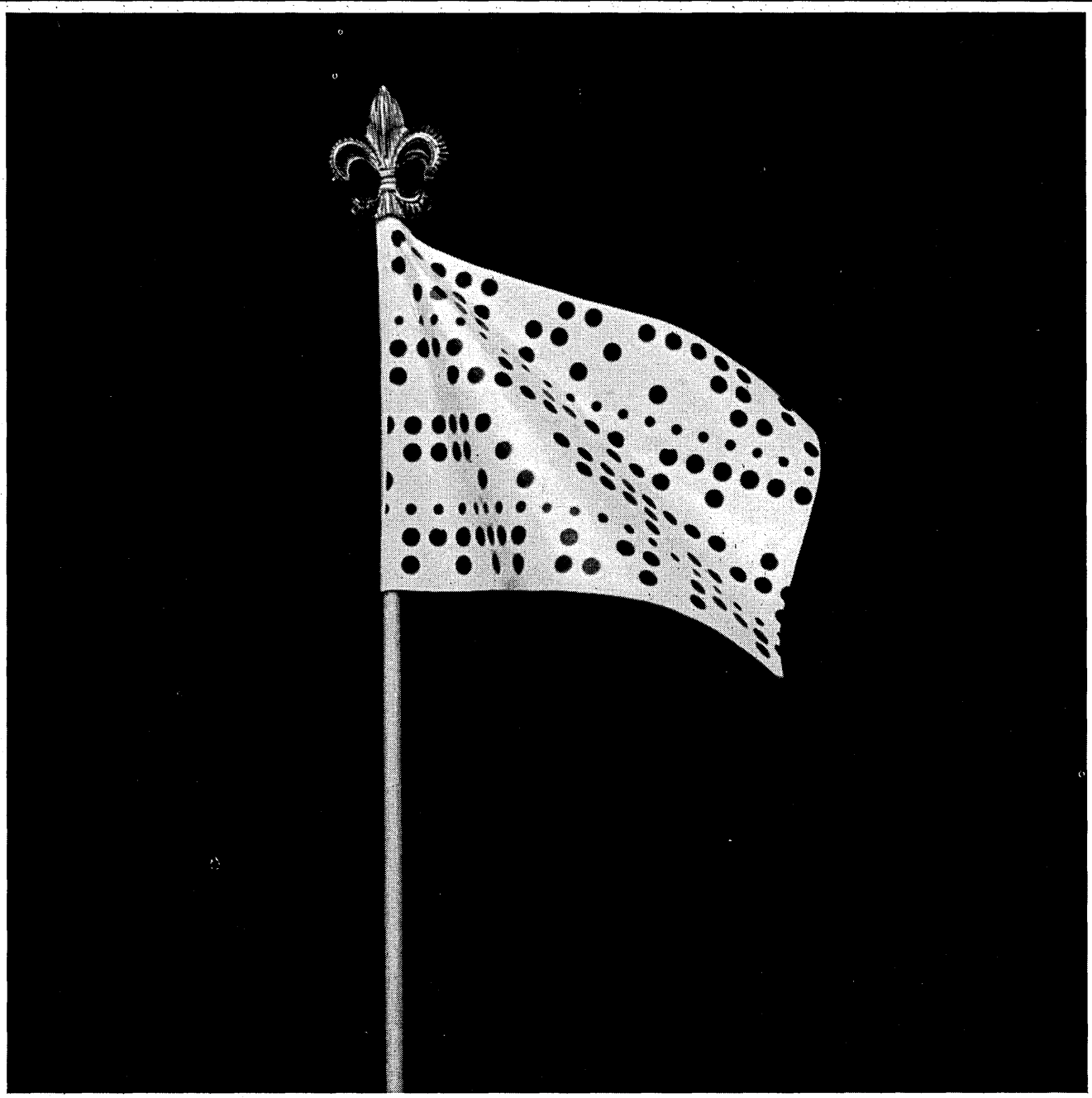

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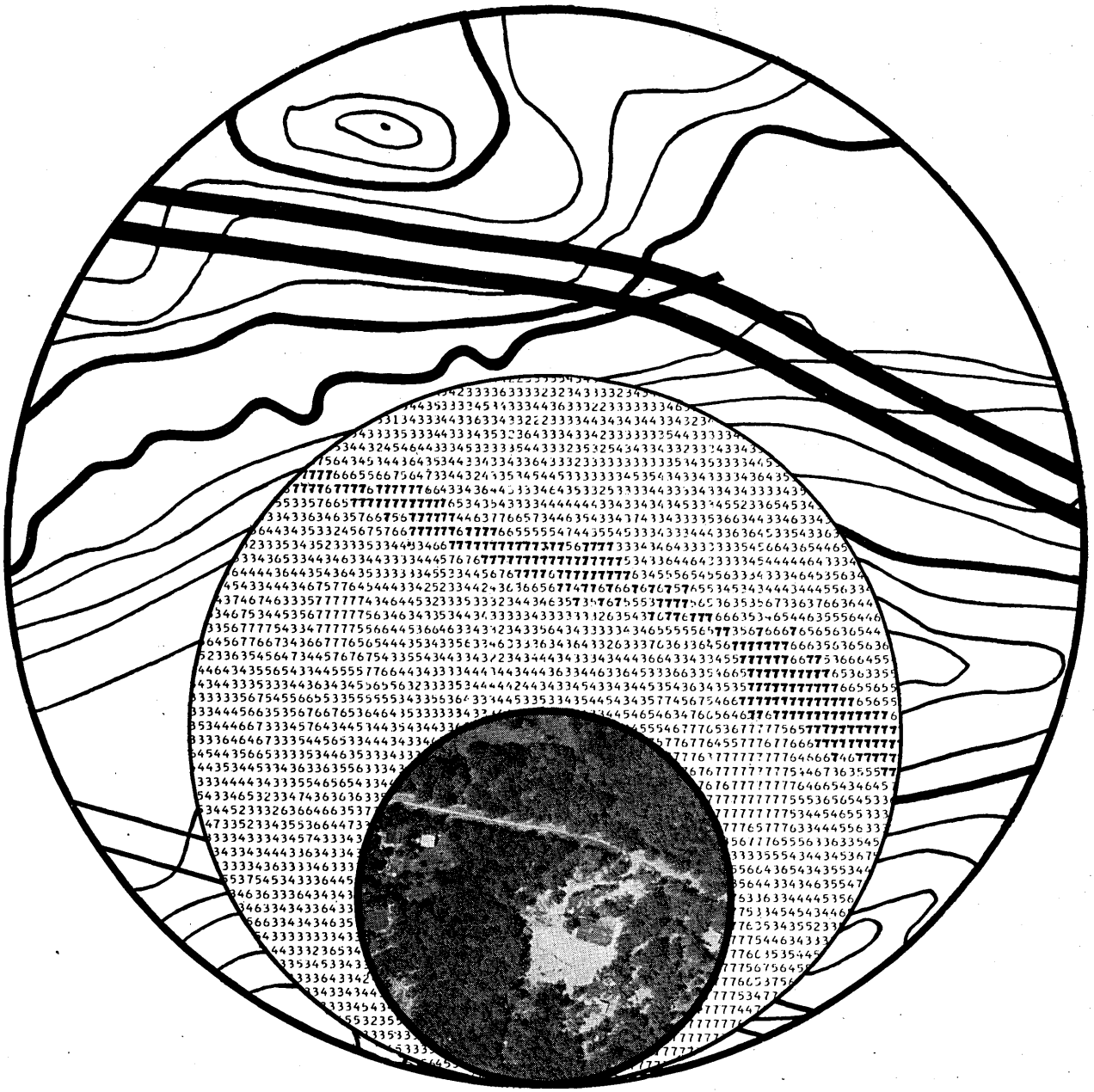

IBM reports on image processing:

How are photographs processed by a computer?

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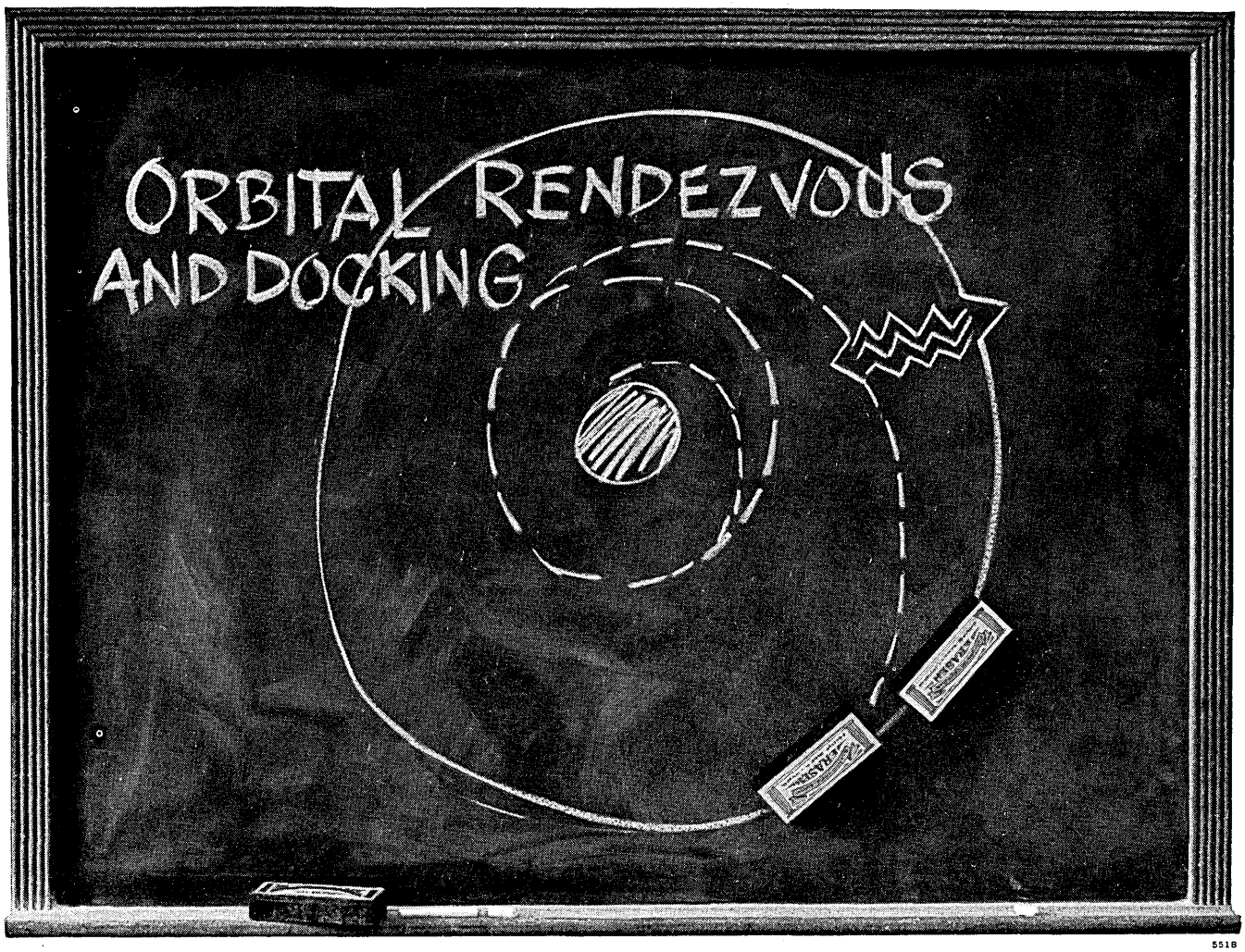
If you are interested in making important contributions in image processing or other fields in which IBM scientists and engineers are making progress, write to: Manager of Employment, IBM Corp., Dept. 701K, 590 Madison Avenue, New York 22, N. Y. IBM is an Equal Opportunity Employer.



Another project in space kinetics at STL

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LOS ANGELES, PALO ALTO and MINNEAPOLIS LOCATIONS

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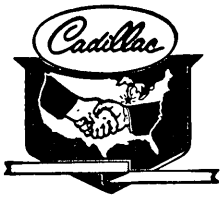

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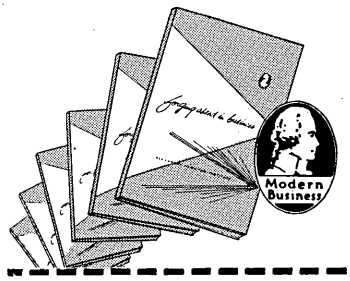

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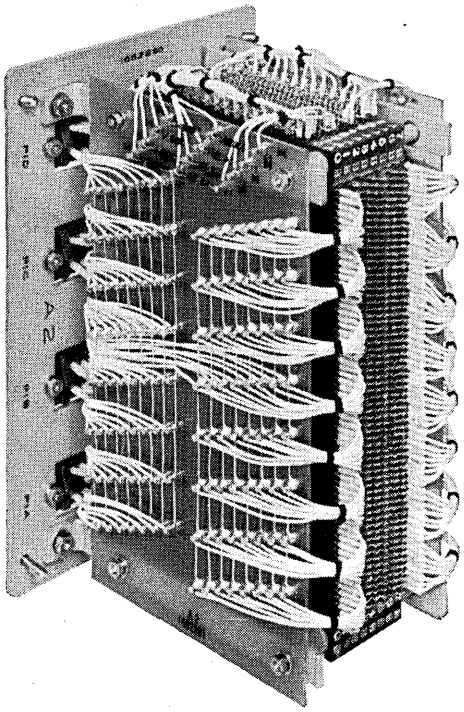

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