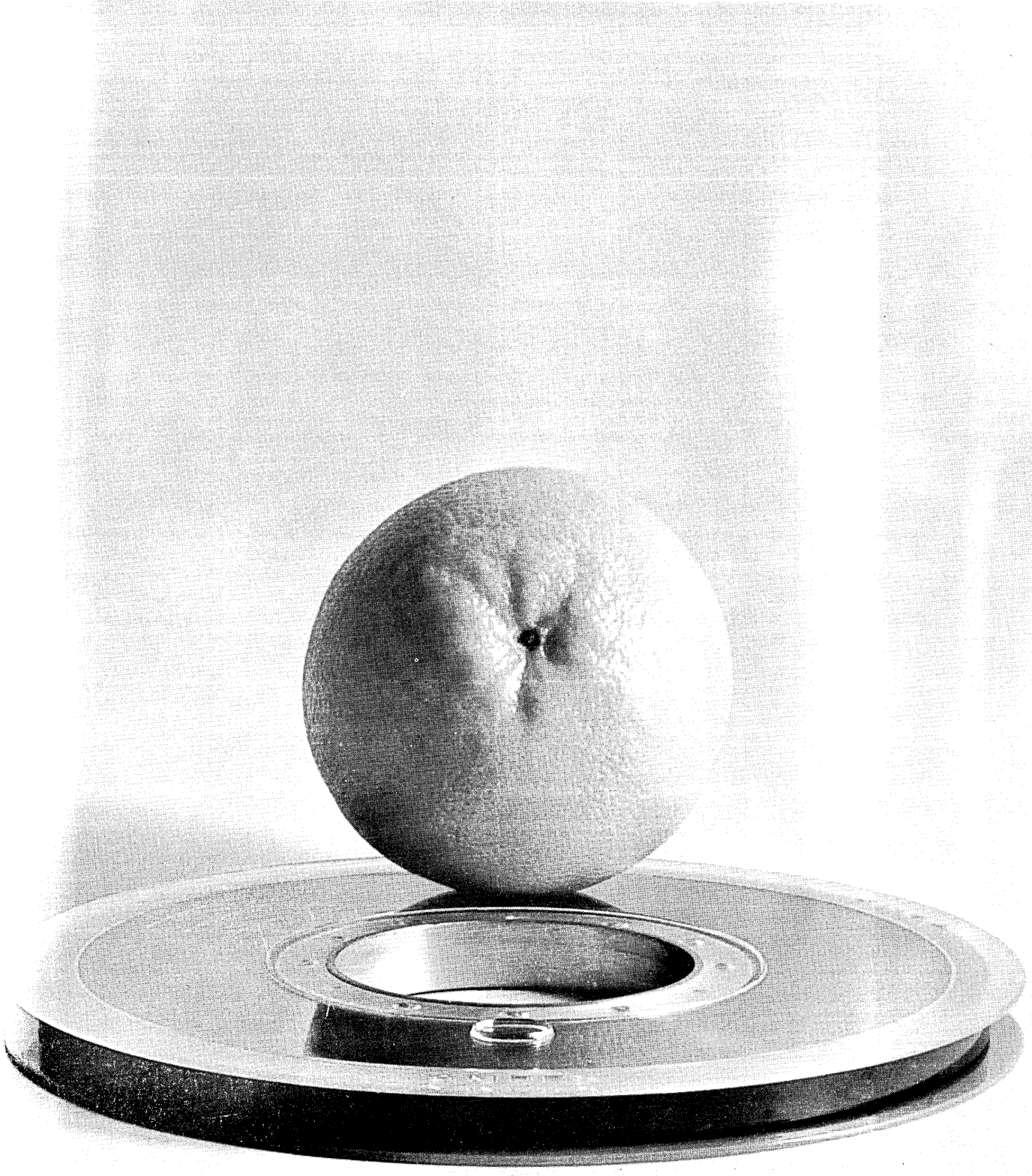
DATAMATION®

66

March



not a grapefruit in 500 miles

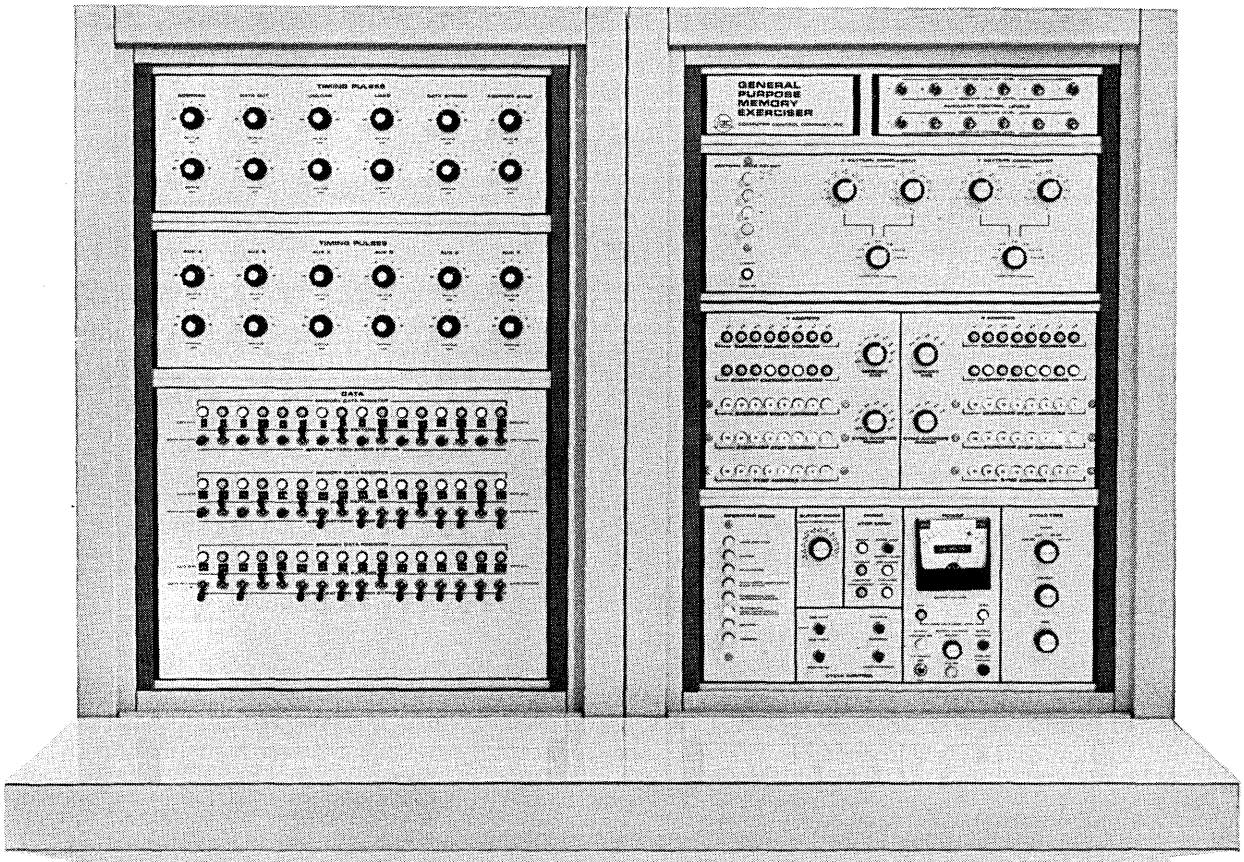
One microscopic bump or particle on a computer tape—equivalent in size to a grapefruit sitting on a 500-mile, four-lane highway—is all it takes to cause a parity error. □ There are no "grapefruits" on Ampex tape. New formula Ampex computer tapes are clean and error-free to begin with, and are formulated to stay that way for hundreds of thousands of equipment passes. You get more data through-put, unparalleled data reliability. □ Prove it on your own computer. Call your Ampex representative for a demonstration. Or for the latest information write Ampex Corporation, 401 Broadway, Redwood City, California 94063. □ You can be sure we won't sell you a lemon — or a grapefruit.

AMPEX

CIRCLE 1 ON READER CARD

ONLY 3C OFFERS

THE FASTEST...MOST VERSATILE MEMORY EXERCISER AVAILABLE!



150 nsecs to 1.5 msecs cycle time, capacity of 65,536 addresses, and word lengths up to 80 bits are only a few of the outstanding features of the 3C Model 3601 general purpose memory exerciser. Eight standard operating modes, plus a wide variety of auxiliary input-output pulses and levels give unequaled programming flexibility. This flexibility plus outstanding operating speed results in a secure long term capital investment.

Accuracy, ease of operation, and significant human engineering concepts have been emphasized. Reliability is inherent because of time-proven 3C 20 mc H-PAC digital logic modules which are used throughout.

Delivery? Not quite as fast as the equipment cycle time — but faster than lesser spec models available elsewhere. Write for complete details, or call your nearest 3C field office.

SPECIFICATIONS

Cycle time	150 nsecs to 1.5 msecs
Address capacity	65,536 addresses
Word length	Up to 80 bits
Output amplitude	Variable to $\pm$ 6 volts

Model 3601 provides selection, adjustment and control of the following:

- Addressing sequence
- Data pattern
- Operating modes
  - Load and Stop
  - Regenerate
  - Read-Modify-Write
  - Buffer
  - Regenerate-Load, Regenerate-Load
  - Cycle Complement
  - Address Data Check
- Error checking
- Clock controls and timing
- System interface signal levels

See us at IEEE, Booth No. 3D09, 11 and 13.

3C

3C SALES OFFICES: NEEDHAM, MASS.; FOREST HILLS, N.Y.; LEVITTOWN, PA.; SYRACUSE, N.Y.; SILVER SPRING, MD.; HOUSTON, TEXAS; HUNTSVILLE, ALA.; COCOA BEACH, FLA.; DES PLAINES, ILL.; DETROIT, MICH.; WEST CARROLLTON, OHIO; LOS ANGELES, CALIF.; KENT, WASH.; ALBUQUERQUE, N.M.

COMPUTER CONTROL COMPANY, INC.

OLD CONNECTICUT PATH, FRAMINGHAM, MASSACHUSETTS 01702

CIRCLE 4 ON READER CARD

Our brand-new time-sharing computer, already it speaks eight languages.

The SDS 940 is a low-cost, high-performance computer designed specifically for general-purpose time sharing.

The complete system is in operation now, and we'll make the first customer delivery in April.

If you'd like a demonstration, come to Santa Monica and converse with the system in any of its eight fully documented and debugged languages.

Or rent a Teletype and call up the system from where you are.

The 940 is very easy to talk to. No expert interpreters required.

It can handle an unlimited number of user stations. With more than 30 users talking at once, the 940 can respond in two to three seconds. With six simultaneous users the response time is less than one second.

The 940 does multi-programming, real-time processing and on-line remote data processing. Its hardware is designed to minimize programmed overhead and make the whole system available to the user.

Hardware features include monitor and user modes, dynamic program relocation, automatic memory fragmentation control, and system protection.

Users may be individuals, machines, or both at once, and they'll never get in each other's way. The Monitor program, and hardware protection, keep users from destroying or gaining unauthorized access to programs or data of other users.

The Executive program lets you call for the language that best suits your problem and your ability to operate the machine. Another program, HELP, tells you how to use the language.

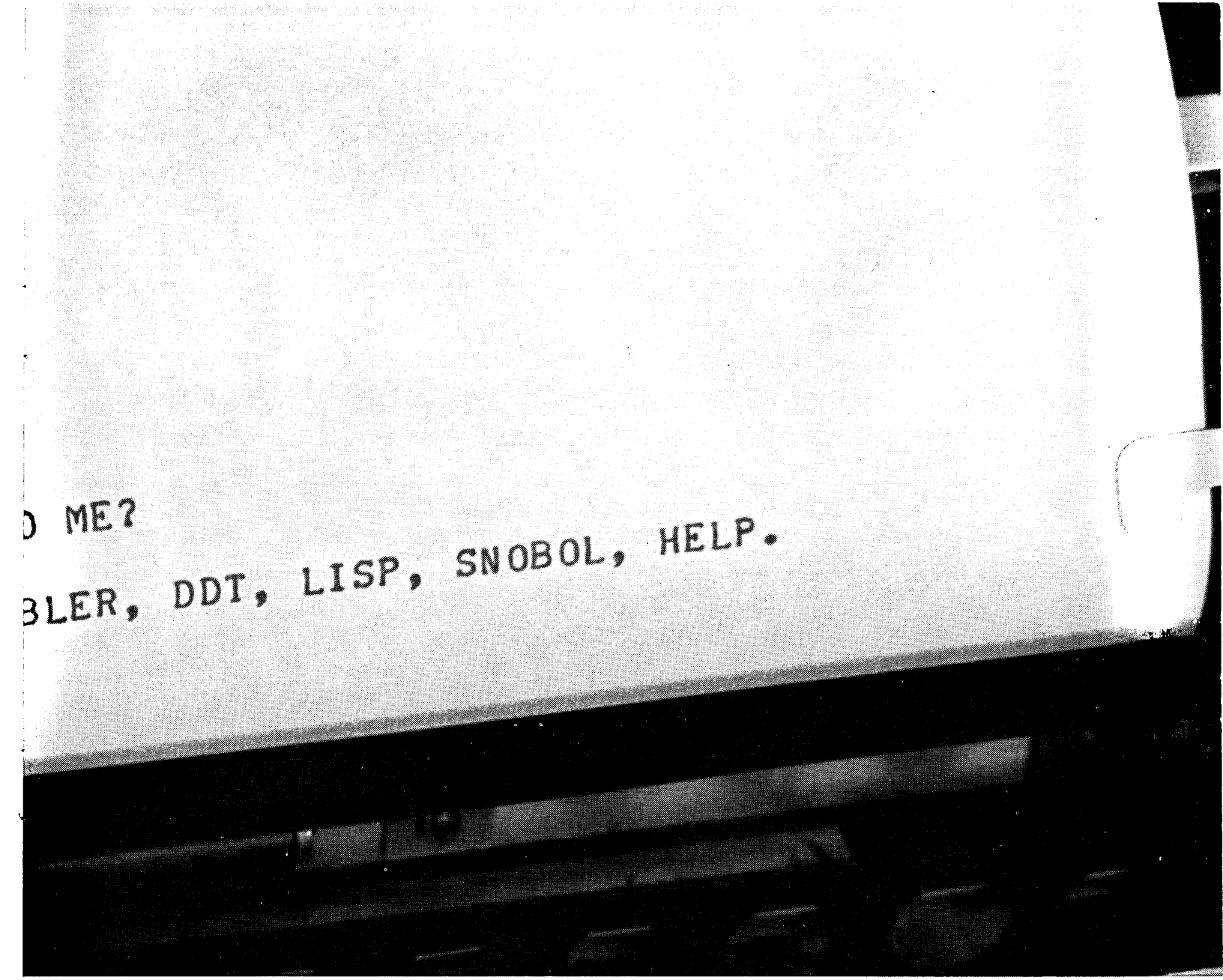
The following subsystems are operating now (with full documentation):

CAL (Conversational Algebraic Language). Resembles Joss. Is primarily aimed at small numerical problems in a highly interactive environment. It relieves the user of all burdens of storage allocation for both programs and data.

FORTRAN. Has all the features of the standard SDS 900 Series FORTRAN II. Can accept symbolic source-language input created on-line by QED, and thus an on-line compile-execute-edit-compile cycle is easily achieved in the system.

QED. A generalized text editor that allows the on-line user to create and modify symbolic text for any purpose. Includes inserting, deleting and changing lines of text; a line-edit feature; a powerful symbolic search feature; automatic tabs the user can set; and ten string buffers. The user can automatically save a set of editing commands for "canned" execution later (cliches).

SYMBOLIC MACRO-ASSEMBLER. A two-pass assem-



bler with subprogram, literal, and powerful macro facilities. It is similar to the standard SDS Meta-Symbol assembler. The output is accepted for use by the debugging program DDT, providing all the symbol tables for effective program checkout in terms of source languages.

DDT. A versatile, sophisticated on-line debugging package. Permits the user to examine, search, change, and insert break-point and step-trace instructions in his program at the symbolic level. Permits the use of literals in the same manner as the assembler. Can load both absolute and relocatable assembler-produced files. Its command language is geared to rapid interactive operation by the on-line user.

LISP. An extremely powerful symbol-manipulating language that uses recursive, list-processing techniques. Particularly valuable for nonnumeric applications and logical analysis. In its current application it is interpretive and has the added capability of employing M-expressions, which are closer to the user's problem language than the normal input form.

SNOBOL. A programming language that provides complete facilities for the manipulation of strings of characters. Is particularly applicable for programs associated with text editing, information retrieval, linguistics, compiling, and symbolic manipulation of algebraic expressions.

HELP. A valuable aid to the inexperienced. Provides on-line question-answering service for use by the time-sharing Executive and the above-described subsystems. HELP gives users convenient access to a direct self-teaching facility, which accepts questions on system or subsystem usage in natural language and answers in English.

Other subsystems are well along in development, including ALGOL.

When not required for time sharing, the 940 operates as an SDS 930—a high-powered general-purpose and real-time computer.

An almost unlimited number of SDS peripheral devices may be used with the 940, including Random Access Disc (RAD) files, single-capstan magnetic tape unit, display scopes with character and vector generators, line printers, card readers and punches, paper tape equipment and digital plotters.

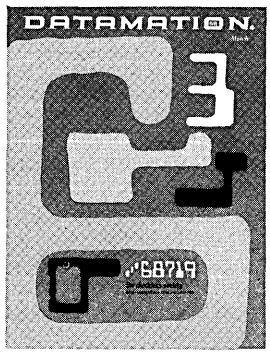
The SDS 940 is not an interim time-sharing system which will be obsolete in a couple of years when software for the "big" systems is delivered. You'll still be contentedly using your 940 system five years from now.

You can start using it in six months if you hurry.

Scientific Data Systems
1649 Seventeenth Street, Santa Monica, California
Offices in principal cities throughout the world.

SDS

CIRCLE 5 ON READER CARD



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This issue 59,952 copies

NASA's new Raytheon 520 Computer and Hybrid Linkage System beats specs by 33%

CHAN. NO.	ADC VALUE	DAC VALUE	PER CENT DIFFERENCE	CHAN. NO.	ADC VALUE	DAC VALUE	PER CENT DIFFERENCE
0000515							
00	+17777	+17777	+.000	01	+17777	+17777	+.000
02	+17777	+17777	+.000	03	+17774	+17777	-.037
04	+17777	+17777	+.000	05	+17775	+17777	-.025
06	+17777	+17777	+.000	07	+17777	+17777	+.000
08	+17776	+17777	-.013	09	+17775	+17777	-.025
10	+17777	+17777	+.000	11	+17777	+17777	+.000

Typical test results for 520 Hybrid Conversion Sub-system.
Test loop includes attenuators, multiplexer, parallel sample and hold, A-D/D-A converters and 100 volt amplifier output.

test 0000515 proves it

So did all the other tests performed on this digital computer and hybrid linkage system before it was shipped on schedule to NASA's Marshall Space Flight Center facility at Slidell, Louisiana for simulation of space vehicle control systems, structure and fluid thrust coupling, trajectory optimization and lateral-load and wind-profile studies.

Procurement specs called for maximum analog loop error of ±0.055%. But test after test showed actual errors much lower, ranging from 0.000% to a high of ±0.037%, 33% better than required. Average error for 12 channels was ±0.008%.

This kind of performance is gratifying, but not entirely unexpected. The conversion sub-system linking the Raytheon 520 with an existing 231RV analog computer was designed to be accurate, providing 13 bits plus sign, parallel sample and hold and buffered digital-to-analog converters to eliminate skew in sampling and desampling.

NASA's system includes Raytheon's new Multiverter®, a single unit combining integrated circuit multiplexing, a sample and hold amplifier with an aperture time under 50 nanoseconds and 4 microseconds settling time to 0.01% accuracy, and a 0.01% analog-digital converter.

Other features of the 520 hybrid system include readout of all points accessible to the 231RV addressing system, 520 control of servoset potentiometers, and sensing and control of 231RV computer modes such as Static Check, Rate Test, Pot Set, Reset, Hold and Operate. Up to nine analog computer consoles can be handled. A 1200-hole supplemental logic patch panel is provided with a complement of logic elements.

Raytheon's hybrid computing software includes Real-Time FORTRAN IV, FLEXTRAN (a macro assembler) and the BOSS monitor. Hybrid programs provide mode control, pot setting, readout, conversion, sense and control line activation and priority interrupt operation.

The Raytheon 520 is a 24-bit small/medium scale computer for hybrid computing, real-time systems and general purpose scientific and engineering applications. It's now being specified for installations in the $100,000 to $300,000 range. New capabilities include a 1 μsec main memory, Keyboard CRT, Disk Pack, Direct Memory Access and Drum. All the facts are in Data File C-127.

RAYTHEON COMPUTER
2700 South Fairview Street
Santa Ana, California 92704

RAYTHEON

Most people like Computape

A few don't

The way repeat sales are going lately, there are an awful lot of people out there who like Computape.

But occasionally we run into someone who doesn't.

Bound to happen, of course. Once in a long while it turns out to be someone who has a legitimate gripe. Like the little car ad says, nobody's perfect.

Much more often, interestingly enough, it's someone who has never even tried Computape. Maybe he's found another brand that seems adequate and would rather fight than switch. Or maybe he has a feeling that the company that does the most and the loudest advertising just naturally makes the best precision tape.

We will respect his opinion without subscribing to its validity.

Nevertheless, we would like the chance to prove to him that Computape is the finest, most dependable tape that money can buy. Tape is our only business, so it jolly well better be.

Maybe you're missing out on something good, too, just because you've never tried it. Why not investigate? After all, most people like Computape.

A PRODUCT OF COMPUTRON INC.
MEMBER OF THE BASF GROUP
122 CALVARY ST., WALTHAM, MASS. 02154

CIRCLE 8 ON READER CARD

DATAMATION 66®

march
1966

volume 12 number 3

automatic
information
processing
for business
industry & science

datamation departments

The 1966 Reference Guide to CEC Analog and Digital Magnetic Tape Recorders and Accessories

This guide includes the new DR-3000– the first truly universal digital magnetic tape system

Type VR-3600—The dean of recorders, and the ultimate choice for the most demanding pre- and post-detection and general purpose use.

- 400 cps to 1.5 mc direct frequency response; and d-c to 500 kc FM frequency response.
- Bi-directional capability including reverse automatic phase equalizers—available on special order.
- 7 or 14 channel systems available as standard.
- Available in "Universal" machine configurations for compatibility with lower bandwidth CEC recorders by switch selection.
- Accessories include monitor meters for display of bias, input and output signals, RFI certification to MIL-1-6181D.

Type VR-3800—This data recorder offers the basic advantages of the VR-3600 at a modest price. Often referred to as the "work horse" of midband recorders.

- 300 cps to 300 kc direct frequency response; d-c to 40 kc FM frequency response with high accuracy FM system.
- Six speeds to 60 ips, instantly switchable.
- All-metal-front-surface recording heads—reduce cleaning to a minimum; reduce tape and head wear.
- 7 or 14 channel systems available as standard.
- Direct system fully amplitude- and phase-equalized.

Type VR-2600—Recognized as the finest, most versatile performer in its class.

- Available with any combination of four types of recording/reproducing electronics and configurations (direct, FM, PDM, PCM).
- All solid-state electronics, push-button controlled for operation without readjustment at six (6) tape speeds.
- 600 kc direct, 80 kc FM, IRIG PDM, and 1000 bit-per-inch PCM capabilities.
- 7 and 14 track analog systems as well as 16 track PCM systems available as standard. Accessories include edge track voice recording/reproducing, shuttle control and monitoring equipment, including both meter and oscilloscope presentation.

Type VR-3300—Unmatched for applications where ruggedness and mobility must be combined with outstanding performance.

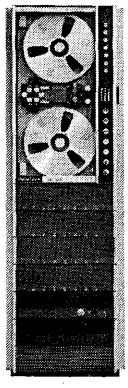
- 100 cps to 300 kc direct frequency response; d-c to 20 kc FM frequency response.
- Dual capstan drive system provides closed-loop speed and tension control equal to standard laboratory systems.
- Interchangeable record and reproduce electronics and heads with CEC's Type VR-2800 laboratory recorder/reproducer and VL-2810 continuous loop recorder/reproducer.
- Six speed record/reproduce system.

Type VR-2800—A highly reliable wideband system for use in laboratory environments with direct and FM electronics.

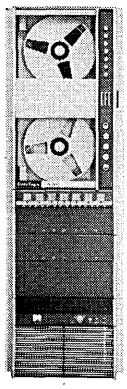
- Six speed record/reproduce operation.
- 100 cps to 300 kc direct system and d-c to 20 kc FM system.
- Up to 7 or 14 channels on ½" or 1" tape respectively on 14" reels provide extended record time.
- Uses all-metal-front-surface magnetic heads, as do all CEC recorders, for long life and minimum tape wear.

Type PR-3300—Designed for mobility at a modest cost.

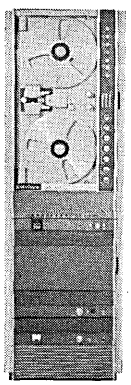
- High quality mobile magnetic tape recorder/reproducer for standard 100 kilocycle work.
- 7 or 14 channel systems or ½" and 1" tape respectively; 10½" diameter reels.
- Handles information via direct, FM or PDM techniques in any combination. Like the VR-3300, this unit can be operated from a-c or d-c power sources using its accessory precision frequency power supply.
- Interchangeable electronics with CEC's GR-2800 and GL-2810 magnetic tape recorder/reproducer systems.



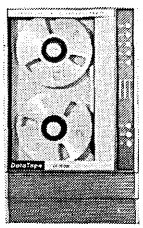
VR-3600



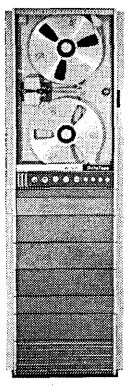
VR-3800



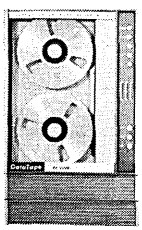
VR-2600



VR-3300



VR-2800



PR-3300

	VR-3600	VR-3800*	VR-2600	VR-3300	VR-2800	PR-3300	GR-2800	GL-2810	DR-3000
TAPE SPEEDS	6 speeds to 120 ips	6 speeds to 60 ips	7 speeds to 120 ips (in two ranges)	6 speeds to 60 ips	6 speeds to 60 ips	6 speeds to 60 ips	6 speeds to 60 ips	6 speeds to 60 ips	up to 75 ips
DIRECT FREQUENCY RESPONSE	400 cps—1.5 mc	300 cps—300 kc	300 cps—600 kc	100 cps—300 kc	100 cps—300 kc	d-c—100 kc	100 cps—100 kc	100 cps—100 kc	
FM FREQUENCY RESPONSE	d-c—500 kc	d-c—40 kc	d-c—80 kc	d-c—20 kc	d-c—20 kc	d-c—10 kc	d-c—10 kc	d-c—20 kc	
CHANNELS	up to 14	up to 14	up to 14	up to 14	up to 14	up to 14	up to 14	up to 14	up to 9
RECORDING METHODS	Direct, FM	Direct, FM	Direct, FM, PDM, PCM	Direct, FM, PDM	Direct, FM, PDM	Direct, FM, PDM	Direct, FM, PDM	Direct, FM, PDM	Up to 800 bpi NRZ or 1600 phase encoded
ELECTRONICS	Solid-State	Solid-State	Solid-State	Solid-State	Solid-State	Solid-State	Solid-State	Solid-State	Solid-State

Type GR-2800—Commonly selected for general lab use in both industrial and military applications because of its operating economy, long life and reliability.

▣ General purpose laboratory recorder/reproducer system accommodating data in direct, FM or PDM recorded format in the frequency range from d-c to 100 kc.

▣ Utilizes all solid-state electronics.

▣ 7 or 14 channel operation on ½" and 1" tape respectively, with reel diameters to 14".

▣ Closed-loop capstan drive system.

▣ Precision capstan drive electronics and tape speed control servo provide tape speed accuracies to within ±0.02% of recorded speed.

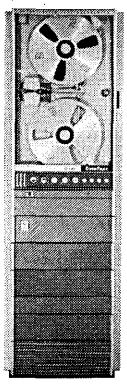
Types GL-2810 & VL-2810—Specifically designed for data reduction or data monitoring and storage where machine workload is heavy.

▣ Accommodate tape loop runs from 2 to 75 feet at six tape speeds from 1⅞ to 60 ips.

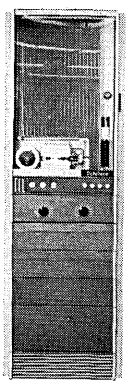
▣ GL-2810 handles data in the range from d-c to 10 kc via FM techniques, and from 100 cps to 100 kc employing direct techniques; VL-2810 handles d-c to 20 kc FM and 100 cps to 300 kc via direct.

▣ Utilizes ½" tape for up to 7 channels, or 1" tape for up to 14 channels, using IRIG geometry.

▣ Accessories include selective erase equipment providing erasure of any combination of 7 to 14 tracks, without removal of the tape loop from the machine. Bulk erase equipment also available.



GR-2800



GL-2810

Type DR-3000—This advanced new instrument offers unequalled versatility and performance—at the lowest cost of any comparable digital tape system available today.

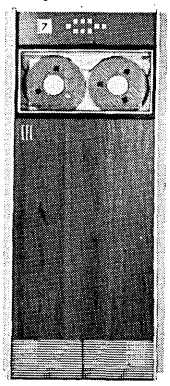
▣ 7 or 9 channel formats including 200, 556, and 800 bpi recording densities or 1600 bpi phase encoding density on special order.

▣ Rigid performance specifications provide machine-to-machine compatibility.

▣ Straight line tape loading requires no threading. Easiest of all to load, entire operation takes less than 10 seconds.

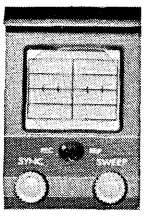
▣ Compact, rugged design with unique tape buffering provides high speed system mountable in a 19" or 24" rack.

▣ Dual capstans with special actuators assure positive and gentle tape drive, completely eliminate tape slippage. And air bearings virtually eliminate tape friction.

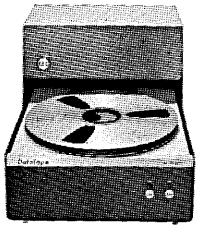


DR-3000

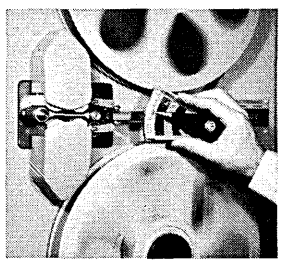
CEC's DataTape® Accessories



The Monitor Oscilloscope is used with tape recorder/reproducers, or any multi-channel instrumentation system to provide visual display of electrical signals ranging in frequency from d-c to 1,500,000 cps. Unique features of this unit include up to 500 kc sweep rate & modular construction.



The Type TD-2903 Automatic Tape Degausser is designed to erase data signals from magnetic tape wound on reels up to 14" in diameter and from ¼" to 2" wide tape. A reel of 1" wide instrumentation tape recorded at saturation level is erased to a nominal 90 db below normal level.



The Dynamic Tape Tension Gage permits accurate tension measurements directly while the recorder is in operation ... helps keep your recorder in proper operating condition through routine maintenance adjustment.

For complete information on any CEC Tape Recorder/Reproducer, write or call CEC for Bulletins in Kit 9008-X4.

CEC

Data Instruments Division

CONSOLIDATED ELECTRODYNAMICS

A SUBSIDIARY OF BELL & HOWELL/PASADENA, CALIF. 91109
INTERNATIONAL SUBSIDIARIES: WOKING, SURREY, ENGLAND AND FRIEDBERG (HESSEN), W. GERMANY

CIRCLE 9 ON READER CARD

calendar

● Course in SIMSCRIPT, modeling and simulation, is being offered by the Southern Simulation Service, March 21-25, Tampa, Fla.

● One-day technical symposium, sponsored by six southern California ACM chapters, will be held March 29, Disneyland Hotel, Anaheim, Calif.

● Honeywell 800/1800 Users Assn. will meet March 29-31, Jack Tar Harrison Hotel, Clearwater, Fla.

● American Univ. is sponsoring the following courses: "The Challenge of Cybernetics to Education," March 29-31, and "Systems Science," Mar 9-12, Twin Bridges Marriott Motor Hotel, Washington, D.C. Fees: $150-175.

● Course on "Top Management Control of EDP" will be given by Automation Training Center, March 31-April 1, Del Webb's Townhouse, Phoenix, Ariz., and April 21-22, Americana Hotel, New York City. Fee: $175.

● Three-day symposium on computer graphics will be held April 4-6, Schoenberg Hall, Univ. of California at Los Angeles. Informatics Inc. is co-sponsor with UCLA. Fee: $50.

● Data Processing Management Assn. is presenting two one-day COBOL seminars: April 14, Statler Hilton Hotel, Cleveland, Ohio; and April 15, Palmer House, Chicago. Fee: $30.

● International congress on dp in Europe is scheduled for April 17-21 at the Technical College in Graz, Austria. Co-sponsors are the Datacenter Graz and the Data Processing Assoc. of Vienna.

● Symposium on process automation will be held April 18-20, Newporter Inn, Newport Beach, Calif. Sponsors are Beckman Instruments, Scientific Data Systems, Consolidated Electrodynamics Corp. and Control Data Corp.

● Computer Usage Education Inc. will present two seminars: "The Reprogramming Problem," April 19-21, Sheraton Motor Inn, New York City, and "Data Communications," April 12-14, Somerset Hotel, Boston. Fees: $195.

● Systems and Procedures Assoc. is sponsoring a Southwest Systems Conference April 20, at the Townehouse, Phoenix, Ariz.

● Symposium on computer-aided basic research will meet April 22 at the Steven's Institute, Hoboken, N. J.

● Meeting of the American Society of Mechanical Engineers on the theme "Computers and Instrumentation" will be April 25-27, Charleston, W.Va.

● Seminars on digital systems engineering are scheduled for April 18-22 in Palm Beach, Fla., and April 25-29 in Los Angeles, Calif. A third seminar, "Digital Electronics," will meet April 25-29, Washington, D.C. Sponsor is RCA Institutes' School of Custom Educational Programs.

● Course on hybrid computation will be held April 25-May 6, Univ. of California, Los Angeles. Registration deadline is April 18. Fee: $300.

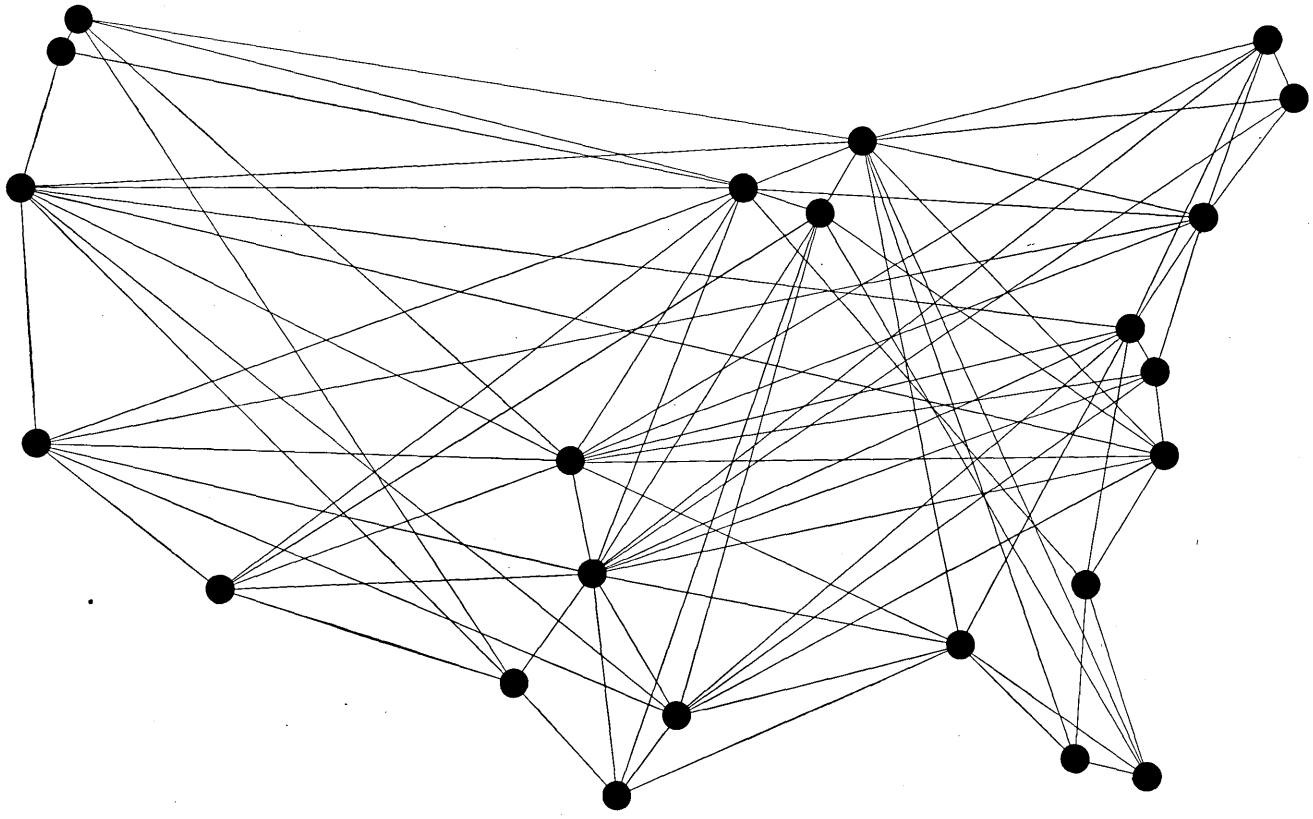
● Spring Joint Computer Conference will meet April 26-28, War Memorial Auditorium, Boston, Mass. Sponsor is American Federation of Information Processing Societies: Assn. of Computing Machinery, Computer Group of the IEEE, American Documentation Institute, Assn. for Machine Translation and Computational Linguistics, and Simulation Councils, Inc.

● Telecommunications exposition to be held in conjunction with meeting of Industrial Communications Association will be May 2-5, Queen Elizabeth Hotel, Montreal, Canada.

● National colloquium on information retrieval is scheduled for May 12-13, Univ. of Pennsylvania, Philadelphia, Pa.

● SHARE Design Automation Committee Workshop will meet at the Jung Hotel in New Orleans, May 16-18.

● GUIDE International Users Organization will meet at the Queen Elizabeth Hotel in Montreal, Canada, May 24-27.



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CIRCLE 12 ON READER CARD

letters

finding unused names

Sir:

We ran into a rather stubborn computer program the other day. Most programs fall more or less naturally into their acronyms, but this one resisted our efforts. Should it be Programming System for Adaptive Learning Machines? Sounds like we're praying for success. Adaptive Learning-machine Programming System? ALPS has been used already. New Algorithmic Program for Adaptive Learning Machines? Sure, it's topical, but—

In short, we racked our brains but to no avail. Others surely face the same problem. To aid them, and to protect and conserve this important national resource, I propose the creation of a (federally-financed, of course) Department of Acronyms, Mnemonics, and Names, whose primary job would be to publish periodically a (hash-coded) listing of used and available acronyms.

JOHN H. MUNSON
Artificial Intelligence Group
Stanford Research Institute
Menlo Park, California

automay & smog

Sir:

I certainly agree with Mr. Patrick that private transportation must be automated ("The Future of Private Transportation," Jan., p. 27), but we must also discard the internal combustion engine. An electric car using battery or fuel cell power for local street driving, and receiving power through the tracks of a freeway rail system for distance driving, is certainly a possibility. This system would also be easier to control than one of gasoline-powered autos riding on concrete highways.

The major obstacle in implementing any automated traffic system will not, however, be technical. All vehicles will have the same performance and appearance, leaving little to encourage the consumer to trade in his present model for a newer one. This will be a more radical departure from our current scheme than even the idea of automation.

ROBERT B. KELLY
Livermore, California

Why buy? You'll probably be able to rent 'em. In fact, you may *have* to rent them.

social implications

Sir:

Paul Armer, in his piece in The Forum (Dec., p. 124), says: "Many loud voices, in particular the Ad Hoc Committee on the Triple Revolution, are saying that we must immediately face up to paying men not to work—we must have a guaranteed annual income . . ."

According to John D. Pomfret in the *New York Times:* "The (Triple Revolution) committee urged that the link (between income and jobs) be broken by 'an unqualified commitment' by society to provide through its appropriate legal and governmental institutions 'every individual and every family with an adequate income as a matter of right.'" Robert Theobald (a committee member) does propose a guaranteed annual income. But none of us speaks for the committee . . .

None of us wants to pay carpenters, or anyone else, *not to work.* What we do want is to increase total production and to provide people with an adequate income so that they could buy what the machines, together with men, produce . . .

DR. LOUIS FEIN
Palo Alto, California

medical computers

Sir:

I must confess surprise and chagrin at having our organization ignored in the article, "The Computer in Medicine, An Overview," by Evon C. Greanias (Dec., p. 24).

The Commission on Professional and Hospital Activities is now in its eleventh year. Each day we receive about 20,000 abstracts of medical records of patients recently discharged from more than 610 hospitals in the U.S., Puerto Rico, Canada, and Australia. These hospitals will discharge approximately five million patients this year, representing one in every six hospitalizations in the U.S. and one in every five in Canada.

The commission does two things with these abstracts. First, we prepare certain routine statistics and indexes for the participating hospitals—information which all hospitals must have in order to maintain their accreditation. Several of the routine reports which the participating hospitals receive form the basis of the hospitals' educational medical audit program. In nonmedical terms, we provide a management information system for physicians who make up the medical staff of the hospital. Various displays of the data, together with exception reporting, give the physicians new insight into their practices.

Secondly, the data are contributed to our growing file of over 17 million records and are made available not only to the participating hospitals but to other bona fide researchers in the health fields. Our own staff completed nearly 400 special studies on these data last year, pointing up variations or similarities in patients and practices in many areas of medical interest.

Each of the medical record abstracts can routinely handle up to 150 kinds of information about each patient, but an almost unlimited variety of additional information can be handled by special arrangement. We have two computers to handle the work, but our staff of over 140 people are the real key to the reputation the commission enjoys in medical and hospital circles. They not only run the Professional Activity Study and the Medical Audit Program but a host of other research projects in such areas as hospital utilization, specialized registries, nursing home records, community health information systems, and the quality of patient care, just to mention a few. Our staff has also made substantial contributions in the fields of statistics, computer methodology, and classification theory. The demands of the Medicare legislation have speeded up our already rapid growth, and it looks like we will spend well over $2 million this year.

WILLIAM H. KINCAID
Commission on Professional and Hospital Activities
Ann Arbor, Michigan

the living machine

Sir:

Congratulations on your excellent January issue! One complaint, however. In "The Computer in Literature," Ned Kelly says:

". . . Still, this is a long way from the idea that mankind may even disappear, leaving behind robots as his only descendants. We ask what this could mean—the mind boggles at the thought—but does the reader recall the weird dialogue between Margaret Mead and Warren McCulloch in the film *The Living Machine?*"

The answer is no, he doesn't. So would

you please give us a brief summary of this weird dialogue? It just isn't fair of you to leave us dangling like that.

EUGEN BOSCH
Arlington, Virginia

Editor's comment: Unable to reach Mr. Kelly, here's my answer to your question. *The Living Machine*, a two-part, one-hour movie, was produced by the National Film Board of Canada, and I saw it at the SJCC in Detroit in 1963. That's quite a while ago, so some of my recollections may be fuzzy or inaccurate, but I don't think there was a direct confrontation between McCulloch and Mead in the film. The narrator, however, interviewed McCulloch, and elicited from him statements affirming science's ability to create machines which could duplicate what many view as the most private (or sacred) human capabilities. In one marvelous scene, McCulloch is sitting in his bathing suit and striking beard, dealing with a grandchild, as the interviewer asks with obvious shock "...even machines which could reproduce machines which can duplicate humans?" (This is a paraphrase of his statement.) And McCulloch, reiterating an earlier conditional statement, allows as how this could be, if the human functions can be adequately and appropriately described. Later, the same narrator asks Miss Mead to comment on McCulloch's statement. Her reply, as I remember it, suggested that this was a form of a power dream common to scientists (I don't think she mentioned the Faust legend, but it leaps to mind). This, as I see it, is the "weird dialogue" Kelly refers to. While we're on the subject, it seems worth noting that later in my own interview with McCulloch, I asked him what he thought of Miss Mead's comment. His unscientific but understandably human reaction (with a wave of the hand): "Oh, Margaret."

dp training

Sir:

Although an effective training program is vital to any dp organization, it is becoming evident that manufacturer-sponsored courses for programmers and analysts are not satisfying this need. Therefore, and in order to more effectively express users' desires, the Education Committee of the Joint Users Group is embarking on an extensive program.

It will include a survey of the current training plans and programs of users' groups, a critique of the survey, and the publication of a suggested training program with the participation of the separate users' groups. Those interested in participating are requested to contact me.

STANLEY M. NAFTALY, CHAIRMAN
Education Committee
Joint Users Group
432 Clay Street
San Francisco, California 94111

Listen to this page.

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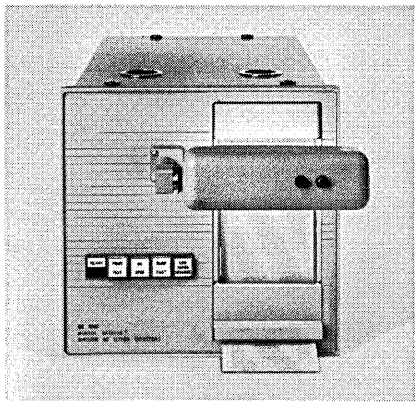

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look ahead

CONVERSION MIGRAINE AWAITS THIRD GENERATION PIONEERS

A huge conversion headache awaits most installations installing third generation hardware...and most of them are either unaware of it, or are pretending the problem will fade if ignored. That's the view of several top-flight systems people who have had long, discouraging looks at the conversion problem. The consensus: hardware and file conversion represent the toughest hurdles; program conversion, while time-consuming and difficult, will be more straightforward.

Hardware problems facing IBM upgradees include different collating sequences for the 360 and its binary predecessors; estimating printer timing and finding the best combination of characters in the extended character set; getting accurate up-to-date information about the 360 and conversion routines. The main problem, says one man, is not just moving to a new machine which can do new things, but the immense variety of ways it can do them.

File conversion will be especially tough for those moving up from word-oriented machines. And then there are the technicalities of different numbers of tracks, different densities. One conversion expert will be surprised if he'll be able to record 1600 bpi on his old tapes.

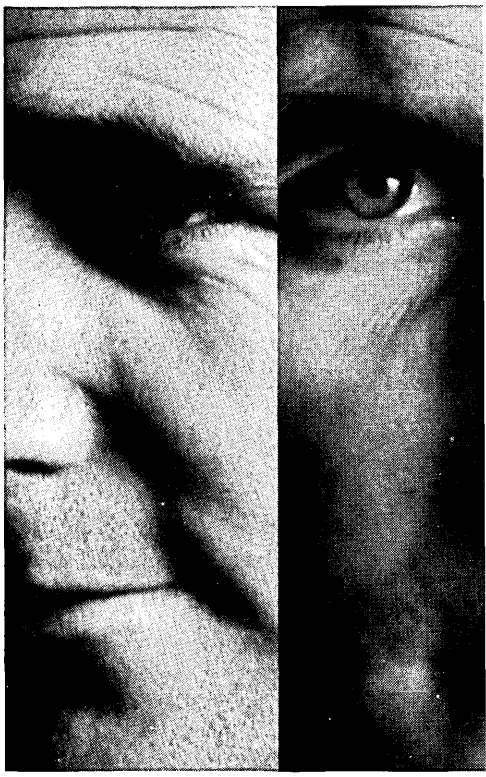
The 360 conversion problem is sticky enough that some people are reconsidering vendors. For 7000 users, the logical alternative seems to be the 635, more compatible with that series than is the 360. Attempting to capitalize on the 360 conversion problem, GE is offering a Cobol conversion package (SCORE, for SCan CObol REserve words), and 7040/90 simulators. Admits one man at an installation long known as an IBM one, "If you're ever going to change vendors, now's the time." And it looks as if many former 360 fans would rather switch than fight... conversion problems.

FOR BIG 360 USERS, A WINTER OF DISCONTENT

Early large-scale 360 performance is causing some disappointment: one user says he hasn't yet been able to run a Cobol program on his 50; times are so bad that he may have to put in another main frame. It's the E level software, says one expert: it's slow, doesn't take advantage of any memory available over 32K bytes. The F level (64K) looks ok, but H level for some processors has been cancelled. IBM will probably hop up E level software by this summer. H level Fortran, under fire for being slow, will probably be released with disclaimers to those who can't live without it. But a new, faster "G" level Fortran is being developed for IBM by Digitek.

PL/I: RAPID RISE TO STANDARD-DOM?

Although it's hardly being used yet, PL/I is already being discussed as a candidate for standardization effort. At a meeting last month of representatives of most major manufacturers, user groups and the government, it was decided to recommend to ASA's X3 info processing committee that PL/I be investigated for its suitability for standardization. They also recommended the nature of the investigation,



and that it be conducted by X3.4 (common programming languages), which has already agreed to do just that. The work to be performed by X3.4 would include recommendation of modifications; proposal of a precise specification of the language, including subsets; and a report on the suitability of the proposed specs (not on the language as it now stands).

Thus other manufacturers hope to influence a generalization of the language, weaning it away from any dependence upon 360 characteristics. But critics claim such development is outside X3's authority, will automatically ensure suitability of PL/I for standardization, cramming the language down the industry's throat before it has been widely accepted.

CDC CHANGES 6800 I/O STRUCTURE, PRICE... CONSIDERS NEW PRODUCTS

The wishes of fickle customers are blamed for the latest change in the design of the CDC 6800. In an attempt to enlarge the I/O capacity, users can now have up to 64 peripheral processors, each with 4K words of core. This makes the Big One even less compatible in the I/O area with the 6600. CDC vp Seymour Cray continues with a crew of only 38, producing the prototype 6800 at Chippewa Falls, Wisc. With the first model due in two years, the price has been upped some 10 to 20%.

Meanwhile, Control Data is mulling over some new products. The 6000 series satellite computers may be fitted with a central core and offered as a package. Another rumored item: a mass core unit, to be available in 2-million-word modules for the 6600, with a .1 usec/word transfer rate. It would also be available for the 6800, but four times as fast.

RUMORS AND RAW RANDOM DATA

The revamped, revitalized activity at the Bureau of Standards is off and running, with interesting work beginning on such ticklish topics as computer selection, performance measurement, documentation standards. Director Norm Ream, looking for some high-level people to move the program, has hired BEMA's Vico Henriques and GSA's Bob Rountree. He's also hoping to get industry to supply research associates. The first R.A. may come from Japan. ... Look for another entry into the computer sweepstakes in a month or two. A brand new western firm will announce a machine highlighting quick delivery, "instant" useability. ... Kodak will announce a certified computer mag tape soon, is lining up sales outlets. Consolidated Electrodynamics Corp. hopes to get exclusive marketing rights. ... Houston Fearless goes into production in six months with a microfilm unit which can store 67,500 images on microfiche cards and sells for under $2K, said to be $4K less than its nearest competitor. The unit will be available with teletype or crt and interface for on-line hookups. Also, in the prototype stage is a camera processor to make the microfiche images. HF expects the $15 million microfiche industry to grow to $150 million in the next five years. ... IBM is developing (or having developed) Fortran and Cobol to PL/I translators. ... Reuben Donnelly has finally settled on a 490 — to be updated to a 494 — for its interline reservations system. ... SEL, which has sold over 30 800 series computers, is offering three i.c. crt displays with refresh memories. PRC and IDC are developing software for the 800's, which will be speeded up. ... Dartmouth moves up in Oct. to a GE 625 with 160-line capability, 80 each for GE and the college, which will cooperate on a superset of the Basic compiler. ... The Cobol compiler for the B 8500 will be developed by Computer Applications Inc.

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CIRCLE 15 ON READER CARD

editor's readout

the missing data base, part 2:

ANATOMY OF AN INDUSTRY IN SEARCH OF MATURITY

It's obvious that the information processing industry lacks a coherent body of facts and statistics about its own activities. It's evident that such information could be of immense and immediate value to users, manufacturers, educators, investors . . . to the entire industry and everyone affected by it. And it's clear that most of the information needed exists and could be gathered, synthesized and made available.

Just who could or should go about gathering this desperately needed information is not so clear. To find out why this is so, let's take a quick look at the anatomy of our industry, a loose assemblage of amorphous bodies connected in random and haphazard ways, each responding differently to wide varying stimuli.

Manufacturers, for instance, respond sometimes to pressure from users (FORTRAN), from government (COBOL), from competition (prices down, internal performance up). As a group, hardware manufacturers (most of them) are represented only by an organization called BEMA (Business Equipment Manufacturers' Association). BEMA coordinates information processing standards work for the American Standards Association, conducts a yearly exhibit of office and edp equipment, does little else. Except in standards matters, it does not represent any unified voice of manufacturers.

The user, responsive in varying degrees to his own management, is even less well structured. User groups have a narrow influence on some important decisions of the one manufacturer they seek to influence. Attempts to increase the usefulness and broaden the influence of the Joint User Group have failed, partly because not all user groups will join, partly because of IBM's predominance.

Professional societies respond primarily to the educational needs of their members. Coming closest to representing the industry (but not close enough) is AFIPS (American Federation of Information Processing Societies), which so far has shown a reluctance to serve as an industry spokesman or to influence anybody.

So far, none of the organizations we've examined seem to offer a source for the information gathering activity the industry needs. Each lacks either the finances, the representative base, the will . . . or some combination thereof.

Let's look at the federal government, which plays several key industry roles. First of all, the government has served from the industry's infancy as the prime source of research funds. And the government, although it does not always act it, is the industry's biggest user. As such it can exert the strongest influence over the broadest range of industry activities – manufacturing, education, software and services—of any organization in the industry as it is now constituted. But the charter of the government extends beyond these two functions: it includes the responsibility for the development of conditions leading to a healthy, competitive, profitable industry; the protection of the rights of the consumer; development of a strong export industry; among others.

We're not talking now about the bureaucracy-heavy, red-tape-riddled Big Brother kind of government, but of government responsive to the needs of every facet and segment of the industry. We're talking about the kind of government which seeks and makes use of the cooperative involvement of industry leaders, serving as the coordinating focal point for an industry in search of maturity.

The development of an industry data base to answer the kinds of questions illustrated in last month's Readout would do much to accelerate the maturation of the industry, and the cohesiveness necessary if it is to conduct its affairs with intelligent purpose. And we think that the government can best direct the first attempts to develop this data base.

We feel that in the charter and organization of the government's ADP activities as outlined in H.R. 4845—the Brooks Bill—(and in the Report to accompany that bill), exists evidence of the government's ability to serve as the coordinating focal point for this industry-wide gathering and synthesizing activity.

We hope that industry leaders—manufacturers (hardware and software), professional societies, users, educators—will agree and bring to the attention of appropriate government officials their ideas on the pressing need for an industry data base, what it should contain, and how it should be developed.

THE CHECKLESS SOCIETY

by ROBERT V. HEAD

It is fascinating, and to a degree frightening, to attempt to trace the fantastically tangled web of implications that derive with seeming inevitability from what is basically a very simple system concept—that of the automatic credit transfer system.

Essentially, an automatic credit transfer system is one that utilizes a terminal device at the time and place of a retail transaction to effect an automatic transfer of funds between consumer and merchant, thus obviating the need for either cash or checks to pay for goods and services. Four main system elements are needed to accomplish such automatic and immediate transfers:

1. Terminal devices located at the site of the transactions.
2. A central file of current deposit balance and credit information.
3. A data network connecting the terminal devices to the data file.
4. A simple and reliable means of consumer identification.

There is an accumulating mass of commentary by observers interested, for various reasons, in the possibilities of establishing automatic credit transfer systems. Thoughtful people from many fields have, over the past year or two, come to grasp the astonishing potential that these systems possess for transforming major facets of our society. Martin Greenberger, from MIT's Project MAC, predicts that:

> Within the next 25 to 30 years the banking industry probably will be transformed into a vast electronic information system of national and international scope. Today's banks may or may not maintain their identities under the transformation. It depends on the attitude and role that banking management assumes while its mode of doing business undergoes a fiery modern metamorphosis.[1]

Speculation on this subject is by no means confined to theoretical prognostications from the college campus. Consider the words of a leading spokesman for the equipment manufacturers, Thomas J. Watson, Jr., of IBM:

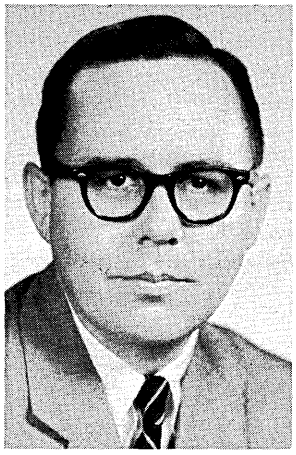
> In banking alone, for example, the advances of yesterday are merely a faint prologue to the marvels of tomorrow. In our lifetime we may see electronic transactions virtually eliminate the need for cash. Giant computers in banks, with massive memories, will contain individual customer accounts. To draw down or add to his balance, the customer in a store, office, or filling station will do two things: insert an identification into the terminal located there; punch out the transaction figures on the terminal's keyboard. Instantaneously, the amount he punches out will move out of his account and enter another.
>
> Consider this same process repeated thousands, hundreds of thousands, millions of times each day; billions upon billions of dollars changing hands without the use of one pen, one piece of paper, one check, or one green dollar bill. Finally, consider the extension of such a network of terminals and memories—an extension across city and state lines, spanning our whole country.[2]

Perhaps most significant of all are the remarks of the bankers themselves, that supposedly starchy and conservative fraternity. Walter E. Trabbold, of the Bank of Delaware, suggests that:

> Real-time is here for commercial bankers. Its cost is not significant with announced equipment improvements. Advances in communications, processors and random devices make it economically possible for us to install a central management information system providing decision-making ability and to plan for the expansion of our bank's services. I say this because the banking industry will move so fast in this direction in the next few years that we can be left at the gate if we don't spend, and spend wisely.[3]

These comments are representative of the computer-wrought ferment in thinking about financial exchange mechanisms that is today taking place not only on the campus but also within the planning offices of the equipment manufacturers and along the hushed executive corridors of the banks themselves.

In all these places, the speculation is not about *whether* these systems will come into being but when, and about what form they will take, who will control them, and what their broad social and economic consequences will be. We shall consider these questions in due course, but before doing so, one overriding and fundamental fact should be emphasized: *the technology and the economic justification to develop these systems are here now,* today, and are such that many entrepreneurs as well as established organizations in the community have already begun to move in the direction of introducing such systems.



Mr. Head is manager of the Advanced Business Systems Dept., Touche, Ross, Bailey & Smart, and was formerly head of the Systems Planning Div. of the Security First National Bank in Los Angeles. Long acquainted with real-time business systems, he worked on the SABRE system while with IBM and on the ERMA project with GE. He is also a contributing editor of Datamation.

[1]Greenberger, Martin, "Banking and the Information Utility," *Computers and Automation,* April 1965, p. 30.

[2]Watson, Thomas J., Jr., "Men and Machines — The Dynamic Alliance," *Proceedings, ABA National Automation Conference,* 1965, p. 13.

[3]Trabbold, Walter E., "Computer Technology — State of the Art," *Proceedings, ABA National Automation Conference,* 1965, p. 308.

It may, as some assert, take 25 years to get there, but that is extremely doubtful. More likely, automatic credit transfer systems will have assumed significant dimensions within five or 10 years. Remember, that piece of paper—the check—that these systems aim to displace, has been with us, from the standpoint of wide consumer usage, no more than a score of years. It is not entrenched. It was only after World War II that consumers were lured away in large numbers from the postal money order system and into the bank checking account system. The checking account habit is not, therefore, so deeply ingrained that consumers might not be persuaded to abandon the writing of checks fairly rapidly if a superior alternative presents itself. After all, we would merely be coming full circle back to something resembling the barter system that prevailed in this country as recently as 100 years ago. Just as we progressed from the barter system to hard national currency and from that to checking accounts, we stand now to advance to the exchange of goods and services on something resembling the old primitive basis, but with an underlying assist from computer technology.

portents of change

Let's take a look at some of the evidence of change in the form of activities now underway which may be regarded as the precursors of automatic credit transfer systems in that they exhibit some of the identifying characteristics of these systems.

1. Many large banks are presently engaged in converting their deposit accounts to third-generation computing equipment and, in the process, are for the first time making substantial use of direct access storage. Indeed, several banks have already installed inquiry devices that can provide tellers with up-to-the-minute account balance information. It does not require a great deal of imagination for these banks to perceive that their terminal devices, now used internally, might someday serve a profitable function outside the walls of the bank.

2. During 1965, at least three major banks introduced the concept and mechanism of overdraft banking for the first time in the United States. These overdraft systems provide for the establishment for qualified checking account customers of a personal line of credit tied directly to the checking account. This permits the automatic injection of funds from the credit line into the checking account whenever the checking account balance declines to zero. The institutions that have taken this step are thus progressing along the pathway toward ultimately providing for automatic credit extension at the point of a retail transaction.[4]

3. Most large banks today offer a payroll computation service to small businesses. One feature of this service provides for the automatic deposit of net pay into the employee's account. Thus, on the input side of the automatic credit transfer system, the checkless approach has made a modest start toward becoming a reality.

4. Computerized credit bureau operations are now in existence, and some of these evidence both the ambition and capability of growing up into full-scale automatic credit transfer systems.

5. A study conducted for a major equipment supplier, which received nationwide publicity, implies an interest on the part of the computer manufacturers in automatic credit transfer systems, both from the standpoint of supplying the equipment as well as possibly becoming the system operator in some communities.

6. Recently the director of automation of the American Bankers Assn. and his counterpart from the National Retail Merchant's Assn. have held exploratory meetings on the development of uniform methods of consumer identification, a necessary first step in achieving the standardization needed to make possible a national network of credit transfer systems.

These developments can all be regarded as significant indicators of the imminence of change.

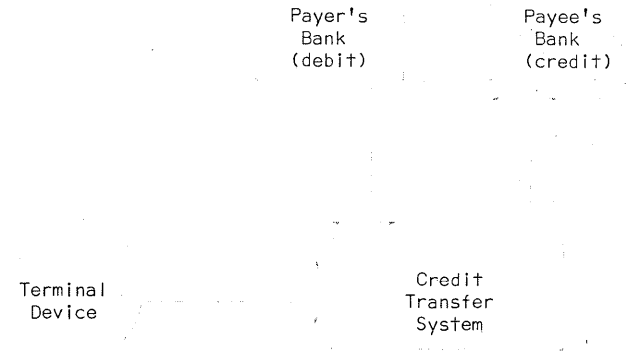
functions of transfer systems

Let us now examine in detail some of the things that automatic credit transfer systems are capable of doing. It is important, first of all, in looking at these systems to understand that they largely eliminate the flow of paper in the form of checks, bills, and invoices. There may indeed be a receipt produced by the terminal device and given to a purchaser at the point of transaction with a copy retained by the merchant for inquiry and follow-up purposes, but this paper stays *outside* the system and does not circulate within it, and, moreover, such a hard copy record is only incidental to the electronic transfer of funds.

The second point is that information flow in the automatic credit transfer system is reversed. In present day check clearing systems, as illustrated by Fig. 1, the flow of information is from payer to payee, then from

Fig. 1 Traditional Check and Deposit Information Flow

Fig. 2 Automatic Credit Transfer Information Flow



payee to payee's bank of account where the check in the form of a deposit is credited to the payee, then from the payee's bank to the payer's bank where the payer's account is debited, with the instrument finally being returned to the payer to complete the transfer cycle. The automatic credit transfer system effects a transaction by first retrieving the payer's account record, and, if sufficient funds are on hand, debiting this record, as illustrated in Fig. 2. The payee's account record,

[4]The reader may have observed that, also during 1965, many banks set up consumer credit card plans, patterned after the long-established BankAmericard. Given the perspective that present-day techniques for the verification and extension of credit are going to be dramatically upgraded, these bank credit card ventures must be viewed more as ill-advised retrogressions than as imaginative breakthroughs into the checkless future.

whether in the same bank or in some other bank that is part of the transfer network, is then retrieved and credited.

A third characteristic of automatic credit transfer systems is that transactions are accomplished in real-time, thus eliminating the lag in effecting transfers of funds inherent in today's check handling systems. The introduction of magnetic ink character recognition and computer processing has speeded the process of check clearing but there still remains a delay of anywhere from several hours to several days before a check makes its way through the clearing procedure to be posted. What the bankers refer to as "float"—the amount of funds for which checks have been written but which have not been collected—is, in the automatic credit transfer system, eliminated.

A fourth distinguishing feature of credit transfer systems has to do with the transformation of credit verification procedures. In discussing these systems, one frequently hears mention of "universal credit cards." Those who use this term exhibit a basic misunderstanding of the nature of credit transfer systems in that *credit* cards as we know them today will be obsoleted and replaced by *identification* cards (or some other form of identification). Today's credit cards, such as the Diner's, air travel or gasoline company cards, represent *prima facie* evidence of credit based upon a prior verification of credit status. They can be issued only to individuals who pass fairly rigorous screening, because they expose the issuing organization to the possibility of loss in the event that the card holder's solvency or repayment proclivities undergo a change after the card is in his possession. For this reason, card issuers are forced to apply not only a tight initial screening (which, of course, necessarily excludes some good risks as well as bad) but must also go through the laborious and expensive process of reissuing cards every few months in order to minimize potential losses. In contrast to these rather clumsy procedures, the automatic credit transfer system permits the issuance of identifying cards to all individuals in the community, since the card in and of itself *has no meaning* in terms of an individual's credit status. It serves only to identify him to the system which can then perform an immediate and up-to-date credit analysis.

kinds of services

Now that we have described briefly the essential characteristics of credit transfer systems, let us consider the kinds of services that could be made available through such systems.

1. Purchase authorization

Before a transaction is consummated, a means must be provided to ascertain the consumer's ability to pay. This the system would do by retrieving the consumer's record to determine if there is a sufficient cash balance in his account to cover the purchase. Because the system operates to credit the merchant's account in real time, it must reserve the right either to authorize or disallow the contemplated purchase. Obviously, this had to be done at the time and point of the sale quickly, conveniently, and without embarrassment to the consumer.

Psychologically, the experience of the consumer at the point of sale is associated in his mind with the merchant in whose establishment he is trading. In order to promote and preserve the relationship between merchant and consumer, the system must not introduce a jarring or undignified flavor into the transaction, or one inconsistent with the image that the merchant has sought to create. The impression of an impersonal and apparently arbitrary refusal to authorize a purchase must be avoided. In the event of a refusal, a minimum requirement would appear to be the interposition of a trained human intermediary, perhaps on the phone or at a special location in the store.

2. Transfer of funds

The transfer of funds between the accounts of payers and payees could, of course, take place either within one bank or between banks that are participants in the system. In both cases, and to a dramatic extent in the case of interbank transfers, there would be substantial changes from today's practice. There would no longer be any check clearing operations, no float, no items returned to the payee marked "insufficient funds," no holds, and no stop-payments. To the system, all transfers would be handled immediately by debits and credits to the designated accounts regardless of the bank in which they were maintained.

3. Overdraft banking

In conjunction with the purchase authorization function, the system might inject credit into a consumer's account to permit a transaction to take place. This is, in a sense, the counterpart of the traditional retail store charge account. These overdrafts might be the result of a debit made at the time of a sale, or might arise as the result of other kinds of transactions where the consumer has preauthorized the system to make payments for him. If the depositor's account, thus overdrawn, is replenished by payroll transfers or other credits within a stipulated period, there might be no interest charge. If the overdraft is not repaid, interest might be charged on overdraft amounts outstanding beyond the grace period.

4. Automatic bill payment

Automatic bill payments are nothing more than preauthorized credit transfers. They would include payments to utilities, mortgage companies, lessors, etc. Sometimes, as in the case of rental payments for example, the periodic payment would be of a fixed amount. In other cases, such as phone bills, the consumer would preauthorize the system to make payment up to a maximum amount on receipt of an invoice.[5] This "invoice" might not be a physical document at all, but an electronic communication generated by the payee's computer system. The credit transfer system, after verifying the authority to pay, would automatically debit the consumer's account and credit the payee's account. If the amount of the invoice exceeded the authority to pay or if there were insufficient funds in the consumer's account and his overdraft limit had been exceeded, notice of nonpayment would be immediately transmitted to both parties.

The overdraft banking feature is an important concomitant to the automatic bill payment function, in that it provides a cushion to facilitate debiting the consumer's account to honor a bill even when his demand funds are insufficient. Thus, it meshes the individual's income cycle to the payee's collection cycle.

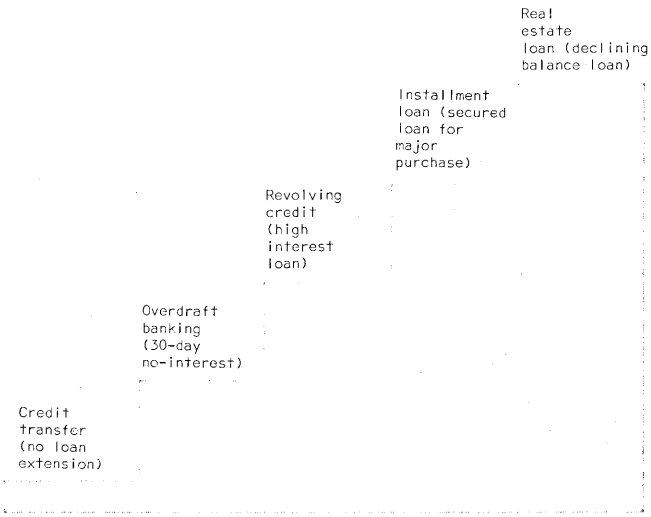
5. Consumer loans

Generically, there would be various levels of consumer credit available through the system, as suggested by the ascending steps shown in Fig. 3. In some cases, the type of transaction would dictate the nature of the loan.

[5]There will, of course, have to be some provision made for handling those bills that the consumer does not wish paid immediately and for reflecting differences of opinion between consumer and merchant. One possibility would be to program into the system an artificial delay in the payment of certain bills. Another would be to place funds in an escrow account when there is a dispute between consumer and merchant that must be settled.

In other instances, the consumer would "graduate" automatically from one class of credit to another. If, in effecting a credit transfer, there were insufficient funds in the demand account, the overdraft banking feature might be invoked. And, then, if the overdraft amount were not repaid within the grace period, it would be converted to revolving credit.

Fig. 3 Steps in Consumer Financing



High-interest revolving charge arrangements are not suitable, though, for large purchases, such as homes or automobiles. Loans for these purposes are secured by a mortgage or other collateral. Such loans would probably continue to be negotiated by the consumer with the bank as at present. The system, however, would play a multiple role. It would assist the bank in rating the consumer as a credit risk. It would credit the loan proceeds directly to the consumer's account, and it would periodically debit the consumer for the installment amount.

6. Payroll distribution

The payroll function constitutes an important connecting link between the bank, the retailer, and the consumer. One essential requirement for expansion of financial services to consumers is the ability to forecast an individual's cash flow. As the probability of forecasting this flow increases, the credit reliability of the individual becomes more firmly established. One general method of controlling cash flow today is the payroll deduction system, and this appears to provide a ready-made, formalized process for permitting the automatic credit transfer system to determine a consumer's ability to generate funds.

Reservation of fixed amounts from the consumer's pay for preauthorized automatic payments should result in reduced financial difficulties for the consumer by minimizing the possibility of an overlimit condition. There should develop an awareness on the part of each individual of his cash flow, since a specific portion of his pay would be reserved for automatic bill and loan payments, with these funds being deducted from his pay before the system transfers the remainder to his account. This increased capability of forecasting income against expenses provides the individual with an opportunity to project cash flow and thus avoid overlimit situations.

The actual payroll mechanism would likely be for large employers to transmit electronically each employee's net pay into the automatic credit transfer system directly from the employer's computer. Alternatively, the system might offer payroll computation service to smaller businesses. In any event, the employer's account would be debited for the total pay, and each employee's account credited with his net pay after deduction of the preauthorized automatic payments.

7. Instant cash

What is theoretically possible—a completely checkless and cashless economy—may in fact be impractical in many situations. This appears to be particularly so when the transaction amount is quite small. It is difficult to visualize an automatic credit transfer being economically viable in the purchase of a newspaper, for instance.

But how *does* an individual obtain cash conveniently, especially since he no longer needs to make regular visits to the bank? Possibly, the automatic credit transfer system might authorize the advancement of cash at certain prescribed locations. Such a transaction would be similar to a purchase authorization. In one respect, it would be different though, in that it constitutes no source of direct profit as in the case of a purchase of goods or services. The instant cash feature may have to be viewed as a cost of doing business, as a "public service" convenience for the consumer.

Obviously, the central theme underlying all these services is the potential for instantaneous transfer of credits for the majority of retail transactions in a community. In the course of accomplishing such instantaneous transfers, the system eliminates checks, deposit slips, retail bills and invoices, and numerous associated documentary processes.

control of the systems

One of the most interesting aspects of credit transfer systems has to do not with their design concepts but with their ownership. There are, it is true, many absorbing problems of economic justification, equipment selection, file security, and the like. But these are subordinate to the question of who shall control the credit transfer system.

• *Banks.* Commercial bankers are able to develop persuasive arguments that the nation's banks are in the most logical position to develop automatic credit transfer capability. They regard this as a logical extension of the fiduciary services performed by banks today. Understandably, the bankers tend to view with distaste the possibility of some intermediary controlling the transfer of information between themselves and their depositors, even if this intermediary might be nothing more than a massive electronic switching center. As if in support of these ambitions, the larger banks are now developing the sophisticated systems capability needed to venture into the automatic credit transfer system arena. And these banks, of course, possess the resources not only to set up the transfer mechanism but to extend credit at the point of a retail transaction.

• *Retail merchants.* It is conceivable that the merchants, instead of acquiescing passively in the introduction of a system by some other agency, might band together in a community to set up a credit transfer system. In fact, the pooling of accounts receivable could be the first evolutionary prelude to full automatic credit transfer capability. The merchants are, however, hampered by a generally low level of experience and sophistication in computer technology and this may consign them to the position of participants or subscribers rather than innovators in introducing the new systems.

• *Credit bureaus.* The nation's credit bureaus find themselves today in most perilous circumstances. They are under severe pressure from their users for more universal and more accurate data. It is demanded, for example, that the increasing mobility of our population be reflected in the credit reports, so that individuals who live, say, in Washington but shop in Baltimore can have their credit records immediately accessible to the Baltimore merchants. It is possible that credit bureaus, at least in

some regions, may grasp the opportunities proffered by automatic credit transfer systems by upgrading and transforming their present functions into an electronic relay center which would interface with the merchants and the banks. It appears likely that those credit bureaus incapable of doing so will eventually perish.

• *Equipment manufacturers.* The equipment vendors may view the emergence of credit transfer systems as an opportunity not merely to supply the rather substantial amounts of equipment involved but to go beyond this in an effort to obtain the additional revenue that will accrue to whatever organization is successful in providing the service. This would, however, represent a rather significant shift in marketing emphasis away from being purveyors of hardware in the direction of being suppliers of service.

• *Communications companies.* Just as the equipment manufacturers might contemplate a shift in their established role, so might the communications common carriers such as AT & T, GT & E, and Western Union. They could logically arrive at the conclusion that they would be willing not only to provide the needed data links and possibly the terminals but to offer a full-scale service for automatic credit transfer.

• *Finance companies.* The major finance companies have a tremendous advantage over the commercial banks, in that many of their systems are already national and able to offer the universality so important to the credit transfer mechanism. The combination of an established national organization and the capability to provide consumer credit should not be underestimated.

• *Entrepreneurs.* If the established organizations, and in particular the banks, fail to move aggressively to exploit the opportunities inherent in credit transfer systems, it is entirely possible that imaginative entrepreneurs may be able to obtain sufficient venture capital to launch automatic credit transfer systems on their own.

• *Federal government.* Because the implications of automatic credit transfer systems are so far reaching, it is inevitable that the federal government will be deeply concerned. And, there is no assurance that this concern will be limited to regulation of the way in which these systems evolve. It is conceivable that the federal government may be impelled to become the owner and operator of these systems. Farfetched? Not when one remembers that the federal reserve system is today heavily involved in the mechanics of routing checks between banks and that the post office has long been in the business of issuing money orders.

It may be that *no* uniform pattern of control will emerge for some time and that implementation pockets will appear at varying rates and under different forms of ownership as the credit transfer idea begins to take hold. Thus, in one community there might be a consortium of commercial banks that persuades the merchants to participate, in another there might be an equipment manufacturer with sufficient leverage to introduce a system as "open for business," and in a third an entrepreneur might succeed in obtaining the cooperation of the banks in establishing a service organization.

If credit transfer systems do begin to evolve in a non-uniform way, the attendant systems and programming problems will be enormous. These potential problems all border on the area of standardization: will the various operators of such systems be able to agree upon uniform consumer identification procedures? Will the terminal devices be of a standard design? Will the rules governing approval of a transaction vary from city to city, depending upon whose system the consumer is dealing with? Will there exist in a metropolitan area one massive credit transfer system or will there be a complex of neighborhood systems tied together by some sort of data network? How can agreement be reached on intersystem message formats so that inquiries can be forwarded from one system to another? These are a few of the unanswered questions having to do with the way in which credit transfer systems will come into existence.

some implications

Regardless of where control is vested, automatic credit transfer systems will have profound implications for many organizations as well as for the individual consumer.

Assuming that the commercial banks, or at least the large ones, attempt to exercise a leadership role, they face a very difficult problem in trying to cooperate to make credit transfer systems operational on a national scale. For there is not, in this country, a true national banking system but rather a patchwork collection of federal and state laws and regulations within which the automatic credit transfer systems must evolve. This can lead to nightmarish difficulties as, for example, those having to do with unit banking regulations.

There are many states which presently forbid a bank to operate at more than one location and where the question must be resolved as to whether the installation of remote terminal devices constitutes branch banking. There is a comparable problem with respect to variations in state usury laws applicable to banks. It may indeed turn out that far-reaching federal intervention will be necessary to modify the diversity of regulations that now envelop the nation's commercial banks. The dual banking system, in which there is co-existence between state and nationally chartered banks, may be one of the casualties of this necessity for standardization.

An almost equally onerous problem to be resolved by the banks is the necessity for restructuring their sources of income. They face, on the one hand, a loss in income from two present sources:

First, their demand deposits may be expected to decrease as the merchants begin to take advantage of their gain in float by reducing balances and investing the funds elsewhere. Remember that the automatic credit transfer system eliminates the float that now exists during the time elapsing between completion of a credit sale and the deposit in the retailer's account of the consumer's check for payment. The banks are today benefiting from this float since these funds (which are, incidentally, interest free) are available for investment by the banks.

Second, the service charge revenue for each check written will begin to dwindle as the checkless society becomes a reality.

It appears, then, that the banks must overcome these losses in revenue by obtaining substantial income from the two chief users of the automatic credit transfer system—the retailers and the consumers. A discount amounting to a percentage of retail sales revenues is one possibility. And perhaps the consumer can continue to pay a service charge that is somewhat less than today's check service charge but is more than sufficient to cover the reduced cost of processing a checkless transaction. Another possibility for augmenting bank income is, of course, the enhanced opportunity to enter the expanding consumer financing field on an unprecedented scale. Here the significance of offering a personal line of credit tied into the demand deposit account becomes evident.

And what of the retail merchants and other suppliers of consumer goods and services? They will benefit from

these systems by no longer incurring the expense of maintaining their own accounts receivable and credit departments, as these will not be needed under the new method of doing business. The costs of preparing and mailing customer bills will disappear, since the individual consumer will receive a statement not from each store with which he has credit, as is the case today, but will instead receive a consolidated statement from the system showing all the transactions that have been consummated through the system over the statement period. In return for these benefits, the merchant will pay a fee to the system, possibly in the form of a percentage of sales volume.

Perhaps the chief problem confronting the retail merchants is that of loss of identity, which has in the past been a stumbling block to participation in community credit card schemes. It is difficult to envision how a merchant will be able "to have his cake and eat it too." If he chooses to remain outside the system in order to retain his identity, he forfeits the benefits associated with participation. It may develop that the more exclusive and lower volume specialty stores will find it desirable to maintain their image by remaining outside the system.

As has been suggested, the equipment manufacturers may be intrigued by the opportunity to provide automatic credit transfer services, regarding them perhaps as a specialized form of time-sharing system. What if the equipment companies are not content to remain as mere suppliers of hardware but seek to become system operators as well and share in the revenues generated by the system? This could turn out to be an extremely dangerous game for them to play, for transfer systems have been rather aptly described as financial information utilities.

The utility analogy is not perfect, but it does hold up in the sense that there cannot be competing systems for automatic credit transfer in a community and that a system must, if it is to be effective, achieve near monopolistic status. Competition in a given community is self-defeating. What merchant would not rebel against the somewhat ludicrous possibility of having a battery of competing terminal devices at his checkout counters? Or what consumer against a bulging wallet full of identification cards required to shop at a variety of establishments? Because of the utility characteristic, any equipment vendor venturing into this new business area will have to ponder over the antitrust implications.

It is no exaggeration to assert that automatic credit transfer systems will force the government into extensive studies of how these systems can best be integrated into our present economic, social, and legal framework. The necessity of intelligent and equitable government consideration permeates the executive, legislative, and judicial branches of the federal government as well as state and local government.

It appears reasonable to assume that the following federal agencies should be and will be intimately concerned with these new systems:

- Bureau of the Budget—national budgetary planning.
- Department of Commerce—business and demographic statistics.
- Treasury Department, Office of Comptroller of the Currency—federal bank regulations. Internal Revenue Service—revenue forecasting and collection, taxpayer identification. Bureau of Engraving and Printing and U. S. mint—currency and coin circulation.
- Federal Reserve System—reserve requirements, credit regulations, and interbank data communications.
- Federal Communication Commission—data transmission requirements.
- Council of Economic Advisors—overall economic implications.
- Department of Labor—employment implications of job displacement and new job creation.
- Department of Health, Education and Welfare—effect on the individual and possibility of automatic welfare payments.
- Federal Deposit Insurance Corporation—effect on individual bank balances and levels of credit.
- Department of Justice, Antitrust Division—antitrust considerations. Federal Bureau of Investigation—consumer identification.
- Department of State—worldwide tie-in of automatic credit transfer systems.
- Post Office Department—decreased volume of business and consumer mail and resultant effect on postal revenues.

Within the legislative branch, there must be an evaluation of antitrust and other control legislation as it might be applied to banks and other organizations attempting to set up credit transfer systems. If the system concept is deemed to be a desirable one for the country as a whole, there should be a legislative climate which fosters the establishment of such systems and avoids smothering them by application of obsolete standards.

The effect of credit transfer systems on our national economy has to be evaluated carefully by many agencies. There should be developed a national economic model which could be operated under the assumption that automatic credit transfer systems existed nationally in order to probe the effects of widespread elimination of float and automatic extension of credit. There are economic implications also in the possibility of building into these new systems a federal and local tax collection capability so that automatic transfers of funds can be made from the taxpayer's account into that of the taxing authority.

These are merely the areas of potential federal cognizance that come most readily to mind. There are, no doubt, others that could be identified and there is, moreover, an equivalent set of problems to be faced by counterpart agencies at the level of state and local government.

And what, finally, about the poor embattled consumer who, having lost the digit dialing skirmish, is now about to be given a universal identification number? It is true that he will be able to jettison all his credit cards, and will no longer have the burdensome job of writing checks and reconciling statements. On the other hand, though, he is going to lose his float. (There have been some consumer attitude surveys which indicate that this problem of loss of float is not too severe from the consumers' viewpoint. Many people *assume* when they write a check that the money has at that point already been transferred from the account). The consumer also will have to find a substitute for his cherished weapon of stopping payment on a check for goods or services that prove unsatisfactory.

But, there will be ample opportunity for human factors specialists and social psychologists to make a fine analysis of consumer attitudes and habits. Meanwhile, there appears to be no fundamental consumer barrier to the introduction of automatic credit transfer systems any more than was the case with digit dialing, zip codes, magnetic ink character recognition, and taxpayer identification numbers.

The public is going to have to learn to live with these automatic credit transfer systems, to accept their benefits and put up with their drawbacks. For there is a compelling technological, historical and economic necessity projecting these systems inexorably forward, and sweeping before them many of the traditional ways of conducting our individual business. ■

(For some further comments on credit authorization problems, see this month's Forum.)

COMPUTERS AND TAX COLLECTION

the i.r.s. system

by PHIL HIRSCH

The world's greatest moneymaker, this side of the U. S. Mint, is a vast adp complex which the Internal Revenue Service has been developing for the past eight years to process income tax returns. Nearly 104 million returns, representing about $118 billion in tax revenue, will be filed during 1966; the new system will handle more than half of them. Next year, when 2 million additional returns are expected, and $6 billion more in revenue, the entire processing job will be computerized.

The focal point of the operation is the National Computer Center, on the outskirts of Martinsburg, W. Va. There, the income and deduction data filed by every taxpayer in the nation is being collected on several hundred reels of magnetic tape. These tapes are organized into two master files—one for individual returns, the other for business returns. The record covers a three-year period in both cases, ending with the last one in which a return was filed.

The master files are the main difference between the new IRS/ADP system and the old one, and the basis of the agency's claim that tax-dodging, a popular U.S. pastime, has become far more risky.

Income tax data flows into Martinsburg from seven regional service centers—located at Philadelphia; Lawrence, Mass.; Cincinnati; Atlanta; Kansas City, Mo.; Ogden, Utah, and Austin, Texas. Each regional center serves a multistate area which includes a number of district offices.

This year, as in the past, most taxpayers will mail their returns to district offices; the remittances will be detached there, and the forms will be forwarded to the regional centers. Taxpayers living in the Mid-Atlantic and Southeastern states who have refunds coming will mail their returns directly to the corresponding regional centers (Phil-

adelphia and Atlanta). Ultimately, IRS wants to receive all returns that way; it would cut handling costs. But permissive legislation, now pending in Congress, must be enacted first.

After being checked and edited at the regional centers, the entries on each form are keypunched. The cards are then read into a 24K Honeywell H-200 computer. On the main pass, the taxpayer's arithmetic is verified, and about 100 validity and consistency checks are performed. For example, the H-200 notices whether the first three digits of the individual taxpayer's social security number are zeros, and whether the gross income entry is less than the amount of the withholding tax. Either situation indicates an invalid return; all of the related data is then printed out on one of several exception tapes. Afterward, the corresponding taxpayers are contacted, either directly or by mail (using forms printed on a 12K H-200 in some cases); the errors are corrected, and the data is fed back to the 24K system.

Meanwhile, the clean tape, representing the mathematically-correct, complete returns, is sent to Martinsburg. Just before it leaves, this tape goes through an edit processing run which arranges the data in IBM 7074 format. This tape, like the others produced by the H-200, contains 556 bits per inch. The tape drives on both Honeywell computers are capable of packing 800 bpi, and are now being modified to operate at this higher density.

the main configuration

Martinsburg has two 7074s, plus a 360/65. Each 74 complex includes a 30K memory, 10 hypertapes and seven standard tape drives. The 360/65 has a total of 22 tape drives—eight accommodate standard reels; the other 14 operate with hypertape or double-dense "super" hypertape. The former records 1511 bytes per inch; the latter, 3022 bytes per inch. Compatibility has been achieved by programming the 74's to produce tapes formatted for the 360. A tape translator re-orders the 360's output to meet the 74's programming requirements.

The basic job performed at the National Computer Center consists of updating the master files. These files, currently on hypertape, are being shifted to super hyper.

In the course of its posting activity, the National Computer Center generates a couple of hundred byproduct tapes. Among these are refund lists which go to a Treasury disbursing office in Birmingham. Some tapes contain cumulative listings of amounts paid and still owed by individual taxpayers. The regional and district offices are the primary users of this information, which supplies the background for these highly instructive get-togethers some citizens have with their district tax collector every year. The cumulative debit and credit listings also enable district and regional IRS personnel to answer the flood of written requests that come in from taxpayers seeking information about payments made and bills received.

These bills, as well as a variety of other forms related to collection and processing operations, are generated from still other output tapes produced at Martinsburg. The tapes are sent to the regional offices, then are cycled through the H-200 to obtain hard copies.

Another program at NCC pulls a given percentage of all current year returns from the master file for subsequent study by IRS auditors. This sample, which includes fixed numbers of returns from given audit categories—i.e. given income, business, and occupational groups involving representative kinds of deductions—will amount to about 10% of the total in 1966. The manual analysis that follows will cut the pile in half, approximately, down to some 5 million returns, which then will be examined in depth.

Most of this output information is recorded on standard half-inch tape to provide compatibility with the H-200s in the regional centers; they, at least at present, can't accept hypertape. The H-200 reads IBM tape marks so the detail doesn't have to be re-formatted.

The cumulative listings of credit and debit transactions, however, are recorded initially on hypertape at Martinsburg. The tapes are fed into a Burroughs Digiprinter which transfers the data to microfilm at a speed of 62,500 characters per second; the film is then sent to the regional and district offices.

Bell and Howell microfilm readers have been installed at each regional and district office. Printout attachments will be added shortly. Currently, if a permanent record of the microfilmed data is required, it must be hand-copied. Actually, this is less of a handicap than it appears to be; most of the hardcopy data needed by IRS regional and district personnel is obtained from Martinsburg.

The 360 and the 74's at the National Computer Center have the capability of being used interchangeably, but actually they handle separate operations. The 360 accesses 8 bytes in .750 microseconds; the 74 requires about 3.3 microseconds to do likewise. As a result, the 360 is used for the longer runs. Typically, it passes through an entire master file, inserting updated accounts and removing accounts that require updating. The processing of each record—for example, the posting of newly-received tax payments—is done on the 74.

IRS purchased the 360 last year, instead of buying another 74. The 360 cost $3.4 million; the 74 would have cost about $3 million. A test run at Martinsburg last December shows what the agency gained by spending more.

The test consisted of passing 340,000 master-file accounts through the 360, pulling out about 10% for subsequent posting, and re-filing an approximately equal number of others that had been removed and posted the previous week. The whole run was completed in 12 minutes, 50 seconds—nearly four times faster than the 74 could complete the same job. Run on a 360/62, which accessed eight bytes in 1 microsecond, this job would go even faster on the Mod 65 with which IBM replaced the 62; the 65 accesses eight bytes in .750 usec. It is probable that the present configuration at Martinsburg is 4.3 to 4.5 times faster than the 7074.

There has been a similar improvement in efficiency at the regional service centers, which originally were equipped with 1401's. Starting in 1964, these units were replaced with H-200's and the 1401 instruction tapes translated by Honeywell's Liberator program into H-200 format.

outsider moves in

The H-200 main claim to fame, and the chief reason IRS switched from its long-standing total reliance on IBM, is the Honeywell equipment's four-channel programming capability. On a single run, data from individual and business returns can be transferred from cards to tape at the same time taxpayers' bills and mailing labels are being printed. The speed of each operation is reduced about 50% below what it would be if handled individually, but there is still a significant overall time saving. When two or three processing operations are handled together, the slowdown is proportionately less.

Although IRS prefers to mention the positive benefits of the new system—its ability to crank out taxpayer refunds faster, for example—the closing of tax collection loopholes clearly represents a much greater improvement.

No one knows for sure how many Americans don't pay all the income tax they owe, but a study the agency conducted a few years ago is indicative. The study encompassed several thousand individuals who reported adjusted gross incomes of less than $10,000; 59% of their returns

contained errors—intentional or accidental—which reduced each individual's liability below what it should have been.

Until the recent past, the revenue service had all it could do to keep this percentage from growing. Even though a small army of examiners was employed, the equivalent of several large armies was needed to do a thorough job.

The examiners managed to check all the arithmetic on all business tax forms, but they didn't go beyond the first page of the individual return. This meant that if a taxpayer subtracted his total deductions from his total income correctly, and picked up the proper figure from the tax table at the back of the form, he had little to worry about. Whatever statistical fairy tales might be spun on the inner pages wouldn't be detected unless his return was among the one in 20 unlucky enough to be subjected to a detailed audit.

Some ingenious ways of profiteering from this situation were devised by a large number of taxpayers. A popular swindle consisted of filing two, or more returns, and requesting a refund on each. Now, such double bookkeeping is caught automatically, by referring to the master file.

The taxpayer who does no bookkeeping at all and sends in no return is caught in basically the same way. Each master file includes the individual's wage, dividend and interest income. Employers, banks, and corporations are required to report such information to the government periodically. Thus, by comparing the individual master file with the individual income tax returns received, it's a relatively simple matter to locate the non-filers.

The new system also does a much more thorough job of checking the taxpayer's arithmetic, and verifies certain key entries—such as the credit claimed for estimated tax payments—which formerly were accepted largely on faith.

Roughly $5 billion of the taxes collected in 1966 will be the result of what IRS, somewhat euphemistically, calls its "service activities"—the collection of taxes from individuals and businessmen who have understated their obligations or ignored them completely. IRS officials don't know precisely how much of this $5 billion will be attributable to the new hardware. But it's likely, judging from recent history, that the equipment investment—which totals about $17 million so far—will pay a handsome dividend.

During 1964, in the Southwest and Mid-Atlantic regions alone, IRS collected an additional $9.5 million in taxes simply because it was able to check taxpayers' arithmetic more thoroughly. These were the first two regions completely phased into the master files at Martinsburg. Since then, three others have been added, and next year, the process will be completed. The same rigorous scrutiny will then be applied to the arithmetic on all individual returns. This, of course, is by no means the only loophole closed by the new system, nor is it the most expensive one.

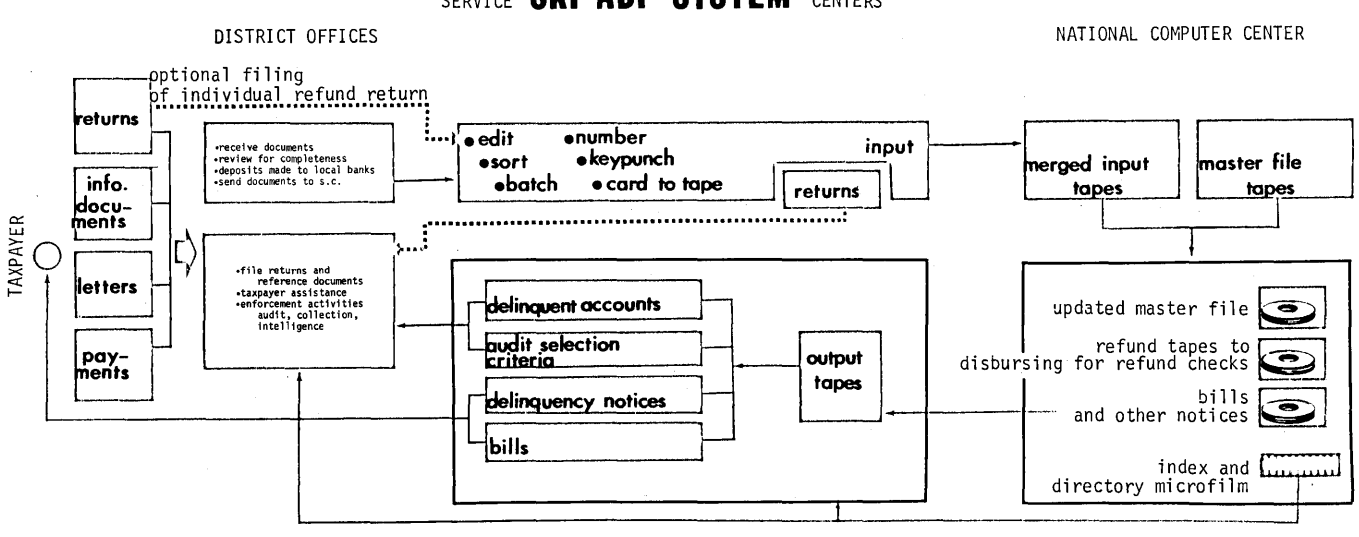
labor-saving device

Since 1960, when IRS began phasing in the new system, about 6,200 of its employees have become redundant. By next year, when the phase-in is complete, the workforce engaged in returns processing and tax collection will be down to 1,800. In 1960, it amounted to 12,000. An IRS official "guesstimates" that this reduction in force represents a saving of something like $50 million a year.

The total labor saving produced by the new adp system is probably greater, because without it IRS certainly would have increased the returns processing and tax collection force to handle the growing workload. Officials indicate that significantly more people would be required, but hesitate to be any more specific.

IRS is extremely proud of the fact that none of its displaced employees has been fired. Retirements, the normal attrition, and training programs have accounted for all employees affected by the implementation of dp. The agency's current policy is to transfer a displaced employee, then train him concurrently on the job and in the classroom to fill a specific position.

Some tax examiners automated out of their old jobs were retrained as programmers. To set up the new dp system required a tremendous amount of software—about 2,000 pages of instruction handbooks, containing some 300,000



symbolic and English-language instructions—and when the job began, IRS had only a handful of technicians qualified to produce it. Now, there are 75 analysts and about 225 programmers. Except for three or four troubleshooters —IRS calls them "resident programmers"—at each service center and at Martinsburg, this staff is located in Washington.

IRS operates an extensive training program to keep these slots filled. The course lasts five months. To qualify, the applicant must pass the Federal Service Entrance Examination, IBM's Programmer Aptitude Test, and a personal interview. Also, he must be a college graduate or have enough programming experience to balance the lack of a degree. The trainee enters school as a Civil Service Grade 5 or 7, which pays, respectively, $5,181 or $6,269 per year.

He learns four kinds of programming language—actual (1:1), symbolic, Honeywell's Easy Coder, and IBM's Auto Coder, in approximately that chronological order. "Our programs generally are written in a combination of actual, symbolic, and one of the other two," explains Edward Ellis, assistant chief of the program development branch. "Using actual and symbolic reduces the need to employ macro-instructions, which often wastes core storage capacity and tends to increase processing time."

The first month of the course consists of fundamentals —e.g., a description of the IRS/ADP system and organizational chart, study of EAM equipment, computer concepts, block diagramming, principles and elements of system design. Approximately the next two months are devoted to the H-200. During the latter half of this period, the student does a complex H-200 programming exercise, including analysis of the system application, preparation and testing of the instructions. The next two months are devoted to the 7074. Here again, the student has to prepare and test a program.

As yet, the training course hasn't been modified to include the 360. IRS has trained several of its journeymen programmers to write instructions for this new equipment, in a course lasting about five weeks. According to Ellis, the agency may tack a modified version of it onto the training given new recruits; possibly, the time now devoted, in that course, to fundamentals, the H-200, and/or 7074 will be telescoped to keep within approximately the present time span.

After he graduates, the trainee is assigned to a programming group. Immediately, he gets a work assignment —for example, a portion of the programming needed to analyze the Form 1120 corporate tax return. A recent graduate is generally responsible for about 10% of a programming job like this, while a more experienced man writes up to half of it. The 10% share involves somewhere between 100 and 150 pages of instructions. The programming group usually finishes writing the instructions in about two months, and spends another month testing its creation.

During his first six months on the job, the graduate is considered a trainee. At the end of this period, the Grade 5's who make it are promoted to Grade 7. Six months later, they, as well as the programmers who started out in Grade 7, can qualify for promotion to Grade 9. Two to three years after graduation, the programmer is usually a Grade 11, and he's earning about $9,000 a year.

Approximately 10% of the trainees wash out before graduation, Ellis reports. He doesn't have figures on subsequent attrition, but guesses it's slightly higher—perhaps 15%. Generally competition from private industry isn't much of a problem, he adds, except at graduation time. "Once a man has been on the job long enough to receive a couple of promotions, he's earning as much as a private company is willing to pay for the same level of skill and experience."

the search for scanners

Although the new dp system has streamlined a good deal of the old returns-processing job, there are still some problems. Weighing down the input side of the operation like millstones are several thousand keypunch machines, and eliminating them is the next major order of business.

In a typical year, IRS keypunches some 30 billion digits of information, according to William H. Smith, assistant IRS commissioner for planning and research. Actually, he adds, the figure is closer to 60 billion digits, since most entries are key-verified. At the Mid-Atlantic region service center in Philadelphia, it took 2,700 keypunch operators to handle the workload during last year's filing period. The others used crews of approximately the same size.

The first reduction in this workload will be small but significant: in June, Rabinow Engineering Co., a Control Data Corp. subsidiary, is scheduled to deliver a single-font optical scanner designed to read numerics off a variety of "turnaround" documents faster and more accurately than they can now be keypunched. These are documents that IRS sends to the taxpayer and then gets back; a typical example is a statement of taxes due. The Rabinow scanner, which will utilize the ASA X3.1 type font, is to be tested at the IRS regional center in Atlanta until the end of the year; afterward, if all goes well, all regional centers will be similarly equipped.

The Rabinow model 915/Page Reader accommodates documents measuring from 4x2½ inches to 12x14 inches, and reads 370 characters, or 37 linear inches, per second.

Phase two of this program will consist of developing a multifont scanner. The specs are scheduled to be released within the next few months; IRS hopes to have a test underway "sometime in 1967" and equipment on-line about six months later, says Smith. "We plan to use hardware that's already developed, instead of funding additional R&D in this field."

The interest in character recognition equipment comes naturally. Each year, the revenue service receives about 125 million dividend and interest reports from banks and corporations, plus approximately 125 million wage summaries from employers. Some of these information returns are now being put on mag tape at the source, but that solution to the keypunch problem has only limited value; not everyone owns a computer. "What we're looking for," says Smith, "is a multifont scanner that will read several type faces at very high speeds in relation to our workload volume, and provide advanced error-detection and correction capabilities."

The biggest part of the keypunching chore, of course, consists of tax returns. IRS has asked the industry to submit proposals by next April 15th covering equipment able to cut the cost and increase the speed of this job. A system that would allow a human operator to transcribe visually-read entries directly onto computer input tape is one possibility. There are many others, says Smith, such as the use of a zero-balancing adding machine as the input device, or a computer that would prove the work of a whole battery of keypunch machines and subsequently generate a tape that could be fed to the H-200.

The official request for proposals contemplates delivery of a pilot model direct-entry system by November, 1966. The test will last until March, 1967. Then, "assuming full-scale implementation" in the words of the proposal request, "sufficient follow-on equipment would be procured to handle the total workload at Chamblee (Atlanta) and one other regional service center of comparable size, by July 1, 1967. The other five service centers would be equipped with the new system by January 30, 1968." ■

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CIRCLE 16 ON READER CARD

COMPUTING AND TAX ACCOUNTING

the need for remote consoles

by EDWARD K. YASAKI

Each year at this time, even people whose minds are trained to associate the 1401 with IBM and the 1004 with Univac are quick to match up the 1040 with income-tax payment. The IRS form with the marginal notation, "Attach Check or Money Order Here," brings in a lot of money to the federal government, and starting this year will do the same for Computax Corp., El Segundo, Calif.

Owned jointly by Commerce Clearing House, Chicago, and Computer Sciences Corp., El Segundo, the newly-formed corporation is geared up to handle the computer processing of as many as 575,000 tax returns, which would produce revenues of $6.6 million.

It is the largest of perhaps a dozen or more such computerized services now being offered on local, regional, and national bases. Available only to the professional tax-preparer, Computax is being used by every major CPA firm in Los Angeles, Chicago, and New York City—exactly where the firm has its three processing centers—and by a total of 4,500 accounting organizations nationally. By the nature of the system's capabilities and the pricing structure, it is not being used by the "corner drugstore" tax man. If you're being charged less than $15 to have your returns prepared, it probably wouldn't pay your tax accountant to go the Computax way.

More in your line would be something like Unitax, a similar service developed by the Skousen Tax Service, Montrose, Calif. Unitax, expecting to process 120,000 returns this year on an 8K 1401 at a service bureau, charges an average $3.20 per return, as against $11.50 by Computax. It's for the smaller folk, the computer run being used only for pages 1 and 2 of the 1040 form and its California income-tax equivalent (form 540).

By contrast, Computax prepares the fancier returns that include the declaration of estimated tax, and even the farm schedule. Skousen, however, supplied the taxpayer interview forms around which CSC wrote its first program for the preparation of returns. In that first year, 43,000 returns were processed for Skousen, similar to what Unitax is now doing. Analysts at CSC spent the remainder of that year designing new interview forms and writing a new and enlarged program for the Univac 1107.

Enlarged again this year, the 75,000-instruction program, consisting of some 23,000 COBOL statements, processes a return in an average of six seconds. And yet the turnaround time—from receipt of interview forms submitted by accountants to the mailing of completed tax forms—is five days. "More than half of that six-second throughput time is overhead," says Daniel R. Mason, Computax president. The 65K 1107 holds only half the program, Mason says, and must take two swipes at each return. Still, this being essentially a paper-handling service, the computer operation is almost incidental.

Picture, if you will, the last two weeks in March, when

up to 155,000 returns could be processed by Computax. (This is determined from schedules submitted late last year by tax preparers who signed up for the service). This anticipated volume has necessitated the availability of 2,500 keypunch operators in the final week of March, alone. All outside help, the girls are employed by Service Bureau Corp., Statistical Tabulating Corp., and Control Data Corp.

"We have looked at optical scanners on the market today," says Mason, who is looking for a way around the keypunching snag. But this, it seems, is no solution yet. "I think it will be many years before scanners will be able to read handwriting." Also given a try but rejected as being of no substantial improvement over the punching of cards was a keyboard-to-mag-tape data recorder. The keypunching, of course, is the most expensive step in the process.

Before these girls receive a lick of work, however, the input forms sent in by the tax preparer are scanned by accountants whose job is to find obvious omissions of data. Phone calls are used to handle any that are found. Each set of forms is then split up so that no one keypunch girl sees the entire return of an individual.* An average return takes 46 punched cards; including the verification, two returns an hour is the average per girl. On hand at the start of the year, and due to be used up by mid-year, were 30 million cards.

When the cards are brought back, they are put on tape (via 1401), processed on the 1107, and the output tape placed on a 1401 printer. This is loaded with three-part forms (original and two carbons) preprinted with such tax forms as the state and federal and their respective schedules. Using the Moore Business Forms model 251 burster-decollator, the forms are trimmed, burst, and the carbon paper removed. They must then be collated—one copy of one return consisting of as many as 70 sheets of paper (the average: 16-17 pages.) Following last year's time-consuming and error-prone method of hand-collating these forms, Computax this year has installed custom-designed, selective collators costing $90K each. With 20 pockets, these 37-foot-long units are said to be able to assemble up to 5,000 sets of returns an hour.

For each return, the accountant receives an average of 50 sheets of paper. Thus, a computer-based service turns out to be a test of paper-handling ability. He who takes longer than the contracted amount of time to do this work, or who collates sheets of paper inaccurately, finds himself with an inordinately light workload the following year.

But as long as the computer people find this venture profitable, accounting houses seem to be happy, too. According to a survey by Dun & Bradstreet, made for Computer Sciences, the average return by the average accountant takes 5.8 hours. By using the computerized system, this is cut by more than half, to 2.4 hours.

Still, that's a heap of paper to be moving. Why not send reels of mag tape to the IRS? "That's a possibility," says Mason. "But sometimes changes are made on the returns by the accountant, possibly because his client forgot to mention a contribution made during the year.

"A more interesting possibility," Mason continues, "is to have input/output devices in the accountant's office. Let him use a keyboard to enter data into a time-shared system. We anticipate doing this within two years."

*This is but one of many precautionary steps taken to maintain the confidential nature of information being handled. Some accountants take it one step further: they send in forms without names, only code numbers, and fill in this information after they are returned from the service center.

Likening the 1040 form to a history book, filled with a chronicle of last year's activities, Mason says: "An accountant should have more than a historian's function. He should have some control over that activity." In the corporate world, he adds, tax implications are a big determinant of business decisions. It should be the same with the individual.

"Through data communications and time-sharing, the accountant will be able to answer almost instantaneously the 'what if' kind of question: 'What would happen if I sold my house this year?' 'Should I pay my property taxes all in December, instead of waiting until next July?' "

This capability, allied with the development of data banks and information utilities, may be a while in the making. With technical backing from Computer Sciences, however, Computax—probably more than any other tax service—appears to be in the best position to implement it. But CSC, which recently sold 50% plus one share of Computax to Commerce Clearing House, publishers of reports on tax and business law, now faces another problem: a law suit against the Computax service.

Stemming from the use last year of franchised dealers to sell the service, the suit charges CSC (then sole owner) with improperly terminating the dealer contract. (Commerce Clearing House now markets the service). In a countersuit, CSC is charging that sales did not meet the contractual quota set. And in separate actions, yet to reach the courts, there are also charges of errors in the computation (CSC claims GIGO) and undue delays in the delivery of some returns (no contract turnaround time was set, says CSC).

Franchised dealers are being used for a similar service by Computers for Industry & Business, New York City. This system, developed concurrently with but independently of Computax, is a product of Robert Philipson & Co., a CPA firm in Washington, D. C. The Philipson firm claims to have been the first to send computer-prepared returns to the IRS, these being the '62 taxes prepared in '63. Starting by field-testing with its own clients, Philipson recently sold the system to CIB, which expects this year to process 25,000 returns. Next year's goal: 100,000.

Tooling up for 175,000 returns, but figuring it will process less, is Litton's Monroe Data Processing Div., which recently purchased the Datatax system. It was developed by Frank Hubert & Assoc., Albuquerque, N. M., tax preparers. Field-tested in '64 with 2,000 returns, it marketed nationally for the first time this year, using Monroe's processing centers in Orange, N. J., Chicago, and Redwood City, Calif. Each is equipped with a 12K 1401; in a fourth center, Albuquerque, a 65K 360 will run full-time handling only tax returns. (The other centers will also be handling the monthly financial statements that Monroe markets to small accounting firms and private firms—a ready market for its tax-return preparation service).

Still another service is FAST-TAX, a product of Computer Language Research, Inc., Dallas, Texas, a company founded to develop and market the Cleartran compiler for the 1620. The standard five-day turnaround time is offered (one-day service if punched cards are submitted), but only individual federal returns are handled (as with Datatax), and the average charge per return is $8-10. Processing is by a 40K 1620 with disc pack. Anticipating 360-processing next year, FAST-TAX is still in the throes of its first year.

Newcomers to computerized tax accounting would do well to listen to Computax's Dan Mason. "In the first year, it isn't too bad," Mason says. "But when the volume reaches upwards of 75,000 watch out." That's when a firm learns that there's much more than tight coding and the efficient use of computers involved in this hectic paper-shuffling venture. ■

THE IMPACT OF HARDWARE IN THE 1970's

the coming system imbalance

by L. C. HOBBS

During the course of a study for the Office of Naval Research on "Technology Applications for Tactical Data Systems" in the 1970-1980 era, we have been impressed with the truly significant progress and changes that will be made during the next five years in some types of equipment in computer centered systems and, also, by the relative lack of progress that will be made in other types of equipment. This is equally as true for commercial systems as for military systems—perhaps to an even greater extent. The lack of understanding of the impact and implications of these differing rates of progress on future systems by the majority of those in the field should be a source of serious concern. Although there is a general awareness that progress appears to be faster in some areas than others, very little is being done about it.

Realization of the tremendous potential offered to users of computers and data processing systems by the almost incredible progress in integrated circuits and other batch-fabrication technologies will be seriously limited by the system imbalance resulting from the lack of comparable progress in peripheral equipment, such as large capacity mass memories and input/output equipment. Some of these problems will be pointed out in this paper and their impact on future systems will be considered.

The hardware for implementing system requirements can be conveniently grouped into four major categories, as follows:

1. Input/output equipment
2. Components and packaging techniques
3. Storage
4. Displays

In some cases it is conceptually difficult to draw a clear-cut line separating particular pieces of equipment into one of these categories or the other. For example, magnetic tape, which is basically an off-line storage medium, is frequently considered input/output equipment. Displays are a form of input/output, but they are considered sufficiently different from other types to justify separate classification.

Some of the major types of hardware in each of these categories include:

Input/Output Equipment—keyboards, character or print readers, magnetic tape, punched paper tape, punched card printers, and plotters.

Components and Packaging—logical circuits for implementing control functions and arithmetic or logical operations, registers or small high-speed control memory, analog circuits, and packaging and interconnection techniques.

Storage—main internal memory, on-line solid-state mass memories, on-line electromechanical mass memories, off-line bulk storage, associative memories, and read-only memories.

Displays—large screen displays and console displays.

The present state-of-the-art in hardware can be indicated by the characteristics of a few selected items that might be used in a typical system:

Magnetic tape units—20,000 to 200,000 characters per second

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5 to 20 million characters per reel
Printers—600 to 1500 lines per minute
120 to 130 characters per line
Logic circuits—5 to 20 nanoseconds propagation delay per stage, clock rates of 1 to 10 megacycles
Magnetic core matrix memories—1 to 6 microseconds cycle time
2,000 to 64,000 words capacity
Magnetic disc files—20 to 200 milliseconds access time
40 to 250 million characters capacity per file

In most cases, these characteristics do not represent extremes but rather a range of typical values of equipment commercially available today.

capabilities anticipated by 1970

In analyzing and evaluating research and advance development efforts presently underway in different areas of hardware technology during the ONR study, it has been apparent that the most significant advances will be made in memories and logical components. Although there will be improvements in input/output equipment, minimizing the need for input/output in the conventional sense offers the best hope for overall systems improvements. Integrated circuit technology will bring revolutionary changes in the size, cost, and reliability of logical components. Lesser improvements will be realized in circuit speed. Memory technology will provide significant improvements in speed, capacity, cost, reliability, and size.

The major improvements in displays will be in cost and in the determination and implementation of the proper functions from the user standpoint. The cathode-ray tube will probably remain dominant as the visual transducer for console displays through 1970, but there are several new techniques for flat-panel, digitally addressed displays presently under development that may eventually replace the CRT in many applications. The advances in memory and logic component technologies will permit significant improvements in the logic and memory portions of console displays.

Advances anticipated in input/output equipment, logical components, storage, and displays will be discussed in greater detail.

There are three major approaches to improving the performance of future systems with respect to input/output equipment. These are:

Improvements in the performance of present types of input/output equipment.

Development of new types of I/O equipment that are not in widespread use at present.

System organization approaches that minimize the need for conventional I/O equipment.

Each of these approaches will play a part in performance improvements in future systems. However, unless much greater effort is placed upon the development of non-mechanical input/output equipment, the best hope for future systems probably lies in developing system techniques that minimize the need for input/output equipment.

Almost all present types of input/output equipment are electromechanical. This imposes limitations on the improvements that can be achieved and on the ability to utilize the benefits of batch-fabrication of electronic and magnetic components. Although these electromechanical input/output equipments will limit systems performance, the effect on systems cost and reliability is even more serious. The performance limitations could be overcome to some extent by using a larger number of I/O units, but this further accentuates the cost and reliability imbalance with respect to the central processor and memory.

Performance characteristics anticipated by 1970 for some of the principal types of conventional input/output equipment are shown in Table 1. Examination of these characteristics will indicate performance improvements of less than one order of magnitude and in most cases of less than two-to-one over equipment commercially available today. For example, speeds available today of 200,000 characters per second for magnetic tape units and 1,500 lines per minute for impact type printers were cited previously. Punched paper tape is not included in Table 1 because it is believed that incremental magnetic tape readers and recorders will replace punched paper tape equipment for most high performance applications. Incremental magnetic tape equipment will be cheaper for high performance, will be more reliable, and will utilize tape records and formats that are completely compatible with high speed conventional magnetic tape units.

Table 1 Input/Output Equipment Characteristics Anticipated by 1970

Magnetic tape units	300,000-400,000 char/sec read write rate	2000-3000 char/inch density
Incremental magnetic tape		
Recorders	800-1000 char/sec record rate	800 char/inch density
Readers	500-600 char/sec read rate	556 char/inch density
Punched cards		
Punches	300-500 cards/min punch rate	
Readers	2000-3000 cards/min read rate	
Line printers		
Impact type (multiple copy)	1500-2000 lines/min	64 character types 132 char/line
Non-impact type (single copy)	3000-5000 lines/min	64 character types 132 char/line

new types of i/o equipment

Several new types of input/output equipment are under development that offer promise for performance improvements in future systems. These include:

Character recognition and print readers
Voice recognition and voice output
Non-mechanical keyboards
Graphic input
Solid-state replacements for magnetic tape equipment

Some of these, such as optical character readers, are in limited use at present while others, such as voice recognition equipment, are probably 10 years or more away.

The term character recognition is applied to a broad range of devices from relatively simple ones capable of reading controlled and highly stylized magnetic ink printing on bank checks to ones capable of reading 15 or 20 different type fonts on pages of printed documents. By 1970, equipment capable of reading 2,000 to 3,000 characters per second from a printed page should be available. Advances in integrated circuit logic components and memories, discussed later, will provide significant reductions in cost since the implementation of flexible character recognition equipment involves complex logical functions.

Research into voice recognition and voice output techniques are being supported in a number of organizations at this time. Limited voice output equipment capable of outputting canned messages is available now and some equipment capable of putting together recorded words to make up a message is operational in special applications (e.g., the stock exchange). However, equipment for *truly* synthesizing voice output from alphanumeric information is still in the research stage. Equipment for recognizing

spoken messages as computer input are in the early stages of research. It is too early at this time to predict any cost and performance characteristics for devices of this type. However, developments in integrated circuits and batch-fabricated memories will greatly reduce the cost for this type of equipment also.

Keyboards have always played an important role as a man to machine-language transducer. This is true both of independent input devices (e.g., keypunches) and of input portions of consoles providing man-machine interaction. Present types of electromechanical keyboards have suffered from reliability problems and have required the user's fingers to operate in a basically flat rectangular area. New types of keyboards are being developed that do not involve mechanically moving parts and that may permit more design freedom from the human factors standpoint. These include pneumatic, optic, and piezo-electric techniques.

Solid-state replacements for magnetic tape may improve the speed and reliability available for this type of input/output function, but cost competition with magnetic tapes is questionable. At least two different programs are underway to develop solid-state storage modules that could be plugged into read-write electronics in a manner somewhat equivalent to placing a reel of tape on a tape unit. If this proves feasible and economical, the input/output and off-line storage functions presently provided by magnetic tape could be provided by high-speed, high-reliability devices and media with no moving parts.

The goals for one development program of this type are 4 million characters per module, read-write rates in the order of 2 or 3 million characters per second, and costs of approximately 0.015 cent per character for off-line storage. A further advantage that would be offered by this particular approach is random access (in 1 usec) to any block of data within a storage module on the read-write unit in comparison to the strictly serial access of magnetic tape. The read-write unit would have approximately 1/10th the power requirements and weight of a magnetic tape unit and about one-half the size. If a device of this type provides random access to a block of data in the storage module, it could also be used as a replacement for electromechanical on-line mass memories such as magnetic discs, magnetic drums, and magnetic card files.

In large data base systems the greatest improvement in the performance of input/output equipment can be achieved by avoiding I/O operations wherever possible. By keeping the data within the system and by capturing data at the source, much of the need for conventional types of input/output equipment can be reduced. For example, the need for voluminous printed reports can be reduced sharply if the user is operating on-line with the processor through an efficient console. When any part of the data base within the system is rapidly available to the user upon request, he will have little need for large reports that are used for occasionally looking up printed results—particularly since these may be out of date by the time they are used. In general, any effort to increase the extent to which systems are "on-line" will tend to reduce the amount of conventional input/output equipment in the system. To achieve the improvements possible in this area will require a combined effort of users, programmers, hardware engineers, and systems planners and designers.

logical components

For the past five to seven years, discrete component semiconductor circuits have dominated the computer field as logic components. A number of alternatives to transistor and diode electronic circuitry have been proposed but none of these has proven superior for the majority of applications. These alternatives include cryogenic logic, fluid logic, all magnetic logic, and optical logic. Cryogenic and optical logic are yet to be proven feasible. Fluid and magnetic logic offer some advantages in slow speed applications, such as the implementation of control functions in input/output equipment. However, semiconductor components in their new guise of integrated circuit technology will be dominate for the foreseeable future—probably for the next 10 to 15 years at least.

The major types of integrated circuits presently under development with characteristics anticipated by 1970 and brief comments on the advantages and disadvantages of each are shown in Table 2. The implications of the circuit speeds shown in Table 2 can be seen by comparing them with the 30-nanosecond propagation delay and 1.6-megacycle clock rate presently quoted for the IBM 360 model 40 and the 4-nanosecond propagation delay and 5-megacycle clock rate quoted for the large-scale model 70. However, the effect on system cost and reliability, which are not shown in Table 2, will be much greater.

The speeds shown in Table 2 for different types of circuits are chosen to be realistic, but many in the semiconductor industry will consider them overly conserva-

Table 2 Major Types of Integrated Circuits

Technology	Performance Anticipated by 1970	Comments
Hybrid discrete/ thin-film circuits	1 to 10 ns propagation delay 5 to 20 mc clock rate	Useful where high ratio of passive to active components is required (e.g., linear circuits) and where higher power capability is required. Higher cost and probably lower reliability.
Monolithic circuits	0.5 to 10 ns propagation delay 10 to 50 mc clock rate	Low cost, high speed, and high reliability. High value and high tolerance passive components are very difficult, but the use of extra active elements can help compensate for this.
Hybrid monolithic/ thin-film circuits	1 to 10 ns propagation delay 5 to 20 mc clock rate	Compromise between the advantages and disadvantages of discrete components and monolithic circuits. More expensive than monolithic circuits but useful for linear circuits requiring higher tolerance passive components.
Metal-oxide-semiconductor (MOS) circuits	20 to 100 ns propagation delay 2 to 10 mc clock rate	Simpler to make and easier to fabricate large arrays of interconnected circuits. Lower power consumption. Speed approximately one order of magnitude slower than monolithic circuits.
Silicon-on-sapphire circuits	20 to 100 ns propagation delay 2 to 10 mc clock rate	Fabrication suitable for large arrays. Promising, but presently being actively pursued by only one company.
Active thin-film circuits	Too early to predict	Potentially cheaper and easier to fabricate very large arrays. Feasibility is not proven and utilization much further away.

tive. Failure rates as low as 0.0005 to 0.0001% per 1000 hours are anticipated. Costs are expected to range between 3 and 5 cents per circuit in large interconnected circuit arrays. The cost will be somewhat higher for linear circuits requiring thin-film passive elements and somewhat lower for repetitive functions (e.g., storage arrays) using large MOS arrays. These figures are intended to indicate cost potentials that can be realized by semiconductor technology. However, the ability to achieve these costs is dependent upon the use of large interconnected arrays of circuits and, hence, upon the computer industry's ability to develop logical design and machine organization techniques permitting and utilizing such arrays.

Since packaging and interconnections are major factors in the cost of an integrated circuit, the cost potentials stated above can be achieved only by batch fabricating large arrays of interconnected circuits in a single package. This raises many difficult and conflicting questions, such as packaging design, maintenance philosophy, flexibility, and functional logic segmentation, which time and space do not permit covering here.

storage

Several different techniques for batch fabricating solid-state electronic or magnetic storage devices will provide improvements in internal storage costs and reliability compatible with those for integrated circuit components. Very large capacity auxiliary storage requiring electromechanical devices will probably continue to be a problem area.

In considering storage in the broad sense, it is helpful to divide storage requirements into four major categories:

Registers and high-speed control memory
Main internal storage
On-line auxiliary storage
Off-line auxiliary storage

Because of the wide difference in characteristics and cost, it is also helpful to differentiate between solid-state on-line auxiliary storage and electromechanical on-line auxiliary storage. A particular type of storage technology may be useful in more than one of these categories but the trade-offs between capacity, speed, and cost will vary with the category. The characteristics anticipated for solid-state storage devices in 1970 are shown in Table 3, and those for electromechanical auxiliary storage devices are shown in Table 4 (see p. 41). The implications of the memory speeds shown in Table 3 can be seen by comparing them with the main internal memory speeds of 2.5 microseconds for the IBM 360 model 40 and 1 microsecond for the large-scale model 70. However, again, the effect on system cost and reliability will be much greater. The characteristics shown in Table 4 for electromechanical auxiliary memories compare with present disc file access times of 20 to 200 milliseconds and capacities of 40 to 250 million characters.

Solid-state electronic and magnetic devices are applicable to registers and high-speed control memories, main internal memories, and on-line auxiliary storage, while electromechanical storage devices are applicable primarily to large capacity on-line and off-line auxiliary storage. As discussed previously, some off-line auxiliary storage devices, such as magnetic tape units, are also considered input/output equipment. In fact, the distinction between off-line auxiliary storage and I/O equipment is somewhat gray, based largely upon whether it is used to store information generated by the processor for its later use, to enter data initially into the system from the outside world, or to transfer data from the system to the outside world.

The costs of storage will vary with speed and capacity and the particular technique employed. The following costs for given categories of storage, including storage media and all mechanical and electronic components necessary to provide an operating memory, are anticipated by 1970:

Registers and high-speed control memory—2 to 5 cents per bit.
Main internal memory—1 to 3 cents per bit.
Solid-state random access on-line auxiliary storage—0.2 to 1 cent per bit.
Electromechanical on-line auxiliary storage—0.001 to 0.01 cent per bit.

Table 3 Storage Device Characteristics Anticipated in 1970

Type of Storage	Registers & High-Speed Control Memories: Typical Capacity (Words)	Registers & High-Speed Control Memories: R/W Cycle Time	Main High-Speed Internal Memories: Typical Capacity (Words)	Main High-Speed Internal Memories: R/W Cycle Time	Solid-State On-Line Auxiliary Storage Devices: Typical Capacity (Words)	Solid-State On-Line Auxiliary Storage Devices: R/W Cycle Time	Comments
Integrated Ckt. Arrays	256	50 ns	0.01×10^6	0.2 us			Most promising for very high speed registers and control memories.
MOS Arrays	512	250 ns	0.02×10^6	0.7 us			Promising for low cost intermediate capacities; volatility is disadvantage.
Planar Thin-Film	512	100 ns	0.1×10^6	0.5 us	2×10^6	1 us	Promising for fast control memories, possibly for on-line aux storage; questionable for main internal mem.
Laminated Ferrite	512	150 ns	0.1×10^6	1 us			Reasonable yields not proven for capacities over a few hundred words; actively pushed by only one company.
Plated Wire	512	250 ns	0.2×10^6	0.5 us	4×10^6	1 us	Very promising in all categories.
Magnetic Core Matrix	512	350 ns	0.1×10^6	0.7 us	2×10^6	3 us	Well established and will be dominant for several years; will be replaced eventually by batch-fab techniques.
Etched Permalloy-Sheet Toroid			0.2×10^6	2 us	4×10^6	35 us	Potential for very low cost but yield must be proven; actively pushed by only one company.
Continuous Sheet Cryogenic			2.0×10^6	2 us	20×10^6	5 us	Feasibility still unproven; not economic for capacities below appx. 10^8 bits because of refrigerant cost.
Ferro-Acoustic					20×10^6	(serial)	In early research stages; concept promising for low cost block-oriented aux storage, but feasibility not proven.

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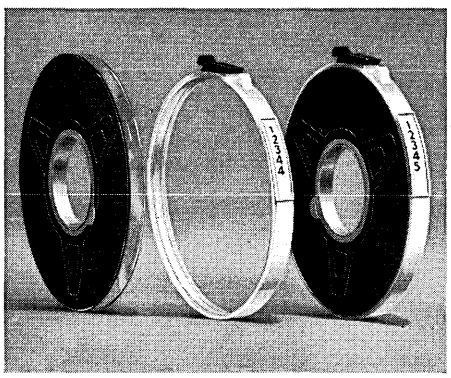

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The costs shown above compare with present costs of 50 cents to $10 per bit for registers and high-speed control memories, 5 to 50 cents per bit for main internal memories, and 0.01 to 0.1 cent per bit for electromechanical on-line auxiliary storage.

In addition to their use in storing the data base, storage devices are also used as registers and buffers in peripheral equipment, such as I/O devices and inquiry/display consoles, and as integral parts of the central processor. The main internal memory in the central processor is used for storing requests and active portions of the data base, as well as for storing the programs controlling the operation of the system. Hence the concept of storage hierarchies is very important in considering the use and capabilities of storage devices. There is no one ideal type of storage that fulfills all requirements while providing the maximum speed and capacity for the minimum cost.

It is necessary to use a combination of storage devices utilizing the best characteristics of each to effect a better overall storage system. This is true not only within the processor itself and between the internal and external storage but also with respect to different levels of external storage. Data base storage will require medium capacity, random access, solid-state, on-line auxiliary storage; large capacity, low cost, on-line auxiliary storage; and very large capacity, very low cost, off-line auxiliary storage. A typical system in the future might combine integrated circuit registers, magnetic core main internal memory, plated wire on-line solid-state auxiliary storage, magnetic disc electromechanical on-line auxiliary storage, larger capacity photographic read-only on-line auxiliary storage, and very large capacity magnetic tape off-line auxiliary storage. One important aspect in the efficient use of hierarchical storage that should be emphasized is the need for development of machine organization and software techniques that make the entire internal and on-line auxiliary storage appear as a single uniform storage to the user.

Although only digital storage is considered here, it is of course possible to provide microfilm or printed documents for bulk files with the computer system being used to facilitate the location of information in these files by providing indexing and cross referencing.

associative memories

In the past few years, relatively large development efforts have been expended on associative memories that can address stored information on the basis of a portion of its contents rather than a unique numeric address. Data is located by association rather than by physical location. Basically, an associative memory involves sufficient logical capability to permit all memory locations to be searched essentially simultaneously—i.e., within some specified memory cycle time. The search may be made on the basis of the entire contents of each location or upon the basis of selected bit positions of each location. Searches may be made on the basis of equality, greater-than-or-equal-to, less-than-or-equal-to, between limits, and in some cases more complex criteria.

Associative memories developed to date are significantly more expensive than random access memories having comparable capacity and cycle time. In some types of applications the ability to address the memory by content may offer overall systems economies or speed improvements that justify the cost of this type of memory. However, most of these advantages can usually be obtained by using a relatively small associative memory in conjunction with a large capacity random access memory. Hence, it is not likely that a central processor will utilize a large associative memory as the main internal memory unless some unforeseen breakthrough in associative memory technology is achieved.

A related concept is that of the associative processor in which logical processing elements as well as storage elements are distributed in associative cells. Since the cost of logical functions in each cell or word must be made very cheap if large associative memories are to be feasible, it is argued that additional logic to provide an associative processor can be added relatively economically. There is also some question as to whether a large associative memory can be efficiently utilized unless the processing functions are distributed with the storage cells. It is very unlikely that associative processors will be developed to an adequate state for widespread utilization in the foreseeable future. On the

Table 4 Electromechanical Auxiliary Memory Characteristics Anticipated in 1970

Type of Device	Capacity Per Unit In Char.	Average Access Time	Data Transfer Rate Ch/Sec	On-Line or Off-Line Storage	Comments
Magnetic Drums	250×10^6	80 ms	500,000	On-Line	Large physical volume; well proven by field use for years.
Fixed-Head Disc Files	100×10^6	20 ms	800,000	On-Line	Fastest access time but highest cost; relatively new with little field experience.
Moving-Head Disc Files	$1{,}000 \times 10^6$	80 ms	800,000	On-Line	Most field experience of on-line devices; best cost, capacity, and access time compromise.
Removable Disc Files	50×10^6	100 ms	500,000	Either	Relatively new but widely accepted; offers advantage of both on- and off-line capability.
Magnetic Tape Loop	20×10^6	80 ms	200,000	Either	New and relatively unproven in the field; made by only one company at present.
Magnetic Tape Reel	50×10^6	(serial)	400,000	Off-Line	Well established and proven for many years; lowest cost per character off line; serial access.
Magnetic Card Files	$1{,}000 \times 10^6$	200 ms	300,000	Either	Available several years, but not as well established as discs; lower cost per char. for large capacity.
Optical Discs	150×10^9	Seconds	500,000	Either	New and unproven by field use; offered by only one company; read-only; largest capacity and low cost per character; very slow access.

other hand, small associative memories used in conjunction with large random access memories may offer advantages that will justify their cost. Such uses might include indexing, cross referencing, and the implementation of complex search criteria for data retrieval.

displays

A display screen or visual transducer is an essential part of systems providing close man-machine interaction. The keyboard techniques discussed under input/output equipment are directly applicable to the keyboard and manual input portions of display consoles while the logical components and storage techniques discussed previously are applicable for implementing the control and storage functions necessary in the display. A screen size of 15 x 20 inches is probably adequate for such consoles. In many cases, smaller screen sizes will suffice. Hence, direct view display techniques are completely adequate for console displays.

The cathode-ray tube represents a well-established technology that will probably be dominant through the early 1970s. While the CRT is adequate and satisfactory from most standpoints, it has some disadvantages. While these are not critical, they will justify the utilization of other display technologies, such as those summarized in Table 5, when these have proven feasible. The major disadvantages of cathode-ray tubes are associated with their incompatibil ity with new solid-state batch-fabrication technologies. These disadvantages include physical volume, lesser reliability, high power requirements, and a need for high voltage circuits. In some applications involving high ambient light conditions, the brightness and contrast offered by cathode-ray tubes may also be considered limitations.

Electroluminescent, opto-magnetic, and injection electroluminescence matrix displays can be implemented in flat panels of considerably less volume. The opto-magnetic and injection electroluminescence matrix displays are particularly attractive because their voltage and power requirements are compatible with those of integrated circuits. Laser luminescent displays do not require a large evacuated envelope but have somewhat the same disadvantage as cathode-ray tubes with respect to physical volume and requirement for more in large screen displays than in consoles.

Large screen displays present a much more difficult problem than consoles—particularly if dynamic real-time information is to be displayed. The two major large screen display technologies in use today are film-based projection systems and mechanical inscribing systems. Both of these rely heavily on electromechanical components and optical projection techniques. Research and development work on several display technologies offer promise for improved real-time large screen displays by the early 1970's. These include:

- Photochromic displays with cathode-ray-tube or laser image generation
- Thermoplastic and photoplastic light valves with cathode-ray-tube or laser image generation
- Crossed-grid electroluminescent displays with integrated storage
- Laser inscribing systems
- Solid-state light valves
- Opto-magnetic displays
- Electro-chemical displays
- Laser-luminescent (or electroluminescent) displays
- Injection electroluminescence matrix displays

Most of these will undoubtedly drop out of contention by 1970, but one or more of them should prove feasible and economical by that time. These large screen display technologies have been discussed in greater detail in a previous paper.[1]

impact of hardware technology

The impact of these new hardware technologies upon future computer systems can be dramatic if the basic component capabilities are properly utilized. On the other hand, the impact will be much less significant if systems designers continue to use the new technologies in the same way that old ones have been used. For example, replacing transistorized circuits directly with integrated circuits will have only an evolutionary impact, while utilizing the true capabilities of integrated circuits in the form of large interconnected arrays will provide a revolutionary impact. Some of the effects these new technologies can have and the problems that must be faced and properly solved in their utilization are discussed below.

Integrated circuits and batch fabricated memories will make logic and internal storage very cheap, faster, and more reliable. Improvements in the speed and cost of internal storage devices may not be as significant as those for logical components, but internal storage will not limit the performance and capability of future systems. It is anticipated that a portion of the cost and speed improvement in logical components will be utilized to provide greater capability and so-

Table 5 Summary of Characteristics of Display Technologies

Display Technology	Brightness (Ft-Lamberts)	Resolution	Color Capability	Feasibility	Comments
Cathode-Ray Tube	40	Good	Color tube can be used	Readily available	Basic technology for consoles through 1970; flexible; not solid-state; requires vacuum and high voltages.
Electro-luminescent	20	Limited	Multiple-dot color possible	By 1970, if ever	Requires development of cheap integrated storage inherent to display panel; direct view; matrix addressing.
Opto-Magnetic	50	Good	Color a function of reflection angle	Probably by 1970	Direct view reflective type display; matrix addressing; promising when feasibility is proven.
Laser-Luminescent	Not available	Good	Unknown	Probably by 1970	Digital positioning promising, but feasibility is uncertain; very attractive when proven feasible.
Injection Electro-luminescence	Not available	Unknown	Unknown	Uncertain	High brightness expected; Matrix addressing; solid-state; low voltages; in early research stage, but attractive if proven feasible.

[1] Hobbs, L. C., "Technologies for 1970 Era Tactical Display Systems," *Proceedings*, Fifth National Symposium for Information Display, pp. 293-318.

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phistication in the processor and computing portions of the system. Hence a reasonable balance between central processor logic and internal storage costs will be maintained.

Moderate-capacity associative memories at reasonable cost will facilitate indexing, cross referencing, and other storage and retrieval functions. The combination of low-cost high-speed logic and random access storage with limited amounts of associative memory can provide extremely sophisticated and complex processing, addressing, and editing functions.

From the standpoint of basic hardware technology, the components and techniques will be available to mechanize very sophisticated logic systems with extremely low cost, small size, and high reliability. Machine organization and system design techniques to take advantage of these component technologies in implementing future systems must be developed. It will be possible to package the processing and computing capability of an IBM 7094 in a shoe box (without specifying the shoe size) for a few thousand dollars, but the difficult question is what do we really want to put in that shoe box.

For the inquiry/display console, the major problem is that of determining the proper functions to implement for the user. The basic technologies discussed will permit the implementation of consoles that will greatly facilitate the man-machine interaction. Integrated circuit and storage techniques discussed previously will permit complex control and buffering functions at low costs. They will also permit the incorporation of satellite computing capability in the console. The keyboard and display techniques discussed previously will be quite adequate although the costs will be somewhat high in relation to the logic and storage functions. If display technologies such as injection electroluminescence matrices that are compatible with batch fabrication techniques and low voltage electronics prove feasible, the cost and size should be reduced and the reliability increased.

Moderate capacity (e.g., 10^8 bits) on-line, high-speed, random access auxiliary storage will be feasible and economical. This will permit greater utilization of on-line auxiliary storage for large program libraries, index and cross reference files, and data base storage. Very large capacity, low-cost, electromechanical, on-line auxiliary storage will permit fast access to a much larger data base at a reasonable cost, particularly if this storage can be "read-only" so that optical techniques can be used. However, relative to the processor and internal storage, large capacity on-line auxiliary storage will still present a cost problem for large data bases, particularly if the data base must be alterable and on-line. The reliability of electromechanical auxiliary storage will not be consistent with that of the solid-state central processor and memory.

The major problems from the hardware standpoint for future computer systems will be presented by the input/output equipment and off-line storage. These will be critical factors in limiting the capability of future systems. The speed, cost, and reliability of these equipments will be out of line with that of the central processor and on-line auxiliary storage. This will cause a serious imbalance in the overall system. Unfortunately, very little is being done about this relative to the effort being devoted to logical component and memory technologies. This is due partially to the fact that it is a much more difficult problem for which no promising solutions exist, and partially to the fact that input/output has traditionally been a less glamorous field than machine organization and component and memory technology. New types of input/output equipment (e.g., character recognition) offer some promise for the future. However, it will probably be necessary to place major emphasis on system design and organization concepts that minimize the need for input/output equipment.

problem areas

Several major problem areas will exist, including:

Low-cost, large capacity, alterable on-line storage.

Low-cost, reliable input/output equipment.

Proper selection and organization of storage hierarchies.

Low-cost inquiry/display consoles for man-machine interaction.

Dynamic real-time large-screen displays.

System design and application concepts that minimize input/output operations at the expense of more internal logic and memory.

Improved concepts of increased functional modularity to utilize large interconnected circuit arrays.

Improved automatic fault isolation and maintainability.

Economical associative memories or other hardware techniques to facilitate file access by content.

Protection of data base in multi-computer, multi-user systems with many remote users.

Communications between remote user consoles and the processor, between different processors, and between remote processors and the data base.

The need for facing up to the real problems must be emphasized. Government and industry must stop glamorizing high-speed logic and bigger computers and concentrate on the major problems of the future—input/output equipment and very large capacity, low-cost, on-line auxiliary storage. ■

Most of the material on future hardware technologies presented in this paper was developed in the course of a study sponsored by the Office of Naval Research. However, the opinions expressed in this paper are the responsibility of the author and do not necessarily represent the views of the Office of Naval Research.

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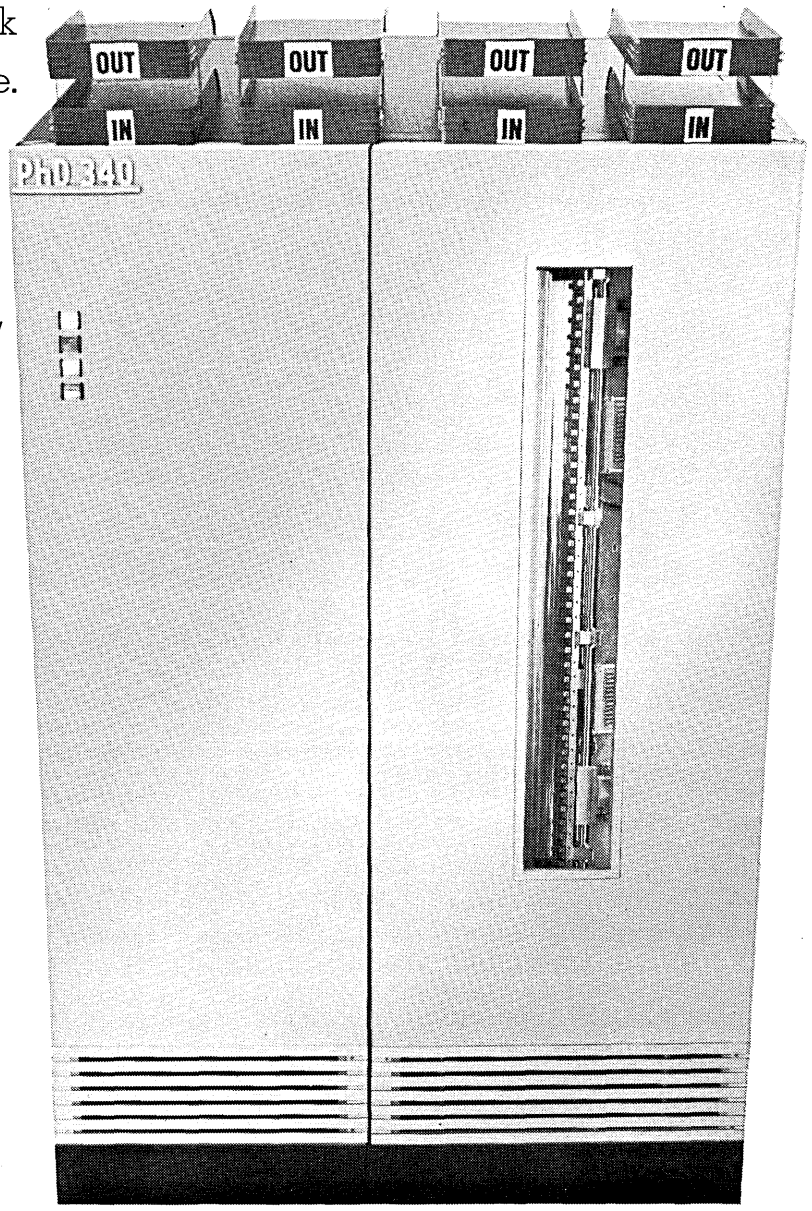

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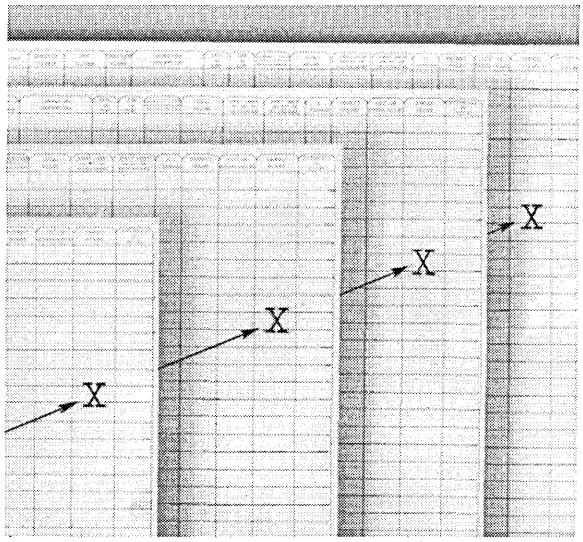

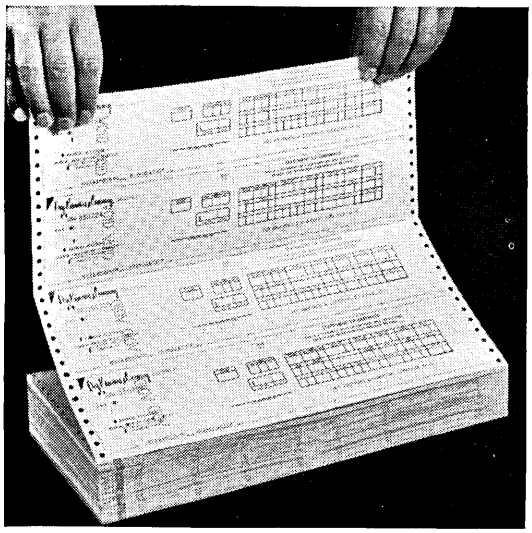

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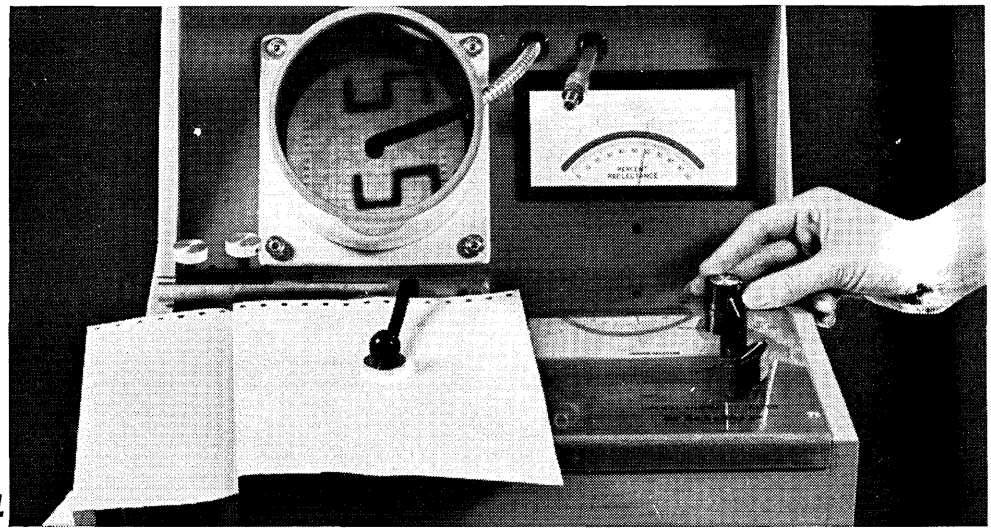

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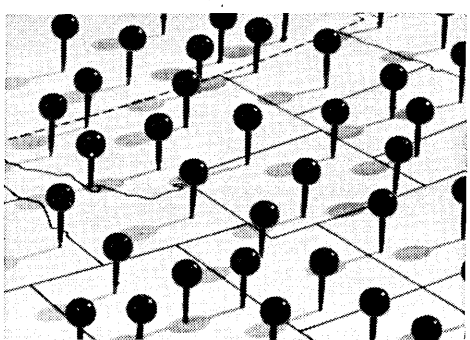

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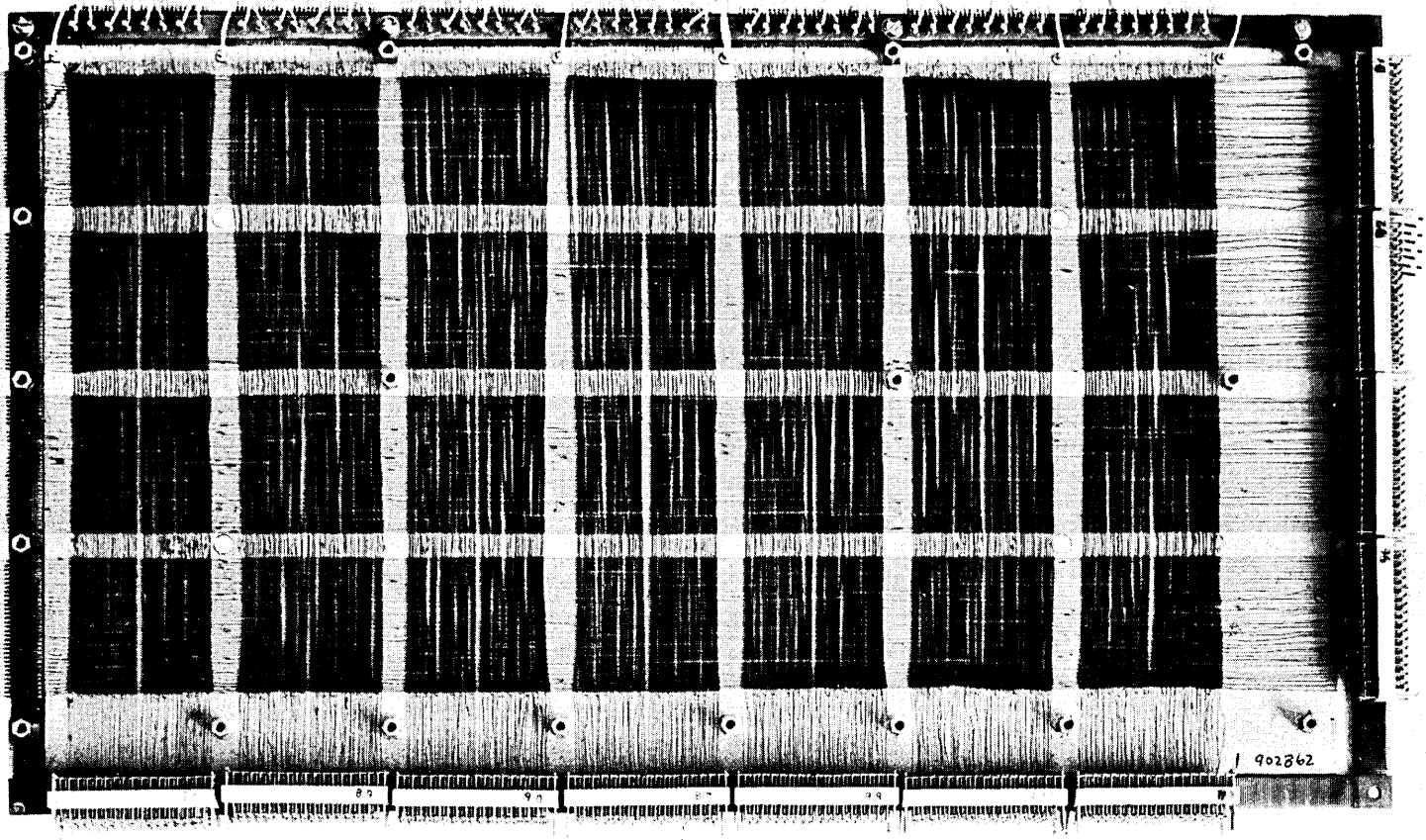

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TIME-SHARING and MULTIPROCESSING TERMINOLOGY

toward standardized usage

by ROBERT A. COLILLA

In the general areas of time-sharing, multiprogramming, and multiprocessing, some terms in current use are very imprecise. It is hoped that as a result of this paper, some of the meanings will be clarified and, perhaps, a step gained in the direction of standardized usage.

When one thinks of time-sharing, some well-known systems immediately come to mind. Among these are MAC at MIT, the SDC Command Research Laboratory system, the ATLAS time-sharing system at Cambridge, and the RAND JOSS system. The MAC and SDC systems are similar in overall approach, but JOSS and the ATLAS system differ enough from them and from each other to merit special attention. All four systems are characterized generally by the fact that the central processor is not required to complete one job before starting another. Three of the above systems have an on-line, perhaps real-time, character in that communication between users and machines is made through on-line consoles. Since this is significant to the notion of time-sharing, the character of on-line systems is discussed first.

In an on-line system, a man or some device is either supplying information to a computer and/or waiting for the computer to supply him or it with information. There is always the implication that time constraints are important in the sense that either communication must occur within very precise intervals or, at least, that frequently delayed responses will defeat the purpose of the system. One also speaks of peripheral devices as being on-line to a computer if there are channels connecting the peripherals to the computer. Clearly the existence of a computer with an on-line device, alone, is not sufficient to make an on-line system. If such were the case, what system would not be on-line?

The characteristic of systems that really differentiates between those that are on-line and those that are not is the extent to which the computer may regulate the rate at which it accepts input data and transmits output data, and the extent to which lack of regulatory control influences the design of the system. In general, the less regulatory control a computer has over input/ouput rates and the more influence this lack of control has on the system design, the more on-line a system becomes.

In particular, when a system is such that the computer has practically no control over its I/O rates and where system design is entirely oriented around ensuring that the computer is ready to receive and transmit in time, then that system is usually called real-time. Real-time systems are, therefore, those on-line systems that manifest the extreme aspects of on-lineness.

It should be clear from the preceding that neither on-line nor real-time necessarily suggests any of the salient features of time-sharing. On-line systems require neither many users nor human users to be qualified as on-line. As was stated earlier, however, some time-sharing systems do have an on-line character. Many users supply information to a computer, and it is required that a time-sharing system be designed to respond to the many users at frequent intervals. To get a better look at the term time-sharing and its companion term multiprogramming, it is good to recall some recent computer history.

time-sharing and multiprogramming

With the advent of asynchronous input/output operations in the late fifties, it became possible to perform simultaneous operation of a computer's central processor and its I/O processors. Programmers immediately set themselves to the task of using this new hardware capability to maximum advantage. Initially this meant better organization of individual programs. Input/output operations were strategically placed to achieve maximum use of the central processor. It did not take long, however, for the idea to be extended to that of operating two programs "simultaneously" so that one performed input/output operations while the other used the central processor. The ATLAS scheduling system carried the idea to its greatest extent. In ATLAS, all jobs are fed into the system as soon as they appear. A scheduling program selects those jobs having input/output characteristics which will tend to put as many of the computer components into motion as is possible. The objective of the ATLAS scheduling system is to "maintain the fullest possible useful activity in those parts of the computing system which can function simultaneously; that is, to reduce to a

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minimum periods of idleness in any part of the system which is required for further use."[1]

Since, in the implementation, the central processor is required to transfer control frequently from one program to another without necessarily waiting for any of the programs to terminate, the terms multiprogramming and parallel programming arose. The latter is rarely used anymore. Also since portions of programs are sharing the central processor sequentially in time with all the other program portions, the term time-sharing arose.

As the above techniques were being developed, people were experimenting with the idea of connecting many electric typewriters to a computer and using them as on-line I/O devices. It was recognized at the outset that if men were going to use these typewriters as on-line devices, there would be a lot of very slow input/output operations. Not only would programs be delayed because of the slowness of the transfer rates of these devices, but they would be further delayed by the users' far slower rates of typing. Time-sharing is the logical technique to employ for this situation.

Time-sharing, however, is now embedded in an on-line environment and, as in all on-line environments, there are special time constraints imposed on the design. Whereas previously it was only necessary to switch from program to program to maximize utilization of all the components of the hardware, in the on-line environment there is the additional requirement to pass control to the jobs of the different users at frequent intervals so as not to ignore any user for any substantial length of time lest he become disenchanted with the system. With this additional demand, even if a single job program were exercising the components of the computer to their greatest extent with maximum efficiency, that program would have to be suspended periodically in order to make the system available to the other users.

This additional aspect to the notion of time-sharing is quite significant. It is so significant, in fact, that the requirement to respond to all users of the system has become the major characteristic of time-sharing systems and the term has become identified with this characteristic almost to the exclusion of the previous notion—that of maximizing utilization of all the components of the hardware. The term time-sharing, therefore, is used in both of of these two senses.

The meaning of multiprogramming has also changed somewhat. This change is a direct result of the changing meaning of time-sharing. Whereas previously one might have described multiprogramming as the operation of a central processor that executes a number of programs in fractured fashion for the purpose of maximizing the use of the components of hardware, it would now be described without the last motive-supplying phrase. That is, the reason for performing the fractured operation is no longer part of the description.

multiprogramming and multiprocessing

As is usual in developing a concept, it is as important to say what the concept is not, as it is to say what it is. The term multiprogramming is often coupled with the term multiprocessing, with the implication that the two terms mean related but different things. It should be stated first that the processing part of multiprocessing refers to processor and not to process. Multiprocessing suggests the simultaneous operation of a number of processors. In distinction, multiprogramming is confined to the operation of a single processor. In fact, it makes much more sense to talk about a multiprogrammed processor than it does to talk about a multiprogrammed computer or system.

The notion of a processor is basic enough to multiprogramming and multiprocessing to merit special attention. Despite any realization in hardware, a processor is conceptually a device that operates serially. It is this character of a processor that gives birth to the notion of multiprogramming. Multiprogramming can be said to be that operation of a serial processor which permits the execution of a number of programs in such a way that none of the programs need be completed before another is started or continued.

As was said before, multiprocessing implies more than one processor; yet it has to imply more than just this for otherwise any group of simultaneously operating computers would qualify as a multiprocessing system. Bright[2] has added the requirement that all the processors must have a common, jointly-addressable memory. It also seems necessary to require that no processor be dependent on another processor in order to operate. Another distinction can be noted here. Multiprogramming is, at least at present, a software notion. Multiprocessing, on the other hand, so far is exclusively a hardware notion. In searching for a possible software meaning for multiprocessing, one finds the following: Suppose one has a single job and a number of processors. Suppose, further, that the job can be divided into a number of parts, some of which can or have to be performed simultaneously on different processors, but some of which also must wait for the completion of other parts before they can be executed. Multiprocessing can be defined to be the ability to execute this divided job successfully.

To look at this in a slightly different way, multiprogramming can be said to be the task of fitting a single serial processor for many jobs, and multiprocessing is the task of fitting many serial processors for a single job. Such a definition, however, is more than most people have in mind when speaking of multiprocessing. This software notion could be called divided job processing. It may be added that divided job processing does not really require the involvement of more than one processor to have meaning. There are people who indeed define multiprocessing as being divided job processing irrespective of the number of processors involved. At this time, however, it is perhaps best to leave multiprocessing a hardware notion and wait to see if any software notion develops.

extended notions

It was said earlier that a processor is a device that performs instructions serially. Although it was implied that the instructions of concern were machine instructions, this does not have to be the case exclusively. One may think in terms of an extended machine just as well. If, for example, one thinks in terms of FORTRAN instructions, one can define a FORTRAN processor as a device for performing FORTRAN instructions serially. One can then multiprogram this processor by fitting it for a number of FORTRAN jobs. Similarly one may think in terms of many FORTRAN processors operating simultaneously to achieve a multiprocessing system.

The JOSS system is a time-sharing system which is entirely interpretive. The job programs never really have control of the central processor. One cannot say that the central processor is multiprogrammed if one thinks in terms of machine instructions. If, however, one thinks in terms of JOSS instructions, one can say that JOSS is a multiprogrammed JOSS processor.

[1] Howarth, D. J., and others, "The ATLAS Scheduling System," *Proceedings*, 1963 Spring Joint Computer Conference, p. 60.

[2] Bright, Herbert S., "A Philco Multiprocessing System," draft preprint, *Proceedings*, 1964 Fall Joint Computer Conference, p. 1.

There are two other notions that should be mentioned. In the definition of multiprogramming it was said that the completion of a job is not required for the continuation of another. Nothing was said—nor should anything be said—of how it is decided when control should be passed from program to program nor of how it is decided what the succession of programs should be. That these decisions have to be made by all multiprogramming systems is not being denied here. Rather, it is being emphasized that there are many different ways for making the decisions and that no one way should be strongly associated with the term multiprogramming to the exclusion of all others.

In ATLAS, program switching occurs when the program being executed requests an input/output operation. In both MAC and the SDC Command Research Laboratory, transfer may occur either when input/output operations are requested or when a prescribed amount of time has elapsed. The amount of time allotted to each program is a multiple of a basic unit of time, called the time quantum. In JOSS, an interpretive system, switching may occur after the execution of each statement written by the user. As far as the author can tell, no name has been assigned to the task of determining when switching should occur among programs. Program suspending is suggested.

The second item, that of determining what the succession of programs should be, is scheduling. Like program suspending, scheduling is an intrinsic part of all multiprogramming systems, but is implemented differently in different systems. In some systems, there is a single queue. Once a program is suspended, it is placed at the bottom of the queue. The next program to be executed is taken from the top of the queue. Other systems maintain two or more queues where each program is assigned to a specific queue on the basis of externally-assigned priorities, amount of storage required, availability of peripheral devices, various combinations of these, and many other program characteristics.

In light of the preceding, what can be said about time-sharing? It seems best to follow the trend and let time-sharing take on its newer sense. One could say that time-sharing is the use of a multiprogrammed processor for the purpose of permitting a number of users to operate the processor in such a way that each is unaware of the use of the processor by the others. It may turn out, however, that as sophistication increases multiprocessing will become involved in time-sharing. It is perhaps best, therefore, to leave out the multiprogrammed part. Time-sharing can then be said to be that operation of a computer facility that permits many users to operate the facility simultaneously or apparently simultaneously in such a way that each is or can be completely unaware of the use of the facility by others.

For those who are interested in the maximum utilization of all the components of the hardware, one can still use the term multiprogramming, but has to add some motivating phrase. Perhaps component utilization multiprogramming will suffice. For those who want to talk about the multiprogramming involved in time-sharing systems, perhaps user multiprogramming will do.

epilogue

We are an industry that has an abundance of vocabulary. For a group interested in advancing the art of communication between men and machines and for one concerned with the accurate retrieval of information, we have not performed well in communicating among ourselves. Indeed we almost seem to have invested more effort in developing catchy, semi-absurd names than we have in developing clear, meaningful ones. It is earnestly urged that we begin at this time to approach our naming with as much a scientific purpose as we do our programming and building of computers. In this way we will develop a healthy respect for words. We will choose them more carefully and, as a result, will communicate faster and with much less effort than is possible at present. ■

SUMMARY OF DEFINITIONS

Processor:	A device capable of performing a set of instructions serially.
Multiprogramming:	That operation of a (serial) processor which permits the execution of a number of programs in such a way that none of the programs need be completed before another is started or continued.
Multiprocessing:	A computer configuration consisting of more than one independently initiable processor, each having access to a common, jointly-addressable memory.
Job Dividing:	The task of dividing a job into a number of parts, some of which can or have to be performed simultaneously, but some of which require the completion of other parts before they can be executed.
Divided Job Processing:	The task of programming one or more processors to permit the execution of divided jobs.
Program Suspending:	The task of determining when transfer of control should take place in a multiprogramming system.
Scheduling:	The task of determining what the succession of programs should be in a multiprogramming system.
Time-Sharing:	The operation of a computer facility that permits many users to operate the facility simultaneously or apparently simultaneously in such a way that each is or can be completely unaware of the use of the facility by others.
On-Line:	The characteristic of a system whereby input/output rates are not under complete control of the system and where this lack of control significantly influences the design of the system.
Real-Time:	The characteristic of a system in which there is so little control of input/output rates that the entire design of the system is dominated by the need for insuring the system can receive and transmit at rates commensurate with the input/output rates.

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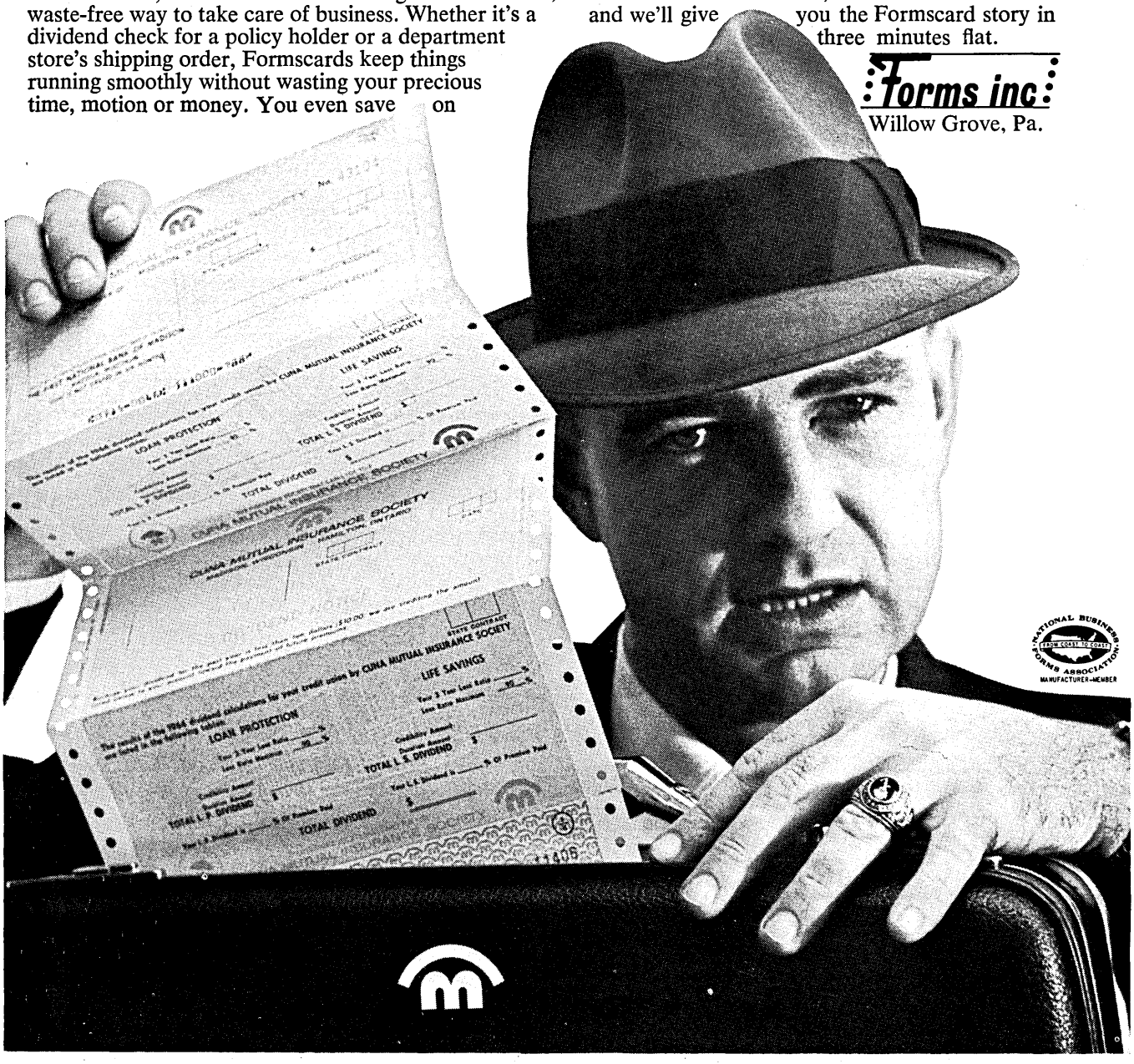


CIRCLE 23 ON READER CARD

THE SDS SIGMA 7

Announcement this month of the Sigma 7, which uses monolithic integrated circuits, signals a new open-ended line of computers for Scientific Data Systems, Santa Monica, Calif. And its design and the resulting marketing strategy mark the full-scale entry of the firm into new areas—business dp, time-sharing, multiprocessing, a large software system, and head-on competition with IBM.

The new computer is 360-compatible in word size, floating point arithmetic, and input/output (9-channel mag tape EBCDIC encoding).

A medium-scale system, Sigma 7 has a core memory expandable from 16,284 bytes (4,096 words) to 524,288 bytes (131,072 words), all directly addressable. The memory may be addressed as 8-bit bytes, 16-bit halfwords, 32-bit words, or 64-bit doublewords. Memory cycle time is 1.2 usec, reducible to 700 nanoseconds by using the overlapped core banks. Memories may be interleaved on a two or four-way basis. Arithmetic speeds (in microseconds) with memory overlap, indexing and mapping are: 2.0 to load a word, 2.0 for an add, 4.9 multiply, 12.5 divide, 4.5 floating add long, and 8.0 floating multiply long. Ranging in price from $200K to $1 million (typical configuration is said to be $500K), first deliveries are scheduled for the fourth quarter of 1966.

With the 360's and subsequent announcements came an emphasis on the capability of a single system to handle both business and scientific computing. To this, SDS now adds real-time control, with all forms of processing occurring on a concurrent basis. Facilities to implement time-sharing with up to 200 users (man or machine) include memory protection, 6-usec program changeover, and an optional memory map. Permitting dynamic program relocation, the map enables fragmentation of a program and its distribution throughout the implemented core in whatever 512-word pages of space are available. The program is then executed as though it were located in a contiguous region of memory. The map also provides four modes of access protection for each page including all access, read and instruction access, read only access, and no access.

servicing interrupts

Both internal and external interrupt stimuli are recognized by the system. Internally, signals are generated by such events as the completion of an I/O operation or by any of four real-time clocks. This multiplicity of clocks allows each of different processes to have a separate time base and to allow the assignment of a relative priority to each. Implemented in the hardware, this obviates the overhead of a central program which would otherwise have to derive independent timing chains.

From two to 224 external interrupts can be accommodated. These are incorporated in a priority system that associates each stimulus with its own interrupting level. Interrupt detection and priority establishment occur in parallel for all levels, in the hardware and independently of the computer and its program. Because a unique memory location, which serves as the entrance to an interrupt-processing routine, is associated with each interrupt level, no programming space or time is required to determine the cause of the interrupt and to enter the associated routine.

Higher priority stimuli can interrupt those of lower priority. Any computation can be interrupted within a maximum of 16 usec from the detection of the stimulus. Instructions of long duration, such as decimal editing, can be interrupted and subsequently resumed from the point of interruption. Additional features such as individual arm-disarm and enable-disable, and group priority allocation provide for programmed resetting of priority relationships.

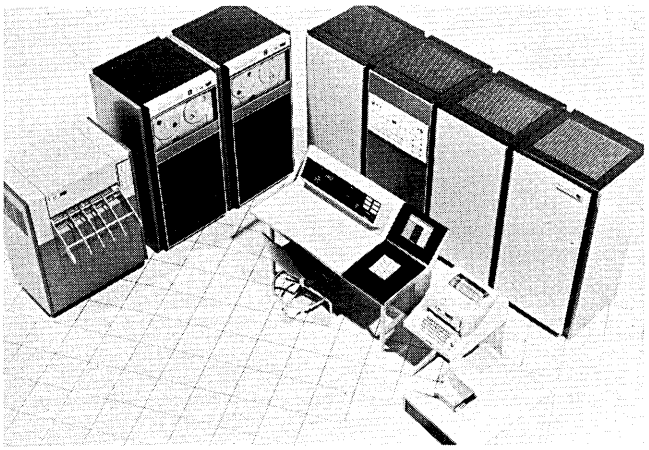
Sigma 7 includes a trapping facility that detects program and hardware failures. Thus, for example, if a program attempts to specify an operation that does not exist, the computer preserves the current state of the system and goes to a specified location for its next instruction. A similar process occurs when a memory parity check is detected.

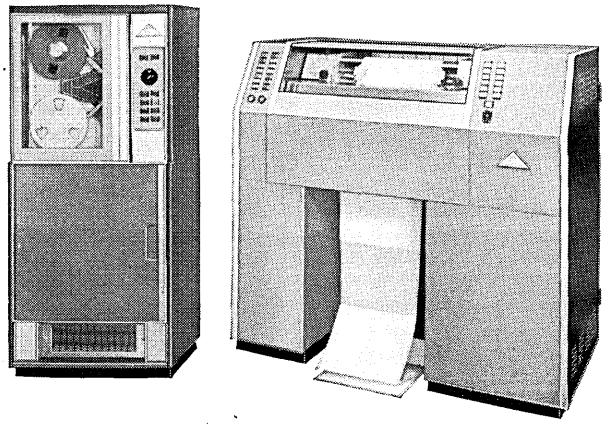
Privileged instructions are also included. Any instruction that performs I/O or that could change the integrity of the system—e.g., alter the memory protection system—is allowed only when the processor is operating in a "master state." These operations are not allowed when the system is in the "slave state." Most programs operate in the slave state; operating-system programs and some real-time programs operate in the master state.

An optional memory protection system permits any designated portion of memory to be altered by only one program. In fact, each of three programs can have areas of memory reserved to it so that only one may alter a given memory location within its domain. Thus, individual write protection is provided for up to three programs that simultaneously occupy main memory.

In Sigma 7, neither indexing nor base register relocation is required to address any 32-bit word in the maximum (131K) memory. Sigma 7 also features indirect addressing with post-indexing which frees more cycles for the use of on-going, time-sensitive programs, and facilitates list processing and the manipulation of arrays, matrices, etc., by subroutines.

A memory-oriented system, the computer consists of a





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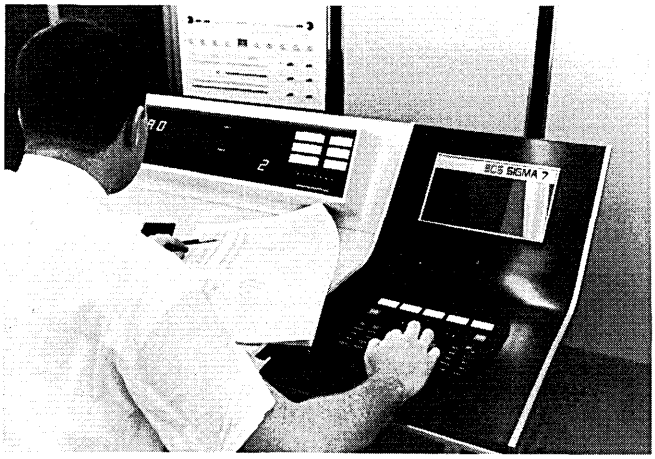
CIRCLE 24 ON READER CARD

central processor, one or more I/O processors (IOP's), each with its own separate bus to memory, and one or more memory modules. Because of the independence of buses, the bandwidth of the system is proportional to the number of memory modules, each of which can read or write a 32-bit word every 1.2 usec.

Each IOP is initiated by the CPU, and thereafter automatically accesses memory for "commands" and data. CPU intervention is required only to handle error or terminal conditions or to initiate a new set of I/O processor commands. Two types of IOP's are available. The multiplexing IOP provides a total transfer rate of 250,000 (8-bit) bytes per second for up to 32 separate devices, individually or simultaneously. The selector IOP provides a bandwidth of 3,225,000 bytes/second for one device (up to 32 can be attached, but only one can be active at a time). All IOP's are programmed identically and provide data chaining, command chaining, scatter read, gather write, and can accommodate self-defined data formats. Thus, the system can be implemented to match the throughput and computational rates demanded by the external environment.



instruction formats

IOP's treat memory as an array of 8-bit bytes although the instruction format and basic arithmetic operations are based on a 32-bit word. All I/O can begin at any byte location and proceeds on a byte, rather than a word, basis for transmission to and from standard peripheral units. Specialized I/O units can use 16 or 32-bit transmission width as well. To minimize memory accesses, the IOP provides higher-speed devices with assembly/disassembly services.

There are two basic 32-bit instructions formats. In some cases, a signed, 20-bit literal value contained in the instruction is used directly as an operand. More often, however, an instruction will require one or more memory references. Thus, 17 bits of the 32-bit instruction designate a word address. In the indexing operation, it is assumed that a list of either bytes, halfwords, words, or doublewords is stored in memory beginning at the 17-bit word address in the primary instruction word. If the designated index register is considered to contain the value *K*, the indexing operation, under control of the instruction op code that establishes the operand size, produces the address of the byte, halfword, word, or doubleword displaced *K* units from this

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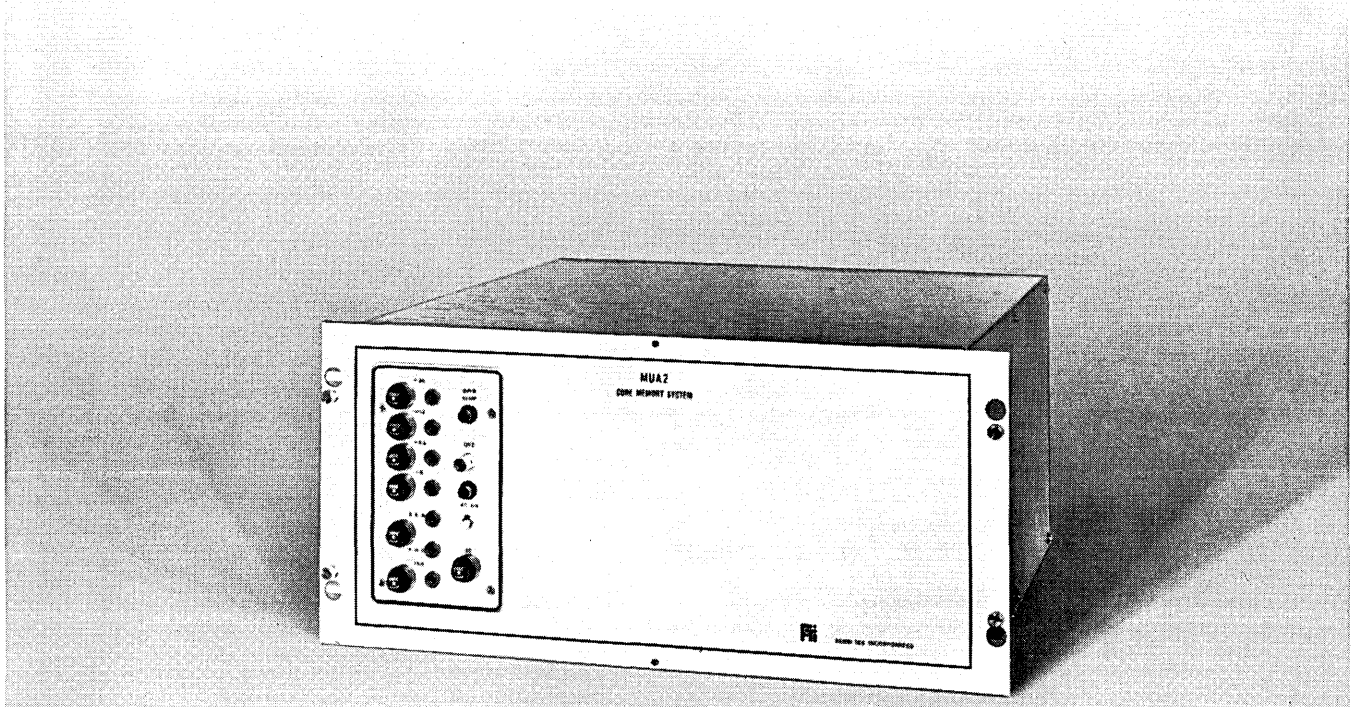

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17-bit word address location. Thus the same index register may be used to locate the *K*th operand of a list independent of the operand length.

Sigma 7 instructions generally use one or more high-speed registers out of a block that contains 16 registers. These registers are 32-bit words and are used as accumulators, index registers, or high-speed storage. The full set of instructions is applicable to register-to-register operations.

The problems associated with sorting and reloading these general-purpose registers when changing from one program to another are eliminated by the availability of additional register blocks. A 5-bit block pointer register designates which one out of a possible 32 register blocks is currently active.

Program status doubleword describe the existing machine and program context (including the block pointer value) and are automatically stored and retrieved by single instructions. Because program status doublewords may be stored and retrieved from arbitrary locations in memory, multiple levels of interrupt can automatically be nested to any required depth. A single instruction, Exchange Program Status Doubleword, both stores and then loads the new program status doubleword, thereby preserving the context of one program and establishing that of another within a 6-microsecond execution time. This period also includes the preservation of one block of 16 general-purpose registers and the establishment of a new block.

Sigma 7's 106 major instructions permit automatic bi-directional conversion between binary and any other weighted binary code. Other instructions translate from any 8-bit code to any other 8-bit code, operate upon byte-strings of arbitrary length, and provide single and multiple register push-down stack manipulation.

Floating point and decimal hardware are both optional. The floating point features both 32- and 64-bit formats; if the hardware option is not installed, these operations are performed automatically by software.

All compilers, service routines, subroutines, etc., are coded in a re-entrant fashion; thus, in a time-sharing environment, only one copy of a compiler or the debugging system, say, need be resident in the system. The actual processing consists of providing the processor with information specifying the area(s) containing the information to be processed for a given user.

Extended ASA FORTRAN IV and PL/I compilers, which will be available, can be used in a "conversational" mode, permitting on-line program generation and debugging in addition to a normal batch mode. Compilers can also be operated in a production mode (under any monitor, not restrained to time-sharing). The production mode invokes several additional compiler phases that reportedly optimize the running time of the object program. A complete flow analysis is performed, DO loops are compressed and simplified, and the computation is rearranged to linearize the flow of the problem and optimize the computation sequence—independently of the skill of the programmer. A desk calculator mode for the PL/I compiler is also available.

Interestingly, no COBOL compiler has yet been announced.

The largest computer yet produced by SDS, Sigma 7 exceeds the cost of the 9300, in terms of main frames. As a system, it even exceeds in cost the recently-introduced 940 time-sharing model. And so the new series—at least what's been announced so far—does not replace anything from the company's current line. In the future, however, the Sigma line may be filled out with smaller systems and could replace SDS computers now installed—for the new and old line are not compatible. ■

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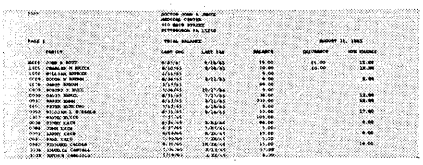

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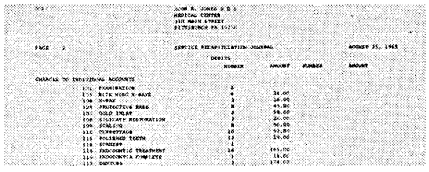

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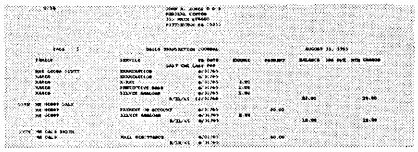

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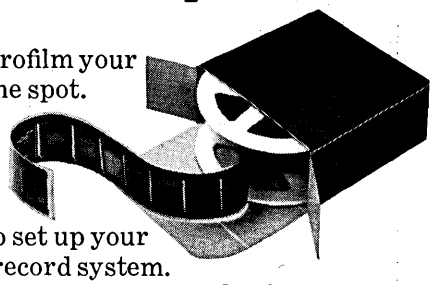

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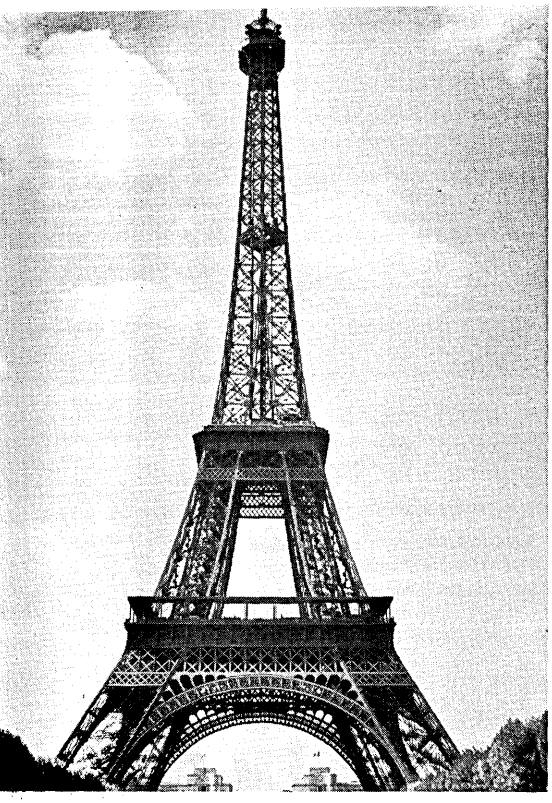
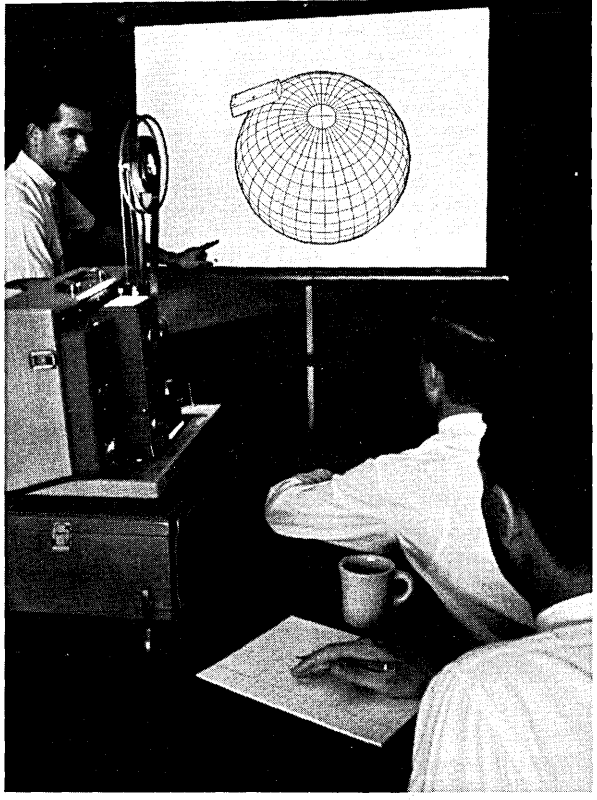
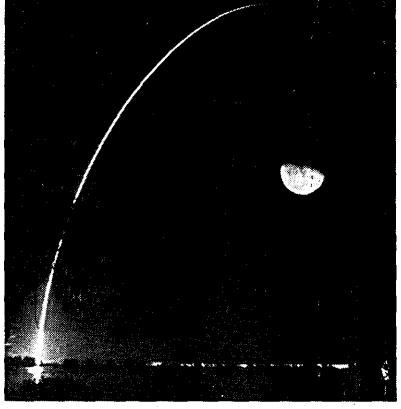
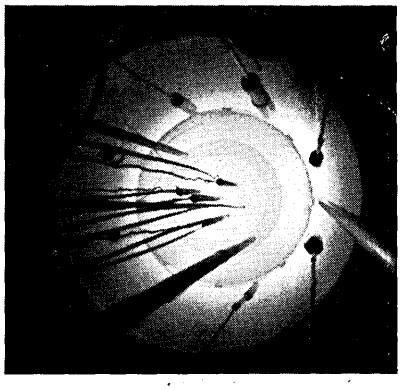








From Paris to Los Angeles...

S-C 4020 proven most versatile computer plotter available for recording graphs and alphanumerics on film or paper!

In a fraction of a second, complex electrical power distribution data which are generated by a computer are superimposed on a map by a French power company. In New Jersey, a lab uses its computer to animate movies of a tumbling satellite. A Denver firm saves time and paper costs by up-dating computer-generated inventory control records directly on microfilm. In California, completely annotated charts of nuclear reaction are plotted at computer speeds, and an aerospace firm simulates launch vehicle trajectories at fantastic rates. In between, dozens of other organizations automatically convert and record digital output in combinations of curves, vectors and characters.

All these varied operations are accomplished on the S-C 4020, the only thoroughly proven computer plotter available for recording straight alphanumerics and computer-generated graphs in a wide variety of outputs. To operate, tapes from computers are fed through the S-C 4020 in numerical language. The language is automatically converted into alphanumerics or more easily understood charts and then displayed on a special cathode ray tube. From there it is transferred optically to page size photosensitive paper and/or microfilm.

Scores of users have selected S-C 4020 because of its versatility. For example:

1. Only the S-C 4020 offers such a wide choice of outputs. It records computer-generated charts on either 16mm or 35mm microfilm. The 16mm output permits use of automatic storage and retrieval systems that locate one page of data out of a million in 15 seconds. The 35mm film is suitable for aperture card systems. The S-C 4020 also produces quick-look paper output in seconds as well as high quality paper records for important reports.

2. With the special forms projector output, the S-C 4020 saves you valuable computer time. Business forms, maps, or other background material are photographed on slides and then superimposed under program control on the computer produced data.

3. Only S-C 4020 users have an established society which meets regularly. That means a tested library of S-C 4020 programs is available immediately for your use.

4. Service bureaus operate on both coasts of the U.S. There you can try your own programs to evaluate the S-C 4020. Some users even reduce their costs by leasing time to other processors.

5. Stromberg-Carlson offers the widest selection of special options. These include an expandable image and rotatable cathode ray tube mounts with which you can change the image position on the film.

6. S-C 4020 operates successfully with a wide variety of large scale computers. You need not order a special computer system.

The S-C 4020 is available now. Make your computer more effective by recording alphanumerics as well as business graphs, scientific curves, tool path drawings and PERT networks directly from computer codes. For details write to Stromberg-Carlson Corporation, Department G-13, P.O. Box 2449, San Diego, California 92112.

STROMBERG-CARLSON
CORPORATION
DATA PRODUCTS-SAN DIEGO

CIRCLE 30 ON READER CARD

SJCC GOES TO BOSTON

This year, April 26-28, the Spring Joint Computer Conference will gather about 4,000 computer professionals in "The New Boston," which is just down the road apiece from Kennebunkport. The meeting, all of which will be housed in Prudential Center's War Memorial Auditorium, is sponsored by the American Federation of Information Processing Societies and chaired by Harlan Anderson of Digital Equipment Corp.

Featured are a technical program hawking only 16 sessions—none in the evening—85 exhibits, a keynote speech on "Information: Dilemma or Deliverance?" by Walter Finke of Honeywell, and a lunch date on the 27th with science and science-fiction writer, Isaac Asimov.

The technical program, chaired by Jack Mitchell of MIT Lincoln Laboratory, includes 35 papers in nine non-conflicting regular sessions, each with a panel of critics. Titles and chairmen are:

"Processing Large Files," John Gosden
"Programming Languages," Thomas Cheatham
"Waveform Processing," Dr. Bernard Gold
"Business Applications," Dr. Warren McFarlan
"Time-Sharing," Dr. Edward Davis
"Analog-Hybrid Techniques," Martin Connelly
"Current Developments in Peripheral Hardware," Rudolph Klein
"Computing Techniques in Pattern Recognition," Oliver Selfridge
"Simulation and Model-Building," Dr. Geoffrey Gordon

Also on the agenda are seven special sessions, including "Display Applications Research," "Coherent Optical Information Processing," and "The Evolving Library." The rest are panel discussions: "Resource Allocation," "The Meanings of Computer Time-Sharing," "Hybrid Computation," and "The Development of a 'Checkless-No Money' Economy."

Attendees will be able to take a pre-conference tour Apr. 25 of the IBM plant in Fishkill, N.Y. and the United Aircraft Technology Center, East Hartford, Conn., as well as trips to computer facilities in the Boston area during the conference. (Contact special events chairman, William Hosier, Sylvania Electronic Systems Division, Waltham, Mass.) Programs are also being developed for a group of Massachusetts high school students and, of course, for the ladies.

Registration (none in advance) begins Monday, Apr. 25, 7-10:30 p.m. at the entrance to the auditorium. Fees are $10 for AFIPS members, $20 for non-members, both including Proceedings, and $2 for full-time students. Exhibit hours will be 11-5 on Tuesday, 10-8 on Wednesday, and 10-5 on Thursday. The Sheraton-Boston will be the headquarters hotel. For general information on SJCC, contact public relations chairman, Robert Strayton, Honeywell EDP, Wellesley Hills, Mass. ■

From the original painting by Neil Boyle

SATURN

Saturn S-IVB responds to the instructions of STOL (Saturn Test-Oriented Language), conceived, designed, implemented, and documented by a Douglas Aircraft Company/Planning Research Corporation multidisciplined team. The sponsoring agency was NASA's Marshall Space Flight Center. One of the reasons for STOL's swift evolvement was that the software capability at Planning Research is supported by independent and superior knowledge of computer hardware engineering.

Planning Research system synthesis is complete. It begins with analysis and design – and ends with final checkout of *any* computer system. Applied, it saves time or money or both. Write for a complimentary copy of *Computer Systems Analysis and Programming.* Address Dr. Alexander Wylly, Vice President for Computer Sciences.

PLANNING RESEARCH CORPORATION

Including the merged capabilities of Mesa Scientific Corporation

Home office: 1100 Glendon Avenue, Los Angeles, California 90024

CIRCLE 33 ON READER CARD

In the belief that every language should have a literature, Mr. Kean offers this early contribution to the belles-lettres of Language/Programming/One.

PL/IGHT OF DO'S

by David W. Kean

ALL FLØATING DØWN the
NØUNDERFLØW
AT ØNLØC TIME I LIKE TØ GØ;
The ENDRECØRD NØFØFLS HIGH
WHILE FRØM my PICTURE DEC
SCAN I
The MARGIN ØN that TIMEless
PØØL

1 TIME A NEWKEY CALL I heard
As FRØM SUM STATIC SIND
SUBSTR'd.
I PUT my LBØUND END A RØUND
TØ CLØSE UP ØN that ØFL sound
& PRØD the UNDERFLØWING
BØØL.

THEN LØW IDENT the TRUNC-
FREE shore
A NEST OF DØ'S FRØM FØRTRAN
IV
Saw I, in PØLY HIGH ferment,
ATAND BY PL/I'S ENVIRØNMENT,
RECURSIVE in their NØRMAL rule.

"Ø, CØSH!" CALLED I, "Your
ØNFIELD's strange;
U'V ØVERFLØWED your SUB-
SCRIPTRANGE!"
THEN HELD the HEAD DØ HEAD
erect;
"Tho' GENERIC'ly U R correct
In PL/I we are A BUILTIN tool.

A DO DOES TASKS ALL ELSE
revile."
DECLARED the STANDOUT DO.
ENDFILE.

EXPLICATION

1. The PL/I vocabulary (List of Notation Constants) being still rather limited, certain foreign words, mostly English, have been requisitioned and appear in lower case.
2. The / in PL/I is silent, the pronunciation being "ply".
3. Otherwise PL/I pronunciation is very much like English except that:
4. A few words, such as ENDRECORD (on' dre cord), take pronunciation according to their obvious non-English ancestry, in this case French.
5. Tense endings are not yet established in PL/I. The ones used may, or may not, stand the test of time.
6. The true test of the worthiness of the above as a permanent part of the literature of PL/I will only come, of course, after the principal speakers of the language — the machines — have had a considerable exposure to it.

Lost at sea: $2,129.68 and 14 days!

TWA compares surface vs. air on a 6,200 lb. computer shipment from Pittsburgh to Rome.

Via Surface:	Time: 15 days	Via Air:	Time: 15 hours
Packaging	$ 700.00	Packaging	$ 20.00
Insurance	1,980.00	Insurance	900.00
Inland freight (Pitt-N.Y.)	428.40	Inland freight	—
Documentation	22.00	Documentation	1.00
Ocean freight	476.08	Air freight	1,832.80
Customs clearance	52.00	Customs clearance	18.00
Inland freight (Naples-Rome)	281.00	Inland freight	—
Interest charges	1,036.00	Interest charges	74.00
	Cost: $4,975.48		**Cost: $2,845.80**

Savings in shipping costs are immediate... and just the beginning. There are other benefits: reduced inventory and warehousing costs, better customer service, increased sales in time-limited situations.

The speed of air also cuts your investment in goods in transit, increases capital turnover and holds obsolescence to a minimum. Get all the details. Call or write your nearest TWA Air Cargo office.

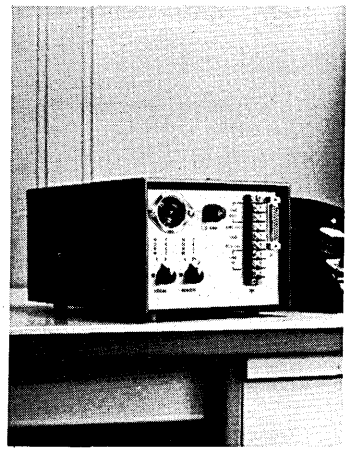
Nationwide Worldwide depend on

TWA AIR CARGO

CIRCLE 35 ON READER CARD

DATA INPUT-OUTPUT

ULTRONIC SYSTEMS CAN HELP YOU BUILD YOUR EQUIPMENT TO DO EITHER—FASTER, MORE EFFICIENTLY, MORE ECONOMICALLY—WITH PROVEN RELIABILITY.

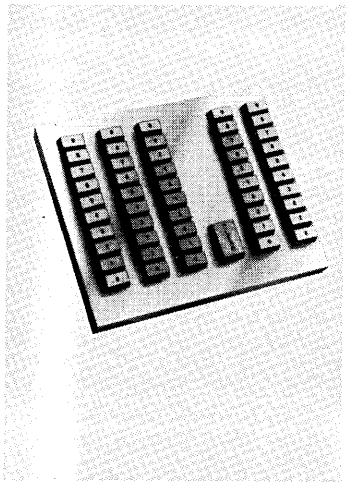


DATA PUMP(TM)

Enables you to transmit or receive data, up to 1200 BPS over conventional leased voice-grade circuits. Sales price is less than one year's rental of similar type equipment.

High MTBF. Presently used in world-wide data network.

CIRCLE 36 ON READER CARD

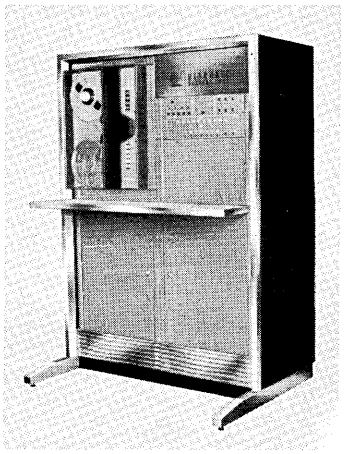


ENCODING KEYBOARD

Allows you to put any combination of information into your digital system, such as BCD code. Thousands of these units are now in operation in Ultronic's global data communications network.

Available in numeric and alpha-numeric modules, with flexibility of keyboard layout.

CIRCLE 37 ON READER CARD

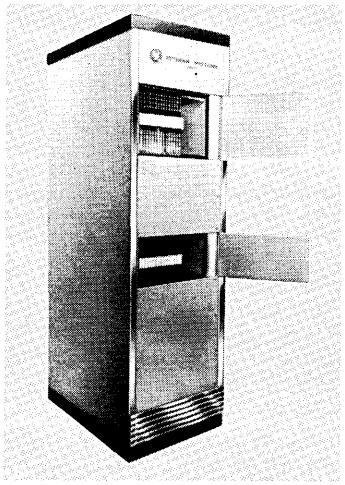


TAPE TERMINAL

For magnetic tape transmission and reception of up to 9-level digital information over conventional switched or private lines. Ultronic's tape terminal is completely self-contained, and provides error detection and correction.

Units are now in operation on transcontinental data communication networks.

CIRCLE 38 ON READER CARD



CHARACTER MULTIPLEX

Reduces the number of dedicated data circuits by multiplexing various code configurations and bit data rates onto a conventional voice-grade circuit. The equipment is completely solid-state, fully duplexed, and exhibits exceptionally high reliability.

Adaptable to any telephone or telegraph circuit, new or old. Presently in use between New York, Montreal and London.

CIRCLE 39 ON READER CARD

Ultronic Systems Corp. is in the business of data communications. 100% of our resources are devoted to the manufacture of hardware for this field. When we contribute these resources to OEM, we contribute the most advanced know-how available.

ULTRONIC SYSTEMS CORP.

Sub-Systems Division, 7300 North Crescent Blvd., Pennsauken, N.J.

The new VersaSTORE 2 μsec I.C. core memory will take anything you've got!

PNP
NPN
3V.
24V.

We've designed it that way—to fit easily into your system. With its flexible PNP or NPN interface, a buffered input range of 3V. to 24V., and output range of 1V. to 12V., VersaSTORE is the only memory that requires no additional buffering or external signal conditioning. And we have provided plenty of output drive for your system requirements.

Another unique VersaSTORE feature is a continuous lamp display of all data registers on the front panel that lets you see the data stored in each register. VersaSTORE operates at 2 usec cycle time with half cycle operation, uses integrated circuits for maximum reliability, has a servoed current drive systems for good operating margins at high temperature, yet requires only a ±12V 5% power supply.

VersaSTORE memories are available in increments of 256 to 4096 words of up to 24 bits, in a compact 5¼ inches of standard rack space. And VersaSTORE's compact price matches its compact package.

We have more to tell you about our new VersaSTORE in a fact filled brochure. For your own copy, write to:

dci DECISION CONTROL, INC.

1590 Monrovia Avenue, Newport Beach, Calif. Tel. (714) 646-9371 • TWX (714) 642-1364

news briefs

EASTERN, BRANIFF AIRLINES ADD COMPUTER FACILITIES

In the wake of United and TWA orders for big airline reservations systems, Eastern and Braniff have announced their plans to expand facilities.

Eastern will spend $34 million, the major share going to IBM for the central Miami equipment. Univac gets the rest for outfitting the Operational Data Center at Charlotte, N.C., with two 494's replacing a set of 490's.

The Miami center will have two billion characters of mass storage. They will handle 1600 agent sets, with CRT displays and keyboards, as well as keeping track of reservations, meals, arrivals, and departures. The system will also produce printed tickets for transmission by mail or Teletype.

Eastern's New York and Atlanta offices will be equipped with touch-tone telephones, complete with card dialers, to provide a means of quick inquiry for checking on changing conditions, such as the number of flights to land at a given airport in a specified period of time. Answers return by Teletype. Eventually some 150 telephone units will be installed.

The Charlotte facility will serve as a message switching center and take care of reservations scheduling for local feeder lines. Installation of both will be next year.

Braniff's information system, now in operation, was supplied under a $1.8 million contract by Bunker-Ramo. It's based on two 335 computers at Dallas, linked to offices in 30 cities.

IBM ANNOUNCES MODEL 90 INSTALLATION SCHEDULES

IBM announced its re-entry in the giant computer business with an installation schedule calling for six Model 90's to be delivered in 1967 and plans to build one a month beginning the next year.

Early customers will be NASA's Goddard Space Flight Center and Goddard Institute for Space Studies, Princeton University, and Lockheed-California Company. Price of "a typical system, including peripheral equipment," will be around $6 million. Those customers who are now negotiating for the 90's will have an option to either buy or rent, but it is understood that future orders may be for purchase only.

FEDERAL RESERVE HEAD SEES WIDER COMPUTER USE

The banking nemesis, check float, and perhaps even checks themselves, will be eliminated by the improving data processing and communications technology, according to Federal Reserve Board governor George W. Mitchell. Speaking before the House of Representatives Subcommittee on Legal and Monetary Affairs, Mitchell put forth a strong case for greater edp use by the Federal Reserve system and its member banks.

Federal Reserve float amounted to $1.8 billion a day last year, he noted, which means loss of credit on that amount to banks. (Float results from the delay between actual transfer of funds covered by a check and the time credit for the check is allowed.) While the use of high-speed check-handling equipment has helped to keep float from increasing with the volume of checks handled, it is only the first step, said Mitchell.

The Federal Reserve System, "alert" to technology, is engaged in operating studies of two developments, he said. One involves a short-range program in

CO-EDS IN DORM GO ON-LINE

With the assistance of the Harvard Computing Center, Radcliffe College has installed a terminal in Cabot Hall student dormitory. The experiment, designed to determine effectiveness of the remote computer as an aid to daily assignments, is being conducted by GE and Harvard. Students can dial the computer in Philadelphia and enter program and data by keyboard. Results are typed out on the same unit.

He's got a 2-million-dollar computer right at his fingertips

(and 49 others time-share it with him)

If you can use a typewriter... if you know simple algebra... you can command a 2-million-dollar IBM computer right from your own desk.

That's because IBM time-sharing makes a powerful computer *yours*. Whenever you need it and for as long as you need it during the business day. Wherever you are.

The photo tells the story. That's an IBM 1050 terminal and just about all you have to worry about. It's linked to a large computer at one of IBM's Datacenters.

Even with 49 other people using the computer at the same time your line is never busy.

The only other accessories you need are a private telephone line and a conventional telephone data set. IBM's QUIKTRAN program lets you use simple algebra to communicate with the computer. And if you understand algebra you can learn how to use QUIKTRAN in just two hours.

IBM expands service

Businessmen and technical specialists alike have responded to the convenience and simplicity of time-sharing. So much so, that IBM just doubled its service in New York and Los Angeles... and will add QUIKTRAN facilities in other major cities in 1966.

Simplicity means you can touch-type or hunt-and-peck your data right into the computer.

Convenience means you never have to leave your desk.

With QUIKTRAN you can debug your problem as you write it... instead of waiting for the final answer and then hunting for an error. Your work is processed immediately and you get your answer in seconds.

Time-sharing frees your staff

Think what a cluster of no-waiting terminals can mean for your company.

Key staff members aren't constrained by computer schedules.

You work out problems at your own pace.

You can commit each step to the computer as you develop it.

You buy only as much time as you need. $325 a month for 25 hours. The terminal rents for $125 a month (plus line costs).

Want to get in touch with a large-scale computer right away?

We've got connections.

IBM®

CIRCLE 41 ON READER CARD

which wideband transmission and computer switching systems would be used to accomplish all steps of check transactions at the same time (debiting one account, crediting another at the proper Federal Reserve and member bank). Thus, float would be eliminated.

The longer-range prospect the FRS is studying, said Mitchell, is the much-discussed system in which the payer will tell the bank, either in person or by cash/credit card inserted into a telephone, who to pay, how much, and when. Ultimately, Mitchell foresees 250 computer centers across the U.S. to handle settlement and deposit accounting.

STANDARD NUMBERING SYSTEM ACCEPTED BY EXCHANGES

The securities field has taken a major step toward standardization with the announcement of a discrete numbering system developed by the Committee on Uniform Security Identification Procedures. This step should lead to simplified techniques in securities processing.

The American and New York Stock Exchanges and many banks have agreed to adopt the system after testing and verification. The second phase, now under way, is the assignment of the numbers to 15,000 corporate issuers trading on the major and regional exchanges, 3,000 foreign corporations traded in the U.S., and 92,000 governmental units. Another project, to begin later this year, is establishment of specifications for imprinting the CUSIP number and standard description in machine-readable type font on the individual certificates.

Specifically, CUSIP, which is sponsored by the American Bankers Assn., has decided on a six-digit issuer number, which will be assigned to each corporate and governmental entity having current outstanding securities issues; a two-character issue number will be given to each separate issue of securities and to each different rate and maturity of bonds.

FALL JOINT CONFERENCE PAPERS DUE BY MAY 2

Papers for the 1966 Fall Joint Computer Conference, to be held Nov. 8-10 at the San Francisco Civic Center, are due by May 2 and a $500 award for the best paper has been established by AFIPS.

Survey and tutorial papers are welcome, dealing with "significant trends, achievements, concepts and techniques covering the entire information processing field."

The technical program committee notes that only new papers not exceeding 10,000 words will be considered. Five copies of drafts, including abstracts of 100 to 500 words, should be sent to Dr. William H. Davidow, Technical Program Committee Chairman, 1966 Fall Joint Computer Conference, P.O. Box 2208, Menlo Park, Calif. 94025.

COMPUTER-AIDED TEACHING STARTS FOR FIRST-GRADERS

A computer-based teaching system developed at Stanford Univ. will be in regular use, starting in September, at the Brentwood School in East Palo Alto, Calif. About 150 first-grade students will have a half hour a day on-line for help with reading and arithmetic.

The project, supported by a $1 million grant from the U.S. Office of Education, will make use of IBM equipment. Central computer is an IBM 1800, connected to specially built terminals that allow response by light pen or keyboard. Questions are projected on the terminal screen, with a correct answer bringing on the next question. Wrong answers or excessive delay bring an explanation. The computer will also keep track of scores, analyzing results for checking on student progress.

CONTROL DATA NOTES PROBLEMS AND PROGRESS

Beset by technical, financial and marketing problems, and some internal dissension (one symptom: the recent resignation of Frank C. Mullaney, one of the original founders and a senior v.p.), Control Data last month staged a press conference to air some of its woes and to announce that the "worst is over."

CDC president Jim Norris admitted that building the 6600 in remote Chippewa Falls was a mistake: the facility, he said, lacked proper quality control, and the first four machines didn't work properly. In addition, Norris said that technical problems—in memory and the cooling unit—as well as vendor failures, slowed down the 6600. But the 6000 series is now being made near Minneapolis and the manufacturing problems ironed out, he said.

But he noted that the problems associated with large machines—especially programming and diagnostics—were appropriately large and other manufacturers wandering into this field will discover this for themselves.

There was talk about the problems posed by the increasing percentage of

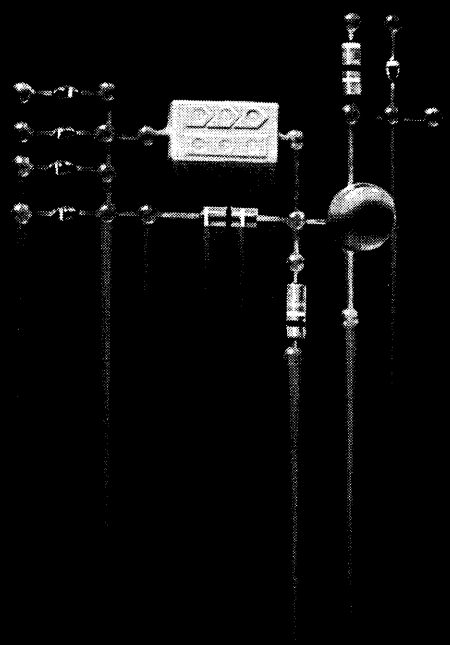
rental orders, now up to 60%. Late in January, CDC announced price changes designed to reverse that trend: three-year lease customers will get a 5% price cut, while the one-year lease price of the 3300 will be upped about 12%. Sales price of the 3300 will remain the same, as will that of the 6600, which was reduced 26% about a year ago. Purchase price of the 1700 will be increased 11%.

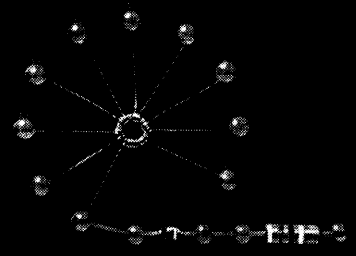
Financially, the company moved to strengthen itself earlier in the month with a two-year loan from 10 banks of $120 million. The company is tightening its belt, says Norris, and the prognosis for the patient is healthy. And despite its big machine problems, CDC remains optimistic about the market for the monsters, thinks it can deliver some 40 6000 series within the next couple of years.

● By refusing to review a Court of Claims decision, the Supreme Court has caused the Internal Revenue Service to refund $11 million to IBM. The money was collected as a 10% excise tax at the insistence of the IRS, even though Remington Rand had obtained a ruling in 1956 that certain computers were not subject to the tax. IBM will pass on the refunds to some 3,200 customers, who will not have to apply for return of the money.

● A new concept in rapid transit, computer-controlled skybuses, is being demonstrated at South Park, near Pittsburgh, Pa. The $5 million project is now under test on a 9,340-foot demonstration loop to determine feasibility of the system in urban areas with medium-density traffic needs. Rubber-tired vehicles, operating in one- to 10-unit trains, cruise on twin concrete elevated roadways, being locked to the roadways by an I-shaped center rail. The speed, stops and doors are controlled and monitored by a small digital stored-program computer contained in a Westinghouse wayside controller at the station. (In an actual system there would be a controller at every station, normally a mile apart). The project is being financed jointly by government agencies and private firms, with most equipment designed and built by Westinghouse Electric.

● A giant multiprocessor for the Army's Nike-X missile defense system will be developed by Univac's Defense Systems Division, under a contract from Bell Telephone Laboratories, Whippany, N.J. The first phase of the





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

a logic circuit that shrank from improvement

In an age of persistently expanding technological complexity, we've used a different approach to sophisticated electronics.

Simplicity.

Our simplified magnetic logic system uses a magnetic core to compare and store its information. It makes decisions, then responds.

We've told here before about fundamental studies of ferromagnetism itself, and about development of square loop ferrites. Now we've developed techniques, components, and circuitry for improved magnetic logic.

A ferrite memory core, a silicon diode, and a resistor combine into a logic module. Put modules together and you can build complete control circuits. Add to these the simple driver circuits we've engineered—to provide the needed input pulses—and the output stage to feed continuous control information to a machine.

True, all-semiconductor logic circuits can do this same job. And they can act much faster than magnetic circuits. But sometimes you don't need all that speed. This magnetic circuit will handle up to 50,000 information pulses per second. And it needs only one-half to one-fifth as many parts.

Its cost approaches that of a relay logic system. It has low impedance, too—10 ohms in the core circuit—providing a high immunity to electrical noise.

These systems aren't out of the laboratory yet. But we think they have a great future.

GM General Motors Research Laboratories
Warren, Michigan 48090

CIRCLE 45 ON READER CARD

news briefs

project has been approved at $24 million. Basic design was done by Univac and Bell Labs and it includes multiple cpu's using a common thin-film memory that is expected to be the largest yet produced. Univac will subcontract about 25% of the work, and Western Electric will build sections using Bell-designed components.

● Rome Air Development Center has purchased a GE-645 computer to aid development work in computer hardware and software techniques which will ultimately be used in Air Force command and control, management, and intelligence systems. The RADC system, which will be delivered in 1967, "can have" up to four cpu's and will be modified to incorporate specialized components and peripheral equipment. A large-scale associative memory and militarized mass memory are being built for the configuration by other suppliers. Remote terminals, including displays and satellite computers, will be hooked into the time-sharing system. (More than 1000 terminals may be plugged into a 645.) To provide the variety of users needed by RADC for evaluation purposes, New York state universities will also share the computer. A GE-635 computer will be installed at RADC in June as an interim system.

● The first IBM 1130 has been delivered, to NASA's Marshall Space Flight Center. The small-scale scientific machine uses interchangeable discs for memory, is being applied to problems of antenna design for the Saturn launch vehicle.

● The RAND Corp. will be host for six linguists during the next academic year, under a grant from the Advanced Science Seminar Program of the National Science Foundation. The group will take part in the company's linguistic research project, attending weekly seminars in mathematics and programming.

● One of the first Foxboro multiple-computer process control systems will be used in petroleum refining at Esso Petroleum Co., Frawley, England. To be installed this summer is a PCP-88 system, announced by Foxboro in October 1965, which will contain "a number" of 97400A digital computers in a master-slave arrangement. The supervisory computer will perform

NCR 500 Series Computers are on their way . . .

. . . Out of the factory. Out to Florida and Washington and California and Maine.

To commerce, industry, finance and government.

The NCR 500 Series offers a solution to data processing and reporting for firms of varying size and with widely divergent needs. Within a given industry it can handle a tremendous range of assignments. A modest sampling would be accounts receivable, billing, disbursements, government reports, costs, accounts payable, sales reports, scheduling, and inventory. There are literally scores of applications that your NCR representative would be happy to fill you in on.

First announced in January '65, NCR 500 systems are setting records for enthusiastic acceptance.

Why? Very simple.

NCR 500's give more input, output and processing capabilities than any other low-priced computer system on the market today.

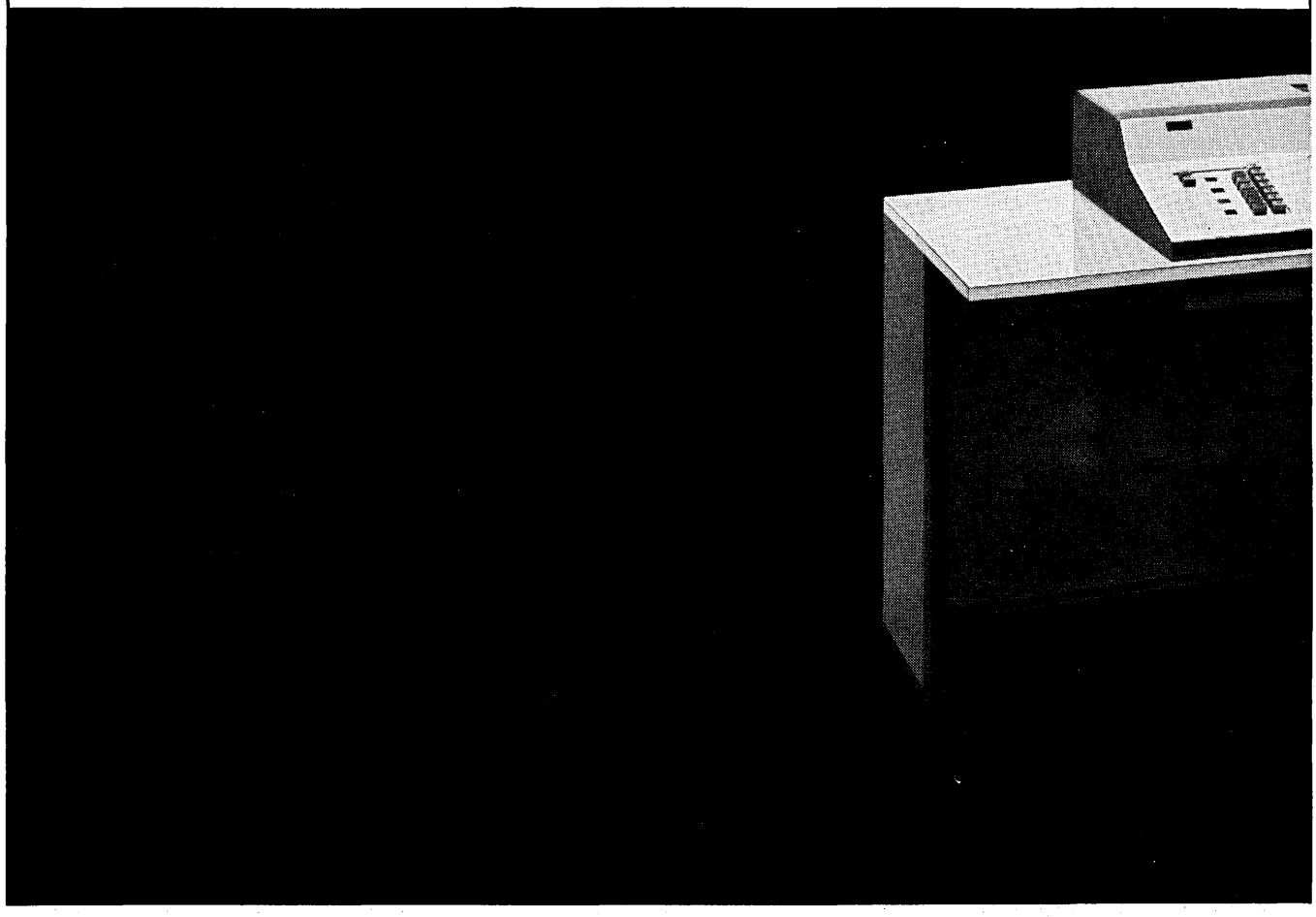
Buyers get NCR's unique "total system" advantage . . . everything from one manufacturer, from data input through processing to output. No costly translating operations.

They get NCR's unique "all languages" capacity, too. (Input and output on punch card, punch paper tape, magnetic ledger card, and optical print.)

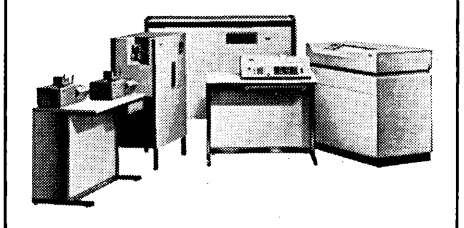
And they get a system of unequalled flexibility. It works alone or as a satellite to any other computer systems. Even within the system itself there's expandable flexibility.

So, in organizing the data required for efficient business operation, users of the NCR 500 Series Computer get more than they can get anywhere else for their money.

No wonder that for businesses of every kind, NCR 500's are on their way . . . all across the country.



NCR



THE NATIONAL CASH REGISTER COMPANY ®

DAYTON, OHIO 45409

CIRCLE 47 ON READER CARD

such functions as setting temperatures, flow rates, and pressures, while subordinate computers will maintain these conditions, directing more than 400 control valves in the refinery. In the past, the process, which involves production of 200,000 barrels of oil a day, has been controlled through nine non-computerized centers.

● Computer-controlled rain will fall over a 1600-square-foot area at the University of Illinois. A rainfall-simulating system is to be used at UI to study water runoff and how to control its flow over watersheds. Electronic Associates Inc. is providing a Pacific Data Systems 1020 computer (4K) which will compose storm profiles, control instruments producing and measuring waterflow, and analyze water runoff data. Each of 100 digital valves will control four raindrop producers, enabling rainfall intensity equivalents of 0 to 13 inches/hour, while output transducers will transmit the runoff measurements from the terrain model. The model will be changed to represent different soils, river basins, urban areas, etc.

● A machine-independent assembler is being offered by Programmatics, Los Angeles software house. Called METAPLAN it is written in a language that can be used to describe other source or assembler languages. The company will offer the program processor as a service or for the customer to use. For users with multiple-computer installations, the program provides a means to use the most convenient machine for assembly of programs to be run on others. For manufacturers, it allows program assembly for machines still in the specification stage.

● With a "first-in-the-nation" claim, the Univ. of California at Los Angeles is conducting a course on computer-assisted instruction. Offered by the Business Administration Extension department, the course is taught by Drs. Gloria M. and Leonard C. Silvern. Sample topics: engineering of instructional systems, man-machine relationships, general and special purpose teaching machines, cost/effectiveness considerations and industry use of CAI. Students will have an opportunity to develop instructional programs and have access to a computer for testing them.

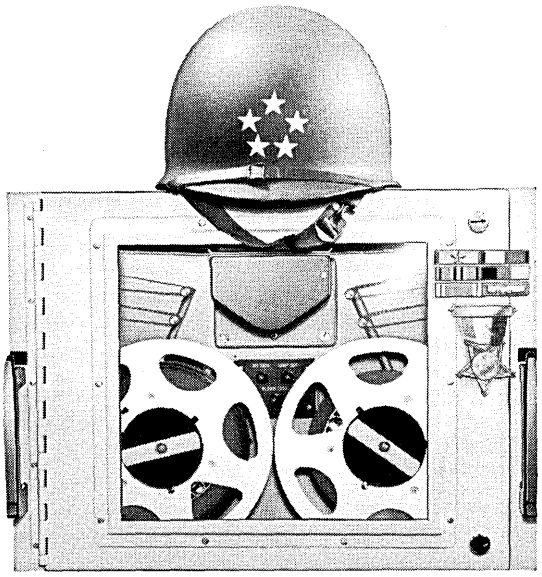
Photocircuits' fully-militarized

500 RM TAPE READER

is the only reader to pass the tests for:

HEAT, COLD, VIBRATION, EXPLOSION, SHOCK, ALTITUDE, RFI, SALT, SAND AND DUST!

(as required by MIL-E-16400 Class 3 and MIL-T-21200 Class 2)



Still...the top military performer

Users of the 500 RM fully-militarized Tape Reader will not be surprised that it passed successfully a complete "campaign" of military environmental tests. Its speed, accuracy and reliability provide a performance that meets all the worst case conditions of the above MIL specs.

Specifically designed as a military unit, the 500 RM is a high-speed photoelectric reader providing speeds to 1,000 char/sec. — with 8" reels to give you maximum data-storage. Its smooth power comes from a unique printed-motor, direct-capstan drive. This means that all tape-reading modes are electronically controlled. The 500 RM has none of the clutch, pulley, brake or pinch-roller problems inherent in conventional or hybrid tape readers, since all of this high-maintenance hardware has been eliminated.

If your department or agency requirements demand top performance with MIL spec reliability — find out about the 500 RM Tape Reader today. Simply write or phone: Photocircuits Corporation, Tape Reader Division, Glen Cove, New York. Telephone: (516) ORiole 6-8000.

Photocircuits
CORPORATION
TAPE READER DIVISION
GLEN COVE, NEW YORK

CIRCLE 49 ON READER CARD

Multigraph® helps Ohio Bell beat the changing numbers game.

Changed numbers. Disconnected numbers. Cancelled numbers.

Ohio Bell handles 2200 of them every day in the Greater Cleveland area.

And overnight they have to be distributed to intercept operators.

Now, Multigraph isn't the only way to handle this job. Ohio Bell just chose us because our system could do it at lower cost.

Working with Ohio Bell systems engineers, we recommended and installed the Photo Direct Master system. It records the changed numbers as they come off the computer. Copies are duplicated and distributed to intercept operators before the next day breaks.

The savings from this system over the previous one are substantial. And as a bonus, the Multigraph equipment is used on other projects during the day.

Ohio Bell wins coming and going. We bet you can, too. Just call your Multigraph man. Or write Addressograph Multigraph Corporation, Department T-6626, 1200 Babbitt Road, Cleveland, Ohio 44117. No matter what your game is.

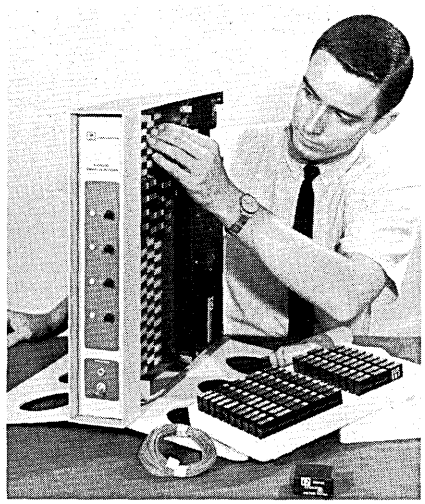
Multigraph
DIVISION OF
ADDRESSOGRAPH MULTIGRAPH CORPORATION

CIRCLE 51 ON READER CARD

new products

logic trainer

Using plug-in logic modules, students can design subsystems with a complexity of up to 240 circuits. Unit comes complete with power supply, regulators, power wiring, wire-wrap



gun, and 100 modules. Welded, single-function modules, color-coded, are plugged into wire-wrapped "mother" boards. CONTROL & COMMUNICATION DIV., RADIATION INC., Melbourne, Fla. For information:

CIRCLE 130 ON READER CARD

core memory system

Series MUA is an integrated circuit, core memory system with a 2 usec cycle time and 950 nsec access time. Capacity range is 64 to 4K words, with two to 30 bits per word. MUA is supplied in random, sequential, random/sequential, and sequential-interlaced modes. Address register, power supply, and self-test are optional features. FABRI-TEK, INC., Amery, Wisc. For information:

CIRCLE 131 ON READER CARD

laboratory computer

The LINC-Eight is a faster, larger version of the MIT-developed laboratory computer, LINC. (Digital Equipment Corp. has been producing a commercial LINC.) LINC's multiplexed a-d inputs, relay register output provisions, dual LINC tape transports, and alphanumeric oscilloscope display are combined with the PDP-8's 1.5-usec memory having a 4K-32K capacity. The system is designed to control experiments and collect and analyze data in biomedical and environment science research. Software includes all PDP-8 software, LINC's LAP assembly system and language, the GUIDE system, and convenience programs. DIGITAL EQUIPMENT CORP., Maynard, Mass. For information:

CIRCLE 132 ON READER CARD

mag tape transport

The 204B-9, which is a half-inch drive for the Honeywell Series 200 computers, has packing densities of 200, 556, and 800 bpi and a transfer rate of 96K cps. HONEYWELL EDP., Wellesley Hills, Mass. For information:

CIRCLE 133 ON READER CARD

data recorder

These off-line units record directly onto mag tape. The model 229 reads Dennison Print-Punch merchandise tags at up to 400/minute, editing as it writes, checking each digit and number of digits, and comparing what was read with what was written on tape. The 220 series performs similarly, reading payment coupons onto tape at 60/minute. CUMMINS-CHICAGO CORP., Chicago, Ill. For information:

CIRCLE 134 ON READER CARD

signal line isolator

Solid-state unit reportedly has isolation characteristics never before attained in commercial units. The device couples timing, control, or data signals between I/O circuits without a conductive path, attaining extraneous signal attenuation of over 100 db. Digital signals may be transmitted at from dc up to 100 kc. Optical coupling system uses an emitter and sensor separated by a conductively and electromagnetically-shielded interface. Price: under $200. BUNKER-RAMO CORP., Canoga Park, Calif. For information:

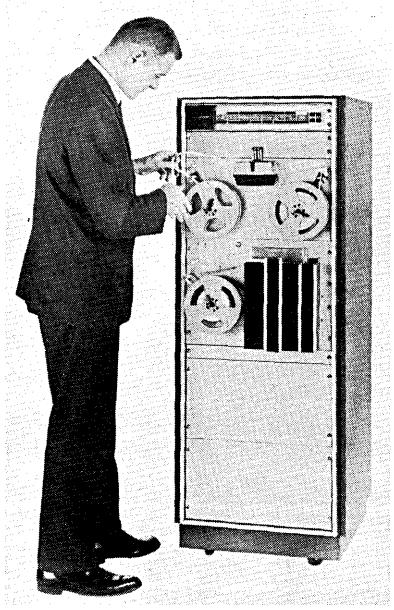
CIRCLE 135 ON READER CARD

photoelectric keyboard

For direct computer input, tape punch, other data handling gear, this unit uses lamps that excite an arrangement of photosensitive devices. Obviating mechanical switches with resulting contact bounce or noise, it has only two moving parts per station. Keys are in modular rows, and each row

PRODUCT OF THE MONTH

A paper-tape communications system capable of detecting parity errors and causing the retransmission of blocks of data, the System 311 operates serially at 120 characters/second. Operating in conjunction with the Bell 202C-2 data set or equivalent, it mounts in a floor cabinet with a tape reader, tape perforator, control panel, and logic. It is capable of unattended operation once tape reels are mounted. The unit can also be used for off-line tape duplication and editing in its spare time.

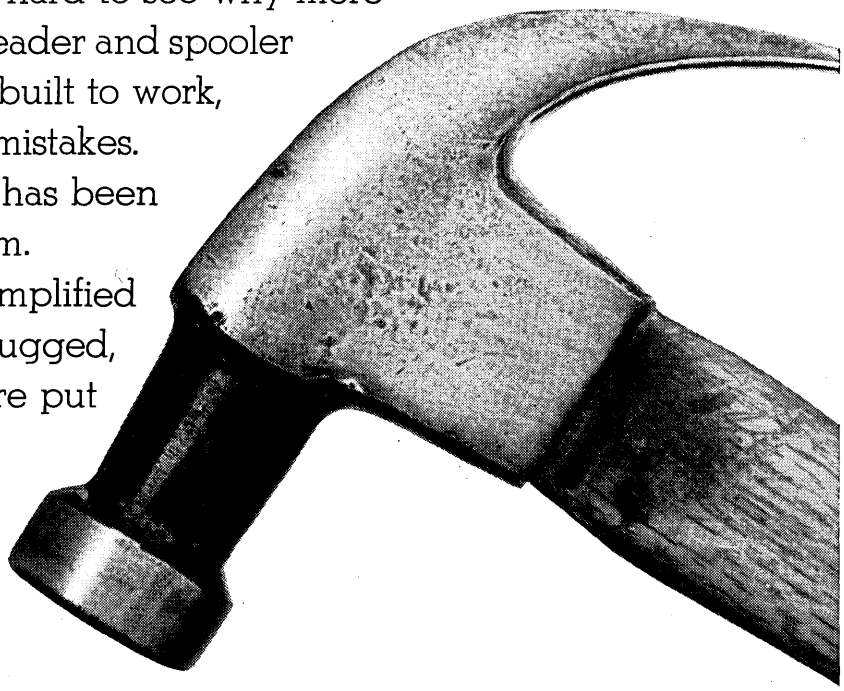


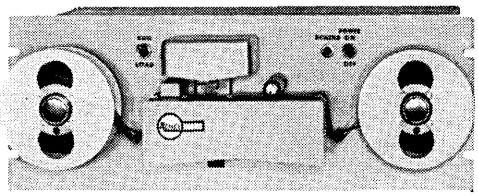
Operating on 5- and 8-level tapes, any code format may be used. For operation of the retransmit feature, however, either an odd or even parity format must be used; there can be no intermixing. Any customer-specified character is accommodated for the block character; typically, a "skip restore" or "print restore" function is used. The speed of the tape reader and the punch is 120 cps.

The tape reader has a capacity of 750 feet on 7.5-inch plastic reels. The perforator has a supply of 1,000 feet, and its take-up reel, 750 feet. TALLY CORP., Seattle, Washington. For information:

CIRCLE 136 ON READER CARD

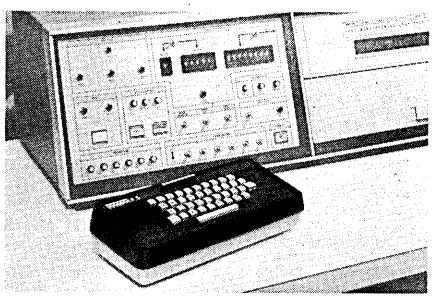
If you ever get tired of waiting for a Remex tape reader to break down, you can always try hitting it with a hammer. It's not hard to see why more companies buy Remex tape reader and spooler units than any other. They're built to work, work, work. Without making mistakes. The number of moving parts has been kept to an absolute minimum. The solid state circuit has a simplified design. And then there's the rugged, yet precise way these units are put together. You may find yourself looking for a bigger hammer. For details, phone 213 772-5321, or write us at 5250 West El Segundo Blvd., Hawthorne, Calif. 90251





REMEX

RHEEM ELECTRONICS
a division of
EX-CELL-O CORPORATION



can generate eight bits plus a clock pulse. Keys are spaced on multiple centers of 0.750 inch, horizontally and vertically, and can be arranged with a unit having from 10 to 66 keys. MTBF of lamps is reportedly more than 20,000 hours. TMC TELEMETRICS DIV., Santa Ana, Calif. For information:

CIRCLE 137 ON READER CARD

core memory

The FX-12 is a 10-usec system with a capacity of 512 (8-bit maximum) words. It features all-silicon, cordwood, motherboard construction, and the cores offer voltage margins of ±10% over the operating temperature range of 0° to 65°C. Applications include code or format conversions and speed buffering. FERROXCUBE CORP., Saugerties, N.Y. For information:

CIRCLE 138 ON READER CARD

drum storage

Replacing the model 7320 for use with the 360/40, 50, 65, and 75 is the model 2303, which can store almost 4 million bytes accessible in 8.6 milliseconds. Transfer rate is 312,000 bytes/second. Capacity is fives times that of the older unit, and speed is doubled. IBM DP DIV., White Plains, N.Y. For information:

CIRCLE 139 ON READER CARD

data terminal

The Type 1B enables 1004 and 1005 computers to communicate via 301B data sets and Telpak facilities at rates up to 40,800 bps. At added cost, it will permit programmed selection of the 301B for high-speed transmission, or the 201A or 201B for medium-speed communication. The units can be field-installed. UNIVAC DIV., SPERRY RAND CORP., New York, N.Y. For information:

CIRCLE 140 ON READER CARD

terminal printers

The 300 series prints out data received over a telephone line at up to 300 lpm with a full 64-character font (96 to 128-character fonts available). The

NEW LOW COST INTEGRATED CIRCUIT

See REDCOR's new Computer Linkage Systems during the New York IEEE Show—the REDCOR Suite will be located at the Essex House, 160 Central Park South, New York, N.Y.

Engineers: If your field is analog/digital data systems or component design, a career opportunity awaits you at REDCOR. Write to Personnel Director.

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CIRCLE 54 ON READER CARD

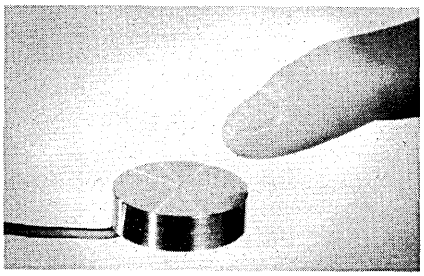
new products

interface is tailored to any computer. Standard frame sizes are for 80 and 132 columns, with 160 columns available; spacing, horizontal is 10 characters/inch, and vertical is six and eight lines per inch. DATAMARK, INC., Westbury, N.Y. For information:

CIRCLE 141 ON READER CARD

touch-operated switch

Solid-state unit is based on a semiconductor surface effect which is sensitive to touch. Hermetically sealed for long life, the unit is encapsulated in epoxy in sizes beginning at 1 inch diameter by ¼-inch deep for the round,



and 1 x 1 x ¼-inch for the square. Models are available in plastic or stainless steel cases. HALL-BARKAN-OPTICON, Tuckahoe, N.Y. For information:

CIRCLE 142 ON READER CARD

off-line printer

Print station PS-6000 consists of a 600-1pm chain printer and a single-capstan tape drive. Tape format is IBM-compatible, 7-channel (200, 556, 800 bpi) or 9-channel (800 bpi). The printer accommodates up to 192 characters on the print chain, and paper widths from 2.5 to 18.5 inches. POTTER INSTRUMENTS CO. INC., Plainview, N.Y. For information:

CIRCLE 143 ON READER CARD

paper tape duplicator

System 128 consists of a paper tape punch, two tape readers, an encoding keyboard, and an indicating master control panel. Operative with 5, 6, or 7-level tapes, it will punch a tape at 30 cps; duplicate a tape (reading and punching line by line); compare two tapes and produce a third; and verify a tape against keyboard entries, producing a duplicate. Odd and even parity checking available. OHR-TRONICS INC., New York, N.Y. For information:

CIRCLE 144 ON READER CARD

tax program

Available for calculating state and federal withholding taxes on computer are a fully programmed subroutine for 1400 series computers and a detailed block diagram which can be programmed for other systems. The subroutine is written in 1401 Autocoder. A table for each government having such taxes and a general purpose formula applicable to all but three states are included. (A separate formula is available for these). The formula requires 1K-2K words of storage; each table, 60-260 words. MANAGEMENT INFORMATION SERVICE, Stony Point, N.Y. For information:

CIRCLE 145 ON READER CARD

communications system

System 400 Dial-o-verter is another in the family of off-line Dial-o-verters, and will handle up to 64 remote high-speed terminals transmitting data and messages over wideband lines at more than 1000 wpm. It consists of a central control station, mag tape terminal with two or more handlers, operator console, printer terminal and, at remote locations, paper tape terminals which will send and receive under direction of the central control station. Data and messages are automatically separated, data being recorded on mag tape and messages being automatically re-routed to addresses by the control station. The system provides for priority messages, multiple and group addressing, message accounting, and private message handling. DIGITRONICS CORP., Albertson, N.Y. For information:

CIRCLE 146 ON READER CARD

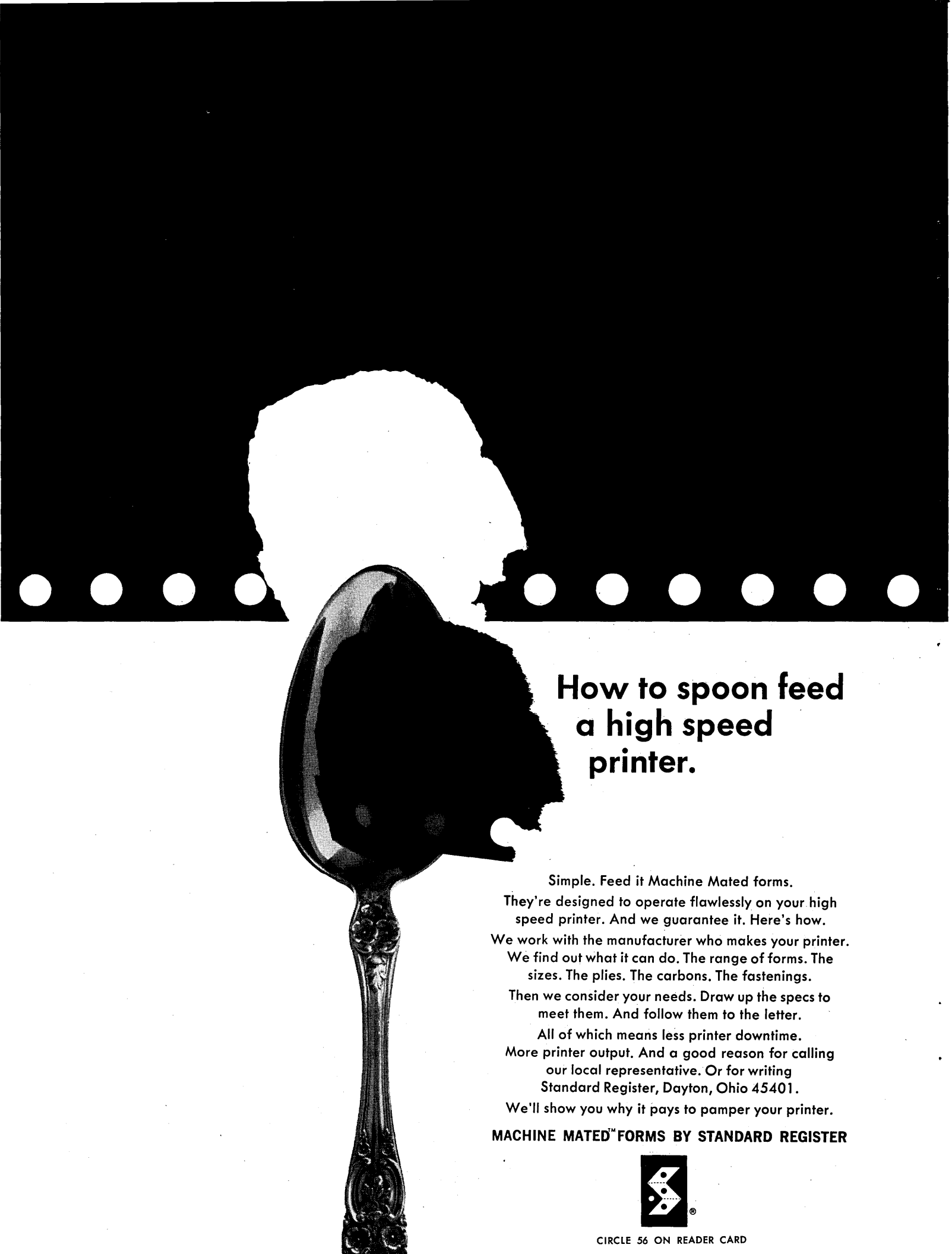
taped data bank

On mag tape are references to all organizations, worldwide, assigned U.S. chemical or chemically-related patents issued since January '50. Listed are 143,000 assignees through December '64, with annual updates scheduled. This file can be merged with the firm's Uniterm file, allowing searches for patents by class or subclass, chemical terms, compounds, assignees, or any combination. INFORMATION FOR INDUSTRY INC., Washington, D.C. For information:

CIRCLE 147 ON READER CARD

digitizer

The 1.092 Digitizer converts data from graphic to digital form and records it on 80-column cards or 5 to 8-channel paper tape. It consists of an input coordinatograph and control unit and will digitize any x-y coordinate point over a 30″ x 30″ surface as depicted by photos, maps, graphs, and strip charts. Accuracy is ± .015



How to spoon feed a high speed printer.

Simple. Feed it Machine Mated forms.

They're designed to operate flawlessly on your high speed printer. And we guarantee it. Here's how.

We work with the manufacturer who makes your printer. We find out what it can do. The range of forms. The sizes. The plies. The carbons. The fastenings.

Then we consider your needs. Draw up the specs to meet them. And follow them to the letter.

All of which means less printer downtime. More printer output. And a good reason for calling our local representative. Or for writing Standard Register, Dayton, Ohio 45401.

We'll show you why it pays to pamper your printer.

MACHINE MATED™ FORMS BY STANDARD REGISTER

CIRCLE 56 ON READER CARD

inch. Speed for card output is 13 columns/second; for tape — 15 cps. ELECTRONIC ASSOCIATES INC., West Long Branch, N.J. For information:

CIRCLE 148 ON READER CARD

data communication

The 680 system can serve as a complete line scanning control or as a peripheral to batch I/O for a central processor. Scanning up to 128 lines, it uses the core memory of a PDP-8 computer to buffer characters. It thus is able to handle lines with differing speeds and character sizes without wiring changes. Cycle time of the PDP-8 is 1.5 usec. DIGITAL EQUIPMENT CORP., Maynard, Mass. For information:

CIRCLE 149 ON READER CARD

tape certifier

The C-33 converts mag tape from 7 to 9 channel operation, and is designed for use with the IBM 2400 series transports. It may be operated in the auto-test inspect mode to determine whether tapes are suitable for 9-channel operation, or in the certify-repair mode. CYBETRONICS INC., Waltham, Mass. For information:

CIRCLE 150 ON READER CARD

tape drive

The 602 is a "low-cost" transport moving tape at 37.5 ips. It records on seven channels at 200, 556, and 800 bpi, and transfers data at 7.5, 20.85, and 30KC, respectively. Features include the ability to read in either direction, and dual-gap head for read-after-write capability. CONTROL DATA CORP., Minneapolis, Minn. For information:

CIRCLE 151 ON READER CARD

tape reader

The PTR-66 reads paper tapes with up to 40% transmissivity at speeds up to 150 cps asynchronously. It is bidirectional, controlled by a front panel switch, and is photoelectric. OMNI-DATA DIV., BORG-WARNER CORP., Philadelphia, Pa. For information:

CIRCLE 152 ON READER CARD

on-line reader/sorter

An expansion of capability is the use of the Chek-Sort for computer input. This reader-sorter of MICR-encoded documents operates at up to 6000 documents/minute, now both on- and off-line. For details, see April, p. 92. LUNDY ELECTRONICS & SYSTEMS INC., Glen Head, N.Y. For information:

CIRCLE 153 ON READER CARD

i.c. core memory

The ICM-40 is a coincident-current unit with a full cycle time of 1 usec and an access time of less than 500 nanoseconds. Designed for rack mounting, it has a capacity of 16K words, operating temperature range of 0°C to 50°C. Standard operating modes include clear/write, read/restore, and read/modify/write cycles. COMPUTER CONTROL CO. INC., Framingham, Mass. For information:

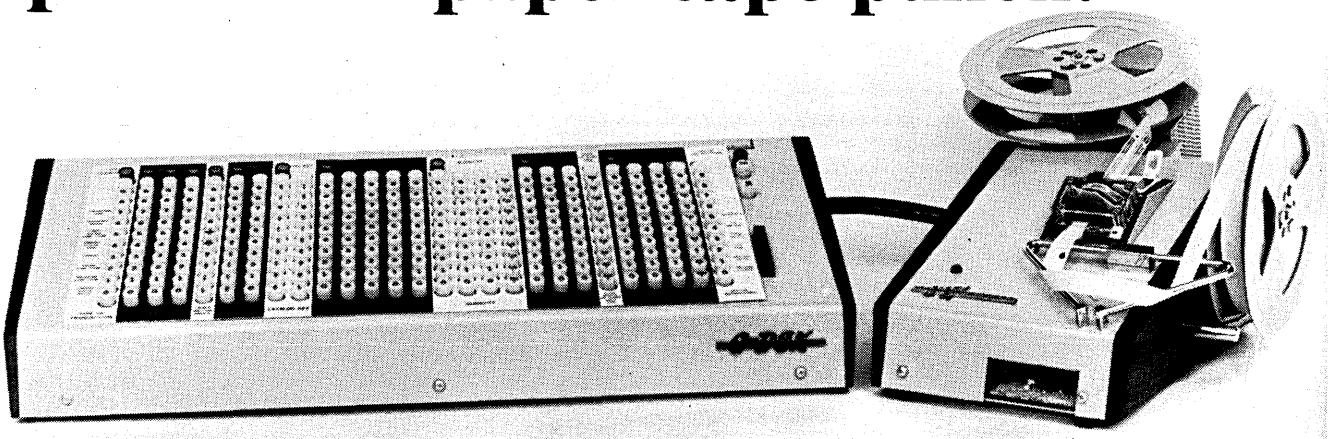
CIRCLE 154 ON READER CARD

incremental recorder

Producing computer-compatible mag tapes, the PI-1167 accepts data at rates from 0-200 steps/second. Recording is at 200 bpi in a 7-channel NRZ format. Internal electronics automatically generate inter-record gaps, parity check characters, end-of-file gap and tape mark. PRECISION INSTRUMENT CO., Palo Alto, Calif. For information:

CIRCLE 155 ON READER CARD

Look what Colorado Instruments did with Roytron's plain little paper tape punch.



Colorado Instruments was developing a data collection device that would turn source data into computer-usable punched tape. And they were looking for a particular kind of tape punch.

Since it just happens that ROYTRON™ produces punches for every conceivable paper tape requirement, it was only natural for us to get together. (The resulting computer data entry system is already in use in over one hundred retail outlets of one of the nation's largest mail order houses.)

Roytron's basic tape punch mechanism suited Colorado's needs to a "T." But we could have delivered it either desk or rack-mounted. With or without electronic circuitry or logic. Reader incorporated or not. Either 20, 50 or 75 CPS. In 24 different models.

Roytron offers more than just the widest range of models. Our clients get punches with the most desirable operating features. Features like efficient electromagnets and off-center springs for smooth, trouble-free punching. In addition, Roytron paper tape punches operate on unusually low power (24 volts, 75 ma).

And they come with a meaningful warranty backed up by a nationwide system of service centers.

However you like your Roytron paper tape punches, that's how you get them. Customized. And we also have a price story to tell. So, before you go a step further with a punched tape system, consider Roytron.

For detailed specifications on the Roytron paper tape punch that fits your exact requirements, write: Roytron, Royal Typewriter Company, Dept. 33CV, 150 New Park Avenue, Hartford, Connecticut 06106.

A DIVISION OF LITTON INDUSTRIES **ROYTRON™**

CIRCLE 59 ON READER CARD

new literature

MUSE SYSTEM: Computer simulation of a class of sound synthesizers that have been successfully used in testing theories of speech production is covered in 95-page book. MUSE, which uses a 7090, translates descriptions of sounds, including human speech, into corresponding analog waveforms. AD-625 734. Cost: $2. CLEARINGHOUSE, U.S. DEPT. OF COMMERCE, Springfield, Va. 22151.

DIGITAL PLOTTING SYSTEM: 16-page bulletin describes how a CalComp digital plotting system can be used with the IBM 360 as a business management tool and in scientific applications. CALIFORNIA COMPUTER PRODUCTS INC., Anaheim, Calif. For copy:

CIRCLE 160 ON READER CARD

MICROFILM RETRIEVAL SYSTEM: Case history report on system for the control of engineering documentation using aperture cards is described in 10-page report. MICROSEAL CORP., Skokie, Ill. For copy:

CIRCLE 161 ON READER CARD

DIGITAL CONTROL: Booklet describes multiple channel, time-shared digital system designed for process control. Included are features, capabilities, loop control stations and system elements. FISCHER & PORTER CO., Warminster, Pa. For copy:

CIRCLE 162 ON READER CARD

DP ACCESSORIES: 48-page catalog lists items that can be used with IBM, Univac, NCR, RCA, Burroughs, Anelex. Types of items included are computer ribbons, tape reels, tab card storage boxes, tabulating card filing systems, tape reel files, reel racks, perforator tapes. Booklet illustrates items and includes sizes and prices. EDWARD OCHMAN SYSTEMS, Fairfield, Conn. For copy:

CIRCLE 163 ON READER CARD

CORE MEMORIES: Four-page technical data sheet describes operating characteristics of random and sequential access and sequential interlace memories which range in size from 8x256 to 18x4096. Included are descriptions of data lock which retains the information wih power off, self check modes, manual load and unload and flag detection for control purposes. ELECTRONIC ENGINEERING COMPANY OF CALIFORNIA, Santa Ana, Calif. For copy:

CIRCLE 164 ON READER CARD

FLOORING: Eight-page brochure describes all-steel, modular floor for computer rooms and other equipment areas requiring underfloor access and plenum. Structural floor systems including tile and trim selections are shown, and specially designed air conditioning packages from 28,000 to 180,000 BTU/hour for use in computer and equipment areas are included. TATE ENGINEERING INC., Baltimore, Md. For copy:

CIRCLE 165 ON READER CARD

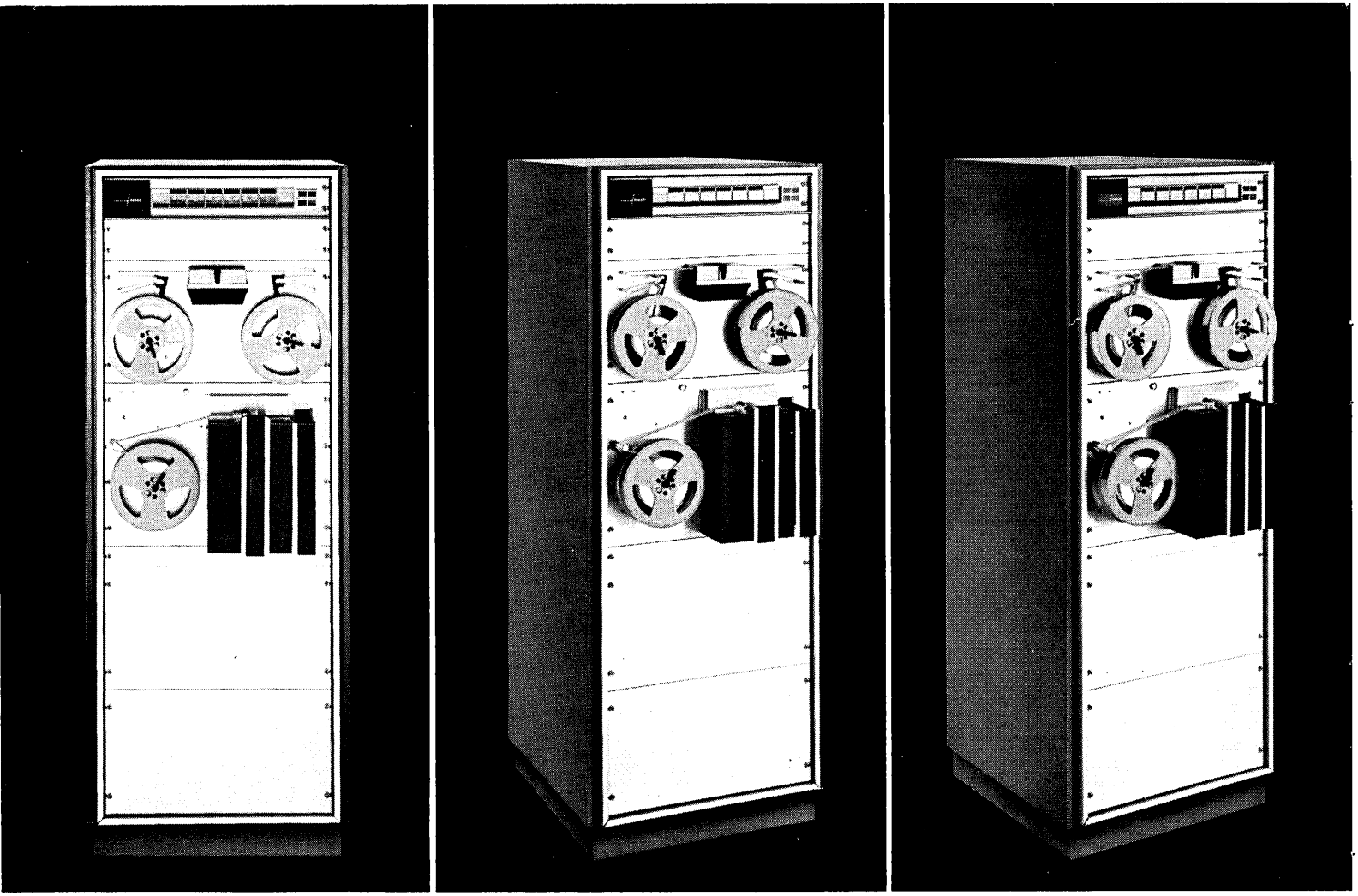
INTEGRATED CIRCUITS: Four-page brochure includes loading and interface rules for the SP600 series monolithic plug-in integrated DTL circuits, which reportedly have high noise margins, high speed and low power dissipation. The series includes a J-K master-slave flip-flop, quad two-input gate, triple three-input gate, dual four-input gate, quad two-input gate expander and a buffer/driver. DIGNETICS CORP., Sunnyvale, Calif. For copy:

CIRCLE 166 ON READER CARD

BINDING SYSTEM: Four-page brochure describes system for general office and continuous form binding. Computer and tabulator continuous forms can be bound in labeled volumes and if the printout is closer to the fold, form consumption is reduced by 10%. Also, edge-to-edge visibility is retained on bound sheets. CUMMINS-CHICAGO CORP., Chicago, Ill. For copy:

CIRCLE 167 ON READER CARD

INTEGRATED DATA COLLECTION: 106-page book covers monitoring, conversion and analysis for psychophysiological research in studying individuals under basal and stress conditions. Book points out that advances in computers and multiple varian statistical methods now make it practical to collect and process a much larger number



Moving data fast is half the battle. The other half is moving it without mistakes.

Now you can get error free data from here to there (or there to here) at 1200 words per minute.

The new Tally Business Communications System 311 Send/Receive Terminal is the most versatile perforated tape station ever offered and the only one which detects and deletes errors. Use the System 311 for transmitting and receiving data over ordinary dial up telephone lines at 120 characters per second and for off-line tape duplication and editing in its spare time.

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of contributing variables than previously. Cost: $4. AD-623 126. CLEARINGHOUSE, U.S. DEPT. OF COMMERCE, Springfield, Va. 22151.

MEMORY SYSTEM: 11-page brochure discusses operation of VersaSTORE core memories in capacities of 256 to 4096 words of up to 24 bits. Features, packaging, addressing options, circuit interfaces, ordering information and specifications are also covered. DECISION CONTROL INC., Newport Beach, Calif. For copy:

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GP COMPUTER: 12-page brochure gives details of the PDP-7 computer, designed for data handling in the scientific laboratory, computing center, or real-time process control system. Brochure discusses the processor, memory, and I/O sections, plus optional equipment. Elements of the programming system are described briefly, and the instructions are listed. DIGITAL EQUIPMENT CORP., Maynard, Mass. For copy:

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RANDOM ACCESS DRUMS: Four-page brochure and 26-page application booklet details specifics on models 170 and 340 which offer independent, simultaneous multiple write/read access. Redundancy capability, rapid access, and reliability of these drums are described in the application booklet. BRYANT COMPUTER PRODUCTS, DIV. OF EX-CELL-O CORP., Walled Lake, Mich. For copy:

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LOGIC MODULES: Benefits and features, advantages of AND logic and high-current capability, general physical and electrical characteristics are included in 6-page booklet describing the T Series modules. SCIENTIFIC DATA SYSTEMS, Santa Monica, Calif. For copy:

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RACK-MOUNTED COMPUTER: Two brochures are available on DATA/620: 36-page brochure includes specifications, systems options and available peripheral equipment. User services, covering program exchanges and software library maintenance are also described. 35-page interface manual, written for systems engineers, provides basic circuits and logic design on I/O of the DATA/620. Manual also contains information on signal characteristics, inter-connections, and installation procedures. DATA MACHINE INC., Newport Beach, Calif. For copy:

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COMPUTING SYSTEM: 18-page brochure illustrates and describes 8800 computer's performance reliability, programming versatility, readout and display equipment; includes equipment summary on analog and digital logic components. ELECTRONIC ASSOCIATES, INC. West Long Branch, New Jersey. For copy:

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TAPE DRIVES & MEMORY SYSTEMS: Brochure outlines transfer rates, tape densities, tape speeds, start/stop time for TM-7, 9, 11, 12 tape drives and TM-7200, 9200, 11200, 12200 systems. AMPEX CORP., Redwood City, Calif. For copy:

CIRCLE 174 ON READER CARD

books

The Production and Distribution of Knowledge in the United States, by Fritz Machlup, Princeton University Press, 1962.

This book is a work of quantitative economics which attracted wide attention among economists when published three years ago. However, its value for the computing field has been overlooked.

Machlup uses the word "knowledge" to refer to any information—whether derived from research and development, churches, photographs, universities, or rock-and-roll music. "The production of knowledge is an economic activity, an industry, if you like. Economists have analyzed agriculture, mining, iron and steel production, the paper industry, transportation, retailing, the production of all sorts of goods and services, but they have neglected to analyze the production of knowledge. This is surprising because there are a good many reasons why an economic analysis of the production of knowledge seems to be particularly interesting and promising of new insights."

The purposes of the book are:

1. To provide a detailed classification of information production and distribution.
2. To derive the most detailed estimates possible as to the quantities of information in the various categories and subcategories, and what it costs to produce and distribute these quantities. Problems of double counting are rigorously analyzed.
3. To discuss how the growth of the "knowledge industries" will continue to change the economic structure of the United States.

Professor Machlup wove together a huge amount of factual material during the four-year period in which the book was produced. The book contains over eighty statistical tables, covering every aspect of the knowledge industries. For example, there are tables for:

Total Expenditures for All Printed Matter and Writing Supplies, 1958.
Telephone: Numbers of Telephones

and Calls, Operating Revenues, and Related Data, 1880-1958.

Legal Services: Gross Receipts of Law Firms and Personal Consumption Expenditures, Selected years between 1939 and 1958.

These tables are thoroughly backed up by the text. The derivation of the figures and their interpretation are exhaustively explained.

Chapter VII, which contains material about computers, seems to be an aside to economists who know little about computers. This chapter is not the reason why the book is of extreme importance for the computing industry.

What is important is the effect the book can have on discussion of the computer as a utility. Discussion of this topic is now characterized by extreme vagueness with regard to the storage requirements of a computer utility, and what the utility might be used for. There is material in this book which can be worked into some sort of factual basis for encoding and transmission models.

—PETER ERRINGTON

Practical Pert, by H. J. Hansen, American House, Division of American Aviation Publication, 1964.

This book is intended as an introduction to the concepts of Pert and CPM, and as a guide to their use. Although it contains some discussion of computers in network analysis and reporting, it does not include any technical discussions of mathematical methods or computational algorithms. In other words, it was written for Pert/CPM users, not for Pert/CPM programmers. It would, however, be useful reading for the relatively small group of programmers and analysts who believe in knowing something about the use of the systems that they design and code.

In his preface the author claims that "esoteric, sophisticated, and highly technical explanations of these subjects have tended to create an overcomplicated picture of Pert and the Critical Path Method . . ." "Millions of dollars have been spent for sophisticated management-system seminars and studies." "Many of these efforts re-invent Pert, forcing it to re-appear under a new name so that only an expert can understand it." It is the noble purpose of this book to combat this evil trend by presenting a straightforward, complete, concise description of the subject, with explanations that can be understood by the layman. Examples are drawn from real life experiences, rather than

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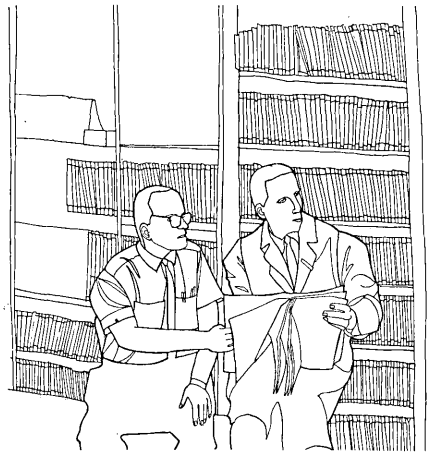
from artificial classroom problems designed to fit impressive academic solutions.

The book assumes that the reader has no prior knowledge of the concepts or functions of Pert and CPM. The early chapters are concerned with the history of the development of Pert/CPM, and discussion of standard terminology and general network concepts. This is followed by a general discussion of the benefits to project planning and controlling that arise from the application of these concepts. A large part of the book is devoted to ideas concerning network design. It contains discussions on subjects ranging from how to train and organize people in network development, to how to assign codes to events, to helpful hints on the types of paper and colors of pencils that should be used.

The book contains good explanations of differences between CPM, Pert-Time, and Pert-Cost. It also includes some of the author's ideas on the use of Pert concepts to keep track of profits, and to measure progress in relation to incentive contracts. Sample input and output forms are included to illustrate each of the versions. One of the final chapters considers the future potentialities of the use of display equipment and on-line terminals, with



project networks and Pert/CPM reporting concepts, to provide information summaries in useful formats for on-line project management.

The book contains a number of useful appendices, including a list of 43 of the existing Pert/CPM computer programs, a glossary of common terms and symbols, and extensive bibliography, a list of a number of companies with the projects on which they are presently using Pert and CPM, and examples of input and output forms.

—TED SHEPHERD

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NOTE: Xerox will conduct Boston Interviews (April 26-28, 1966) during Spring Joint Computer Conference. Please check the local papers for details at that time.

washington report

STAATS NAMED NEW GAO HEAD

President Johnson's appointment of Budget Bureau deputy director Elmer Staats as Controller General may affect efforts to revamp government dp management procedures, despite passage of the Brooks Bill. Staats' predecessor, Joseph Campbell, was a staunch backer of the Brooks measure, which among other things was intended to centralize federal computer procurements, and indeed favored use of stronger language and provisions. General Accounting Office reports provided most of the documentary ammunition for the Brooks forces.

Staats, who testified for the Budget Bureau at the bill's hearings, leaned towards a more moderate course. On the issue of centralized procurement via a revolving fund, he said: "...as a general practice, we would not expect to use the funds to procure, centrally, the equipment requirements of agencies other than for joint utilization arrangements." He also evidenced a disbelief in the usefulness of having government-financed computers used by contractors placed under centralized procurement. Whether or not Staats will retain these opinions in his new position is moot. Odds are, however, that implementation of the more controversial aspects of the Brooks Bill will tend to go into low gear.

ADVANCED RECORD SYSTEM GOES OPERATIONAL

Elaborate computer "netting" and time-sharing plans by government agencies moved a step closer to practicality with the mid-February inauguration of the General Services Administration's long-heralded Advanced Record System, built by Western Union. ARS, the civilian agency counterpart of DOD's Autodin, began operations with 312 station subscribers, 433 station lines, hopes eventually to get up to 2,800 subscribers, 4,000 station lines. The system will provide long-distance voice, facsimile, teletype, and computer-to-computer data transmission. According to officials, ARS is ready to begin handling some high-speed, high-volume data transmission for its customers as soon as they are ready on their end. GSA's Federal Supply Service and the Dept. of HEW are expected to be among the first to use the dial-up service for this purpose.

Subscribers to ARS will also be able eventually to interface with Autodin at its message-switching centers, only one (of a projected three) of which is now operational. This is in Romney, W. Va., where back-to-back Univac 418's are handling store-forward functions.

JOVIAL GETS BOOST, SCHOOLS GET MONEY

The Air Force reportedly is moving toward issuance of RFP's for construction of a Jovial compiler for its Librascope 473L, which would be a might boost for use of the language as an overall AF C&C standard. PL/I is the only real alternative and it's far away.

The National Science Foundation is asking Congress for $12 million in fiscal '67 to support university computing facilities, up $3 million from this year and more than double last year. While prepared to pick up the tab on perhaps 40 installations, NSF indicates it would like to see more inventive, enterprising approaches to computer projects.

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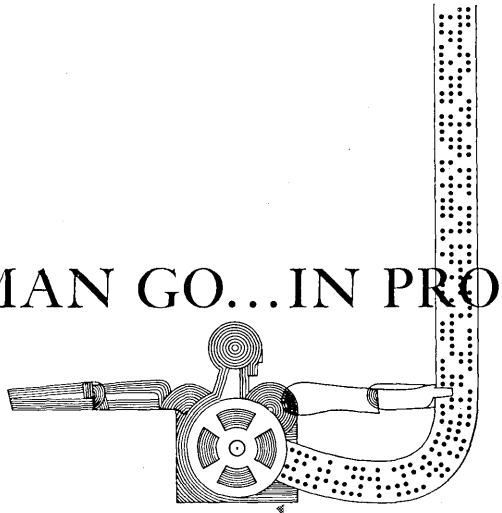

From abacus to computer, human progress can be measured in increments of man's skill in processing data. Originally no more complex than the fingers of one hand, computer systems are today truly revolutionizing the very times in which we live. For as civilization grows ever more aware of the skills of these uncanny servants, so too grow in importance the programmers who initiate and then interpret all that these instruments are able to accomplish. Program: A trajectory for optimum ballistic flight far out in space. Program: Simulation studies. Program: Advanced software. Real-time management, and business systems. In brief, wherever there exists the need to do things better: Program. Lockheed offers an unusually wide range of advanced programming tasks at one of the world's largest centralized industrial computer installations. Write Mr. K. R. Kiddoo, Professional Placement Manager, Sunnyvale, California. Lockheed is an equal opportunity employer.

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CIRCLE 102 ON READER CARD

world report

COMPUTER MAKERS SEEK CHANGED EMBARGO LIST

A series of bulk purchases of computers, expected about mid-year from central purchasing agencies of five Soviet bloc countries, has set off a clamor in Europe. The pressure is on Cocom, representing NATO countries in drawing up a strategic list of goods not permissible for shipment behind the Iron Curtain. Privately-voiced complaints from manufacturers suggest that an alleged attempt at a new definition may allow IBM to ship 1400-series computers while barring U.K. and Western Europe machines. Lobbyists are requesting stricter definition by application, so that machines with an obvious weapons-systems implication or containing marked micro-electronic advances are out.

U.K. ALLOCATION: BIG MONEY WITHOUT INSIGHT

After a six-month wait, the report on how Britain is to dole out its $84-million allocation for computers in universities and research councils is complete. On the plus side is a $56 million handout to some 25 establishments. With some swinging remarks on existing set-ups, it also called for a far more professional approach to the staffing and administration of computer facilities with an accompanying plea for autonomous departmental status. With unequivocal fearlessness it also recommends only two manufacturers, IBM and Control Data, as in a position to supply really large machines for regional centres at London, Manchester and Edinburgh. The bulk of other recommendations go to ICT and Elliott-Automation, with currently installed English Electric – Leo-Marconi's KDF9 computers recommended for immediate upgrading.

Another proposal is for universities to adopt card-oriented systems, as against traditional paper-tape I/O. Software recommendations followed for a medium-sized installation: basic hardware of a 2-usec memory with 3K (36-bit) words or equivalent, drum or disc, mag tapes with at least one IBM 7-track deck, standard interface to link various remotes, etc. Programmers should have Fortran II or IV and Algol.

Universities and manufacturers have been cautious in their criticism of the report since both have waited too long for this and are not going to jeopardize their positions. The most favorable comment from a university coffee room: "It would have been a great report if produced five years ago." Concern has been expressed because it is analytical with hindsight, rather than insight, to the future demands and trends. Multi-access operation, for example, gets one brief mention — easily missed on quick perusal.

COMPUTING BEHIND THE IRON CURTAIN

Statistical analysis for the complete wholesale and retail trade of Czechoslovakia will be processed for the Central Commission for Statistics and Control on a Bull Gamma 30. After a trial period, information needed to control the movement of consumer goods throughout Czechoslovakia will be computer-prepared. Several machines are to be installed in specific applications areas, such as footwear control, at distributive levels. A short report on the future

(Continued on page 111)

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NEW DIRECTIONS IN ELECTRONICS SYSTEMS

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(Continued from page 109)

of the Czech computer market has been published by Electronics Intelligence Digest, 33-39 Bowling Green Lane, London ECI. Price: 10 shillings.

An All-Union Automation Conference for Soviet businessmen took place in mid-February aboard ship in the Black Sea. Discussed were discrete systems, non-linear and statistical methods of evaluation, tele-machines, machine tool control, and plant optimization techniques. Papers on plant control quoted use of known machines, such as Ural, Besm and Razdan, and new systems, Process-1, Ekran-4 and 7, and Syrius.

TELEFUNKEN DEBUTS LARGE, SWIFT COMPUTERS

A new integrated-circuit computer compatible with its present TR 4 has been announced by W. Germany's Telefunken. The TR 440 has up to 262K words, and can reportedly access a 48-bit word in 300 nanoseconds. Says Telefunken: "Measured by the Gibson Mix, the computer performs approximately 1 million operations per second." With the operating system, time-sharing is said to be possible, but there's no word on the number of on-line users accommodated. Software includes Cobol 65, Fortran IV, Algol, and PL/I. Approximate price: $1.7 million.

AUSSIE SOCIETY FORMED

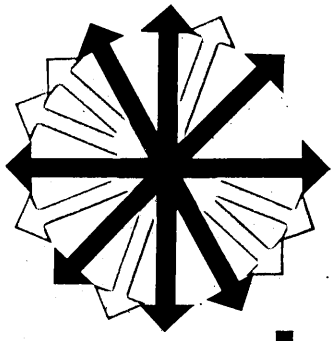
The Australian Computer Society has elected Prof. John M. Bennett, of the Univ. of Sydney, president. T. Pearcey of CSIRO was elected vp. Membership in the society is about 1,500. In addition to holding regular symposiums and publishing a journal, plans are to establish standards of professional competence for new members. Britain's Computer Society will also tackle the problem of qualifications. Its council has agreed to establish standards and a syllabus.

BULL-GE ADDS TO COMPATIBLES 100

Extending their Compatibles 100 series, Bull-GE has produced models 140 and 141. The former has up to 32K (34 bits) with a 2.8-usec cycle time; the latter comes with up to 64K at 2.1 usec. Featured are a 150-nanosecond thin-film scratchpad and a read-only memory. Compatibility is with the Gamma 10 and 115 on the smaller system and with the Gamma 30 on the large. They're compatible with each other.

BITS & PIECES

Honeywell has opened a Spanish branch in Madrid, a joint venture with Omnium Iberico Industrial S.A.... Friden received its first big Collectadata order in the U.K. for an on-line production control complex from British Aircraft Corp. It will go with a $2-million multiple ICT installation...IBM is reported to have delivered 400 mod 30's and 40's in Europe... ICT has taken the unusual step of entering contract programming. Industry pundits are shattered to learn that ICT has the manpower for the new service... ITT's British subsidiary, Standard Telephones and Cables, has introduced the 6300 ADX, a stored-program message switcher handling up to 60 duplex lines...A National-Elliott 503 computer has been installed at the Institute for Data Processing, Dresden, E. Germany. This supplements a digital ZRA-1 and an analog Endim 2000.



people

■ Robert E. McDonald has been named president, Sperry Rand's Univac Div. Gerald G. Probst will succeed Mr. McDonald as vp and general manager, Defense Systems Div.

■ Ray R. Eppert has been named chairman and chief executive officer of the Burroughs Corp., Detroit, Mich. Ray W. MacDonald succeeds Mr. Eppert as president.

■ Dr. George Chapin has been named director, systems analysis laboratory, Litton Industries' Data Systems Div., Van Nuys, Calif. He was formerly director of advanced systems and programming at Univac.

■ David Bonn has been appointed corporate director, dp, Grosset & Dunlap, Inc., book publishers, New York City. He was formerly dp manager, Schenley Industries Inc.

■ Marvin R. Gore has been named director, computing sciences, Aerojet-General Corp., El Monte, Calif.

■ Dr. John Baird has been promoted to the position of vp, research, Control Data Corp. Minneapolis, Minn.

■ Fred Gruenberger, computer enthusiast, author and educator, has left the RAND Corp., and is now a member of the staff at Informatics Inc., Sherman Oaks, Calif.

■ The Dow Chemical Co., Midland, Mich., has named Dr. Charles D. Alstad manager, information services, and Dr. Robert Metzger manager, commission to create an integrated dp and communications system.

■ Carl H. Reynolds has been named president of Computer Usage Development Corp., a subsidiary of Computer Usage Co., Inc., New York City. He was formerly director of software development of IBM's Systems Development Div.

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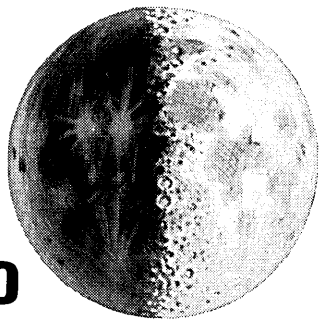

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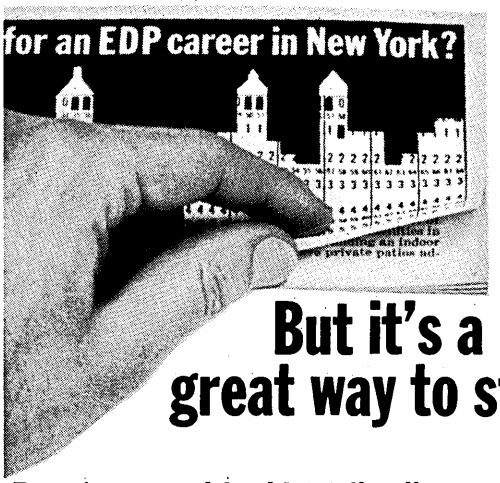

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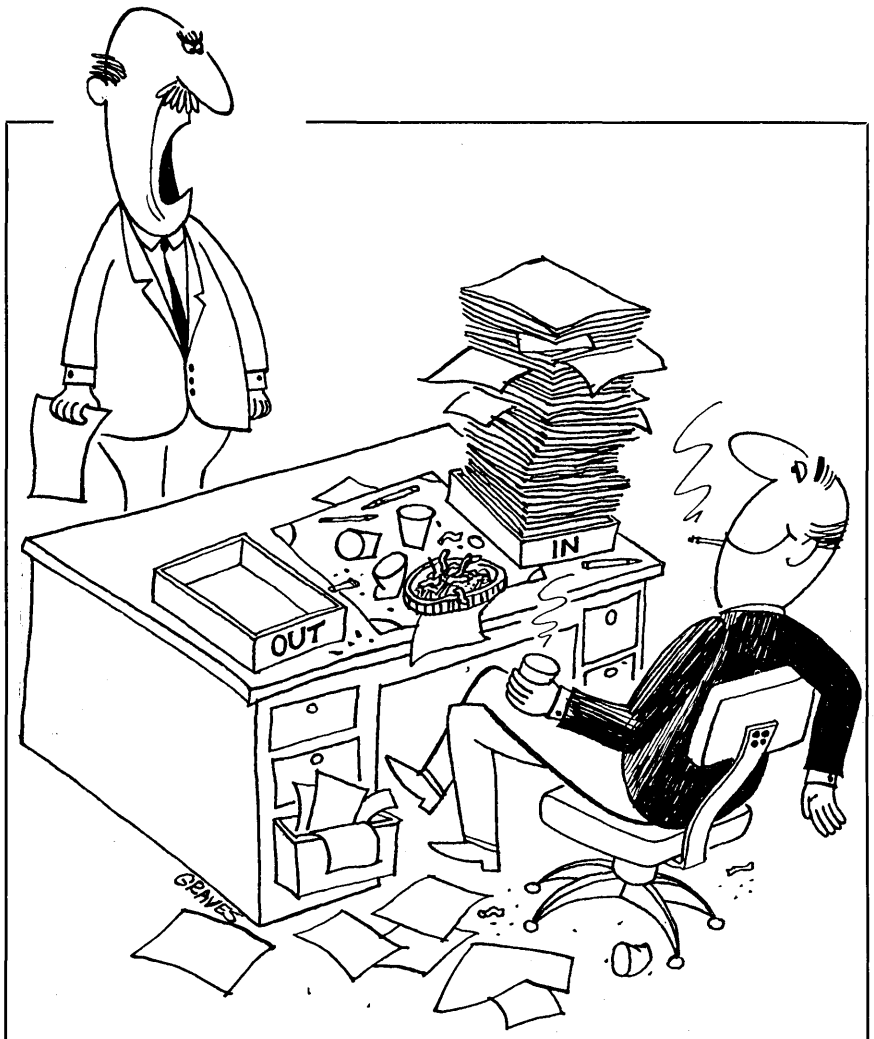

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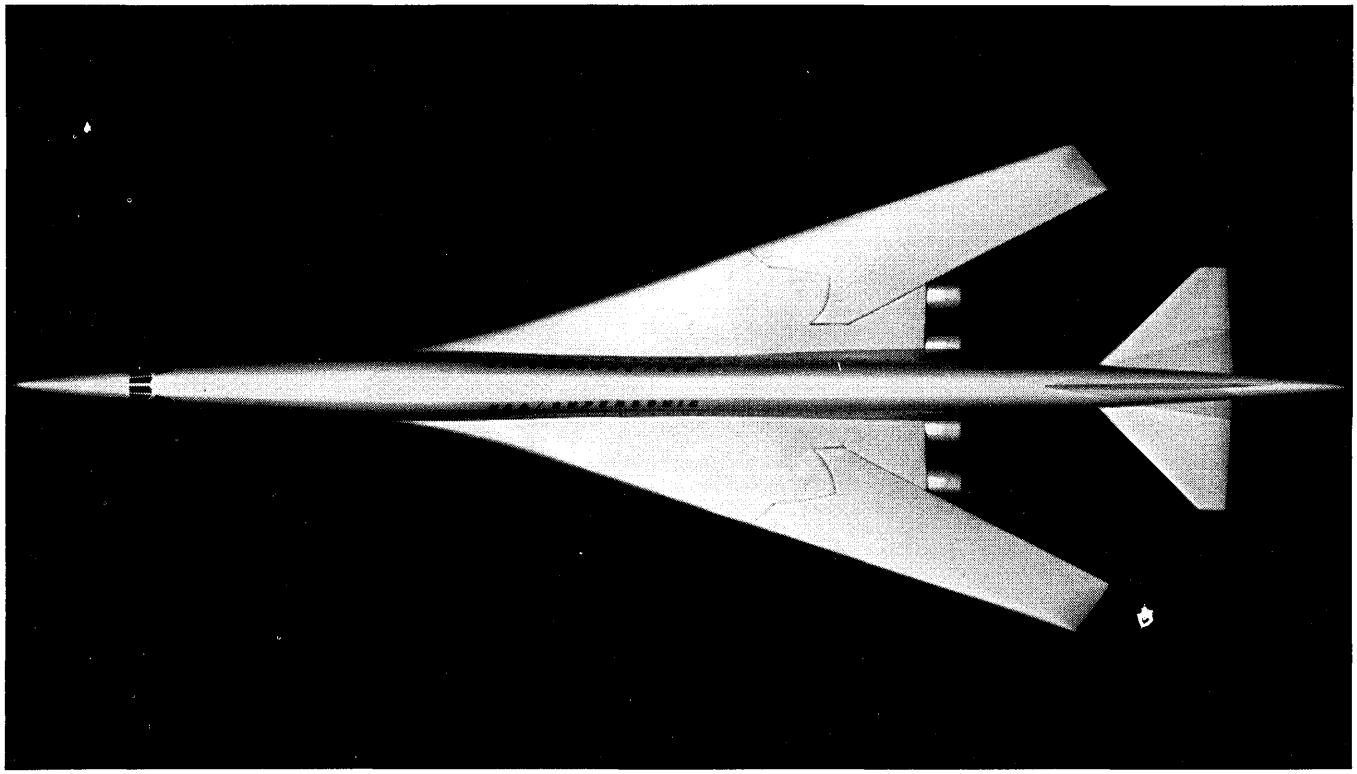

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CIRCLE 121 ON READER CARD

the forum

The Forum is offered for readers who want to express their opinion on any aspect of information processing. Your contributions are invited.

A PRACTICAL VIEW OF UNIVERSAL CREDIT

Most of us have long recognized the possibility of reducing the use of cash and the volume of checks and credit charge documents through the evolution of systems utilizing any of a variety of possible media to facilitate automatic transfers and credit charges on-line and/or off-line. The prospect has been an engaging one and, recently, with the emergence of more suitable equipment and facilities, the concept has received rather wide attention. On the more conservative side there have been discussions of a national identification card or a national credit card; on the more glamorous side, terms such as the "money card" or "money key" have been introduced. Such discussions inevitably lead to conjecture of a cashless, checkless society.

automatic transfer

In general, a nationwide or worldwide identification medium is envisioned — perhaps a card, containing a number uniquely identifying the individual (together, perhaps, with additional data) to facilitate the automatic transfer of funds and extension of credit through a network of interconnected computer facilities accessible from inscriber/outscriber devices located in business establishments and, perhaps, from instruments in the home.

Let me state that I believe these thoughts portend the direction of future developments, but the concept is not new and little will be achieved in the way of actual progress by merely popularizing the topic.

To date, one fundamental point seems to have received relatively little attention — yet it is decisive for it is the question of return. Any of the systems contemplated involve very handsome investments and, without a satisfactory return, these investments simply will not be made. The concept and the hardware techniques are captivating but one of the time-tested ways of losing money is to start with a hardware technique and attempt to develop a marketable system around it. Instead, one must commence by identifying a potentially marketable service, determine the market and the minimum service needs in relation to maximum market potential, develop alternative systems meeting these needs and, for a "least cost" system, evaluate the market in light of the prices necessary to make such a system profitable.

To my knowledge, very little has been done along these lines. Let's explore some of the considerations.

method of identification

The over-all concept — a universal identification system — would embrace credit card and cash transfer transactions and would extend to some type of credit information interchange. This concept requires identification of all individuals in the population for it is, perhaps, as important to identify those who are unworthy of credit as it is those who are. On this basis, any numbering system considered should embrace the total population.

Another consideration might be the credit identification medium. Should it be a card; if so, to what extent should an effort be made to make it self-identifying; should it be both visually and machine readable — in effect, what are the requirements? Who should issue it, what is the cost, how should the cost be allocated, what return can be assured on this investment? These questions are associated with the corollary subjects of applications and services. Broad areas for study would include: 1) access to an increasingly large clearinghouse of credit information, 2) credit card sales transactions, 3) automatic cash transfers, etc.

From just this brief review, two decisive considerations seem to evolve: 1) proprietary interest of individual institutions, and 2) cost in relation to the value of whatever added measure of service accrues.

who pays whom?

The question of proprietary interest is unclear and, certainly, extensive study would be required before any conclusion could be reached. Frankly, however, I would find it difficult to visualize wide approbation for any system under which one organization furnishes its customers at its expense the medium to facilitate their transactions with other organizations — including competitors. In a way, it is similar to the old problem of a restaurant accepting the credit card as an indication of credit worthiness and then handling the billing as part of their own accounts receivable. Any concept which relies wholly or in part on a spirit of altruism is almost certain to prove unrealistic in a competitive environment.

Certainly these considerations do not invalidate the over-all concept; however, I believe they do indicate a need for careful and thorough study.

Some of the problems to be resolved are, I believe, typified by one of the applications which is frequently discussed — credit card transaction processing. I select this because it is an activity with which we have had years of experience. BankAmericard is a general purpose credit card and parallels in several respects the universal credit system that has been suggested.

Our 50,000 merchant members use some 55,000 imprinters which we supply — in addition to otherwise available imprinters. Just to gain some feeling for the magnitude of what is entailed (ignoring additional costs for

cards and other facilities) 55,000 inscriber/outscribers for the "documentless" operation at a minimum of, say, $200 per unit, would alone represent an investment of $11 million. For the credit card application, the return on this investment would have to be found in three areas: 1) merchants' operations, 2) cardholder utilization, and 3) bank operation.

Keeping in mind the concept of the total universal system but limiting our attention to the credit card/charge account function already performed in the BankAmericard operation, let's consider these three areas:

three comparisons

Merchants' Operations. Instead of imprinting a sales draft and completing it in a fashion which is more or less customary in sales transactions, the identification card would be inserted in an inscriber/outscriber and pre-defined variable data would be entered via a keyboard and adhering to a fairly rigidly prescribed format. The transaction would be immediately transmitted to a data center where it would be recorded or re-transmitted (through, perhaps, other intermediate centers) to the center storing the cardholder's account. Keep in mind that the $11 million investment did not include the cost of communications facilities, nor the data center equipment — and these costs are *sizeable*.

Compared with our present BankAmericard system, it is difficult to visualize any significant benefit to the merchant or at least any for which he would be willing to pay an increased fee. Immediate on-line credit authorization might have some appeal, but with a general purpose credit card catering to a multiplicity of small outlets as well as larger stores and with the number and variety of sales people employed, the proposal seems to have very little added actual value potential for the merchant. It will indeed be very slight if the credit card limit covers the majority of purchases without prior authorization — and without liability to the merchant.

Cardholder Utilization. This mode of processing implies the elimination of the sales draft and, hence, a change from "country club" billing to some type of descriptive statement. The customer's acceptance of a detailed statement is, to a large extent, influenced by the accuracy and completeness of the descriptive information and this, in turn, relies on the accuracy of the coding at the point of sale. A single consolidated monthly BankAmericard statement is rendered to the cardholder covering purchases from all merchants which means the coding for descriptive billing would need to embrace the products and services marketed by 50,000 different merchants. This is a problem which, in itself, would require extensive study. In addition, there are a number of minor considerations including the customer's desire for a written descriptive receipt for certain types of transactions at the point of sale, etc. In any event, it seems difficult to assign any increased value to the cardholder from this arrangement. The difficulties (and sales and advertising cost) of converting customers to a new system are not, however, very obscure.

Bank Operation. Most of the system proposals advanced under this concept rely heavily on the value of eliminating documents, particularly punch cards, from the processing flow. I believe this value is substantially overestimated.

BankAmericard is a large operation, but of the total staff, fewer than 30 keypunch and sorter operators are needed to handle the statewide volume of those activities directly related to document processing. Additional people are involved in computer operations and various accounting functions, but many of these positions would remain relatively unchanged and others would be offset by different positions created by the new system. Our analysis leads us to the conclusion that there is limited potential return in this area.

Immediate detection of fraudulent use of credit cards, of course, offers some potential if one assumes (to the merchant's displeasure) verification of every transaction. Credit losses occurring after the transaction was approved would, of course, be largely unaffected.

The reduction in postage expense achieved by not returning sales drafts would be more than offset by the problems of descriptive billing, tracing questionable items, incorrect coding by merchants, etc. (While the postage savings to be achieved through the elimination of checks with the "universal" system is more significant, it does not appear that this saving will, at an early time, defray the substantial cost of the hardware and communications network required by the "cashless" society, let alone the tremendous sales and advertising cost required to re-shape people's habits.)

the need for perspective

I agree there is unquestionable merit in the possibilities suggested by the universal information interchange concept that leads to the "cashless" society. My comments are meant only to bring it into proper perspective and suggest that if progress is to be made, it must be approached with realism — not emotion.

In the final analysis, without the potential for profit, the investment will not be made. Of immediate importance is our failure to address ourselves thus far to a question which must be resolved to provide a sound foundation for such systems. This is the adoption of universal identification numbers to uniquely identify every person, agency and enterprise. Every adult now has a proliferation of numbers — numbers for telephones, drivers licenses, a variety of credit cards, bank accounts, loans, insurance policies and a host of others. And we hear on every side the complaint that people are treated as numbers — not as individuals. The chances of overcoming this last objection would be enhanced by substituting a single identification number for the great variety now used. If numbers cannot be eliminated, they can be reduced — and one number would be far more convenient and acceptable to the individual if it served for a wide range of transactions.

Because of its widespread use, the logical candidate for such an identification number is the Social Security number — or taxpayer's identifying number. The addition of a transposition check digit to the number to assure accuracy would be relatively simple. Indeed, the number could eventually be assigned at birth to identify individuals throughout their lifetime. I venture to forecast that the "cashless" society and the "checkless" society will not come to pass without such a number, nor will the real potential of advanced information systems be realized.

If we are really serious about the universal information interchange concept, let's consider this first unglamorous, but vital, step. If we are not, we can simply continue to talk about the glorious future.

— A. R. ZIPF

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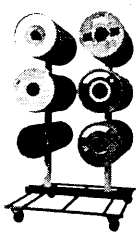

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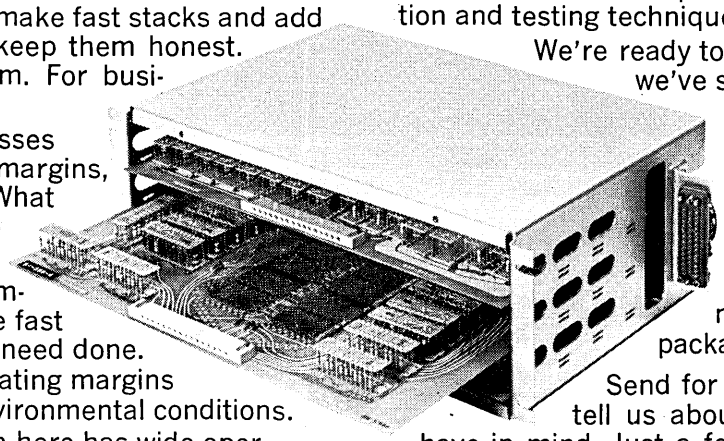

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