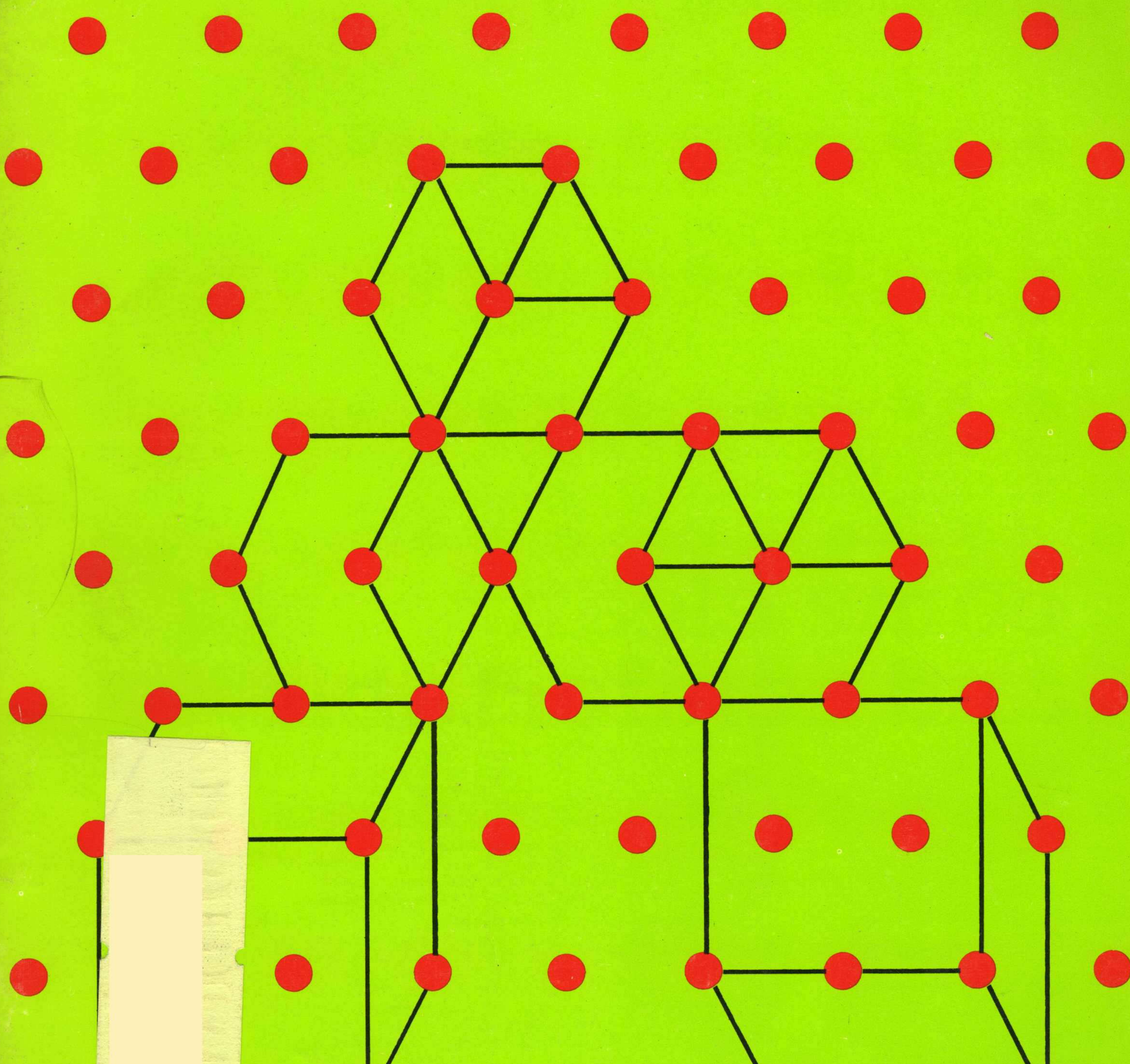
DATAMATION

67

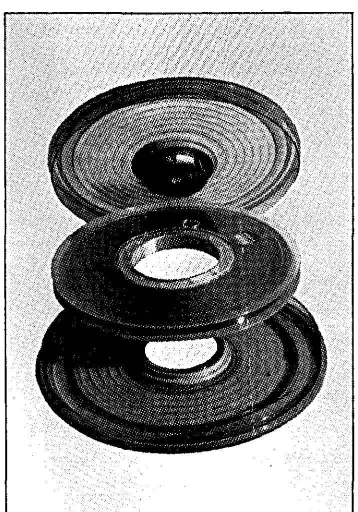
June

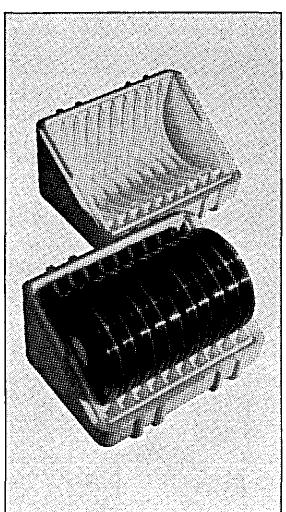


building blocks for small-scale edp

Ampex makes computer tape

come clean and comfortable.





Ever since we started making magnetic tape, we have worked hard to make it as clean as possible. First we developed an inherently clean coating for it. Then we began giving it a super cleaning before and after certification. Now two packaging innovations will make certain you get it clean and comfortable and keep it that way.

1) **A new canister:**
Our exclusive new design eliminates all the problems you may have had with canisters before. It has an all-plastic positive locking mechanism that cannot introduce contamination.

2) **A new shipper:**
Probably the best idea the industry saw last year, we modestly admit, was our new TAPE-SAFE Environmental Shipper. Made of expanded-bead polystyrene, this shipping container individually supports and separates up to ten tape canisters. Guards them against shock, vibration, temperature and humidity variations. Won't contaminate your computer area. And these unique reusable boxes are standard with your minimum order of Ampex tape for IBM and IBM-compatible computers.

What it comes down to is this: *We're not simply selling you tape. We are providing you with unparalleled data reliability even after hundreds of thousands of equipment passes.*

If you would like a free copy of our new technical booklet, "The Care and Storage of Computer Tape," just write us at 401 Broadway, Redwood City, California 94063.

AMPEX

CIRCLE 1 ON READER CARD

Our optical reader can do anything your keypunch operators do.

(Well, almost.)

It can't get mad and make silly mistakes. Or pout for days. Or cry. But it *can* read. And gobble data at the rate of 2400 typewritten characters a second. It can read hand printing, too. And compute while it reads. And reduce errors from a keypunch operator's one in a thousand to an efficient one in a *hundred* thousand.

Our machine reads upper and lower case characters in intermixed, standard type fonts. It can handle intermixed sizes and weights of paper, including carbon-backed sheets.

An ordinary computer program tells our reader what to do . . . to add, subtract, edit, check or verify as it reads. Lets you forget format restrictions, leading and trailing zeros, skipped fields, and fixed record lengths. And our reader won't obsolete any of your present hardware because it speaks the same output language as your computer.

Our Electronic Retina Computing Reader can replace all—or almost all—of your keypunch operators. At least that's what it is doing for Perry Publications.

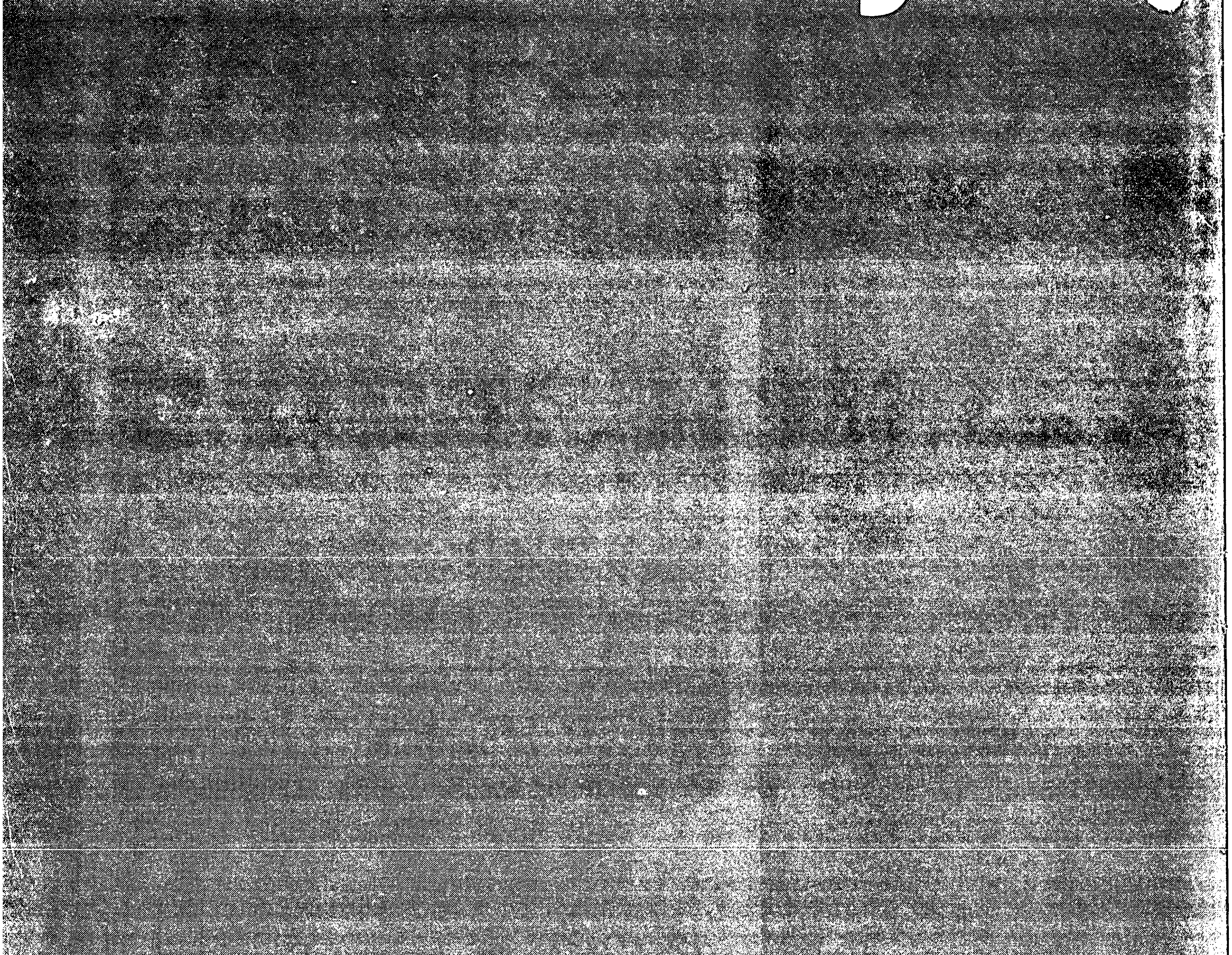
If you have a volume input application, it can do the same for you. Tell us your problem and we'll tell you how.

RECOGNITION EQUIPMENT Incorporated

U. S. Headquarters: Dallas, Texas 214-637-2210 Offices in principal U. S. cities, subsidiaries in Frankfurt, London, Milan, Paris and Stockholm

CIRCLE 4 ON READER CARD

15 million bytes



Who needs it?

Nobody we know of.

If there's a customer somewhere with that much data we'd like to hear how he plans to deliver it to the machine and take it away again.

If he's got that figured out, we're ready. Either Sigma 7 or Sigma 5, with a maximum number of options, can handle a throughput of 15 million bytes per second, concurrent with full processing speed. Even little Sigma 2 can handle 450,000.

Why do Sigmas have such high throughput rates?

Because they're designed so they'll never have to take time from their main job to cope with input/output.

All Sigmas have multiple I/O channels that are automatic and operate independently of the central processor, which merely starts and stops them.

Sigma 2

Sigmas 5 and 7 can have multiple independent memory banks, and each bank can have multiple ports and busses so that the central processor and up to five input/output processors can get in

and out of any or all of the banks at any time.

There are two kinds of these I/O processors, and the user can have them in any combination he wants. One kind, the Multiplexor IOP, can control a lot of high-speed devices simultaneously. The other kind, the Selector IOP, controls many very-high-speed devices one at a time. Both kinds operate on their own, without program intervention except at start and finish.

Sigma operations are not tied to a central timing source but are asynchronous. Thus input/output processing doesn't have to keep step with the CPU, and in Sigmas with multiple memory banks, memory cycles can be started in any bank at any time or in all banks at once.

Asynchronous design also means that delays caused by interference can be virtually eliminated through interleaving and overlapping in the memory banks.

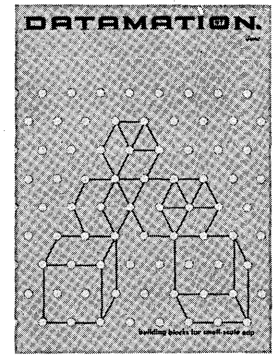
So if you have more information than you know what to do with, see if you can't wrap it up somehow.

Anything you can deliver we can handle.

SDS
Scientific Data Systems
Santa Monica, California

CIRCLE 5 ON READER CARD

june
1967
volume 13 number 6



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BPA
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ABP
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This issue 72,736 copies

CIRCLE 7 ON READER CARD

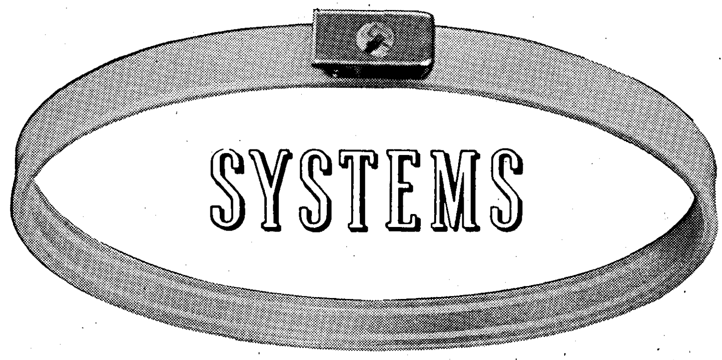
DATAMATION 67 ®

june
1967

volume 13 number 6

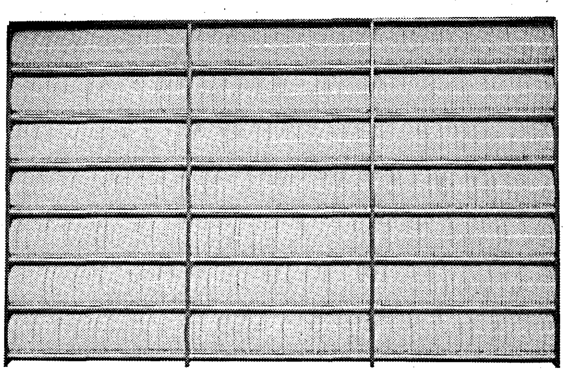
datamation departments

automatic
information
processing
for business
industry & science



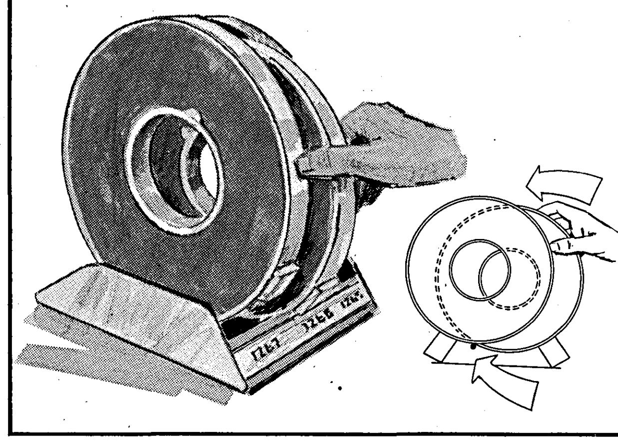
NEW TOTAL CAPACITY CONCEPT

High Density Reel Seal Storage with Exclusive, Touch-Reel Retrieval



COMPARE...

- STORAGE FACILITY FOR OVER *1000* REELS IN A 1' x 12' AREA!



COMPARE...

- TOUCH-REEL RETRIEVAL FOR EASE IN HANDLING.
- FINGERTIP ACCESS AT EVERY LEVEL.
- SAFE, CRADLED, STORAGE.
- FULL, VISIBLE LABELING.

COMPARE...

- 93% GREATER STORAGE THAN CANISTERS!
- 40% GREATER STORAGE THAN HANGING SEAL TYPE STORAGE!

WHAT'S MORE... We'd like the opportunity to prove to you that High Density Reel Seal Storage can save 45% of your storage equipment cost! *Send today for a full descriptive brochure, and prove it to yourself.*

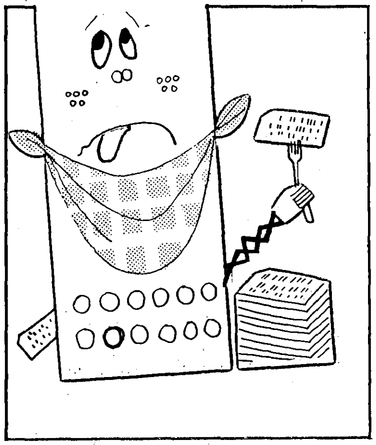
SYSTEMS
MANUFACTURING CORPORATION
13 BROAD STREET • BINGHAMTON, N. Y.

CIRCLE 9 ON READER CARD

calendar

DATE	TITLE	LOCATION	SPONSOR
June 19-22	Design Automation Workshop	Biltmore Hotel Los Angeles, Calif.	SHARE & ACM Design Automation Committee
June 26-30	Symposium: Computers in Chemistry	Univ. of Calif. San Diego, Calif.	American Chemical Soc. & American Physical Soc.
June 27-28	Users Meeting	Water Tower Inn Chicago, Ill.	Digitronics Users
June 28-30	Joint Automatic Control Conference	Univ. of Pennsylvania Philadelphia, Pa.	ISA, IEEE AICE, ASME AIAA
Aug. 14-18	SHARE XXIX	Carillon/Deauville Hotel Miami, Florida	SHARE
Aug. 15	One-Day Session: Computers in Aerospace Guidance & Control	Huntsville, Ala.	Dr. Eugene Levin AIAA Aerospace Corp.
Aug. 22-25	Western Electronic Show	Cow Palace San Francisco, Calif.	IEEE & WEMA
Aug. 23-25	Conference on Computational Linguistics	Grenoble Univ. Grenoble, France	International Committee on Comp. Linguistics
Aug. 26-28	Symposium on Interactive Systems for Experimental Math	Sheraton-Park Hotel Washington, D.C.	ACM
Aug. 28-Sept. 2	5th Congress, Analog Computation	Lausanne, Switzerland	Intl. Assn. for Analogue Computation
Aug. 29-31	Annual Conference	Sheraton-Park Hotel Washington, D.C.	ACM
Sept. 6-8	First Annual Computer Conference	Edgewater Beach Hotel Chicago, Ill.	IEEE Computer Group

MOHAWK
DATA-RECORDERS



Is your computer tired of punched cards?

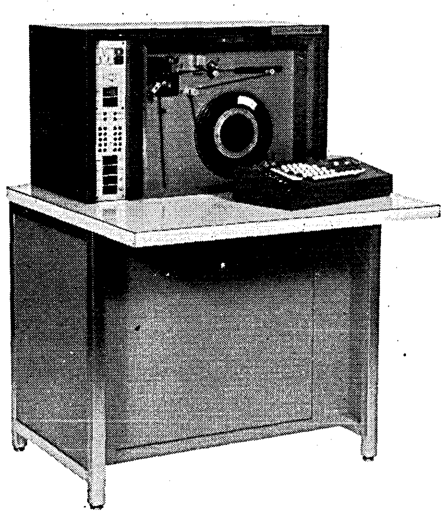
More and more magnetic tape-oriented computers are coming down with a bad case of heebie-jeebies. And you don't need a medical degree to be able to diagnose the cause. It's just that "old faithful" has developed an allergy to punched cards.

But don't push the panic button. Help is yours for the asking. Do as others are doing.

Go magnetic tape all the way from source document to the computer

The Mohawk 1101 Data-Recorder is the new, faster, more accurate medium for preparation of computer input.

In most cases, Data-Recorder users have found it possible either to completely eliminate punched cards or reduce their use to a minimum.



MOHAWK 1101
DATA-RECORDER

Information is transcribed from source documents direct to computer magnetic tape in the 1101... verified on the same machine... ready for the computer.

Instant error correction on the tape...a Mohawk exclusive...provides greater input accuracy than is possible with any other system. Fewer errors reach the computer, resulting in minimum re-run time.

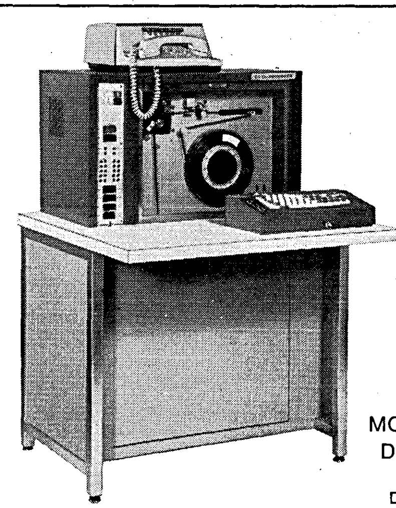
Users are experiencing improved operator productivity, lower input preparation costs, more profitable use of computer time. In many applications, 1101's have made it possible to handle increased work loads with less equipment than would be necessary with punched cards.

Greater programming flexibility

The 1101's magnetic tape permits program modifications that free systems programmers from the rigid limitations of punched cards.

True "full information per record" transcription, in a computer-compatible format, is easy with the 1101. Under certain conditions, it's possible to transcribe "formatless" records. Much of the duplication required to maintain card deck integrity is eliminated.

Record characters, computer edit and time are saved. No program checks are needed to prevent loss of records from tape.



MOHAWK 1103 LDC
DATA-RECORDER
For Long Distance
Data Communication

New models round out Mohawk Data-Recorder line

The inherent versatility of the basic Mohawk 1101 Keyed Data-Recorder has been utilized to good advantage in a rapidly expanding Data-Recorder line.

The 1101, introduced to the data processing user early in 1965, has won wide acceptance through its capabilities in the area of computer input preparation.

With the 1101, the data processing user now can go magnetic tape all the way from source document to the computer.

Information may be transcribed direct to computer magnetic tape . . . with no intermediate media . . . and verified on the same machine. Verified tape becomes computer input. In most Mohawk installations, punched cards have been eliminated. The 1101 replaces the functions ordinarily performed by a Card Punch, Key Verifier, and Card-to-Magnetic Tape conversion runs.

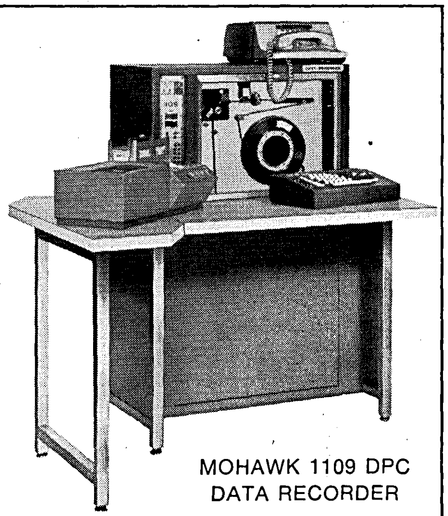
The Mohawk Data-Recorder line now includes:

1102 MTP Multi-Tape Pooler . . . 1103 LDC for Long Distance Transmission of Data . . . 1104 AMC with Adding/Listing Machine . . . 1105 PTR with Paper Tape Strip Reader . . . 1106 PCR with Punched Card Reader . . . 1109 DPC, with Punched Card Reader and Long Distance Transmission . . . 1112, with Adding/Listing Machine and Long Distance Transmission . . . 1115, with Paper Tape Strip Reader and Long Distance Transmission...1118, with Output Typewriter...1181, with Input/Output Typewriter . . . 1183, with Output Typewriter and Long Distance Transmission . . . 1122/902 for converting magnetic tape recorded data from 7 channels, 200 BPI to 9 channels, 800 BPI, or vice versa . . . 1320 Buffered Line Printer/Data-Recorder combination . . . 6401, the first in a new series of Mohawk Data-Recorders designed for compatibility with computer systems requiring 9-channel, 800 BPI magnetic tape input.

When companion devices are off-line, each Data-Recorder may be used the same as the 1101, for routine input generation.

MOHAWK VERSATILITY

The Mohawk 1109 DPC Data-Recorder provides the routine transcribing and verifying functions of the 1101, the turn-around document handling advantages of the 1106 Punched Card Reader, and the Long Distance Transmission features of the 1103... in a single, flexible unit for specialized applications!



MOHAWK 1109 DPC DATA RECORDER

Notes about recent Mohawk installations

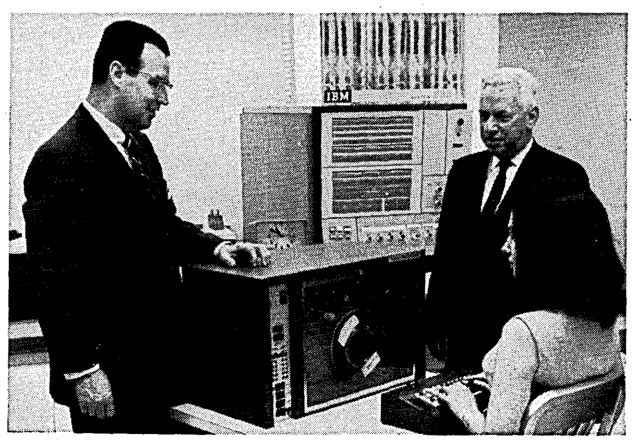
66 Data-Recorders for Chemical Abstracts Service

Installation of 66 Data-Recorders is nearing completion at Chemical Abstracts Service, Columbus, Ohio. Thirty of the units are equipped with typewriters instead of Data-Recorder keyboards. They provide typed copy of chemical textual information simultaneously recorded, in bit form, on magnetic tape.

Great American Insurance Companies installing 65 Mohawk units

Great American Insurance Companies, New York City, will have 65 Mohawk Data-Recorders in their Home Office and sixteen Regional Offices throughout the U.S. Installation is expected to be complete by mid-summer.

Mohawk electronic data transmission will replace the former system of periodically shipping punched cards to the Home Office for central computer processing. Eventually, data transmission will be on a two-way basis between Regional Offices and the Home Office.



Administrative Executive Samuel H. Gamble, right, of Great American, explains use of Mohawk 1101 Unit to Marketing Services Director, Donald L. Anderson

Can Data-Recorders work for you?

The surest way to find out is to phone or write us. Tell us about your present data processing system...your firm's type of business...your present method of computer input preparation . . . what you might hope to accomplish through use of Data-Recorders. The more facts you furnish, the more accurate our answers will be. *We welcome your inquiry.*

MOHAWK DATA SCIENCES CORPORATION

P. O. Box 630, Herkimer, New York 13350 • Telephone 315/866-6800

Originators, designers, sole manufacturers of Data-Recorders . . . for transcribing data from source documents direct to computer magnetic tape.

CIRCLE 11 ON READER CARD

letters

the public eye

Sir:

In his article "Alameda County's People Information System" (March, p. 28), Mr. Milliman neglected to mention one of the most important implications for the public: the total destruction of privacy. Congress has been debating the advisability of authorizing such an undertaking as Mr. Milliman describes, and seems to be leaning toward the conclusion that it would cost more in privacy loss than it would be worth in efficiency. In the meantime, it seems that Alameda County has quietly gone ahead and built the very thing we've been afraid of.

It is interesting to note that one of the chief beneficiaries of the system seems to be the police. I suppose that, under the heading of "county-state-federal linking," Alameda County will ultimately place inquiry consoles in the offices of the CIA, FBI, IRS and Post Office, thus allowing all of the organizations to perform their services of prying into our private lives more efficiently.

I'm sure Senator Long would be interested to know that the government data bank he has argued against so fervently is not a bugbear of the future, but an accomplished fact. Happy goldfish bowl, boys.

DONALD E. VAIL
Houston, Texas

The author replies: We agree with the concern of Senator Long, Congressman Gallagher and anyone else who insist that a proper balance be maintained between technological advance and the right of privacy. To this end, we are against the building of personal dossiers, and our county will go to great lengths to not invade the privacy of law-abiding citizens. In fact, we are improving the security of confidential data far beyond that which a manual process will allow. The article hinted at this when it stated, "Note that most information handled by counties is of non-confidential nature and security requirements are not involved. For any files that are confidential, access is carefully controlled by permitting only authorized terminals, and where necessary, authorized persons—by means of secret codes—to inquire into such files. Future plans also call for monitoring techniques to determine what terminals are accessing any given file." And this is why we maintain two completely separate systems—one for police information and one for social service information—neither system having the capability of accessing the other.

You are correct, Mr. Vail, when you state that "one of the chief beneficiaries of the system seems to be the police." Law enforcement officers, as well as the people they protect, are beneficiaries of the Police Information Network. We believe this is as it should be, because of the great need to at least partly restore the balance between the "rights" of the law enforcer and the law breaker. The officer on the street needs information. While we subscribe to the belief that a man's privacy is a precious right and should be protected, we also subscribe to the belief that a man's life is equally precious. If timely information can help the law enforcement officer protect lives, we think he is entitled to it.

Finally, we assure you our county will not install consoles in post offices.

Sir:

Legislation to protect privacy is doomed to at least partial failure. With the development of electronic devices and of more sophisticated systems for deducing "private" information from large "public" data bases, it will become extremely simple to violate such laws. Privacy is more easily treated as a matter of ethics and morality, and, accordingly, the problem should be attacked by educational means. It should also be remembered that as people become less excitable about the release of certain kinds of information, there will be less need for strict privacy. We are finding once again a problem which is largely an example of cultural lag.

THOMAS W. MORAN
Madison, Wisconsin

write now, think later

Sir:

Whoever wrote the following sentence (Look Ahead, April, p. 19) knows very little about the airline systems and their requirements: "The system's storage requirement is reportedly greater than the airline systems, storing 60,000 seats for Madison Square Garden for six months in advance of each event . . . opera and theatre seats for two months."

The airlines, United for instance, are storing information affecting 70,000 passengers a day for 330 days in advance, on up to 350 flights. For each passenger stored, which may be up to 330 days, 100-300 characters are required. United Air Lines has announced, via an advertisement in DATAMATION, 196K of main memory and two billion characters of bulk storage.

ALFRED F. LYNCH
Philadelphia, Pennsylvania

educational data centers

Sir:

I read with interest Dr. Grossman's article ("The California Educational Information System," March, p. 32). However, I noticed the conspicuous absence of any mention of using these centers for instructional purposes.

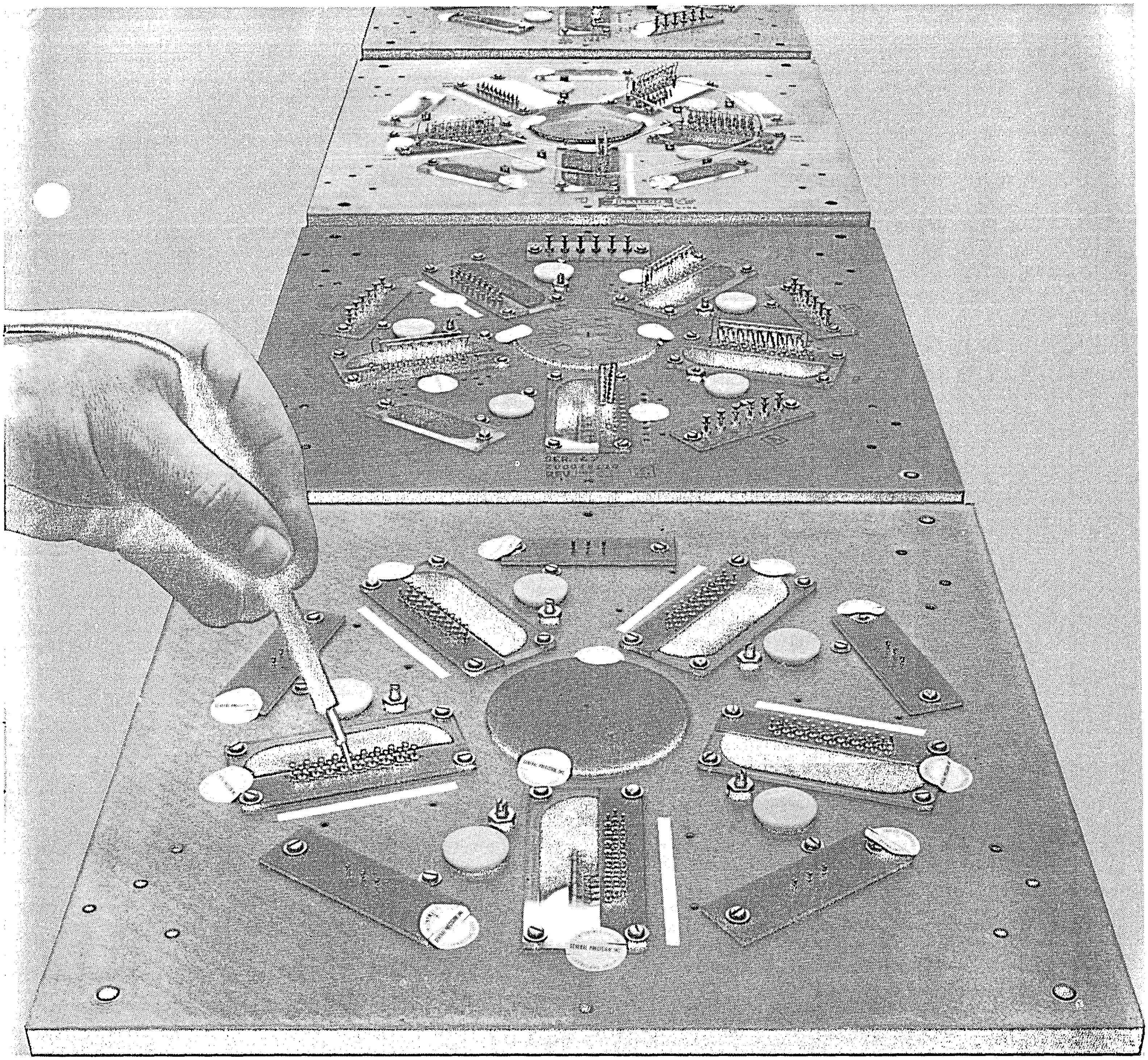
I recall that when these centers were proposed, one of the big selling points was that the facilities would be available for instructional use by neighboring schools. Since their opening, however, no consideration has been given to this use, as evidenced by the article.

Have we in the classroom been used again to gain the approval of a project and then forgotten?

LEROY FINKEL
Woodside High School
Woodside, California

The author replies: The concept of the California educational data processing centers is one of local-regional control. The centers are established in cooperation with the State Dept. of Education, and utilize the California Total Educational Information System. Above and beyond this basic data system, each regional center proceeds on its own to best serve the needs of its users. Quoting from the manual on regional centers in California—"the region served by the center would include local school districts and county offices of education. Participants in the regional system would be those who would wish to utilize the center's services. Since the center would be run and managed by its users, the system would be truly a cooperative endeavor. Areas of cooperation would include the development of all systems; the types, qualities and volumes of data to be processed; instructional programs; input and output forms; and all other essential aspects of operations at the center." Quoting from Section 11 of the manual—"who is in charge of regional centers?—in every case the answer to this question must be that the user determines how a certain operation will take place. It is anticipated that in each center there will be formed an Advisory Committee composed of representatives from the various school districts being served. This Advisory Committee makes the final decisions on what services will be implemented within each center."

From my knowledge, Woodside High School of the Sequoia Union High School District is



letters

being served by a regional center in San Mateo County. This district has an official representative on the Advisory Committee of this center.

hello, machine

Sir:

In The Forum ("The Personification of Computers," March, p. 147), Mr. Holt cited examples of people who talk as though computers were people. A charming example of this is quoted below. It undoubtedly has priority over most.

> The attendant would then go to the drawer containing the pasteboard cards representing its table of logarithms. From amongst these he would take the required logarithmic card, and place it in the machine. Upon this, the engine would first ascertain whether the assistant had or had not given *him* the correct logarithm of the number; if so, it would use it and continue its work. But if the engine found the attendant had given *him* a wrong logarithm, it would then ring a louder bell and stop itself. On the attendant again examining the engine, he would observe the words, "wrong tabular number," and then discover that he really had given the wrong logarithm, and of course he would have to replace it by the right one. (Babbage, C., "Passages from the Life of a Philosopher," Longman, Green, 1864).

It is interesting to note the tone of Babbage's last sentence. How clearly it foretells Holt's point B3: "A detrimental change in our appreciation of our own creative functions on the grounds that 'computers can do it as well or better'."

Of course, the attendant would have to replace that pasteboard card. He would also have a reduced opinion of himself. Fortunately, Babbage invented subroutines in place of table look-up two pages later. Let us hope we can continue to keep mastery of the situation.

B. Farrell Chown
Ottawa, Ontario, Canada

usasi glossary

Sir:

The News Briefs section (April, p. 85) states: ". . . it appears likely that X3 will junk the U.S. Glossary in favor of an extension of the IFIP-ICC Glossary."

Your readers will be interested in knowing that, at its April 13 meeting, USA Standards Committee X3 authorized the preparation of an expansion of the USA Standard Vocabulary for Information Processing from its present 700 or so definitions to approximately 1400 definitions. It is expected that the revised vocabulary will be published as a proposed standard near the end of this year. (The 700 definitions currently in the Vocabulary Standard will remain the same except for some minor editorial changes. About 85-90% of the present definitions will remain exactly the same in the new edition with 10-15% change in wording or format, but not in substance.)

Clearly, X3 has not "junked" this standard, but has taken steps to expand its contents and thereby increase its usefulness to the data processing public and laymen.

Paul B. Goodstat
Secretary
USA Standards Committee X3
New York, N.Y.

hip, hip, array

Sir:

Having used ALGOL for programming in Britain for several years, I find the lack of dynamic array allocation in FORTRAN (i.e., inability to define an array bound as a variable), an unfortunate restriction especially for programs which require optimum use of core storage.

A subsystem of FORTRAN to use dynamic array bounds is presently in use at MIT. Why don't the major computer companies, in modifying their FORTRAN compilers for their new machines, include this most useful feature?

I. A. Macleod
Vancouver, British Columbia, Canada

t-s & believers

Sir:

In your coverage of the FJCC (December, p. 55), you comment on "grumbling about the show biz nature of the time-sharing exhibits where, one disgruntled visitor said, you could shoot simulated pool, get some simulated psychiatric counseling, or play some simulated games; but if you had a real problem requiring computation you were out of luck."

We find just the reverse problem. For instance, recently at the ACM-IEEE show in Philadelphia we demonstrated relatively simple problems such as prime number generation, continued fraction calculations, etc. One interested observer stalked out of the room, claiming that the results demonstrated were impossible from a time-shared system. This in spite of the fact that the problems were kept relatively simple to conserve demonstration time.

We would be happy to hear of computation problems which would demonstrate the interactive capability of our system, and would happily demonstrate that they can be solved without delay on a large-scale time-sharing system. We invite your readers to simply send in such problems by mail or by Dataphone.

RICHARD M. COLGATE
President
Applied Logic Corporation
Princeton, New Jersey

softwhere?

Sir:

Many competing and overlapping software development projects are now lurching forward in a number of cities in the United States. A unification of these efforts might significantly improve the ultimate results. An appropriate site for such an effort might well be the ancient and beautiful Rumanian city of Cluj.*

EDWARD A. FINN
Alexandria, Virginia

*The city has a different name in German, but movie buffs will recall that Jonathan Harker stopped there on his way to Castle Dracula.

mnemonics

Sir:

The Mnemonics system described by Michael Jackson (April p. 26) has been installed at Centre-File Ltd. within the accounting and analysis service we provide for London's brokerage houses. Although conceived for on-line use, the Model 40 implementation is now also used in a batch mode for accessing a file of 14,500 securities. Development of this and allied techniques are essential if the computer utilities of the '70s are to be attractive to use. We look forward to larger, cheaper memories which will allow us to imitate more closely human mental processes.

A. E. L. deWatteville
London, England

Datamation welcomes your correspondence concerning articles or items appearing in this magazine. Letters should be double spaced . . . and the briefer the better. We reserve the right to edit letters submitted to us.

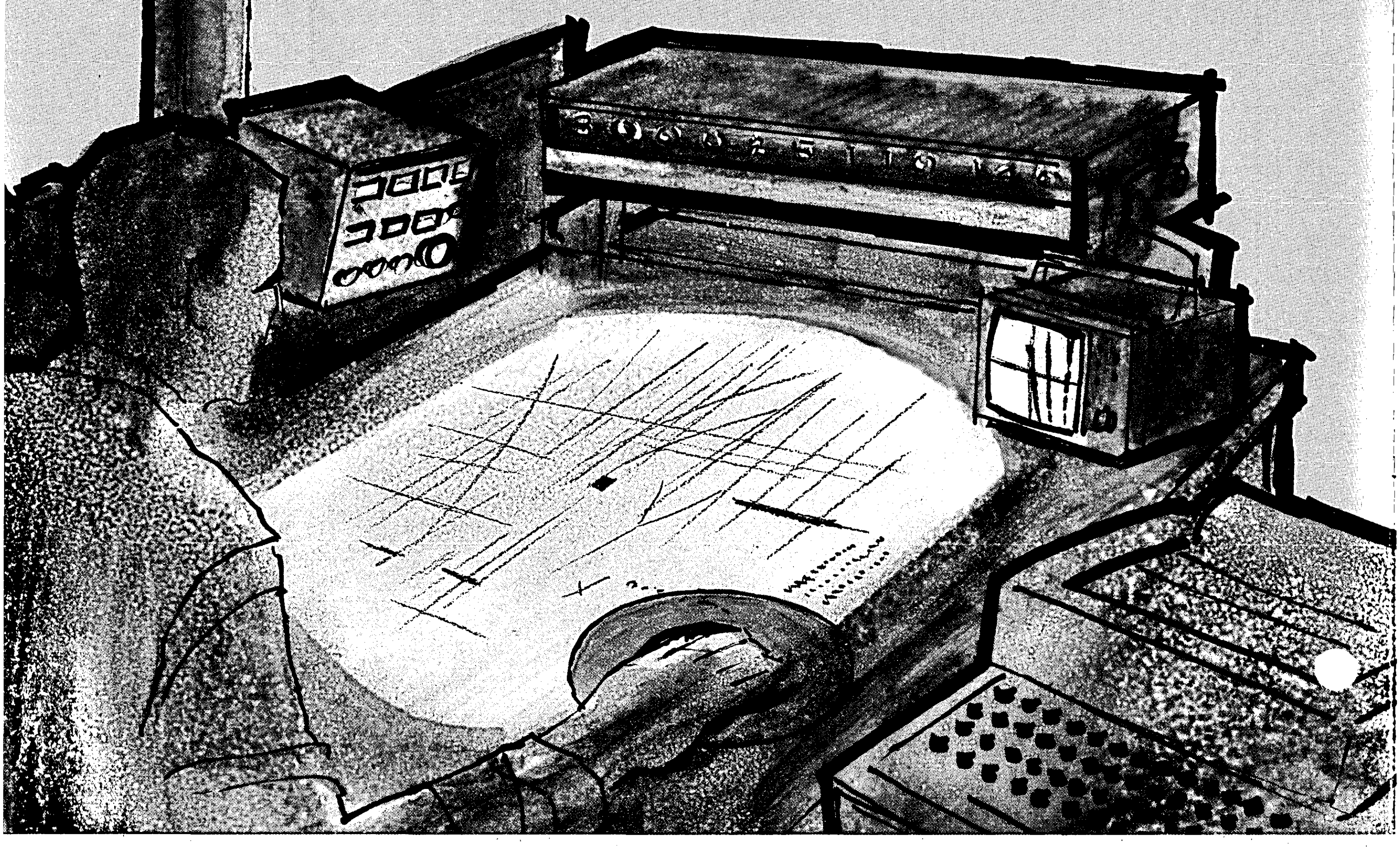
At SLAC an EMR Computer fingerprints the atom*

In Stanford's linear accelerator, energetic electrons travel a two-mile freeway bent on collision with atomic nuclei to knock sub-atomic particles loose. The free particles then pass through a bubble chamber, leaving tracks as evidence of their passage. These tracks are signatures of atomic events that are analyzed by an EMR *ADVANCE* 6020 computer at SLAC* (STANFORD LINEAR ACCELERATOR CENTER). On-line with a number of film projection measuring tables, the computer scans films of bubble-chamber data, checks and validates track position information automatically and prepares the data for final processing. With the EMR computer, bubble-chamber data is completely analyzed in greatly reduced time without human intervention or, most important, without human error.

An important reason for the choice of an EMR computer was BUCAPS, a programming system specially devised for bubble-chamber analysis by EMR. An EMR computer can control up to eight bubble-chamber measuring tables simultaneously with BUCAPS.

This is only one example of the many kinds of special programming assistance offered by EMR. Perhaps we can help you with your special computing problems, whether they are concerned with software or hardware. We'd like to help, and encourage you to write or call: Computer Division, EMR, 8001 Bloomington Freeway, Minneapolis, Minn. 55420.

COMPUTER DIVISION EMR



look ahead

NONE GENUINE
WITHOUT THIS TRADEMARK

Some confusion has arisen among System/360 users concerning IBM's Conversational Programming System (CPS) and the Rush programming system developed by Allen-Babcock Computing. It's true that CPS is the same as Rush — but it's Rush 1 that is the equivalent. Babcock has since moved on to later versions — is now using Rush 3. As a pocket guide to distinguishing between them, Rush 3 has full PL/I direct access file management facilities and PL/I character manipulation facilities for non-numeric processing. Version 3 is now available only to customers of Allen-Babcock's time-sharing service. We understand, however, that it may soon be available from A-B on a lease basis to any user of a 360 Model 50, 65, or 75. Those who sign up will also be entitled to later versions as they come along — reportedly Rush 4 about October and Rush 5 in March next year.

DO-IT-YOURSELF
PARALLEL PROCESSOR

A multiprocessor operating in parallel, said to be capable of performing 10 million logic operations per second, is under development at Boeing in Seattle. It's called the Basic ISS (information systems simulator), and will be used to perform simulations of proposed real-time computers.

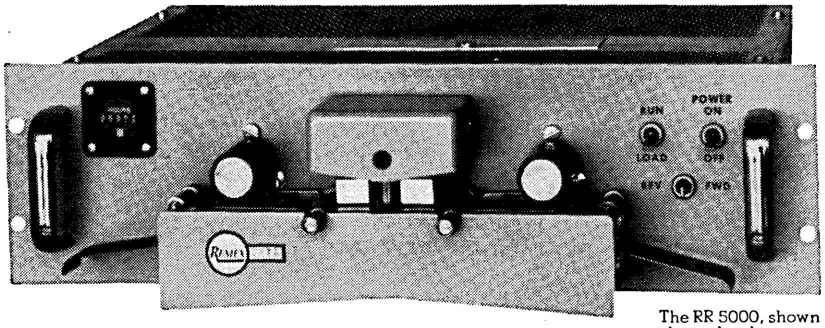
The system will consist of an array of four processing modules, each with a processor and two memories of 8K (48-bit) words. Cycle time will be 650 nanoseconds, communications between processing modules will be at 1200 megabits/second. An electric crossbar-switch arrangement will permit access to the processing modules by up to four external processors — commercially-available computers or another ISS.

What all this enables Boeing to do is to simulate the performance of a computer proposed for a real-time environment — in an advanced aircraft, for example. They've been doing this for several years with gp computers, but when performed at the detailed logic level (gates, flip-flops, etc.), the running time becomes prohibitive. The ISS, implementing an "event-logic" technique, will be capable of simulating digital systems of up to 30,000 logic variables, will have substantial growth capabilities beyond that. The Basic ISS facility is scheduled to be on the air in December '68.

A NEW GAP-PLUGGER
FROM THE MARKETING CHAMPS

Reaction to IBM's "new" stripped-down 1401 — the $1300/month 1401-H card system that has a 70-1 purchase-lease ratio — is that it's a wise marketing move. Makers of small systems aimed at the tab-gear replacement market, where IBM has not been strong, and EAM leasing firms will find the H tough competition with its ready software, quick delivery.

Those who lease EAM gear and planned to hedge the loss of tab customers by buying and leasing stripped



The RR 5000, shown above, has been selected for future Surveyor shots.

109,534 commands without a single error.

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CIRCLE 16 ON READER CARD

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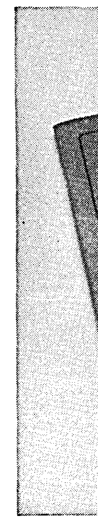
define your terms, please

Whatever your work in information processing, you'll communicate better with the help of this authoritative glossary.



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1401's will find the $92K price prohibitive. These firms, like MAI, are surely remembering the Oct. '65 blow when IBM stopped depreciation for tab and some computer equipment. (The high price-low rental is reminiscent of the move with stripped 402 and 650's.)

Observers note that IBM probably won't want to rent more than 3 or 4,000 of these systems here and abroad since it has been refurbishing many of the 1401 peripherals (1402 card reader/punch and 1403 printer) for use on 360 systems. As for the overseas market, IBM is not bound by the consent decree. So where purchase is mandatory, as it is primarily in East Europe, the price could come down.

HARDWARE FOR THE MIDDLE-CLASS TIME-SHARER

RCA's new time-sharing model, the Spectra 70/46, will handle 48 terminals, they say, but we understand it's aimed at users wanting to do batch and t-s on a reasonable number — 12-15. At $25-35K/month, they won't be bothering the 645 or 1108 market. Features include a 262K-byte main memory accessing two bytes in 1.44 usec, a 128 (4-byte) word scratchpad accessing in 300 nsec, another 1K bytes (300 nsec) for virtual address translation, and read-only storage for microprograms in three 2K banks with a 480 nsec cycle time. Virtual memory size is up to 2 million bytes. There's also paging and dynamic memory allocation.

DEACON NEEDS TO TAKE UP ANOTHER COLLECTION

Project DEACON, GE Tempo's highly publicized on-line data base system, may be headed for the rocks. There's enough dough in the till now to keep the project alive through July, and the Defense Intelligence Agency may come through with another $75K, which could extend it to October. But new faces at the DOD Research & Engineering operation may not understand the company's overhead rate of 150% ... and currently cautious GE may not want to continue putting matching funds into the project. Renowned H.R.J. Grosch is no longer head of DEACON, will soon relocate.

SERVICE OFFERS MACHINE-PRODUCED SCHEMATICS

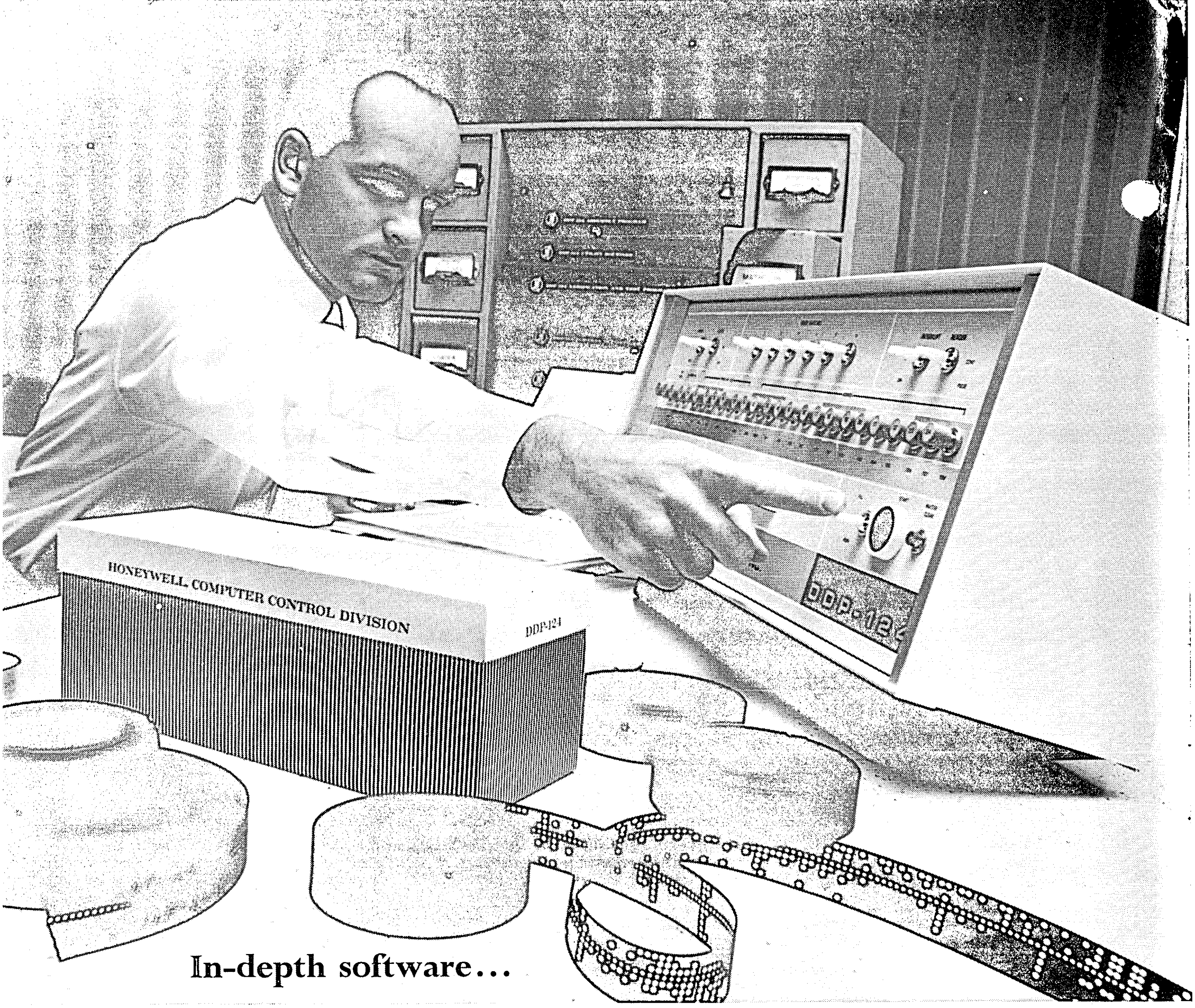
A computerized method for preparing electronic schematics, block diagrams, cabling diagrams, and such, has been developed and is being offered as a commercial service by Auto-Graphics, Inc., Monterey Park, Calif. The typesetting firm currently uses an 8K Bunker-Ramo 230-B computer to generate a paper tape that drives a Photon 713 phototypesetter. Both the software and a special matrix drum for the Photon, bearing alphanumerics and symbols, are proprietary developments of Auto-Graphics.

An early user and prime mover in the development of the system is North American Aviation's Space and Information Systems Div. S&ID's Don Millenson, who received a $6,000 employee suggestion award for his part in the development, says they've experienced a cost saving of 30% and a time-saving of 25% by using the service.

Due to replace the B-R 230 later this year is an 8K SDS Sigma 2 with discs and tapes. Although programming for the new configuration has not begun, the idea is to improve the facilities for maintaining, updating, and indexing the drawings. According to Auto-Graphics' Robert S. Cope, each drawing can average four or five revisions before completion.

A similar service is about to be offered by Photo-Comp Inc., Phoenix, Ariz. They, too, developed their own matrix drum for the Photon 713, but they'll

(Continued on page 141)



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COMPUTER CONTROL
DIVISION

CIRCLE 17 ON READER CARD

WORDS, WORDS, WORDS

It was probably wishful thinking when we reported in the April issue that the U.S.A. Standards information processing committee would probably shoot down the standard vocabulary. No such luck. As Paul Goodstat reports (*see* Letters, p. 14), the vocabulary will be expanded, not junked.

This earth-shaking news sent us scurrying to review a copy of the vocabulary. After some study, the kindest thing we can say is that this volume, containing some 700 terms, will never receive the kind of classic, terse review—it's got to be one of the great book reviews of all time—accorded a book by a grade school student: "This book tells me more than I want to know about rats."

Let's look at some typical (?) entries. Our favorite is the one for "**Modem.** MOdulator-DEModulator." The underlining, in case you're curious, means that the "underlined term is significant in the definition and has been defined elsewhere in the vocabulary." In this case, that statement doesn't seem true: we could find no entry for Modulator-Demodulator in our copy. FORTRAN is defined as "(FOrmula TRANslating system). Any of several specific procedure oriented languages." COBOL: "(Common Business Oriented Language.) A business data processing language."

As we continued our excursion through the vocabulary, we were struck with a thought: what is the purpose of the vocabulary? According to the vocabulary itself, the purpose is "to present a selected body of terms relevant to the field of information processing, and to establish the corresponding meanings for these terms." Seems reasonable—if vague—enough. Then we wondered, for whom is the vocabulary intended?

For the answer we had to turn to the chairman of X3.5, who told us that it was intended for "the widest possible audience . . . the novice and the professional."

Here, we think is the heart of the matter. For it seems to us that no vocabulary aimed at this broad and amorphous audience can satisfy either end of such a range. Certainly the definitions we've quoted above do little to help the novice. And to the professional, they offer less than he already knows.

The X3.5 vocabulary committee which produced this document held its organizational meeting September 22, 1960. Their work was accepted as a U.S. standard in June of 1966. Many honest, honorable and competent men have put a lot of work into producing this document. We do not intend to impugn their technical capabilities or their integrity.

We just think they developed a vocabulary which oversimplified and underdefined the most basic question which the author of any document has to ask—and answer—before he can produce something useful: who will use this . . . and how?

In case there's any doubt about the audience and the intention of *this* particular polemic, let's spell them out. It's addressed to *you*, dear reader—data processing manager, teacher/trainer, analyst, programmer, designer, user. We'd like you to study this vocabulary, come to your own conclusions about it, and pass on to the committee your suggestions for making it a more useful and representative document.

Your comments for changes or additions should be addressed to the U.S.A. Standards Institute, 10 E. 40th St., New York, N.Y. 10016.

If you think the vocabulary is as bad as we do, you'd better hurry. Mr. Goodstat says that the new, expanded vocabulary will probably appear as a proposed standard late this year. And, he says, "About 85-90% of the present definitions will remain exactly the same in the new edition . . ."

Like help.

ARE YOU WORKING ON THE RIGHT PROBLEM?

beware the obvious

by R. GEORGE GLASER

The installation of a computer for business data processing is justified only to the extent that it is used to make a direct and substantial contribution to the achievement of the company's objectives. Unfortunately, this rather obvious principle is not always applied in practice. This article describes how a critical analysis of the economics of the company and of the computer's role in improving those economics can lead a company to the proper choice of applications.

The responsible data processing manager wants to do his job well; he wants to work on problems which are important for his company, and he wants to provide a satisfactory solution to these problems. However, in practice, the data processing manager, often through no fault of his own, is put to work on the wrong problem. How does this happen and what can be done about it? Let's begin by examining the typical process by which a company acquires its first computer.

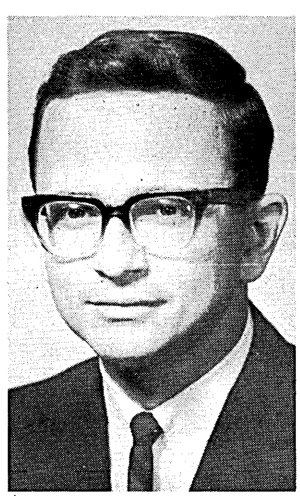
cataloging the potential applications

One of the first steps taken by any company considering installation of a computer is to catalog its potential computer applications. In most cases, by the time the company is sufficiently large to be confronted by this decision, there are a number of "obvious" applications. But the obvious applications are not always the best ones and small companies often assign their scarce human resources to development efforts that have a relatively marginal impact on the company's operation. And when these limited resources are poorly assigned, the cost of development is far greater than the out-of-pocket salary costs made visible by the accounting system.

This misuse of scarce resources can be avoided—and the computer applied to those areas with the best potential for improving company profits—if the principles of economic analysis are applied.

Successful businesses routinely apply economic analysis to their operations. When considering the use of a computer, they apply these same principles by asking themselves questions like these: What are the most important decisions we make? How could these be improved with better information? Where would a small percentage change in cost have a relatively large impact on profits? What are our most important resources—e.g., plant capacity, raw material reserves, etc.—and are we managing them well? The answers to these questions lead them to selection of the most profitable areas for their computer applications—rather than the easiest and most obvious. Providing the answers to such questions is the function of economic analysis.

Every industry, and even companies in the same industry, will have unique economics. If raw material costs are a significant portion of the sales dollar realized from a



Mr. Glaser is an associate in the San Francisco offices of McKinsey & Company, Inc. He was previously product manager for tape drives at Ampex Corp., computer products division. He was chairman of the 1966 FJCC and will be national chairman of the ACM Special Interest Committee on Business Data Processing. He has a BS in electrical engineering from Notre Dame.

manufacturer's product, the use of the computer for raw material inventory control may be a very worthwhile endeavor. On the other hand, if labor costs are a significant portion of product costs, then the use of the computer to identify and improve labor utilization and reduce overtime may be the most important application. For a wholesaler, control of distribution costs would be very important; for a trucking company, vehicle maintenance.

New users of data processing techniques face the same problem that experienced users do in selecting computer applications. But, because the new users would like to bypass the punched card era, they are faced with greater hazards than they would have been a few years ago. Those who started with punched card machines have had experience in systematic operations; they started with simple EAM applications and graduated to more complex ones made possible by computers. But small companies now installing a computer would like to take advantage of third-generation capabilities; they are likely to begin directly with a tape and disc system—with resulting higher costs of equipment and greater demands on staff skills. The importance of using the computer to solve the right problem has never been more critical.

Finding the right problem for the computer's first assignment is essentially a job of matching the unique characteristics of the computer with the unique characteristics and problems of the business.

Consider first the unique characteristics of the computer. The computer is singularly useful whenever the job to be done is complex, or tedious, or demands fast response. In a small company, examples of *complex* applications would include production scheduling, inventory control, and sales forecasting. *Tedious* operations would include processing of most paperwork, e.g., sales orders, customer invoices, and the like. *Fast-response* applications are typically not found in small businesses but there are examples in large organizations that are familiar to almost everyone—airline reservations systems, hospital patient monitoring, and process control of refineries. Given these unique characteristics of the computer, how can they be matched to the unique needs of the company?

the feasibility study

This question is resolved by the classical feasibility study—which should answer three basic questions: (1) *can* the job be done?—a technical question, (2) *should* the job be done?—an economic question, and (3) *will* the system work?—an operational question.

The first of these—technical feasibility—nearly always gets the most attention because it lies within the formal skills and training of the systems staff. In answering this question, the approach to the problem is defined and the equipment and technology required to implement it are identified. In the context of a small company, technical feasibility is rarely an issue because of the advanced state of current computer technology. Note carefully the distinction here between the issue of technical feasibility and the need for a formal system definition. In practice, system definition takes place at the time technical feasibility is being questioned. But a go/no-go decision usually is not the issue—it's a question of *how* to go and this requires rigorous systems analysis and design even when technical feasibility is not in question.

The second question—economic feasibility—often is not given the attention it deserves. Economic feasibility is determined by comparing the costs—one-time development costs and continuing operating costs—with the benefits of a new system. If there are no limitations on resources, then the problem is relatively straightforward: the one-time cost of development is compared to the savings in operating costs projected for future periods. When resources are scarce, however, their cost is considerably larger than the out-of-pocket cost for salaries and employee benefits. The real cost, which is not measured by accounting systems, is the foregone opportunity to apply these resources to other important problems. And if the assignment of two or three systems analysts to the mechanization of a paperwork procedure precludes the development of an application of more importance to the company, then the cost of mechanization may be many times that of the visible costs associated with development staff salaries.

The systems staff usually is best qualified to estimate development costs and, in most cases, operating costs. And they can best estimate the level of system performance that will result from the development. However, they are often poorly equipped to estimate the potential benefits from a new system. These should be estimated by an experienced manager in the user department who can impute a dollar value to the improved performance. For example, the systems staff can design a sales analysis report and can deliver the report at specified intervals for a given development cost. But they should not be asked to estimate the benefits the report will produce for sales management. Only an experienced sales manager can establish the dollar value of such a report.

The third question—operational feasibility—is rarely considered in any formal sense. Operational feasibility is a measure of how well the system will function within the operating policies, organization, and economic environment of the corporation. Yet it is at least as important as the other two feasibility questions. The data processing system can never be fully effective unless the user *wants* to use it. When the feasibility of a new application is being examined, "the desire of the user" is an elusive (and sometimes illusive) quality to evaluate. Computer-based systems require more than "tolerance" on the user's part; they require active cooperation on the part of those who supply data to the system or who use the output reports.

Suppose a marketing manager reads in a leading business journal about a useful report that ranks each product in the line on the basis of profitability. He requests that such a report be prepared weekly and distributed to his sales force. According to the article, they will then work hardest to sell those products that are most profitable, thereby increasing the company's over-all profit. However, if the sales force is paid a commission based on volume of sales (and in no way related to profitability of sales), then it is obvious that the report will never be used. The salesmen will continue to sell all they can of whatever they can, regardless of company profits.

Another example might be the installation of data collection terminals at service stations. While the technical staff must decide if this is the most efficient way to collect the needed information, they must also consider how the service station operator can be motivated to use the equipment properly and to provide accurate input data. If they don't, the system may fail—technical and economic feasibility notwithstanding.

ABC's first computer

Consider the ABC Manufacturing Company—a typical company that has just ordered its first computer. ABC is a young company but it has been increasingly successful with a few products and now employs around 350 people. Since its founding some five years ago, four members of management have personally been in close touch with all aspects of the business. Their success has largely depended on this very characteristic—any one of the group could quickly reach agreement with the others on major decisions with little time lost. Although the members of the group specialize in the manufacturing, financial, and marketing areas, all of them have had a firm grasp of each other's problems and their interrelations.

Now—quite suddenly, it seems—all this has changed. Increased orders have made it necessary to start another production line; extensive changes in products are required to meet new competition; the sales organization is being expanded, with new geographical areas included; new products are being introduced, with consequent changes in production scheduling; manual inventory control is no longer effective. The most visible result: paperwork piles up as sales order processing and customer invoicing fall behind. The demands on the company are growing faster than its ability to deal with them. In short, management is beginning to lose control of the business.

the paperwork problem

So the subject of computers comes up inevitably; computers are widely known to have been useful in relieving the paperwork jam for other companies. A small team is formed, headed by the financial officer, to investigate the feasibility of a computer installation. The company's paperwork problems are cataloged and manufacturers are asked to bid on suitable equipment. The cost of the clerical staff needed to process the increased volume is calculated and credited as a potential saving to the computer installation.

Soon there is general agreement that a computer is justified and it is assigned—almost by default—to the "paperwork" problem. *But* this is the crucial point when the *whole* business operation should be subjected to economic analysis to determine the most profitable applications for the computer.

Let's take a look at some of the reasons leading to the selection of paperwork processing as the computer's initial application.

First, ABC's systems group is attached to the financial function. And this group is well acquainted with the paperwork problems and anxious to solve them.

Second, paperwork applications are relatively straightforward; there is very little technological risk involved. Procedures are well known and the processing of most transactions is relatively mechanical. Further, the cycles are regular and predictable, thus more easily adapted to automatic processing.

Third, paperwork applications have a high visibility of potential clerical cost savings. They appear on the profit and loss statement and "if we had the computer we wouldn't need Susie."

Fourth, ABC has been using a service bureau punched card installation for certain accounting applications; by processing their own paperwork, the monthly cost of this service can be used to help offset the computer rental.

Finally, the basic transaction data of the company eventually must be "captured" in machine-readable form anyway in order to develop a management information system.

economics rears its head

Suppose ABC broadens its search for the most appropriate computer application by examining those major factors which control its profits. If it does so, paperwork processing may appear considerably less attractive.

The paperwork jam is highly visible; but other, more important, changes are taking place at ABC. Profit margins are shrinking and capital resources are becoming scarce. What can the computer do to help out? Where can costs and working capital requirements be reduced?

For the purpose of illustration, assume that the material costs are, in fact, a significant portion of the product costs at ABC and examine a potential inventory control application.

the inventory problem

The head of manufacturing is well aware that inventory control could, and should, be improved. But if he examined this area with the computer in mind, several annoying problems would appear immediately.

The first problem that arises concerns the difficulty of establishing physical control (status and location) of each item in inventory. There also may be problems in the structure of the part numbering system; if this structure is inconsistent or has grown like Topsy during the company's early years, it presents a formidable problem to the systems analyst.

Second, it will be necessary to formulate inventory ordering rules. But to do so it's essential to know historical demand patterns, information that probably does not now exist in the required form. Projections of future demand will be based on sales forecasts; these must have the proper form, content, and accuracy. If outside vendors supply parts or components, it is important to know each vendor's lead-time history and the quality of his shipments —how many of each 100 units ordered will meet specifications? If the source is in-house production, the systems planner will need to know set-up costs, unit costs, production cycles, and yields.

Although all this information has been "known" roughly before, the knowledge has been in the form of a few men's experience and a fair amount of intuition. This phenomenon leads to the "everybody knows" syndrome—it is the bane of the systems analyst's existence. This syndrome is widespread, and many computer applications have been disappointing because the computer didn't "know" what the production manager "knows."

One of the most significant contrasts between inventory control and a proposed paperwork application is the effect on functional areas of the company. Accounting functions stand alone to a large extent; as long as the bills are paid and the payroll is prompt and accurate, other areas of the firm will not be much affected. But consider how other parts of the company will be affected by planning for computer-directed inventory control:

Manufacturing would like to cut set-up and overtime costs by making long production runs; this leads to a relatively large inventory since any one product will be produced less frequently.

Marketing would like to be able to tell customers "we'll air-freight your shipment in three hours"—a goal that requires a large shelf inventory of all products.

Finance wants to cut the cost of maintaining inventory; from their standpoint, small inventories are desirable to minimize the amount of working capital tied up and the danger of stockpiled items becoming obsolete.

Each of the functional groups would like to "optimize" that portion of the system which satisfies its own objective. In a practical sense, however, it is impossible to satisfy their individual needs without conflict; extensive compromises will be needed. These compromises never were made explicitly with manual systems; now they must be negotiated—and by relatively high level managers if the decisions are to be effective.

In addition, although inventory control technology is reasonably well known, the application is operationally more difficult to implement than most accounting applications and is more risky—if one part of such a complex system fails, operations will be seriously disrupted.

One further contrast: The dollar value of the benefits expected from an inventory control system are difficult to quantify in advance. It is not difficult to identify the *source* of benefits—reduced working capital, lower obsolescence losses, faster delivery to customers, longer production runs—but it may be necessary to undertake a pilot study to project the percentage improvement expected in any of these in order to convert the benefits to a dollar amount. What, for example, is improved customer service worth? Furthermore, the savings will not materialize the moment the system is installed. Actually, inventory control systems frequently cause an increase in inventory levels over the short term because it is easier to build up inventories of items that were below their targeted levels than it is to reduce inventories of those products which were held in excessive amounts. This is a frequent cause of executive disenchantment. And the data processing manager (whose job is on the line) may be anxious to produce a quick, and highly visible, payoff from his efforts. He may be understandably reluctant to undertake risky ventures, despite their considerably greater potential.

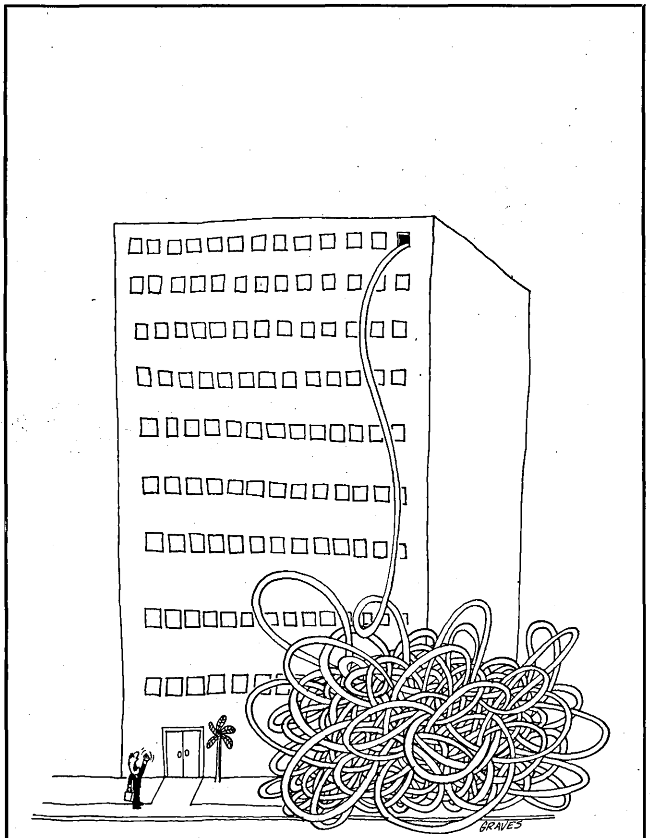
In spite of these difficulties, however, an important fact remains: the hypothetical company is likely to improve its profits much more by using the computer for inventory control than for paperwork processing. The reason for this is not obscure: assume that the budget for accounting department salaries is $240K a year and that the annual cost (including carrying costs, obsolescence, etc.) of raw material is $10 million. Consider the relative impact of reducing the two costs.

A 1% reduction in material costs would yield $100K—equal to a cut in accounting department salaries of 40%. And, while the 1% reduction is a relatively conservative estimate for many companies, the 40% reduction in salaries is outrageously ambitious. Furthermore, the inventory control system can be expected to provide additional non-dollar benefits for the reasons stated above. And very few companies, especially small ones, are highly successful because of low clerical costs.

Nonetheless, the company may well be wary of embarking on the development of a major inventory control system. After all, the evidence would indicate that development would be long and costly; it would be much easier to start in the accounting department where experienced systems people are available. And the accounting data will be needed in the long run for other information needs of the company. Most important of all, the people in production are just too busy to take on this kind of development effort.

In certain cases, these reasons will be compelling. They may dictate that the company should delay the inventory control system. The argument for capturing the data is quite valid in some cases, but capturing data should not be an end in itself. It is justified *only* if the data is needed as input to other, more important, applications. But the "too busy" argument is more short-sighted; the economics may indicate that the cost of additional production staff and systems analysts to develop and install the system will be returned manyfold by the benefits. In either case, the economic analysis will point out the implied cost of deciding against the inventory system.

This should not be taken as a plea for starting with inventory control in every company. In fact, it is literally impossible to do so before developing a solid base of related systems—sales forecasting, physical status of goods, vendor performance, and so on. But it is a plea for working *only* on those applications that contribute directly to the major objective of increasing profits (in this case, through inventory control). And it's a caution that the obvious application may not be the best.



"How many times do I have to tell you? . . . keep the windows shut during readouts!"

a case from the food industry

Application of the principles of economic analysis has led to surprising initial applications for the computer. Here's an actual example.

A food processing company that successfully markets a low-cost product had reached a point where increases in sales did not produce proportionate increases in profits.

Market conditions effectively ruled out increases in the selling price, since the product is a traditional one and the price had long been stabilized. In addition, the product is simple to make and further economies of production are unlikely.

Analysis showed that the most promising way to improve profitability was to lower the average cost of the product's principal ingredient. This ingredient fluctuated widely in price, but since it was perishable, large inventories could not be accumulated when prices were low. However considerable information about the potential sources of supply and the demand for the end product was available. Using a computer, it was possible to project price movements with sufficient accuracy to improve the timing of the "buy" decision. This is the type of complex problem well-suited for solution by computer and the resulting program enabled the company to take positions in the commodity futures market that led to a continued reduction of over-all costs in acquiring and storing the main ingredient of its product.

summary

I have not intended to disparage the use of the computer for paper work processing and for mechanizing other routine aspects of the business operation. But I do argue for a careful examination of those factors which make your particular business unique and for relating these to the unique capabilities of the computer. Be sure *you* are working on the right problem. ■

relief in sight

THE REPORT PROGRAM GENERATOR

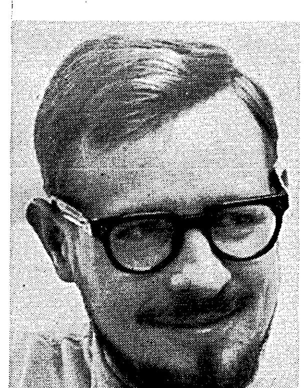
by HARRY LESLIE

The shortage of programmers in the United States, or the "software crisis" as it has been dubbed by experts, is producing fallout among practicing professionals today. Writing programs is fascinating and rewarding work but the functions of many programs are identical and rewriting these sections can not only become tiresome but also can get a programmer bogged down on one assignment and unable to move quickly onto a new one.

The Report Program Generator (RPG) is providing a means, on many programs, for programmers to move more rapidly from one program to another. The purpose of this article is to describe some useful areas of the new generation of RPG processors and to briefly explain the language processor Computer Usage Co. developed for RCA and its Spectra 70. IBM introduced the language on the 1401 series and has also developed a new processor for the System/360. The same RPG language has also been adopted by Univac. Perhaps this means the beginning of an industry standard in RPG language.

The RPG language provides an automatic means of handling matching records (merge operation), level breaks, record identification, table handling and editing. It doesn't handle binary arithmetic, work files or the typewriter. It is meant for straightforward problems such as reports normally are.

An RPG uses fixed field cards with six different formats. There are file description cards where the characteristics of a file are described on one card. There are file extension cards for defining tables and chaining (disc) files. There are line counter cards for use when print files go to tape instead of the printer. There are input specification cards for defining record identification and field definition. There are calculation cards for defining logical decisions and calculations. There are output specification cards for



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defining output record selection, field definition and editing.

shocked programmers

Programmers who have never worked with RPG's receive a mild shock when they find the issue neither reads nor writes, and they do not have to move input records to work areas, define special work sections, or move fields to output records. Gone, then, is a sizable part of the cause of the programmer's occupational disease, writer's cramp. The RPG accomplishes this by taking advantage of the fact that an output record is always made up of previously defined fields, edited fields, or constants. When an output is specified, it is merely given the same name as the field wanted moved and the RPG moves it.

The RPG has predefined program logic variable enough to fit most applications, which allows it to control the I/O and to determine when to issue a read or write. Most data processing jobs will fit into this program logic (some being squeezed in). As a general rule, you could say that the less complicated the field handling problems the more suitable a program is for the RPG. For example, the RPG does not allow work tapes within a program (e.g., tape may not be written on during the first part of a job and read in the second part; this would have to encompass two separate RPG programs). Also, the more input files there are to process, the more complicated it is for a programmer to work with the RPG.

Let's pin down the usefulness of the RPG a little bit more. The way the RPG operates, one could not ask "should we use assembly language or RPG?" or again "COBOL or RPG?" Instead, RPG should be used in addition to some other language, and the question asked should be: "When do I use COBOL or assembly language and when RPG?"

Six pertinent questions must be applied to the RPG, with the answers telling us not only if it should be used at all but, if so, when:

1. Is it easy to learn?
   Most programming languages tend to be about equally difficult to learn. The RPG is no exception to this. It is as difficult to learn as any other programming language.
2. Is it easy to use?
   Ease of use depends on the application. The RPG is intended for straightforward applications without complicated logic or complicated use of files. If it is applied where intended, it is certainly easier to use than either COBOL or assembly language. File description statements are short and effective. One RPG source statement completely defines a file's structure. Inputs and output field statements also require only one line, giving the "from" and "to" address, decimal positions and name, and certain other optional features associated with the field (e.g. a programmer could tell the RPG to test if the field is plus, minus, zero, or blank). The calculations tend to be fewer than with COBOL or assembly language when used in straightforward situations. No file control logic is included in the statements, so one source of error and several lines of coding are eliminated.

speed

3. Can a program be written quickly in it?
   Once again, if the application is proper, the speed with which something can be programmed is amazing. For instance, a two-tape merge could be written with 10 RPG cards in less than half an hour by an experienced RPG programmer. An optional printed report with proper spacing and headings at certain level breaks could be added with perhaps 10-20 RPG source cards, also in less than half an hour. The instruction set is comprehensive, featuring a powerful table lookup instruction and including a variety of moves and a compare, add, subtract, multiply and divide with automatic decimal alignment. In addition, it allows reference to linkage to programs external to the RPG.
4. Does it produce a fast running program?
   The RPG does not produce an efficient program, but it does usually produce a program that will run as fast as one written in any other language. This is because the execution time will normally fall completely within I/O time, eliminating the necessity of efficiency. Again, we see the need for using the RPG for straightforward problems. A long, complicated problem involving many loops may turn into a slow running program in RPG, for the execution time might exceed I/O time.
5. Does it facilitate conversion?
   In the absence of an industry standard for RPG's, conversion will probably mean rewriting. However, all RPG's tend to be very similar and it would certainly be much easier to rewrite than an assembly language program. In fact, it is not a difficult thing to write a program to convert from one RPG to another.
6. Does it facilitate maintenance?
   An RPG program will normally have fewer statements than either assembly language or COBOL. For that reason there will be fewer statements to change if maintenance is necessary. Also, it is quite simple to make additions to an RPG program. However, a complicated problem coded in RPG is as difficult to maintain as the same problem coded in COBOL or assembly language.

The RPG can obviously be a very useful language if used in addition to a more comprehensive language. There are many applications of the RPG and it deserves a place in any data processing shop.

I have drawn a very vague dividing line between the times when the RPG should be used and when it should not. The reason is that no clear dividing line exists. It is possible, though, to apply three general questions to a data processing program.

1. Does the input or output structure include multifile reels, work tapes or special tape control operations?
2. Is the relationship between input files complicated?
3. Does the program include difficult logical processing or many loops?

If the answer to each is no, then the program is probably suitable for the RPG.

The way a processor works can be as important as what it does. For instance, a very slow compiler or one that gives few diagnostics can be pretty useless. The RPG CUC wrote for the Spectra 70's POS, TOS and TDOS systems set out to accomplish three major objectives.

1. Fast compilation
2. Efficient object programs
3. A clear, comprehensive program listing.

CUC produced a compiler that will output loadable programs at rates up to 900 cards per minute, with tailored object code, optional double buffered I/O and a printout with calculation object code listed with each source line plus any diagnostics (over 200 are possible). Listing the object code with the calculation statement is especially appreciated by users who have program errors and need to know in which statement or field an interrupt occurred.

binary table searches

One of the most interesting things to come out of the RPG processor was a new method of handling binary table searches. Previously, a binary table lookup with a table length not a power of two involved a division each time through the loop. However, the object program the

RPG produced is capable of doing a binary search of any size table, using a shift instruction instead of division. This increases the speed of the lookup many times, as the shift instruction on the Spectra 70 (or the 360) is usually about 10 times as fast as a divide.

The method simply involves dividing the table into two overlapping parts, each a power of two, in number of entries. A compare to the midpoint of the table to find out which area of the table to search is the only overhead paid for this method. The increment (or decrement for tables in descending order) is kept in a register and, each time through, the loop is halved by a shift of one bit. The time saved could be significant—probably half a millisecond per lookup on a Spectra 70/45.

The RPG processor itself operates in a fairly typical fashion. It breaks source statements down into either data attribute or a codified form of a statement. After data attributes have been submitted for names, the program generates object code in a unified format. Then this code is output in a form acceptable to the linkage editor. Although this sounds as though it is passing over the input four times (and in a sense it is), the actual compiling speed is limited mainly by the original input speed and final output speed.

Speed is achieved because only the data that need be passed over again is actually written and read again.

COBOL Version

```
LINE NO. SEQ. NO.       SOURCE STATEMENT

      001   IDENTIFICATION DIVISION.
S     001   PROGRAM-ID. 'SELECT'
S     001   AUTHOR.  A DAMICO.
S     001   ENVIRONMENT DIVISION.
S     001   CONFIGURATION SECTION.
S     001   SOURCE-COMPUTER. IBM-360.
S     001   OBJECT-COMPUTER. IBM-360.
S     001   INPUT-OUTPUT SECTION.
S     001   FILE-CONTROL.
S     001       SELECT OLD-MASTER ASSIGN TO 'SYS004' UTILITY 2400 UNITS.
S     001       SELECT NEW-MASTER ASSIGN TO 'SYS006' UTILITY 2400 UNITS.
S     001       SELECT PRINTED-REPORT ASSIGN TO 'SYS008' UNIT-RECORD 1403
S     001       RESERVE NO ALTERNATE AREA.
S     001       SELECT CARD-INPUT ASSIGN TO 'SYS010'
S     001       RESERVE NO ALTERNATE AREA.
      002   DATA DIVISION.
      002   FILE SECTION.
S     002   FD  OLD-MASTER  DATA RECORD IS RECORD-1  LABEL RECORDS
S     002       ARE STANDARD  RECORD CONTAINS 100 CHARACTERS
S     002       BLOCK CONTAINS 5 RECORDS RECORDING MODE IS F.
S     002   01  RECORD-1.
S     002       02  INCUSTNO           PICTURE X(5).
S     002       02  FILLER             PICTURE X(15).
S     002       02  INAREA             PICTURE XX.
S     002       02  FILLER             PICTURE X(8).
S     002       02  INNAME             PICTURE X(25).
S     002       02  INSTREET           PICTURE X(19).
S     002       02  INCITSTAT          PICTURE X(14).
S     002       02  FILLER             PICTURE X(12).
S     002   FD  NEW-MASTER  DATA RECORD IS RECORD-2  LABEL RECORDS
S     002       ARE STANDARD  RECORD  CONTAINS 100 CHARACTERS
S     002       BLOCK CONTAINS 5 RECORDS  RECORDING MODE IS F.
S     002   01  RECORD-2.
S     002       02  FILLER             PICTURE X(100).
      003   FD  CARD-INPUT  DATA RECORD IS RECORD-3  LABEL RECORDS
S     003       ARE OMITTED  RECORDING MODE IS F. .
S     003   01  CARD.
S     003       02  PARTA              PICTURE X(75).
S     003       02  PARTB              PICTURE X(5).
      004   FD  PRINTED-REPORT LABEL RECORDS ARE OMITTED  DATA RECORD
S     004       IS CUST-LINE RECORDING MODE IS F.
S     004   01  CUST-LINE.
S     004       02  FILLER             PICTURE X.
S     004       02  CUSTNO             PICTURE X(5).
S     004       02  FILLER             PICTURE XX.
S     004       02  AREA               PICTURE XXX.
S     004       02  FILLER             PICTURE X(10).
S     004       02  NAME               PICTURE X(25).
S     004       02  FILLER             PICTURE X(10).
S     004       02  STREET             PICTURE X(19).
S     004       02  FILLER             PICTURE X(11).
S     004       02  CITSTAT            PICTURE X(14).
S     004       02  FILLER             PICTURE X(33).
S     004   WORKING-STORAGE SECTION.
S     004   77  SUB                    PICTURE 999 COMPUTATIONAL VALUE ZERO.
S     004   01  TABLE.
S     004       02  TABLE-AREA.
S     004           03  FIRST          PICTURE X(75).
S     004           03  SECOND         PICTURE X(75).
S     004           03  THIRD          PICTURE X(75).
S     004           03  FOURTH         PICTURE X(75).
      005   01  RTABLE  REDEFINES TABLE.
S     005       02  SELECT    PICTURE XXX    OCCURS 100 TIMES.
S     005   PROCEDURE DIVISION.
      005   START.
S     005       OPEN INPUT OLD-MASTER CARD-INPUT OUTPUT PRINTED-REPORT
S     005       NEW-MASTER.
S     005       PERFORM CARD-READ.
S     005       MOVE PARTA TO FIRST.
S     005       PERFORM CARD-READ.
S     005       MOVE PARTA TO SECOND.
S     005       PERFORM CARD-READ.
S     005       MOVE PARTA TO THIRD.
S     005       PERFORM CARD-READ.
S     005       MOVE PARTA TO FOURTH.
S     005   LOOK-UP.
S     005       READ OLD-MASTER AT END GO TO EOJ.
S     005       MOVE 1 TO SUB
      006   LOOP.
S     006       IF INAREA IS EQUAL TO SELECT (SUB)
S     006           GO TO WRITE.
S     006       IF SUB IS EQUAL TO 100
S     006       GO TO LOOK-UP.
S     006       ADD 1 TO SUB.
S     006       GO TO LOOP.
S     006   WRITE.
S     006       MOVE RECORD-1 TO RECORD-2.
S     006       WRITE RECORD-2.
S     006       MOVE INCUSTNO TO CUSTNO.
S     006       MOVE INAREA TO AREA.
S     006       MOVE INNAME TO NAME.
S     006       MOVE INSTREET TO STREET.
S     006       MOVE INCITSTAT TO CITSTAT.
S     006       WRITE CUST-LINE AFTER ADVANCING 1 LINES.
S     006       GO TO LOOK-UP.
S     006   EOJ.
S     006       CLOSE OLD-MASTER, CARD-INPUT, PRINTED-REPORT, NEW-MASTER.
S     006       STOP RUN.
      007   CARD-READ.
S     007       READ CARD-INPUT AT END GO TO LOOK-UP.
```

RPG Version

```
DOS/360*RPG*CL 2-1                     SELECT                            03/29/67

   01 000 H
   01 010 FOLYIPT   IPEAF 500 100                 TAPE    SYS004S
   01 020 FSELCPT   O    F 500 100                TAPE    SYS006S
   01 030 FSELPRT   O    F 132 132                PRINTERSYSLST
   01 040 FAREATBL  IT   F  80  80               EREAD01 SYSRDR

   02 01  E     AREATBL          TABAR   25 100   3   A
   04 01  IOLYIPT   AA   01
   04 02  I                                           1   5 CUSTNO
   04 03  I                                          20  22 AREA
   04 04  I                                          30  55 NAME
   04 05  I                                          56  85 STREET
   04 06  I                                          86 100 CTYST
   04 07  I                                           1 100 RCD
   03 01  C            AREA     LOKUPTABAR                          10
   05 01  OSELCPT   D        10
   05 02  O                          RCD       100
   05 04  OSELPRT   D        10
   05 05  O                          CUSTNO      5
   05 06  O                          AREA       10
   05 07  O                          NAME       45
   05 08  O                          STREET     74
   05 09  O                          CTYST      99
```

Since the needed coded data will occupy only one quarter to one tenth the room of the original input, large savings are made. In fact, only two and a half passes actually take place. This brings us to a point where processing speed is determined mainly by the speed of the input and output units. For instance, a 1200-card RPG program using card in, printer out and producing an object program on tape will take a little more than a minute to read the cards, two and a half minutes to print out (with object code and diagnostics two and a half times as much is printed as is read in), and less than half a minute for immediate processing. Total time is a little under four minutes.

Certainly, from its initial implementation a few years ago, the use of RPG's has grown. For many applications where COBOL and assembly language were used formerly, an RPG has proved a faster and less expensive means of communication. In the future, I feel that the RPG language will find even greater application and a wider base of acceptance.

text with sample

This sample program coded in both RPG and COBOL points up a couple of the advantages gained from the RPG. The RPG program took about a half hour to write while the COBOL program took about two hours. Significant savings in this program are in the file descriptions (this is always similar data appropriate to a fixed format), field descriptions (no fillers are needed), the table handling (the table is automatically read and the LOOKUP instruction handles the lookup, with indicator 10 turned on if an equal is found), and the output creation (no write is necessary and no moves are necessary).

This sample program processes a master file in customer number sequence. The problem is to select the tape records of customers in certain areas. The areas are determined by a table of 100 areas contained on input cards. Selected records are to be written on tape and certain fields printed. ■

RPG: THE COMING OF AGE

who laughs last?

by LOU M. FRIEDBERG

In February, 1962, Tabulating and Business Services, Inc., entered the computer age. Our passport was an 8K, four-tape 1401. We entered with all the confidence and naïveté of Alice in Wonderland. In our first five years of corporate existence we had honed our EAM skills to a fine edge. The most difficult specifications for a 407 control panel rarely took more than a day to wire, and another day to de-bug. We felt certain that our technicians could readily master the mysteries of programming.

Three months before the machine's arrival we grimly faced the facts. A tough two-day 407 board would take a week or longer to debug on the 1401. Our few "hot-shot" wiring technicians, while able to keep up with former demands, would not be able to cope with a computer-hungry market that was pressing us for more and more programs. And finally, even the simplest problems required a wealth of routines that had been taken for granted on the tabulator.

First card cycles, total levels, run-out indications, etc. were all concepts that were easily supplied by exit hubs on a board. Now we had to analyze, program test and constantly be aware of all the logical ramifications of these functions. Before, there were easy boards and hard ones, and only the latter had to be wired by the "ace." Almost everyone in the tab department knew basic wiring, and even account executives would "turn-to" and wire the easy boards, if they were in a hurry. Now, however, all report requirements could be satisfied only by a "Programmer" (with a capital "P") and they were in extremely short supply. We needed help . . . and fast.

help

We turned for this help to two outside sources. First we began recruiting "experienced" programmers. Unfortunately, "experience" means different things to different people, and our early choices were frequently dictated by the scarcity of applicants. We rationalized these 90-day programming wonders with the consoling thought that "in the land of the blind, the one-eyed man is king."

For our second source of help, we turned to the manufacturer, seeking solace in some language panacea that would reduce our programming effort and catch our mistakes for us. We went through his store of goodies like hungry children, but after tasting each, we moved on to frustration and disappointment. COBOL was not ready yet, and *if* ready, looked too slow and inefficient. IOCS used core extravagantly, had poor diagnostics and more than doubled our assembly time. Besides, it didn't do enough for us to make programming available to non-programmers. We got our hopes raised briefly by the "load-and-go" virtues of FARGO, but though we found places where it was helpful, it was far too limited for general use.

In January, 1962, we stumbled on IBM's Report Program Generator. Available information was scanty; the only manual was a preliminary edition. (It wasn't until years later we learned there were many variations of this software, including an unsupported version, secured by clandestine means. It would create the object deck without the need for an intermediate symbolic deck.)

Timorously, we decided to try the manufacturer's supported program for use with both card and tape. To truly test its capability we used our weakest programmer . . . me. If I could make it work, anyone could. Slowly, painfully, I read the manuals and struggled to understand and fill out the coding sheets. I, who had trouble with a single form Autocoder sheet, had to figure out four different sheets. It took time, but if it worked it would be worth it. And did it work? Hell, no! When we made the first assembly, the program "bombed out" before it ever reached my control cards.

"What's wrong? What did I do wrong?" I asked Hugh McDevitt, then our senior programmer.

"Nothing . . . yet," he answered. "The program's bad."

"But how could that be?" I queried. "It was written by IBM and they *must* have debugged it?" He laughed and laughed. So did others when I told them my trouble. Thus ended my first attempt at RPG.

we try harder

Almost a year passed. Our programming skills grew as we reconciled ourselves to writing "straight" programs, but our problems increased faster than our skills. There were just too many programs, and not enough people to handle them. We were dangerously back-logged and turning away work at an alarming rate. I had a year to recuperate from my first bout with RPG and was desperate enough to try anything to alleviate the jam-up.

Once more I turned to RPG. In December, 1962, the manufacturer supplied us with a later version, and, after considerable nagging on our part, we also got the source program listing for the deck we would use. Applying the coding sheets to the easiest report I could find, I again approached the assembly with grave doubts. This time we were able to complete the assembly, and after several more attempts I had a completed object

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deck that really worked. There were problems yet, but it proved potentially valuable.

We agreed it would be worthwhile perfecting the generator. Hugh McDevitt, armed with the source program listing, studied the RPG for several weeks, then began making minor modifications. Input and output tapes were rewound during the housekeeping. This protected us from forgetful operators and assured us that all reels were at load point before the job began. The overflow switch was turned off after the detail calculation, thus allowing for testing on the first detail record of each page. This would permit us to control first line indications on each page—a function normal to a 407 tab, but not written into the early RPG versions.

After several similar changes were made, the most significant move was to load the generator on to tape, and place the Autocoder assembler right behind it. Thus, when the RPG punched out its intermediate deck (which happened to be in Symbolic Programming System), it only required hitting the tape load button to complete the assembly. By the time we had advanced to a 16K four-tape 1460, average assembly time was down to 12 minutes.

the first test

The first *real* test came immediately, with a three-program system for a large chemicals manufacturer. The programming department estimated it would require three weeks of billable effort, or approximately $1,500, to complete the package. Because of computer scheduling, etc., this represented six weeks of elapsed time. Furthermore, no programmer was available for at least two weeks. We decided to gamble on RPG.

The first program contained a master-detail file, with calculations to be performed on the details from factors *selectively* pulled from the masters. Extensions, plus other amount fields, were accumulated and distributed in various relationships based on warehouse codes, types of master and other variables. Product total summaries were punched for use in the remaining programs, which were similarly constructed. To show off a little, I wrote them with a title page, and dressed up my total levels with fancy dots and wording. I found it difficult to conceal my smug satisfaction with the finished results. I had created three "programs" . . . and they worked . . . in three elapsed weeks . . . at approximately one-third the estimated cost.

I was sold. And like all fanatics, I began proselyting. More to escape my nagging than from conviction, the account execs began writing RPGS and with each successful program, I had a new convert. Within three months we had 12 non-programmers writing RPG's and the number kept growing.

For the first time the supervisors felt free of the tyranny of the programming department. It was delicious . . . and sometimes delirious. There was much abuse and mis-use before we learned the physical and economic limitations of RPG. For example:

1. Only single file inputs, either card or tape, were possible.
2. Although various output card types could be punched, only one tape file could be created, and this had to be in *single record blocks.*
3. RPG had no table look-up capabilities.
4. The calculation and logical looping were limited.

trim and true

It should be no surprise, therefore, to find beleaguered non-programmers bulling their way through programs which, while operable, would have been cheaper and more efficient in Autocoder. Some of these deficiencies were overcome by the creation of our own proprietary software. The outstanding example of this was TRIM (Tape Record Information Manipulator). The name was coined before the program, hence it doesn't reveal the fact that TRIM handles both card and tape as input and/or output. TRIM not only gave us physical formatting flexibility (changing record lengths, blocking factors, etc.), but it added mass switch-testing and table look-up capabilities. This permitted rapid and inexpensive file creations and file building by simultaneously providing extensive record and field selection, and insertion of fixed master data via a binary search table look-up. Its partner, TRUE (Tape Records Updated Easily), allowed us multi-file input for updating either arithmetically or by field substitution. Both were developed during the first half of 1963 at an estimated cost of $15,000. Improvements and maintenance during the remainder of the year added another $5,000 to the cost.

By 1964, the trio of RPG, TRIM and TRUE were accounting for more than half of our computer production time. This, in spite of a rapidly expanding programming department that refused to even consider such a "tinker-toy" language. But ironically, RPG was a primary reason for the strengthening of the programmers. By relieving them of all the mundane and unsophisticated applications, it freed them to concentrate on the more difficult and esoteric assignments. This, in turn, appealed to them, reducing our turnover, and assisting in our accelerated recruiting efforts.

improvements

In the next four years, TBS wrote well over 800 programs using RPG alone. Our techniques improved, permitting us frequent uses that didn't seem possible in our early experiences. Occasionally we would circumvent the single tape file input requirement. By using TRIM to stretch a master or detail record to coincide with one another, we could then sort the two files together and treat both as a single file. Emboldened by their many successes, non-programmers took to doing simple patches and in other ways increased RPG's flexibility.

The major reasons for the rapid acceptability of RPG were:

1. It was easy to learn. Guided by someone with a little experience, the manual could be almost ignored, and the novice needed only about eight hours of instruction. Three or four programs later, he was an "expert."
2. It was easy to write. With only a little experience, the average program could be entirely coded in less than one day.
3. It was easy to debug. Not only were the diagnostics clear and easily understood, but with a little practice, a crude printout of the required report was achieved on the first assembly in 75% of the programs. This meant the programs would run to end of job, thus reducing debugging time to no more than three or four assemblies. (Frequently one assembly and a little easy patching was enough.)
4. It required little technical or logical skill. This freed the administrative supervisor from dependency on the programmer and quickly made him feel at home on the computer.

As we used RPG more and more, I was surprised to find a universal apathy, outside our company, to its merits. Opinions were generally divided into two categories. Programmers felt that no one worthy of the title would use such a "simple" tool. And managers expressed the view that it couldn't handle enough to justify the investment of time and energy to learn it. I never fully understood why others didn't recognize it as the aid it was. I could only conclude that the programmer's attitude was dictated by ego, while the managers were overly influenced by the programmers. Even IBM didn't seem to be actively pushing it . . . until the 360.

on a new machine

With the imminent arrival of our 360/40, we looked to RPG with great interest. We were intrigued by the new capabilities it held. No longer would we be restricted to single file input or single block output. Better yet, we would no longer have to pre-process our files with TRIM. Although they would be much slower than TRIM's binary search technique, the 360 RPG had built-in table look-up features. Inter-file matching would also eliminate our dependence on TRUE. It seemed to promise much, for both programmers and non-programmers.

We tackled our first 360 RPG's enthusiastically, therefore, as a joint venture between our technical and administrative personnel. We started in January, 1966, with the 8K BOS version of RPG on the 360/40, and soon were finding the flaws in the software. It became evident, quickly, that this wasn't the same easy-to-use language its predecessor had been. Four coding sheets had grown to six. One day's writing was now at least two. And, worst of all, although the diagnostics seemed explicit, we couldn't be certain, without the aid of the programmers, which errors were caused by coding and which by software. We learned to circumvent certain error-creating entries, without being sure of the reason. Unmatched file indication was erratic, for example. And the performance of the page overflow routines was so spotty we felt safer relying on line-counting techniques. Still, since more people were engaged in coding RPG than ever before, we made good progress. Rapid (four minute) assemblies, easy linkage from assembly to test data, and general flexibility encouraged our continued use. By mid-1966, and the impending arrival of a 360/30, we felt fairly satisfied with our accomplishments . . . until our conversion to 16K DOS rocked the boat. Suddenly 25% of the 200 programs we had written started "bombing out." A major cause was that the 8K BOS permitted us to define or refer to labels in *any* sequence, while the 16K DOS required that all labels had to be defined first. Other incompatibilities between 8K BOS and 16K DOS showed up with startling frequency and, in many cases, inexplicably.

Once again we had to learn how to avoid error-creating entries without adequately understanding the software deficiencies. IBM was only nominally helpful, and spent as much time learning from us as vice-versa. Gradually, however, we worked our way around the problems.

programmers converted

It is interesting to note that during this year, with the programmers actively coding appropriate applications in both COBOL and BAL, their respect for RPG grew in proportion to their experience. I believe this is because:

1. RPG is now more powerful than its 1401 predecessor.
2. RPG's switch setting and testing logic is closely akin to those techniques used in Autocoder and BAL.
3. BAL is considerably more complex and time-consuming than Autocoder.

And, perhaps,

4. Programmers are maturing enough to recognize that job efficiency is a more important yardstick than ego satisfaction.

At any rate, we made our next foray into RPG in anticipation of our 360/20, which was to arrive in early 1967. Selecting those applications that seemed well within the 16K capacity of our two-tape system, we wrote, assembled and de-bugged on the 360/30. We felt that the well-advertised "compatibility" of the two systems would permit us to get the 360/20 on the air quickly, by re-assembling our proven programs on it, when it arrived. Live and learn!

new problems

Once again we found that the manufacturer had created a separate card and tape generator. The card version wasn't too bad, once you made certain allowances such as its greater restrictions in the edit word handling. But the tape version!

Tape RPG for the 360/20 insisted that the input file must begin with a tape mark. This immediately limited our file compatibility with the other two systems we have.

Further, when the mode switch was in the time-sharing position, tape reading caused erratic carriage control and forms skipping. Turning the switch off permitted the tape to read properly, but it also eliminated the overlapping of the I/O units with the main frame. This effectively reduced program efficiency to the level of an unbuffered computer.

At first inspection, it appeared that both these difficulties were caused by software deficiencies. This assumption proved valid for the tape mark problem which was rectified in April, 1967, by an updated RPG version.

The "time-sharing" problem, however, turned out to be a hardware aberration, and was corrected quickly once it was identified.

And yet, after all the gibes at manufacturer's frailties are underscored, the major reason RPG is emerging as a viable language is because IBM is not only supporting, but actively encouraging its use. With extensive experience gained from the 1401/60, with outspoken feedback from users like ourselves, and with the recognition of the demanding meticulousness of the BAL language, a powerful user-oriented tool had to be created.

conclusion

In summary, RPG meets the important requirements of such a tool.

1. It is flexible enough to permit multiple input and output files of virtually any practical physical format.
2. It permits economical file handling capability such as matching, updating, selection, etc.
3. Its calculation sections permit extensive switch-setting, testing, and "branch to" logic manipulations approximating Autocoder and BAL capabilities.
4. It is efficient in assembly time, and practical execution, (particularly for slower I/O applications), without extravagant use of core.
5. It works well in a "stacked job" environment, because of its ready linkage and cataloging.
6. It is actively supported and constantly updated by the manufacturer adding to its general capabilities.
7. It is easier to teach, learn, write and de-bug than any other major language in current use by IBM.

Is it, then, the panacea some new converts claim it is? Hardly. Still, we expect that fully 75% of our future programs will be turned out in RPG, while only 15% will call for COBOL, and the remaining 10% be divided between BAL and some FORTRAN. Purists may point to minor systems or machine time inefficiencies as a result, but it should be remembered that cost should be measured overall. This means that incremental job set-up costs due to efforts to satisfy these purists should be cost-justified within two years. In a service bureau environment this is not as frequent as they might suppose, especially when set-up costs are measured in days, weeks, and months of man-machine time, while operating gains are measured in hours, minutes and sometimes microseconds.

Clearly, RPG has grown up and is here to stay. ■

WHITHER KEYPUNCH?

out the door?

by DENNIS G. PRICE

The keypunch machine has traditionally prepared source input for data processing systems. As computer systems have come increasingly upon the data processing scene, the keypunch has begun to appear as a bottleneck to efficiency. The computer system itself has become ever cheaper per unit of throughput, whereas the cost per unit of throughput for data preparation by keypunch machines has actually increased as operators' salaries have risen.

The activity of keying data for computer input not only carries a relatively high cost but also produces more errors than any other processing function. Systems analysts attack the problem with various kinds of turnaround documents, and the equipment manufacturers are developing a wide variety of document readers. Still another approach is possible with on-line systems. When a computer can monitor the data-input function, even with manual keying, the quantity of data requiring original entry and/or verification may be greatly reduced.

We in the government of the state of New York have specific plans for the future use of on-line data collection equipment. There seems little doubt, however, that the manual keying of data into off-line equipment for later computer input will continue to be an important part of data processing for several years. While looking ahead, we also surveyed alternatives to the keypunch that are currently available. In 1966, we installed approximately 200 Data-Recorders manufactured by Mohawk Data Sciences. The immediate gains have been worthwhile.

The basic unit consists of a keyboard similar to a keypunch. The operator, working in "entry mode," keys in data which is temporarily stored in a magnetic core unit and then transmitted as a complete record to magnetic tape. Another operator on an identical machine, working in "verify mode," keys in the information which is verified against the record which has been read back from tape into core storage. The unit includes its own error checking capabilities, such as a complete read-after-write check. In addition, parity checks are performed on each character and longitudinally on each block.

The data reader is inherently faster than a keypunch since there are no mechanical actions to be completed between key strokes, except for the writing of a block of data on tape. For practical purposes, the unit will

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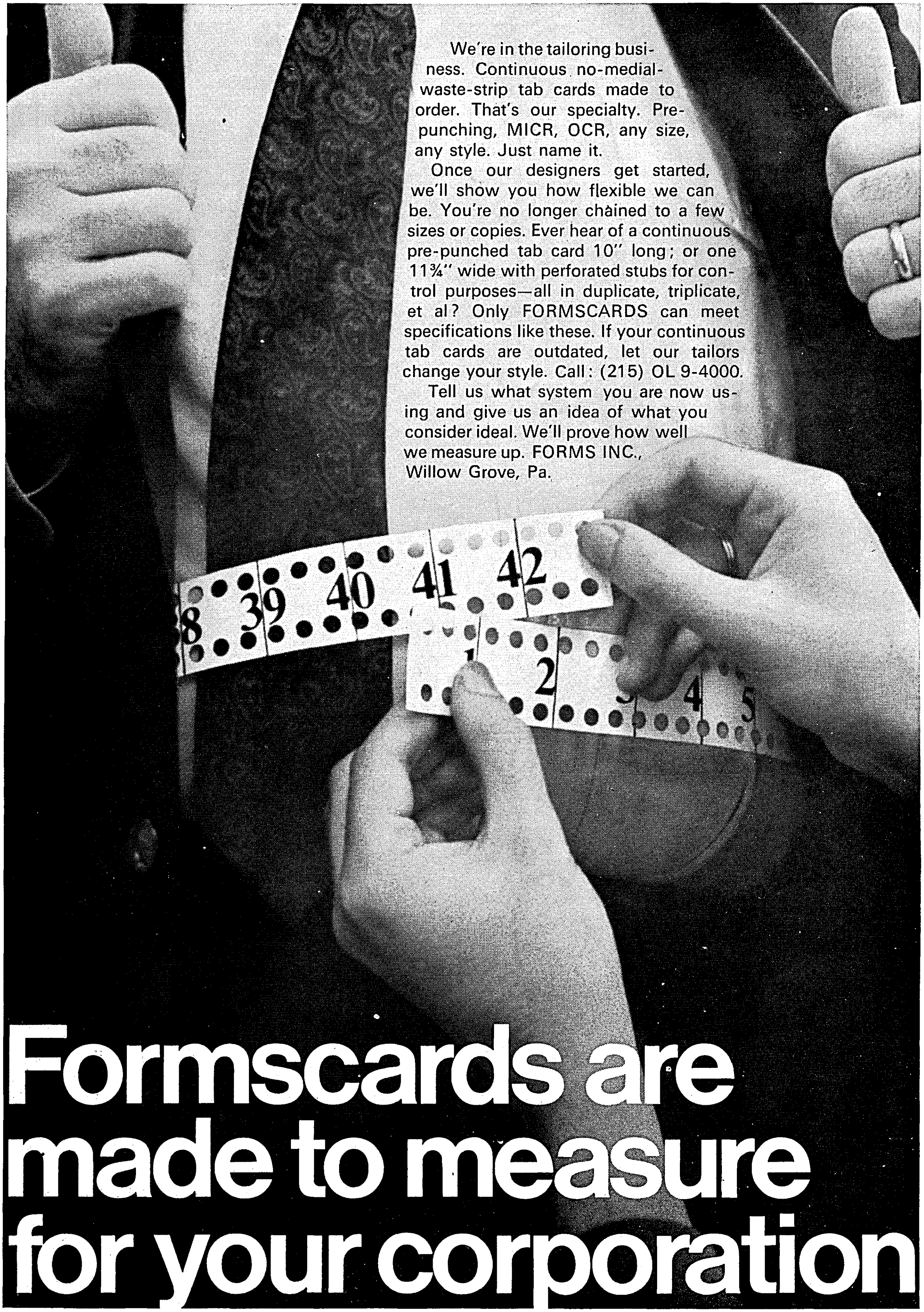


CIRCLE 22 ON READER CARD

operate as quickly as the operator can depress the keys.

A number of extra-cost devices can be attached to the basic machine, including an adding machine to balance the controls and a paper-tape reader. A pooling device can be attached to any unit so that it can transcribe data from one magnetic tape to another. In this way the data from several tapes can be merged on one tape for more convenient entry into a computer system.

economics

Without special devices, the MDS Data-Recorder costs about three times more than a keypunch. The break-even point for production work depends on the cost of equipment plus personnel. We calculate that a keypunch girl, including the cost of fringe benefits, costs about $425 per month. A keypunch or verifier averages about $50 a month, so that the operator plus equipment costs approximately $475 a month. Similarly, a girl plus MDS machine costs $425 plus $150 (assume one recorder/pooler at $176 for every eight recorders at $142) or $575 per month. Therefore, to break even it is necessary for the MDS operation to increase throughput by a factor of 575/475, or 21%. This will vary, of course, with the cost of keypunch operators.

Does the Data-Recorder make up the 21% in performance? We have found that the unit does, in fact, reduce total costs of data preparation through increased efficiency (1) in keying and verifying data, (2) in the steps between data capture and computer input, and (3) in the back-up equipment required.

There is no doubt that the keying action is faster on the Data-Recorder than on a keypunch. The advantage, as one would expect, is greater where input involves considerable duplication, skipping, and zero fills, and where the operator can concentrate on only one type of input.

The unit allows for considerable flexibility of format. Where applications use several cards per record, it is necessary to duplicate the identification information. This is not necessary with the MDS unit, since the records will follow one another on the tape and cannot get out of sequence. Also, the length of the record can be increased. The standard unit produces an 80-character block, but options are available for a 160-character record.

During original entry and during verification, error correction is simple. Most errors are sensed by the operator immediately after she has made them. With conventional keypunch equipment an error necessitates skipping out the card; with the MDS equipment it is possible to backspace and make the correction.

When errors are detected in the verifying process with conventional equipment, the operator indicates the correction to be made and reroutes the card to a correction operator who punches a new card correctly. With MDS equipment, the verifying operator corrects the information in the core and on the tape. This not only eliminates the correction operator, but also the need for making the card and identifying it for correction within the batch.

Due to the characteristics of the equipment related to keying and verifying, the increase in throughput for our six agencies has varied from close to zero (for installations with only three machines) to upwards of 60%. It appears that where the application is favorable for the MDS machine (with much skipping, duplicating, and left zero fills), the increase in throughput should be about 40%. These figures have been obtained by careful measurement of "before and after" operations in each agency.

The cost of punch cards is eliminated and the tapes used by the MDS equipment are re-usable. For a large installation which daily processes tens of thousands of cards, the physical inconvenience of handling and storing cards is considerable. The transportation of a few tapes, rather than many trays of cards, to the computer room is a small but noteworthy consideration.

In many installations, sorters, collators, and operators are on hand only to sequence and balance input cards. In this situation, the equipment and personnel can be eliminated, and the savings can be substantial.

When intermediate EAM operations are eliminated, the elapsed time between data capture and master file update can be materially reduced. The extra computer functions, such as batch balancing, are usually offset because the computer time to read cards is eliminated and the much faster tape-read operation substituted.

Apart from the reduction in the number of machine units resulting from the increase in throughput, there is another reduction which is not so obvious. With keypunch and verifier, it is common practice to have a few machines as back-up for when other machines are down. Since the MDS unit is capable of working in either the entry mode or verify mode (at a flick of a switch), the number of back-up machines can be reduced because the same back-up machine can act as either an entry or verifying device.

impact on the operator

The formal training period for operators is about one week. Depending on the ultimate efficiency achieved, the operator is able to equal her previous keypunch rate within three to four weeks of the end of her formal training. She reaches her former level of relative efficiency on the equipment between six and ten weeks after her formal training.

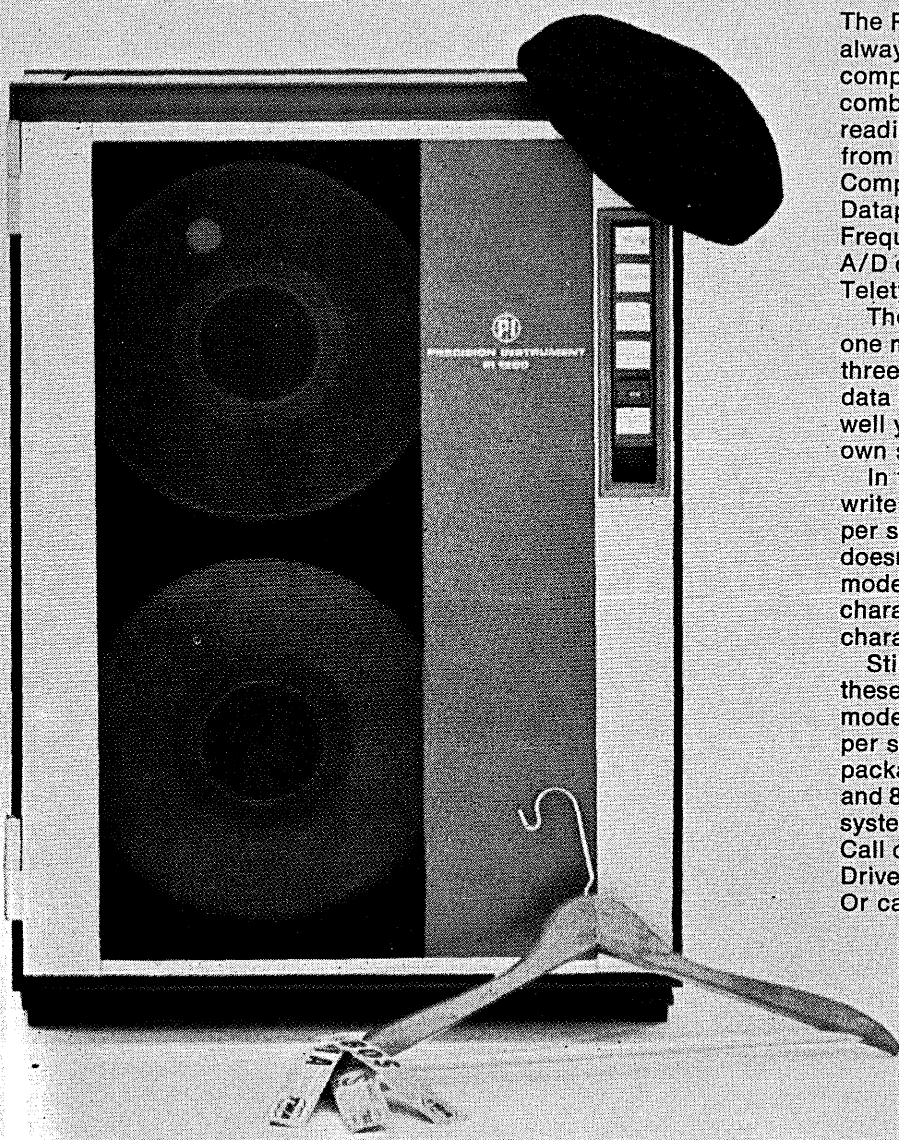
The type of operators who have been trained on the new equipment have usually been former keypunch operators, since the keypunch machines are those being displaced. We have successfully trained typists in one agency and it appears that keypunch operators and typists develop the same efficiency on the MDS equipment. One of our agencies believes that the former keypunch operator may take somewhat longer to adapt to the MDS unit since she must "unlearn" her old skills.

Generally speaking, the operators have a very positive response to the new machines since they are quieter, more attractive, easier to key, and do not generate heat like keypunch equipment. There is also some reason to believe that the new equipment appears to them to be more glamorous—it seems to bring the operations closer to the computer. One of our agencies has found that operator attachment to the new machine is so great that working on it can be used as a reward for good performance, or conversely poor performance will mean "back to the keypunch machine."

In the past year, New York State has witnessed a reduction in its number of keypunch and verifier machines from about 800 units to about 550 units today, despite an increased volume of input resulting from expanding applications. Thus, 200 Data-Recorders have replaced about 250 keypunches and verifiers, and have also handled an increased workload. We also have reduced costs for punched cards, EAM equipment and EAM operators.

I believe that the direct source entry approach (on-line) will eliminate many more keypunch and verifying units over the next three or four years. But for off-line keying of data for translation into machine language, we are well satisfied with the savings generated from the use of the MDS Data-Recorder. ■

One-suit wardrobe for data handling systems... the PI-1200



The PI-1200 is an all-occasion recorder that always fits in . . . whether it's mingling with jet-set computers or plodding typewriters. It has a unique combination of synchronous and asynchronous reading and writing styles that let you record from or read to:

Computers	Line printers
Dataphones	Plotters
Frequency meters	Paper tape punchers
A/D converters	Shaft position encoders
Teletypewriters	and many more

The PI-1200 is reversible too. You can choose one mode, or a combination of modes from the three offered by the 1200, whatever fits your data system best. In fact, the 1200 will fit so well you'll think it's been hand-tailored to your own specifications.

In the high speed mode you can read and write synchronous data at 0 to 20,560 characters per second, stopping on a record gap. If that doesn't suit your taste, try the synchronous slew mode. It reads incremental blocks at 0 to 1100 characters per second and writes them at 0 to 1600 characters per second, stopping on a character.

Still haven't found what you need? Then check these numbers. The PI-1200 has an asynchronous mode that writes and reads 0 to 300 characters per second, bit by bit, for hours or days on end, packaging them into IBM-compatible 200, 556, and 800 BPI formats. Why not outfit your data system with the PI-1200? It's only $6000, complete. Call or write Precision Instrument, 3150 Porter Drive, Palo Alto, California. (415) 321-5615. Or call one of our representatives.

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PRECISION INSTRUMENT

PI

PLANNING CHECKLIST FOR A COMPUTER INSTALLATION

be prepared

by DONALD L. ADAMS

The installation of a computer, even a small-scale system, is a complex undertaking. Normally, the installation will involve at least several minor crises no mattter how well it has been planned. The accompanying checklist for the physical planning aspects is designed to minimize the number of critical situations that arise during installation. Some of the points mentioned may seem trivial or obvious, but it is amazing how often they can be overlooked. More than one computer has been unloaded at its site only to have it discovered—to everyone's surprise—that the computer could not be moved into the building because it was wider than the widest available opening.

The checklist is not all-inclusive; no checklist ever is, but it does cover many of the trouble areas that have been encountered in new computer installations. All the points should be carefully considered and none of them should be taken for granted.*

site location and layout

Weight-bearing characteristics of building. Floor must be adequate to support weight of equipment.

Elevators, corridors and doors. Machines should be located in an area into which they can be moved without disassembly of the building or the machine. Temporary ramps will be needed to cover all steps. If the floor loading of machines in transit will exceed floor strength of halls, temporary covering will be needed.

Location in relation to other departments. If possible, machines should be located near the potential users of the output and/or creators of input. In some instances, location may be influenced by a desire to use the computer as a showpiece during company tours. A window allowing visitors to see the area without entering will reduce interference with operators.

Noise problems. Computer should be located in an area where computer noise will not disturb others and outside noise will not disturb computer operations. Soundproofing will probably be required.

Traffic flow. The layout should minimize the amount of walking the operator must do during machine operations. Components should be located to allow relatively unhampered movement of materials in and out of the machine room.

Clearance around machines. Room must be left on all sides of each component to allow the manufacturer's engineering personnel free access to the machines.

Clearance for movement of carts. Floor space around the reader, the printer and the punch must provide clearance for movement of carts.

Engineering area. The manufacturer's engineering personnel must be provided with a work area within the computer room. Ideally, this area should include a workbench or table, storage space for spare parts, filing cabinets for manuals and for diagnostic program decks, and room for storing an oscilloscope. Working and storage space should also be provided for the handling of tape reels, disc packs, and datacells. Additional space will be needed for cart access. Ask the manufacturer if there are special power requirements for the maintenance area.

site preparation

Electrical current. Wiring must be adequate to provide proper voltage and amperage for each unit. In-

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* Additional points were supplied by Robert L. Patrick from his experience with installations.

dependent circuit breakers should be installed in the computer's electrical system. Follow the manufacturer's instructions and be sure that there will be no interference from other loads with the computer power.

Electrical outlets. Note that some manufacturers require special receptacles. Outlets should be located next to each machine to minimize cable length. Outlets must be grounded and must provide proper connectors to receive the computer's cables. Provide light and convenience outlets separate from the computer power. Be sure to allow sufficient lead time.

Floor. Consideration must be given to installation of a raised floor. Floor surface must be static-free. Have floor structure electrically grounded. Ramps should be provided to allow the movement of carts into and out of the computer area.

Environment control. Proper equipment for temperature and humidity control must be provided. Consider the necessity of providing support equipment if the main system should fail. Install a device for recording temperature and humidity. Check out the air conditioning before installing the computer. Sound-condition walls and ceiling, using rugs or tile on floor. Vacuum site before installation, including under floor and air-conditioning ducts.

Lighting. All parts of the room should be well illuminated. The lights in the console area should not be so bright that they obscure the indicator lights on the panels.

Room color. Color scheme should be coordinated with machine colors.

Communications. Adequate telephone facilities should be provided in the machine room. Ordinary telephone bells often cannot be heard over the noise of a printer or a punch, so extra loud bells or flashing lights may be needed. Night lines should be provided since the machine room may work shifts when the switchboard is closed.

Cable lengths. When layout has been finalized, interconnecting cables must be ordered in the proper lengths. This may not be a consideration in small installations but should be carefully considered in all tape or disc systems. Ask the manufacturer for assistance but engineer the job yourself.

emergency facilities

Fire detection devices. Prompt fire detection lessens the chances of damage to files and equipment. Check with both the computer manufacturer and your insurer before installing an automatic deluge system.

Fire-fighting equipment. Equipment for fighting both electrical and regular fires should be available—mounted and labeled—and employees should be trained to use it.

Electrical and air-conditioning emergency cutoff. A single-switch cutoff should be available to shut down the electrical and air-conditioning systems in emergencies. The computer power source switch should be separate.

Emergency power supply. The necessity for and extent of emergency power for machines and air-conditioning should be evaluated in regard to the need for continuous operation and possible damage to equipment in case of a sudden power loss.

Emergency lighting. Battery-powered emergency lighting should be available to allow proper clean-up and shutdown during a power failure.

External catastrophe. Consider the consequences of fire or flood affecting the computer or tape library.

selection of support equipment

Keypunch. Every installation should include a keypunch as part of the computer room equipment needed by programmers during program testing, and by operators for punching date and header cards. The machine should be ordered at least nine months in advance. If the computer is not an IBM model, the punch formats for special characters and symbols may differ from those available on standard keypunch models. In such cases, it may be necessary to request modifications in the keypunch. Such modifications usually involve a one-time cost of $350 to $500 per keypunch and require considerable advance planning.

Sorter. A sorter may be needed as part of the computer room equipment in a card installation. It permits rapid blocking of files to reduce time on large computer runs. Machines should be ordered at least nine months in advance. Plan for power and air-conditioning requirements.

Collator. In a tape installation, a collator may be placed in the computer room for use in running sequence checks on card files before they are converted to tape. Machines should be ordered at least nine months in advance. Plan for power and air-conditioning requirements.

Forms handling equipment. Final bursting and decollating requirements are difficult to determine, so it is advisable to purchase relatively simple and inexpensive equipment in the initial installation stage.

Card-to-tape converter (magnetic tape). If the installation will involve large amounts of card-to-tape conversion, consideration should be given to the use of a high-speed, off-line converter in order to free the main computer for processing the data.

Magnetic tape conditioning and cleaning equipment. In a large tape installation, the costs of tape cleaning and conditioning may justify the use of equipment within the installation, rather than outside service facilities.

furniture and fixture requirements

Tables. Adequate work space is needed for storing input and output during computer runs.

Desks and chairs. Programmers and supervisors need adequate working space.

Stools. Machine operators may need high stools in order to observe console or printer units.

Sorting racks. If a sorter is part of the computer room equipment, fixed or movable sorting racks may be required to hold cards duirng the processing of a sort operation.

Carts. Should be provided for moving trays of cards, cases of forms, reels of tape, datacells, and disc packs.

Card equipment. Items and uses are as follows: (a) *storage racks*—for small supplies of cards near punching devices; (b) *files*—storage for old files pending destruction; (d) *storage shelves*—storage for unopened cases and boxes of cards; (e) *carrying cases*—for transporting cards between locations; useful during pre-installation testing at outside locations; (f) *mailing cartons*—suitable for punched cards.

Tape equipment. The following are the items in this category: (a) *storage racks*—used to hold cases and reels currently in process; (b) *storage vault*—storage for current and back-up files; should be fire-proof; (c) *storage shelves*—storage for unused tapes (d) *carrying cases*—for transporting tape reels between locations; useful during pre-installation testing at outside locations; (e) *mailing cartons*—suitable for reels.

Disc equipment. The included items are: (a) *cover holders*—to hold covers when modules are mounted on drives; (b) *storage vault*—used as storage for all discs; should be fireproof; (c) *carrying cases*—for transporting disc packs between locations.

Printer and forms equipment. This category includes: (a) *storage racks*—used to hold forms supply; (b) *carriage tape racks*—to hold printer carriage control tapes; (c) *wastebaskets*—large baskets which can hold scrap continuous forms; (d) *forms racks*—to hold continuous form input to and output from printer operations.

Time and date stamps. These are used for logging jobs on and off machines.

supplies and miscellaneous

Cards. Various colors of 5081 or other standard cards should be ordered.

Forms. Short and long stock (ruled or blank) forms in one, two, three, and four parts should be on hand before the installation is complete.

Magnetic tapes. Full, half, and miniature reels in various colors should be ordered several weeks in advance. Decide in advance what color coding conventions will be.

Disc packs. Provide several extra disc modules to meet estimated requirements. These modules should be ordered at the time the computer is ordered. Initial requirements are usually underestimated.

Card indexes. To identify files within card drawers.

Card protectors. To protect card files, particularly program decks, from damage during handling and filing.

Card gauges. Gauges are used to check registration of punching devices.

Card weights. When boxes and drawers are not completely filled, these weights can be used to keep card files from falling down.

Printer ribbons. Ribbons are usually replaced based upon printing volume. A good supply should be on hand when the computer arrives.

Carriage tapes. To control form movement and skipping on the printer.

Carriage tape punch. To punch carriage tapes.

Carriage tape glue. To fasten carriage tapes into a loop.

Binders. Special binders in various colors and sizes, to hold burst and unburst tab runs.

Tape labels. Pre-gummed labels to identify tape reels and cases. Color-coding can be used to depict security levels.

Felt marking pens. Prepare labels for files that can be read across the room.

Floor panel vacuum lifter. To raise panels from floating floors when access is required.

System control forms. Machine logs, down-time reports, program halt status, and other management forms are required.

Vacuum cleaner. A small industrial cleaner with a small nozzle or crevice tool should be adequate.

Facilities management. Check with facilities manager to see who else is drawing power from the same transformer. See that they have independent switches so their equipment can be serviced without disturbing the computer. Negotiate an agreement to allow off-hour air conditioning maintenance, long notice before all scheduled shutdowns, and immediate service for all emergency calls.

Future requirements. Project requirements for hardware configuration deletions and additions. Provide enough space, power, and air-conditioning for expansion as well as ample room to get new equipment in without disrupting operations. ■

SIMULATION AND SALES FORECASTING

by GEORGE SCHUSSEL

Whereas the usefulness of simulation to help solve scientific and engineering problems has been readily accepted for some time, it has only been within the last several years that researchers and practitioners of simulation have developed this technique to the point where it is now readily accepted as a useful tool in the analysis of business decision problems. One of the primary reasons that detailed simulation of the business environment has become practical is because our ability to manipulate and process large amounts of data rapidly has grown fantastically with each new generation of computers.

The field of simulation has grown up to the point where we now see universities teaching courses in it. This substantial growth and interest has resulted in an increase in relevant theory and literature. Within the last five years or so, a new subfield of simulation, called behavioral theory has been developed and expounded by researchers at various universities, notably Carnegie Tech.

Two of the earliest books describing the behavioral theory approach were *A Behavioral Theory of the Firm*[1] and *Portfolio Selection: A Simulation of Trust Investment*.[2] Since these books, other studies have appeared; a recent example is *Forecasting in the Photographic Industry: Testing a Simulation Model*.[3] These studies primarily generated interest among researchers; however, the subject of behavioral theory and human behavior simulation seems to be working its way into the real world as may be attested by some recent articles such as "Heuristic Programs for Decision Making" in the *Harvard Business Review*[4] and an economic commentary in *Business Week*.[5]

A basic premise of behavioral theory is that it is possible and desirable to simulate human decision behavior. Proponents have argued that by simulating human decision behavior it is possible to fuse the worlds of psychology and economics into a new model of economic behavior.

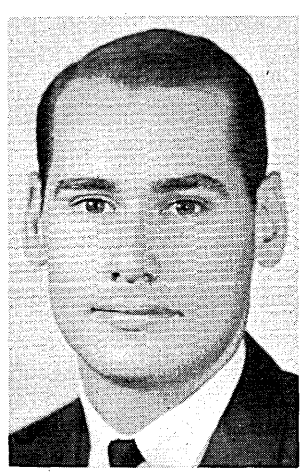
economics and behaviorism

To a large extent, it may be said that conventional economic theory is normative, describing simply logical behavior in a simply logical world. Decision rules which can be derived from this economic theory are those that should be followed by a "rational" being. This view of the world assumes that a person or people in general can prescribe explicit objective functions and proceed on a course to maximize these. In fact, most people, including business executives, are probably not capable of explicitly delineating any objective function; and if they were, they would not have the ability or desire to maximize it. Instead of maximizing an objective function, it can probably be said that most human beings satisfy subjective functions. If this is so, say the behaviorists, then we had better reexamine some of our normative economic models and substitute in their place descriptive models which may then more validly predict economic behavior—at least until everyone is required to obtain a graduate education in operations research.

Pure mathematics, unfortunately, does not generally possess the requisite power to provide a behavioral description or model of human behavior. It may be, however, that the technique of simulation does provide this power. As support for this assertion, this article describes a successful attempt at writing a computer program which was able to simulate some of the decision behavior of retail camera store managers.

the program

This program was written to test the feasibility of simulating the decision behavior of a large, nonhomogeneous sample of people and to test the usefulness to a firm of simulating the external environment in which the firm operated. It was felt that the only valid way to test these points was to construct the simulation in such a manner that it could be used for forecasting. The heart of the simulation consisted of a model that was constructed of the film reordering techniques of 33 photographic dealers. The simulation was constructed to aid a manufacturer in determining the orders for film that would be placed at his warehouse by these dealers. Due to historical experience, the manufacturer had thoroughly good ideas as to what the retail sales of his various film types were; however, he had difficulty in forecasting his own sales because of uncertainty about the way that the dealers reordered film. Because the film product of the manufacturer was



Dr. Schussel is executive assistant to the corporate director of management information and dp at Northrop Corp., Beverly Hills, Calif. Now developing mathematical and economic models for solving production decision problems, he holds MS and DBA degrees from Harvard.

[1] Richard M. Cyert, and James G. March, *A Behavioral Theory of the Firm*. Prentice Hall, Englewood Cliffs, N. J. 1963.
[2] G. P. E. Clarkson, *Portfolio Selection: A Simulation of Trust Investment*. Prentice Hall, Englewood Cliffs, N. J. 1962.
[3] George Schussel, *Forecasting in the Photographic Industry: Testing a Simulation Model*. Unpublished D.B.A. thesis, Baker Library, Harvard Business School, Boston, Mass. 1966.
[4] Jerome D. Wiest, "Heuristic Programs for Decision Making," *Harvard Business Review*. Sept.-Oct., 1966, p. 129.
[5] "The Shake-up of Conventional Economics," *Business Week*. June 25, 1966, p. 186.

very perishable, forecasted sales became an extremely important input to the production scheduling decision.

Even though the manufacturer felt that he could forecast retail sales fairly accurately, his past attempts at converting forecasts of retail sales into forecasts of company sales had proved very inaccurate. From this problem came the idea of interviewing dealers and constructing a simulation model of their behavior which would take a forecast of retail sales as input and then convert this forecast into a forecast of orders placed at the warehouse.[6]

The basic information for the simulation of dealer behavior was derived from detailed field interviewing of the 33 sample dealers in the study. Retail sales forecasts were obtained from company executives and other sources.

In order to test the efficacy of the simulation model, and establish a bound on the accuracy of the model, it was necessary to devise a testing procedure for the model. This test consisted of determining actual retail sales in the five types of film made by the manufacturer for the group of stores over a 15-week period and using these actual sales as input for the simulation model. After the 15 weeks had passed, the output of orders from these dealers was available and, with true sales as input, the basic accuracy of the simulation model was testable. Weekly inventory counting at each store in the study, plus the record of shipments made from the manufacturer, was sufficient to determine the actual weekly retail sales over the period of the study.

Several sales forecasts were generated by different methods. These methods ranged from the simple technique of asking three executives of the manufacturing firm to submit their intuitive forecasts, to the statistical technique of linearly extrapolating seasonally adjusted historical sales data. These sales forecasts were then used in conjunction with the simulation to forecast orders for the 15-week period. Also, in addition to the sales forecasts, several order forecasts were obtained by more conventional statistical and informal means. These order forecasts were used to test the usefulness of the simulation model as a forecast aid. From the results of the study, it was concluded that the order decision processes of certain classes of retail merchants can be simulated. The simulation model performed well when actual retail sales were used as input. It was also concluded that using the simulation in conjunction with forecasted retail sales was the most accurate of the various examined methods of forecasting orders to the manufacturer.

The 33 dealers in this study were placed into two separate samples so that the orders placed by the large dealers would not swamp the ordering of the small dealers. The nine dealers in the large volume sample averaged slightly over 10,000 rolls of the manufacturer's film sold in 1964, the largest dealer selling 20,000 and the smallest dealer selling 5,000. The 24 dealers in the small volume sample averaged 1,500 units in sales in 1964. The smallest sold 340 rolls while the largest sold slightly under 4,000.

The retailers were interviewed in depth about their ordering procedures and, with the exception of the store size in terms of sales volume, the most important distinguishing characteristics of the dealers are listed below.

1. *Having a periodic review, and how often they had it.* Three dealers counted their stock twice a month, four counted it once a month and 21 of the 33 sample dealers didn't use a periodic review.
2. *Ordering constant amounts of film versus having a desired inventory level; and the values of these amounts.* Twelve dealers conceived of the ordering process as one of bringing stock up to a certain desired level; while the other 21 dealers thought of it more in terms of ordering fixed amounts. The actual values varied from as little as 10 units to as much as 400.
3. *Average delay from the time the decision to place an order is made to the delivery of this order.* For 21 of the dealers this was one week and for the other 12 it was two weeks. This delay included the relevant store delays for processing outgoing orders and the incoming shipments.
4. *Types of film carried.* Twenty-five of the dealers carried all five types of film made by the manufacturer. Five did not carry Type 3, two did not carry Type 1, and one dealer did not carry either Type 1 or Type 3.
5. *Regular and emergency order trigger levels on film.* These figures varied substantially with the size and type of dealer, ranging from zero to 200 units as the trigger level.
6. *Batching orders, i.e., whether a dealer reviews and possibly adds to his order other items which are not below their trigger levels, yet are made by this manufacturer.* The idea of batching orders arises because it is very simple to add other items to an order once it is already being placed with a manufacturer. The order is considered a batched one only if it contains some items which would not have been ordered had not an order been placed with the manufacturer at this time. By this definition, 4 dealers batched their orders while 19 did not.
7. *Dealers who tried to order so as to take advantage of the manufacturers' billing dates, thereby picking an extra two weeks to a month of financing on their film inventories.*[7] Eight dealers tried to take advantage of the billing dates, while 25 paid no attention to them.
8. *Percentage of total sales made to industrial accounts.* This percentage varied widely among the different film types in dealers; some dealers had no industrial sales of any types, while others sold 80% of their Type 1 film to industrial users.

Of course there were many other distinguishing characteristics among stores in the study (store type, sales volume, number of employees, etc.). These factors are related to the ones mentioned above. For example, a store with a large sales volume will tend to have high trigger levels and reorder amounts. However, all of these other distinguishing characteristics did not present any meaningful difference with respect to ordering patterns that could not be handled by quantitative descriptions of the above points. In fact, very few consistent clues to ordering behavior were discovered by examination of these more visible characteristics.

The information that was derived from the interviews was used to first conceptualize and then construct the model representation of the manner in which retailers order film. This model explicitly covered all of the above mentioned differences in the dealers and constructed a logical framework for these differences.

The simulation model was programmed in FORTRAN and run on the IBM 7094 at the Harvard Computing Center. The total programming to accomplish the simulation was split into two jobs. The first program (the demand program) took the basic input data, which primarily consisted

[6] To eliminate confusion in the remainder of this article, "retail demand" will mean the amount of film sales requested by customers of the dealers; "sales" will refer to the actual sales made by the dealers. The quantity "sales" is always less than or equal to "retail demand" because of film stock-out conditions. The word "orders" refers to sales of film by the manufacturer to the dealer.

[7] The manufacturer's payment policy was that payment for any order placed between the 25th of one month and the 10th of the consecutive month is not due until the 10th of following month. For example, payment for an order placed on May 28 is not due until July 10. Any order placed between the 11th and 24th of the month has payment due the 10th of the following month.

of the statistics describing gross retail demand, and generated specific forecasted consumer demand per dealer. The second program which was the heart of the simulation, took the demand and simulated the dealer decision behavior.

demand generator

In addition to some secondary chores, the primary purpose of the first program (demand generator) was to take the general sales forecasts made by the executives and break these forecasts down into specific demands for each dealer, for all five film types and for each week. The basic inputs for this program were:

1. An expectation of the way that retail sales would vary over the 15-week period.
2. Factors that assigned what percentages of the entire forecast were to be given to each dealer and each film type. The records of past orders to the manufacturer were the criteria used to determine these percentages.
3. The total forecast distribution of sales for each film type in the period under construction.

The program first generated a figure for the total demand by using a cumulative probability distribution curve for forecasted sales in conjunction with a random number. The actual conversion from random number to sales figure was done by means of a cumulative probability curve. The theory for this is rather simple and is explained on pages 323–325 of R. Schlaifer, *Probability and Statistics for Business Decision.*

The simulation model was constructed so that each dealer could be completely represented by 104 numbers, 29 of which directly pertained to the modeling of the dealer and 75 of which were related to both the modeling of the dealer and the particular period that the simulation was run over. A list of the 29 variables for each dealer is given below.

Basic 29 Numbers for Dealer I

I24ORD(I). One number telling whether the dealer pays attention to the billing cutoff date in ordering.

IDICO(I). One number telling whether the dealer reorders in constant amounts or up to a desired level.

IDELAY(I). One number giving the delay in weeks from an order decision to the time that delivery is received.

IBATCH(I). One number telling if the dealer batches his orders.

TRIGER(I,K). Five numbers giving the basic levels in each film type where the dealer will be indifferent between reordering the film type or not. (50% probability of reordering.)

CONCORD(I,K). Five numbers which are the amounts reordered in each film type by a dealer who views his reordering as being in constant amounts.

DESINV(I,K). Five numbers which are the levels that are ordered up to by dealers who conceive of the ordering process in terms of desired inventory levels.

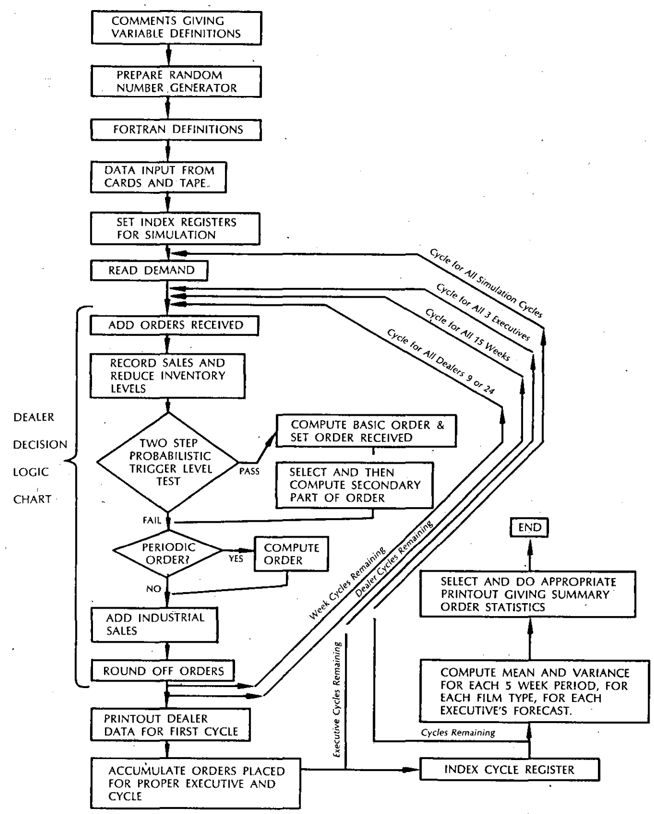
DSINV2(I,K). Five numbers which are the secondary desired levels in each film type. These levels are used in the supplementary part of an order.

The Figs. 1 and 2 are representations of the main program in the dealer simulation.

The Fig. 1 is the general flow chart of the entire program. Fig. 2 is a more detailed chart that explains the dealer logic. It is a representation of the part of the simulation model that emulated the dealer's logic in making his reorder decision.

While much of the programming in the main program was devoted to bookkeeping and other secondary chores, the dealer logic is rather interesting and is partially described below.

Fig. 1



dealer logic

The first thing that the program did for each cycle through the model was to add the amount of film received at the dealer during that period because of orders placed during previous periods.

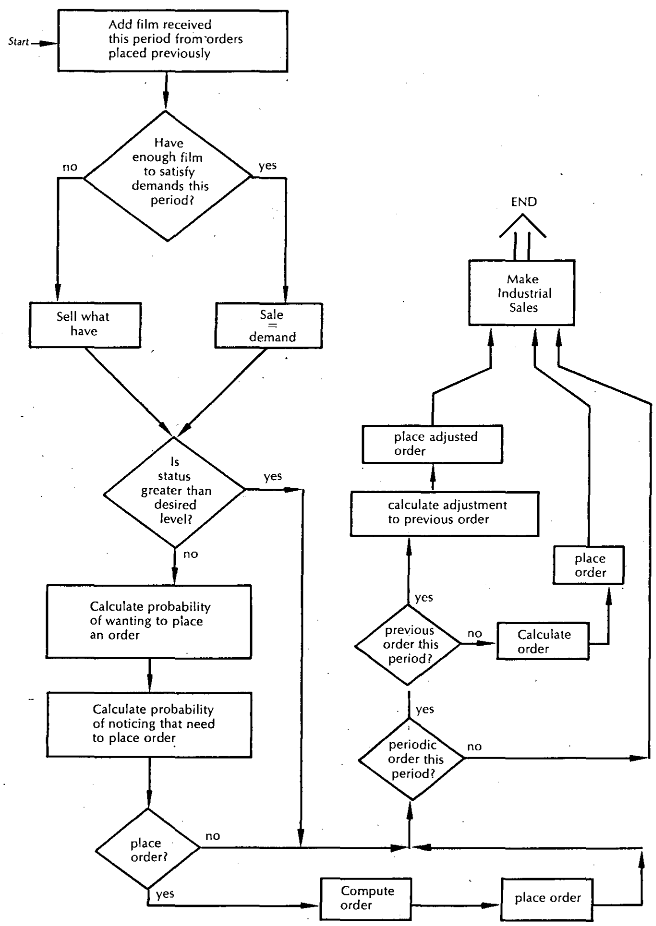
The specific retail demand generated by the first program was next presented and if the dealer had enough film to cover all of his demands, sales equal to the demand were made. If not enough film was available, sales were made up to the level of film in stock.

The trigger level order routine was next entered. All dealers, whether or not they had a trigger level type of reorder system, had a low point trigger which could cause them to order stock. If orders were never placed other than at periodic intervals, then this trigger was considered to be negative.

Where "status" is defined as the amount of film on hand, plus that on order, the program next tested whether the status was greater than the desired inventory level of the dealer. If it was not, then a probabilistic order factor was calculated. This factor was an interpretation of the trigger level questions that were asked of the dealers. The interpretation was that this factor was the percentage "chance" that the dealer would want to place an order if he noticed that a film type was below its trigger level. (Whether or not he noticed will be discussed later.) This percentage "chance" was calculated by linearly interpolating or extrapolating from two known points. These two points were two levels of film where it was assumed the correct corresponding "chance" was known and could be derived from the following conceptualization of the dealer's decision process. The amount of film that was the answer to a trigger level question directed at the dealer was assumed to be the point at which there was a 50% chance of the dealer's wanting to place an order. At zero units of film, the dealer was assumed to have a 100% chance of wanting to place an order. Any amount of film in stock, plus that on order, corresponded to a "chance" that could be calculated by linearly interpolating or extrapolating from these two points. For example, if the trigger level was 20 rolls on hand and on order, then the factor was .75 for 10 rolls, .5 for 20 rolls and .25 for 30 rolls.

Next, a second probabilistic factor was calculated independently of the first. This second factor was time related and could be interpreted as the probability that the dealer would notice that his film stock had reached a reorder point. Dealers tended to order more before a holiday and this factor reflected this point. On top of this, some dealers paid attention to the payment due date so that they could get added financing on their inventories. More than one dealer was encountered who would not place an order from around the 20th to the 24th of the month.

Fig. 2



Therefore, there were two time probabilistic factors: one for the dealer who watched the cutoff date and one for the dealer who didn't. The proper factor was selected and mutliplied by the first probabilistic factor. The rationale for this was that the probability that an order would be placed was equal to the product of the probability that the dealer would notice he needed to order times the probability that he would want to order if he noticed he needed to. A random number was generated and if this number was less than the product of the probability factors, the order was placed.

trigger levels

The actual order placed next depended on whether the dealer was a "desired inventory level" or a "constant order" dealer. The difference was noticed in the interviews, where it was ascertained that some dealers conceived of the ordering process as a bringing of stock up to a predetermined point, where others simply put in an order of a constant given amount (such as 50) of a type when they were below trigger.

Before the trigger level routine was left, a test was made to determine whether this dealer batched his orders. A dealer who batched his orders was simply one who reviewed his other film stock for ordering when he had to reorder one type. If the dealer did not batch his orders, then the trigger level order routine was cycled for all of film types. However, if he did batch orders and an order for one type of film had been placed, then the trigger level routine was left and the batch routine was entered.

This batch routine used secondary trigger levels and secondary desired inventory levels. If an order had already been placed for one type of film, then the likelihood was increased that the dealer would include others that were below their desired levels, although still above the primary trigger levels. Therefore, the seondary trigger levels were higher than the primary trigger levels. When this type of secondary order was placed, however, the amount ordered was usually less than would have been the case if this film had been ordered because of being below the primary trigger. Accordingly, the secondary desired levels were always lower than the primary desired levels.

Perhaps this section might be made clearer by a numerical example. Assume the primary and secondary trigger and desired levels to be as follows:

	Types				
	1	2	3	4	5
Primary Trigger Level	10	15	10	20	15
Secondary Trigger Level	20	20	20	30	25
Secondary Desired Level	40	60	25	70	60
Primary Desired Level	50	75	30	90	75

If the inventory levels of the dealer were 5, 18, 12, 85, and 31, and the level of the first film type succeeded in triggering an order, then the desired order would be for 45, 42, 13, 0, and 0 units of film. Because this film can only be ordered in multiples of ten, the actual order would be rounded to 50, 40, 10, 0, and 0 units of film. If, because of the random nature of the triggering device, the first film type had not succeeded in triggering the order, then no order would have been placed because no other film type is below its primary trigger. Therefore, for batched stores where a primary order had been placed, the batch routine added an order for any film whose status was below the secondary trigger level.

If no primary order was placed or one was placed but the store was one that didn't batch order, then the trigger level routine was exited from. The next section of the program took care of finishing out the primary trigger order for the dealer. It could have been possible that a level was lower than the trigger and yet because of the random number that was generated, no order for that particular film type had been placed. If an order had been placed in the primary trigger routine, it is only reasonable to expect that any other film that was below its primary trigger would have been added, even if the dealer didn't batch orders. A subsequent section in the program took care of this.

The next section of the program was periodic review. The logic in placing the trigger level orders first was that in the stores that used the periodic order concept the trigger level was an emergency order level which took precedence over regular periodic orders. The first test in the periodic order section was for whether the store had a periodic review that period. If it did not, then the section was skipped. This was always so for stores that did not use the periodic order concept.

If the store did have a periodic order review this period, then the next test was for whether an order had already been placed because of a trigger. If no order had been placed, the periodic review was completed. The order was calculated according to either the constant order or desired level policy and it was placed. If an order had been placed, then the next test was for whether all of the film types were ordered. If they were, the program proceeded to the next section. If some film types had not been ordered this period, then the program entered a section which calculated a supplemental order section, if necessary, to the one that had already been placed.

orders and output

This supplemental section was necessary because if this dealer regularly ordered only at periodic intervals and a partial order had already been calculated for him in this period, then the model had interpreted this partial order as an "emergency" order to fill in the dealer's stock until the next regular reordering period. Since now the model became aware that this was the regular ordering period, the amounts formulated as an "emergency" order for this period were converted into the regular amounts that would have been ordered in a regular periodic order. The supplemental section did this conversion. Since all of this happened in one time period, the "emergency" order and supplemental order showed up as one order.

The program took care of the dealer's industrial sales after the periodic review section was over. These industrial sales were different from ordinary sales in that they were usually made to a relatively small number of customers who called infrequently and ordered rather large amounts of film at a time.

The rest of the program consisted of certain bookkeeping operations, output and the statistical section which computed the basic statistics on sales and orders that were of interest.

The main part of the program was cycled through four different cycle indexes: the number of dealers, the number of periods (15), the number of executives who had made forecasts (3), and the number of simulation cycles. Because of their interactions, the five film types were taken care of interdependently on each cycle. The other four factors, however, operated independently and therefore could be handled by cycling. From the innermost to the outermost, the central part of the program was cycled for all dealers, then all periods, then the executives, and finally the simulation cycles (which, along with random numbers, introduced the distribution aspect to the outcomes).

The final output from the simulation was a single page giving the mean and standard deviation of the total orders placed with the manufacturer for each of the three five-week periods in the study. A typical output page is presented in Fig. 3.

There were many items besides sales and orders that could be calculated from this program: average inventory levels, fluctuations in inventory, lost sales due to stockouts, etc. However, these were not of immediate interest to the point of the research and therefore the only printouts concerned the above points.

conclusions

When the accuracies of all of the forecasts made by other methods were compared with the accuracy of the forecasts made by using the simulation, the very obvious conclusion was that the simulation method was substantially superior. The methods were ranked by two statistics, absolute and squared deviation, for both dealer samples.

Fig. 3

SAMPLE OF 24 DEALERS

IMPLICATION OF SALES FORECAST BY JONES

	FIRST FIVE WEEKS			SECOND FIVE WEEKS			THIRD FIVE WEEKS		
	TOTAL ORDERS		SALES	TOTAL ORDERS		SALES	TOTAL ORDERS		SALES
FILM	MEAN	STD. DEV.		MEAN	STD. DEV.		MEAN	STD. DEV.	
1	836.	149.	551.	447.	121.	458.	461.	148.	492.
2	1786.	262.	1716.	1336.	315.	1351.	1822.	340.	1835.
3	470.	74.	406.	316.	94.	325.	377.	85.	387.
4	1774.	209.	1420.	1139.	252.	1122.	1349.	247.	1411.
5	1442.	264.	1332.	1066.	249.	1052.	1214.	297.	1239.

IMPLICATION OF SALES FORECAST BY SMITH

	FIRST FIVE WEEKS			SECOND FIVE WEEKS			THIRD FIVE WEEKS		
	TOTAL ORDERS		SALES	TOTAL ORDERS		SALES	TOTAL ORDERS		SALES
FILM	MEAN	STD. DEV.		MEAN	STD. DEV.		MEAN	STD. DEV.	
1	868.	82.	543.	332.	84.	367.	363.	68.	385.
2	1918.	83.	1896.	1270.	139.	1148.	1465.	173.	1608.
3	404.	25.	303.	128.	37.	200.	291.	51.	241.
4	1800.	142.	1451.	1021.	201.	1013.	1216.	207.	1290.
5	1113.	89.	1034.	756.	108.	687.	799.	106.	831.

IMPLICATION OF SALES FORECAST BY MURPHY

	FIRST FIVE WEEKS			SECOND FIVE WEEKS			THIRD FIVE WEEKS		
	TOTAL ORDERS		SALES	TOTAL ORDERS		SALES	TOTAL ORDERS		SALES
FILM	MEAN	STD. DEV.		MEAN	STD. DEV.		MEAN	STD. DEV.	
1	918.	92.	601.	389.	90.	439.	447.	83.	470.
2	1959.	117.	1929.	1398.	160.	1307.	1697.	257.	1785.
3	434.	44.	359.	234.	83.	262.	324.	66.	314.
4	1747.	249.	1355.	845.	168.	890.	1138.	180.	1153.
5	1096.	161.	992.	762.	178.	721.	835.	199.	870.

The simulation method had substantially smaller deviations. For example, in the four cases of the two dealer samples ranked by the two statistics, every executive's sales forecast operated on by the simulation was superior to the straight forecast of orders made by the same executive.

Unsophisticated retailers seem to have a sufficiently systematic set of procedures to permit simulation of these procedures by a computer model. This is not such a surprising conclusion, since we would expect successful dealers to have a rationale for their actions. Those that do not have rational (not necessarily sophisticated) patterns of business behavior have probably gone out of business. For many products, these procedures may be determined by interviewing retailers. There is nothing particularly abnormal about film that would lead us to believe that we can successfully model the reordering of film and not of other products.

Considering all of the results that were derived from the study, it was concluded that a behavioral simulation model of the type constructed can be useful in the analysis and prediction of retailer behavior. More generally, we can state that a behavioral simulation model can be useful for analysis or forecasting in marketing problems where one tries to simulate the external environment of the firm. Whether the simulation approach is the correct one, in terms of cost justification, depends on the specific problem area.

There were many particular characteristics, both of the market place and of the particular product line that led to the model developed in this research. However, these were not requisite characteristics for developing a simulation model of the reordering process. For example, if film were heavily promoted, a section in the simulation model could have taken this into account. By definition, if one wishes to simulate a process, he must model the special characteristics of that process. Just because another process does not possess those characteristics, does not mean that it can not be modeled likewise. It does mean that the model constructed for the first case probably will not fit the second.

A simulation model of the type that was constructed for this research could also be useful in experimentation leading to a better understanding of the market environment. One variable could be changed, while the rest are held constant and variations in the output could then be compared with the changes in the input variable so that a better understanding of the environment can be obtained. For example, a step function of sales could be arbitrarily introduced, so that the resulting ordering pattern could be studied. Sensitivity tests would also be possible. If a change in corporate policy affecting dealer ordering was being contemplated, this change could be programmed into the model and the effect on the forecast of orders generated by the model could be studied. This type of information could be valuable in corporate decisions.

Because the primary purpose of the study was to examine the ordering process which acts as a transfer function between retail sales and wholesale orders, little attention was paid to the factors not immediately relevant to this transfer function. It is obvious, however, that any improvements that can be made in retail sales forecasting would improve order forecasting. As a matter of fact, the results of the research suggest that by using behavioral simulation, the transfer function between the retail sales and wholesale orders is tractable and that further work should be in the area of forecasting retail sales. ■

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STUDYING MULTIPROGRAMMING SYSTEMS

with the queueing theory

by E. G. COFFMAN

Queueing theory has been used to study the scheduling of digital computer operations under a variety of priority rules (service disciplines). Work on efficient scheduling stems from the desire to reduce the considerable cost attached to inefficient computer operation. Improved scheduling by changes in priority rules and through improved organizational design can expand the class of problems subject to feasible computer solution.

Computer systems are similar to other systems to which queueing theory has been applied. In digital computer systems, however, we are particularly interested in the reduction of idle computer time while there is a non-empty queue (there are jobs to be processed). Idle time reduction is complicated by the existence of setup (loading and unloading operations). With multiprogrammed computer systems, emphasis is also placed on providing a particular response time (waiting time) distribution for the different types of system users.

The purpose of this paper is to review the formal queueing models which can assist in the analysis of priority rules in multiprogramming computer systems.

The basic purposes of a time-shared multiprogramming system are to improve the utility of the digital computer for the user, and to provide a personal, hands-on type of relation between the users and the machine. These purposes are accomplished in part by reducing response time. With few exceptions, most of these systems can be modelled at least at one level of abstraction, as queueing systems with running-time priority disciplines, i.e. service disciplines, in which priority decisions are made on the basis of the amount of time required by the programs or jobs in the system. Our particular interest focuses on systems where the service (running) times are not known beforehand, but where it is desired to favor, by reducing waiting times, the shorter running programs or jobs.

In addition to queueing theory, multiprogramming systems have been studied by computer-based simulation using conventional simulation models, by Monte Carlo methods applied to mathematical models, and by the observation of an actual system in productive operation. Our purpose here is to point out the work that has been and is being done in the direct mathematical approach to the study of computer performance in a multiprogramming environment. In particular, we shall indicate the extensions to the general theory of queues that have been brought about by the studies of computer performance. The word "extension" is to be emphasized; we shall not consider instances in which a solution is obtained by a substitution for parameters in a more or less classical model derived for other queueing systems. We do not pretend, and indeed, can not hope to be exhaustive in this brief survey; it's difficult to acknowledge the *ad hoc* studies that have been conducted by various organizations and which have not appeared in widely circulated literature.

the general model

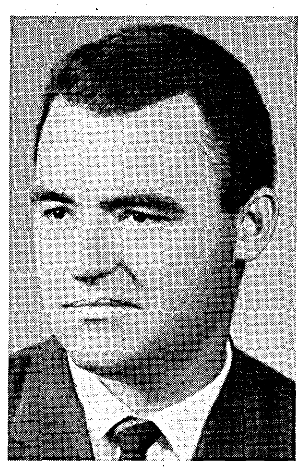
We now describe the structure of the queueing model for which variations applicable to multiprogrammed or time-shared computer systems have been analyzed. With reference to Fig. 1, a specific case of the general model is defined by assumptions as to the arrival mechanism, the service time required by the (job, program, or service request) arrivals, and the service discipline. Specifically, the models are defined by:

1. A probability distribution $A(t)$ where t is related to the time between successive arrivals. (We give specific definitions below.)
2. The probability distribution $B(\tau)$ for the time τ to service a job to completion.
3. The service discipline which specifies the sequence in which queues are selected for service, and the rules for determining how specific jobs are selected from the queue(s) for service.

Possible variations to the basic model consist of:

1. Breaking up the arrivals into (externally assigned) priority groups; a different distribution $A(t)$ (the difference is usually only in the mean value) results each group.
2. Using "quantum-controlled" service disciplines, which means that jobs are allocated only a limited time interval in which to be processed; if they require more time in any given instance they are returned to the queue after the interval for future continuation of the processing.
3. Assuming that there is a cost associated with loading and unloading (or preparing, in general) jobs for operation on the processor, (this usually takes the form of a "swap" or "overhead" time added to the operation time).
4. Assuming a finite source (i.e., a population of potential customers that is finite in size), as in time-sharing situations.

The definition made for $A(t)$ depends on whether or not a finite source is assumed. For a finite source, $A(t)$ is assumed identical and independent for each customer or job and t is defined as the time elapsing between the completion of the last service and the time of arrival of the next request for service. For the infinite source assumption, t is defined differently as the time between successive arriv-



A member of the original design group for the SDC-ARPA time-sharing system, Dr. Coffman was particularly concerned with the design of scheduling algorithms and the analysis of system performance. He has a PhD in engineering from UCLA, and is presently on the electrical engineering faculty at Princeton Univ.

als of (distinct) jobs. Whatever the interpretation for $A(t)$, this distribution has usually been assumed to be the exponential distribution because it leads to great analytic simplifications. For the infinite source assumption this distribution means that the arrivals constitute a Poisson process.

The measures by which system performance is usually studied include the (steady-state or equilibrium) probability distribution of the number of jobs in the system, the waiting time distributions, or what is more common, the mean values of these distributions.

A few remarks seem appropriate here as to when a mathematical (queueing theoretic) analysis can be expected to be useful, realizing that alternate means of obtaining roughly the same results exist. Two applications come to mind for use in preliminary design: mathematical analysis may be less expensive to implement than simulation, and yet provide adequate preliminary design guides, and it may be used to confirm the results of simulations. With the former application the results of the analysis allow one to gain insight into the behavior of the system being modelled, especially as system loading and the values of structural parameters are varied. The comparative features of alternate service disciplines may also be assessed. More will be said in this regard later on.

The basic shortcoming of the analysis of queueing models lies in the fact that the models are always approximations, in varying degrees, to the real world. Thus, it is seldom possible to use actual measurements of system performance to validate analyzed results. Because of this, the analysis may soon reach a point of diminishing returns from the point of view of the system designer. On the other hand, as proven in the past, analysis for its own sake may pay off because it provides techniques for analysis of similar systems in the future.

queueing models

We will now describe more precisely the models that have been analyzed, after which the corresponding results will be indicated in tabular form. (Because of our purposes here, the model definitions we give will not be mathematically precise in all cases.) The reader is assumed familiar with the basic characteristics of multiprogramming or time-sharing systems (e.g., *see* DATAMATION, Nov., 1965); however, this familiarity is necessary only for understanding the motivation for these models.

First, consider the well-known round-robin model of Fig. 2. In this model jobs are assumed to arrive either from a finite or an infinite source and are made to join the end of the queue immediately on arrival. The jobs are taken from the queue first-in-first-out and allocated a quantum (a certain time interval) of service which may depend on the state of the system—in particular, the number of jobs in the system. If the service required by a job exceeds the quantum size then it is placed at the end of the queue after it has received its quantum of service. Thus, jobs will "loop" around in this fashion until their total service requirement has been met. In general, one assumes a swap of overhead time associated with each quantum service which accounts for the loading and unloading of jobs on the processor.

Table 1 summarizes the results that have been obtained for the round-robin model under a variety of assumptions regarding the parameters mentioned earlier. The last column references the complete analyses of the model defined by the assumptions indicated in each row of the table. In Tables 1-3 we shall make no distinction between waiting time in system and in queue, since in all cases the former may be obtained from the latter by simply adding the required service time of the job(s) in question.

In order to illustrate the usefulness of the results reported in Tables 1-3 we shall present a simple but instruc-

Fig. 1 The General Model

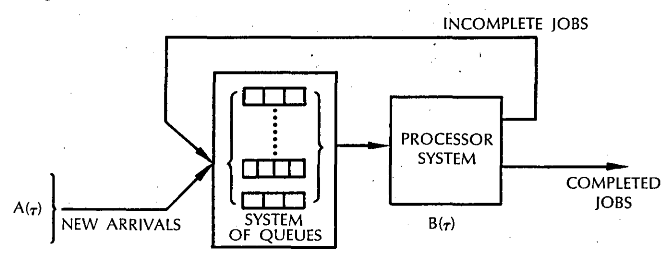


Fig. 2 The Round-Robin System

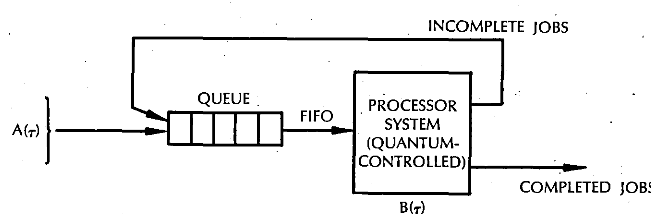


Table 1—The Round-Robin System

Input Source	A(t)	B(τ)	Quantum Size	Swap Time	Performance Measure	References
Infinite	Geometric[1]	Geometric	Arbitrary but fixed	no	W_k[3]	1
Infinite	Exponential	Exponential	Arbitrary but fixed	no	W_k	8[6], 3
				yes[2]	$W_k, \{p_n\}$[4]	3
Infinite	Exponential	Exponential	Arbitrary but fixed	yes	$W_k(t)$	6
Finite	Exponential	Geometric	Arbitrary but fixed	yes	W_c[5], $\{p_n\}$	3
Finite	Exponential	Exponential	Arbitrary but fixed	yes	$W_c, \{p_n\}$	2
Finite	Exponential	Exponential	Inversely proportional to number in the system	yes	$W_c, \{p_n\}$	3

NOTES:

1. With the (discrete) geometric distribution time is assumed to be quantized into discrete intervals corresponding to the quantum size. The geometric distribution in discrete time is analogous to the exponential distribution in continuous time, and possesses the same simplifying properties.
2. Assumed constant in all cases.
3. Denotes waiting time conditioned on the service required; specifically W_k denotes the average waiting time of a job requiring k quanta of service, and $W_k(t)$ denotes the corresponding distribution.
4. $\{p_n\}$ denotes the steady-state probability distribution of the number in the system. That is, p_n is the equilibrium probability of there being n (active) users in the system.
5. W_c is the mean cycle time, which can be defined informally as the average time elapsing between consecutive quantum services for any given job.
6. Reference 8 also analyzes a multiprocessor round-robin model under the given assumptions. In all of the other models only single-processor systems are assumed.

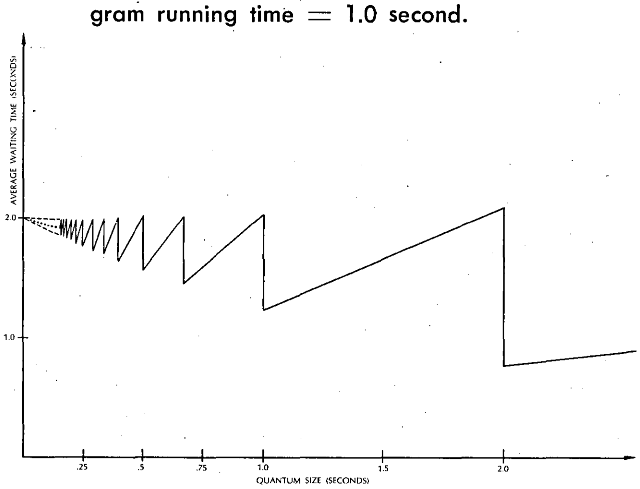
tive example, and apply it to a representative entry in each of the three tables. For a round-robin model we shall take the so-called Markov model defined by the third row of Table 1 with the assumption of zero swap time. The specific result referenced and defined in the table will clearly be some function of the arrival rate, the service rate, and the quantum size In particular, we have from reference (3) that the average waiting time in queue of a program requiring between k and $k+1$ quanta of service is given by Equation (1):

$$+ W_k = \frac{\rho k q\ (\lambda/2)}{1-\rho}\ \frac{[1-\rho\beta^{k-1}]}{1-\beta}\ [1-(2\mu q+\epsilon^{-\mu q})\,\epsilon^{-\mu q}]\ (1/\mu^2) + \frac{1}{1-\rho}\left[\frac{\rho^2}{1-\rho}(1/\mu) - \frac{\rho q}{1-\beta}\right][1-\beta^k] + \frac{\rho\epsilon^{-\mu q}}{1-\rho}(1/\mu)\ [1-\beta^{k-1}]$$

with $\rho = \lambda/\mu$, $\beta = \rho + (1-\rho)\,\epsilon^{-\mu q}$, and where q is the quantum size (seconds), λ is the average arrival rate (programs or requests per second), and $1/\mu$ is the average processing time (seconds). (The symbol ϵ represents the base of natural logarithms.)

As a numerical example, suppose that we desire, as a function of quantum size, the waiting time in queue of a program requiring 2 seconds of operation time in a system for which $\lambda = 0.5$ arrivals/sec and $1/\mu = 1.0$ sec. Substituting into Equation (1) we may compute the graph of waiting time vs. quantum size shown in Fig. 3. In this figure it is interesting to note the discontinuities or

Fig. 3 Mean Waiting Time of a 2-second Program in RR System as a Function of Quantum Size. Mean arrival rate =0.5 programs/second. Average program running time = 1.0 second.



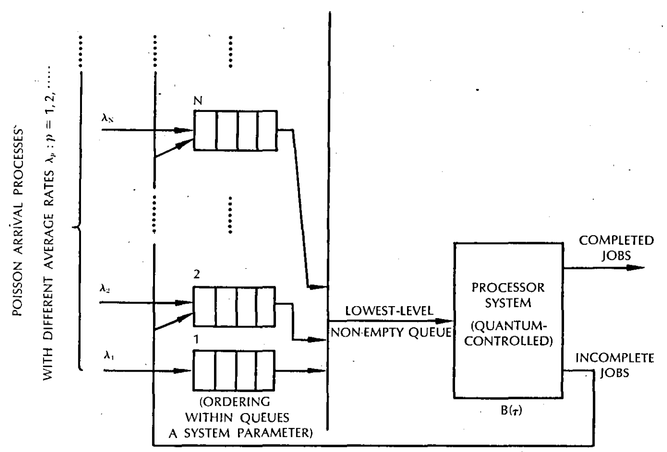
jumps at quantum sizes that are sub-multiples of the required operation time (i.e. at $q = 2/n$ sec for $n = 1, 2, 3 \ldots$). We may explain the effect by examining the discontinuity at $q = 2$ sec. For a quantum size just a little larger than 2 seconds a 2-second program need wait only once in the queue; i.e. it will make only one pass. But if the quantum size is just a little less than 2 seconds we see that the 2-second program must make passes through the queue, although it will require very little service the second time in the processor. Similarly, quantum sizes just greater and just less than $2/n$ seconds require a 2-second program to make n and $n+1$ passes, respectively. Of course, the sizeable difference in waiting n and $n+1$ times through the queue for relatively small n accounts for the discontinuities of $q = 2/n$ seconds. Beyond a quantum size of 2 seconds the program will always require but one pass. As shown, however, the waiting time increases as programs ahead of the given program are allocated a larger quantum of service. This last remark also explains the increase in waiting times as the quantum size increases between the discontinuities. At a quantum size of zero (at which $n = \infty$) we have a "processor-shared" model which we discuss later on in connection with Table 3.

It is to be emphasized that the above example is only one of the many studies that can be made of system behavior. The papers referenced in Table 1 also include investigations of the effects on waiting times of non-zero swap times, changes in system loading, and a finite-population source.

multiple-level feedback models

The most general model, in which priorities are included, is shown in Fig. 3. Here again, service is provided on a quantum basis with a quantum size that may vary from level to level in the hierarchy of queues. If a job in a given queue has a remaining service requirement in excess of the

Fig. 4 The General Feedback System



quantum at that level, it is put at the end of the next higher-level queue after it has had its turn in the processor (higher-level queues receive lower priority).

If only a finite number, (N), of levels is assumed then it is necessary to state what happens at the N^{th}-level queue. The assumption has been that jobs at the N^{th} level are serviced a quantum at a time until they complete; i.e., no feedback occurs at the N^{th} level. However, after a job receives a quantum at the N^{th} level it does not receive the next quantum (if required) until all of the N-1 lower level queues are again empty.

The priority assignment may or may not be correlated with service time. If it is (as, for example, when priority is assigned on the basis of job size or an estimate of running time), then this must be taken into account in the description of the service time distribution.

With regard to the method of queue selection it is assumed that, following any given quantum service, the job serviced next is the one at the head of the lowest level, non-empty queue.

Another parameter connected with the general model is the rule for determining the job to be considered at the head of the line in the next queue to be serviced. Two variations have been studied: (1) each of the queues is ordered by the time of arrival of the constituent jobs, and

(2) the jobs in each queue are ordered by the queue-level of original entry to the system—lowest level first. This in turn is determined externally.

Table 2 indicates the results obtained for the feedback models in the same fashion as Table 1 did for the round-robin model.

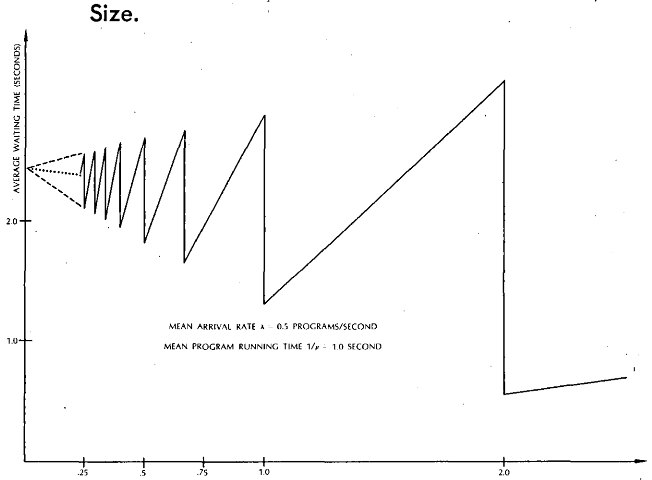
To illustrate the results for the multiple level models let us consider the model defined by the third entry of Table 2 with N = ∞. (This also corresponds to Schrage's model in the next entry of the table with the assumption of exponential service times and the same quantum size for each level.) With the exception of the service discipline this model is identical to the example selected for the round-robin discipline. Corresponding to Equation (1) we have for the average waiting time in

Table 2—The Multiple-Level Feedback Systems

Number of Levels	A(t)	B(2)	Priorities	Quantum size	Queue Discipline	Swap Time	Performance Measures	References
2	Exponential	Exponential	no	Arbitrary, same for both levels	FIFO	yes	$\{p_{mn}\}^1, W_k$	3
N	Exponential	Exponential	no	Different for each level	FIFO	no	W_k	3
∞	Exponential	General	no	Different for each level	FIFO	no	$W_k(t)^2$	4
∞	Exponential	Exponential	yes	Different for each level	ordered by priority	no	W_{pk}^3	3
∞	Exponential	General	yes	Different for each level	ordered by time of arrival	yes	W_{pk}	7

NOTES:
1. The steady-state probability distribution of there being m in the high priority queue and n in the low priority queue.
2. The conditional waiting time distribution (See note 3, Table 1.)
3. The mean, conditional waiting time of a job entering at priority level p.
4. The number of levels in a given application may be made finite by assuming an infinite quantum size at some level.

Fig. 5 Mean Waiting Time of a 2-second Program in the Multiple Level System as a Function of Quantum Size.



queue of a program requiring between k and $k+1$ quanta of operation time,

Equation (2):

$$W_k = \frac{(\lambda/2)\ [E_k + \gamma_k E_1]}{[1 - \rho(1 - \epsilon^{-\mu kq})]\ [1 - \rho\ \epsilon^{-\mu(k1)q})]} + \frac{\rho(1 - \epsilon^{-\mu(k-1)q})}{1 - \rho(1 - \epsilon^{-\mu(k-1)q})}(k-1)q$$

with $\rho = \lambda/\mu$, $\gamma_k = \dfrac{\epsilon^{-\mu kq}}{1 - \epsilon^{-\mu q}}$, and $E_k = (^1/\mu^2)$

$$[1 - (2\mu kq + \epsilon^{-\mu kq})\ \epsilon^{-\mu kq}],$$

and where λ, μ, and q are defined as before. Again taking $\lambda = 0.5$ arrivals/second and $1/\mu = 1.0$ second we calculate the waiting time of a 2-second program vs. the quantum size. The resulting graph is shown in Fig. 5.

The discontinuities at the sub-multiples of 2 seconds are described as before except that the "passes" referred to earlier are now through successively higher level queues instead of the same (round-robin) queue. In comparing Figs. 3 and 5 we may observe that a 2-second program waits longer (on the average) in the multiple level model than in the round-robin model for all values of the quantum size less than 2 seconds. For a quantum size greater than 2 seconds, however, the 2-second program requires only one pass and waits less in the multiple level model. The references given in Tables 1 and 2 provide a more detailed comparison of these and other models under a variety of assumptions.

processor-shared models

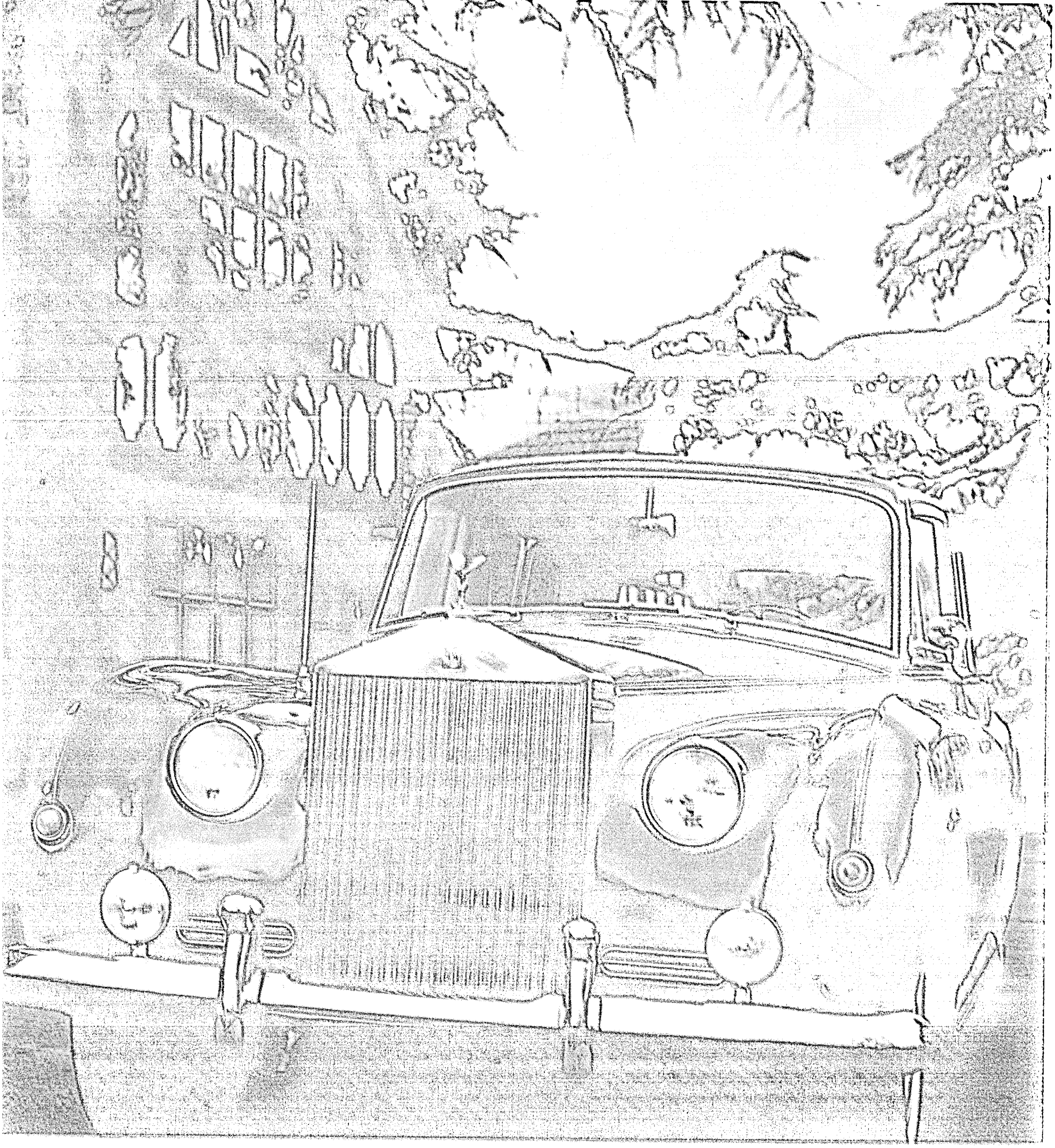
For the most part, the so-called processor-shared or pure time-sharing models may be viewed as limiting cases of the round-robin and multiple-level models in which swap time is assumed to be zero. In particular, if we allow the quantum size to approach zero while holding other parameters constant, the earlier models become processor-shared (PS) models. In the PS models two or more jobs may be serviced *simultaneously* on the processor. Thus, these models are at present more of theoretical interest in the way they provide insight into time-sharing behavior than they are models of real systems. This is made clear in the following descriptions.

Four different PS models have been studied:

1. *The simple* PS *model.* This model is obtained by allowing the quantum size to approach zero in the round-robin models where an infinite source has been assumed. In allowing the quantum size to approach zero we arrive at a system in which jobs are cycling (see Fig. 2) around at an infinite rate, receiving an infinitesimal amount of service infinitely often. Assuming k jobs in the system, we see that this is identical to a mode in which each job receives continuous service (with no waiting time in queue at a rate that is $(1/k)^{th}$ the rate it would receive service were it alone on the processor. The number k varies, of course, as jobs leave the system and new ones arrive.

2. *The* PS *model with priorities* (PSP). The PSP model involves the more general case of processor-sharing in which jobs are assigned priorities which determine the rate at which they receive service relative to the other jobs in the system. Thus, a given job may receive service at a fractional rate greater or less than $1/k$ depending on the relative priorities of the k-1 other job in the system.

The pre-emptive PS *model* (PPS). This model arises when we allow the quantum size to approach zero in the infinite level feedback model without priorities. In contrast to the



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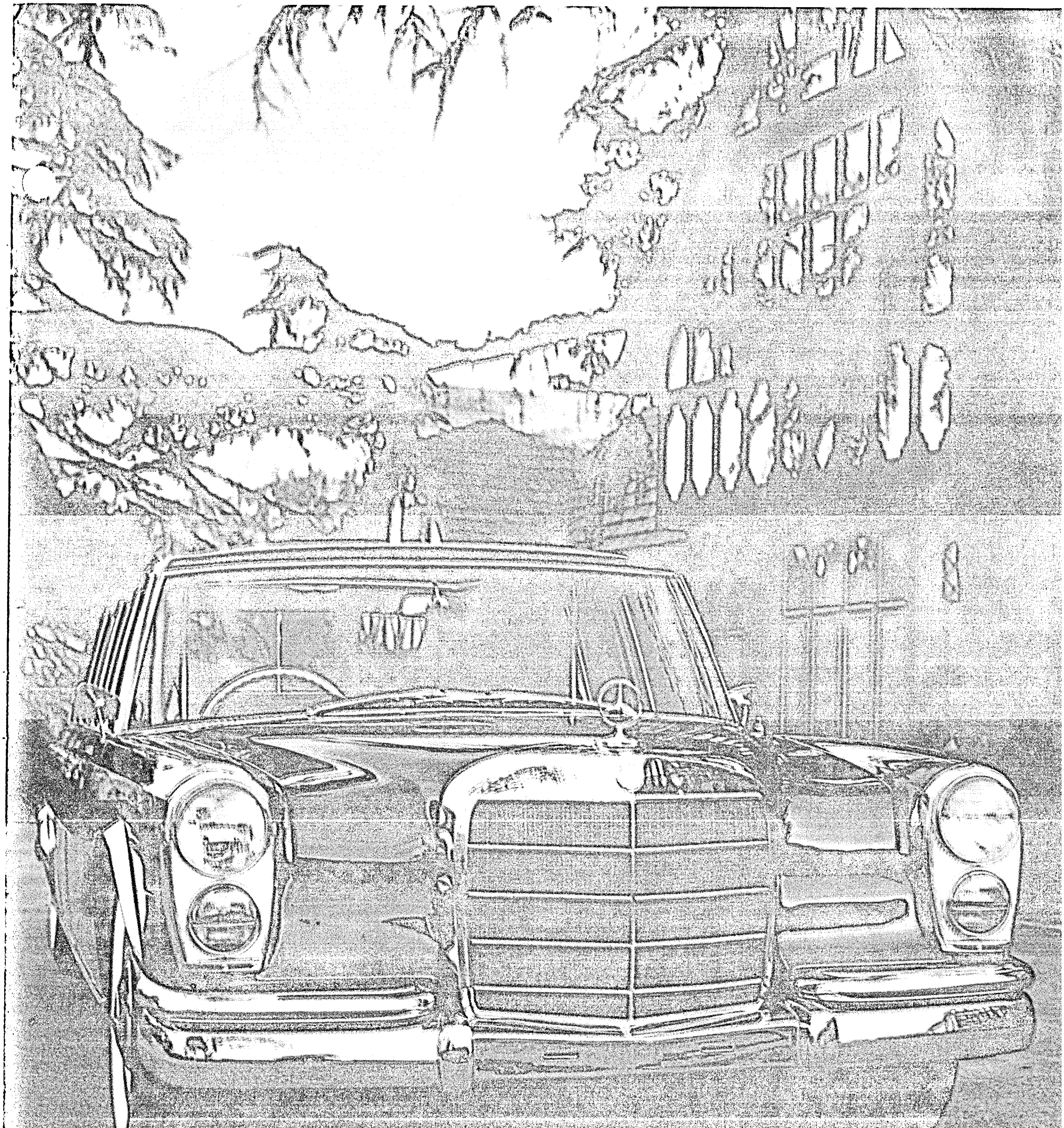

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previous PS models, a job in the present model will generally experience some waiting time in a queue. The PPS model corresponds to a system in which arrivals always pre-empt the job, if any, in service and are allowed to operate until their time of operation exceeds that having been received by some other job in the queue. When there exists at least two jobs having received the same amount of service then the processor begins switching between them infinitely often. Thus, under these circumstances we have the processor-sharing case as described for the simple PS model. The two jobs together then proceed to share the processor until their received service reaches that received by some other job, if any, in the queue. At this time the two jobs are joined by the third one and all three share the processor. This sort of process continues until jobs are completed (thus reducing the number sharing the processor), or until a new arrival occurs, at which time it receives the whole processor and the procedure above begins once again.

Table 3—The Processor-Sharing Systems

System	A(t)	B(τ)	Performance Measure	References
PS	Exponential	Exponential	W_{τ}[1]	5,3
PSP	Exponential	Exponential	$W_{p\tau}$[2]	5
		Exponential	W_{τ}	3
PPS	Exponential	General	$W_{\tau}(t)$[3]	6
PPSP	Exponential	Exponential	$W_{t\tau}$[4]	3

NOTES:

1. Mean waiting time of job requiring τ seconds of service.
2. Mean waiting time of p^{th} priority job requiring τ seconds of service.
3. The distribution of waiting time for a job requiring τ seconds of service.
4. The mean waiting time of a job with time-priority t requiring τ seconds of service.

4. *The pre-emptive* PS *model with priorities* (PPSP). This model follows when the quantum size goes to zero in the infinite level priority model that orders the jobs in each queue by priority. The PPSP model corresponds to a system in which each arrival has a time-priority (τ) associated with it (τ is any real number greater than or equal to zero). If at the time of arrival of a job with time-priority τ there are any jobs in the system with time-priority $\epsilon < \tau$ then the new arrival is not given service unless all such jobs have been given at least τ-ϵ seconds of service. When this situation finally does obtain (of course, it may exist at the time of arrival), then the new arrival shares the processor in the same fashion as described for the PPS-model. Thus, the present model is essentially the same as the PPS model except that pre-emption (i.e. when service commences) is governed by the time-priorities of the jobs in the system as well as their past service.

Table 3 specifies what measures of performance have been obtained for the PS models.

To illustrate the results of Table 3 we shall consider the PS model. The average time spent in the processor-sharing system by a program requiring t seconds of service in a conventional processor (with no sharing) is given by: Equation (3):

$$W(t) = \frac{t}{1-\rho}$$

with $\rho = \lambda/\mu$

Putting the parameter values of our earlier example into Equation (3) we find for a program requiring 2 seconds of service an average waiting time of 4 seconds. Subtracting the required operation time of 2 seconds we obtain the value of 2 seconds indicated in Fig. 3 for the limiting case $q = 0$. This follows, of course, from the definition of the PS model; i.e., adding t to Equation (1) (to obtain the total time in system) and taking the limit as $q \to 0$ (and $k = t/q \to \infty$) yields Equation (3).

future work

In the systems presented there have been a number of degrees of freedom by which the waiting time distribution conditioned on service time can be manipulated. In the general feedback model, for example, the quantum size, number of levels, external priority assignment, and the ordering of jobs in each queue constitute degrees of freedom. The approach has been analytical, investigating the performance of *given* systems. The synthesis problem has not yet been attacked satisfactorily, nor can it be, solely through the methods of queueing theory. Thus, a basic research problem is the development of a general design methodology in which the rules are specified for manipulating the degrees of freedom in the various multiple level priority models described earlier, to meet specific operational requirements such as the distribution of waiting times.

It is also clear that the currently used, highly complex multi-programming systems are only crudely represented by the microscopic models we have presented. In this respect, for example, if the input/output processes which occur as part of job operations were separately included in the model many of the problems of input/output interference could be investigated in the context of a stochastic system. Furthermore, the use of paging systems requires the use of more intricate scheduling algorithms and the recognition of the page organization of programs in terms of swap times and running times. ■

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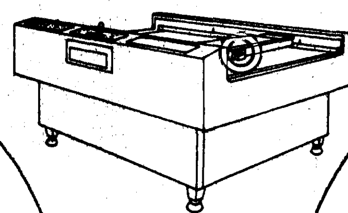

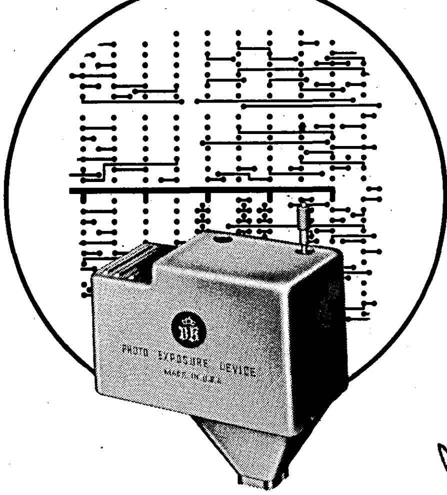

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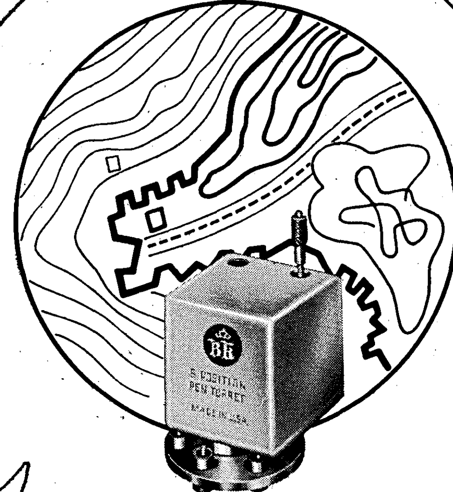

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ACTION-ORIENTED INFORMATION SYSTEMS

think first, but then act.

by RICHARD WERLING

Present management information systems have been designed by people who "THINK!"—and the results are Thinking Men's Systems; but there is a need for systems designed for use "where the action is."

Every Friday morning a foot-high stack of reports goes from the computer center of a major American company to the men responsible for controlling the company's freight and physical distribution. The reports, prepared on the most modern and expensive machines, contain virtually everything that should be needed to control the physical distribution system: locations of freight cars and histories of their movements, loads and destinations of each car, estimates of cost for each trip, precise descriptions of the physical characteristics of each car.

Are these reports simply waste paper? Listen to comments by the users:

> "All the information I need is there someplace, I guess. But who has time to read a report that big? When I need to know something, I pick up the phone and call three or four places; that's faster than trying to get the information from the computer reports."

> "There's a lot of information there; it must do somebody some good. But it doesn't help me find a freight car when I need one."

> "They're two weeks out of date by the time I get them. The reports are fine for history, but the data inputs don't even get to the computer until ten days after I need the information."

> "There are too many mistakes. Many people have to spend half a day checking for the errors before they can make use of the reports."

In summary, reports are too bulky, ill-arranged, have the wrong information for the user, are too late to be of real value, and too often are incorrect.

These examples, drawn from a well-managed company ranking among the leaders in its industry, are symptoms of the aggravations still too common in manage-

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ment information systems. They show that management information systems are generally still failing to meet their prime reason for existence. They fail to provide *action-oriented information*—information that enables responsible individuals to identify needs for action, and assists in accomplishing those actions.

After more than a decade of business experience with computer-based information systems, and investments in the billions of dollars, why do they still fail to meet action needs? Why do they still involve so much wasted effort? And, more importantly, what must be done to overcome these deficiencies?

deficiencies of present systems

A close look at the limitations of computer-based information systems, even in computer centers equipped with the latest exotic (and expensive) equipment, reveals a variety of ills. Among them:

1. Failure to meet the extremely wide range of managers' action-oriented information needs.

There is common agreement that the purpose of any *management* information and control system is to provide information on which management can base its actions. But the complexities and the demands on information systems have only recently been appreciated. "Managing" involves a large number of discrete types of actions taken by individuals at various levels and geographic locations.

The information needs of higher management, usually requiring extensive analyses, are usually well served by existing reports. For example, it is not uncommon to find accounting analyses available that utilize marginal cost analysis, ignoring fixed costs for certain decisions, and other sophisticated techniques. However, these analyses are usually derived from manual analysis of data drawn from massive tabulations of all available data. Hours of expensive analysis time are required to derive "action-oriented" data for higher levels of management. Since the decisions at stake are usually very large, and the problems unstructured, this manual analysis is appropriate. Table 1 shows that the first three levels of management action are usually well served in this manner.

However, at lower levels many routine management actions are taken for granted, and some are ignored because they are performed by non-managerial personnel. Often the information needs of these "managers" are neglected by information systems.

The number of different actions taken in managing even simple systems is large. Table 1 (p. 62) shows an abbreviated list of eight different managerial actions required for a tank car fleet. In fact, for this fairly simple tank car fleet, at least a dozen discrete types of routine management actions can be identified, and the list has not been exhausted.

To illustrate, for the management action "strategic evaluation," the types of action taken by the board are to evaluate, and possibly change, plant locations. Corresponding division strategic evaluation actions include changes in levels of plant operation, process economics, or method of distribution. Extensive analyses are normally prepared for this type of nonrecurring action. The frequency of the strategic evaluation type of action is no more than annually, but when taken it has major effects on operations and profits of the company.

At a lower organizational level the freight yard clerk, whose repetitive actions involve assigning individual cars to individual shipments, can also have significant effects on operations and profits. He must consider order size, car size and construction, type of fittings, expressed preferences by customers, and car lease costs in this "simple" action. Thus it is clear that different levels of management require different action-supporting information.

A further dimension is added by the requirement at each level for information to help in two broad tasks:

"Tool" information (deciding what action to take)

"Measurement" information (measuring the results of actions taken)

In practice, the two types of action are not independent; they are highly interrelated.

To meet these needs, information now must come from a variety of sources; it is not limited to computer-generated reports. For example, past experience, accounting reports, personal notes and files, and informal personal contacts are often still the most important sources of management information. Indeed, at the present time computer-generated information is still only a small part of the total needed for effective management action. Computer-based systems will increasingly tend to supplement the present sources of management information, but for the foreseeable future these will remain important.

This broad spectrum of needs notwithstanding, the information system must make available—to those responsible for taking each type of action—the information needed to decide on appropriate actions and to measure their results. The need is not yet satisfactorily met by computer-based systems.

2. Failure to capitalize on the action-supporting strengths of computer-based systems.

Computer systems' strengths are in their ability to rapidly sift large volumes of data, to rearrange and pre-digest data, to compare against standards, to compute forecasts, and to detect out-of-control conditions. Although computer programs utilize these abilities constantly, the effect of such pre-digesting is still only rarely seen in action at lower levels of organizations. Still most commonly seen are reports that could as easily have been produced by electric accounting machines. Forecasts using exponential smoothing, selective editing, and selectively *not* printing in-control items on reports, are still very rare. In short, the computer's strengths are not yet fully utilized.

Present systems are usually oriented toward producing information needed by accounting or accounting-oriented people, whose needs are primarily for historical information—*not* the forecast information more useful in the management action process. This orientation has been recognized by the accounting profession, and steps are gradually being taken to make reports more management-oriented.[1,2]

Reports are often out of date—hence valueless for action—when published. In the tank car fleet example, expediting information needed daily was only available weekly from the computer system. Inadequate report preparation frequency has the same effect. For certain applications, long-distance data transmission, real-time computation, and television-type information display are helpful, but expensive.

3. Failure to "THINK"*—before printing.*

Too voluminous reports are a universal complaint. This symptom simply involves too much use of a good thing—the high speed printer. It appears that very large reports demonstrate either poor systems design or the inability of the systems department's customer to decide what he

1 Robert Beyer, C.P.A., *Profitability Accounting for Planning and Control*, Ronald Press, New York, 1963.

2 W. J. Reddan, "Financial Reports: Results versus Planned Performance," in American Management Association publication, *Reporting Financial Data to Management*, 1965, pp. 76-87.

wanted during systems design. So the reports simply show all the data on the magnetic tape records, regardless of its importance.

This stems from two quite human traits:

1. Reports usually contain all the information that *might* be needed by somebody.
2. The human tendency to want a copy of each report the boss gets, just in case he might ask about it. Thus countless reports are waste when printed.

Even when the content of reports is completely satisfactory to management, another need must be met. To compete with the older, more informal information channels, computer-generated reports must emphasize brevity, timeliness, and clarity. This requires that only information of maximum significance be presented to assist in taking actions, where additional detail is in fact a hindrance. (Naturally, this should not be distorted to mean withholding necessary information.) Action-oriented reports, containing a carefully selected minimum amount of information bearing maximum significance, must be supportable by detail, probably required by others for other types of action.

4. *Most importantly, failure to provide return on investment comparable to that required for other investments.*

Considerable surprise resulted when it became known that returns of 30% on their computer systems investments were being obtained by a few companies.[3] The impact of this knowledge is still being felt. The newness and rapid change of the technology, uncertainty as to what could reasonably be expected, and the initial applications in overhead areas (where many benefits were defined as unmeasurable)—all these made accurate measurement extremely difficult during the first years of computer use in business. Only recently have systems groups found it possible to develop:

1. Adequate procedures for evaluating the benefits of new applications.
2. Long-term applications plans involving the entire business.

These are the common deficiencies. What must be done to overcome them?

overcoming present deficiencies

The conditions for high computer-systems payouts are well known.[4,5,6,7] They include:

Top management interest: viewing the investment in computer-systems work as similar to other company investments and deserving of proportionate guidance, support, and measurement. From this stems the second:

Responsible involvement by operating management in the development and implementation of management information systems;

Focus of applications in the critical problem areas of the business; and

Broad range and depth of technical skills among the systems staff, including prior experience in an operating division of the company.

Experience with management information systems in several companies has convinced me that successful systems programs involve a fifth essential: *action-orientation* of individual applications.

3 John T. Garrity, "Top Management and Computer Profits," *Harvard Business Review*, July-August 1963, p. 7.

4 John T. Garrity, *ibid.*, entire article.

5 John T. Garrity and John P. McNerney, "EDP: How to Ride the Tiger," *Financial Executive*, Sept. 1963, pp. 19-26.

6 John Dearden, "How to Organize Information Systems," *Harvard Business Review*, March-April, 1965, pp. 65-73.

7 William J. McLaughlin, "EDP Contribution to a Manufacturing Operation," *Financial Executive*, April 1966, pp. 14-26.

It is axiomatic that the most profitable use of management information systems is to *identify and support necessary action by responsible individuals within the organization.*

The distinguishing feature of the action-oriented system is not the equipment—which may include the simplest or most complex apparatus—but the dedication to providing information that identifies and supports required action by company personnel. *The emphasis is on action-relevance, and on timely presentation of data, predigested and tailored to the action needs of responsible individuals.*

Other characteristics include:

1. Concern with forecasts and the future, rather than with history;
2. Indication as to which of several actions is appropriate (i.e., which action meets prespecified criteria for certain conditions);
3. Tailoring the information presentation to the use to which it will be put, favoring short simple reports telling what is needed by the recipient to support his actions, and uncluttered by extraneous information;
4. Using computer-based equipment when there is a clear *economic* advantage, but recognizing that informal personal contact, telephone calls, handwritten notes—when satisfactory—may be economically superior.

Action-oriented systems can of course often use the same data developed for the company's normal financial reporting systems, but they usually involve additional data as well. Table 2, Sample Action-Oriented Reports, illustrates the type of information needed for the eight management actions listed in Table 1. (Tables 1 & 2, p. 62, 63)

profits from action-oriented systems

Most of the business systems development effort during the past decade has been concentrated on record-keeping systems. The effort has paid off; in most companies administrative systems function smoothly and involve many of the record-keeping tasks of the company.

But clerical and administrative costs, the typical object of record-keeping computer applications, generally involve only a small percentage of the total operating costs of a business. Only in very unusual circumstances can actual *profits* be developed in the record-keeping areas. It is mainly in the business mainstream, the marketing-purchasing-manufacturing-distribution functions, that profits can be made. These functions involve the major part of the costs of the business and the sole source of income.

How can an action-oriented information system be used in the mainstream of business?

- In the physical distribution area, benefits in the tank car fleet example derived from improved car utilization with resulting lower lease costs, reduced penalties incurred to avoid delayed shipments, and reduced labor overtime costs.

- In the marketing area, information systems are being put to work routinely identifying the most profitable customers, product lines, and distribution channels; evaluating sales force performance, and allocating salesmen's time to increase their effectiveness.

- Applications like these, distinctly oriented to action rather than to record-keeping and analysis, are also being developed in purchasing, inventory control, physical distribution, manufacturing, and money management.[8] What steps must be taken to identify potentially prof-

8 M. Valliant Higginson, *Managing with EDP: A Look at the State of the Art*, American Management Association Study No. 71, American Management Association, 1965.

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CIRCLE 28 ON READER CARD

itable systems applications, obtain staff for their development projects? The next section answers these questions.

opportunities for action-oriented systems

The profits that will be obtained through the use of action-oriented systems will not appear on the books of the information systems department. They will be reflected in the sales and operating costs of the operating departments—of marketing, purchasing, distribution, or manufacturing.

In marketing, for example the improved profits will tend to accrue from three sources:

1. Concentrating the efforts of the sales force on the products and product lines yielding greatest incremental profits to the company, and on those territories and customers giving the highest incremental profits;
2. Quickly detecting changes in profitability—by product, territory, distribution channel, or customer—permitting actions by marketing that will result in increased profits (or decreased losses) to the entire company;
3. Keeping sales, production, and inventories in balance.

And, in purchasing, improved profits tend to come from:

1. Reduced costs of material purchased;
2. Reduced inventory carrying costs.

None of these directly affects the information systems department; yet all can contribute significantly to increasing sales or reducing costs of the over-all business—and all can be assisted by action-oriented information.

In general terms, identifying profitable opportunities involves concentrating on the basic dynamics of the specific business. That is, *determining what must be done well for the business to succeed within its industry*, and reflecting those requirements in the information system. For example, customer service needs—a critical factor in the competitive airline industry—require that airlines maintain efficient reservation systems. Tight control of relatively fixed costs (aircraft and crew scheduling being another critical cost area) also represents significant improvement potential.

selecting potential applications

Selecting the potential applications is usually the responsibility of the systems department; but participation and involvement by top level management is necessary for success. In the process of selecting the action-oriented systems most advantageous to the business, nine definite steps are required:

1. *Identify the critical opportunity and cost areas in the business.*

As discussed above, these are the areas where successful action is essential for business survival, or where the greatest opportunities are for profits, or where the greatest costs are incurred. Those areas that account for the largest proportion of potential profits (or costs) should be selected. These will usually involve the main areas of the business.[9] Table 3 (p. 65). Potential Profitable Applications, will be of help in this stage. It should be used to help in identifying costs that behave favorably in response to changes in product volume, and taking advantage of the relationships. For example, if high fixed costs make lower volume economically unattractive, emphasis on product marketing is necessary.

2. *"Some actions are more equal than other actions."*

It must be determined which areas have the greatest leverage. If sales were to be increased by 20%—or if costs were to be reduced by 20%—in which of these critical areas would total profits be increased most? These areas will obviously represent the best investment of time and money in the design of an action-oriented information system.

3. *For the most promising of the areas selected, investigate alternatives. How could the work required be done better than it is now with the better information processing equipment available?*

Table 1

TYPICAL ACTIONS NECESSARY IN MANAGING TANK CAR FLEET

Management Action	Specific Actions Affecting Tank Car Fleet	Level of Individual Responsible for Action	Action Frequency
Evaluate strategy	Change in plant location	Board of directors	Annual
	Levels of operation, process economics, or methods of distribution	Division management	Annual
Forecast requirements	Forecast size of fleet required to service planned sales	Division management, with division distribution manager	Semi-annual
Maintain resources and requirements in balance	Lease or borrow tank cars as required	Division distribution manager	Quarterly
Assign facilities to specific opportunity areas	Assign certain car groups to specific product service	Division tank car specialist	Monthly
Schedule individual facilities	Assign individual car to individual order	Plant freight yard manager	Daily
Identify where schedule not being met	Identify cars behind schedule	Expediter	Daily
Expedite facilities behind schedule	Expedite tank cars in yard, on railroads, or at customers' plants	Expediter	Daily or more often
Service to: government, industry groups, other departments, stockholders	Financial and other data	Accounting department	Monthly or less often
Insure integrity of input data	Maintain validity of input data Maintain information system	Yard men, clerks Systems group	Daily As required

9 Peter F. Drucker, *Managing for Results*, Harper & Row, 1965.

In a fast-changing environment, conditions change rapidly enough that this is often a meaningful question. A helpful technique for nót-so-obvious areas is to ask "What would have to be done to cut the costs in this area by 20%?" Such a dramatic cut is often feasible, but usually must be done by changing policies, procedures, and ways of doing the business.[10] Thus it is essential that high levels of management be represented on the team that does this task.

Having chosen the most promising areas, the next steps involve orienting the system to the action needs of management:

4. *Within the areas selected, determine what actions are required by various levels of management for doing the work.*

Table 2

Management Action	Action-Oriented Report
Evaluate strategy	Car Utilization Report: Identify excessive average times on trip and at destination, by route and customer. Identify excessive cost per cost of serving specific customer by tank car. Product Shipment Analysis Report: Identify opportunities to change mode of shipment and reduce freight costs (e.g., from tank car to barge or drum)
Forecast requirements and maintain resources and requirements in balance	Fleet Size Planning Worksheet: Identify car types and sizes expected to be in excess or shortage condition. Car Lease Expiration Report: Identify leases by termination dates
Assign facilities to specific opportunity areas	Fleet Size Planning Worksheet: Identify car types and sizes expected to be in excess or shortage condition. Car Assignment by Product Service: Identify cars assigned to specific product service, in order of cost to interchange with another product
Schedule individual facilities	Car Location Report: Identify cars out of plant, destination, and estimated return date. Cars identified by product service
Identify where schedule not being met	Car Expediting Report: Identify out-of-plant cars behind schedule current probable location
Expedite facilities behind schedule	Manual operation by expediter, using Car Expediting Report and telephone contacts with railroad. (At the present time this is the most advantageous economically, but in future economics may change.)
Service to others	Accounting Distribution Report: Service to accounting for distribution costs in proportion to car use for transportation, etc.
Information system integrity	Input Error Reports: Erroneous input data, detected by failure to pass a series of edit and logic checks, must be corrected and resubmitted.

The specific information needed to identify and support these actions grows from the actions themselves. In the tank car system, for example, the daily car location report grew from the need to support daily action of expediting overdue cars.

5. *Determine the sources of information needed to support these actions.*

What information is now available in acceptable form, what can be calculated, and what must be collected in a different way or at a different point? It will often develop that manual methods are still least expensive, but in other cases computer-based systems, perhaps involving remote data collection, will be superior.

6. *Balance the cost of furnishing action-oriented information developed by this procedure against the benefits from the information.*

Managements have recently come to believe that a computer information system should satisfy the same requirements for return on investment that are established for any other investment of company resources. This rule has seldom been observed in the past, but it is becoming increasingly clear that computer applications require investment of company resources indistinguishable from resources allocated to new equipment, warehouses, or new processing plants. Indeed, since there is considerable risk in information system applications, with life expectancy of specific applications often averaging less than five years, tough-minded evaluation of economics is essential.

With this in mind, does the benefit of the specific application exceed costs by enough to satisfy the company's requirements for return on investment? If the company normally requires a 15% annual return, can the system realistically be expected to yield this? If so,

7. *Enter the application on the management information systems potential applications catalog.*

The potential applications catalog is the file of potential projects for harnessing the computer-systems capability. Before a potential project is developed and installed, sizeable additional investment of company resources will be required—in the detailed analysis, systems design, programming, and implementation of the application. Some potential projects in the catalog will not progress beyond the catalog; i.e., they will not be developed into completed applications.

8. *In picking specific applications for development, take care to insure that a mixture of high- and low-risk applications is chosen.*

The mix of high-risk and low-risk applications must be carefully chosen to minimize the likelihood of multiple "strikeouts" while retaining the probability of at least one "home run."

As in any complex undertaking, there is risk in the development of an information systems application. The risks derive from insufficient data base, insufficient technical knowledge to completely evaluate an application before development work has really begun, insufficient knowledge of necessary related areas, and occasionally an unfavorable organizational environment. Since many low-risk applications have already been transferred from tabulating machines to computer systems, higher risk applications will tend increasingly to be selected.

staff selection

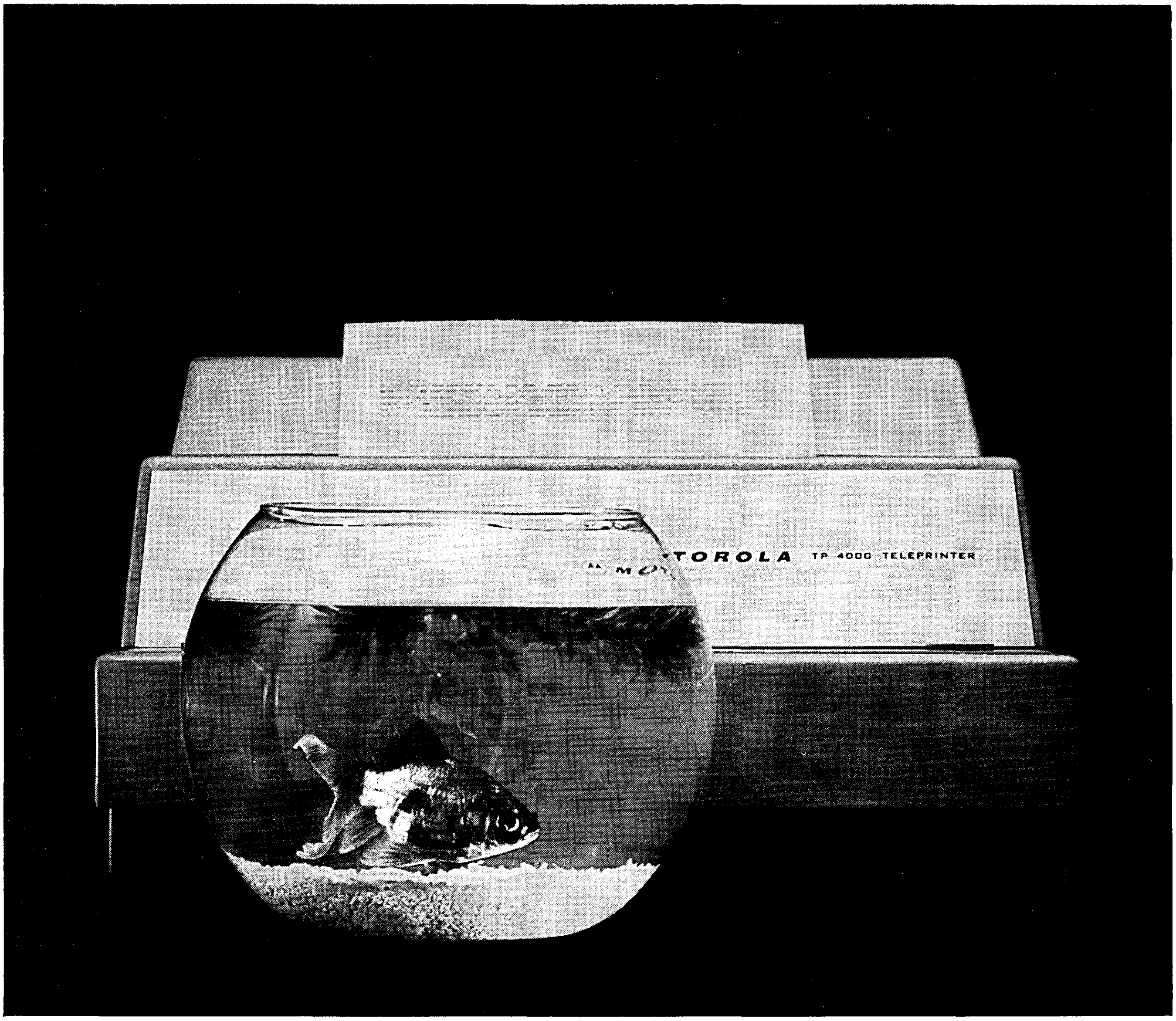
Information processing equipment available, or soon to be made available, is capable of overcoming the present deficiencies. The critical limiting factor in systems design at this point in time is no longer equipment capability but rather insufficient availability of people who can put the equipment to work in meeting needs for management information.

The plain fact is that *there is virtually no supply of individuals who are familiar with both the over-all needs of the business and with computer-systems applications in business.*

Why is this so? Basically, because the relatively recent appearance of computers on the business scene—scarcely a decade ago—has allowed insufficient time to grow a crop of top-level information systems managers, or for top management to become sufficiently familiar with the capabilities and potential of computer-based information systems.

Computer-systems personnel are usually too young or

10 Frank O. Hoffman, "Improve Your Profits Day by Day!" *Harvard Business Review*, July-August 1963, pp. 59-67.



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disinterested in management to have sufficient experience with operating management problems. The interests and capabilities of computer personnel have tended in the past to lead them to highly structured, routine applications. This tendency has kept them tied to lower level management applications and kept them from seeing the bigger problems of the business. The common early experience with management information systems developed by systems personnel who were unaware of their own ignorance of business problems has underscored this; the early failures are still impairing the credibility of systems people as being capable of contributing in major ways to improvement of business operations through better information.

Management people tend to be more interested in solving operational problems than problems required to develop profitable information systems.

In selecting a staff to work out the proposed information system improvements, a high level of understanding of the business, higher than is commonly found in information processing and systems departments, is required. Thus the systems department's capability must be supplemented by high-talent operating and management people. In view of the expense of the high-talent people from operating divisions, management and systems required for action-oriented system development, it follows that careful project control is necessary.

conclusion: act!

The present limited success in attaining adequate returns on the management information systems investment stems from the failure to effectively focus management information systems on the action needs of responsible individuals in the business. This limited success can be overcome by the systematic program described above.

The results of the program will be in the form of increased profits or reduced costs in the operating departments, and not directly in the systems department's budget. After all, the majority of the costs and virtually all of the income of the business typically come from the results of operations.

The program involves four phases:

1. Identifying opportunities for action-oriented systems in the business;
2. From these opportunity areas, selecting potentially profitable systems applications;
3. Implementing selected applications;
4. Through the project team approach, broadening the understanding both of the systems department and of the operating people within the business.

Identifying opportunities for action-oriented systems involves going directly to the mainstream of the business, determining what must be done well for the business to succeed within its industry and for the business to grow.

The nine steps involved in selecting potentially profitable applications concentrate on obtaining excellent return on investment in the critical areas of the business. The systems department must have the responsibility, but the system must reflect the objectives of the business, and its future markets, products, and organization. Therefore heavy participation and guidance from the topmost levels of management are required during this phase.

Due to the lack of people qualified to conduct work of this breadth and depth, the project team approach is required. Operating and management people must be intimately involved in the design of the system. Systematic project controls must be maintained in order to properly use the high-talent and high-cost manpower required for this work.

Finally, the objectives of the systems department involve not only making profitable investments in identification and design of action-supporting management information systems, but promoting a better understanding of operating problems on the part of the systems group as well. ■

Table 3

POTENTIALLY PROFITABLE APPLICATIONS OF ACTION-ORIENTED SYSTEMS

Critical Opportunity Area	Potential Application	Source of Profit
MARKETING: Highly competitive—field sales activities need to be focused on increasing incremental profits	Product profitability reporting system, identifies net profits by territory, product line, distribution channel.	Channel sales effort to highest net profit products, customers. Base operating decisions on incremental cost data. Increased sales of high incremental profit products. Decreased net-loss product sales.
Product lines need to be augmented and pruned constantly	Field sales performance planning and control assists in allocating salesmen's time to best attain sales goals.	Keeping sales, production and inventories in balance. Reduce missed sales and inventory holding costs, obsolete products costs.
	Forecast product sales and revenues—assists in sales and production planning; identifies market changes.	
Credit evaluation and control is important	Credit risk evaluation. Controls risky accounts receivable.	Reduce funds tied up in accounts receivable or lost.
MANUFACTURING, PURCHASING AND DISTRIBUTION:	Raw materials cost system, identifies purchased material costs by vendor, material, plant, quality.	Reduced material cost
Cost control is essential for older, "commodity type" products. (Cost data needed more for pricing decisions for newer high-margin products)	Optimum plant production mix, based on linear programming model.	Reduced net costs of production and distribution.
	Inventory control system.	Reduced inventory carrying costs.
NEW PRODUCT DEVELOPMENT: High profits in new products	Project selection system. Project evaluation and control system.	Higher percentage of marketable new products.
		Early identification of project success or failure.
		Faster introduction of new products.

1967 DPMA CONFERENCE

Urbanly renewed Boston, given a full year to recuperate from the '66 Spring Joint Computer Conference, will host the 1967 International Data Processing Conference and Business Exposition June 20-23. Sponsored by the Data Processing Management Assn., the conference will fill the four days with papers and panels at the Sheraton-Boston Hotel; at the War Memorial Auditorium, nearly 100 exhibitors will spread themselves over 200 booths.

The first day, Tuesday, June 20, has been set aside for 13 hours of registration and six tours. Attendees will have their choice of visiting the U.S. Army Labs in Natick, the Internal Revenue Service, Honeywell Computer Div.'s Brighton plant, a General Motors assembly plant, the Research Center of Liberty Mutual Insurance Co., or IBM's Cambridge Scientific Center and Boston Programming Center.

On Wednesday, the first day of the educational program, Erwin D. Canham, editor-in-chief of the *Christian Science Monitor*, will give the keynote address before the general assembly. Mr. Canham will speak on "Automation and Society," tracing some of the effects of the computer age on modern living.

C. W. Spangle, vice president and general manager of Honeywell EDP, will address the farewell luncheon on Friday.

The '67 educational program has been divided into five categories: workshops, seminars, management guidelines, and management and industry panels.

In the workshops, registrants will be divided according to the size of their installation: large-scale, medium-scale, and small-scale and unit record. In these sessions, the general topics will cover management of systems projects, operations and personnel.

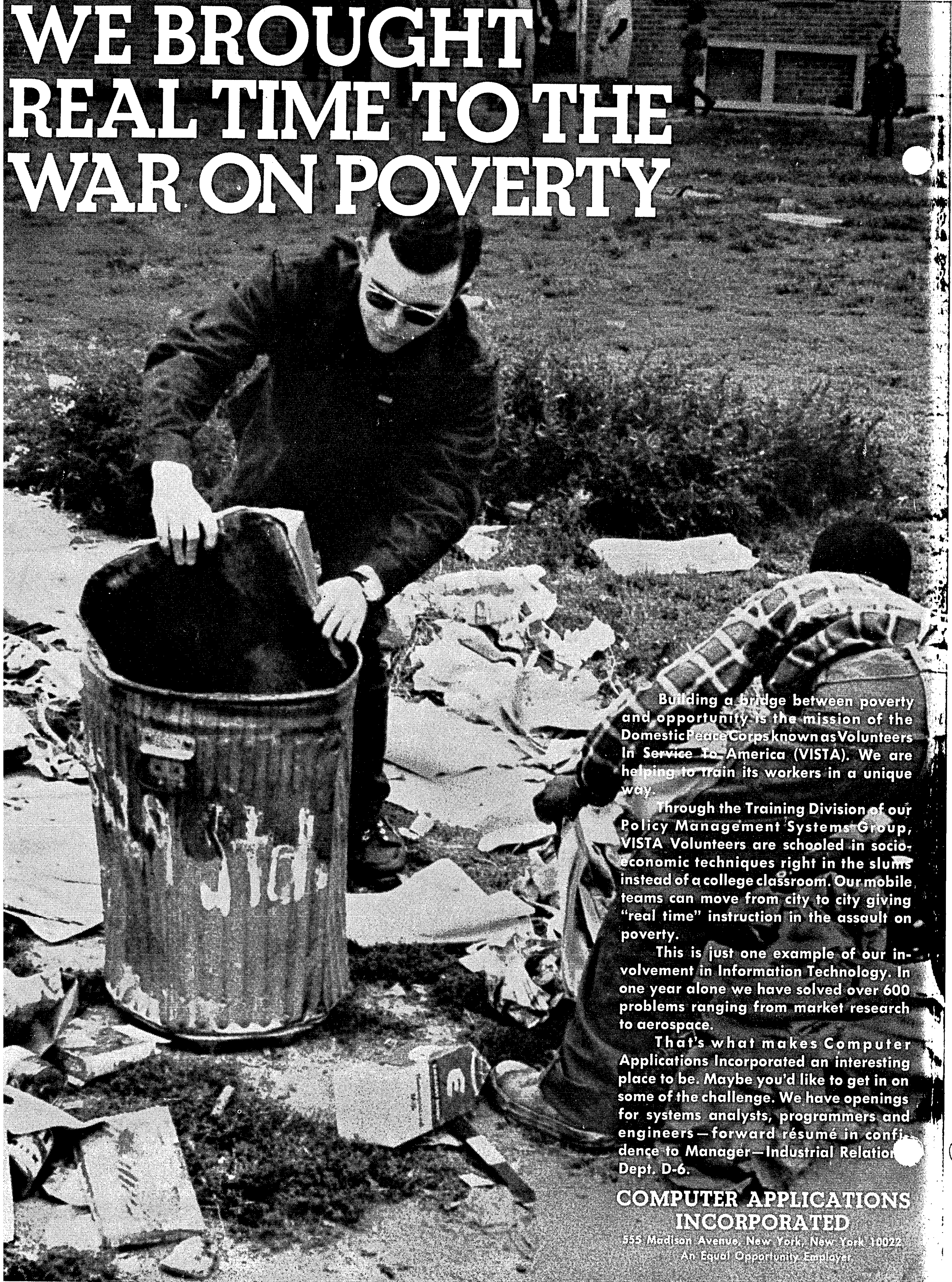
The management guidelines are designed to assist companies in the control of system, procedures, programming and operations. Three areas of discussion to be emphasized are budgeting and accounting, project scheduling, and personnel development.

Speakers at the management seminars will discuss financial models, problems with time-sharing techniques, decision tables, file organization in mass storage, optical character recognition, evaluation of operating systems, cybernetics in management information systems, motivation, creative thinking and heuristic programming.

The panel sessions have been divided into two general categories: management and industry. The changing nature of management, organizational dynamics, COBOL, private edp schools, sequential batch or direct access processing, communications, blue sky applications, and managing by crises, will be a few of the subjects discussed at the management

panels. A series of nine "how-to" industry panels will be presented by men who have designed, installed and operated a variety of installations in manufacturing, banking, insurance, utilities, distribution, municipal systems, educational institutions, retail systems and transportation.

In addition to the educational program, a few special features have been planned to lure the conferring managers into the historic environment. A Wednesday night clambake —at $10 per—promises to offer chicken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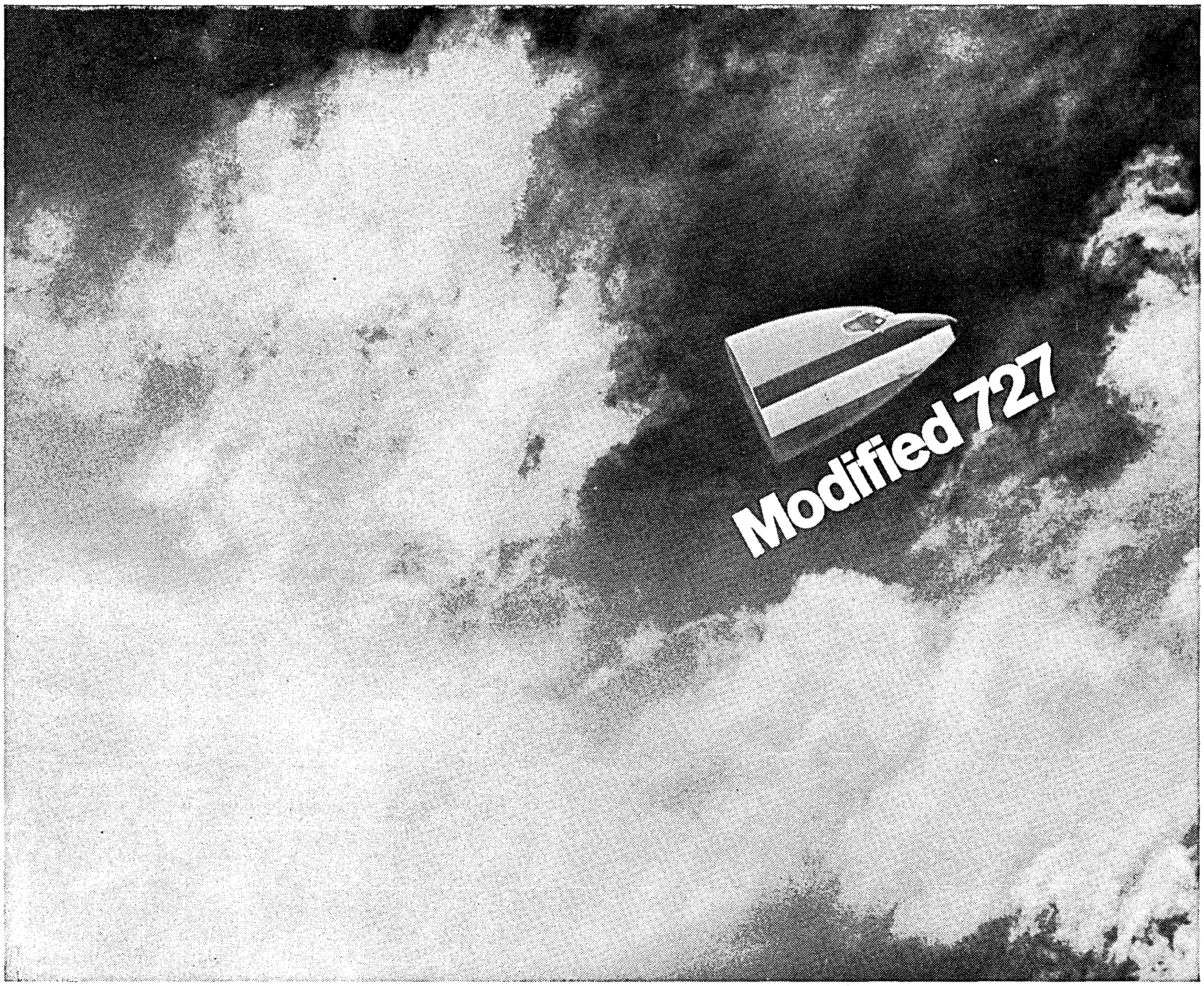
The chairman of the '67 conference is William J. Horne, director of corporate systems and data processing, United Shoe Machinery Corp., Boston.

Tuesday, June 20
8 a.m.-9 p.m.—Registration
8:30 a.m.-12 noon—Tour: Liberty Mutual Research Center
8:30 a.m.-12:30 p.m.—Tour: Internal Revenue Service
9 a.m.-12:30 p.m.—Tour: IBM Cambridge Scientific Center
1 p.m.-4:30 p.m.—Tour: U. S. Army Labs
1 p.m.-8 p.m.—Exhibit viewing
1 p.m.-5 p.m.—Tour: Honeywell Computer Division
1 p.m.-5 p.m.—Tour: General Motors Assembly Plant

Wednesday, June 21
8 a.m.-4 p.m.—Registration
9 a.m.-6 p.m.—Exhibit viewing
9:30 a.m.-11 a.m.—General Assembly
12 noon—Conference luncheon
2 p.m.-4:30 p.m.—Seminars and Workshops
5:30 p.m.—Clambake

Thursday, June 22
8 a.m.-4 p.m.—Registration
9 a.m.-11:30 a.m.—Seminars and Workshops
9 a.m.-6 p.m.—Exhibit viewing
12 noon—Conference luncheon
2 p.m.-4:30 p.m.—Seminars and Workshops
7 p.m.—Banquet

Friday, June 23
8 a.m.-12 noon—Registration
9 a.m.-11 a.m.—Seminars and Workshops
12 noon—Closing luncheon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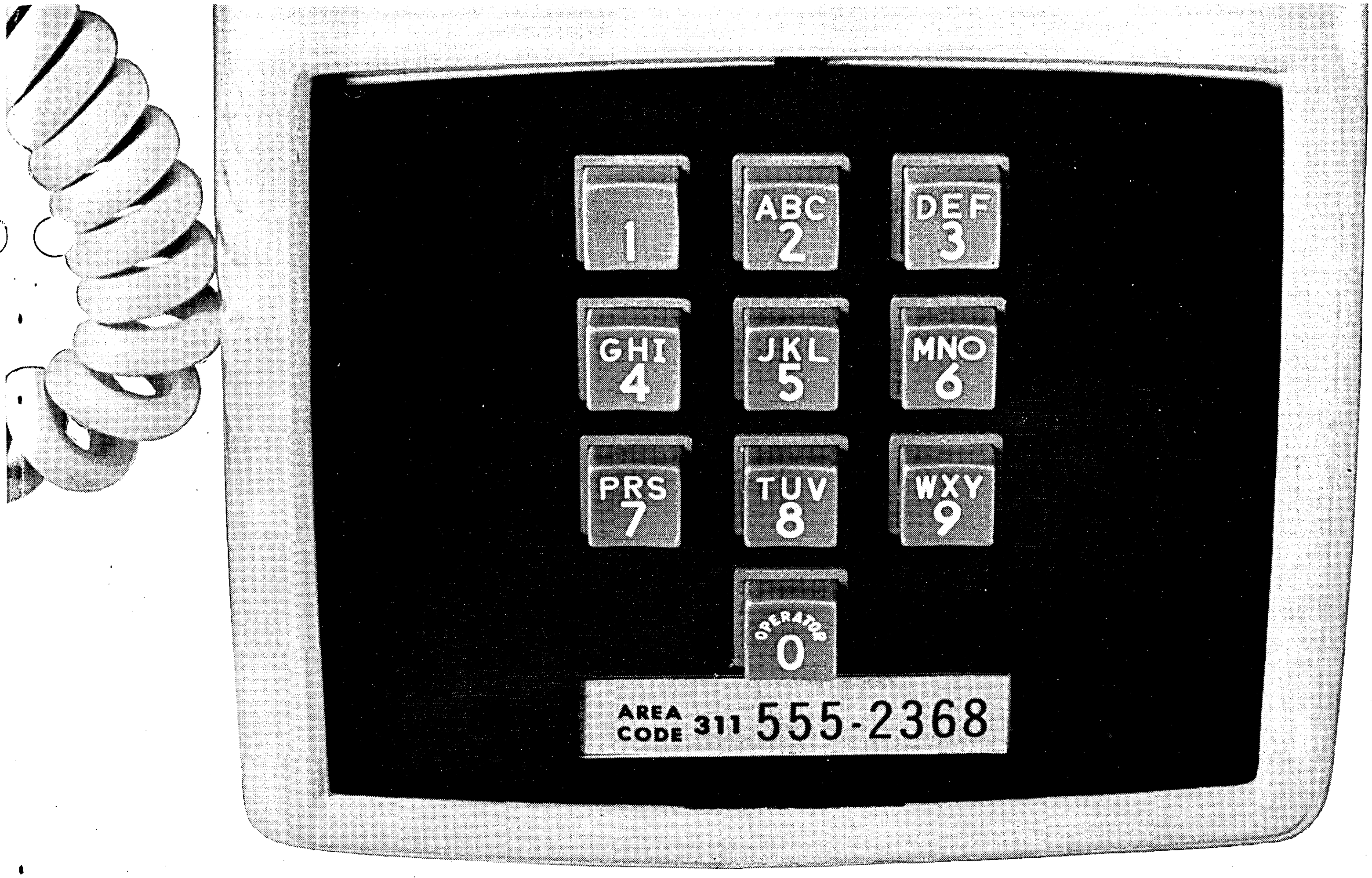

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CIRCLE 36 ON READER CARD

THE SJCC REPORT

bangles, baubles & cores

Registrants for the Spring Joint Computer Conference got little booklets in the mail before they left home, explaining how easy it is to get to Atlantic City. These were good for reading during the approach to the Philadelphia airport as the ceiling and visibility deteriorated to the point where James Cagney and Pat O'Brien would have given up trying to land their Ford Trimotor. From there on, members of the Ambassador Club mixed democratically with the Greyhound Group.

The weather stayed rainy and windy, even inside the hotel rooms, until the last day when some 5000 registrants and a total of over 7000 exhibit watchers had been checked in.

The exhibits were a triumph for the larger manufacturers, those with composers and choreographers in their advertising departments. It was possible to watch a movie at the SDS booth while listening to RCA's banjo players at the other end of the hall and still hear an occasional grumble from the mighty Wurlitzer, which played Auld Lang Syne as the exhibitors began to fold up their tents. Nearly every exhibitor had girls in very short skirts and very long stockings, but only Control Data had real go-go girls. Honeywell just had a robot, but it was a girl robot.

remote users

There wasn't much new equipment to be found in the displays of the large manufacturers. IBM had a Model 50 with terminals, their newly expanded 1130, and an experimental "home calculator." This was a Touch-Tone telephone from which visitors could dial a computer in New York and get voice answerback to arithmetic problems keyed in.

RCA, in addition to its musicians and enclosed communications show, had some time-sharing going and a Videocomp system on display. Honeywell had its robot and brought out the Emett Forget-Me-Not Computer again. NCR showed a Rod Memory Computer, Cram unit, and a new asynchronous tape perforator. Burroughs, as usual, displayed only fringe activities—including its new quad tape unit. And GE, whose little red schoolhouse has been packing them in for the last couple of years, didn't have a computer exhibit at all.

The smaller manufacturers and service firms were lighter on the hoopla but had more new things to show and talk about. SDS was running a Sigma 7 for the first time at a show, with a FORTRAN IV program in background mode and two real-time jobs underway. Another SDS machine, the 940, was in action at Com-Share, a time-sharing service bureau.

Systems Engineering Laboratories had an airplane simulator. An SEL 810A digital computer and CRT display reacted to throttle and attitude controls manipulated by visitors so that they could maneuver the plane in a simulated flight. Programming was done by Charles W. Adams Associates.

The Interdata 3 computer, announced early this year, was on display. So far 58 orders have been taken, mostly in the $11-15K range. Prime competitor Digital Equipment Corp. had a new low-cost disc memory module for their fast-moving PDP-8 and 8/S. More than 1500 of these have been sold, a fact that registered on Vermont Research to the extent that they had a bargain drum at the show to be used as a memory extender for the 8/S. It adds 131K words for $9950, sells for even less with fewer heads, and can be joined to other small machines with minor interface changes. DEC also had a PDP-10 on hand. It was playing organ-like music, in keeping with the Barnum & Bailey theme of the show.

OEM suppliers were in full cry. Rixon was luxuriating in a 400-unit sale of the Sebit-48M data set to University Computing and another order for 70 copies from the Service Bureau Corp.

Sanders Associates had a good crowd to admire its 720 display and sturdy core memory, now commercially available. New orders for the 720 have been received from Illinois Bell (30), Harris Trust in Chicago (12), and the Chicago Police Dept.

A new entry in the fast-growing

plotter business was the DP-203 from GeoSpace Computer Division, a digital CRT-to-film unit which can be attached to such computers as the IBM 1130 and 360/44 and is marketed by IBM as well as GeoSpace.

prizes & products

Software, consulting, and time-sharing service groups were out in force, with Advanced Computer Techniques drawing massive crowds to get free copies of a jigsaw puzzle (a comment on Atlantic City night life?) which was reported to be a real bear to put together and rewarded the diligent with a replica of the company's recent *Wall Street Journal* ad.

Xerox and 3M furthered their flirtation with the computer users, the former demonstrating its machine to shrink and reproduce printout forms, and 3M introducing a dry-process copier using ultrasensitive paper to register CRT displays in hard-copy form. It can be added to a terminal for around $50/month, with total costs depending on volume of copies.

Electronic Associates was another one with an enclosed booth. Patient queuers were subjected to arguments

in favor of hybrids by smiling ladies who had recently learned to pronounce the technical words phonetically ("the analog computer is like a phys-i-cist and the digital computer is like an accountant—very *fussy* and has to have *every*thing in *num*bers").

While this extravaganza was going on, the sessions were getting under way. (See News Briefs for further reports.)

Keynote speaker was Rep. Cornelius E. Gallagher (D., N.J.) who enlarged on recent talks warning of the dangers of computerized invasion of privacy—particularly in the form of the Budget Bureau's proposed national data bank. Stanley Rothman of TRW Systems and Alan Westin of Columbia Univ. also commented on the problem, with Rothman taking the position that adequate planning for use of safeguards now available should lead to appropriate solutions.

At a press conference later, Gallagher used the occasion to make the first announcement of his planned committee hearings on credit bureaus to assess the dangers to personal privacy from that direction.

more privacy

Wednesday morning, after the session chaired by Willis Ware dealing with security and privacy in computer systems, some old hands in the time-sharing business got down to practical matters in a panel discussion of the privacy problem, with examples from their own operations.

The panelists were Dr. Robert Galati of the New York State Identification and Intelligence System, James Babcock of Allen-Babcock Computing, and Edward Glaser of MIT's MAC.

The comments of most interest were those that might be considered supplementary to Rep. Gallagher's position—in that the panel participants considered some of the ways that time-sharing systems may improve the chances of maintaining privacy.

Babcock noted, for example, that in the past it was impossible to have secure information systems as long as they were manual. Time-sharing, he said, is the latest step in assuring security since it even gets the programmers out of the machine room.

Glaser said that the "computer makes it easier to invade privacy but also easier to protect it." And he reminded the audience that "for $50 worth of phone calls you can find out anything about anybody in this country." Systems should be compartmented, he said, and this is already being done anyway to simplify check-out procedures.

A question from the floor: Isn't it a waste of time to guard the computer system but not the communications lines? Babcock's answer: If you don't think your phone line is secure, call the Justice Department.

A special session on Thursday, chaired by James Anderson, brought together some top management members for a panel discussion of management conditions needed for successful use of management information systems. Only two of the five panelists listed in the program showed up: Bruce Curry of RCA and A. D. Norelli of Union Carbide. A later recruit was Eric Waldbaum of E. J. Korvette.

Curry said he thought there was a payoff on MIS but that he was against the theme that we would all be wired in by CRT's soon. "Fanciful articles," he said, "create a major obstacle to management information systems," presumably because they inflame the managers who are soon disenchanted and then want nothing to do with

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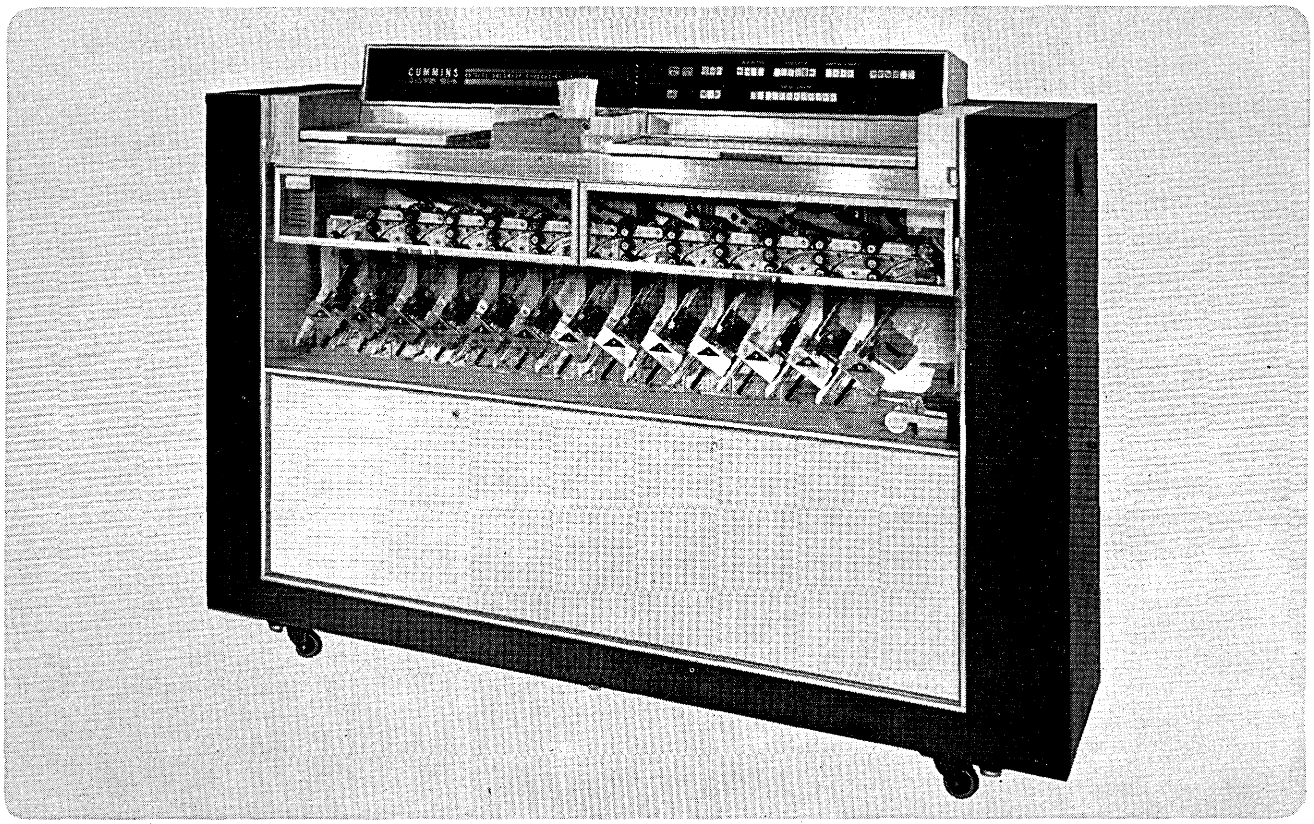

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MIS. He stressed the idea that such systems must be designed to consider the needs of all levels of management—executive, staff, and operational. Who needs what varies greatly with the type of business: the top management of an airline cares about daily details while it's middle management in some businesses.

Curry noted that RCA is just starting an MIS course for management and has about 300 executives signed up.

Norelli, describing the MIS activities at Union Carbide, said, "We are now installing the kind of data processing operational systems that we were talking about 10 years ago." One area of particular success in their operations has been use of computer analysis to determine the proper product mix to fit market conditions.

Carrying on the theme of management's need to know which level of management needs detailed information, Waldbaum pointed out that in retailing it is the lower levels who act on data received before top management even sees it.

All participants agreed on the essential need for involvement of management in any design efforts leading to information systems.

system standardization

The conference banquet speaker was Maj. Gen. J. W. O'Neill, commander of the Air Force Electronic Systems Div. He reviewed Air Force activities in using computers to improve support for management, command, scientific applications, and operations. In describing the proliferation of computer makes and programming languages at AF facilities, he summarized the need for some degree of standardization—a need that will presumably be partially met by the recent award of the big Phase 2 contract to IBM.

As the weary hordes scrambled for transportation home, the general conclusion on Atlantic City as a convention site seemed to be that that's the only thing it's good for. The hall is big enough for even more exhibitors with even more gaudy displays; the hotels are ample, if beat-up, and conveniently clustered; and visitors are attracted to both the exhibits and the sessions since there's nothing else to do.

We would like to take this opportunity to deny a rumor heard at our booth that the enormous demand for DATAMATION bags at the show was caused by the Viet Cong using them to carry their supplies south. ■

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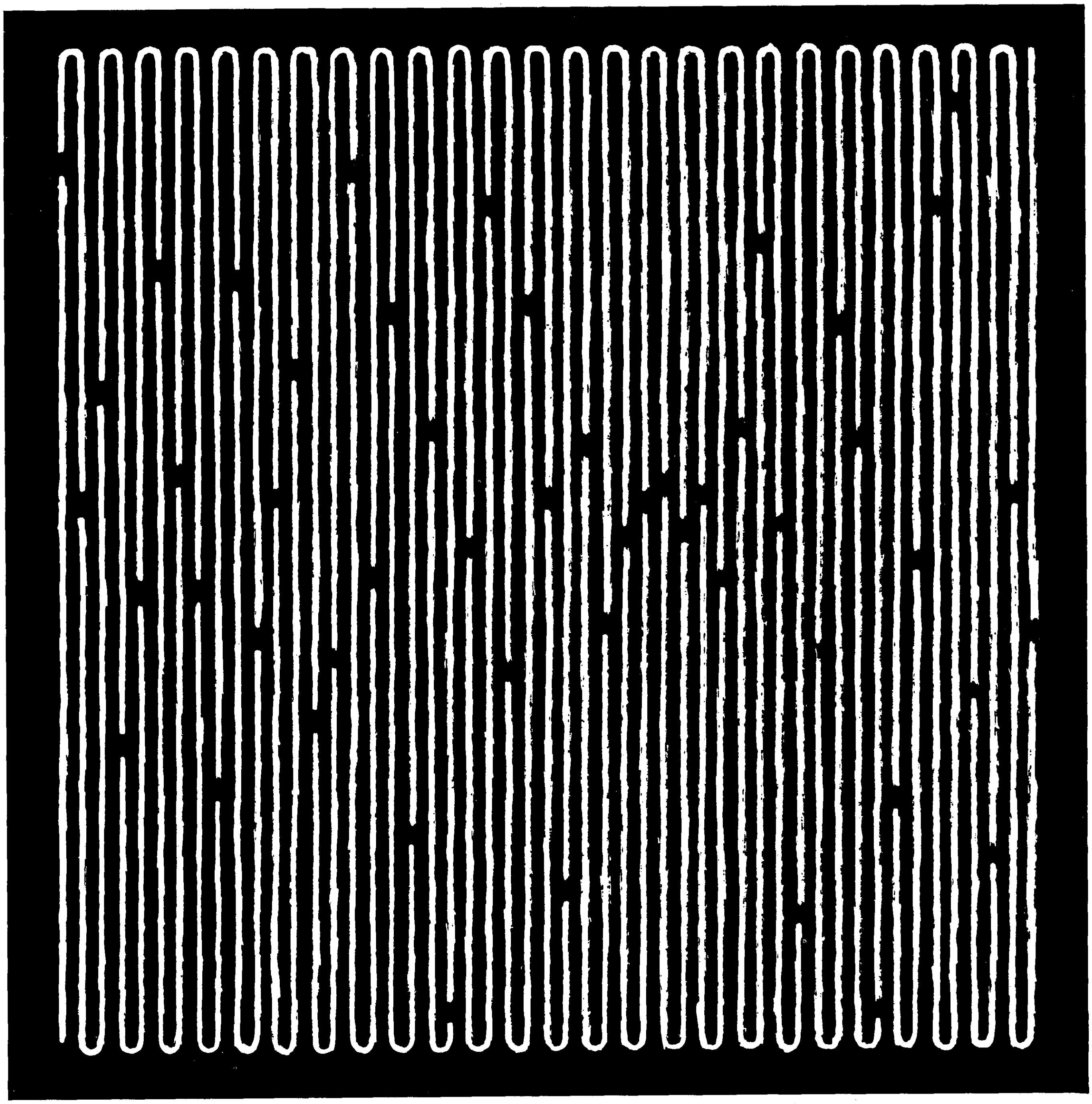

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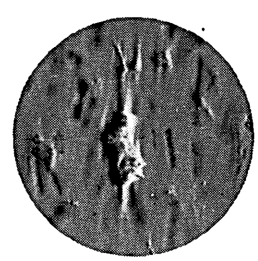

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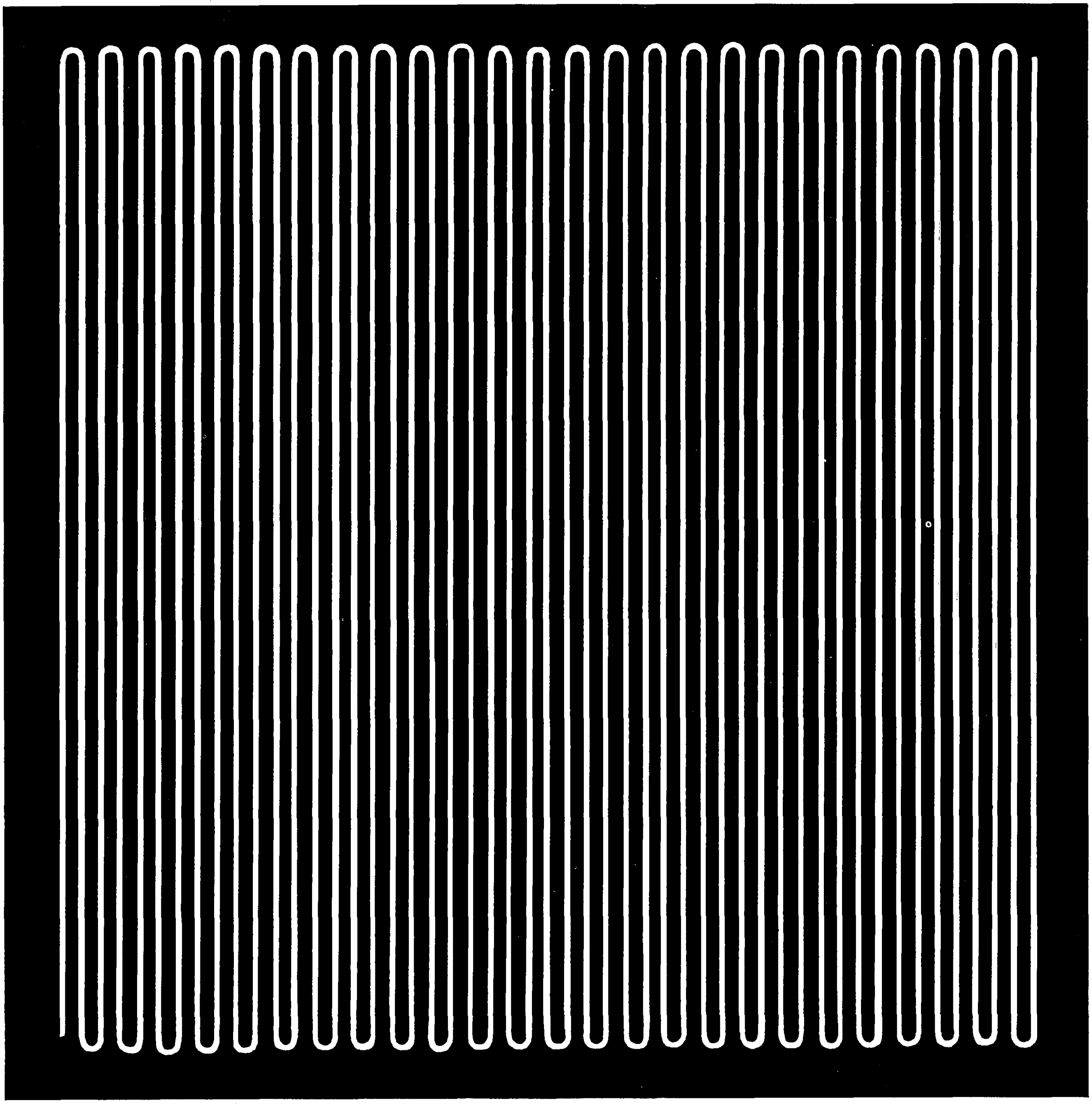

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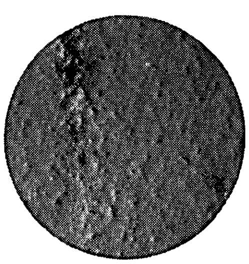

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the schizophrenia-free computer

It's not that all those other, conventional digital machines are mentally ill. But they do show signs of split personality when forced to process analog signals. Not so with Ambilog 200.

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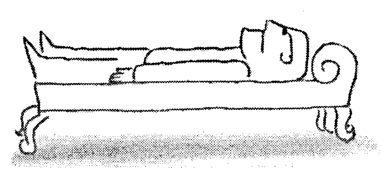
Ambilog 200 simply cannot be compared with conventional machines. It offers far greater computing power per unit cost. And when it comes to communicating with the analog world, Ambilog 200 doesn't need special adapters or extra linkages.

Ambilog 200 is a fully modular gp computer with a wide range of expansion options and I/O peripherals. System software includes a monitoring and operating system with on-line editing and debugging, and a self-extending macro assembler. Fortran, too. (We're at least that conventional.)

Perhaps you have an on-line application involving data acquisition and reduction, or signal analysis, simulation, or computer graphics. You could help support mental health by considering Ambilog 200.

At least it might help keep you off the couch.



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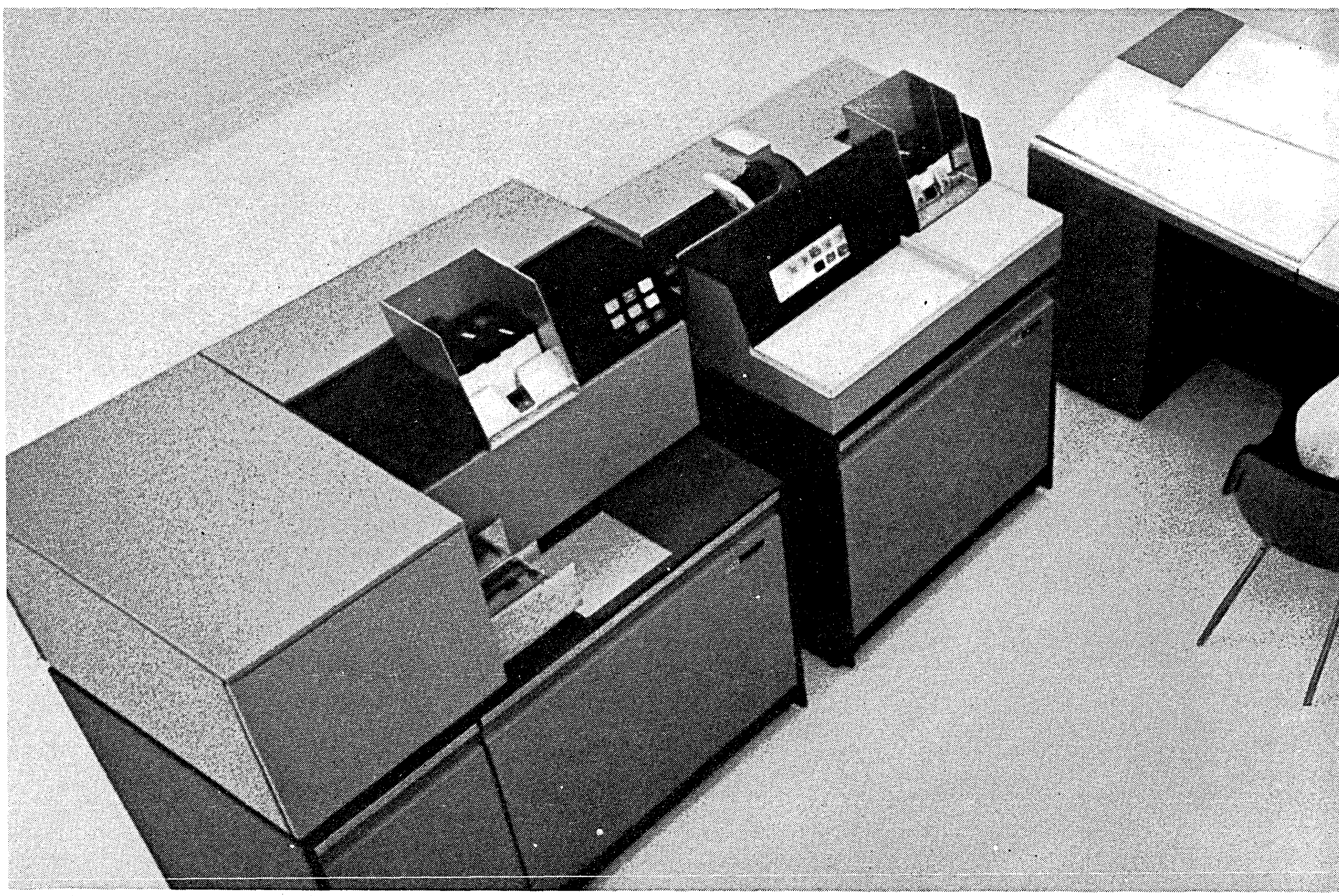
CIRCLE 43 ON READER CARD

IBM announces:

big computer features for the "little" 1130.



Now you can get a faster, more powerful, more responsive IBM 1130 Computing System. We've just introduced five new CPU models. We've extended the range of input/output speeds and on-line storage capacities. And we've improved data communications capabilities for the 1130.

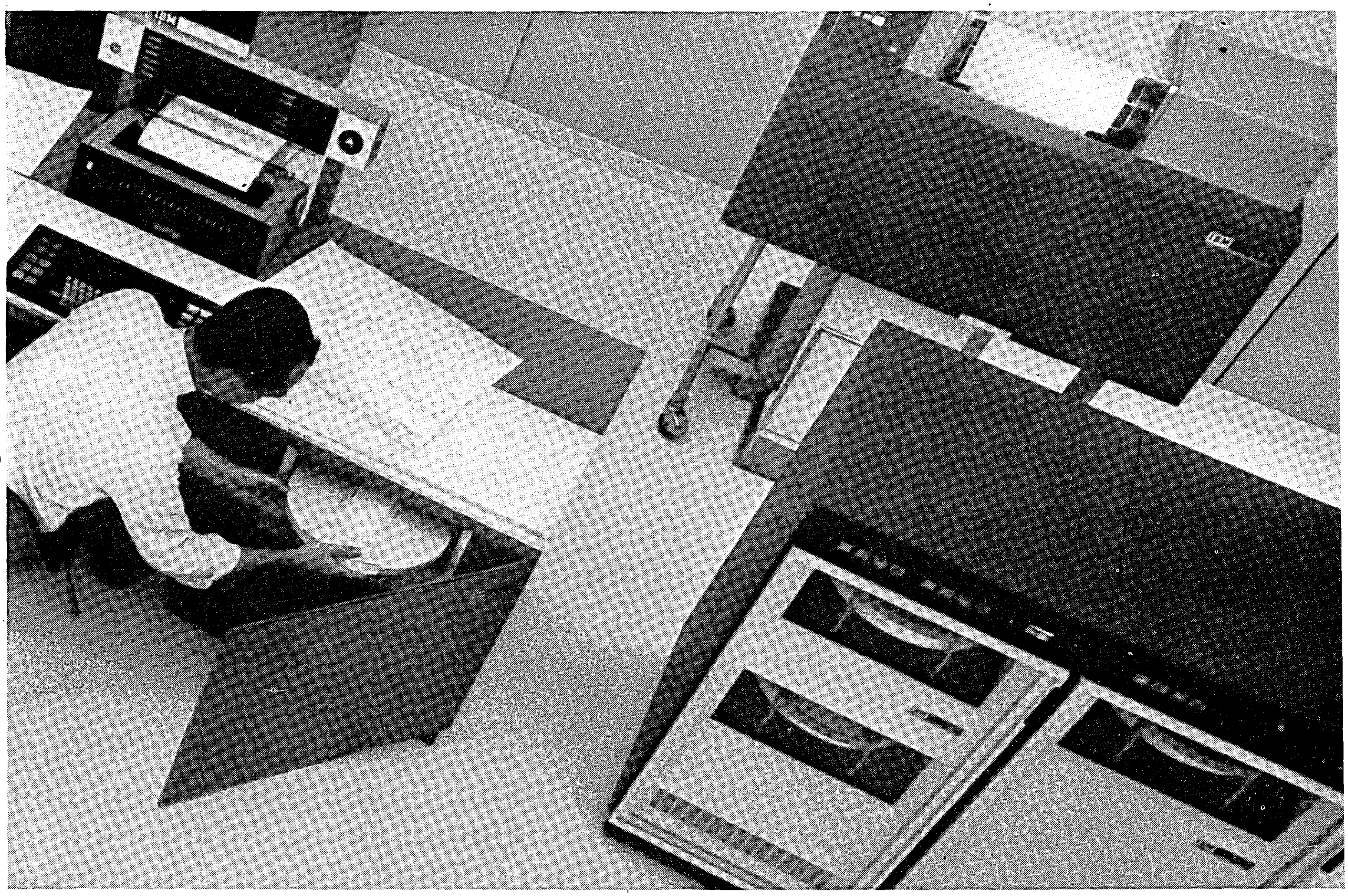
In short, we've enhanced the present 1130 line so it can grow as your needs grow. Now you can get an 1130 that will tackle the big jobs—an 1130 with bigger capacities and faster throughput.

Five new CPU's. Now you have a wider choice of core sizes and speeds. We've added five new CPU's for a total of nine. You can get an 1130 with 4K, 8K, 16K or 32K words of core, depending on your requirements. And you have a choice of two memory speeds.

Up to five disk drives. Now you can hook on up to five disk drives for an on-line capacity of 2,560,000 words. All five disks can be operated simultaneously. Since the drives use interchangeable disk cartridges, you can amass unlimited off-line storage.

Faster printers and readers. Take your pick of three printers with speeds ranging up to 600 lines a minute. Choose one of four card readers with speeds ranging from 300 to 1000 cards a minute. You can even add an optical mark page reader. With an expanded line of I/O gear, you can put the 1130 to work on a wider range of applications.

Improved data communications. With the improved Synchronous Communications Adapter, the 1130 can become an economical terminal for your



SYSTEM/360 while retaining its stand-alone computing power. The adapter can transmit at 2400 bits per second in either of two modes—Synchronous Transmit Receive (STR) or Binary Synchronous (BSC) depending on your interfaces and programs. With the addition of BSC, you get more efficient, more flexible data transmission because it is code-insensitive.

New Disk Monitor System. IBM supports the 1130 with a Disk Monitor System which includes a FORTRAN compiler, a Supervisor Program, a Disk Utility Program, an Assembly Program and a Subroutine Library.

Then, there's quite an array of application programs already available for the 1130. In the engineering fields, for example, there are programs for civil engineering, programs for petroleum engineering and exploration, programs for gear and spring design. There are scientific subroutines, linear programming and project control programs. There are commercial subroutines for applications like payroll and cost accounting.

Room for growth. With the expanded capabilities of the IBM 1130, you have a system that will grow with you. As your company or department grows, as your data processing applications become more numerous, your 1130 will keep right in step. Extended capabilities, powerful programming support, versatility, growth potential. These are the things you get, along with IBM service, from the 1130, our "little" computer.

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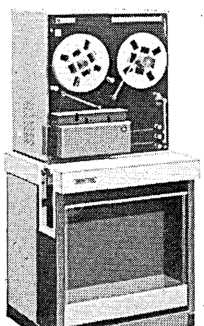
A computer cannot express direct dissatisfaction with her peripheral system. But there are ways you can tell. Lagging input, a piled up printout job or too much off-the-job time. FUJITSU can satisfy you AND your computer with a perfect range of high-performance peripheral equipment. Each component has high-speed treating capability and fieldproven reliability backed up by our proven technology. Hire them and your computer will take a new lease on efficient operation.



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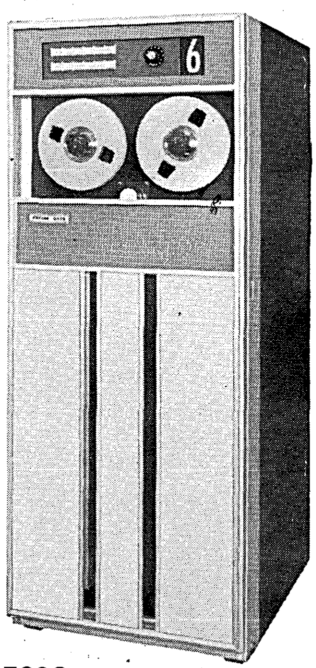

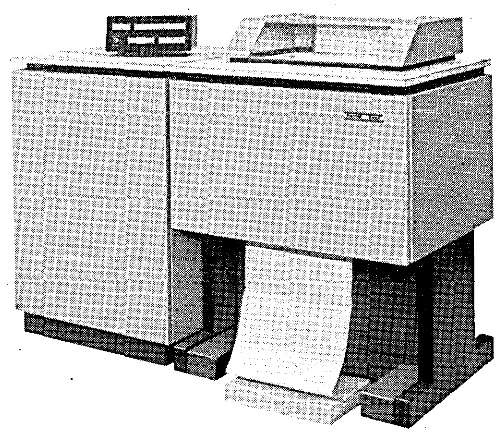

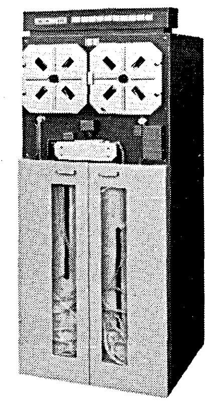

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Rugged, high-speed printer with wide compatibility. Printing speeds: 500—1,500 lines/min. Number of printable characters: 16—109. 136 columns. Low-speed model F643 also available—400—120 lines/min. Number of printable characters: 50 or 100. 80 columns.

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CIRCLE 47 ON READER CARD

news briefs

$100-MILLION CONTRACT STAYS WITH IBM, AF SAYS

Honeywell, Burroughs, and RCA have met with Air Force Secretary Harold Brown to file protests over the April selection of IBM for the largest-ever single edp contract—the $100-million-plus Phase II Base Level Automation Standardization program. Reportedly, the questions were: why did the AF go for a bid that was $50 million more than the others, and how about a re-evaluation?

The AF reply was that it doesn't recognize any difference in the price because "you can't compare apples and oranges," the three losers not having passed all mandatory requirements. The AF will continue to answer all questions from vendors, a spokesman says. Thus, the only alternative left to the losers is to take the issue to "higher authority," which may still occur.

The Air Force has not announced the figures of the bids, and the contents of the protests have not been made public, but one source says that IBM's bid was for $115 million purchase price (purchase and/or lease decision to be announced in July) for 135 systems, and $20 million for maintenance over six years. The Phase II contract calls initially for 100-160 compatible systems capable of 100% modularity (whatever that means), but it ultimately could contain or be tied into other major programs, namely the personnel data system now in NCR 390's around the world, which will probably begin to be replaced by 1969, and the Base Level Supply system with over 160 Univac 1050's (some still being installed) which has at least five years more of life. The AF says that even if the personnel system is included under Phase II, other manufacturers will of course have, as always, equal opportunity with IBM in going after subsequent contracts. But one source says that the Phase II selection will undoubtedly discourage bids (which for this contract cost each bidder upwards of $1 million) for any AF procurements, and particularly noted that some decisions have already been made not to bid on the 10- to 12-system Air Force Logistics Command program. Phase II, this source said, is interpreted by many manufacturers as a movement toward total one-manufacturer business systems on most bases.

The AF computer selection procedure has been the most highly touted in the government—indeed in the computer field. And this particular set of specifications, aiming at standardization, system compatibility and modularity to improve efficiency and cut costs, has been called a framework upon which many agencies and firms will be building their own specs. But several criticisms have been leveled at the point-grading system on the evaluation criteria, which generally are cost, support, technical performance, and benchmark tests. Further, one bidder feels that the relative value applied to each of these criteria should be divulged, although it has not been AF policy to do so.

Among the rumors that crackled after the selection was that IBM's bid did not meet specifications. The AF, annoyed at the allegation that they would chuck the foot-high specs developed after countless meetings of selection and command personnel and based on years of mass-procurement experience, emphasized that there were basic requirements and IBM met every one of them.

The reason a bidder loses is never divulged to the public, but at least one problem that reportedly lost points for RCA was the use of the new Friden 7311 terminal which still had several bugs in it at the time of the tests. Burroughs also used and had trouble with the unit, but the firm moved to the IBM 1050 it had on hand for the test.

The systems that were bid to replace the Phase I B-263's (over 160), IBM 1401's, and RCA 301's (about 25) were the IBM 360/30 and 40, a modified Burroughs 2500 (the 2503), the Honeywell 1200 and 2200, and the RCA Spectra 70/35 and 45. The mysterious Univac, it turned out, had pulled out of the contest five days before the bids were due last year because the AF required the award be on a year-to-year, fixed-price basis, and Univac feels that if fixed price is required, the contract should also be multi-year—ironically, a reason IBM was rumored early in the year to have withdrawn from the bidding.

SPACEBORNE COMPUTER NEEDS OUTLINED BY NASA

At a briefing for industry last month, NASA outlined its systems needs as space missions are measured not in the number of orbits but in years of travel, and as vehicles become subjected to intense heat in the several hundred degrees Centigrade range. Speaking of these needs, Gene G. Mannella of NASA's Electronics Research Center in Cambridge, Mass., said: "Techniques must be developed which will permit elementary decision functions aboard unmanned vehicles for alteration of mission profiles without continuous recourse to human intervention and, ultimately, to a more sophisticated type of integrated experiments package in which the instrumentation comprises a laboratory which is controlled continuously by the on-board computer."

The computer, Mannella said, should be a multiprocessor system with a "pool of identical memory and processing elements switched into appropriate combinations as one or more tasks demand service." The multiprocessor organization would have the advantage of being able to serve many different functions on a mission without being subject to the catastrophic failure of the single processor. Two key hardware advances offering hope for multiprocessing are microelectronic and batch fabrication techniques, which could provide volume reduction and higher memory capacities, Mannella added. (The laminated ferrite stack reportedly represents a 75:1 volume reduction over the memory of an IBM 7094.) The trend toward LSI will help in achieving additional advantages, he said. Also, he added, software—particularly computer languages and programming concepts—must advance correspondingly.

Speaking on microelectronics, NASA's W. Crawford Dunlap noted that "the Apollo computer represents one of the most advanced operational microcircuit applications." This computer has 5,600 micrologic gates that are the equivalent component count of 39,200 resistors and transistors.

The computer requirement for the year 2000 on a planetary explorer, Dunlap said, will be "cognitive multiprocessor" capable of processing up to 99% of the raw data on board in order to minimize the communications problem. It will probably have to provide as many as 10^{10} logic elements and 10^9 memory bits to do it, and still be the same size as the one cubic foot Apollo computer, he added.

"The solar probe, which may involve a spacecraft orbiting only 4.5 million miles from the sun, in an ambient of about 500-800°C., depending on the thermal shielding, will require dp equipment . . . outside the scope of presently available circuitry. The same may be said for the Venus lander, which may have to operate for days, weeks, or months, on the surface of Venus at more than 400° C."

The current silicon monolithic structures are not suitable for environments above 150-175° C. Thus the question is, should the silicon be replaced with a higher temperature material? Use thin-film electronics which may have a high range? Or use vacuum tube microelectronics? NASA, Dunlap said, is working on all three areas.

BILLS, BILLS, BILLS AND GOVERNMENT EDP

Congress is pregnant with plans for applying systems analysis and dp to government administration, but whether any offspring will result, and when, is problematical.

The bill with the best chance of enactment this session is probably S355, the proposed Legislative Reorganization Act. Passed by the Senate in March, it awaits the pleasure of the House Rules Committee. S355 empowers BOB, GAO, and Treasury to set up a government-wide standard classification system for budgetary and fiscal information, and a dp system for dishing up this data in response to Congressional needs. The bill also establishes a Joint Committee on Congressional Operations to study potential applications within Congress, and authorizes the Legislative Reference Service, renamed the Legislative Research Service, to acquire and operate a dp system.

In the first session of this Congress, Sen. Ted Kennedy introduced SJ187 to study the feasibility of an information retrieval system capable of serving all three government levels. Basically, data on federal aid programs would be cranked in, together with progress reports and evaluations. Applicants for grants would consult this data base to find out whether they were eligible, how much and what kind of assistance they could qualify for. Federal officials would tap off management information periodically. SJ187 didn't get very far last session, but Kennedy was preparing to reintroduce the bill as we went to press.

Sen. Edmund Muskie has introduced two bills (S1485 and S699) which would help underwrite state and local personnel administration programs. A major aim is to develop better methods. Projects using dp are specifically included. The bills also would help support the training of state and local dp technicians, among other specialists. Non-government agencies could be hired as teachers. Hearings were recently held on S1485 and S699, and legislation should be reported out soon.

Another Muskie bill (Senate Resolution 68) would establish a Senate committee on Technology and the Human Environment, to study the future impact of machines on man, including computers. The committee is to report in 1970. This proposal received a hearing in April. Four other bills along the same general lines have been introduced:

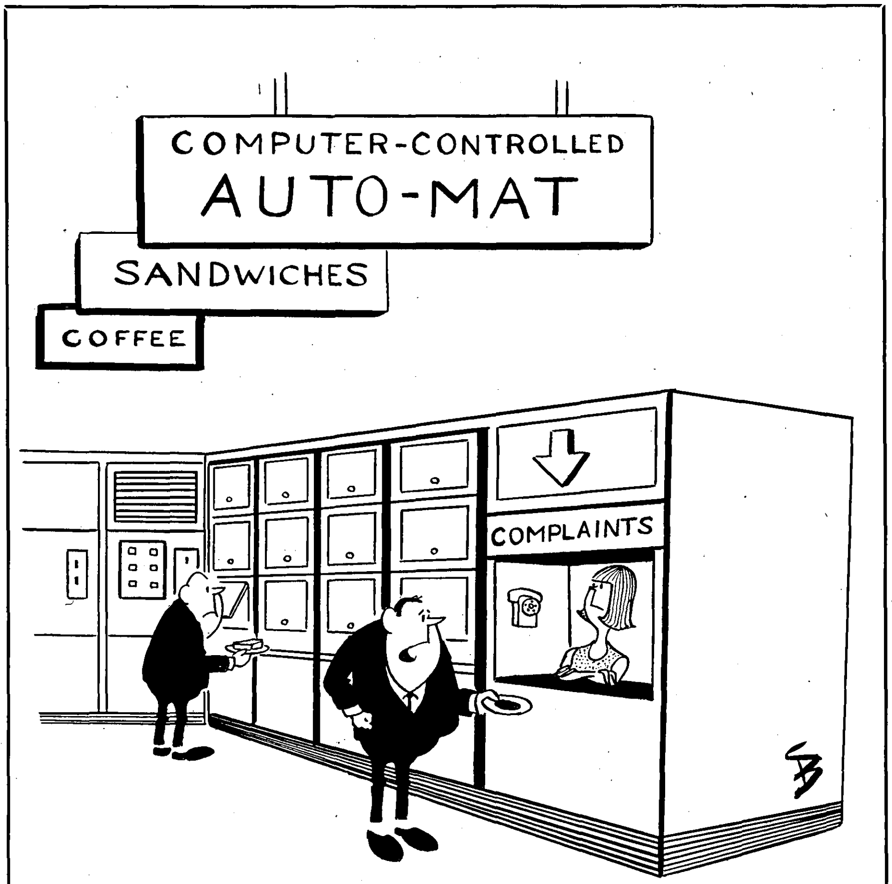
S467, authored by Hugh Scott, would set up a National Committee on Public Management; the House version, HR20, was introduced by Brad Morse, of Massachusetts; HR 6698, proposed by Rep. Emilio Daddario, Connecticut, provides for a Technology Assessment Board. In each case, the group would be composed largely of non-government experts. Meanwhile, Sen Gaylord Nelson, of Wisconsin, has introduced S430, to underwrite systems analysis studies of national problems by federal, state, and local governments with outside help.

GSA MOVES TO IMPLEMENT BROOKS BILL

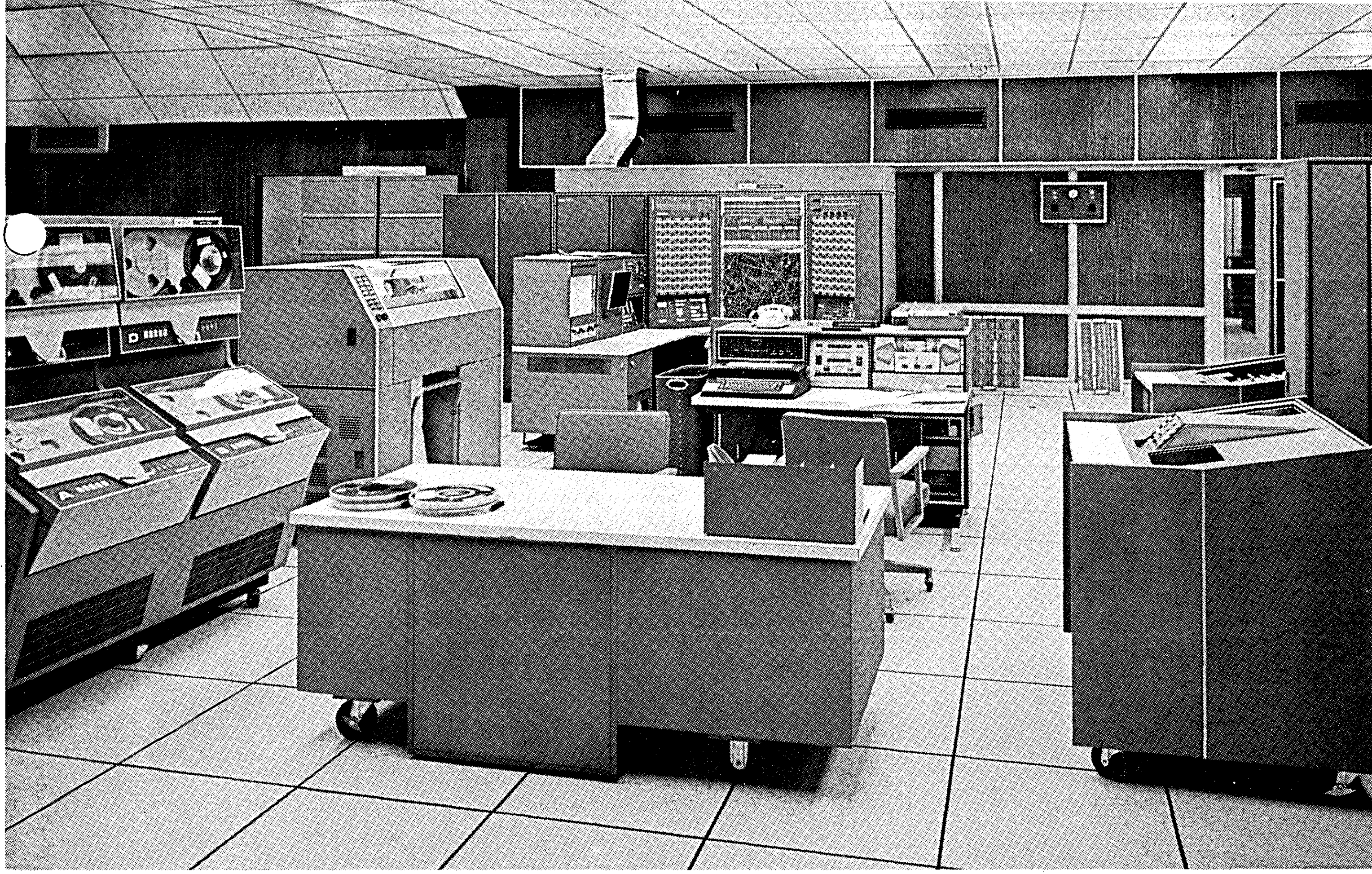
GSA will purchase 14 computer systems presently leased by federal agencies, establish inter-agency dp networks, centralized tape-cleaning and certifying facilities, and may finance prototype development of a new data reduction system in fiscal '68, if Congress approves.

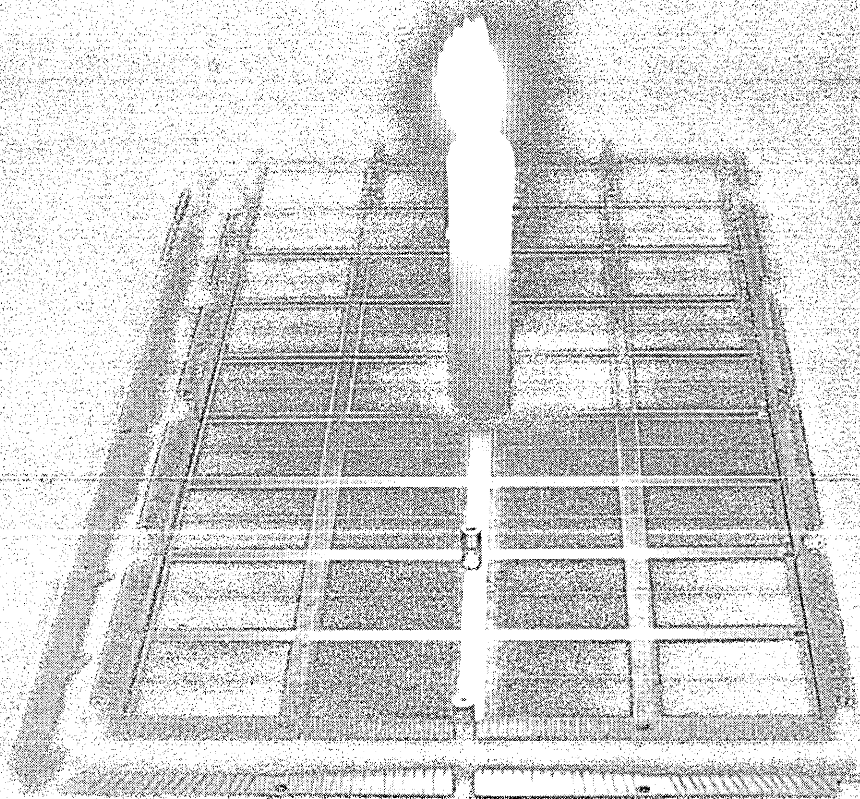
The approval will consist of appropriating $10 million to launch, in fiscal '68, the revolving fund authorized by the Brooks bill. These plans were described at a House Appropriations subcommittee hearing in March; the testimony was released recently. The Congressmen were receptive, so GSA probably will get the money. The hearings also revealed that federal agencies requesting appropriations to acquire dp equipment will be out of luck if suitable excess gear is available, or sharing is practical. The management information system that GSA is setting up to control dp equipment inventories should go operational this month; BOB hearing examiners will rely on it to evaluate all related procurement proposals.

DOD and VA will be among the first beneficiaries of the plan to use the revolving fund for equipment purchases. Reportedly, up to $5 million



'There's a transistor in my soup'





has been earmarked for this purpose.

Another $1 million is earmarked for in-house mag tape cleaning facilities. The Air Force will do the work for other federal agencies. AF now operates 23 cleaning plants throughout the U.S. Centralized tape certification will be handled by another federal agency, at a facility located in the Washington, D.C. area.

An unspecified amount will be invested in inter-agency dp networks linking third generation computers operated by certain agencies to remote installations operated by others. NASA's Slidell, La., facility is one likely nucleus; another is Navy equipment in southern California.

The new data reduction system utilizes a small bismuth-coated or nickel foil tablet. Data is "drilled" in by a concentrated electron beam (a laser has not been tried, but it's a possibility). A tablet less than 2 in. in diameter reportedly stores all the data on a 2400-foot reel of half-inch mag tape. The system was developed by John Dove, a civilian engineer at the Rome, N.Y., Air Development Center. He was aided by Braddock, Dunn, and McDonald, a scientific-engineering development firm. Besides GSA and the Air Force, Bryant Computer Products, IBM, Univac, and Litton are reportedly interested. Right now, the system is only a breadboard. About $250K is needed to build a prototype, which is where the revolving fund comes in.

GSA also disclosed, at the hearing, that it plans to hire 15 more dp managers. The federal government expects to acquire about $410 million worth of computing gear in fiscal '68, versus $398 million in '67.

USER ROYALTIES REQUIRED BY COPYRIGHT BILL

The hassle over the pending copyright bill entered the final round this month after Sen. John McClellan's Judiciary subcommittee collected several days' testimony on computers. Despite, or perhaps because of, the extended discussion, the Senate is likely to approve a bill patterned closely after the measure which the House passed early this year.

That bill (HR 2512) requires computer users to pay royalties, or at least get prior permission, before inputting or outputting virtually any copyrighted work, including computer programs. Educators contend the House bill is inconsistent because it permits copyrighted material to be used royalty-free in conventional classrooms but takes away this freedom if the same material is used in a computer-assisted instruction system.

Presidential Science Adviser Donald F. Hornig sent a letter to Sen. McClellan, near the end of the hearing, suggesting that the pending legislation would hobble programmed instruction and information retrieval systems being sponsored by the federal government. Spokesmen for the Interuniversity Communications Council (EDUCOM), Electronic Industries Assn., and other groups had said as much earlier.

Dr. Hornig wanted DOD, NASA, and other big federal users of automated information handling systems to have their day in the committee room. He also reported that COSATI, the scientific clearing house within the Executive branch, should complete a study of the copyright law's impact sometime this month. Sen. McClellan agreed to give the agencies a day to present their case; also, the COSATI report will be added to the hearing record.

Frank Merriwell frequently saved the day by appearing at the last minute, but Dr. Hornig, according to many observers, will be less successful. The House, they point out, spent years drafting a new copyright bill, and isn't likely to welcome far-reaching, last-minute revisions, particularly when proposed to the Senate first.

Privately, several computer users say they can live with the bill as is. Much of the argument about infringement, they admit, is rhetorical, since IBM, RCA, and GE, the chief producers of computerized information handling equipment, have publishing affiliates and aren't about to sue themselves or their customers. Users think an advisory commission could ameliorate any other problems. A strong push is being made to provide for one in the pending bill.

SUPER-SCALE COMPUTER PROPOSED BY ELLIOTT

For more than two years there have been murmurings among French, German and British manufacturers that they intend to resist the American invasions into the big scientific, university and time-sharing markets. With some costly experience behind them, however, they have been reluctant to turn their threats into promises. But at the beginning of May, Elliott Automation summoned up courage and made the first really big bid for a market that could escalate to way over $200 million by 1975.

Elliott is proposing to develop two new systems called the 4140 and 4140-4150. There is one proviso. They are asking the British government to guarantee six orders for universities, science research councils, and defence establishments. To the trained American commercial eye, this may smack of a smart piece of horse trading somewhere along the line.

As it happens, this ain't so. For Elliott could well have come up with a proposal that will get Britain, and other European governments such as France and Germany, out of a jam.

The story dates back to January '66 when a special committee, chaired by Professor Brian Flowers, produced far-reaching recommendations for the establishment of a national system of computers for science and universities. The scheme was to be based on a number of regional centers; (archivists who probe the past performance of DATAMATION will find that this proposal was officially accepted as a splendid idea). But there have been delays.

The proposals were put to a government which is committed to bolstering a national industry. But in their no-holds-barred report, the Flowers Committee underlined the supremacy of the U.S. in large machine development. It went as far as to say that the big systems for the future were not available from the U.K.

Specifying these much needed super-processors in general terms, they recommended machines of up to 100 times the power of 7090's for their advanced program. The past 18 months has seen some argument behind locked government doors. But the question of who develops the big machines remained unanswered. Against this background, Elliott decided to jump in. They have made some big machine proposals to the government, universities and whoever else will listen.

The Elliott men have set out to meet the requirements put down by the Flowers Committee.

The 4140 is constructed from fast integrated circuits and core stores of 128K and 650 and 350 nanoseconds cycle time. The system is 24 bit words. It uses paging, but with special small pages of 64 words, and segmentation. Backing store is a 4 million word drum. Tapes and discs make up the file hierarchy. In various configurations, it will batch process with some modest time-sharing. Prices are $1 million to $2.8 million. For going really big, the 4150 is added. It is six times faster and handles all the number crunching requirements of the biggest system. The 4140-4150 combinations come in the $4 to $6 million class. Store sizes are two modules of 128K 350 nanoseconds and expansion in 128K modules, plus a store organiser

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Total system responsiveness, computing power and the flexibility to handle two complex time-critical hybrid programs concurrently are just a few of the characteristics that make up McDonnell Automation Company's CONTROL DATA 6400 computer system — *the nucleus of the most comprehensive hybrid computing facility in operation today.*

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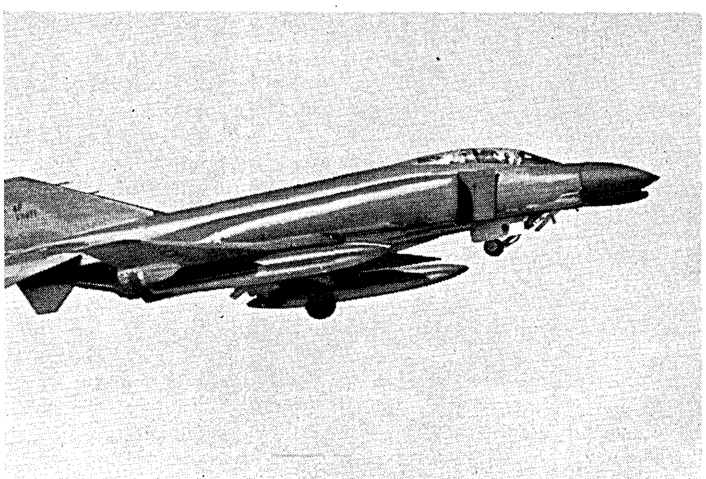

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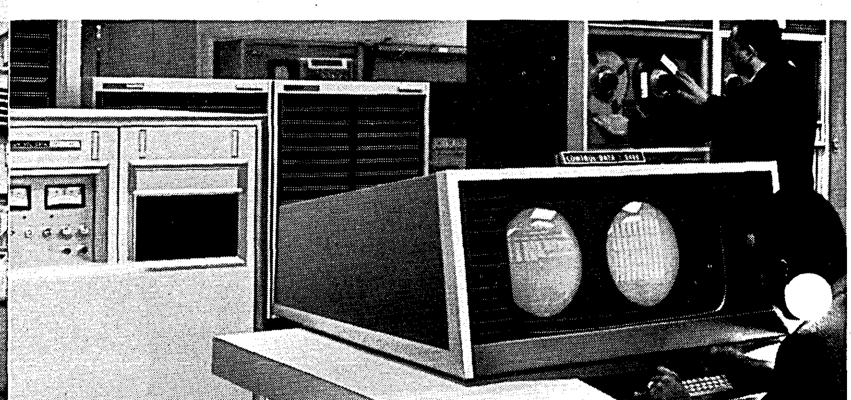


CIRCLE 52 ON READER CARD

and 1024-word 50-nanosecond memory that hitches straight up the CPU.

While the scheme is at the development stage, Elliott is shopping for other European manufacturers who might like to join in. This may be sound thinking, because other governments are in a situation not too dissimilar from the British.

MACHINE LANGUAGE STANDARD DEBATED AT SPRING JOINT

The staggering software development costs created by the introduction of third generation systems are forcing the industry and users to look in all corners for solutions. A Spring Joint Computer Conference panel began exploration of one possibility—standardization of machine language instructions (defined by chairman Richard Utman as "somewhere between the basic operational characteristic of the instruction and the assembly language instruction").

Major questions raised about such standardization were: would it impede or help technological programs; is it feasible; and is it necessary? Proponent W.R. Lonergan of RCA felt there should be some standard language close to the hardware and, indeed, a de facto standard machine language already exists—the IBM 360 set, which is one reason the Spectra 70 language is similar to it.

A programmer, Lonergan thought, should be able to slightly modify existing software in the same manner engineers do existing circuits; this would enable manufacturers to deliver software *along with* hardware. A good example of this was the relatively rapid development and delivery of total Univac 1108 systems, whose software was drawn from that of the 1107. "From a common platform you progress faster." The industry should not wait for a better set of instructions to declare them standard; it is easy to move from one standard to a successor (i.e, FORTRAN II to IV). Furthermore, customers no longer care what the machine language looks like—they care only about throughput per dollar, he noted.

Brad MacKenzie of Burroughs was skeptical about the virtue of such standardization and, to boot, was against programming in machine or assembly language in the first place—a long-practiced Burroughs philosophy.

Unfeasible, was the feeling of R. W. Bemer of GE: who could you get to agree what the standard should be? Even IBM would not want the language to be standard. Among the technical decisions the industry would have to make, said Bemer, are what instructions are indispensable to information processing and whether privileged as well as non-privileged instructions would be included in the standard set. Also, the language should not be dependent on implementation or hardware technique and should not impede emulation or simulation of an existing computer.

Bemer also pointed out that the process of standardization is slow and cumbersome, taking about six years, during which changes always occur. And if it did come about, it could impede progress in the field because: 1) such standardization may draw anti-trust accusations against the industry, and 2) the attainment of stability is often followed by a characteristic economic resistance to change. To the latter, Fred Ihrer of Comress commented that it is the reprogramming when hardware changes that has always slowed the evolution of system development.

PATENT BILL PANICS PROGRAMMERS

To patent or not to patent computer programs was the subject of an SJCC panel on "Legal Protection of Software." There were heavy arguments on either side, but the immediate issue was whether the pending patent bill before Congress should—at this stage of the computer industry's development—exclude programs virtually forever from patentability. [Laws can be changed, but the process is long.]

The issue is muddy on numerous counts and, according to Applied Data Research president Richard Jones, the wording of the bill's Section 106 is even muddier: "A plan of action or set of operating instructions, in whatever form presented, to cause a controllable data processor or computer to perform selected instructions, should not be patentable." Some panelists warned that the phrase "in whatever form" could lead to the interpretation that even the hardware doing an equivalent job could be rendered unpatentable.

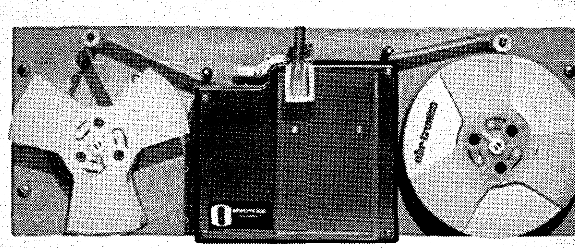
William Keefauver, Bell Telephone patent lawyer, noted that the House subcommittee on patents had been advised by presidential science adviser Donald Hornig to study the section and its wording further. This, he said, seemed to be an invitation to the computer industry to explain all consequences of 106 to Congress. The proponents of patenting programs pleaded with the audience to write to congressmen about it (Robert Kastenmeier of House Patent and Copyright Subcommittee, Emanuel Celler of House Judiciary Committee, and Sen. McClelland of the Senate Patent and Copyright Subcommittee). But much to their chagrin, the late Thursday session had only a few listeners scattered around the massive Grand Ballroom.

Among the purposes of the patent systems, noted chairman Morton Jacobs (patent lawyer involved in ADR's AUTOFLOW patent application), are to provide an incentive to invent, to risk capital on development and marketing, to encourage early public disclosure of technical information which might otherwise be kept secret, and to encourage exchange of products and services. This is why programs should be patented, said Jones; lack of protection is "responsible for the stagnation of software development," and the bill's exclusion would "retard a growth industry whose population is made up of many small companies." Furthermore, the section would enhance an existing monoply by perpetuating the manufacturers' unfair tie-in practices—charging for programs in the hardware prices and calling it 'free'." "The lack of competition . . . does not encourage manufacturers to build the most effective software."

Frances Thomas of Anelex added the peripheral manufacturer's concern over lack of protection—both because of the effect it has on the growth of its users and on the future programs that will be developed for peripheral systems.

Stephen Briar from the Justice Department's Anti-Trust Division could not take a stand but he did raise pertinent questions. Will patent or copyright protection actually be an incentive to production since it will be difficult to find out who is infringing? Many user groups are interested in exchanging information and modifying programs; many of them don't want patents because they would need a lawyer every time they innovate. Possible result: a decrease in programming innovations. Too, users aren't as interested in selling a program as in using it, so possibly a system could be devised which protects against sale but allows copy and use of a program in the user's own machine. The copyright, he said, is more dangerous than the patent, since it is difficult to determine at what point one program is a copy of another. The patent, at least, only protects the original idea, not the total program.

The one panelist against patents was Control Data's Thomas Devine, who said that, first, it takes too long to get a patent, three years, to do the inventor much good; and second, that



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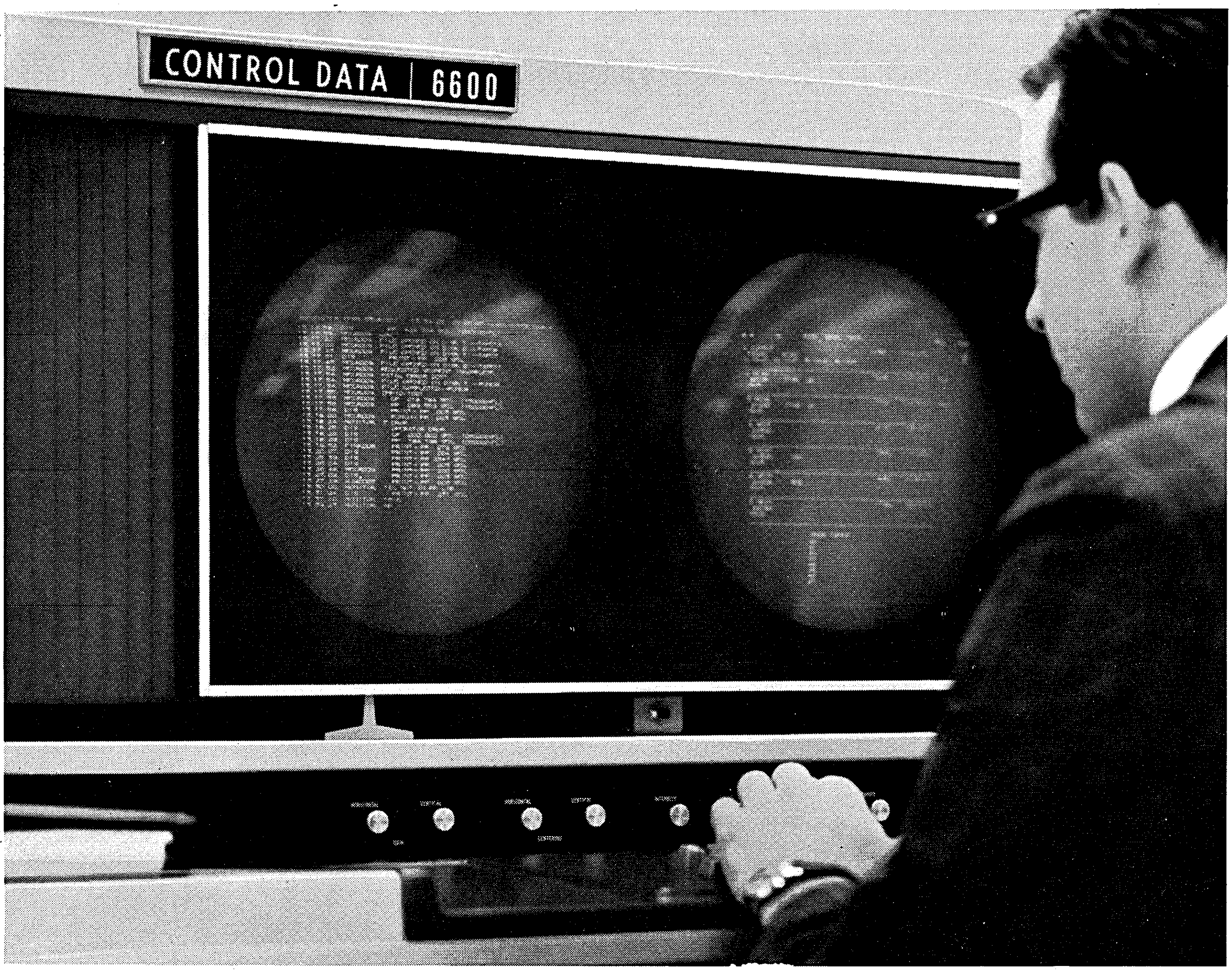

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CIRCLE 55 ON READER CARD

copyrights are enough to stimulate the disclosure of new material for the benefit of the public. But exact copying is not the worry, proponents argued, it is the inventive portion. From here the panel and audience became embroiled in definitions relative to classes of patentable items under existing law. Robert Bailey of the Patent Office said that a program is neither a machine nor a process (a patentable process is one which was not within the contemplation of the inventor of the machine—and a program was, he claimed). Thus the program doesn't fit in any statutory class, although it is possible that a machine with a program that turns it into a new machine may be patentable. The office has never received such an application.

Several in the audience were inflamed by the implication that all programs were within the purview of the computer inventor. Further, chemical processes are patentable, said one attendee, but if the same interpretation were applied to them as to programs, all chemical patents after the invention of the bunsen burner should be thrown out. It is clear that the words "programs," "algorithms," "logical processes," and even "information" (as anything other than an abstraction) are not well understood by lawyers or the Patent Office—and this in itself is the fault of the computer industry, the lawyer panelists told the audience. It was suggested that adequate clarification could lead the way to a solution, possibly creation of a separate category for logical processes.

SESSION ON LARGE COMPUTERS RAISES TEMPERS AT SJCC

Probably the liveliest session at the SJCC was a debate on the best approach to large computing capability. Chaired by Gary Hollander, the panelists were George West of SDC; Dick Fuller of Librascope, Dan Slotnick of the Univ. of Illinois, and Gene Amdahl of IBM. West and Fuller presented their viewpoints in a manner relatively free of expostulation. However, Slotnick and Amdahl took such vigorous positions relative to their architecture and in opposition to the other's that it became immediately clear between whom the debate centered.

Slotnick was able to draw on the technical discussion of the ILLIAC IV presented at the conference on the preceding day. This described the ILLIAC IV as consisting of 256 processing elements (four quads in linear arrays of 64 each) that are individually capable of floating point operations on 64-bit words. Execution time for each processing element was estimated to be 200 nanoseconds for floating point addition and 350 nanoseconds for floating point multiplication. An overall measure of performance was stated to be equivalent to 2000 to 10,000 IBM 7094's. As in his position paper, Slotnick made scathing remarks about the attitude of manufacturers (exemplified by those having more than 50% of the computer market) towards non-conventional architecture.

Amdahl presented a single slide that purported to show performance relative to the degree of parallelism of computational tasks. The pipeline architecture was identified to be significantly superior to processing arrays for all except a fraction of problems that were superbly parallel. By hardware monitoring of typical IBM computing facilities, it had been found that 40% of executed instructions were for housekeeping purposes —a fact they found to be essentially true even for installations thought to have problems especially well suited to array processing. Also, boundary values for array processing are generally very troublesome and unsuited to parallel processing.

Slotnick's retorts to these remarks were (a) Amdahl's design was not documented, and therefore it presumably could be anything at any time, (b) IBM has traditionally, but unsuccessfully, attempted to make large improvements in the state of the conventional computer art, with the Watson-admitted mistake of Stretch, and now with rumors that the 90 series of the 360 line may be discontinued, and (c) there are a lot of massive problems suited to array processing that have not been identified simply because there has been no equipment suitable for their solution in the past.

Prof. Gerald Estrin of UCLA had asked for the opportunity to make a statement, which was to the effect that performance figures for ILLIAC IV would have to be tested by actual machine use before they could be deemed to be credible.

Industry spokesman Herb Grosch had also made arrangements to make a statement—an eloquent tirade against ILLIAC IV and its promulgators. He based his right to comment in this manner on his association with the computer field from the dawn of time. One of his strong feelings was that the ILLIAC IV project is a travesty on the American taxpayer of a magnitude in keeping with Project MAC. The vitriolic nature of Grosch's comments made all that had preceded pallid by comparison.

Two subsequent comments are worthy of note—both related to the Grosch speech. Slotnick responded by saying that he thought the worst thing that had been said about him was that he was too young, a situation that would be corrected with time. A questioner from the audience described his own credentials as dating back at least as far as Grosch's, and he considered this to be irrelevant to the topic at hand (great audience applause).

Some observers felt that the "debate" exceeded the propriety that should be accorded to public dialogue on controversial technical questions. To some extent, the panelists were debating different things: two were representing architectural viewpoints for large-scale but general purpose applications; the other two were concerned with architecture for specialized large-scale problems.

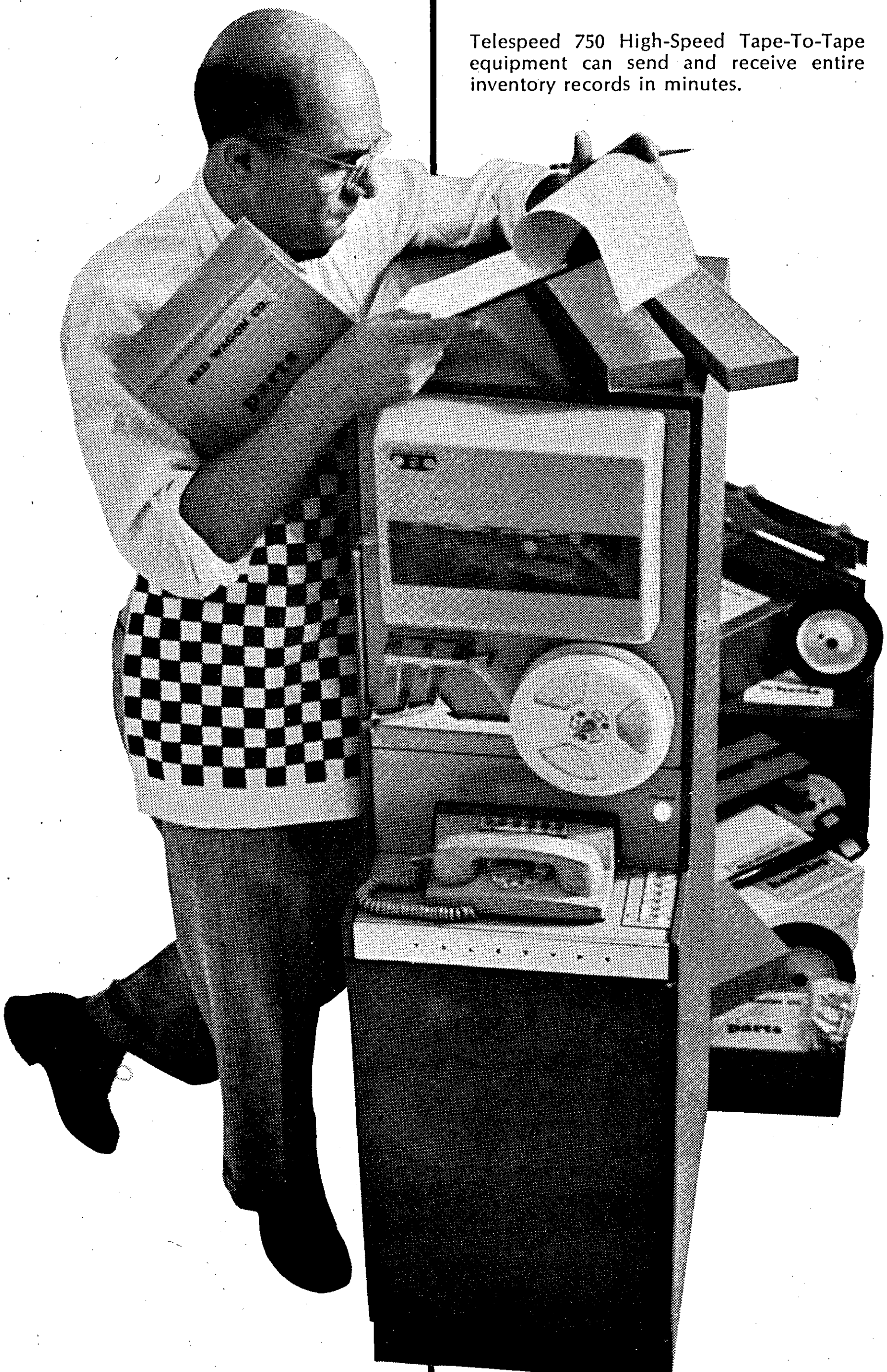
PROCESS COMPUTERS TO TOTAL $1 BILLION BY '72

In an effort to get the most value out of the large investments in plants and equipment planned, manufacturers in several major industries will be installing over $1 billion worth of computers in industrial process control systems in the next five years, according to GE's Dr. Louis Rader.

In a late April press seminar, General Electric, which leads in PC computer installations with 227 of a total 1,027, enumerated the growth of the process control industry and its applications. By industry, chemical and petroleum firms will install $80 million worth of computer systems by 1972; steel companies will go from a present $22 million worth to $47 million; primary metals—$12-25 million. Utilities are another multimegabuck market for process control. Developing areas are the automotive ($3.1-17 million by 1972), textiles, glass, transportation, electronic, and education and research industries.

Since the first digital computer-based process control installations in 1959, examples of cost-savings have been shown in all user industries, said GE. One customer, an electric utility using a system to monitor power plant performance, showed an annual saving of $214K on a $900K investment. Full control of a hot strip steel mill is saving $1 million/year.

Thus far, most industries have automated one or a few of their processes. But the increasing emphasis on quality, as U.S. products run into stiffer competition from abroad, calls for integrated manufacturing systems whose end function is inspection—a job now costing U.S. firms $11 billion



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KEYED TO CONTROL INVENTORY COSTS

In today's marketplace, consumers demand variety. Most merchandise has to be available in many colors. Many styles. And with many features. And so it goes throughout all industries . . . with spiraling inventory costs causing serious problems.

Yet, many companies have cut inventory costs while keeping a larger selection of stock on hand! They did it through data systems that include Teletype data communications equipment.

This is how it works Teletype equipment is used to send and receive inventory data among warehouses, distribution outlets, and a computer center. The computer analyzes the inventory at each location and considers past stock requirements as well as seasonal demands and, where applicable, possible obsolescence. It determines the stock needs and material requirements of each ware-

a year. Under such systems, a general purpose computer would prepare and transmit operational information to the process computer at or near a plant, which may not only be tied into tools and machinery but also into plant terminals. From this terminal, an operator can call the program for a particular manufacturing and inspection process.

Such integration means an even bigger communications equipment market in the form of sensors, telemetry units, modems, multiplexers, etc. It now totals $1.9 billion, excluding AT&T and GT&E purchases from its own subsidiaries ($2.6 billion). GE and others have been successfully testing long-distance control. "We recently operated a machine tool in Virginia from a computer in Arizona (2000 miles away) . . .," and the machine performed flawlessly, the firm said.

PL/I PROGRESS, PROBLEMS DISCUSSED; USERS WARNED

One of PL/I's creators, Doug McIlroy of Bell Labs, candidly discussed his child before a meeting of the L.A. chapter of the Assn. for Computing Machinery last month.

"PL/I is really very good," he said, considering . . . "the time and resources allotted it, and the pressures put upon it." He admitted that the language has many holes (scope of variable names is the biggest one) and that it is very difficult. "Most of you won't use it." he told his audience, "and beginners can't use it."

The major emphasis of the talk was upon the major goals for upgrading the language once it's working in the "universe" of the computation center, "two years from now." Categories of improvements needed, listed in order of importance: program structuring, modes of access to data, presentation (I/O), and data operations.

Arguing that there is no such thing as scientific programming or commercial programming, McIlroy said, "It would be a sad loss if PL/I died; there is nothing to fill its gap." Refusing to comment upon the chances of the language expiring, he felt that what *could* kill it would be lack of openmindedness. "It's easier to use Fortran," he said, "and easier to fall back on Fortran after you've messed up in PL/I." The obvious moral: give it a chance.

In answering a question about MULTICS (the operating system for the GE 645 being prepared cooperatively by Bell Labs and GE), he said that PL/I was being used to program MULTICS, although not all of it. And he noted that the resident part of the operating system takes up to 200K of the 256K core. But that's an improvement, he added; it used to require 300K.

Between the lines of McIlroy's speech is evident the warning that it will be several years before PL/I takes hold, and before efficient compilers for it are available.

COMPUTERIZED FREIGHT BILLS CHALLENGE NEW FIRM

The complexity of freight billing procedures used by the trucking industry has buffaloed computerization just long enough. Now Traffic Counsel of America (TCA), Canton, Ohio, has announced a system that will compute freight rates, select the fastest and cheapest routes, name carriers involved, determine each carrier's share of the total billing, print out a six-part freight bill, and provide data on combination rail/truck shipments. One problem that has hindered past attempts at computerized billing is the variation in format of each carrier's freight bill. TCA has solved this by using a carrier code for each company which precedes the input and refers the computer to the program for that carrier's particular format.

The TCA system operates from a central computer facility in Dayton, Ohio. This configuration, consisting of a 160K RCA 3301 computer with 5½ billion characters on a Race unit, and 2 million characters on a drum, has six tape drives and can handle 164 separate communications lines simultaneously. Normal response time is reportedly 5-6 seconds. Now stored in the computer are all known routes and tariffs, information on 18,000 carriers and 350,000 points of origin in North America.

This system should provide interesting competition for Information Utility's Miller Traffic Service (March News Brief, p. 81), a Maywood, Calif., firm that has tested its program on Allen-Babcock Computing's 360/50 in April, and expects to go on the air in early July. Unlike TCA, who has already successfully computerized Rocky Mountain tariffs, Miller is concentrating on generalized rating for California only.

The testing ground for the two systems is California. With nearly 15% of the $62 billion national freight billing (over 300,000 bills per day), California has a rate structure that is different from the rest of the nation, although most of the standardized

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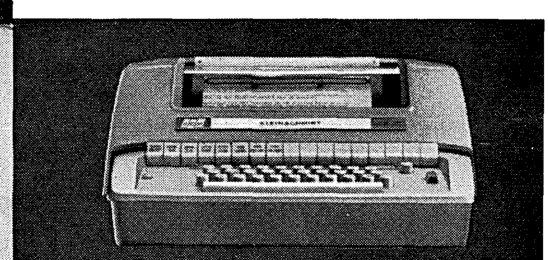
CIRCLE 58 ON READER CARD



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national rates are included in the California structure as subsets. One of the peculiarities is the use of a distance table to determine equalized mileages; i.e., 10 miles of mountain roads may be rated as 15 miles to equal 10 miles of freeway.

In addition, a watchful Public Utilities Commission requires careful auditing of all factors that determine a rate: class, commodity, mileage; and with hundreds of factors involved, the carrier is directed to find the minimum charge for the customer.

So who's going to be in the driver's seat? According to Allen Fiffer, vp of Miller Traffic Service, it'll be the outfit that successfully solves the problem involved in split-delivery (unloading of various amounts of freight at different stops between two points). The PUC has directed that in this situation the carrier must take the shortest way between any two points on the route. The mileage is an important element in determining the rate, and it must be calculated exactly, with careful records maintained for PUC auditors. Fiffer says he can do it, but so far neither he nor TCA has demonstrated this ability.

The California Trucking Association (CTA) is enthusiastically supporting all attempts at untangling the rates by computers. But Hamilton Kollmyer, CTA's assistant manager of transportation economics, is a little wary. He's seen other pioneers fail from lack of financial support during the years of complex programming and he remembers the billing system started a few years ago by Yale Transportation and IBM. A partial application, the installation handled billing between certain points along a line from New England to New York, included only the largest terminals and rated only the most frequently shipped commodities. Before the system went beyond this limited extent, Yale Transportation ran out of money.

I. R. DESIGNERS, NO USERS, GATHER AT COLLOQUIUM

The fourth annual National Colloquium on Information Retrieval, held last month in Philadelphia, had as its theme "The User's Viewpoint—An Aid to Design." But there were no users' viewpoints expressed, according to Claire K. Schultz of the Institute for Advancement of Medical Communication, who reported on the meeting for DATAMATION. Some 300-plus designers of IR systems, however, did show up. The colloquium was sponsored by the ACM's Special Interest Group on IR and co-sponsored by the Delaware Valley chapters of ADI, ACM, the IEEE, Univ. of Pennsylvania, and Frankford Arsenal.

At a half-day session on generalized file management systems, it was stressed that computer systems must be adapted to man, rather than the reverse. The Commerce Dept.'s Chalmers Sherwin said that after basic standards for writing unit records were complied with, he wanted a registry through which each user could list additional, idiosyncratic aspects of his record—and be free then to proceed. Remote console programmers who presented papers said they were making things convenient for human users, but their illustrations of this were unconvincing.

The nature of researchers being what it is, the idea of gathering data about users at remote consoles was also aired. To achieve this, however, the user must be willing to allow a program to trace his actions. This trace could be the information scientists' first opportunity to record some fine points of man's communicative behavior.

According to our reviewer in attendance, the all-time best paper among user studies was by Urback of the Clearinghouse for Federal Scientific and Technical Information. This paper also came closest to fitting the theme of the meeting. Other papers were of the "how I do it," "how I hope to do it," or "this is my problem" variety. They, too, were reportedly of surprising interest and insight.

But both attendees and stay-at-homes will have to wait several months to see the proceedings. To the surprise of registrants, none was available. This despite the $5 charged at the registration desk for it, and "no one told until you asked that this was a prepublication price."

TO STOP MODIFIERS: IT'S A ONE-TRAC LANGUAGE

Since the use of the procedure-describing language TRAC is increasing, author Calvin Mooers of Rockford Research plans to issue language standards and apply a trademark to the name TRAC to control its development. The trademark is a novel move in programming intended to prevent application of the name to any system not conforming to basic standards.

TRAC is now being used in installations in 14 locations around the world in applications such as text editing, multi-processing, research design and testing of macro modules, an interactive data bank for vocational guidance, and computer-assisted instruction.

TWO NEW T-S FIRMS PLAN MIDWEST CENTERS

Tapping the time-sharing market in the midwest is the initial aim of Data Central, Inc., in St. Louis. The 15-man firm, which made $1 million in its first year, 1966, by brokering computer time and offering scanning and programming services, will this June install a 360/30 with the RAX teleprocessing system for remote batch and, in October, an SDS 940 for conversational use. Offering the remote service to Memphis, Cincinnati, Dallas and Kansas City, initially DCI will fight the big-time battle by absorbing long-distance line costs, the user paying only for intra-St. Louis communications. If business is good, president Don Hogan, formerly of McDonnell Automation Center, says DCI will put computers into these cities, ultimately may go nationwide.

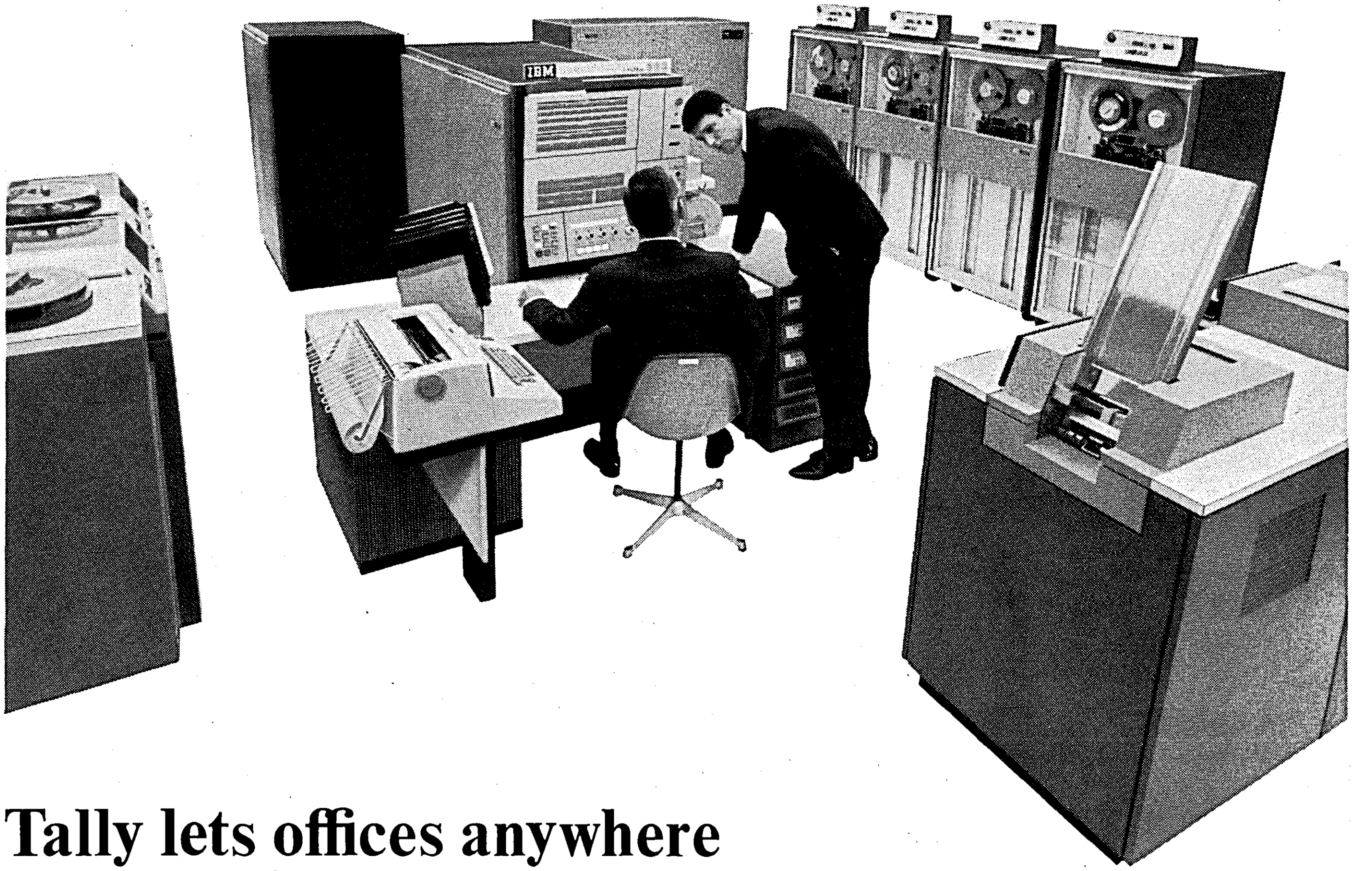
The 64K mod 30, serving 60 total and 10 simultaneous users, will have three 2311 disc drives for dial-up use, and five tapes for off-line batch use. A mod 50 may replace it in the fall. The 64K 940, said to serve 210 terminals—32 at once—will have 75 million characters of disc storage; software includes Fortran II, IV, Basic, CAL, other languages. DCI also has a CDC 915 scanner, with two more to come in this year, for source to mag tape conversion. Charges for the t-s services have not been announced yet.

Elsewhere, Pillsbury-Occidental's Call-A-Computer t-s centers, located in Atlanta, Raleigh, N.C., and Minneapolis, have attracted almost 200 customers in their first year of operation for a $500K gross. Remote service from New England to the Raleigh GE-265 system (used in all centers) began late April, and Minneapolis is now getting underway with remote service to several midwest locations. Two additional centers will also be set up this year.

NEW YORK AREA USERS GO ON-LINE TO B-5500

Realtime Systems Inc. in New York is in swing with an ambitious time-sharing service using a modified Burroughs 5500 which will have one billion characters of disc storage by the end of the year. It's neither in the scientific t-s category occupied by GE-265, SDS 940, or Quiktran services nor in the commercial fixed-program slot represented by Keydata. The specialization is in doing large jobs, like linear

Now that you've got a computer, why not let all your offices use it?



Tally lets offices anywhere in the nation talk to your computer by phone at low cost.

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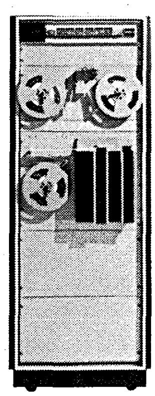

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CIRCLE 60 ON READER CARD

programming, and commercial applications which require unlimited disc and large core storage, providing some conversational capabilities while compiling and job running in background mode. Eighteen customers are now using the service for such applications as large scientific statistical work, engineering design, accounts receivable, order entry, payroll, and credit checking with reject explanations.

In the conversational mode (using Teletypes, IBM 1050's and other devices), Realtime says it has implemented a command and control language that has most of the functions planned for the 360/67. Subscribers can log in with security check; create and remove files; edit, update, delete, or modify programs and files; develop, compile, debug and execute programs in Algol, Cobol, or Fortran; and, after the job has been run in background mode, remotely check the solution and control where it is to be printed out; execute and obtain the current status of any program; communicate with console operator. Cost of the service is $360/hour for basic cpu time and $10/hour for phone connection charges. Charges for I/O channel, disc storage, tapes, printer vary with use. For example, disc storage is 1.5¢ per 1000 characters per day. (Present disc storage is two 9.6 megacharacter disc files with six more to come in shortly.) The firm is currently serving New York City and upper N.Y. State, western Pennsylvania, and southern New Jersey.

At least two or three other B-5500 time-sharing centers are being set up, including Time-Sharing Systems in Milwaukee.

EKG CHAIR, SCREEN DEMONSTRATED BY PHILCO

Casually seated in a naugahyde chair with his hands resting on the arms, a fully-dressed "patient" can now be tested for cardiac and cardiac-related conditions without electrodes being fastened to his body. In some 20 seconds, the MediScreen system records the patient's heart rate, electrocardiogram, heart sounds, pulse, volume and rate of breathing, and emotional reactions.

Sounds of the heart are picked up by an extremely sensitive microphone embedded in the chair and are transmitted by the control unit on the back of the chair to a four-channel strip-chart recorder.

On the control unit, in addition to the electrocardiogram switch, is a galvanic skin reflex channel. For the use of psychiatrists and psychologists, this channel correlates emotional responses (transmitted by electrodes in the arm of the chair) with heart and breathing rates to determine emotion-related conditions.

The output of the MediScreen is specifically intended for input to a computer. Any general-purpose computer would be suitable for such EKG analysis, and both IBM and CDC reportedly have written programs for this kind of work. A hard-wired special-purpose computer would be the ideal tool however, but John Joss, manager of biomedical applications at Philco-Ford where MediScreen was developed, says that this will only be feasible when the concept of computer analysis of EKG traces is accepted by the medical community and can be reduced to a specific computer format.

The MediScreen will be available in many configurations such as physician's chair, dental chair, couch and operating table; it can be operated by paramedical personnel, but interpretation of the charts requires the services of a doctor.

The system is currently being displayed in medical facilities by the Western Div. Laboratories of Philco-Ford Corp., Palo Alto, Calif.

MORE SUMMER COURSES OFFERED BY COLLEGES

(For other listings, see May News Briefs, p. 87).

University of California, Los Angeles, Calif.:

July 10-21, On-Line Computer Control Systems.

July 17-28, Applications of Artificial Intelligence to Control System Design, $300.

July 31-Aug. 4, Computer Languages and Their Philosophies, $225.

University of Wisconsin, Engineering Extension, Madison, Wisc.:

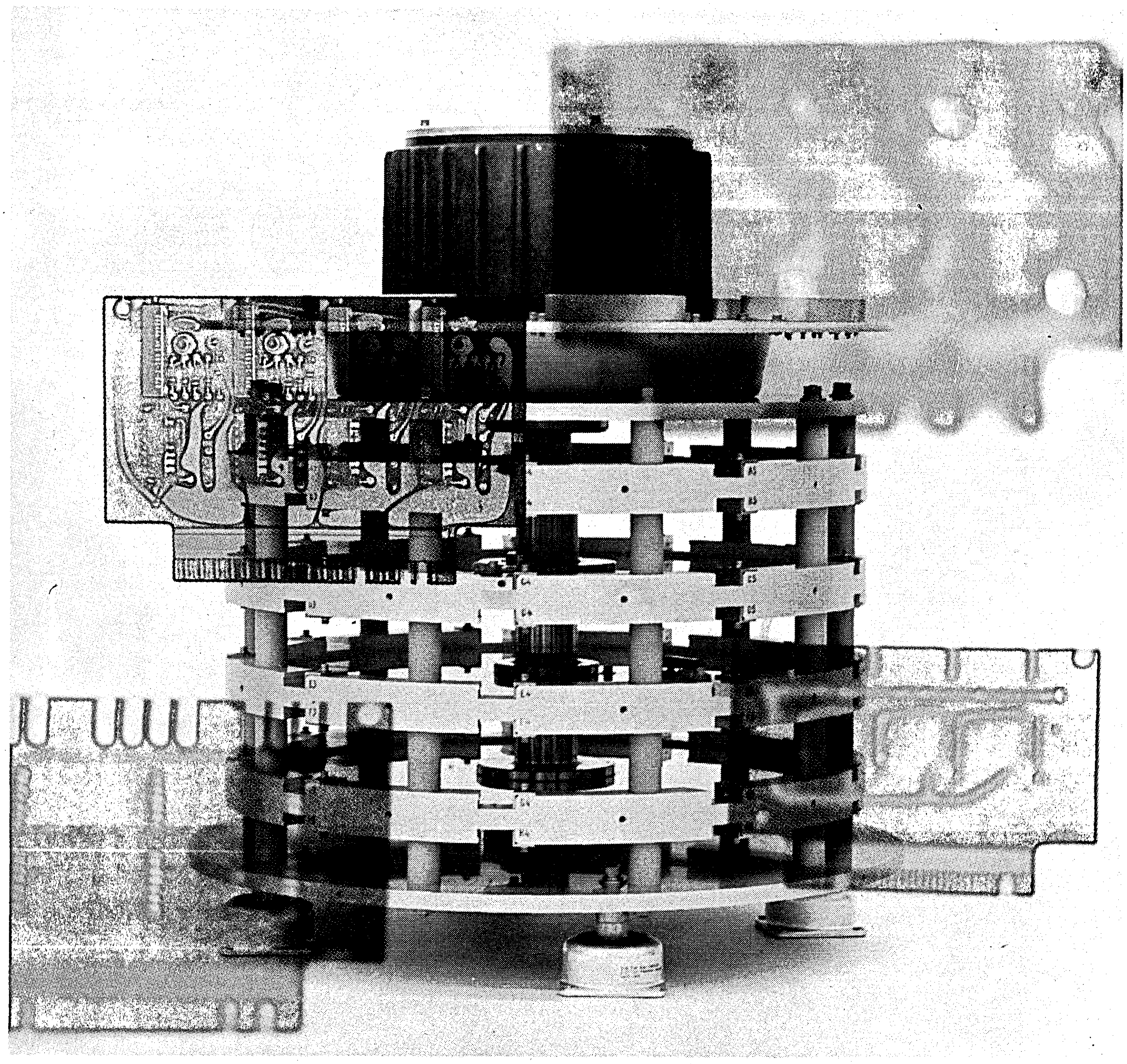
June 12-16, Iterative Analog Computation, $150.

June 19-23, Hybrid Computation, $150.

July 24-28, Introduction to Digital Logic, $150.

July 24-28, Use of Computers in Optimum Design of Mechanical Systems, $150.

July 31-Aug. 4, Computer Applications in Structural Engineering, $150.



DISC MEMORIES...? INTEGRATED CIRCUITS...? 10 MEGABITS...?

Magne-Head Integrated Circuit Disc Memories with memory capacities from 100K bits to 10 Megabits are available with data transfer rates up to 2 Megacycles. The system interface is +5v. Power Nand DTL. The Magne-Head Integrated Circuit Disc Memory system offers modular growth from 100,000 to 10,000,000 bits. For information on any or all of our high-performance Magnetic Memory Components, write or call today. Write for: free TYPICAL DISC SPECIFICATION BULLETIN.

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NEW FORMS PROCESSOR

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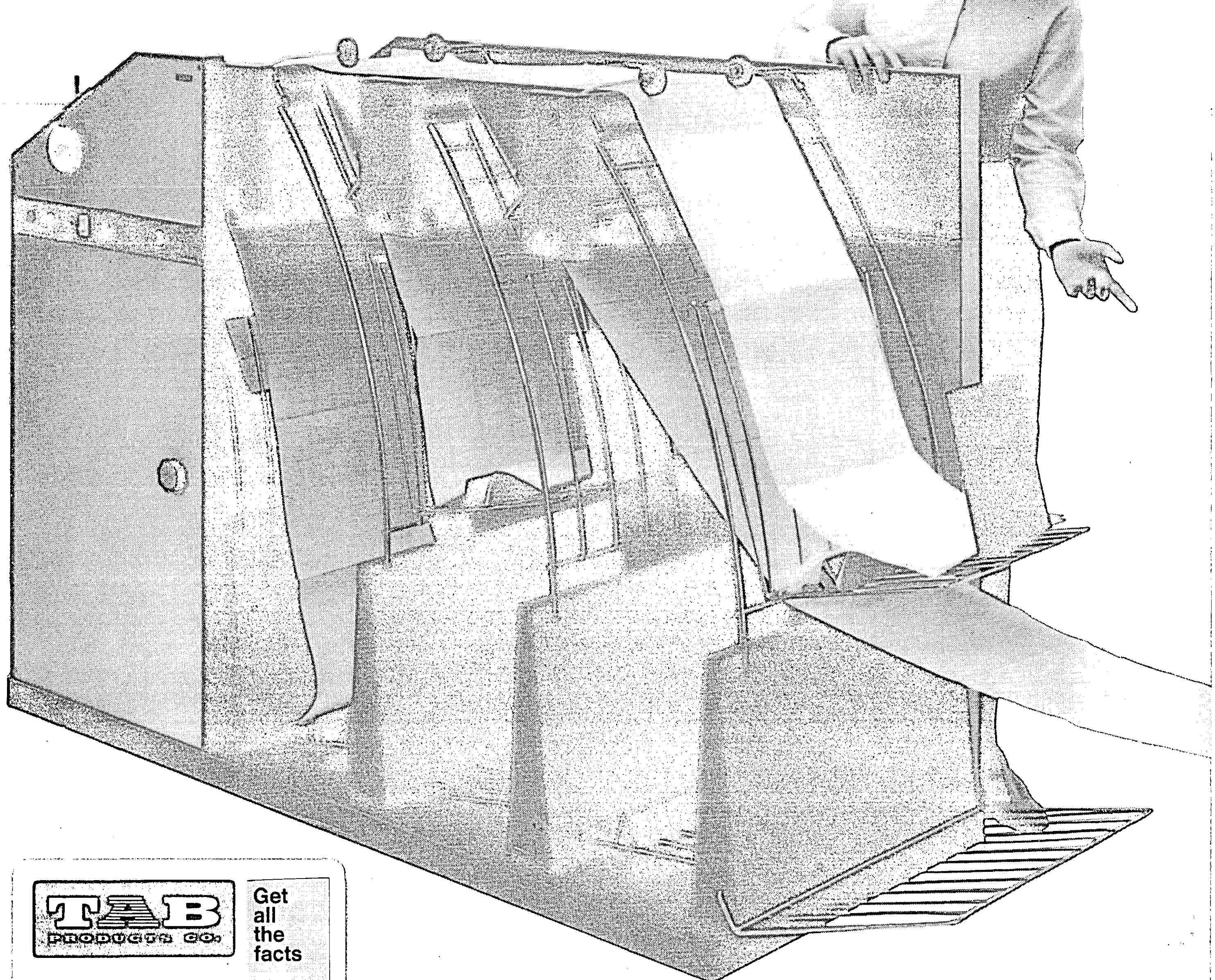
New exclusive features PATENTS APPLIED FOR

- **Solid state positive control** linked with **electric eye** allows paper to dip into light and switch machine to preselected alternate speed. This permits true "in-line" operation without tearing paper or interfering with high speed printer.
- **Exclusive Quickset program rod** allows presetting for form sizes in seconds—saves countless hours of training and experimenting.
- **Chain drive feed** eliminates jamming and other problems at high speed. Pins retract in a plate, allowing handling of any type form.
- **Exclusive adjustable wire chutes** are walk-in-type, unusually static-resistant and providing fast, easy carbon removal.



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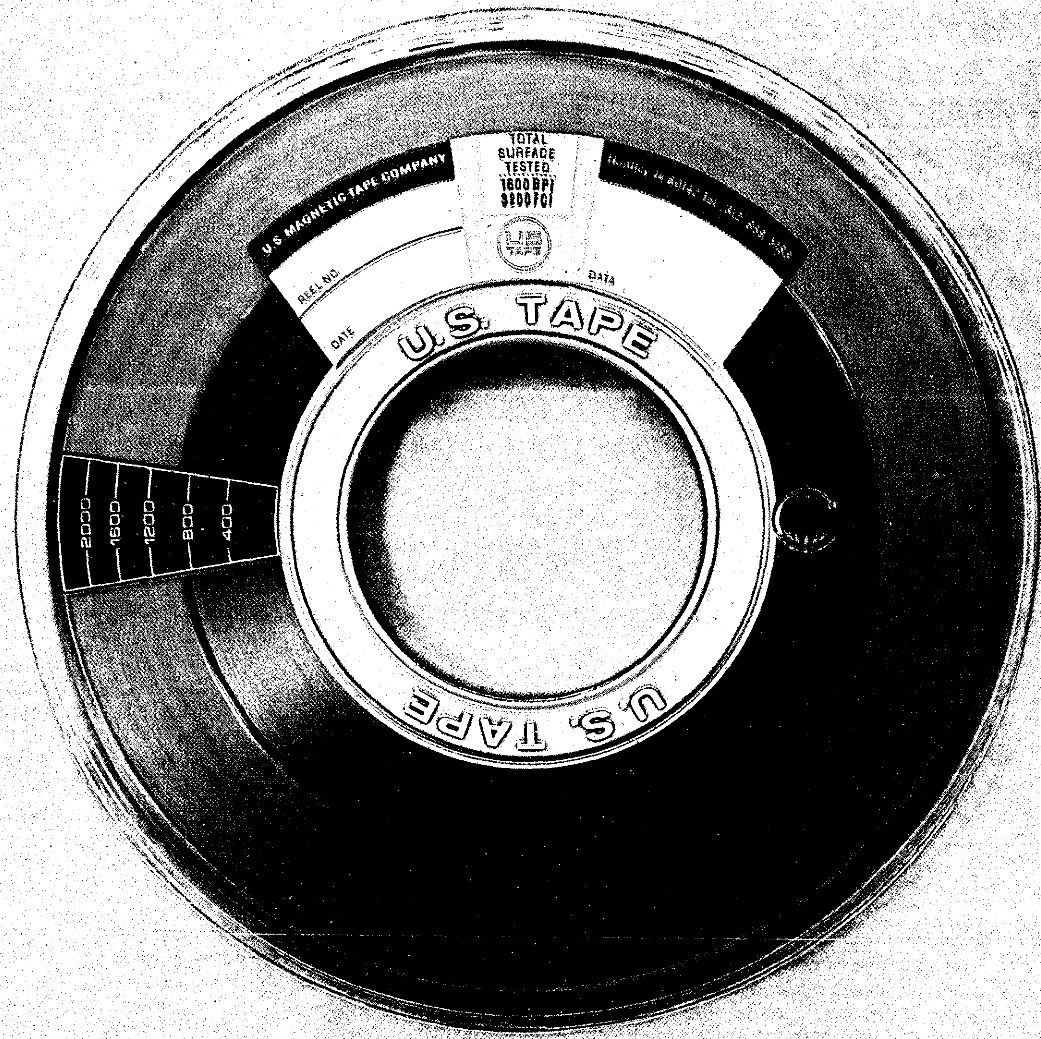


To be as good, some other tape would have to have Duramil 7.

No other tape has.

U.S. Magnetic Tape Company US TAPE **Huntley, Illinois 60142** / *A Subsidiary of Wabash Magnetics, Inc.*

 CIRCLE 64 ON READER CARD

washington report

THE PHASE II FUSS CONTINUES

One Phase II loser, Honeywell, has formally protested to GAO, and another, RCA, was reportedly preparing to do likewise at press time. After the selection was announced, Honeywell re-evaluated the 1200-2200 configuration it had offered and concluded that the system could meet the 200-hour requirement except in one special case. Another $1.25 million worth of memory, Honeywell told GAO, would have eliminated this exception. IBM's bid, reportedly, was about $45 million higher than Honeywell's, but was accepted anyway, according to another source, because IBM met the 200-hour requirement in far less than 200 hours, thus reducing the future need for more hardware. The GAO has now asked the Air Force for a report on its decision, standard practice when a protest is filed.

BOB CIRCULAR SETS EDP RULES

DOD contractors who lease or purchase edp equipment for the government came under continuing GSA surveillance last month, when BOB Circular A-83 was issued. About $1 billion worth of gear is affected. Likely results: tighter control over equipment charges, non-contract uses, and eventual disposition. Equipment sharing will be pushed hard.

HEARING SET ON CHANNEL-SHARING

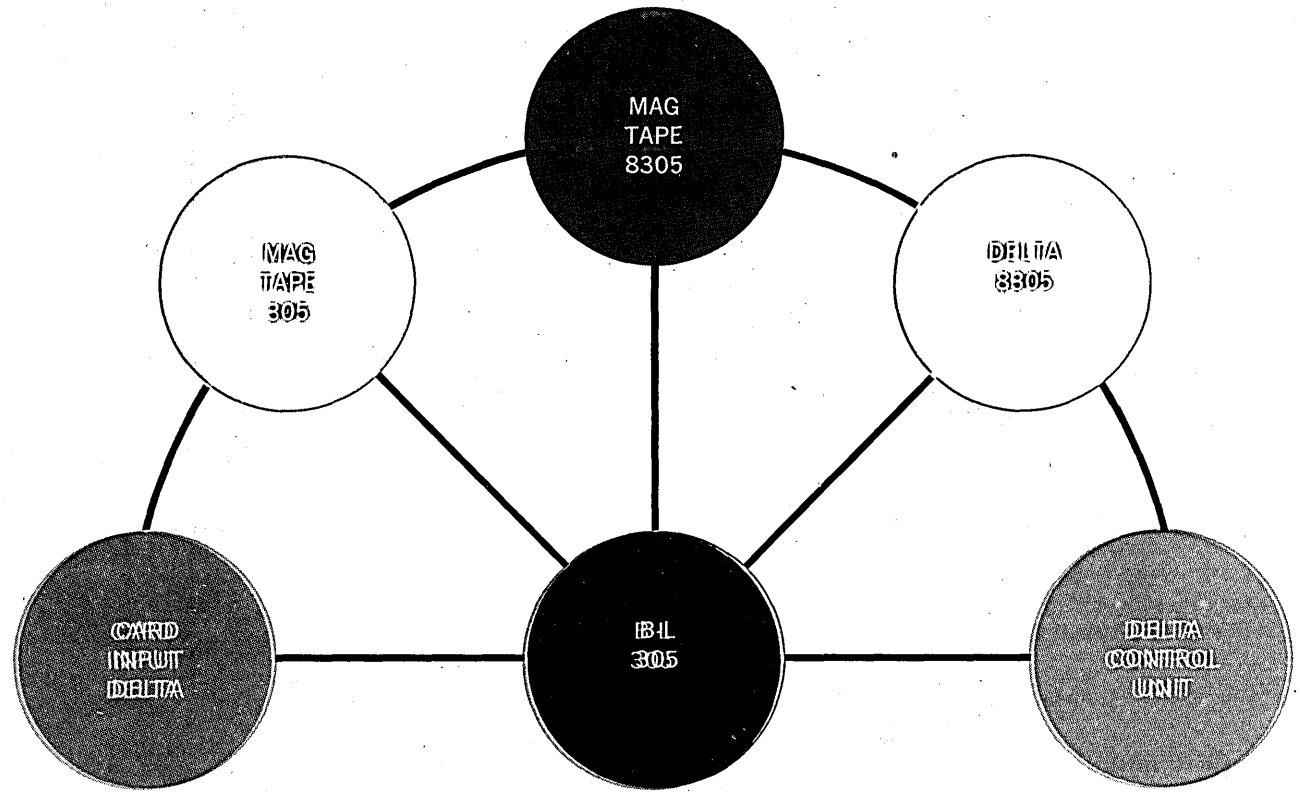
Private users of Telpak C & D who want to share channels were encouraged by the FCC last month. The commission, prodded by Cong. John Dingell and the National Retail Merchants Assn., ordered an examiner's hearing. Three commissioners called for fast action. A pre-hearing conference is scheduled this month.

DATA CENTER PLANS DRAW FURTHER COMMENT

The Federal Statistics Users Conference is neutral regarding the proposed National Data Center, a spokesman told the Congressional Joint Economic Committee last month. Significantly, FSUC's 160 members are among those who would benefit most from a data center. Another JEC witness, Prof. Frederick Stephan, Princeton, said data center files pertaining to individuals should be printed out so each person could check their accuracy. Cong. Cornelius Gallagher wonders whether credit bureaus should do likewise. He's going to ask them at a hearing scheduled for this month.

CAPITOL BRIEFS

A Phase II loser has admitted that his firm did "a lousy job" preparing its bid, and went so far as to compliment the Air Force in writing for its evaluation. Subsequently, on orders from higher up, a second letter was sent, criticizing the Air Force. ... Frederic D. Frasch, formerly an adp specialist in the Federal Supply Service of GSA, has become an adp manager at the Post Office. ... William E. Davis, senior management analyst in Joe Cunningham's shop at BOB, has gone back to the Army, where he has been appointed a staff assistant to the Assistant Secretary for Financial Management. The latter job, formerly held by Brewster Kopp, is now held by Joseph Becker, who was budget manager for the City of New York. ... GSA is studying the establishment of in-house programmer pools, hoping it will reduce the need for outside software development contracts. ... GAO field men gather in Washington this month to discuss development of inter-agency dp networks in several areas throughout the country. A report is due later this summer.



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CIRCLE 65 ON READER CARD

world report

PL/I AND ALL THAT

Excitement mounts among the Algol-minded Europeans who are awaiting the basic specs for Algol 6X (the all-bells-and-whistles answer to PL/I). Details should be outlined in the next Algol bulletin, which is imminent. Interest is largely confined to academics and developers. Production users have more than they can cope with, if a PL/I conference at the end of May is any guide.

This was a one-day joint user-manufacturers meeting organised by the British Computer Society. Few people came down hard on IBM in criticising language facilities, but the big commercial users were scathing about implementation. There was no obvious single school of thought, although there was plenty of support for University College of London's Professor Paul Samet (a 360/65 user) who quipped: "Like war is too big to be left to the generals, so programming language design and implementation is too important to be left to one manufacturer."

ICT's software planners made it clear that they were against jumping on a bandwagon that would put them at the mercy of another manufacturer's whims and fancies. But the other big U.K. manufacturer, English Electric, disclosed that it had a PL/I sub-set in development for System 4 (the Spectra-70 cousin that starts first deliveries this month).

IF BRITAIN JOINS THE COMMON MARKET ...

Britain's decision to apply for membership in the six-nation European Economic Community may have far-reaching effects for the development of an independent European computer industry. Membership of the community could almost certainly guarantee inter-nation collaboration on research and development. There is common ground between the three government chiefs who will give the approving nod for joint work; France's Minister for Science, M. Alan Peyrefitte, Germany's Minister for Science and Research, Dr. Gerhard Stoltenberg, and Britain's Minister of Technology, Anthony Wedgwood Benn.

Dr. Stoltenberg confirmed in an interview last month that he was as committed to stimulating the German industry as were his opposite numbers in France and the U.K. Over the past weeks he has been negotiating areas for cooperation with the other two, particularly for large machine R&D. Although firms such as Siemens are dependent on American licenses for their present bread and butter lines, they are working on the next developments which will free them from restrictions that are inherent in licensing.

English Electric and Siemens are known to be negotiating. Elliott Automation are exploring an Anglo-French deal for their new paper tiger, the 4140-4150 (see News Briefs).

WHO RUNS TIME-SHARING?

There has been some alarm from the independent bureau operators in the U.K. about a government scheme that allows the Post Office to offer a national data processing service. By 1971 the Post Office expects

(Continued on page 113)

RCA ESTABLISHES NEW DIVISION TO SERVE THE COMPUTER AND DATA PROCESSING INDUSTRY

They're geared for big things at Needham, Mass., headquarters for RCA's new Memory Products Division. Recently elevated to full Division status in RCA Electronic Components and Devices, the Needham activity has been implemented with a major expansion program at home and abroad—in engineering, manufacturing, and quality control—to meet your expanding requirements for high quality memory products.

RCA HAS 100% IN-HOUSE CAPABILITY FOR CORES, PLANES AND STACKS

- 100% in-house core manufacture gives RCA *full control* over electrical characteristics of planes and stacks
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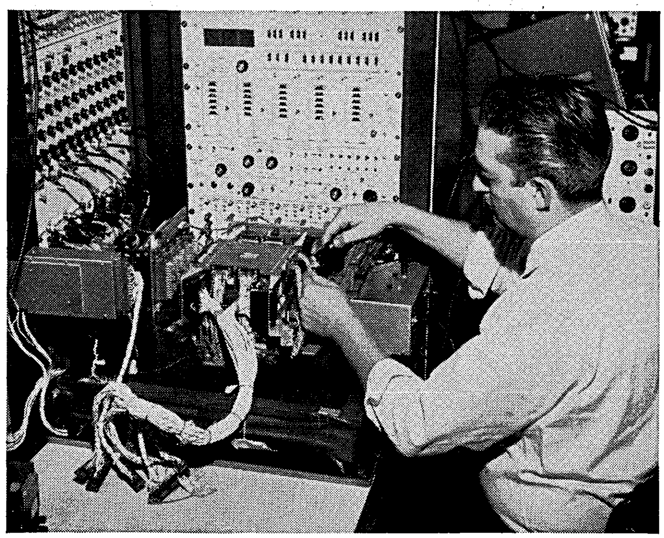
- high density stacks, non-destructive read out devices, printed circuit and molded plastic frames, and other custom features



RCA tests *every* plane and stack under simulated operating conditions with dynamic testers and custom interface equipment to assure ultra-reliable memory products.

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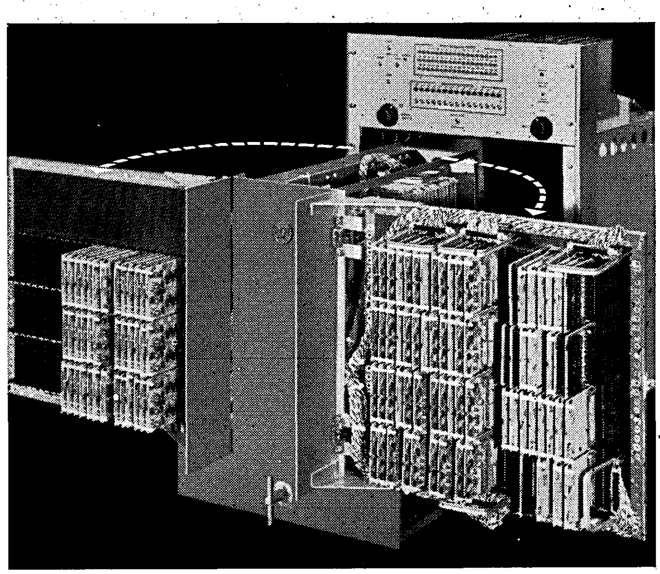
RCA 1-μS MEMORY SYSTEM is a coincident-current, integrated-circuit system with 400 nanosecond access time... capacity available to 32,768 words x 36 bits. Front-panel accessibility for easy maintenance... panels slide out and open like a book. Optional features include self-tester.

From wide-temperature cores to complete state-of-the-art memory systems, RCA's total capability in research, development and manufacturing can answer your memory design problems as well as your volume production requirements. See your nearest RCA Field Representative today. Or call 617-444-7200, RCA Electronic Components and Devices, Memory Products Division, 150 "A" Street, Needham Heights, Mass. 02194. For specific technical bulletins, write RCA Commercial Engineering, Section FD-6, Harrison, N.J. 07029.



RCA Electronic Components and Devices

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CIRCLE 66 ON READER CARD

(Continued from page 111)

to have 20 large machines (all British and worth $1.6 million each) spread around in a data net. Although primarily installed for its own use, the Post Office will have at least two shifts free for hire. The bureau operators see this eating into their business, which is increasing by 10% a year (total U.K. bureau and consultancy market is worth $30 million a year plus).

Some manufacturers also see the GPO as serious potential competition. IBM has called for a meeting with the Postmaster General, Mr. Reginald Short, to give its views.

FIRST STATISTICS ON U.K. INSTALLATIONS

The first ever statistical breakdown of computers and their usage in the U.K. has shown that the British do not yet rank as sophisticated purchasers. The government's Ministry of Technology has turned out its first quarterly review gained from a manufacturer's survey.

It shows that 1,001 machines were installed in 1966. Of these, 383 were valued at less than $56,000 each. Other main points of the statistical breakdown are that in the $150,000 to $350,000 price range there were 483 installations; 297 of these were imports. This compares with only 14 imports for the $50,000 to $150,000 bracket. Industrial on-line control systems have been slow to develop, in spite of earlier forecasts that 1966 would be a good year. Only 10 major industrial on-line systems were recorded, worth a total of $11.8 million. Deliveries of remote terminal devices for off-line and on-line data communications systems were also lower than expected at $4.2 million. Over the next 12 months a sharp increase is expected in the peripheral area for data transmission. The estimated backlog of orders for computers and peripherals at the end of 1966 was $255 million for the home market and $80 million-plus for export. A total of 37 manufacturers cooperated in the survey, which will be compiled quarterly.

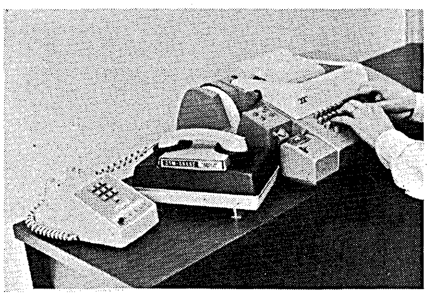
BITS & PIECES

On the eve of steel industry nationalisation by government decree, two of Britain's big commercial users have disclosed $8.5-million plans for computer-communications complexes. The Steel Company of Wales has ordered twin 360/40's, two Elliott Automation Arch 102 systems, two English Electric System 4's and an IGE 412 process controller. The United Steel Companies Ltd. have ordered $4.5-million worth of machinery for a similar integrated management system. ... Honeywell has set up a new division, Computer Control Operations Europe. This is the outlet for the DDP 416 and 516 machines introduced in the States last year. Scheduled to be made in the U.K. in 1968, these two systems are aimed at the burgeoning process control market. In the U.K. alone this is estimated to be worth $150 million by 1970. ... The French aircraft manufacturer, Sud Aviation, has ordered a Control Data 6600 for delivery this year. It will process data for test flights of the supersonic Concord airliner.

new products

terminal/coupler

The Time Share Terminal/Coupler allows telephone access to a computer by means of a coupler and a modified Mod 33 Teletype. The terminal is portable, and operates in any system that uses 103A2 data sets and ASCII input. The coupler is available in an



acoustic and a magnetic model for compatibility with most telephone equipment. Standard features offer half- or full-duplex operation, and a 72-character line (six lines/inch). Paper tape I/O with automatic start/stop is optional. COM-SHARE INC., Chicago, Ill. For information:

CIRCLE 100 ON READER CARD

accounting software

The Automated Installment Loan Accounting System is written in assembler language and runs under the basic operating system on an IBM 360/30. The system accepts punched card input, and requires a minimum of 32K storage and four tape units. Special features include management control reports, automatic generation of delinquency notices and creation of payment stubs. McDONNELL AUTOMATION CO., St. Louis, Mo. For information:

CIRCLE 101 ON READER CARD

military computer

The R-25 digital computer consists of a CPU and a basic memory of 4096 24-bit words. The memory is expandable in increments of 4096 or 8192 words to a maximum of 65,536 words; cycle time is 3 usec. Designed for military applications, software for the i.c. computer includes a full range of subroutines and a symbolic assembler. RAYTHEON CO., Bedford, Mass. For information:

CIRCLE 102 ON READER CARD

data acquisition system

A series of Stored Program Data Acquisition Systems (SPDAS) which will sample a number of analog and digital inputs, perform A/D conversion, format data for computer compatibility, and record data on magnetic tape is available in three models. Model 100 includes essential commands to control sampling sequence and tape block length; model 200 features a larger command list. Model 300 has a gp computer interface to allow on-line processing of collected data. Standard system includes a 16-channel multiplexer which is expandable to 100 channels, an A/D converter, a 4K word (8-bit) core memory, and a digital tape transport. INFORMATION CONTROL CORP., El Segundo, Calif. For information:

CIRCLE 103 ON READER CARD

graphic recorder

The Contour/Riter graphic recorder combines the functions of X-Y and multi-point recorders in one unit, permitting three-input (X-Y-Z) recording on a single chart. Null-balancing potentiometric drives are used for the X and Y axes, which have an accuracy of ±0.5% of full scale. A 24-position multi-point head is used for recording the Z axis inputs; print rate of the Z axis is once per second, with digit change rate of one per second. The initial application will be for material flatness plotting. TEXAS INSTRUMENTS INC., Houston, Tex. For information:

CIRCLE 104 ON READER CARD

crt plotter

The DP-203 is a CRT plotter for on-line applications. It can print on film and paper of up to 40 x 60 inches in 32 gradations from black to white. In addition, it has high-contrast film for plotting PC masters and IC or discrete component semiconductor masks. Plotting speed is 2 usec/bit (500KC) with 100 x 100 or 200 x 200 data points per square inch—0.010 or 0.005-inch dots. The recording medium is attached to a drum from single-sheet film cartridges that are rolled on and off automatically; thus there's daylight loading and unloading. Plotting is done in 4-inch-wide strips around the drum, a 40 x 60 surface plotted in 75 seconds. Interfaces and driving software are available for use with the IBM 360/

PRODUCT OF THE MONTH

The Series 500 is an on-line graphic display system that consists of the control, which interrupts normal computer operation only for a definition of each new line, and three output devices: the 522, a pen-and-ink plotter; the 532, a printed circuit artwork generator with an optical exposure head; and the 575, a large-scale drafting table. The series is the lowest in cost of the firm's graphic systems.

The control accesses three 16-bit words from the computer at a time. The first two words express the magnitude of the line length in the X and Y axes (no intermediate point interpolation is necessary). The third word contains the arithmetic sign of the axes, program stop commands, pen and head commands, etc. For byte-oriented computers, the instructions would be in six 8-bit words. Interfaces for the control to an IBM 1130 and Univac 418 are underway; others reportedly can be done.

Output devices are the 522, which has a 4 x 5-foot drawing area, plotting speeds of 150, 300 and 600 inches/minute with accuracies of ±0.007 and .009 inch over the entire area. The 532, with its optical exposure head, has accuracies from ±.0009 to .0025 at speeds ranging from 60 to 200 ipm. It has a 4 x 5-foot drafting area. The area for the 575, however, is 5 x 24 feet. It plots at 300 to 750 ipm with accuracies of ±.005 and .009 inch. First deliveries of the series are scheduled to begin in August '67. GERBER SCIENTIFIC INSTRUMENT CO., Hartford, Conn. For information:

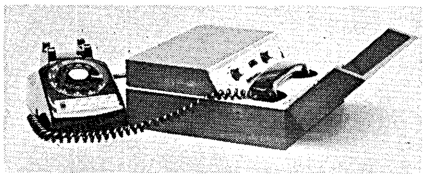
CIRCLE 105 ON READER CARD

30 and up, the IBM 1130, and the CDC 3000 and 6000 series. GEO SPACE COMPUTER DIV., Houston, Texas. For information:

CIRCLE 106 ON READER CARD

data coupler

The ADC Acoustic Data Coupler sends and receives data between any remote terminal (which interfaces with a 103A Dataphone) and a telephone. It can also be used with a



mod 33 or 35 Teletypewriter. The unit can handle a bit rate of up to 200 baud, and has switches that provide for either upright or inverted code and full- or half-duplex. ANDERSON JACOBSON, Mountain View, Calif. For information:

CIRCLE 107 ON READER CARD

card read/punch

The 9280 Card Read/Punch reads and punches an 80-column card in a single pass using column by column punching which eliminates the need for corner-turning buffers. The OEM unit will read 500 cards a minute, and punch 100 cards a minute. CONTROL DATA CORP., Minneapolis, Minn. For information:

CIRCLE 108 ON READER CARD

data modification kit

Modification kits permit the S-C 4400 Data Recorder to accept data on 7-track BCD or 9-track EBCDIC tapes from the mod 1, 2 or 3 versions of the IBM 2401 transports. The S-C 4400 translates computer codes into alphanumerics and records the output on 16mm or 35mm microfilm. The new interface allows two tape units to be connected simultaneously to the data recorder. STROMBERG-CARLSON, DIV. OF GENERAL DYNAMICS, San Diego, Calif. For information:

CIRCLE 109 ON READER CARD

expanded memory system

Two new memories are modifications of the FX-12 core memory system (512 8-bit words). FX-12/E has 1024 8-bit words, a 10 usec cycle time, and can be used for code or format conversions and speed buffering. FX-12/F, also a 1024 8-bit core memory, features a cycle time of less than 5 usec, and is supplied with data registers and timing and control circuitry. FERROXCUBE CORP., Saugerties, N.Y. For information:

CIRCLE 110 ON READER CARD

recorder-translator

Model M8110 recorder-translator, composed of a storage translator and an incremental magnetic tape recorder, will produce IBM-compatible tape records from digital input sources such as digital voltmeters, A/D converters, and counters. The system has a buffer memory which stores new data as older data is being recorded at a maximum rate of 500 characters/second. Translator will accept up to 80 characters of BCD information. Recorder will operate with either synchronous or asynchronous data, and

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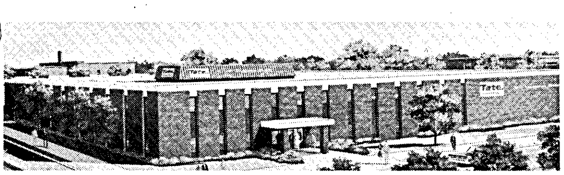

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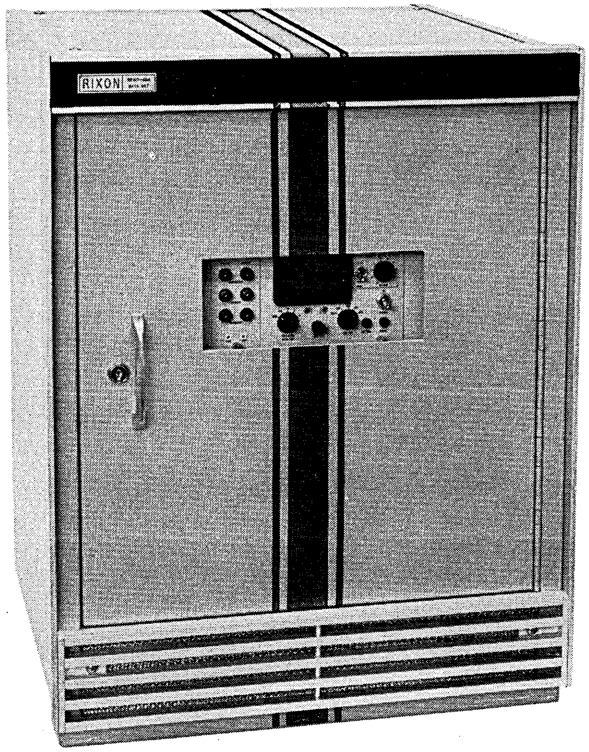

The Rixon 4800 bps SEBIT-48M Data Set. Cabinet and striping optional.

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With an automobile you usually sacrifice economy for speed. Not so in data communications. The Rixon Sebit-48M Data Set which operates at 4800 bits per second proves that speed produces significant economies. You achieve higher throughput, increase off-line time, ease schedules and make more efficient use of communication circuits. These benefits help you effectively reduce many of your costs. The 48M, like all of Rixon's data sets, will interface with all EDP equipment and uses voice grade telephone channels. We've just published a brochure that details the economies that Rixon data sets can give you. May we send you a copy.

RIXON ELECTRONICS, INC.

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CIRCLE 69 ON READER CARD

records at densities of 200 characters/inch in a NRZI (nonreturn to zero inverted) mode. MONSANTO CO., St. Louis, Mo. For information:

CIRCLE 111 ON READER CARD

data recording system

The 300 Series data recording machines include the mod 353 data console, a typewriter magnetic cartridge tape recorder; the mod 355 data console, the typewriter-recorder with playback; and the mod 356, typewriter-recorder and data transmission set. The operator enters alphanumeric data on a coventional typewriter keyboard; data is recorded on ¼" mag tape in a cartridge suitable for wire transmission or on-line input. Each cartridge has a recording capacity of over 175,000 characters. The equipment can transmit 100 or more characters per second over conventional telephone lines using Data-Phones. WYOMING ELECTRODATA CO., Riverton, Wyo. For information:

CIRCLE 112 ON READER CARD

optical reader

The ODPS 216 is a scanner for processing club and installment account payments, school savings deposits, and other turnaround-type documents. It can read gang-punched, humanly readable characters, a five-level "one code" produced by a line printer, the Addressograph-Multigraph bar code, variable information marked manually by a special pen or pencil, and encoding that is perforated or imprinted on a sales ticket from a charge card. The scanner reportedly can read any four of these on the same document in a single pass. Designed to be operated off-line, the information read is transferred to paper or mag tape at up to 300 documents/minute. The device is available with or without digital sorting capability at speeds up to 500 items/minute. CUMMINS-CHICAGO CORP., Chicago, Ill. For information:

CIRCLE 113 ON READER CARD

expanded computer system

The 1130 computing system, formerly available with a 4 or 8K core memory and cycle time of 3.6 usec, has been expanded to include a 16 or 32K word size and a 2.2 usec cycle time. An optical mark reader has been added to the peripherals; printing speeds of 600 lines a minute, and reading speed of 1000 cards a minute are also new. Upgraded software includes a Commercial Subroutine Package with decimal arithmetic capability. In disc-oriented systems, previously providing direct access to one disc in the CPU, up to two storage drives accommodating one or two discs each, may now be attached to the system. IBM DP DIV., White Plains, N.Y. For information:

CIRCLE 114 ON READER CARD

core memories

The BMS Series of ferrite core memories provide storage capacities ranging from 64 to 4096 (2 to 36-bit) words, access time of 2 usec, and cycle time of 5 usec. The memories consist of I/O data registers, digit drivers, sense amplifiers, current drivers, and address switches; cost is $1,000. BORDERS ELECTRONICS MFG. CO. INC., Pennsauken, N.J. For information:

CIRCLE 115 ON READER CARD

reader/sorter

Bar Code Reader/Sorter sorts paper documents at a speed of 1800 a minute, and interprets fluorescent bar

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CIRCLE 71 ON READER CARD

codes at rates up to 144K characters a minute. The unit uses vacuum and air pressure to separate and control paper, and can process documents that are folded, crumpled, stapled or torn. Documents pass through sorter at 400 inches a second and are routed to one of 12 output pockets. The Reader/Sorter also includes a programmed controller that can perform parity and validity checks. RECOGNITION EQUIPMENT INC., Dallas, Tex. For information:

CIRCLE 116 ON READER CARD

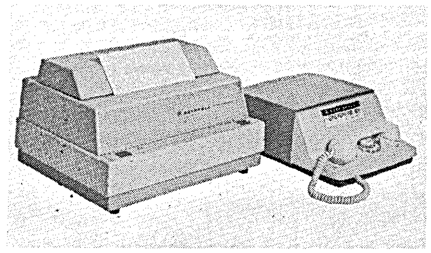
i.c. memory system

The 2½D i.c. memory system uses ferrite cores and integrated circuits, has a cycle time of 500 nsec, and a basic capacity of 16K 36-bit words. The system combines 2-wire linear select memories with coincident-current memories (4-wire). The ferrite cores have a switching speed of 220 nsec. RCA MEMORY PRODUCTS, Needham Heights, Mass. For information:

CIRCLE 117 ON READER CARD

data-phone printer

Interface circuitry has been designed that will allow the TP-4000 teleprinter to print data from 201 and 202 Data-Phones. The system operates at rates of 600, 1200 and 1800



bits per second with the 202; 2000 and 2400 bps with the 201. The printer will handle 8-level ASCII code, includes parity check and a data dropout warning. GOVERNMENT ELECTRONICS DIV., MOTOROLA, INC., Chicago, Ill. For information:

CIRCLE 118 ON READER CARD

auxiliary printer

The PrintFlo 300 auxiliary printer produces typed documents at a rate of 30 characters a second, or 300 words a minute. The unit accommodates fanfold forms 9″ in width, and 11″ in length, and receives information from the primary input printer, tape or tab-card readers, mag tape or a computer. PrintFlo 300 is an optional output device for SCM's Typetronic system, and is activated by control codes. SCM CORP., New York, N.Y. For information:

CIRCLE 119 ON READER CARD

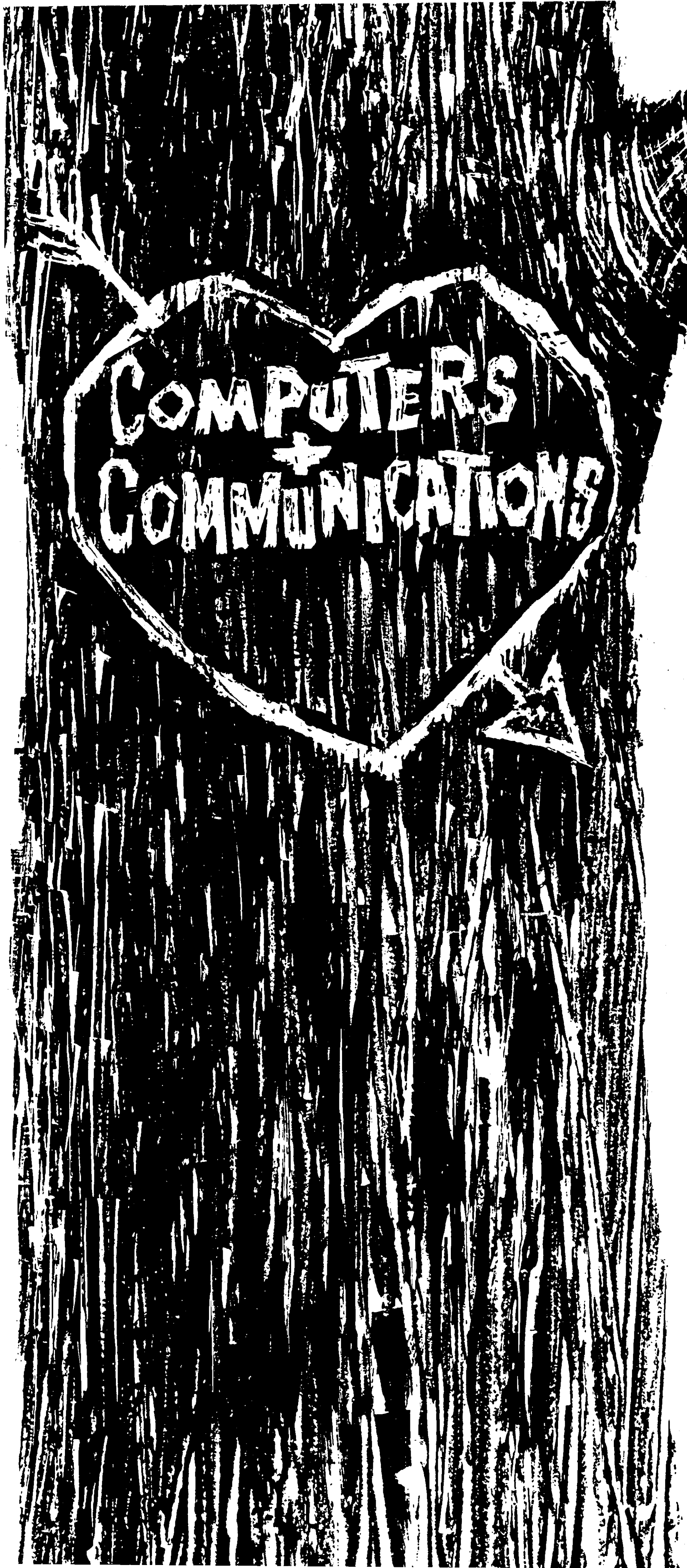
phone-to-keypunch translator

The Phone-to-Keypunch Translator links a Touch-Tone telephone with a keypunch, receives incoming signals from the telephone and transmits them to the keypunch, where the information is recorded on punched cards. COMPUTER TELEPHONE CORP., Washington, D.C. For information:

CIRCLE 120 ON READER CARD

time-sharing software

The Basic Time-Sharing System software package is for the Spectra 70/45 computer system, and is available to all users without charge. The package has an interactive mode, statement-at-a-time Fortran compiler, and can handle 16 remote users simultaneously by use of either Teletype or



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video display units, and with a maximum delay of about two seconds. A special feature is the HELP routine, which furnishes the programmer with information about the structure of the computer. RCA EDP, Cherry Hill, N.J. For information:

CIRCLE 121 ON READER CARD

incremental tape coupler

The ITC-100 incremental tape coupler accepts data from A/D converters, time code generators, and counters, and formats it for recording on an incremental magnetic tape transport. The unit will accept 4-6 bit words of from 4-12 characters, and produces computer-compatible tape at 200, 556 and 800 bits per inch. Modes of operation include advance one character, advance one word, advance one record and continuous cycle. The coupler interfaces with standard i.c. logic levels. INFORMATION CONTROL CORP., El Segundo, Calif. For information:

CIRCLE 122 ON READER CARD

core memory system

The Micra-STOR coincident-current memory system has capacities of 256-4096 (4-36 bit) words, and a cycle time of 1.75 usec. The "Party Line" option permits the input of two or more memory units (up to four) to be connected in parallel by a single set of cables, giving a maximum capacity of 16,384 words. An output select term is provided on each system output gate to permit disabling the memories which are not being accessed. STANDARD MEMORIES, Santa Ana, Calif. For information:

CIRCLE 123 ON READER CARD

display refresher memories

Memory system for CRT data displays stores information on a drum which supplies a repetitive signal to refresh the display. Storage capacity is from 2-10K bits; capacity can be extended to 20K bits. Operating at a frequency of 200 kHz, system includes write-current range of 40-80 ma/leg, and a read-output range of 20-100 mv. WESTERN MAGNETICS, DIV. OF GJM INC., Glendale, Calif. For information:

CIRCLE 124 ON READER CARD

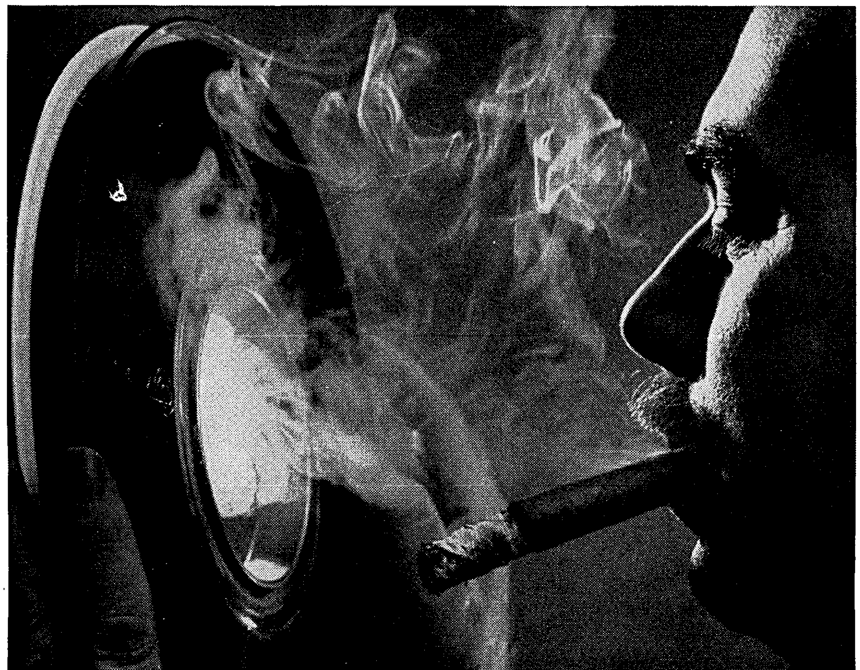
photoelectric keyboard

The Series PK-200 photoelectric keyboard converts operator alphanumeric input information into coded electrical signals. When depressed, the keys move binary coded shutters to interrupt light beams. The difference in light intensity reaching one or more

photo-resistors produces changes in their individual resistances. These ohmic changes are available as direct outputs or may be converted by amplifiers to corresponding voltage level changes. The amplifiers have low output impedances and may be connected to other data system devices. INVAC CORP., Waltham, Mass. For information:

CIRCLE 125 ON READER CARD

Air pollution kills.



Nothing kills computer tape more quickly than dust. The slightest speck of ash, under the pressure of layer after layer of tape, can depress the tape surface and create permanent errors.

Moral:
Don't smoke in the computer room.

You can breathe easier when you use Audev computer tape. The top U.S. companies do. **Audev** COMPUTER TAPE BY AUDIO DEVICES, INC.

FOR A FREE POSTER-SIZE REPRODUCTION OF THIS AD, AND THE OTHERS IN THE SERIES, WRITE DEPT. DA-2 AUDIO DEVICES, INC., 235 EAST 42ND STREET, NEW YORK CITY, NEW YORK 10017.

The new, small DECdisk provides 32K words extra memory for the PDP-8 for $6,000. Additional 32K DECdisk units cost $3,000 each. Since a basic $18,000 PDP-8 computer has 4096 words in core, with four DECdisk units, that could give you a high speed computer with 135,168 12 bit words for $33,000!

DECdisk is compatible with the $10,000 PDP-8/S, too. Adding four DECdisk units gives you a slightly slower computer with 135,168 12 bit words.

More memory for less cost than any other computer.

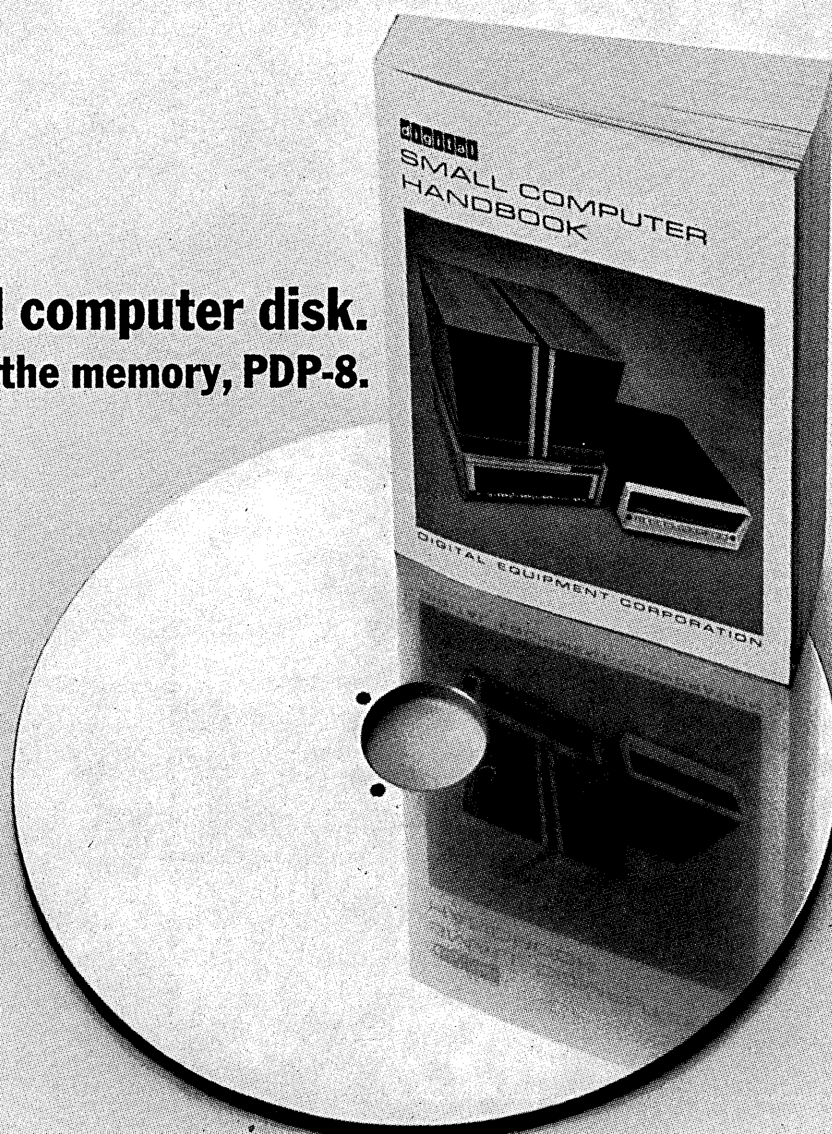
At last count, more than 700 PDP-8 computers have been sold to scientists and equipment manufacturers. The PDP-8 is, by far, the most successful and proven on-line, real time, small computer in the world. And that was before DECdisk.

DECdisk was developed, like all DIGITAL peripherals, to customize a basically inexpensive computer to special applications. Yours. DECtape was developed the same way. The unique 3½" reels of magnetic tape not only provide low cost storage, but permit you to carry your program library in your pocket. And displays — did you know that DIGITAL was the first computer manufacturer to put a CRT on a computer?

Computer manufacturers who worry about what the customer needs, worry a great deal about peripherals. DIGITAL has one of the largest lines of peripherals in the industry. Write, and we'll send you a free "Small Computer Handbook" and tell you all about our peripherals.

New, low cost, small computer disk.

Thanks for the memory, PDP-8.



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new literature

RESPIRATORY ANALYSES SYSTEM: Bulletin provides data on model OCC 1000 oxygen consumption computer with a standard range of 0 to 1000 cc intended for basal metabolism studies. General description of the equipment which includes breathing mask, sensors and analog computer are provided. Instantaneous mass rate of flow of the expired gas is monitored by a flowmeter that provides a linear output voltage proportional to the mass flow. Specifications cover power requirements, mass flowmeter, P^0_2 electrode, temperature control and various outputs. TECHNOLOGY INC., Dayton, Ohio. For copy:

CIRCLE 140 ON READER CARD

CORE MEMORY DEVELOPMENT: Four-page brochure illustrates memory development during the past decade by comparing the SEMS 5 military memory with the first commercial core memory built in 1955 for the JOHNNIAC computer. Brochure includes comparison of JOHNNIAC and the SEMS 5 memories in size, weight, storage capacity, power requirements, speed and temperature. ELECTRONIC MEMORIES INC., Hawthorne, Calif. For copy:

CIRCLE 141 ON READER CARD

HUMAN FACTORS ENGINEERING: Study of 20 design engineers shows they have little or no interest in human factors, human factors information or in the application of human factors criteria to design. Their attitude toward human factors is consistently negative in practice, although they pretend to be quite positive on a verbal basis, asserts the report. Cost: $3; microfiche $.65. AD-642 057. CLEARINGHOUSE, U.S. DEPT. OF COMMERCE, Springfield, Va. 22151.

STORAGE TRANSLATOR/TAPE RECORDER: Brochure describes translator which will accept data from digital input sources and translate them into a form compatible with various data acquisition systems. Recorder will handle either synchronous or asynchronous data at speeds up to 500 cps. MONSANTO CO., St. Louis, Mo. For copy:

CIRCLE 142 ON READER CARD

TAPE TESTER: Four-page brochure explains functions, features and performance characteristics of model 3200. Tester cleans and tests entire width of the tape and checks tapes which have been converted from seven- to nine-track. GENERAL KINETICS INC., Arlington, Va. For copy:

CIRCLE 143 ON READER CARD

OPTICAL READER: 15-page brochure explains advantages of optical processing to an investment company, printing firm, gas supplier and a retail chain. Listed are 46 customers, their addresses and applications of the NCR 420 optical reader. NATIONAL CASH REGISTER CO., Dayton, Ohio. For copy:

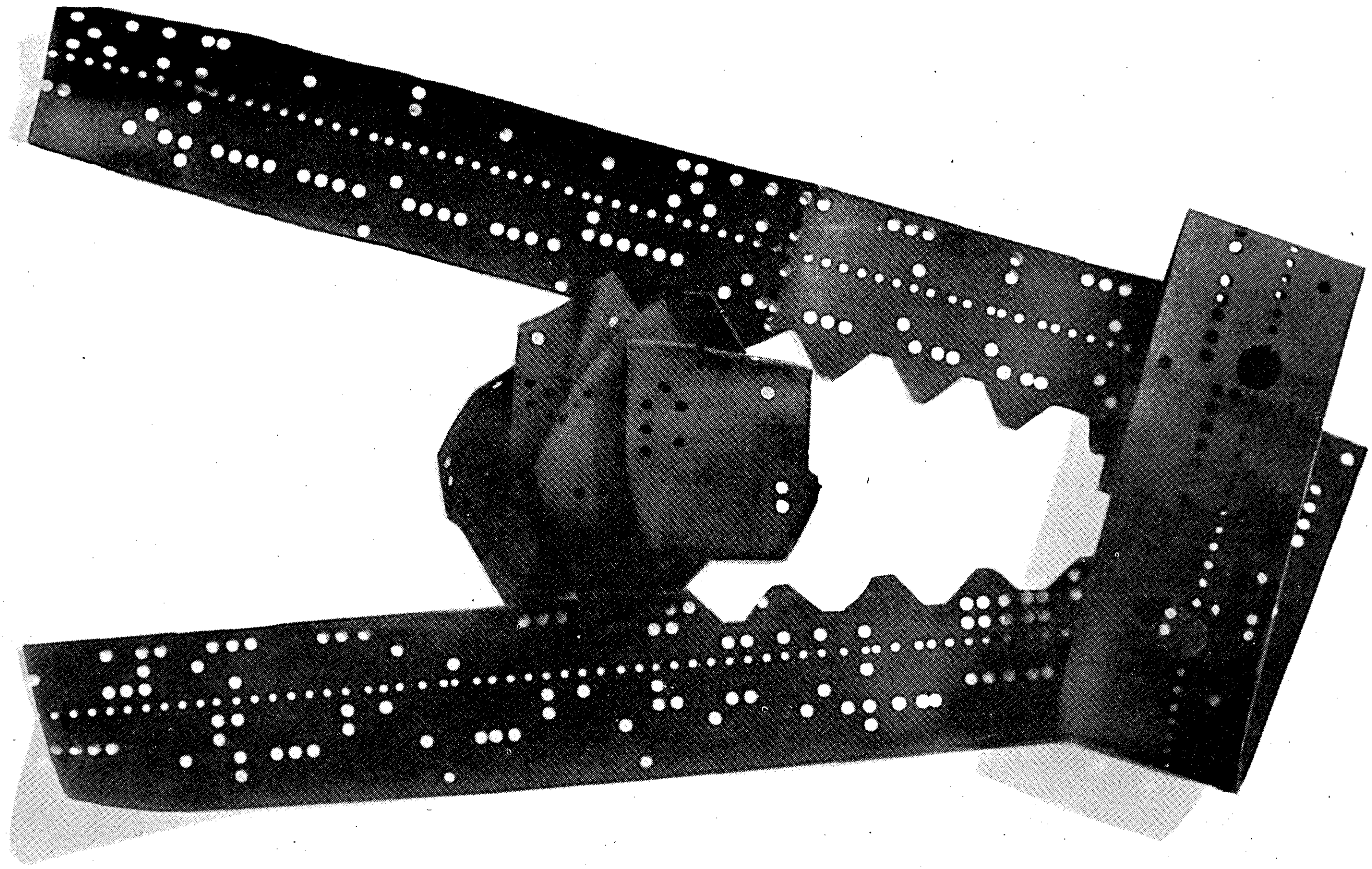
CIRCLE 144 ON READER CARD

HYBRID TUTORIAL: 14-page booklet explains concepts of hybrid computation and offers a summarized evaluation of a combined analog-digital computing tool for real-time simulation. Cost: $.50. DYNAMIC ARTS AND SCIENCES, 3500 E. Hampden, Englewood, Colo. 80110.

THREE-DIMENSIONAL PLOTTER: Brochure describes plotter which makes "hard-copy" records, charts and graphs. Model 501 has removable plotting boards, direct plotting of data without interpolating contours or fitting to rectangular grid, positioning of data point anywhere on board within resolution of positioning mechanism, and display of mathematic functions of empirical data involving any three variables. Plotter can be used in aerospace, electronics, scientific research, relief mapping, civil engineering, mathematical analysis, meterology and business economics. SPATIAL DATA SYSTEMS, INC., Goleta, Calif. For copy:

CIRCLE 145 ON READER CARD

TAPE LOOP TRANSPORT SYSTEM: Six-page brochure gives details for tape recorder which has been designed for acquisition and correlation of data and real-time analysis primarily for geophysical applications, but also suited for aircraft, automotive and shipboard recording. Model LT-1500 provides



Software is the hard nut. Can you crack it?

The real problem today is not building computers, it's mastering them. They're expensive only if they don't do the work. They're cheap if they do. Our business, at Link Information Sciences—is making them pay.

Software is the name of the game, and that's where you come in. We're a team out to crack the software problem, and you can join us. We've entered a new phase of our development with a new name. From now on we'll be doing commercial as well as scientific and military work. We're already a top organization in Systems Analysis, Application Programming, Mathematical Analysis and Computer Systems Programming. And we'll grow. Fast.

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BS or BA Degree in Scientific or Business discipline with 4 or more years programming or systems analysis experience in inventory control, labor distribution, payrolls or information storage and retrieval. COBOL or Auto-Coder, tape and disc application.

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up to a 35 million bit memory stored on a continuous 60-, 120- or 240-foot magnetic tape loop. Tape is driven by a single capstan which maintains motion control during tape acceleration and deceleration. Solid state drive circuitry is packaged on printed circuit cards mounted in the back of the transport. POTTER INSTRUMENT CO., INC., Plainview, N.Y. For copy:

CIRCLE 146 ON READER CARD

PLOTTING SYSTEM: 12-page brochure describes DPS-6 system which includes an x-y plotter, input source and supporting software. Plots for production scheduling graphs, highway roadbed diagrams, building component designs and schematic engineering drawings are illustrated. MILGO ELECTRONIC CORP., Miami, Fla. For copy:

CIRCLE 147 ON READER CARD

GEOLOGICAL APPLICATION OF FORTRAN IV: Publication deals with a method of treating geologic information which may be cyclic by using double Fourier series for surface fitting of irregularly spaced data. Cost: $.75. EDITOR, COMPUTER CONTRIBUTION SERIES, KANSAS GEOLOGICAL SURVEY, UNIV. OF KANSAS, Lawrence, 66044.

DESTATICIZING COMPUTER ROOMS: Booklet covers dust control, disinfection, deodorizing and reduction of the static generated by daily traffic. Methods of application of a specialized finish and daily upkeep are included. WALTER G. LEGGE CO., INC., New York, N.Y. For copy:

CIRCLE 148 ON READER CARD

TEST MODULES: Series 2000 line of 20MHz is designed for memory testing, telemetry timing and circuit evaluation. Modules provide signal parameters for bench testing and systems applications. Brochure explains features, specifications and prices for trigger, timing, positive and negative current driver modules and two enclosures with and without power. Function and logic diagrams are included. HONEYWELL INC., COMPUTER CONTROL DIV., Framingham, Mass. For copy:

CIRCLE 149 ON READER CARD

RENUMBERING AND EDITING PROGRAMS: TIDY is a FORTRAN code for editing and renumbering statements which have become unwieldy and whose readability has deteriorated as a result of many revisions, patches and corrections. Statement numbers are increased in consecutive order, FORMAT statements are collected and appear at the end of each routine, excessive blanks are deleted from each statement, while other blanks are inserted as necessary to ensure uniformity and to improve readability. Cost: $3; $.65, microfiche. AD-642-099. CLEARINGHOUSE, U.S. DEPT. OF COMMERCE, Springfield, Va. 22151.

KEYBOARD DISPLAY: Model 7550, a combination keyboard input and CRT display device for use with Sigma computers, is described in brochure. Physical description of the unit, optional features, a user-oriented discussion on how to operate the keyboard display and specifications are covered. SCIENTIFIC DATA SYSTEMS, Santa Monica, Calif. For copy:

CIRCLE 150 ON READER CARD

TAPE-TO-TAPE EQUIPMENT: 12-page brochure describes equipment which transmits and receives data at 105 cps and operates on any 5-, 6-, 7- or 8-level code, including ASCII. Teletype 1050 equipment can transmit tape output of automatic send-receive sets, self-contained paper tape punches, computers and other business machines. Several industry applications are cited. TELETYPE CORP., Skokie, Ill. For copy:

CIRCLE 151 ON READER CARD

CIRCLE 302 ON READER CARD

TIME-SHARING SERVICES: Eight-page booklet covers on-line storage features and the TELCOMP language (a combination of English and algebra), gives examples of solutions and printouts, and describes three different rate structures ranging from $12 to $20/hour. BOLT BERANEK AND NEWMAN INC., Cambridge, Mass. For copy:

CIRCLE 152 ON READER CARD

PHOTOTYPESETTING SERVICE: Four-page brochure illustrates increased typesetting quality, ability to condense data on a page with cost savings in paper, printing, binding and postage. System can take mag tape output and produce phototypeset pages, ready for platemaking in bold, Roman and Italic characters, upper and lower case, with proportionate spacing in various styles and sizes, in line lengths up to 11″, at the rate of 600 cps. SEDGWICK PRINTOUT SYSTEM CORP., New York, N.Y. For copy:

CIRCLE 153 ON READER CARD

TRANSFORMER MEMORY SYSTEMS: Four-page brochure and data sheets explain braided transformer read-only assemblies. Data sheets cover features and mechanical specifications for the Memory Pac and integrated circuit modules; current source selector and gating modules are described. Possible applications include look up tables for industrial control, radiation patterns for phased array antennas, numerical control, function generators and hyphenation memories for computerized typesetting. MEMORY TECHNOLOGY INC., Waltham, Mass. For copy:

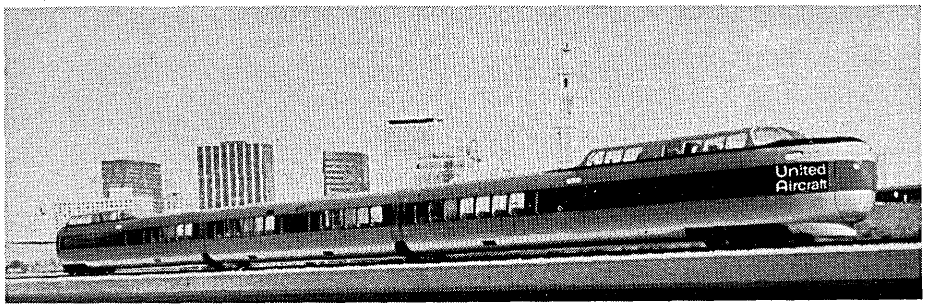
CIRCLE 154 ON READER CARD

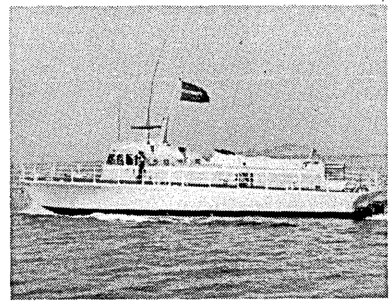
INFORMATION RETRIEVAL SYSTEM: Brochure describes system which provides companies with a means to exchange salary and other compensation information and assists persons to evaluate and compare compensation policies of his company with those of other firms. SYSTEM DEVELOPMENT CORP., Santa Monica Calif. For copy:

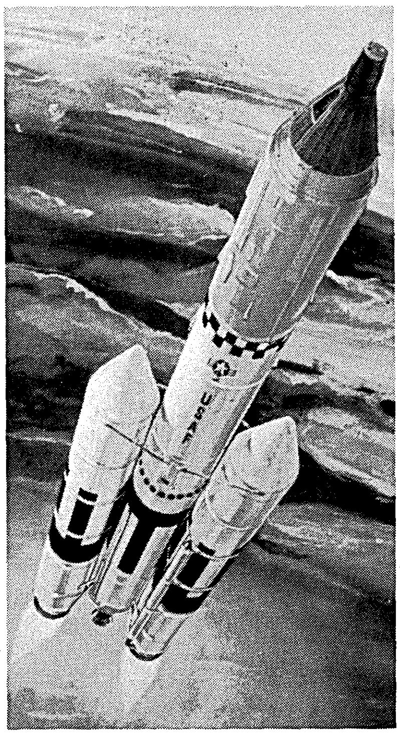
CIRCLE 155 ON READER CARD

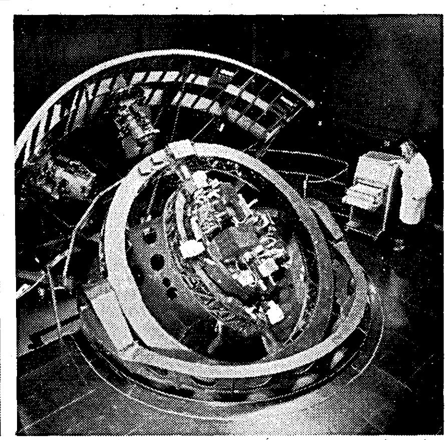
ANALYSIS OF THE SYSTEM/360: Excerpts from a 420-page analysis report are available in brochure form. Sample pages show how the System/360 report describes and evaluates hardware and software. Individual subreports on each of the 360 models describe their characteristics, pricing and overall performance on a group of standardized problems, including one that measures real-time file updating performance in the random access mode. AUERBACH CORP., Philadelphia, Pa. For copy:

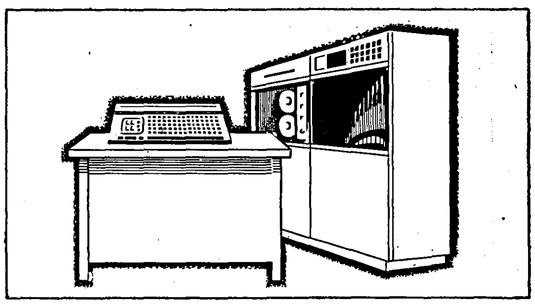
CIRCLE 156 ON READER CARD











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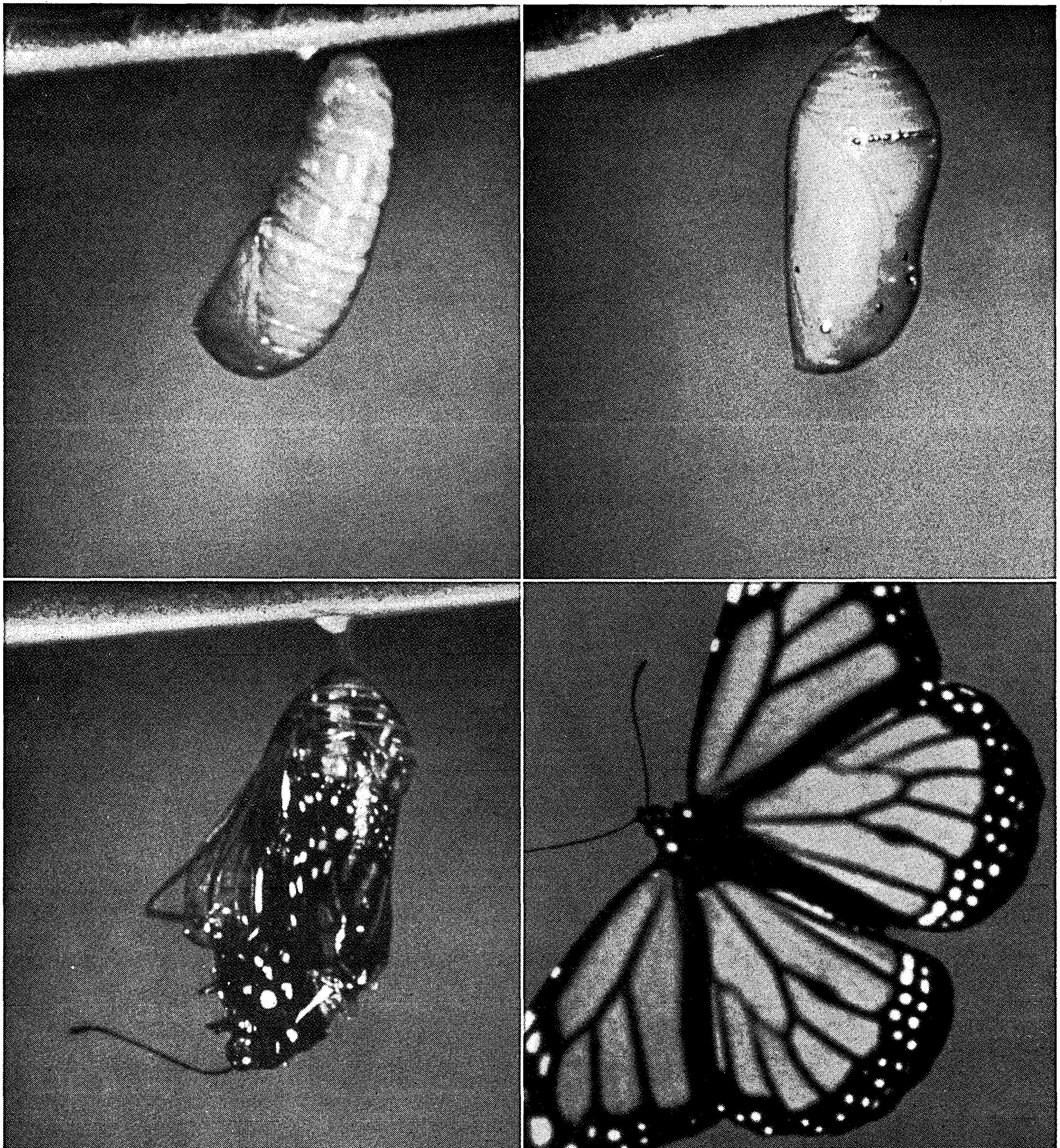

books

***The Impact of Computers on Management*, edited by Charles A. Myers, MIT Press, 1966, $10.00.**

This book contains the edited proceedings of a conference held at the Sloan School of Management at MIT in April, 1966. There are seven papers, each followed by a discussion. Summaries of the conference's nature and results precede and follow the papers, and an appendix contains a case study of the impact of computers on a manufacturing company.

For some years now it has been an article of faith in the data processing business that computers would profoundly change organizations' structures and the nature of management. To suggest that they would not has been a kind of heresy; perhaps an admission that we aren't as important as we thought. The early prophets of this change could only speak of the future; there was no experience, there were no organizations far enough along to provide convincing evidence. A number of years have passed since the early prophecies, though, and many organizations have used computers for 10 years or more. One suspects that there should now be an increasingly indicative body of evidence, and that it may be time to test the early prophecies.

Most of the participants in this conference, primarily from the faculties of Harvard and MIT but also from some other universities and from IBM, are men who should be in a good position to do this testing. Their professions involve careful and perceptive observation of trends in organizations' structures, and highly skilled analysis and extrapolation of them. What do they conclude?

In a word, they disagree. Though they would surely resist this categorization, they seem to this reviewer to split fairly sharply into two classes: the "hawks" (changes will be profound, and in many cases unwelcome —if they haven't taken place yet, it's only because the available technology isn't fully utilized), and the "doves" (most really important management information is not recorded or quantifiable, so none of the essentials will change). In the discussions a few "dawks" appeared, who suggested that the differences among the participants were ones of semantics, or points of view; the speakers were usually courteous enough to accept this. However, the dichotomy among the basic papers remains fairly sharp.

Donald C. Carroll, one of the hawks, presents the thesis that on-line, real-time systems will profoundly affect the nature of organizations. He says:

"We can therefore postulate the existence of totally flexible and general computer systems which provide simultaneously three crucial capabilities: a current, global data base; substantial computational power available for real-time decision-making; and a convenient, efficient man-machine interface providing for data access and cooperative problem-solving. And this implies that in a given problem context, whatever permutation or combination of human and machine problem-solving attributes is needed can be supplied with data inputs of whatever quality of currency or scope is desired."

He concedes that there are flaws in these systems when regarded as sole and entire supports of management, and that few are completely realized (though he believes that some military systems, "e.g., SAGE, NORAD", are examples). He does not address the formidable difficulty of obtaining the required data (impossibility, in some cases), and the non-trivial task of determining the quantitative interactions among them.

David Klahr and Harold J. Leavitt, also of the hawk disposition, believe that fully defined tasks (or decision processes) can be programmed; only undefined or "heuristic" tasks cannot. They note the continuing experimentation with heuristic programs, and expect that the defined task (therefore, the programmed task) will move steadily upward in the organizational ranks.

Thomas L. Whisler might be characterized as a "reluctant hawk." He notes that the subject is cloudy; there are few quantitative measures of organizational change available, and the experience that underlies individuals' opinions varies widely. He goes on to state that, in his opinion, the computer is a force for centralization. He sees one level of management eliminated, and the seat of decision making moving higher in the organization. He notes that management of the computer is moving away from functional areas and toward a central, "neutral" position in the organization. Finally, Whisler sees an increasing emphasis on time discipline, on the "deadline." He is not especially happy about this. In speaking of a particular organization, he says:

"Most managers in this corporation perceive the nature of the computer-

induced change and the implications it has for the structure of control. They are still generally dedicated to the idea that decentralization is a positive virtue but are reluctantly becoming aware that it will be necessary to redefine it in some fashion."

John A. Beckett devoted his paper to an examination based on case studies of what the "Total-Systems Concept" means in practice. He interprets the phrase as describing an attitude, rather than a particular plan of data processing. He finds the concept of formal systems to be a pervasive one, with the result that in operational areas there is an increasing formalization of processes and methods of getting things done, while in "non-operations" (i.e., planning) areas there is an increased use of a broad spectrum of research tools of a "systems" character. He examines the apparent impact of this trend toward what he terms "management-by-system" on various classes of personnel, and finds that in the main they like it. He concludes that management-by-system is likely to be a good thing, both for organizational efficiency and for human satisfaction, so perhaps he may be considered a mild hawk.

George E. Delehanty is the only author who cannot be categorized as belonging to either side, since his paper is devoted to an objective presentation of the results of a study of the impact of data processing on life insurance organizations. In an area amply supplied with opinion and short on facts, such studies are most welcome. Delehanty concludes that there has been no association of computers with centralization of management in the life insurance industry. The more successful firms using data processing have, however, made many organizational changes—including experiments with placement of the computer activity in the organization—that have not produced conclusive results. These more successful firms generally show a high degree of management interest in the data processing function, and a pattern of rapid promotion for promising young men. Delehanty is also politely critical of the clerical efficiency of life insurance companies.

John Dearden is a widely known dove (his "Myth of Real-Time Management Information"[1] was counterattacked by a hawk in the pages of this magazine[2]), and he presents some interesting support for his views in his paper "Computers and Profit Centers." He asserts that decentralization of profit center responsibility is desirable in most organizations regardless of information availability, because it is useful for motivation and performance measurement of subordinate management, and because many of an organization's myriad decisions are better made by individuals close to the problem (and having specific technical skills) than by over-all management. He concedes that "logistics systems" and the management of data processing itself are generally being centralized, but believes that this will not reduce the existing degree of profit center decentralization. In fact, he suggests, more convenient availability of information may result in more decentralized decision-making rather than less.

Charles R. DeCarlo, after a thoughtful review of the nature of modern business organizations, declares himself a dove by opining that the traditional pyramidal structure of authority and responsibility, and the reasons for it, are not affected by the computer. He warns that "over-designed" information systems can, in fact, impose an undesirable increased degree of rigidity on the pyramid. DeCarlo generally espouses a humanist point of view, maintaining that organizations do, will and must reflect human values and the realities of human interactions if they are to be successful, rather than a highly mechanized structure.

The doves are given the last word because Jay Forrester summarizes and comments on the conference as a whole, and he explicitly says:

". . . I lean more heavily on what Dearden and DeCarlo have just said, as my experts, because I am predisposed to view management and information technology in the same way."

He believes that "non-recorded" information passing between individuals is, and will remain, crucial to organizations, and that any organization not permitting its use will fail. He concedes that such interactions between individuals must take place within a framework of policy, but goes on to suggest that in the future even this restraint may result in more individual freedom, with an orientation more like that of an individual relative to the law (abstract) instead of the present orientation toward a boss (individual).

Judging from this general disagreement among men who should know, 15 years is not long enough for the nature of the computer's impact on management to be clearly evident. One thing is evident though; whatever change there is, is slow. At least, one group of the early prophets is wrong:

[1]*Harvard Business Review, May-June, 1966.*
[2]*DATAMATION, August, 1966.*

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those who predicted rapid revolution in organizations and management because of the computer.

The book is well produced, indexed and debugged of typographical errors. It is somewhat surprising that there is not one illustration, drawing or visual aid in the book. Presumably the conference was so structured that these were not used. However, this must surely be the first book on organizational structures without an organization chart anywhere in it!

—FREDERIC G. WITHINGTON

book briefs

(For further information on the books listed below, please write directly to the publishing company.)

Threshold Logic, P. M. Lewis II and C. L. Coates. John Wiley & Sons, Inc. New York, N.Y. 1967. 483 pages. $15.00.

An exposition of threshold logic with emphasis on synthesis for prescribed sensitivity constraints. Intended for the circuit designer and students interested in detailed theory.

The Design and Analysis of Scientific Experiments, K. C. Peng. Addison-Wesley Publishing Co., Inc., Reading, Mass. 1967. 252 pages. $12.50.

A discussion of estimations, constructing common experimental designs, and testing hypotheses, from a statistical viewpoint. Assumes a background of calculus, elementary matrix theory, and a one-year course in statistics.

Introduction to Numerical Methods and FORTRAN Programming, Thomas Richard McCalla. John Wiley & Sons, Inc., New York, N.Y. 1967. 359 pages. $7.95.

A unified presentation of numerical methods and FORTRAN programming with examples and exercises.

IITRAN/360: Self-Instructional Manual and Text, C. P. Bauer, A. P. Peluso, W. S. Worley, Jr. Addison-Wesley Publishing Co., Inc., Reading, Mass. 1967. 212 pages. $4.95 (paperbound).

An introduction to the basic techniques of programming using the IITRAN language developed at the Illinois Institute of Technology.

Elements of Data Processing Mathematics, Wilson T. Price and Merlin Miller. Holt, Rinehart and Winston, Inc., New York, N.Y. 1967. 452 Pages. $9.95.

A text for students, relating the study of logic to contemporary computer languages.

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be using a 360/30 at the nearby Valley National Bank. With a Tally 600 system, Photo-Comp will convert paper tape to mag tape, input that to the 360, and convert the output tape before going into the Photon. Software is by Wolf Research and Development.

DARTMOUTH'S GE-265 SHUFFLES OFF TO BUFFALO

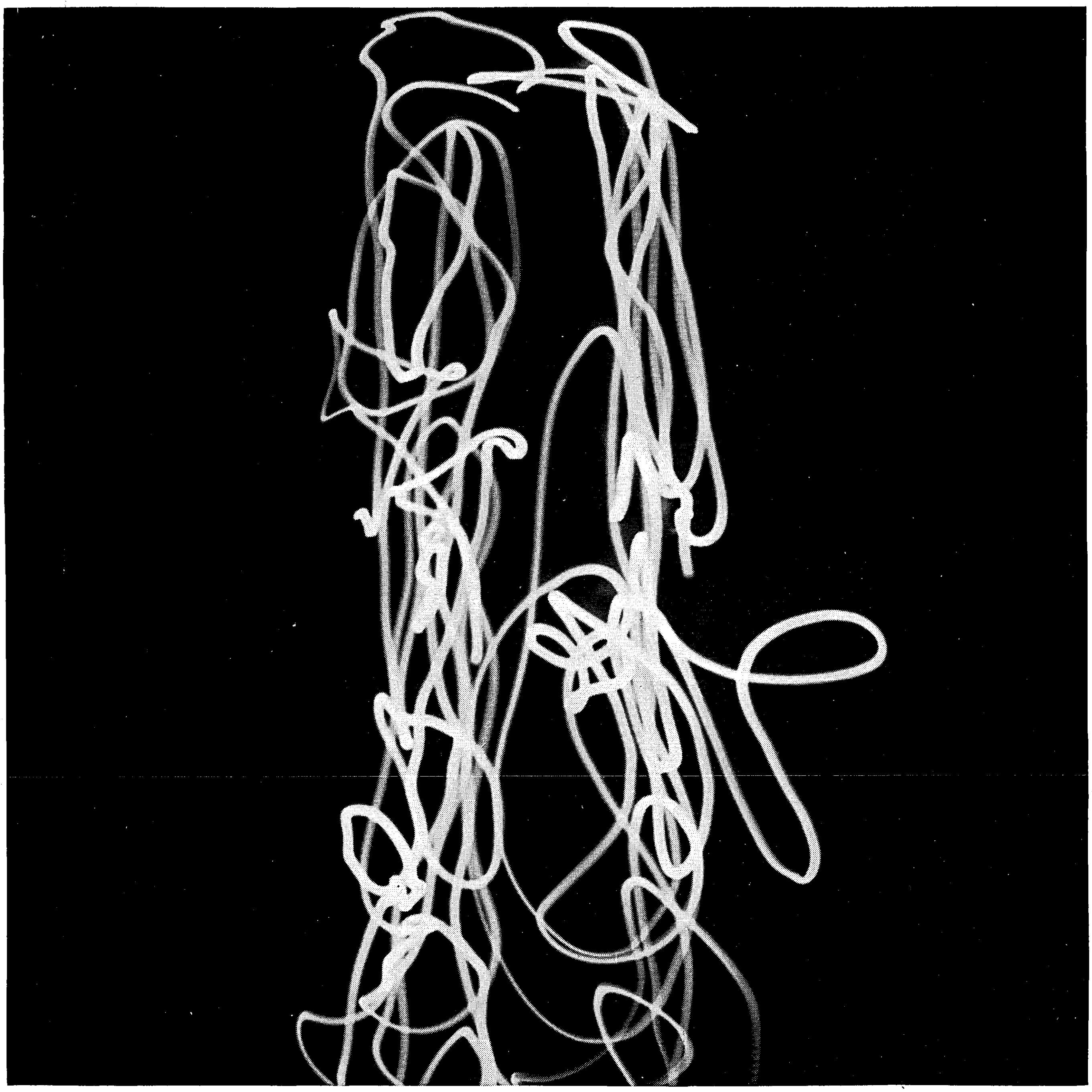
Graphic Controls — maker of continuous dp forms, recording charts, and creative packages — has bought the Dartmouth GE-265 system to start a t-s service operation which may ultimately go nationwide. The computer comes into Buffalo in July, to be followed at yet undecided locations by two more 265's (the last of the GE deliveries in the series) early 1968. Also on order are two SDS 940's for third quarter '68, and a CDC 6600 first quarter '69.

The Dartmouth system, which comes with Basic and Algol software, as well as several financial analysis and engineering programs developed by the school, will service areas around Buffalo, Syracuse, Rochester, and Pittsburgh. Eighteen firms and two colleges have already signed up to use it. Cost is $350 for 30 hours/month terminal time and 60K character storage on the 18 megacharacter disc. CPU time goes at $180/hour. Additional storage is $2.50 for each 1500 characters and $10/hour for extra terminal time.

Initial applications will primarily be scientific, although later GC plans to offer commercial packages for such areas as inventory control. The firm has been doing on-line inventory updating from its seven plants with a modified 1440 for three years.

RUMORS AND RAW RANDOM DATA

It appears that GE is retrenching in still another area. General Learning Corp., formed 18 months ago by GE and Time Inc., has fired its president and shifted its emphasis from product development to research on learning. ... Scientific Data Systems is running into the same conversational time-sharing software delays as the big boys. We hear release of the Sigma 7 package has been delayed 18 months. Look for increased production of the 940 and changes in its t-s package to tide over anxious users. ... Reportedly nearly ready for signing: an agreement for University Computing to acquire Benson-Lehner. Terms, if approved, would involve part cash and part stock — with more cash over a five-year period. ... Release #3 of the PL/I F-level compiler is scheduled for delivery Oct. 31, and may come out earlier; users say generally it's "running like a charm" and has a "significant performance improvement." ... Bryant Computer Products, long known for its drums and discs, is experimenting with an optical/photochromic read-only memory. ... IBM, we hear, has 200 orders for its voice response systems, 100 of them in the banking industry. And Buroughs, RCA, Univac, GE, and Honeywell, which have or plan their own offerings in this area, are reportedly talking about OEM agreements with Cognitronics for its VAB units and interfaces. ... Bell Systems is experimenting with 12- and 16-button touch-tone phones for transmission of numbers, letters, and symbols. ... An agreement in principle has been reached for Data Products to acquire 80% of the stock of Uptime, Colorado producer of peripherals, from Western Nuclear.



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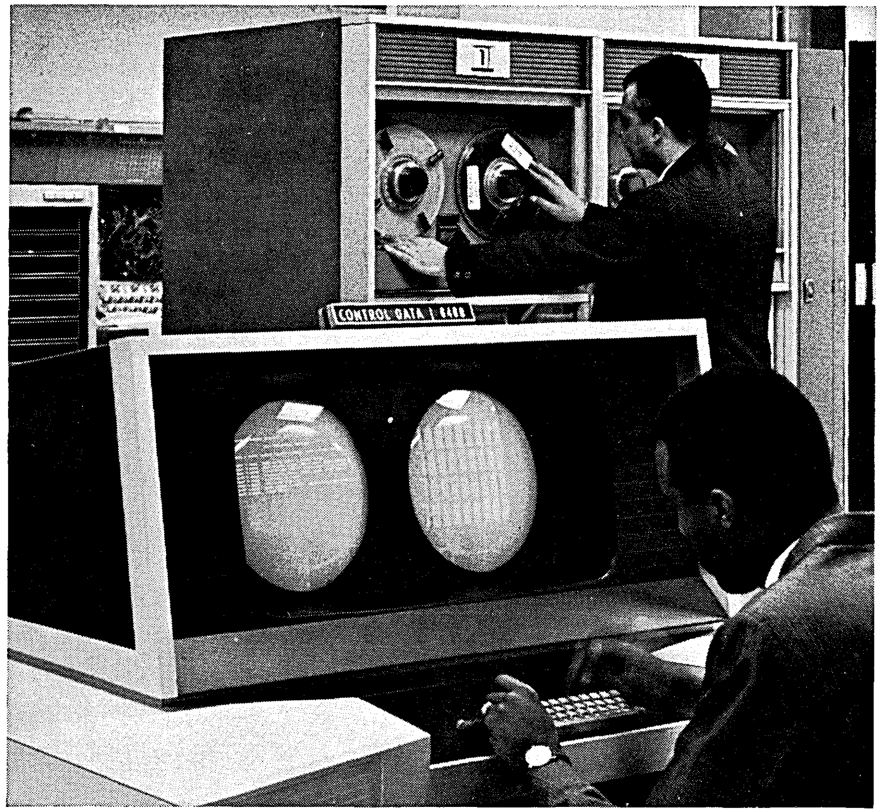

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people

■ J. Frank Forster has been elected chairman and chief executive officer of the Sperry Rand Corp., New York, N.Y. He succeeds Harry F. Vickers, retiring chairman, who will remain on the board of directors. Forster will continue as president.

■ The U.S. Military Academy at West Point, N.Y. has established an education research and technology division to coordinate and supervise the activities of the academic computer center and the instructional t.v. center. Lt. Col. William F. Luebbert heads the new division.

■ Systems Application Corp., a computer programming and analysis firm, has been formed in New York City. Heading the organization is Dr. Rudolph Lowenthal, president.

■ John J. Mason and Joseph C. Mihm have been named vice presidents of Holland Assoc. Inc., Washington, D.C. Mason was most recently manager of business consulting at CEIR Inc. Mr. Mihm was manager, field systems support, for the international division of Burroughs Corp.

■ Frank H. Coyne has been appointed vp, management services, for the Northern Pacific Railway Co., St. Paul, Minn. He was formerly assistant general auditor for the Southern Pacific Co. in San Francisco.

■ Sam Weigand, ex-Honeywell western regional sales head, has joined Information Handling Services, Denver, as director of sales. IHS develops microfilm document retrieval systems.

■ On July 1, Dennis G. Price, New York state's computer systems director, joins the management consultant firm Touche, Ross, Bailey and Smart in Puerto Rico.

■ Myrl E. Dake and Robert E. Castaldo, both previously with RCA EDP, have formed Data Management Services Inc. in Philadelphia, Pa.

■ Bruno W. Augenstein has been appointed vice president, research, The RAND Corp., Santa Monica, Calif. Previous to his promotion, he was research adviser to the president and vp of The Institute for Defense Analyses.

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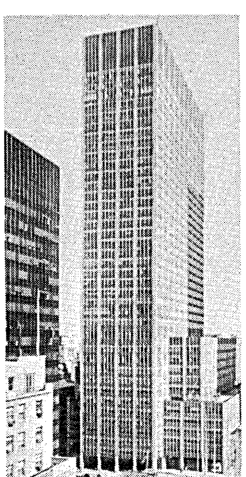

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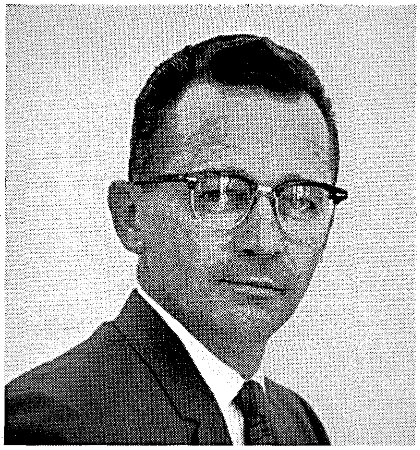
APOLLO

Business Data Processing and Space Exploration



Mr. C. Kenneth De Witt
Manager, Management Data System Department
Houston Aerospace Systems Division
Lockheed Electronics Company

Man is going to the moon, and he is going beyond the moon to planetary exploration, and orbital laboratories in which literally "far out" research will be undertaken. Each one of these undertakings will be supported by a vast complex of business data processing applications of the most exciting kinds.

The logistics problems of the Apollo man-to-the-moon program are uncompromisingly unique, just as are the problems surrounding the processing of data received from tracking stations scattered in a ring about the surface of the earth.

Configuration management of the hardware of spacecraft extends beyond that attempted in any other discipline of aircraft or electronics manufacture; and the problems of testing the hardware can only be solved with real-time computer applications which, once again, are unique in the present day world.

Most significant of all—all these applications must be tied together into an integrated management information system that permits split-second decisions by the highest levels of NASA and industrial management.

Lockheed is in the process of developing business data processing systems at the Manned Spacecraft Center in Houston, Texas for which there are no prototypes anywhere else in the nation. The problems described above are only a few of those which our analysts and programmers are working on daily.

The task is huge—we need analysts and programmers who can call upon both their experience and their imagination to convert these problems to workable solutions. We are constructing the organization from which man will explore the universe, and, incidentally, we are being forced to invent the data processing principles of the Twenty-First Century.

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As for hardware, the Manned Spacecraft Center has seven complete computer systems, including large, third-generation digital, analog and hybrid computers available for the support Lockheed is performing for MSC.

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the forum

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

ANOTHER SIDE OF THE COMPUTER'S IMAGE

This article describes the computer's image as viewed from a vantage point different from that used by Dr. Robert S. Lee ("The Computer's Image", Dec. '66, p. 33).

Our assessment is not as rosy as his. We feel that there is a popular mistrust of computers, specifically in the minds of consumers, and that this mistrust is being fanned by an uninformed press and by timid or uninformed comptrollers who prefer to blame all errors brought to their attention by consumers on defenseless computers rather than admit to poor programs, faulty systems analysis, or lack of quality control in their data processing facilities.

This assessment is based upon an analysis of a still growing anthology of articles being sent to me in response to an appeal that appeared in the June, 1966, issue of Computopics (ACM-Washington, D.C. Chapter Newsletter) and later in ACM *Communications* (Vol. 9, Oct. '66, p. 774). This appeal requested members to send me articles gleaned from the press or received by them from private media such as credit card clubs, department stores, banks, etc., either relating to anthropomorphic qualities of computers or blaming computers for bookkeeping or other errors.

Unlike the paper preceding his, namely, that presented by Dr. Gainsbrugh, Dr. Lee's does not include the questionnaire, does not describe the sampling design, nor the results. These are available, the footnote states, elsewhere. Hence, it is difficult to assess the relative importance of his conclusions.

We would agree, however, that anthropomorphism is an important misconception. Our evidence points to the press as the guilty party. Typical items are: (1) "Training a computer to compose poetry or music or render sketches is not the fanatic, mad-scientist venture it might appear to be . . ." (Cross, Wilbur: "Machine Miltons;" N.Y. *Times* Magazine, Dec. 4, 1966). (2) "If the computer has really failed in the relatively simple task of transferring thought content from one language to another, the result is to challenge the whole broad assumption that we are entering upon a new 'age of computers.'" (*Washington Post* editorial, Sunday, Nov. 27, 1966). (3) "The California 'machines' apparently became temperamental, these columns noted last week, and injected from one to three hours delay in vote tallies." (*Electronic News*, June 20, 1966).

It is difficult to understand how Dr. Lee arrived at the conclusion: "Then there is the idea that the computer always gives the right answer." The articles in our collection seem to indicate otherwise. They portray the consumers' inability to communicate with business institutions, particularly credit card clubs, department stores, and banks, alerting them to mistakes that have been made. Finally, after a series of telephone calls, one-way letters to the business establishment, including the mutilation of the punched card, the consumer, if he is lucky, receives a letter stating the "computer made the mistake." In view of these experiences, it is difficult to buy Dr. Lee's conclusion. Although this may sound heretical, I would caution the consumer: "If a computer did it, recompute it yourself."

Dr. Lee is silent on the consumers' computer-assisted invasion of privacy. I shall pass over the larger debate currently taking place in Congress. I am worried, for example, about (4) the lady in Beverly Hills who received a computer-produced letter that began with "Dear Ellen." She considered this an insult (and so do I). (See the item in the Los Angeles *Times*, Matt Weinstock's column, December 4, 1966).

I am also concerned about computer-assisted cheating. (5) Hospitals, for example, have a habit of collecting from an insured patient the deductible portion of a bill and of submitting the entire bill to an insurance company. Because of batch processing considerations, refunds are processed about every ten weeks. This has the effect of giving the hospital the benefit of an estimated $50,000 interest-free loan per annum. When, in a personal experience, I complained to a Washington hospital about this practice, the hospital replied that all of the hospitals were doing it. This makes it socially proper. I am concerned also with (6) the bank practice of batch processing deposits less frequently than the processing of withdrawals. A member of my committee received a computer-produced threatening letter and a penalty charge. He made the mistake of withdrawing $150. In so doing, his balance fell below the $200 minimum. However, the bank had not yet processed his payroll check that had been automatically deposited earlier by his employer.

No, Dr. Lee, the consumer has a fear of computers. He is annoyed by them. In his own mind, he feels that he is threatened by them. His is the experience of the consumer and not of the MIT MAC user. One must not overlook the fact that the background and training of the MAC designers and the MAC programmers, *as well as* the background of their users, are far different from that at a department store computer facility, for example. The environment is different. The experience is different—and hence, the attitudes are different.

It is this consumer image of computers and the newspaper columnist's habit of distorting news about computers to arrive at "a human interest angle" that concerns us.

—SIDNEY KAPLAN

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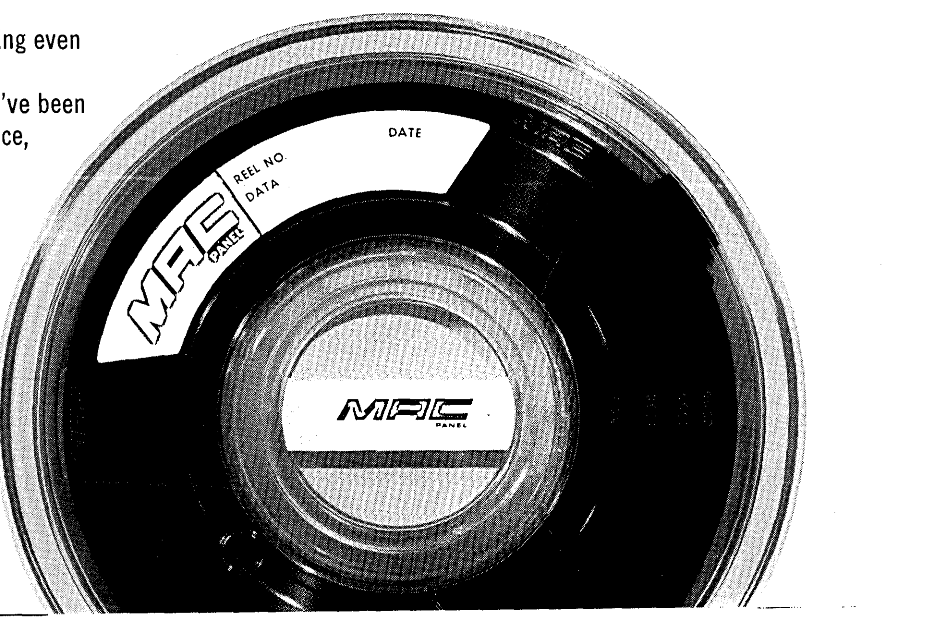

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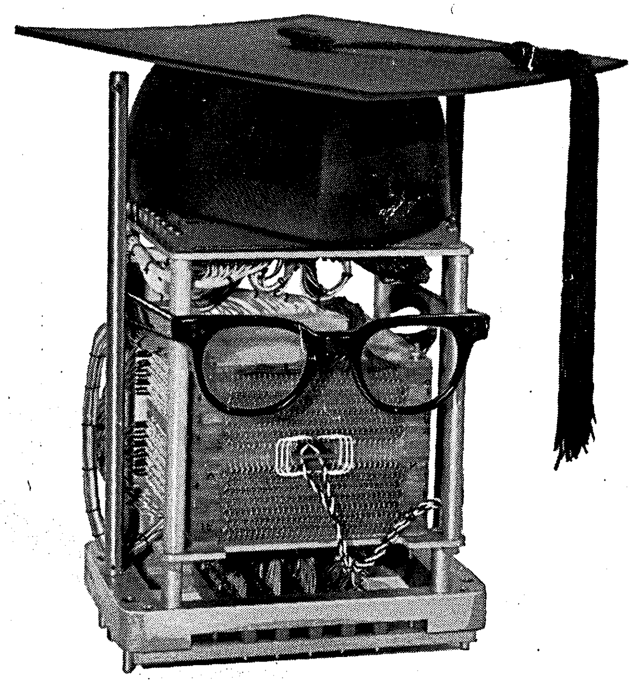

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