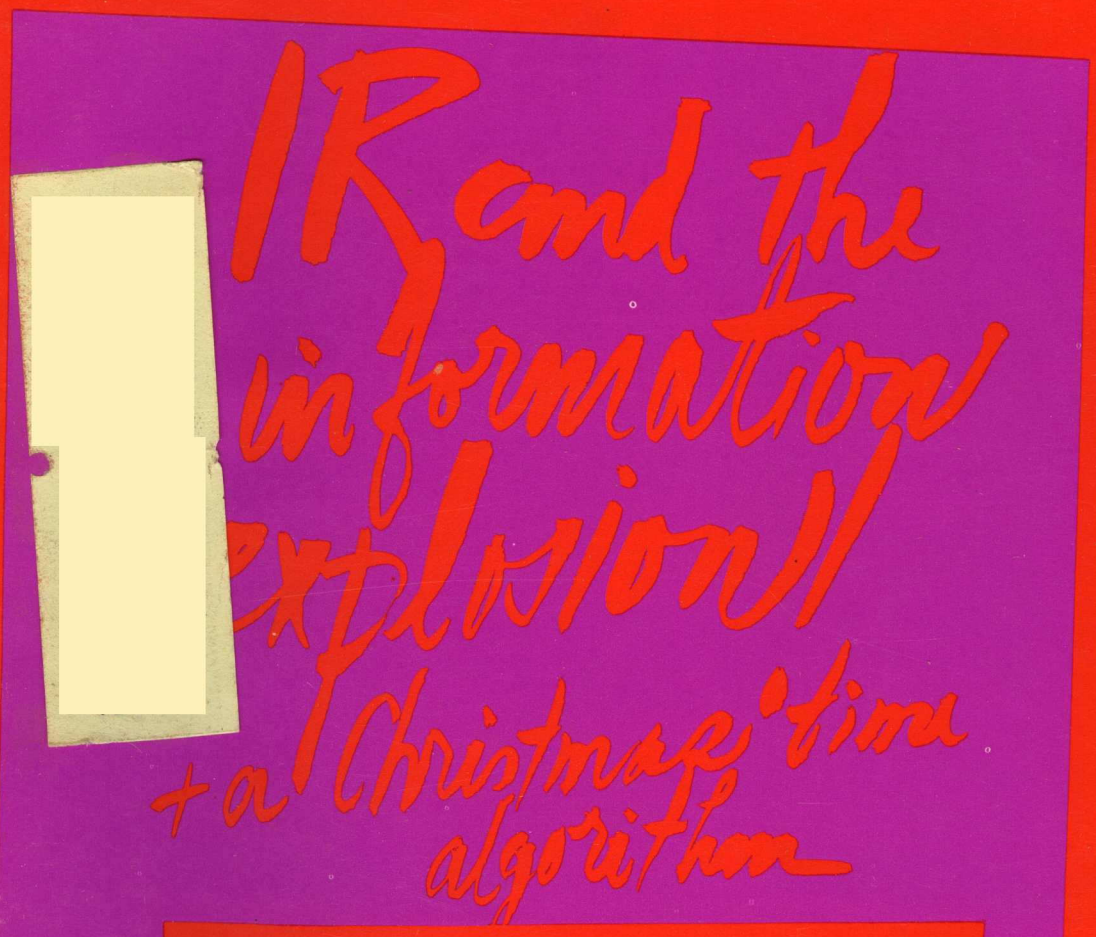
DATAMATION®

64

December



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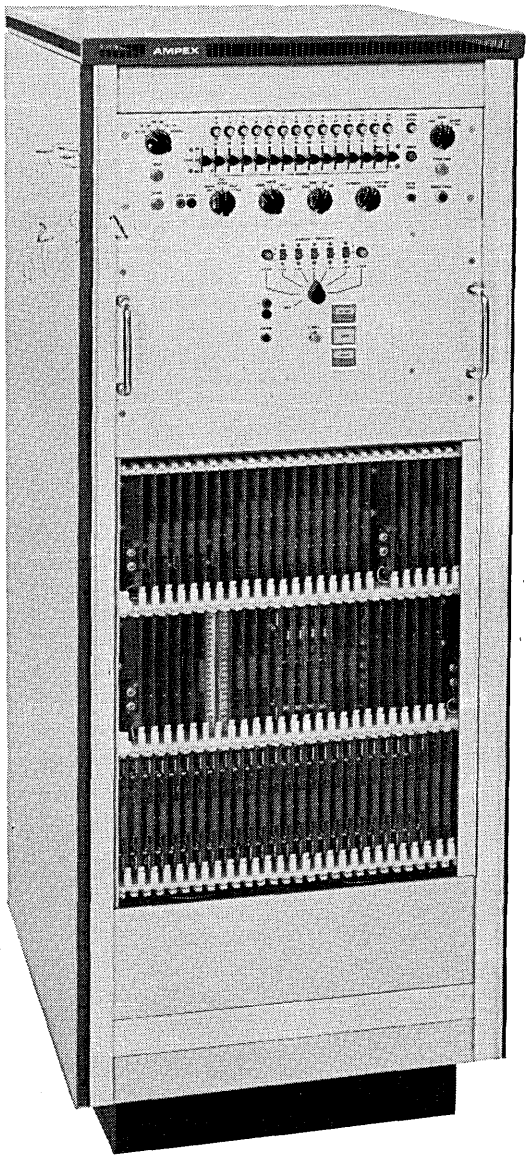

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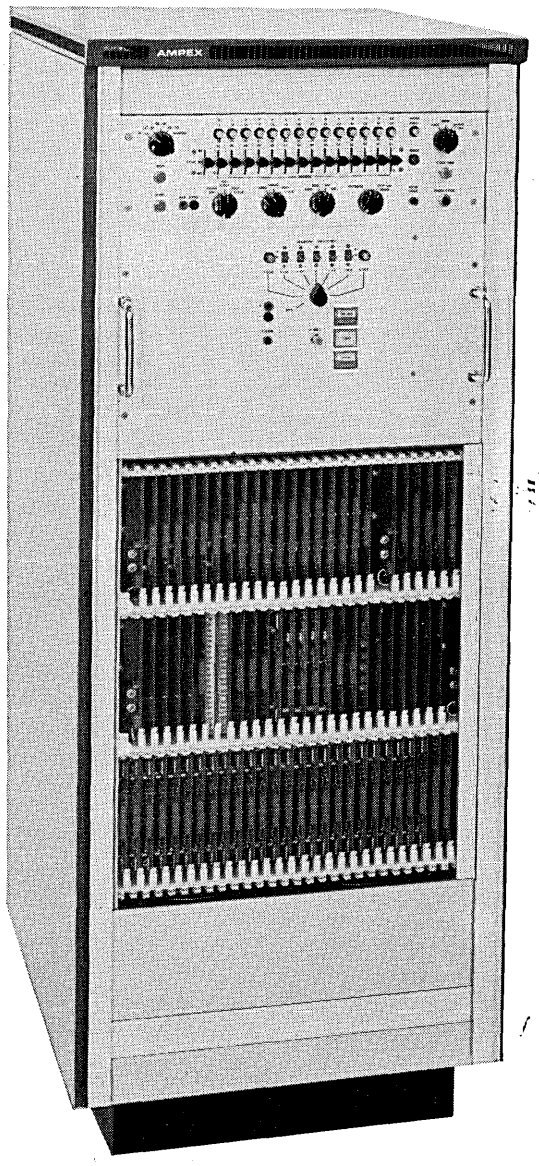


NEW COINCIDENT CURRENT MEMORIES

Newest of the proven R Series systems, the RS and RZ are practically identical—except for memory cycle time speeds and price. And the price of the 1.0 RS averages only 20% higher than the 1.8 RZ. If your immediate requirements are for a 1.8 system, but you might need a 1.0 in the future, the RZ is an ideal selection. It can be quickly (24 hours) and economically converted into a 1.0 RS—just by plugging in a new stack, replacing two card types and making minor component changes. Both models have a capacity of 16,384 words—in 4,096 modules, 8 to 56 bits per word. (Illustrated is the 8 K model.) Temperature range is 0°C to 45°C without the use of current compensation, stack heaters or other compromising gadgetry. MTBF is high—a product of the stringent derating practices that have yielded unswervingly high performance from the Ampex R Series systems. Because of their modular magnetics, both systems are easily expandable with minimal circuit redundancy. A wide variety of options are available: data bus selection, zone control, parity generation and checking, built-in or remote tester. For details, call your Ampex representative, or write Ampex Corp., Redwood City, Calif.

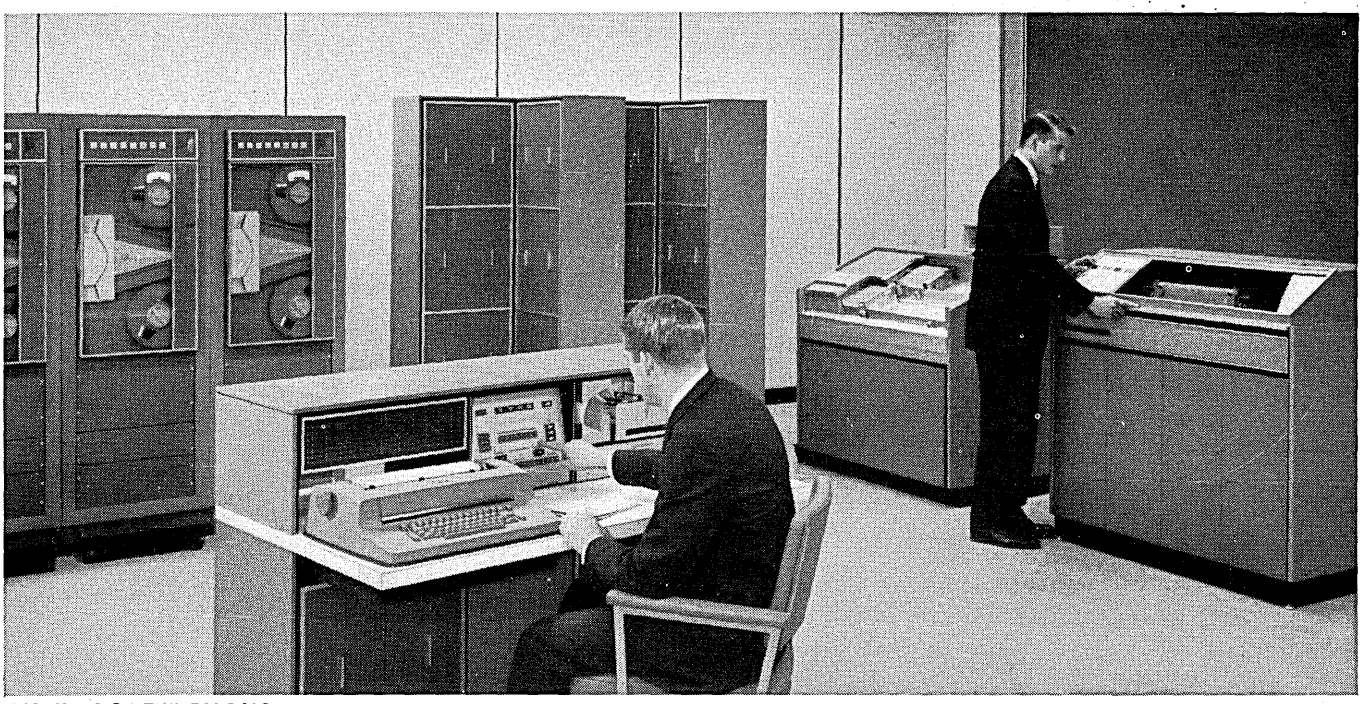
AMPEX

CIRCLE 1 ON READER CARD

SCIENTIFIC COMPUTATION ADVANCES TWO GIANT STEPS

INTRODUCING EAI 8400 SCIENTIFIC COMPUTING SYSTEM

THE FASTEST FLOATING-POINT REAL-TIME DIGITAL COMPUTER—SPECIFICALLY DEVELOPED FOR SCIENTIFIC COMPUTATION The new EAI 8400 Scientific Computing System offers—for the first time—floating point programming that is practical for fast real-time applications such as digital and hybrid simulation or on-line monitoring and control, as well as general purpose computation. The capability results from ultra-fast arithmetic speeds (5.5 usec FLOATING MULTIPLY), a 32-bit memory word for floating point precision and storage efficiency, and built-in hardware for FLOAT/FIXED operations. New from its memory oriented organization to its silicon and micro-logic circuitry, the EAI 8400 is available now with basic systems of 4, 8 and 16K memory and many in-field expansion options. Specifics on the all-new EAI 8400 will be sent to you immediately on receipt of your request.



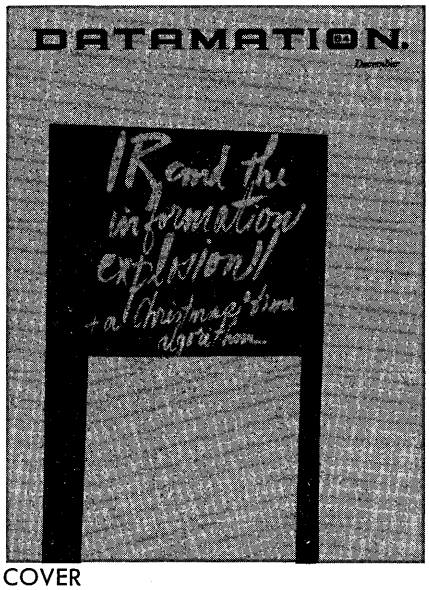
FEATURES OF THE EAI 8400

- 32-bit word—balanced for floating point precision and storage efficiency, and maximum instruction power.
- Powerful instruction repertoire — contains over 750 commands designed to reduce the number of instructions per program.
- Ultra-fast, multiple precision floating and fixed point arithmetic. (FLT MPY = 5.5-7.5 usec) (FLT DIV = 8.75-10 usec)
- Flexible data handling capability with complete set of I/O and Boolean instructions for 16, 8, 4, 2 and 1-bit byte manipulations.
- 2 usec memory—from 4 to 64K words—with direct, multi-level indirect, immediate and byte addressing; 7 index registers and optional fast memory.
- Simultaneous communications with external devices through data channels designed for the new Standard Interchange (and existing) Codes.
- Unique EXEC bits for dynamic relocation and memory protect; autonomous modular organization for multi-processor and multi-user requirements.
- Programming systems including FORTRAN IV, Symbolic Macro Assembler, Real-Time Monitor and special software for digital and hybrid simulation.

DATAMATION 64

december 1964

volume 10 number 12



COVER

The challenge for IR of the big forceful explosion of information in industry, business and science is the subject of this month's cover by art director Cleve Boutell.

automatic information processing for business industry & science

DATAMATION

december 1964

volume 10 number 12

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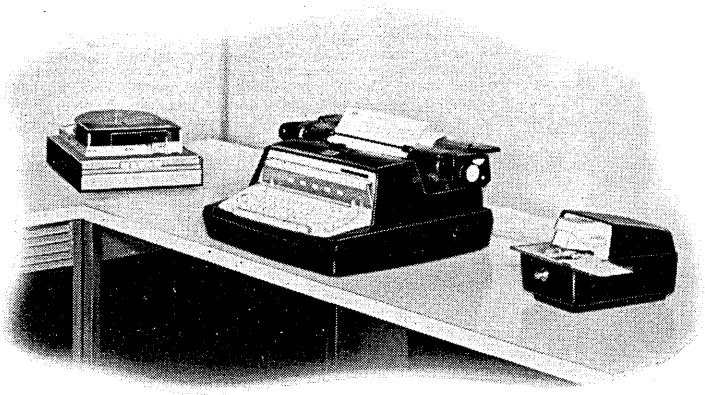

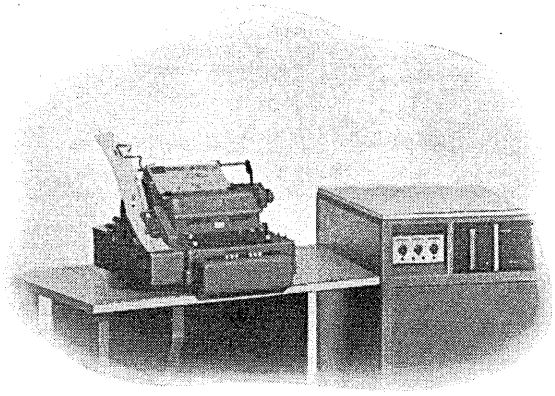

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30 CPS	**Reading Speed**	10 CPS
30 CPS	**Punching Speed**	10 CPS
10 CPS	**Printing Speed**	10 CPS
X + 40%	**Throughput Speed**	X
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Yes	**Solid State Circuitry**	No
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Complete	**Modular Construction**	Limited
Yes	**Variable Carbon Control**	No
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Electronic	**Computations**	Electro-Mechanical
Photo-Electric	**Type of Reader**	Mechanical

*operates during the carriage motion

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***Source Data Automation** capitalizes on the fact that it always takes at least one girl and one typewriter to generate a needed piece of paper—invoice, statement, or whatever—and develops all other systems information as a 100% by-product of the typing operation.

SCM® SCM CORPORATION
DATA PROCESSING SYSTEMS
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Gentlemen:

I would like to learn more about the features of SCM TYPETRONIC SYSTEMS and their applications—no cost or obligation on my part, of course.

Name.....

Title.....

Company.....

Address.....

City..... State..... Zip Code.....

8

CIRCLE 8 ON READER CARD

(1) Model 33 Keyboard Send-Receive set sends and receives printed copy at 100 wpm. (2) Model 32 Receive-Only set receives printed copy at 100 wpm. (3) Model 35 Automatic Send-Receive set sends and receives page copy and punched paper tape at 100 wpm. (4) Telespeed

WHICH TELETYPE MACHINES

All Teletype machines have the real-time capability of instant reception for transmissions of messages and data. Their speed and accuracy are essential to any system that continually adapts and relates changing facts to changing situations.

COMPATIBLE WITH BUSINESS MACHINES

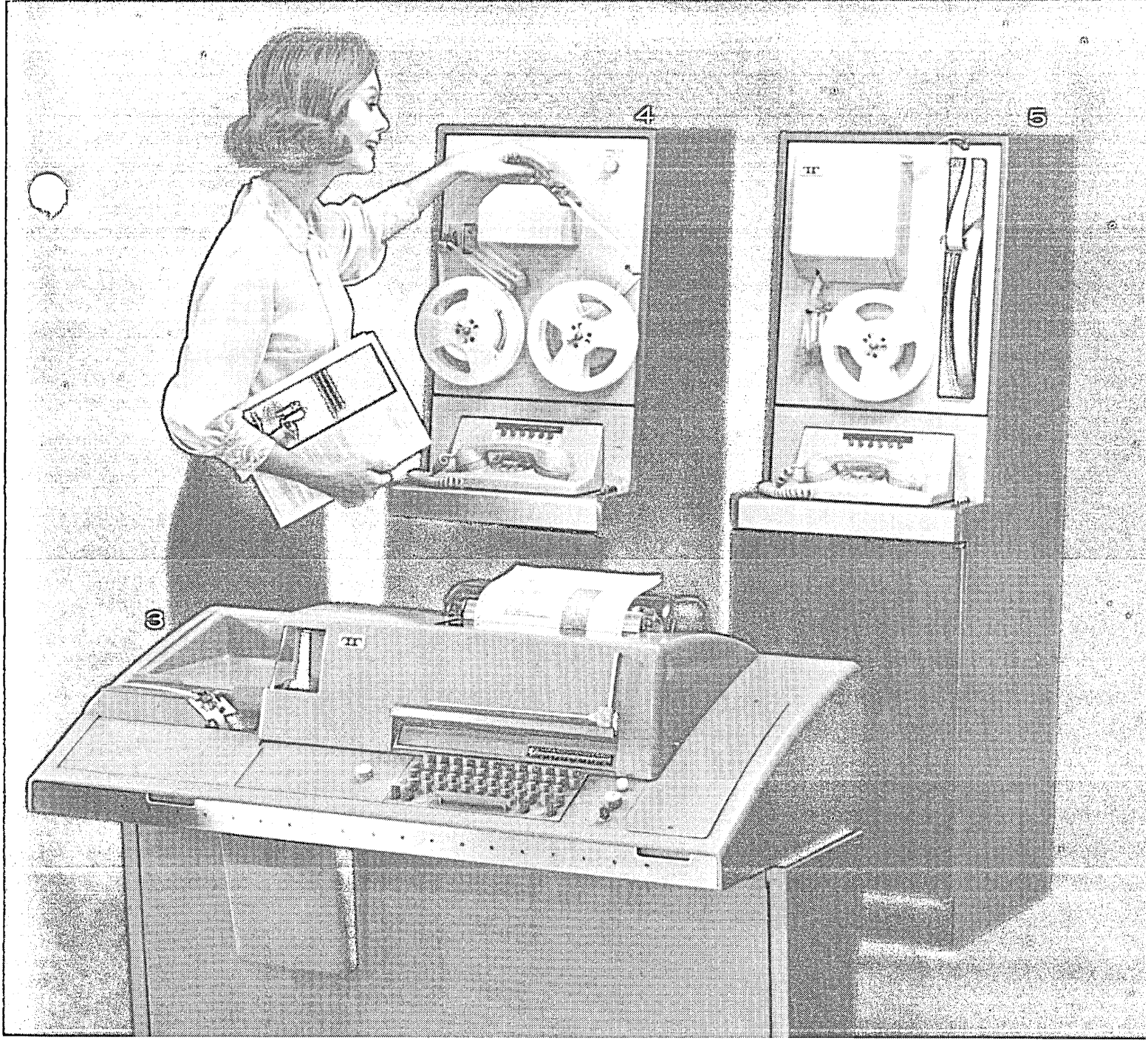
In addition, the Models 33 and 35 ASR sets and Telespeed tape-to-tape equipment transmit punched paper tape on the same code as most business machines. This means data acquisition and other computer functions can be initiated at distant locations and transmitted to the central computer.

DEPENDABLE REAL-TIME OPERATION

Built for dependable operation with a minimum of maintenance, Teletype communications equipment is used in real-time data processing systems, telemetering, and computer transmissions. For instance, real-time computers have been combined with Teletype terminal equipment in business and industry to help level off production peaks and valleys, to improve order processing and billing, and to quicken highly sophisticated systems like the following.

LINKS BRANCHES TO REAL-TIME COMPUTERS

A large electrical manufacturer uses Teletype machines



Tape-to-Tape Sending set sends from punched paper tape at 1,050 wpm. (5) Telespeed Tape-to-Tape Receiving set receives on punched paper tape at 1,050 wpm.

HAVE REAL-TIME CAPABILITIES?

to link its nationwide offices, factories, and sales branches with a pair of real-time computers. As a result, they have cut order processing time from days to minutes. In addition, this real-time system is used for other data processing functions including audit and assembly of financial results, production of payroll checks, control over stock inventories, and generation of statistics on the corporation's sales efforts.

PROVED RELIABILITY

The reliability of Teletype equipment has been repeatedly proved over the years, and it's still the fastest, most accurate means of communicating written data. That's why this kind of equipment is made for the Bell System and others who supply the nation's communications services. Incidentally, the brochure he's reading is real, too. It contains information on the real-time uses of Teletype equipment and you can obtain a copy by writing: Teletype Corporation, Dept. 81M, 5555 Touhy Avenue, Skokie, Illinois 60078.

CIRCLE 9 ON READER CARD

TELETYPE ®

DATAMATION calendar

● A symposium on on-line computing systems will be presented Feb. 2-4, 1965, at the UCLA Campus, Los Angeles, Calif. The meeting, sponsored jointly by Informatics Inc. of Sherman Oaks, Calif., and the UCLA Extension Service, will feature papers by foremost experts in the several disciplines of on-line systems. All sessions of the symposium will be held in Schoenberg Hall.

● The institute on managerial implications of the emerging technology at American Univ., Wash., D.C. will hold a conference on Feb. 8-11, 1965, and will focus discussion on technology and its relationship to managerial sciences. Total registration fee of $175 includes background materials and luncheon each day. The meetings will be conducted at the Executive House in Washington.

● Los Angeles will be the site for the IEEE computer group conference on impact of batch-fabrication on future computers, March 2-4, 1965.

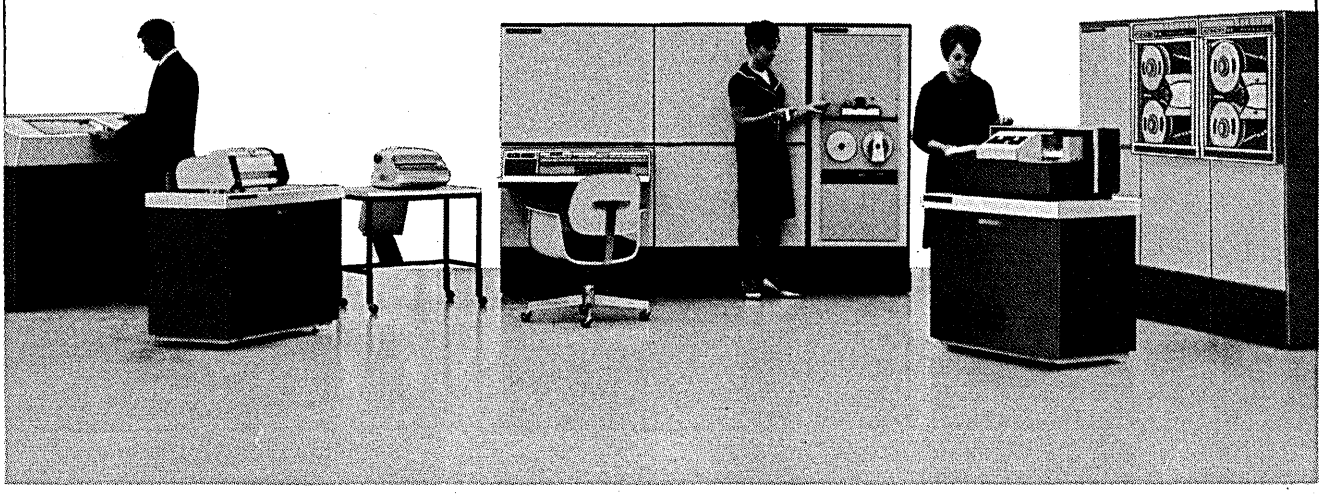
● The national automation conference will be held in San Francisco on March 8-10, 1965. For further information contact the American Bankers Assn. in New York.

● The fifth annual one-day technical symposium of the Washington chapter, ACM, will be conducted at the Marriott Motor Hotel in Washington, D.C., on April 15, 1965.

● The University of Alabama, Birmingham, will host the 10th annual dp conference, April 20 and 21, 1965. The conference is sponsored annually by the certified public accountants, National Accountants Assn., DPMA, Univ. of Alabama, and Auburn Univ.

● The Mathematics Research Center, U.S. Army, of the Univ. of Wisconsin, Madison, will sponsor a symposium on error in digital computation, April 26-28, 1965. The program will consist of invited addresses by leading research mathematicians from the U.S. and Europe, and will be concerned with theory and technique of error estimation and control in the numerical solution of mathematical problems of current importance.

From ASI's continuing program of new product development . . .



Two new computers in ASI's *ADVANCE* Series for scientific, engineering, and on-line systems applications

New *ADVANCE* Series computers are modular . . . they can be expanded freely without obsolescence or costly reprogramming. Standard and special peripheral units plus system design services provide complete systems to meet your exact needs.

6020—LOW COST

MEMORY Word Size: 24 bits plus parity. • 1.90 microsecond total cycle time. • 4,096 to 32,768 word directly addressable memory.

ARITHMETIC AND CONTROL Three index registers, in memory. • Multiply: 30.4 microseconds. Divide: 47.5 microseconds. • Over 120 instructions. • Double precision hardware. • 16 definable Programmed Instructions.

INPUT/OUTPUT Buffered input/output. • Multilevel interrupts. • Special purpose channels.

SOFTWARE One-pass FORTRAN II compiler. • One-pass symbolic assembler. • Executive system.

PRICE Purchase prices begin at $79,500.

6040—HIGH PERFORMANCE

MEMORY Word Size: 24 bits plus parity. • 1.90 microsecond total cycle time. • 4,096 to 32,768 word directly addressable memory.

ARITHMETIC AND CONTROL High speed arithmetic. • Multiply: 9.5 microseconds. Divide: 11.5 microseconds. • Three hardware index registers. • Over 120 instructions. • Programmed Instruction feature.

INPUT/OUTPUT Buffered input/output. • Multilevel interrupts. • Special purpose channels.

SOFTWARE Fully compatible throughout *ADVANCE* Series.

PRICE Purchase prices begin at $104,500.

Write to ASI for additional information on the ADVANCE Series

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CIRCLE 11 ON READER CARD

letters

typesetting revisited

Sir:

I would like to take exception to several statements made by Mr. Swofford in his report, "Computer Typesetting Conference," (Sept., p. 81). I would question his choice of adjectives in stating, "The burning question is how to go about it." This is more of a smouldering question now as more and more people are coming up with better ways of making the changeover to computer composition. Among them, the use of OCR readers for copy input (one system is already on order), the improvement of high-speed printers for output, and the more general high-speed phototypesetter.

As of now, several books have been successfully set by computerized composition, and one off-line system, the Photon Zip, is now being used to set the *Index Medicus* (mag tape input, 250-500 cps output).

As Mr. Swofford indicates, progress is indeed rapid. What he does not mention is that the present systems can and will serve as orderly transitions to the completely computerized system. No matter how revolutionary some of the changes seem to be, the overall process is one of change by evolution, rather than by revolution . . .

P. L. Anderson
Anderson Associates
Paoli, Pennsylvania

digital simulation

Sir:

The article on "Digital Simulation and Modelling" (Oct., p. 25) gives a fairly understandable description of systems simulation. Very well explained are Monte Carlo techniques, questions of the validity of the models and of the interpretation of results. There, the author stresses the need for "judgment and experience." But not much that is valid about hardware or software simulation and modelling is told. And his ideas about technical and mathematical models do not seem very sound. Nowadays, engineers probably don't receive an orientation in the Theory of Models and Similarity in their education.

The method, in brief, is: Based on the correct concept that mathematics is itself a model (for example, the simple equation $3 + 2 = 5$ is valid for all objects), in the technique for similarity are built relationships of units without physical dimensions. The combined constants give the scaling factor for the model, just as on a geographic map. Then a model according to these equations "is similar to the real thing" for all physical qualities within the validity of the basic equations from which the model equations are built up. (We have, in the theory of models, complete similarity, geometrical similarity, etc.).

Walter H. Burkhardt
Williston Park, New York

standards & flowcharts

Sir:

The ASA X3.6.5 working group is developing a proposed standard on flowchart conventions. Such conventions are specified by rules, techniques and other information used in conjunction with the symbols on a flowchart. For example, the interest is in conventions such as the identification of symbols, rules for illustrating switching, I/O, communications, etc.

To develop a standard which reflects practices of the broadest cross section of users, it is important that the working group consider all ideas in this area. Readers with access to information on flowchart conventions may submit them to the Secretary, X3, BEMA, 235 E. 42nd St., New York, N.Y. 10017.

Vico E. Henriques
Secretary, X3
BEMA
New York, New York

computer conferences: phfft

Sir:

I was discouraged by the limited value of the recent Fall Joint Computer Conference . . . I would like to consider one of the aims—dissemination of information. If one looks

at the time spent in technical sessions, the conclusion would have to be that herein lies the overriding importance of the computer conference. A delusion. For two reasons.

First, the level and detail of the papers are such that almost no one who reads the current computer literature (even superficially) is surprised or even very informed by attending the technical sessions. I am not sure of the reasons, but I'm inclined to think that one possibility is that much of the good work in the field is done in industrial companies. Their position is competitive. If an idea is new and worthwhile, why tell the competition? Or could it be that the rate of generation of new ideas has diminished drastically in recent years?

Second, the form of the session is well designed to discourage discussion of important topics. In a roomful of several hundred attendees, how good, really, is the question period? A possible alleviation of this might be a release of the preprints several weeks before the conference. At the conference, sessions could be broken into many parallel sub-sessions with about 30 or so attending each. Every sub-session would have a moderator and all moderators would meet later in a large room accessible to all to discuss the paper with the author in light of comments at the sub-sessions. I'm sure the logistic problems could be worked out—which leaves the objection of discipline. Will people really read the reprints? My answer is that it could hardly be worse even if they won't . . . A large number will read the preprints.

As far as the other aims of a conference, I would prefer to encourage comments from your readers.

SAMUEL A. ROSENFELD
The MITRE Corporation
Bedford, Massachusetts

software & copyrights

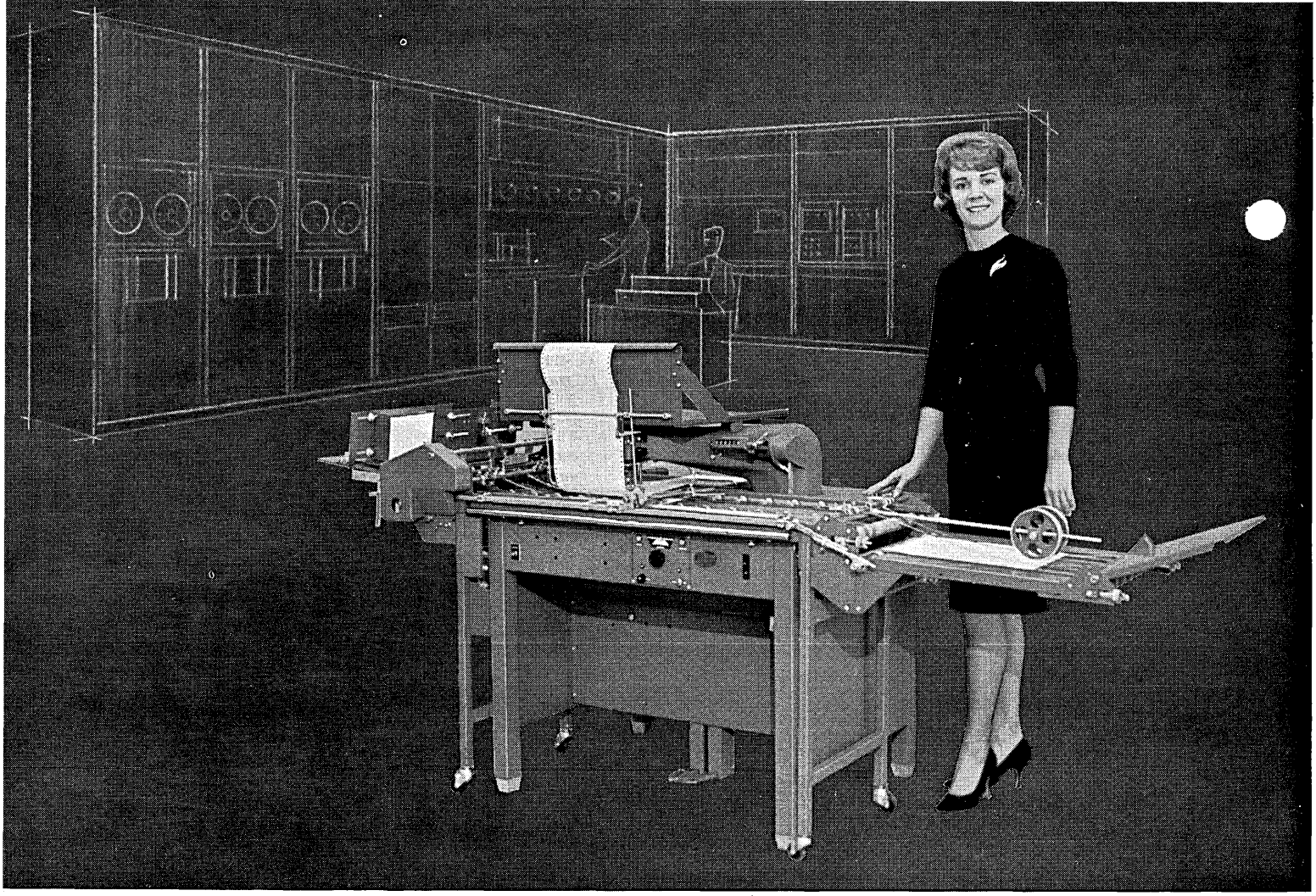
Sir:

I think DATAMATION should sponsor a contest. Anyone is eligible to enter, and the aim is to fill in the missing number in the paragraph:

Almost any copyrighted (patented) program can be used without paying a fee by changing at least _ instructions.

Entries would be judged on the basis of being caught, and the decision of the judges would be final. Losers would receive one year in jail or $1,000 fine or both.

J. RICHARD SWENSON
New York University
New York, New York



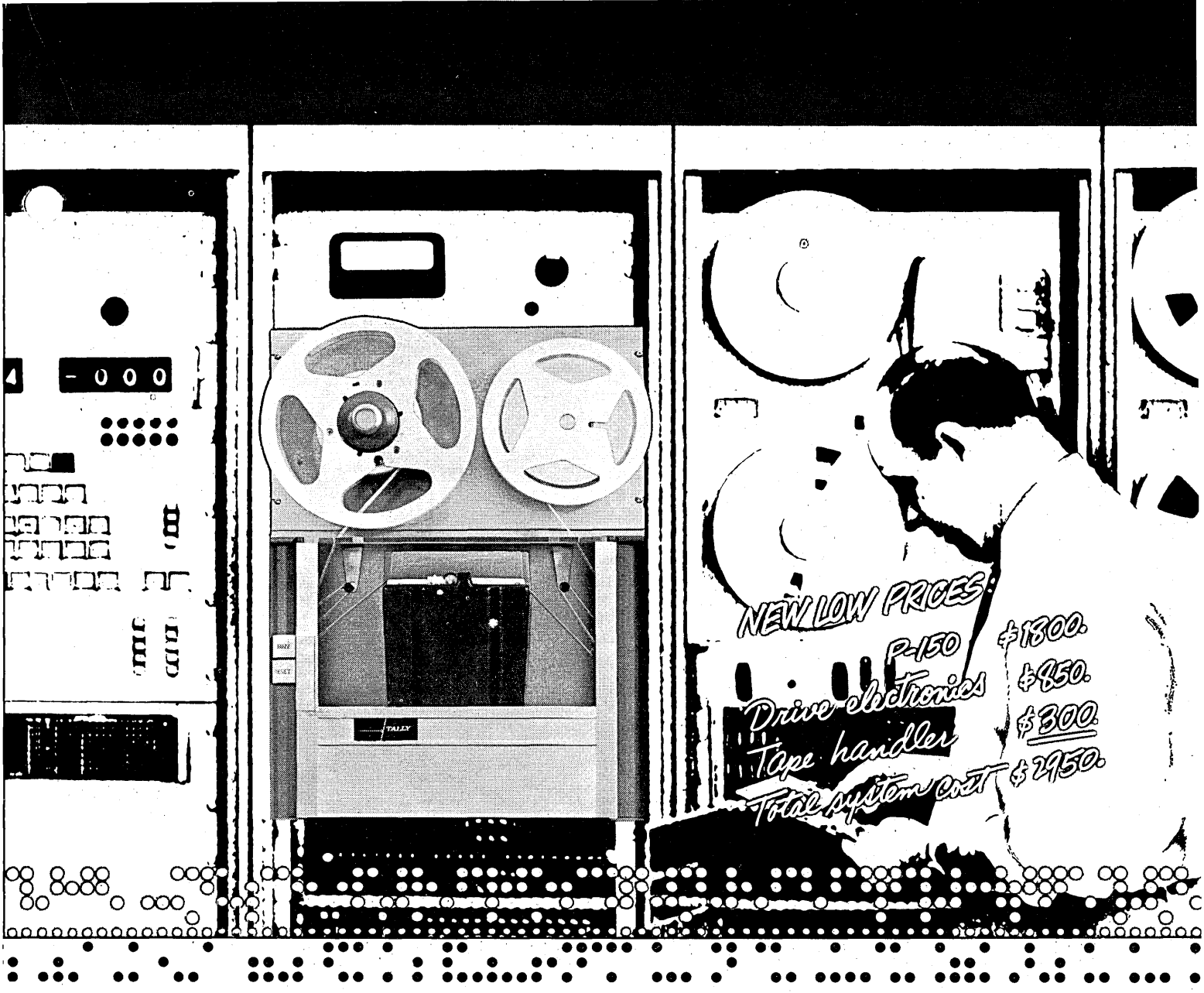
A-M transfer printers automatically imprint unit forms directly from computer print-out

A-M Transfer Printers tie into your data processing system for direct computer print-out to all kinds of business documents at high speeds with quality results. This provides new versatility for your data processing equipment. ■ The A-M Model 831 Transfer Printer accepts pin-fed, fanfold continuous Transfer Masters of computer print-out and automatically registers and transfers multi-line postings to ledgers and unit forms. ■ Other models include high speed feeders for direct print to envelopes, magazines, cards, checks and mailing pieces. ■ A-M Transfer Printers eliminate or reduce run time of high speed computer printers and simplify off-line printer programming. And every imprint is sharp, permanent, legible. ■ For more ideas on improving the efficiency of your EDP investment, call your nearby A-M office, listed in the Yellow Pages. Or write for Booklet SP-93-E, Addressograph Multigraph Corporation, Department T-6523, 1200 Babbitt Road, Cleveland, Ohio 44117.

Addressograph Multigraph Corporation

CUTTING COSTS IS OUR BUSINESS

CIRCLE 13 ON READER CARD



SPEED DEMON ON PAPER

New Tally Perforator does 150 cps on paper, mylar, or foil tape

Why is the new Tally P-150 the most advanced paper tape perforator on the market today? Speed, of course, is one reason. A price of $2,850 is another.

But there's much more to the story of this remarkable new product. For instance, pin sense error checking through odd or even parity summing is standard on every punch. When a parity error is sensed, the flow of data and tape advance can be inhibited and the incorrect character deleted instantly at full character rate. Bi-directional tape handling and a remotely controlled backup speed of 25 cps simplify error correction even further.

The Tally P-150 offers asynchronous operation so that associated systems need not be synchronized to the cyclical rate of the perforator.

If you would like to know more about this well-designed and well-engineered new product, let us hear from you. Please write Tally Corporation, 1310 Mercer Street, Seattle, Washington 98109.

TALLY®

CIRCLE 14 ON READER CARD

When it comes to simulation, SDS is second best

(But only to the real thing)

Faster than you can say "application of digital technology to hybrid computation and simulation," SDS can show it to you. Nobody but SDS gives you *all* the tools you need to solve the classical set of analog simulation problems—and you don't have to be a digital computer expert to use them.

For instance, the SDS DES-1 Differential Equation Solver is an extremely fast general-purpose computer with an "analog-like" language and a console that lets you operate the computer using analog techniques. The DES-1 is significantly less expensive than analog equipment for a large class of problems. It also lets you solve differential equations requiring higher accuracies than you can get with analog equipment. And the DES-1 is ideal as the digital portion of a hybrid computing system.

The SDS Hybrid Programming Library permits fully integrated operation of analog and digital computers. You can apply this library directly to simulation problems without extensive training in digital programming. The library includes routines for all of the operations typically required for simulation such as integration and function generation, problem verification and executive routines that facilitate intercontrol of the analog and digital portions of a hybrid system.

As part of its long range program in hybrid computation and simulation, SDS offers a series of courses in hybrid computation, analog computation and the use of the SDS DES-1 at the SDS/Beckman Computation Center in Santa Monica, California. These courses are taught by outstanding guest lecturers and the Center's full-time staff of specialists in analog and digital simulation, hybrid computation, real-time systems programming and digital differential analysis.

SDS also offers a complete line of hybrid interface equipment that lets you link any of the six compatible SDS high speed digital computers with almost any analog computer on the market today.

If your aim in simulation is to come in second best only to the real thing, why don't you send for our books, *Advanced Hybrid Computation* and *The DES-1 Differential Equation Solver*. Or, for further information, write to SDS or call (213) UP 0-5471.

SDS SCIENTIFIC DATA SYSTEMS
1649 Seventeenth Street, Santa Monica, Calif.

Sales offices in New York, Boston, Washington, Philadelphia, Pittsburgh, Huntsville, Orlando, Chicago, Houston, Albuquerque, San Francisco. Foreign representatives: Instronics, Ltd., Stittsville, Ontario; CECIS, Paris; F. Kanematsu, Tokyo; RACAL, Sydney.

CIRCLE 15 ON READER CARD

ıtant and later as a design
started looking for more
e, 1961, he began a career
Processing Systems Engi-
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career, consider Data Process-
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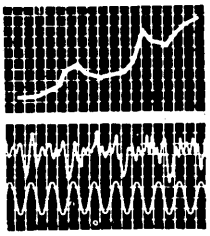

BUSINESS & SCIENCE

FROM TIGER TO PUSSY-CAT IN ONE YEAR

Could it be that we're coming up on the Year of the Pooty-Tat? The rush is on, anyway, to market small-scale computers for the yet-untapped educational market, as well as systems applications. Hardware prices range from $5.5K to $30K, and the pitchmen include a core constructor, a neophyte, and a module maker.

The core-stacking Fabri-Tek Inc., Amery, Wisc., will soon announce a "hands-on" digital trainer for basic computer education (programming, logic design, circuit analysis, trouble-shooting, et.al.). The portable $5.5K Bi-Tran Six has 128 (6-bit) words of core, adds in 1.75 msec. It's binary, and operates in magnitude & sign arithmetic. To satisfy curiosity, optional circuit cards will have clipped-on components to enable students to see what happens when, say, a transistor is pulled off.

Rumored ready for release is a ±$30K decimal machine aimed at educational institutions by the eight-man Questronics Inc., Hemet, Calif. It has 5-10K characters of core, each accessible in some 20 usec, a 10-digit add time of 300-500 usec, and 10 x 10-digit multiply of 10-25 msec — all fixed point. Price includes 5K characters, paper tape I/O, and typewriter.

In Newport Beach, Calif., Decisional Control Assoc. is following up its series of three delay-line computers with the gp DMI 620, a system-oriented, rack-mounted core machine. For $28K you get 2K (16-bit) words cycling every 1.8 usec, hard-wired index register, mod 33 Teletype, memory interrupt, and a system that operates in temperatures to 131°F. Add time is 3.6 usec. And on the drawing board is a larger-scale 630.

It remains to be seen now whether these domesticated Tigers can find a home.

WHILE IN JAPAN THEY GO LARGE-SCALE

A large-scale, binary system with two satellite processors has been developed by three Japanese firms: Fujitsu, Nippon Electric and Oki. Called FONTAC, the system was delivered last month to the Japan Electronic Industries Development Assn., is scheduled to go on the air in March. The mainframe, by Fujitsu, features 16K 42-bit words (36 plus flag and parity), a 2.2-usec core and a 4.4-usec add time. Thin films reportedly will also be added.

System software will include ALGOL, COBOL, and FORTRAN IV. The makers have set up a sales firm, hope to peddle 5-10 in Japan, but haven't set a price yet. Fujitsu, recent FJCC exhibitor, will also use the FONTAC processor with its own peripherals in its FACOM 250 system.

ADVERTISERS' I

COBOL TO GET NEW LOOK

COBOL is due soon to appear in a slightly new format. The CODASYL executive committee, chaired by Thomas D. Morris, assistant Secretary of Defense for Installations and Logistics, plans to publish early next year a revised version — tentatively called COBOL 65 — which is expected to overcome some user objections.

The new COBOL will clarify and incorporate under one cover all language improvements since COBOL 61, and will include ad hoc modifications suggested by CODASYL's language subcommittee. New features include provision for random access mass storage gear, more efficient "built-in" table handling functions, and specs for "Compact COBOL," which is expected to abet the development of efficient compilers for small-scale machines. It's estimated that some 35-40 COBOL compilers have been written, plus another 18-20 overseas.

JAPAN COMPUTER FIRM BOWS OUT

Matsushita Electric Industrial Ltd., Japan's largest appliance manufacturer, has decided to back out of the computer business. Its computer subsidiary, Matsushita Communications Industrial Ltd., which had produced the MADIC computer, will continue to make communications gear, however. The reported plans of IBM to manufacture in Japan may have had something to do with the decision. But one industry observer feels the Matsushita retreat may be only temporary.

SOFTWARE COPYRIGHT DRAWS LEGAL EYES

The November issue of the Columbia Law Review carries what is reported to be the first legal article devoted to the topic, "Copyright Protection for Computer Programs." It examines the scope of present protection, the spread of the umbrella under legislation now before Congress, and possible effects on the computer industry. First submitted in draft form to the Copyright Office at their request, the paper was in part responsible for their decision to register software copyrights.

PHILCO SELLS BIAX TO RAYTHEON

Joe Ricca, reported last month on these pages as moving "with caution and humility," has placed his old BIAX baby back on his lap. The engineering lab and manufacturing facility for the fast but higher-priced memories have been acquired by Raytheon, and will be moved to the computer facilities in Santa Ana, Calif. It had been a $1-2 million per year business for Aeronutronics.

RUMORS AND RAW RANDOM DATA

RCA says it will implement NPL for its new series of computers when the language has been defined. And the 70/45 will have a read-only memory with elementary operations to handle programs written for its own 301, 3301 and 501, as well as IBM's 1401. What's it called when you emulate an Emulator? . . . It's been estimated by an industry source that some 80% of computerized typesetting installations are in unionized shops.

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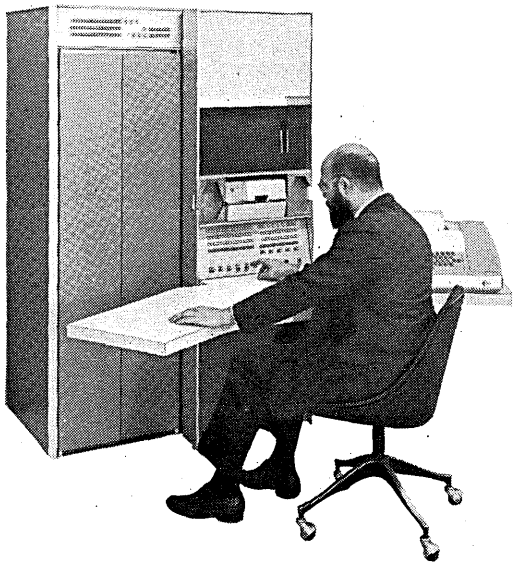

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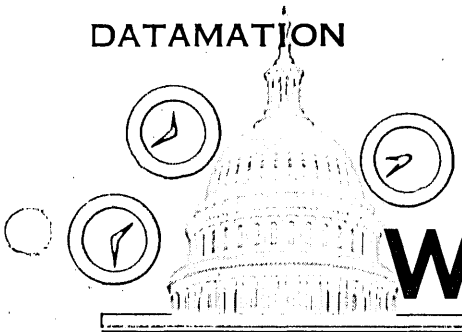


WASHINGTON REPORT

CSC, CDC BUYING BIG

The corporate cards in the high-stake, round-the-calendar poker game played in Washington, D.C., were recently reshuffled. The resulting new deal saw once-diminutive Computer Sciences Corporation of El Segundo, Calif., emerge with something close to a royal flush, and Control Data Corporation draw successfully to an inside straight.

Quadrupling its size in a week's time, CSC acquired Documentation, Inc., operators of NASA's Scientific and Technical Information Facility, in an exchange of stock, and Communications Systems, Inc. and Intelcom, Inc., two orphan divisions of International Telephone and Telegraph, for an undisclosed amount of cash. Control Data, always acquisition-minded, meanwhile picked up small but well regarded Datatrol Corp. of Silver Spring, Md., fulfilling its long-standing desire for an East Coast software house.

With Documentation, Inc.'s projected annual revenues of $6.5 million, and the approximately $12 million represented by the ex-ITT divisions added to its own, Computer Sciences became in two bounds a corporate goliath with annual revenues in excess of $23 million, according to its president, Fletcher Jones, and one with a powerful base of operations in Washington. On its part, Control Data is expected eventually to put Datatrol's programming expertise to use in abetting its government sales efforts, though Datatrol will remain an independent, largely autonomous division.

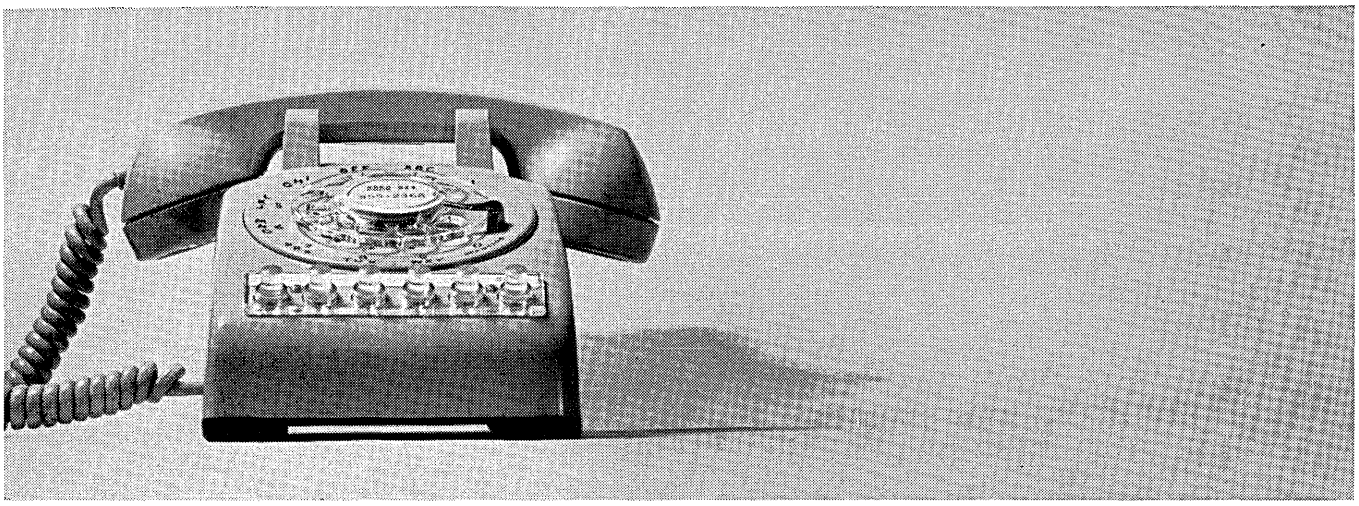
The acquisitions were made under omens of continued favorable business prospects for Washington-area "think"-type firms. Adam Yarmolinsky, special assistant to Defense Secretary McNamara, recently told the Science Bureau of the Washington Board of Trade that he foresaw no basic change in government R&D expenditures, a statement which was widely interpreted as being the word with the bark on it. There are also recurring reports of a Congressional vendetta in the works against non-profit firms for taking too large a bite of government R&D expenditures.

PRICE-CUTTING STIRS MARKET

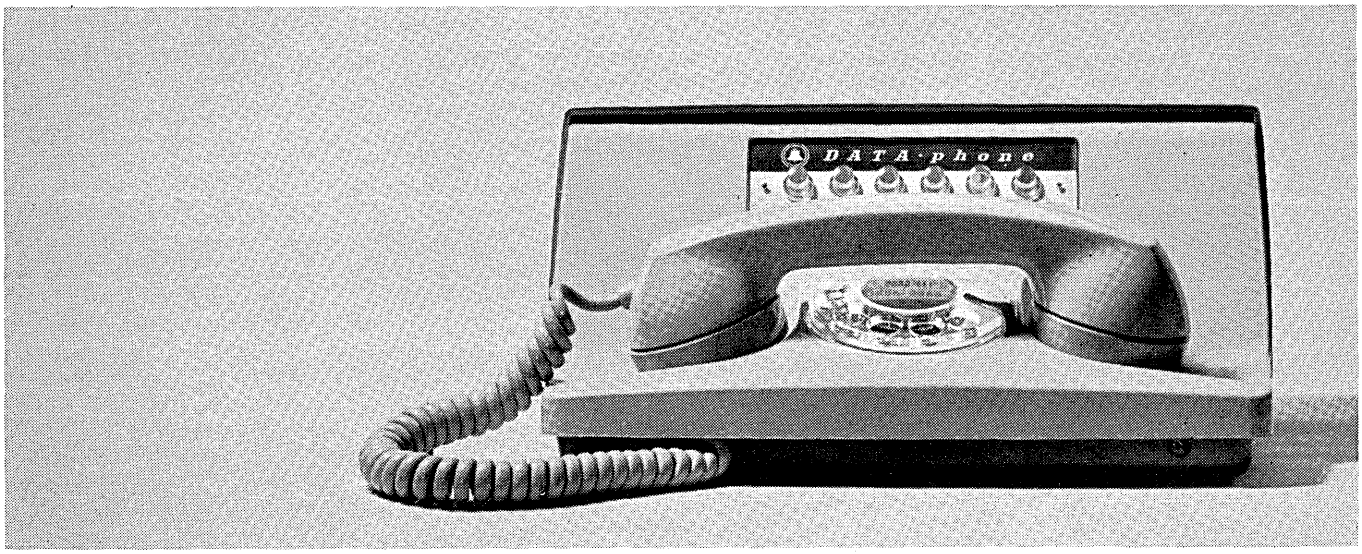
Of immediate concern to most Washington area computer sales reps is recurrent talk of price cutting, and possibly a partial withdrawal of the so-called IBM "price umbrella." IBM chairman Thomas J. Watson, Jr., stated in a recent interview that his company "is going to compete at whatever price level is necessary to maintain our position in the industry," words which were well-noted in Washington where IBM has lately finished out of the running on several large procurements, largely on the basis of price.

Some claim price cutting has already put in an appearance. "It hasn't been too obvious," said one government marketeer, "but you take a machine, change

Continued on page 85



What's the connection?



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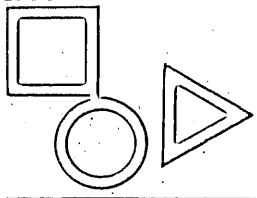

EDITOR'S READOUT

COMPUTERS & SOCIAL IMPLICATIONS

The Washington, D.C., chapter of the Assn. for Computing Machinery recently formed a Special Interest Group on the Social Implications of Information Processing. This follows past formations of a national ACM committee and a social implications committee of the American Federation of Information Processing Societies. This topic, covering the interrelated economic and social consequences of computing and automation, has also been the focus of some attention at the semi-annual Joint Computer Conferences and similar gatherings.

Yet, these discussions have generally failed to focus on specific problems and needs, generating, instead, ideas of either utopian lives or merely a restatement of existing and upcoming problems in slightly-altered and obtuse terms.

It should be questioned whether a general economy-wide approach can be taken in a discussion of this subject. How edifying can a dozen men with disparate specialties, ranging from computer professionals to pie-in-the-sky economists, be in a short evening's time? How much more effective would it be, one might ask, if specialists were selected on the basis of their experience with a segment of the economy? And restricted to a discussion of that area only—say, manufacturing or the service industries? Or, more narrowly, the auto industry or agriculture? Or file clerks or middle management? No no, AFIPS wouldn't want to step into DPMA waters.

To many, even this approach is questionable. Their argument runs about like this: you can bring in an economist (who's supposed to know what it is that affects our economy) and a sociologist (ditto, the social animal), but it appears to be only the man in the industry who knows what computers are all about—what their potentialities (and, therefore, possible effects) are.

It is thus of some comfort that groups have taken what is only the first step toward the creation of an intra-industry dialog on this subject.

No one is suggesting that only computer professionals can come up with a non-disruptive solution to the imminent impact of computers on our society. In fact, there are some pie-in-the-sky thinkers among them, too—people whose discussions would carry more weight if they'd realize that they don't understand economics. But it may well be that until the lay public is sufficiently informed to discuss the technology, the ministers of computerdom should get the ball rolling.

E.K.Y.

personal observations

SOME COMMENTS ON INFORMATION RETRIEVAL

by GARY R. MARTINS

One of the most evil of all effects of the Information Explosion is the mild hysteria occasioned within the text-processing community upon the publication of new and ever more alarming evidence of the Information Explosion's progress and implications. It is my experience that even mild emotions within the professional data processing community are sufficient cause for alarm. Another more insidious, evil effect of the Information Explosion is the accumulation of incalculable megatons of high-quality paper rendered useless by marring its surfaces with meaningless patterns of printer's ink; a generous percentage of these patterns represent "state-of-the-art" reporting, a lot of it dealing with Information Retrieval.

And a new menace looms before us—the proliferation of "state-of-the-'state-of-the-art' " surveys and reviews. The larval state of this novel parasite's development resembles the somewhat more acceptable bibliographic survey and "overview" report, both long familiar to workers in the more baroque sciences such as Aristotelian metaphysics and astronautics. Contemplating the full-grown beast is a delight (like the study of fallout-mutants) that must be left to future generations of scientists. Rather than indulge in more of this type of nonsense, let me simply review here, for the non-specialist, some aspects of the things Information Retrieval workers worry about. At the heart of it all, one can discern a single, complex purpose: *to make available unusually attractive library services dealing with relatively recent publications (or other data), usually employing modern EDP hardware.*

There are two parts worthy of separate consideration in the foregoing statement of purposes; both of these contrast modern IR goals with those of the traditional library systems. The phrase "unusually attractive" library services merits some consideration. I assume that, fearful of Mooers' Law,[1] IR workers aim to develop systems that will be used—systems that offer advantages not available from the neighborhood library and its academic and corporate counterparts. Such advantages might include any of the following: 1) convenience of access, 2) high-speed results, 3) suggestive indexing and reference services, 4) unusually broad and/or deep stockpiles of available information, 5) abstracting services, 6) "creative" retrieval, and so on.

The statement of purposes also mentions "relatively recent" source materials. This point might well have been subsumed under the "unusually attractive" services were it not such an important issue all by itself. "Relatively recent" takes on different degrees of significance for different potential IR user groups; to many geologists, for

A system analyst and reseacher in the Synthetic Intelligence Dept. of Bunker-Ramo Corp., Canoga Park, Calif., Mr. Martins has worked in machine translation (Russian to English), I.R., command-control systems, and syntactic studies of both artificial and natural languages. He has also worked with man-machine relationships in numerical and non-numerical dp. He holds a BS in theoretical linguistics from Georgetown U., Washington, D.C.

[1] *Information Retrieval Selection Study, Part II: Seven Retrieval Systems Models,* by Calvin N. Mooers, Zator Company, Report No. RADC-TR-59-173, Contract AF 30(602)-1900.

instance, it may be almost meaningless. To the command and control and telemetry communities, on the other hand, it may well constitute the single most important criterion for a useful IR system. Let's consider in somewhat greater detail these two complementary goals of modern IR activity.

a plethora of papers

The short-range aims of the various IR projects now in existence are so multifarious that it is almost impossible to write anything worthwhile about the subject of Information Retrieval as such. Strangely enough, this is a healthy sympton of the field. The overall problem of Information Retrieval is one of those many problems which can be called "unstructured;" i.e., so little is known about it, *as a single, unified problem area,* that words are not available to formalize, or clarify, its situation, and general topography. This may explain the avalanche of "state-of-the-art" papers—there 's very little else that can be said.

Since there is so little which can reasonably be said about the problem *as a whole,* it is encouraging that so many different kinds of activity, devoted to such a broad range of immediate goals, are in progress at one time (in spite of the difficulties this poses in trying to talk about them all at once).

One of the six possible "unusually attractive" library services is "convenience of access." This is illustrated by the location of at least one of Project MAC's I/O typewriters in a key project worker's bedroom.[2] The whole idea here is to put the library at the user's fingertips through numerous and widespread remote-access "consoles." The problems involved in providing such consoles to information users are entirely dependent upon the kind of library services the console has to mediate; mainly, the problem is one of cost—the more worthwhile the underlying library services, the more expensive the remote console set-up (which can range from a simple I/O typewriter to an impressive array of CRT, keyboard, lineprinter, and facsimile gear, not to mention the centrally-located buffering and query-stacking devices that service the remote consoles).

"High-speed results" as a novel library service was a key motivation for most early work in IR. Overawed with the speed and power of modern computational systems, some early workers in the field promised truly astounding results in time for 1984. The all-important question regarding just what sort of library services were to be provided (much less, perish the thought!, how) was often neglected.[3] The weakness of this early wishful thinking was summarized, in 1961, as follows:[4] "Speed itself may be of some relevance but, ... (we cannot justify) the unfortunately prevalent belief that mechanization of a process that doesn't work to begin with will improve matters." The speed can be bought, like the remote consoles, but only when the customer can be persuaded that the rapid and convenient stuff he gets is worth more than its cost.

Turning to the availability, through IR work, of "unusually broad and/or deep stockpiles of available information," we encounter again cost/effectiveness ratios. Engineers will provide, on demand, whatever is needed in the way of ultra-large, very-fast-random-access storage media (even at reasonable costs) as soon as the demand is backed up with cash. Also available will be useful multifont page readers, to load these memories, as soon as the requirement is justified, if not before. The key questions are: what will we load these mammoth memory systems with? And also: how do we find what we want, once it's there? Unusually attractive data bases are not yet of very great concern within the IR community as a whole; this will become a pressing issue (by virtue of certain correlaries to Parkinson's Law, if for no other reasons) only when the ways and means of providing unusually attractive access to quite ordinary repositories of data are solved.[5]

The question of getting at particular fragments of data, even in more humble storage systems, is however already a most important one. And here we have a moral obligation to note that in contrast to size there is another means to achieving attractiveness in a library data base. How attractive it would be to enter a library that had just those documents that really meant something—nothing but high quality sources! However few.

Unfortunately, there has been no enlightening work done yet on the problems of *direct* quality identification in library materials. Several schemes for complicating the judgment of ordinary librarians on incoming materials have been proposed, but none of these offers any real advantages over traditional screening methods. Frequently, the discretion of committees, rendered through a maze of "rating forms," is substituted for that of a single reviewer. There is no hope of automating any of these schemes.

One more democratic direct quality identification scheme that has been proposed would require library *users,* as part of their "payment" for services, to score documents on a simple machine-readable data card; it would be no problem then to automate the tallying of such scores.

There are two *indirect* quality identification techniques which may also be of some help in reducing the trash problem that threatens, at times, to strangle existing library systems. Both these techniques can easily be automated, and neither depends upon the whim of evaluation committees. The first such technique may be called "citation-scoring." This technique determines the "value" of a document or other data group by the frequency with which it is cited in other documents. The basic notion underlying this technique is at once simple and convincing; numerous methods for implementing it have been studied, involving more or less elaborate linear rating functions.

the request-scoring technique

A second, indirect quality identification technique which has been widely studied is not much different from the first. Here a document's popularity with library users, rather than with authors, is used as the basis for determining its "value." We may call this the "request-scoring" technique. The most heavily used documents are considered to be the most valuable. One or the other of these schemes, and quite possibly both, will almost certainly be incorporated in most future IR systems. They both share an important shortcoming, however, which should be mentioned here. In order for any of these quality identification schemes to be effective, we need to have "experi-

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[2] F. J. Corbató, Massachusetts Institute of Technology; from a lecture given in April 1964 before the Western Los Angeles chapter of the A.C.M.

[3] One is reminded of early talk about tele-reproduction in people's homes of such nonsense as the morning newspaper!

[4] *Information Retrieval: State of the Art,* by Don R. Swanson, Thompson Ramo Wooldridge, Inc. presented at the Western Joint Computer Conference, May 1961.

[5] Studies have been made, for instance, of the problems of automating some functions of the Library of Congress (a most attractive data base); but no one really expects anything serious to be done about these problems until the Library's contents overflow into the reserved Congressional parking spaces outside the building itself.

ence" on the document. That is, it must have been around long enough, in our library or elsewhere, to build up some kind of score. Which simply means that both techniques will be more useful for library *purging* than for input control.

On returning to the question of getting at already stored materials we can consider the unusually attractive "suggestive indexing and reference" services which a useful IR system should provide. The goal here is to provide, as a minimum, an automated version of the ordinary three-way library card catalog (which ordinary libraries can't afford), and, at the foreseeable most, an associative indexing method which would respond pleasingly to intricate, direct natural-language requests. There are two related sub-goals in this problem: to avoid the burdening of the system's user with unwanted information, and to make sure that he is not "cheated" out of documents (or parts of documents) implicitly addressed by his request. Unfortunately, it is probable that both these sub-goals cannot ever be fully satisfied even in theory; but we ought to be able to come as close as anyone wants to pay for.

Several complex issues involved in automatic indexing and reference techniques have been isolated for concentrated study by IR workers, and the volume of reports devoted to these studies is considerable. Some of these are worth reading. In the broadest terms, two highly refractory sub-problems occupy the IR specialist's attention in this area:

1- effective indexing of the library's contents:

2- development of powerful request processing methods.

The indexing problem is, briefly, one of finding a workable set of categories that describe the libraries' contents, defining the network of relationships with this set, and producing a procedure for properly labelling the contents of the library with appropriate categories. Most proposals for the solution of this exasperating problem involve the use of a rather large number of categories/descriptors/index-terms, and a thesaurus to define their relationships. The procedures that have been used for labelling the contents of libraries range from straightforward manual indexing, in the traditional manner (i.e., arbitrarily), to elaborate key-word and title-manipulation schemes designed for automation. Many presumably programmable schemes have been considerd for this purpose, none of them completely satisfactory. Generally, these involve the identification of key terms in a text by means of weighted frequency counting, the weights being assigned on the basis of "physical" location in text (e.g., heavy weighting for words in a document's title), syntactic function (e.g., heavier weighting for the subjects of sentences than for objects of prepositions), critical-term lists, and so forth.

the need for tests

It has never been easy to estimate the worth of the many indexing and reference schemes proposed simply because, in most cases, it has been impossible to gather convincing evidence and agree on how to evaluate it. The sheer labor and expense involved in the compilation of a broad thesaurus, suitable for Information Retrieval tasks, have combined to make such work unpopular. For this and similar reasons very little automatic indexing is actually done. The complexity of the difficulties involved makes it impossible to determine the relative merits of the various proposals solely on the basis of their authors' claims. The possibility of automatic thesaurus compilation, using reciprocal dictionaries (e.g., Russian-English and English-Russian), may help to reduce the magnitude of this one obstacle, at least, to the large-scale testing of automatic indexing and reference methods. Without such testing, it appears unlikely that any outstanding progress in this area will be made or, if made, be recognized.

Very closely related to the indexing problem is the problem of processing data requests. The ideal IR system might accept such requests in the form of ordinary voice telephone calls with the same professional patience as today's librarians. But that won't happen soon. A large-scale step in that direction will have been taken, however, when IR system users are allowed to type information requests in ordinary English. Something very near this could certainly be implemented within the bounds of present technological competence; again the problem is an economic one. There are many challenging syntactic, semantic, and stylistic subtleties that must be dealt with whenever we want to automate the "understanding" of natural language; most of these difficulties have been discussed at great length in machine-translation circles for some time. In spite of all this discussion, there is today only one full-time production-oriented machine-translation facility in this country, and its operations are justified on other than purely economic grounds.[6]

indexing & request processing

For the foreseeable future, it is highly likely that IR system users will have to learn some kind of so-called "query language" in which to express their information requirements. In general, of course, the more restricted and complex is the query language, the simpler will be the IR program which "understands" requests formulated in it—and thus one portion of the initial cost will be less. On the other hand, highly artificial and/or cumbersome languages (like Esperanto or English for example) tend not to be learned unless we're too young to know better—and consequently don't get used. But the most formidable obstacle to the development of useful request-processing procedures is the lack of indexing systems into whose terms data requests must be translated. Neither the indexing problem nor the request processing problem can really be solved by itself; a great deal more of real work is needed in both areas before many of the early dreams of IR forecasters can be realized.

Similar to the problem of indexing the library's contents though much simpler, is that of indexing its (most frequent) users. By building up a file of so-called "user profiles," derived from past data requests, automatic dissemination of appropriate new materials to interested parties can be achieved. All in all this doesn't seem to be so difficult to set in motion just as soon as somebody decides they can afford it.

Yet another unusually attractive library service that IR research has promised is that of automated abstracting of documents. If this could be done economically it would be of great benefit to library users since manual abstracts are both costly and slow, and are ordinarily available only by subscription to specialized user communities (e.g., lawyers and chemists). That genuine auto-abstracting is still a long way off is guaranteed by the singular banality of much of the literature dealing with it. On the other hand auto-extracting, in which key sentences are automatically selected to characterize the source document, is now being done routinely on a small scale and with reasonable, if not earth-shaking, results.

[6] This system is operated by the Foreign Technology Division at Wright-Patterson AFB near Dayton, Ohio.

The programs which perform this service are not terribly sophisticated; it's quite likely that as progress in auto-indexing is made a resultant increase in the sophistication of auto-extracting programs will considerably enhance the product.

Probably the most fascinating of all the unusually attractive services that some future IR system might offer are those that can be collectively called "creative retrieval." This would include all processes which produce *responsive data* directly rather than *references to responsive data* as output. Let me bury this crude distinction under an example: Suppose you wish to know which is the most widely used plastic. You can request from an automated IR system "all works on plastic," and be drowned in an avalanche of references (or full texts, depending on the kind of output the system produces). Perhaps the query language will allow you to specify "use of plastics" or some other more restricted expression of my needs. You will still have to hunt through a large number of documents to find the answer to the question. If, however, the IR system has a creative retrieval capability, the query language might allow the question, "Which is the most widely used plastic?" After a suitable delay you would be given the output: POLYETHYLENE. Or perhaps: POLYETHYLENE IS THE MOST EXTENSIVELY USED PLASTIC, which the system could have picked up from the top of page 81 of November's *Scientific American.*

creative retrieval method

But that's still fairly elementary compared to some other creative retrieval functions since it only involves lifting a responsive phrase or sentence from a stored data base. Suppose, for another example, the system has the sentences "Socrates is a man." and "All men are mortal." And not another word about Socrates. Now, ask the obvious "Is Socrates mortal?" The system having failed to find a stored answer must deduce the correct response.

Many forward-looking IR workers have studied different kinds of creative retrieval problems, including automatic essay writing, fact correlation, question answering, and inferential response. The implementation of any or all of these capabilities, when finally achieved, will usher in a whole new generation of automated systems.[7]

The ideal IR system's ability to deal with "relatively recent" data deserves separate consideration. Just what is meant by "recent," of course, depends upon the application. For the librarian of the physical sciences, it probably means something like "less than 2 years old," particularly with reference to journal articles. On the other hand, in a strategic command and control system the term "relatively recent" might mean something like "within the last eight hours." In telemetry applications it could come down to a matter of seconds, or less. Where the capability to deal with "relatively recent" data is of primary importance, and where the term takes on a meaning that demands performance approaching that expected of "real time" systems, the singular power of modern EDP techniques is most clearly appreciated. There is, after all, a complete, running, long-established model that embodies *all* the capabilities we have discussed earlier: the special Congressional services groups in the Library of Congress! A member of Congress has only to pick up his phone to avail himself of a wide range of unusually attractive library services. The one type of service he *can't* get is precisely what we're talking about here—access at very high speed to a rapidly changing data base.

Prestigious users of information, such as the military and NASA, have placed a premium on systems involving highly dynamic data bases and have been willing to pay for their development. Generally, however, very little if any genuine text-processing is involved in such systems; their performance depends mainly on the engineering and numerical methods talents of their creators. We cannot, therefore, look to such systems for guidelines toward the solution of the more ordinary library system's problems in dealing with "relatively recent" documents. This problem will have to await the slow and painful development of useful indexing methods as well as very-high capacity input and storage devices before it will be solved—that will take both time *and* money and in large quantities.

Perhaps a word on the many ingenious mathematical models for IR systems may be said here. These formulations, based upon analogies with linear and non-linear electrical circuits, the percolation process, genetics, and a variety of other structures, seek to portray the behavior of different parts of a general IR system. Much of this literature has only intrinsic interest, however, due to our inability to map the elements of the model meaningfully onto corresponding elements of an observable (and often even thinkable) operating system. A more immediately useful subset of this literature is that which deals with file organization and search strategies and with related hardware design. And, of course, there is an inevitable residue of more or less clumsily disguised trivia.

on-line retrieval

Recently it has become fashionable to talk about the application of so-called "on-line" data processing techniques to problems whose structural density defies a direct analytic approach. The "on-line" approach in this dialect, simply refers to a division of tasks between men and machines,[8] assigning to each what they can do best. This can be a useful approach only if we don't ever become too happy with it—so long as we keep working at assigning more and more of the total system's labor to the machines.

It is not difficult to envision an evolving IR system which involved a good deal of man-machine interaction, and which also incorporated a heuristic sub-system which would gradually "learn" how the human element behaved. Consider the indexing problem in this light. Begin with a very "permissive" thesaurus, which would associate each index term with a rather large number of other terms ranging from the obvious to the absurd. After a set of associations has been made, the system's user is then called upon to "cross out" irrelevant associations and to add relevant ones which the system overlooked. The user's intervention could be requested again when the system produced a group of presumably responsive references—non-responsive references would be "crossed out" and possibly additional relevant references would be added by the user. A suitable heuristic sub-system, acting on the results of many such man-machine encounters might eventually be able so to modify the thesaurus and the assignment of index terms as to make further man-machine interactions unnecessary.

Similar remarks can be made about fact retrieval, abstracting, and so on. Several contracts have already been let for research in this particularly promising area; it is possible that, once the magic of the words "on-line" and "man-machine" has tarnished somewhat, the dutiful exploration of this approach will bring us several steps closer to the long-promised Golden Age of truly useful and economical Information Retrieval. ■

[7] In a very real sense machine translation can be considered a "creative retrieval" problem of a very complex kind; the history of machine translation illustrates the difficulty such problems involve.

[8] This same term ("on-line") is often used in other, and equally legitimate, ways (in process control applications, for instance).

THE MEDLARS SYSTEM

an application report

by CHARLES J. AUSTIN

MEDLARS (Medical Literature Analysis and Retrieval System) is a computer-based information storage and retrieval system currently in operation at the National Library of Medicine (United States Public Health Service) in Bethesda, Md. As the world's largest biomedical library, the National Library of Medicine is responsible for collecting and indexing the world's scientific literature in the fields of medicine and biology. Because of the tremendous and still increasing growth of the biomedical literature, the library realized in 1960 that the only way to maintain rapid bibliographic access to this vast reservoir of information would be through a carefully planned program of mechanization. For this reason MEDLARS was designed to do three major jobs:

1. *Index Medicus*—The computer is used to compile and print this monthly listing of current journal references in the medical field. A typical monthly issue of the *Index Medicus* will contain reference to over 14,000 new scientific articles published in recent months. Approximately 60% of these articles come from journals published outside the United States.
2. Recurring Bibliographies—In addition to the *Index Medicus*, data is drawn from the computer files to produce periodical lists of citations in more specialized medical subject areas such as cancer research, heart disease, mental health and new drugs.
3. *Demand Bibliographies*—The main reason for mechanizing the library's information files is to allow rapid searching for answers to complex bibliographic questions which cannot be effectively handled by reference to a printed index or catalogue. The results of such searches are called demand bibliographies.

The items listed above represent the immediate objectives of MEDLARS. However, the library realizes that this is only one phase of a much broader program in research and development in documentation directed toward the overall improvement of biomedical communication and modernization of library techniques to keep pace with new technology in electronics.

The MEDLARS data processing system is a relatively unsophisticated one in that it relies upon proven techniques of coordinate indexing with related Boolean search techniques. However, MEDLARS is unique in several other respects. It is the only system of this type in the medical field. It is also the only large-scale information retrieval project based in a research library, thus providing both bibliographic access as well as copies of the documents themselves. Another important aspect of the system is the fact that it is *actually operating* on a large scale. The problems of systems engineering have been sufficiently worked out in order to produce an operational reality with an average of 700 new documents being processed and en-

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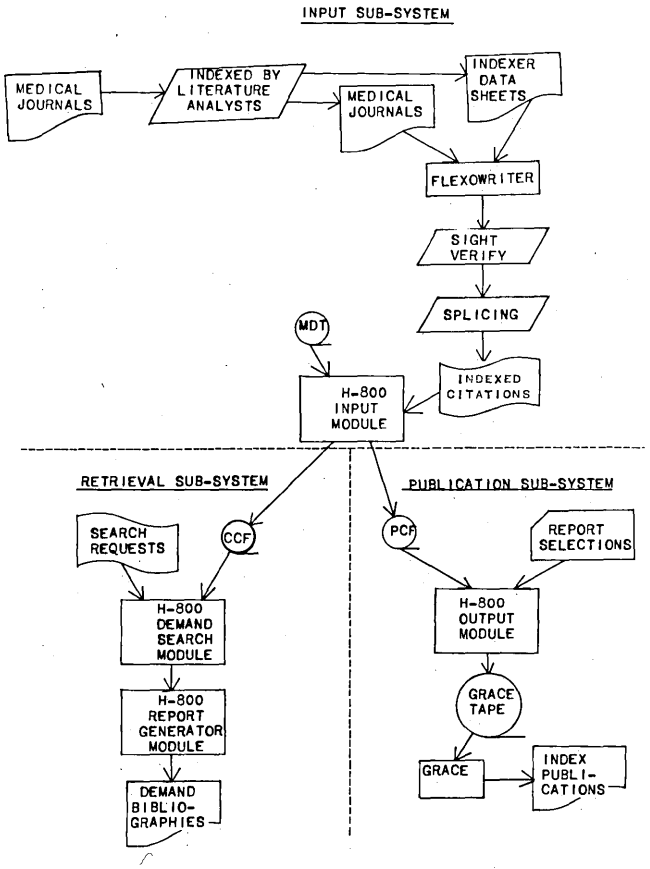
tered into the files each day. By January of 1965, the total data base will consist of well over 200,000 documents. Another interesting facet of the system is its special printing mechanism, the Photon 900 computer photo-typesetter, referred to by the library staff as GRACE, (Graphic Arts Composing Equipment). This magnetic tape-driven photocomposer is described in more detail later in the article.

system overview

A brief description of MEDLARS can be obtained by referring to Fig. 1. The system is subdivided into three major components, an Input Sub-System, a Retrieval Sub-System, and a Publication Sub-System.

The Input Sub-System combines the intellectual talents of trained literature analysts with the processing and

Fig. 1—MEDLARS System Flow Chart



storage capabilities of the computer. New medical journals are checked in detail and forwarded to the index unit where trained literature analysts classify the subject content of each article in the journals by assigning appropriate descriptors from the library's controlled list of terms called MeSH (Medical Subject Headings). The indexers are also responsible for translation of foreign titles and transliteration of titles for articles written in non-Latin alphabets. Journals with indexer data sheets attached are forwarded to the input section where Flexowriter operators prepare paper tape input for the computer system. The basic unit record consists of the article's title, author names, journal reference, and subject headings assigned by the indexer. The Flexowriter hard copy is sight verified by a staff of proof-readers, and once a day, all corrected tapes are batched and spliced together for entry into the computer.

The input module contains those computer programs which accept the paper tape, edit the data extensively, and prepare the two major data files—the compressed citation file (CCF) and the processed citation file (PCF). The compressed citation file is a highly coded, time-sequential store of citations used for searching and retrieval of demand bibliographies. The processed citation file is an expanded and formatted file of current citations which are used in publication of *Index Medicus* and recurring bibliographies. The system at this point is subdivided into two independent parts, one for storage and retrieval, and the other for publication of periodical indexes.

The Retrieval Sub-System begins with the receipt of a request for a demand bibliography. Such requests are forwarded to a staff of search specialists who have had extensive training in both indexing and the logic of a computer search. These specialists formulate the request into a list of search parameters and up to three search statements linking these parameters in logical conjunction. The formulated search requests are punched into paper tape, proofread, and batched for daily computer processing. The demand search module matches a batch of search questions against every record in the compressed citation file. Citations retrieved are printed in any one of a variety of output formats by means of the report generator module. The resulting lists of citations are referred to as demand bibliographies.

The Publication Sub-System is concerned with preparation of periodic indexes to current literature. Each working day report selection cards are entered into the output module telling the computer which recurring bibliographies (or the *Index Medicus*) are to be compiled on that particular day. The output module selects the appropriate citations from the processed citation file, performs a rather complicated task of page composition, and prepares a magnetic tape file of one-line print records for the phototypesetter. This tape is used by GRACE to convert the digital information from magnetic tape to characters on photographic film. The exposed film is developed by an automatic film processor, inspected, cut into page-size sheets, and packaged for mailing to the printer. The resulting film masters can then be used directly for plate-making, printing, and binding of the final publication.

system loads

A brief examination of data volumes will help to point out the need for mechanization. The current annual volume of approximately 150,000 papers indexed is expected to increase to 250,000 by 1969. In addition, at some future date, about 10,000 citations of monographs (books and other non-periodical volumes) will be entered into the system annually. The total annual input load will grow from the current 62 million characters to 100 million in five years. Output loads will be proportionally larger since the system produces the monthly and annual *Index Medicus*, several recurring bibliographies of varying frequency, and the demand bibliographies which will grow from the current load of about 10 per day to at least 90 per day in 1969. Thus the output printing load is expected to grow from about 290 million characters in 1964 to 590 million in 1969.

data processing equipment

The following items of automatic data processing equipment are currently employed in the MEDLARS system:

1. Friden Flexowriters (13), Programmatic, with specially modified key boards to include diacritical marks required for certain foreign languages. The keyboard allows for inputting of 88 different characters. The typewriters also have code and line-delete features for use by the typist in making rapid corrections.
2. The computer is a Honeywell 800 system with seven

magnetic tape units, paper tape reader, card reader and punch, and high speed printer (see Fig. 2). The central processor contains 8,192 words (48 bits) of core storage. A Honeywell 200 system will be installed early in 1965 to replace all of the peripheral equipment currently on the 800.

3. As mentioned earlier, the primary output device for recurring publications is the Photon 900 computer photo-typesetter (see Fig. 3).

With the foregoing information as background, the three main MEDLARS sub-systems can now be described in more detail.

Fig. 2—Picture of Computer Room

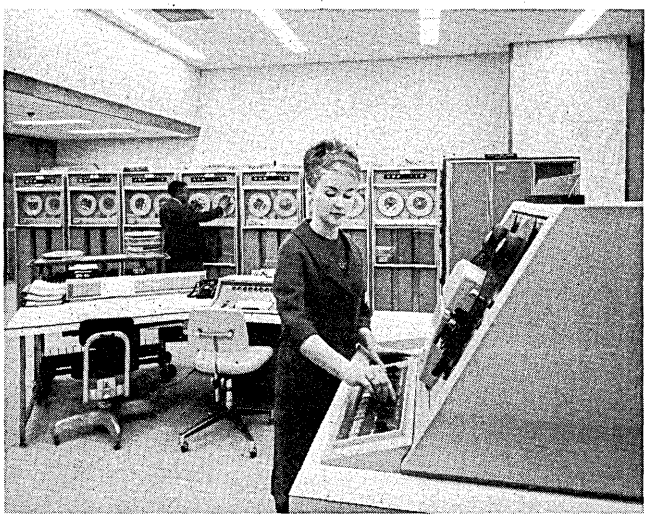
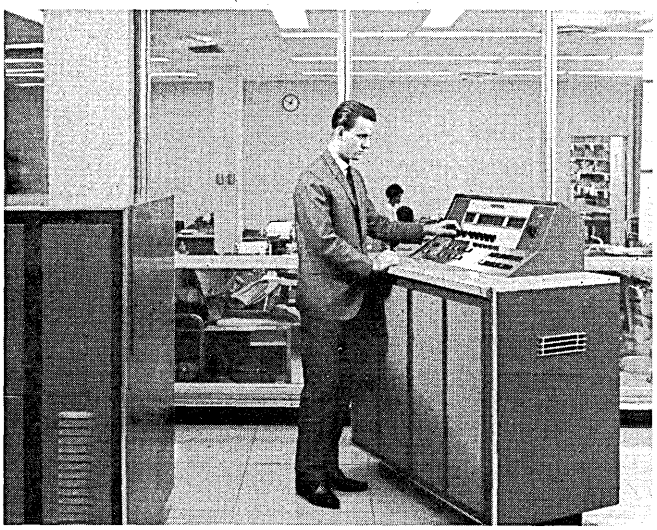


Fig. 3—Picture of GRACE



input sub-system

The basic unit record which becomes input to the MEDLARS data files consists of the following bibliographic information: title of the article in English and the original vernacular in the case of a foreign language article; names of all authors of the paper; language abbreviation; necessary journal reference data including a journal title code, volume and issue number, publication date, and pagination; and finally all subject headings assigned by the indexers with an indicator whether each subject heading is to be used for purposes of the printed *Index Medicus*, or only as a retrieval parameter for the MEDLARS search files.

The input module which processes these basic unit records each working day consists of five major sub-modules. The first sub-module reads the rolls of paper tape input, performs edit and validity checks, and matches correction tapes to the original input records requiring modification. The journal validation sub-module matches each input record against a master file containing a record of each medical journal included in the system. Each journal issue is checked against previous receipts to assure that no issues have been missed, and overdue notices are prepared by the computer when issues are not received within an expected time period. The MeSH validation sub-module matches each medical subject heading assigned by the indexers to a master file or thesaurus of terms to insure that the indexer has used a descriptor from the system's controlled vocabulary. The CCF sub-module creates the magnetic tape file used in the Retrieval Sub-System, and the PCF sub-module creates the tape records used in the Publication Sub-System.

retrieval system

MEDLARS search requests are formulated by a staff of trained literature analysts. The following elements may be included as search parameters: subject headings and other descriptive tags, specific journal titles, author names, specific languages, year of publication, and computer entry date.

The search strategy employed in the system utilizes a two-phased approach. A batch of search requests is entered into the computer by means of paper tape and edited extensively before the search process can begin. Each request is then analyzed to determine the most significant element for that request. A significant element is defined as that search parameter which must be present in order for the search expression to be satisfied and which has a *lower* frequency of use than any other parameter in the request. The resultant table of significant elements is then used in the high-speed search sub-module which is a tape-limited search of the compressed citation file. If significant elements were not used in the

Fig. 4—Sample Decision Table

MEDLARS

Decision Table Logic

Example: M1 * (M2 + M3 + M4)

* = "and"
+ = "or"

Retrieval Element	No Match Code	Match Code	No Match Jump	Match Jump
M1	5	1	0	1
M2	0	3	1	0
M3	0	3	1	0
M4	5	3	0	0

No Match Codes

0 = Examine next element in table
3 = Retrieve this citation
5 = Reject this citation
7 = Jump

Match Codes

1 = Jump
3 = Retrieve this citation
5 = Reject

No Match on M1 : Reject citation
Match on M1 : Jump to look at M2
No Match on M2 : Look at M3
Match on M2 : Retrieve citation
No Match on M3 : Look at M4
Match on M3 : Retrieve citation
No Match on M4 : Reject citation
Match on M4 : Retrieve citation

Fig. 5—Sample page of *Index Medicus*

INDEX MEDICUS ACID-BASE EQUILIBRIUM

ACETOACETATES (D2)

Factors affecting acetoacetate production rates by normal and ketotic pregnant sheep. Bergman EN, et al. **Amer J Physiol 206:453-7, Feb 64**

Acetoacetate turnover and oxidation rates in ovine pregnancy ketosis. Bergman EN, et al. **Amer J Physiol 206:449-52, Feb 64**

[The acetoacetate content of the liver in relation to cholesterol metabolism]. Baccino FM. **Boll Soc Ital Biol Sper 39:1547-9, 15 Dec 63 (It)**

ACETOBACTER (B3)

The variable relation of oxygen consumption to cellulose synthesis by Acetobacter Xylinum. Webb TE, et al. **Canad J Microbiol 10:11-5, Feb 64**

Fine structure of the gram-negative bacterium Acetobacter suboxydans. Claus GW, et al. **J Cell Biol 20:217-33, Feb 64**

Deoxyribonucleic acid base composition of acetic acid

Effects of bronchoactive agents on static pressure-volume characteristics of dog lungs. Yoshida S. **Amer J Physiol 206:321-6, Feb 64**

Choline acetylase and cholinesterase activity in denervated electroplax. Rosenberg P, et al. **Biochim Biophys Acta 82:266-75, 10 Feb 64**

Leakage of transmitters in salivary glands. Assarson N, et al. **Brit J Pharmacol 22:119-25, Feb 64**

The action of the toxin of Prymnesium parvum Carter on the guinea-pig ileum. Bergmann F, et al. **Brit J Pharmacol 22:47-55, Feb 64**

The sympathetic mechanism in the isolated pulmonary artery of the rabbit. Bevan JA, et al. **Brit J Pharmacol 22:176-82, Feb 64**

The responses of the guinea-pig isolated intact trachea to transmural stimulation and the release of an acetylcholine-like substance under conditions of rest and stimulation. Carlyle RF. **Brit J Pharmacol 22:126-36, Feb 64**

The ganglion blocking action of procainamide. Paton WD, et al. **Brit J Pharmacol 22:142-52, Feb 64**

ACETYLCHOLINESTERASE (D5)

Histochemical distribution of cholinesterases in the testis, epididymis and vas deferens of the rat. Risley PL, et al. **Anat Rec 148:231-49, Feb 64**

Some morphologic, histochemical, and chemical observations on chemodectomas and the normal carotid body, including a study of the chromaffin reaction and possible ganglion cell elements. Pryse-Davies J, et al. **Cancer 17:185-202, Feb 64**

Acetylcholinesterase in bull spermatozoa. Nelson L. **J Reprod Fertil 7:65-71, Feb 64**

[Effect of various oximes derived from 1-phenyl, 1-benzyl and 1-phenacyl pyridine and analogues of 4-formyl pyridine in paraoxon intoxication] Milošević M, et al. **Med Exp (Basel) 10:73-8, 1964 (Fr)**

ACETYLESTERASE (D5)

Properties and classification of the soluble esterases of human kidney. Ecobichon DJ, et al.

initial search of the full tape file, the search would be processor-limited and inefficient. After the CCF has been substantially reduced by the high-speed search, a complete logical search is performed using decision table logic. An example of a simple decision table is given in Fig. 4. Citations retrieved by the logical search are written on magnetic tape, and a table is prepared listing the number of references found for each search request.

At this point processing is interrupted and the search statistics are returned to the literature analyst who uses this quantitative information in deciding how to format his final bibliographies. The searcher prepares report generator cards specifying the sequence and format of each bibliography in this batch. These cards are returned to the computer for the processing by the report generator module which prepares the demand bibliographies on the computer's high-speed printer.

publication sub-system

The basic function of the output module is to prepare tapes for use by the photo-composer for producing *Index Medicus* and other recurring bibliographies. The programs contain rather complicated page composition routines including: preparation of a one, two, or three-column page format; partial right-hand margin justification by varying inter-word spacing (no word hyphenation is attempted); and establishment of page headings, intermediate subject headings, running headings, and page numbers. (Refer to Fig. 5 which is a sample page of *Index Medicus*). After a complete page has been composed in core memory, it is written one line at a time on the magnetic tape used by GRACE.

GRACE is an off-line photo-composer which prints from a font of 226 characters onto nine-inch-wide positive photographic film or paper. It operates at a speed of 1.7 lines per second or approximately 300 characters per second. The character set includes a 6-point font, regular and bold-faced, upper and lower-case, with a large subset of special characters including diacritical marks for foreign languages; a 10-point font, upper-case, bold face; and a 14-point font, upper-case, bold.

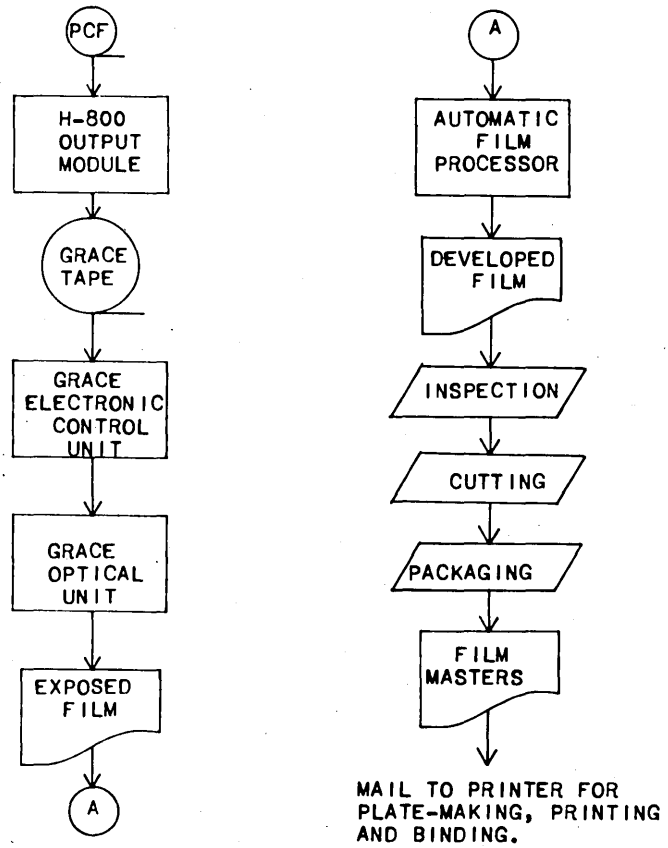
GRACE is made up of three components. Print lines are delivered from a standard Honeywell magnetic tape drive with medium tape density of 400 frames per inch. The electronic control unit of GRACE includes an operator control panel, an input converter, a small amount of core storage, and special purpose logical circuitry which computes timing signals for driving the optical unit. The optical unit has five major sub-assemblies: flash tubes, a matrix of characters etched onto glass plates, a reciprocating lens, a mirror block assembly, and film handling unit. The lens makes one complete horizontal sweep for each print line during which time the control unit sends a signal to each of the flash tubes at the exact instant required to illuminate the appropriate character at its proper position on the film. As the lens sweep is completed, the film is advanced, a new record is read, and the cycle is repeated.

The basic data flow through the Publication Sub-System is shown in Fig. 6

summary

The MEDLARS system was designed to meet two major requirements, the publication of comprehensive indexes to the medical literature in various subject specialties and the storage and retrieval of bibliographic data upon demand. The system has been in operation since January 1964 and is contantly being scrutinized for improvements resulting from technological developments in both hardware and software. The National Library of Medicine is heavily involved in other new systems studies directed toward the use of data processing equipment as a tool to modernize traditional library functions, and what is more important to improve the flow of communication of new scientific knowledge resulting from work in medical research and development. ■

Fig. 6—Publication Sub-system Flow Chart



PHOTOCHROMIC INFORMATION STORAGE

by JOSEPH BECKER

While most microfilm or micro-image applications now in use employ either silver halide or diazo film as the recording medium, The National Cash Register Co. has announced a process called photochromics which also provides a practical means for high-density storage of textual and graphic images.

NCR photochromic coatings are similar to photographic emulsions in appearance and other properties. They can be coated on the same type of surfaces as photographic emulsions and exhibit excellent resolution capabilities. The basic principle behind the photochromic process is the ability of individual molecules in the coating to switch alternately from a colored to a colorless state. The materials switch when subjected to near ultraviolet radiation and back to the colorless state when subjected either to heat or visible light. The concept of PCMI is a fresh idea in the field of information storage and retrieval. The PCMI process is now out of the laboratory and available from NCR for special applications on a contract basis.

brief history of micro-images

In 1839, John Benjamin Dancer, an Englishman, coupled photography with microscopy for the first time to produce microphotographs of a page of text. He employed the Daguerreotype photographic process in his experiments. Twenty years later, Sir David Brewster further disclosed how microphotographs could be concealed in small places like an ink blot. The German Army, in World War II, adopted this principle in a technique called "microdot." It transmitted information to its agents by hiding microphotographs of secret messages in the punctuation marks contained in book print.

The French government, during the Franco-Prussian War, used microphotography to communicate dispatches into Paris when the city was under siege. As many as 3,000 messages could be photographed and reduced on one collodian plate. A surface layer called a "pellicle" was then peeled from the plate as a thin film. This lightweight film was rolled into a scroll, slipped into a quill, and attached to a pigeon's tail feather. When the pigeon reached Paris, the film was recovered from the quill, projected, and the messages copied by hand. "Pigeon Post" was the forerunner of the familiar V-mail process employed by the U.S. in World War II.

Microfilm is the principal method known to man for compressing graphic and textual data without alteration of information content. Libraries use it extensively for space reduction of archival files of newspapers, periodicals, and books. In addition to compacting passive files, industry and government are using microfilm more and more as the keystone of active and dynamic information systems. As long as information can be stored more densely on microfilm than on magnetic tape, microphotography will be an attractive and important medium for micro-recording printed and graphical data.

Delivered at the 1964 BEMA conference in Los Angeles, this paper appears through the courtesy of the Library Technology Project, American Library Assn.

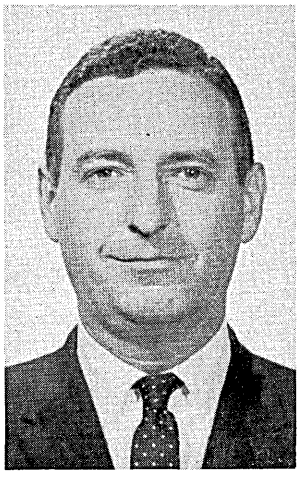
properties of other film recording media

Silver-Halide is the most popular photo-recording medium. It is fast, grainy, exposed with white light, and developed wet. It is used widely in the home and for commercial purposes. *Diazo* film was introduced many years ago. It consists of a Mylar base coated with a photosensitive dye. It is slower than silver, exposed with ultraviolet light, and developed by ammonia vapor. Ultra violet light disintegrates portions of the dye compounds and ammonia vapor brings out the remaining dye in the coating. Since the dye imbeds itself in the film, the intelligence at once becomes visible to the human eye. More recently another recording medium was introduced, called *Kalvar*. In the Kalvar process a plastic film is coated with microscopic gas bubbles. On exposure, the bubbles are excited by an ultraviolet light source. The film is developed dry by heating it at a temperature equivalent to that of a warm iron. Heat caused the excited bubbles to burst and form light scattering centers. The unaffected coating that remains on the surface provides the intelligence for the picture.

Diazo and Kalvar are quick, dry, and offer acceptable resolution characteristics for most applications. That both processes are dry gives them an important advantage over the silver-halide family of films which still require chemical development and fixing.

Silver-halide, diazo and kalvar film are used in many different forms. Microfilm images can be rolled into spools, cut up into strips and inserted in jackets, contained on sheets of film called *microfiche*, or scotch taped into the window of an *aperture card*. These are translucent forms. The results of microfilming can also be applied to opaque forms. Images can be contact printed onto *microcards;* or contact printed onto adhesive-backed strips known as *microtape;* or projected and burned into a multilith plate for offset runs onto paper called *microprint*.

All of the forms described above require a viewer to help the user inspect and use selected micro-images. Some



An independent dp and library consultant, Mr. Becker is also a lecturer on automation at the Catholic Univ. of America in Washington, D.C. He is co-author, with Robert M. Hayes, of "Introduction to Information Storage and Retrieval," Wiley & Sons, 1963. He holds a bachelors in aeronautical engineering at Polytechnic Institute of Brooklyn, and an MS in library science at Catholic Univ.

of these viewers are combination printers, permitting a user to make a paper enlargement (i.e., hard copy) on the spot after selecting his micro-image. When microfilm is combined with xerography, entire paper files can be recreated from the film automatically at high production speeds. Further, several sophisticated devices have been manufactured to facilitate the automatic retrieval of microimages from a large file.

description of the pcmi process

Photochromics derived from NCR's chemical research in the fields of encapsulation and dye chemistry. NCR photochromic materials are light-sensitive organic dyes. The dyes can be placed as a molecular dispersion in suitable coatings and applied to almost any surface. With photochromics, the molecular coating can be exposed with ultraviolet radiation and erased with white light. It is this reversible characteristic that gives PCMI a powerful advantage in film technology. It is grain free, thus permitting the recording of very high density micro-images. It also exhibits excellent gray scale characteristics which facilitates the recording of both textual and graphic information in the same medium. The reversible feature enables inspection, error detection and correction, and at the same time provides a method for adding and subtracting information. Photochromics brings to film technology some of the same power that magnetic recording brought to computer technology.

High-density microrecording is feasible with PCMI at linear reductions of 200 to 1, representing an area reduction of 40,000 to 1. One limitation of the photochromic coating is its semi-permanency. PCMI coatings are sensitive to ambient temperature. Coatings kept at lower temperatures have a longer life than others. Room temperature image life is normally measured in minutes or hours, whereas a drop of 30 to 40 degrees will rapidly extend this life to months.

As a general rule microform systems require exacting quality controls at all stages of processing—in the optics at the time of filming, in the storage medium, and in subsequent stages of film duplication.

In the PCMI process the user's original documents are first photographed under strict quality control conditions to conventional 35 mm (sprocketed) microfilm. Computer output generated on 35 mm microfilm using an SC 4020 can also be made compatible as input to the PCMI process. A machine, called a Camera Recorder, then accepts the 35 mm microfilm as its input. Ultraviolet light is projected through each microfilm frame to a glass plate coated with the photochromic emulsion. The optical train between the film and the plate produces the desired reduction ratio by focusing the image on a controlled coordinate location on the glass plate. After each exposure, the image becomes immediately visible for inspection. Thereafter, in a step and repeat fashion, successive images can be exposed one at a time, or automatically until an entire matrix is produced. Inspecting for errors is done a frame at a time, or by backspacing the exposed matrix. When an imperfect image is detected, light in the appropriate erasing waveband erases the image and the ultraviolet projection is repeated.

After exposure, the photochromic plate is contact printed on a second plate coated with a high-resolution silver-halide emulsion; a bulk transfer of the images in the matrix occurs. The latter plate is used as a master to produce subsequent transparency copies after appropriate chemical development and fixing. Finally, the copies are laminated between two protective plastic sheets.

Copy resolution achieved with PCMI is above normally accepted standards for viewing and enlarging. Contact printing to film on a mass production basis of large quantities of high reduction ratio micro-images on a single substrate is unique with PCMI.

A reduction ratio of 200 to 1 allows for the storage of 2,500 pages on one 3x5 transparency. Four hundred 3x5 transparencies, representing a file of 1,000,000 pages, occupies only six linear inches. A shoebox file of transparencies can therefore hold as many as 3,000,000 images!

At present, the PCMI process to produce micro-images is available at NCR to customers on a service bureau basis. Production cost for a single 3x5 photographic master plate is estimated to be $250. The cost of subsequent dissemination transparency copies, produced by contact printing, ranges from $.50 to $1 each depending on quantity. High density micro-images can, therefore, be mass produced with unprecedented economy. At the rate of 50 pages per penny the concept for disseminating whole libraries of information grows extremely appealing. A relatively low-cost high-performance viewer has also been developed to the pre-production prototype stage to facilitate the retrieval and utilization of the micro-images.

Apart from the revolutionary advance which PCMI brings to film technology, it also introduces a new dimension into information processing system design. Its principal advantage rests with the ability to mass produce micro-image dissemination files economically. Thus far, document retrieval systems have tended in the direction of providing a central store of images that could be placed on-line with users through remote consoles. Though technically feasible, such schemes have been uniformly thwarted by prohibitive cost. PCMI, for the first time, makes the decentralized file concept appear as an attractive alternative. For example, unique special collections in the library of one country could be filmed and the resultant micro-images disseminated to other repositories all over the world. A similar idea would be applicable to industry and government where decentralized operations rely heavily on the ability to possess the same information in the field as is available at headquarters. Since micro-image files can be produced so inexpensively, it is also conceivable that entire libraries may eventually be available for home use as well.

The ultimate success of a micro-image dissemination system will rest with the user. Since he is the one who must handle and view the film product, his attitude toward the system is important. His acceptance will hinge on how "comfortable" he feels with film as a reference medium. Accordingly, studies have been made of his habits, and a great deal of experimentation has been conducted with viewer equipment. Design goals for a PCMI viewer include high optical quality, eight-point print resolution on the screen, simple mechanical access to the desired image, easy loading and unloading, portability, and hard copy printout capability. If such a viewer is eventually to be sold for home use, it will also need to be manufactured in quantity at low cost.

In summary, PCMI represents a unique capability in the field of information storage and retrieval. While the level of this technical development is high, its principal areas of potential application remain to be explored. It does, however, appear destined to have an impact on microfilm publishing methods associated with the mass production of a plurality of images for dissemination purposes.

REFERENCE:

Myers, Wilbur C., "Photochromic Micro-Image: A new Technique for Data Recording and Data Dissemination," presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) and Society of Information Display (SID) joint workshop on "New Technologies in Data Recording and Data Display" in Los Angeles, California, June 1-2, 1964. ■

RCA's NEW SPECTRA 70 SERIES

The competitive picture in the computer industry is about to undergo its second dramatic shift of the year. The reason: RCA's announcement this month of its new Spectra 70 series—the company's "third generation" offering for the computer marketplace. It is by far the biggest and most complete package RCA has ever introduced and certainly the most important announcement in the company's EDP history. In fact, the Spectra 70 announcement includes as much new equipment in a single shot (four compatible computers) as the firm has offered over its six-year history.

Just from the name of the open-ended series—Spectra 70—the development of a broad new marketing approach for RCA can be seen. The new series covers a broad spectrum of computer applications and capabilities—from the very small to large configurations.

Spectra 70's most significant features are:

- All non-privileged instructions, formats and character codes are identical with the corresponding features on IBM's System/360.
- Multi-lingual capabilities — implemented through both hardware and software techniques—that allow the systems to work efficiently with a broad range of machine and programming languages, and data and communications codes.
- The first use of monolithic integrated circuitry in full scale commercial data processing, along with multi-level platter techniques for back panel wiring.
- All the elements needed for total information systems including an extensive array of input/output, data storage and communications equipment. Enormous flexibility is added through Spectra 70's standard input/output interface which allows Spectra 70 peripherals to operate with any processor and provides for easy interchange of units.
- A favorable cost/performance index, achieved through RCA's use of advanced circuitry, new production techniques, and other hardware and software innovations.

high degree of compatibility

In the long run, one of the most important aspects of the Spectra 70 series—to computer users and manufacturers alike—is the wide range of compatibility that has been achieved. General David Sarnoff, RCA board chairman, in his keynote address to the Fall Joint Computer Conference last October said that the burden of incompatibility has resulted in "needless duplication, delay, and waste —both to the manufacturer and to the user—in cost, in equipment, in operating efficiency, and in manpower and skills." Obviously, RCA intends to help correct the situation.

The two larger RCA computers—the 70/45 and 70/55—respond and work for the user like System/360 through equivalence of all non-privileged instructions. The smaller Spectra 70 computers—the 70/15 and 70/25—use more limited instruction sets that are essentially subsets of the larger models.

The "native tongue" of all four is Extended BCD Interchange Code (EBCDIC) and each computer can generate and work with the American Standard Code for Information Interchange (ASCII), as do the new IBM computers.

But there the similarity ends. RCA's aim was to make its new computers compatible only in the sense that they would "speak a common language" to the programmer. This is where the potential savings is. What RCA has accomplished is analogous to what occurs in the automobile industry where manufacturers tacitly agree that their products will look alike, functionally, to the driver. But in the body and under the hood, there's a big difference.

Under the hood, Spectra 70 computers are quite different. In fact, each in the series is quite different—employing unique logic and special characteristics to increase overall effectiveness in its range.

RCA's decision to pioneer by becoming the first commercial data processing manufacturer to make computers in quantity with fully integrated circuits was the result of logic and circuitry studies that began over two years ago. The Spectra 70 solid-state chips—which place two complete logic circuits with 15 transistors and 13 resistors in a single element about the size of this "O"—were found to be produceable early this year, thus giving RCA a green light. The smaller 70/15 and 70/25 will use discrete components because of differences in design cycle time.

advanced technique advantages

RCA's drive to incorporate fully integrated circuits was based on the increased reliability, performance and economy that this advanced technique makes possible. The single and multi-level back panel platter wiring—which replaces the "spaghetti" normally associated with computers—also enhance Spectra 70's speed and reliability. Platter wiring is especially effective in cutting down noise and cross-talk problems and drastically reducing the number of solder connections.

Other interesting features: an 840-nanosecond memory cycle on the 70/55 that is the fastest core memory available in that price and size category . . . a 300-nanosecond memory cycle "scratch pad" memory for both 70/45 and 70/55 (a concept carried over from the RCA 3301) that provides for extremely fast register operations and makes it possible to buffer data transfers ranging up to millions of bits per second.

Some execution times may supply an idea of internal speeds. For a binary add (memory to memory), with a 32-bit operand, in microseconds:

70/15	62.00
25	36.75
45	9.60
55	2.58

A move instruction, 10 bytes, memory to memory:

70/15	60.00
25	25.50
45	23.52
55	14.76

A binary multiply, 32 bits for each operand:

70/45	78.12
55	12.78

Spectra 70's unique interrupt system also clobbers one of the big problems in today's complex computers—the cost associated with executive routines, both in terms of the amount of memory required and the machine time it normally eats up. In Spectra 70 computers there are several processor states, each with its own set of registers. Thus interrupts are handled more quickly and efficiently because there is no need to unload and store register contents to handle a higher priority problem. This makes possible simplification of the executive routine and a reduction of its memory requirements.

new peripherals

The Spectra 70 series also comes up with novel and interesting peripherals. These include:

Videoscan Optical Character Reader—a triple threat transport that combines optical character reading with mark sense and card reading options in one unit, providing flexibility and economy. Reading rate: up to 1800 documents per minute.

Video Data Interrogators—provide for remote display of up to 480 characters on a 14-inch cathode ray tube with up to 16 pre-recorded message formats available. To interrogate the computer, a message is "written" on the display through the standard keyboard. After any corrections are made, the entire message is sent to the computer by depressing a single button.

Data storage capabilities include three compatible mag tape systems and three mass random access systems. From a systems standpoint, the tape controller and the random access controller for these storage systems are extremely important. The three tape systems offered have data transfer rates of 30,000, 60,000 and 120,000 EBCDIC alphanumerics (eight information bits) or twice that number of digits. Optional versions of these tape units handle industry-compatible seven-level codes.

The Spectra 70 tape controller increases these basic capabilities by making it possible to mix a wide variety of units—both seven and nine-level formats and transfer rates from 7,500 to 120,000 characters per second—all connected through a single controller, and with the programs executed without regard to which tape transport is connected.

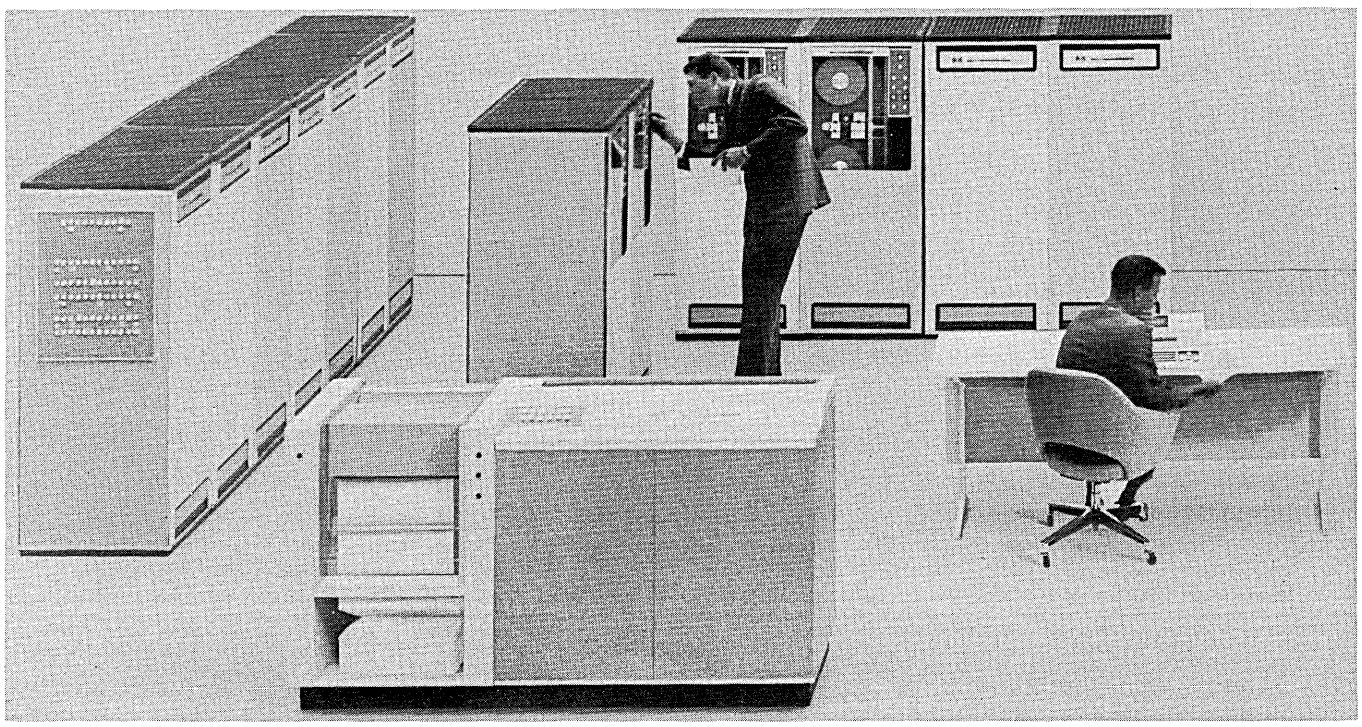
Mass storage devices include the RCA 70/568—an updated version of the multi-billion-byte-capacity RCA 3488 mass random access system introduced earlier this year. In addition, the new series includes a drum memory with storage capacity up to 1,000,000 bytes, and a disc storage unit with a capacity of over seven million bytes.

The random access controller adds the same intermixing capabilities as the tape controller. A single random access controller permits up to eight random access devices online in any mix desired. The big advantage here is that all devices look alike to the programmer.

software package

The multi-lingual Spectra 70 family will be able through its various software systems to work with the following programming languages: Spectra 70 assembly language, FORTRAN IV, and COBOL. Through the use of the metalanguage processor that is the basis for the assembly system, a wide variety of application oriented higher-order languages can be implemented.

Certainly, with RCA's long proven capabilities, it would



be expected that a complete range of data communications equipment would be made available—and RCA came through. The new series blankets the entire communications spectrum, including two methods of memory-to-memory data transfers.

Monthly rentals for central processing units only (depending on memory size) are as follows:

70/15	$ 800- 1,000
25	1,850- 3,950
45	3,600-10,800
55	8,350-22,550

The delivery cycle on the Spectra 70/15 and 70/25 is 12 months from the date of order; Spectra 70/45 and Spectra 70/55 deliveries are set for 18 months from date of order.

SPECTRA 70 EQUIPMENT SUMMARY

Processors

Spectra 70/15
A character-oriented two address computer operates on one 8-bit byte at a time. Cycle time: 2.0 usec. Memory capacities: 4096 or 8192 bytes. Processing is serial with I/O devices.

Spectra 70/25
A character-oriented two address computer. Basic operation is one byte at a time. Under certain conditions data can be extracted and restored to memory four bytes at a time. Sixteen registers are provided. Memory cycle: 1.5 usec and one to four bytes. Memory capacities: 16,384, 32,768, 65,536 bytes up to eight selector channels and one multiplexor channel to control low speed devices.

Spectra 70/45
A diad-organized variable format computer operates on two bytes at a time. Memory cycle: 1.44 usec for two bytes. Memory capacities: 16,384 to 262,144 bytes. Uses 300-nanosecond scratch pad memory, has 43 general purpose registers. Floating point arithmetic is optional . . . 144 instructions . . . separate scratch pad registers for interrupt and executive systems. Up to three selector channels provided as options. Multiplexor channel provided in basic complement to multiplex low speed devices. Storage protection and direct control are optional.

Spectra 70/55
A word-organized, variable format computer operating on four byte fields . . . 144 instructions identical with 70/45 set. Memory cycle: 840 nanoseconds for one word (four bytes). Memory capacity: 65,536 to 524,288 bytes. Uses logic rather than control memory to implement order code. Scratch pad memory, registers and other functions identical to 70/45. Floating point arithmetic is standard.

Peripherals

The Spectra '70 series employs advanced peripheral devices, including an upgraded version of the RCA random access mass memory unit, punched card and paper tape handling equipment, two high-speed printers, optical character readers, three mag tape stations, Video inquiry and display units, and data drum and disc pack memories.

A multiplexor channel built into the central processor and optional selector channels make possible the utilization of more than 300 high-speed I/O devices, such as mag tapes, and more than 250 other low-speed peripheral devices, such as printers, punch card units, and communications terminals. ■

THE '64 FALL JOINT

Neither rain nor hills nor the lack of conveniently -located hotel space stayed computerites from the recent Fall Joint Computer Conference in San Francisco. The official count: 3,100 registrants (for the technical sessions) plus another 9,100 who went through only the exhibits area, for a surprising total of 12,200. But then the conference was just full of surprises.

Two manufacturers took the occasion to announce new digital computers, a third got into the act to show off an on-line display unit, and the technical sessions included a runnning commentary on all three days of what were termed "very high-speed computers." Presented were papers on the CDC 6600, the mod 92 of IBM's System/360, and Philco's newly-announced 213-plus (the philosophy of present and projected designs). Each was followed by a critique of the papers and some healthy questioning of manufacturer's claims. For those interested, the papers reportedly will be published in Volume 2 of the proceedings.

In the volume that precedes it is the prize-winning paper: "Error Correction in CORC" by David N. Freeman of IBM. An algebraic compiler developed at Cornell Univ. to facilitate the teaching of programming, CORC also has extensive error-detection and correction features and the ability to supply novice coders with complete and explicit diagnostic information.

Other software-type sessions that received above-average grades from polled attendees were Input and Output of Graphics, which generated much comment (mostly favorable), Time-Sharing Systems, and Non-Numerical Proces-

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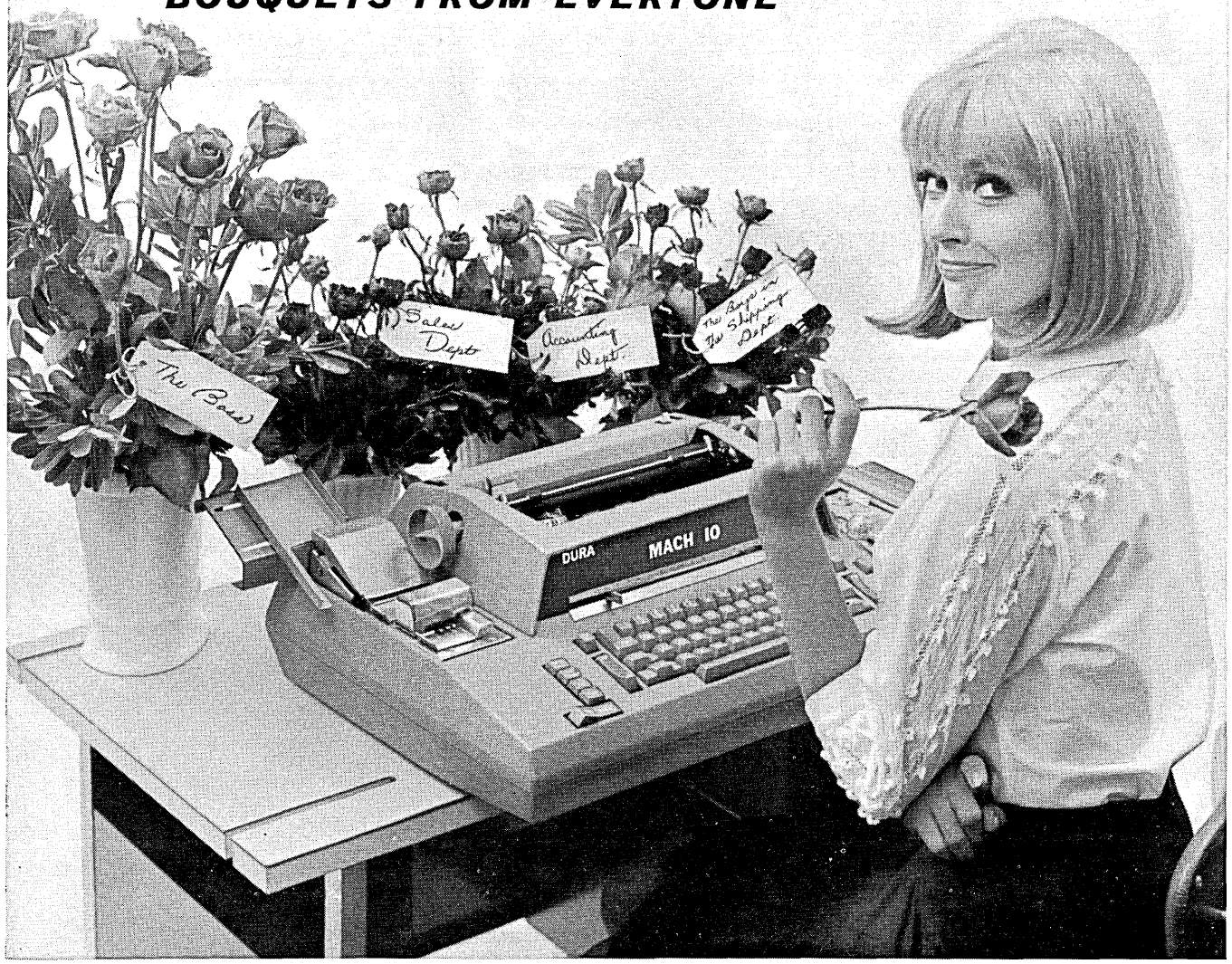

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CIRCLE 23 ON READER CARD

sing. An interesting comment on the latter: the great innovations have been made, says an information retrieval specialist; what we're getting now are refinements.

(In the Letters column of this issue is another attendee's viewpoint of computer conferences).

In an evening session on Thin Films vs. Ferrites, panelists seemed in agreement that the problem today is not so much the need for faster memories, but rather to reduce the cost of existing systems. For the next three to four years, it was said, large main memories will be cores, with which sub-microsecond speeds are being attained. Holding up the promises of thin-film advocates: fabrication difficulties, specifically the lack of uniform memory elements.

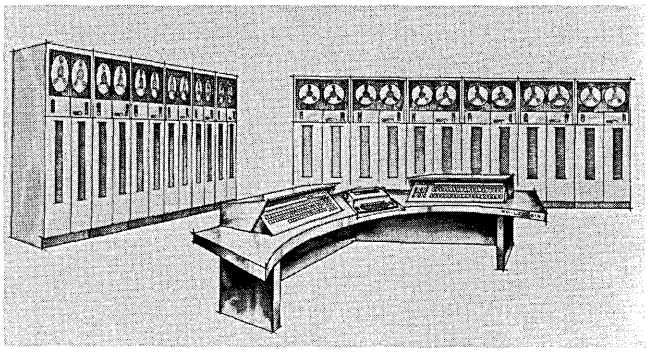
Another evening session had the working title, "Plans, Procedures and Constructive Suggestions on What to Do to Minimize the Dislocations to be Expected in the Transition from the Society of Today to the Computer-Automated Society of the Future." And for the second time in a row, following the debacle at the Spring Joint, this social-implications discussion fizzled in a disorganized heap of verbiage.

the exhibits

The exhibits area, chock full of operating gear and chokingly full of viewers, was impressive. Exhibitors didn't seem to mind the crowds. There was, for instance, a human curtain constantly hiding from view Number One's 360, mod 40, blinking lights and all. An equally impressive crowd sat through a Beckman Instruments demonstration of on-line EKG reading and analysis—a reclining blond mercilessly linked by numerous wires to a Beckman/SDS hybrid configuration.

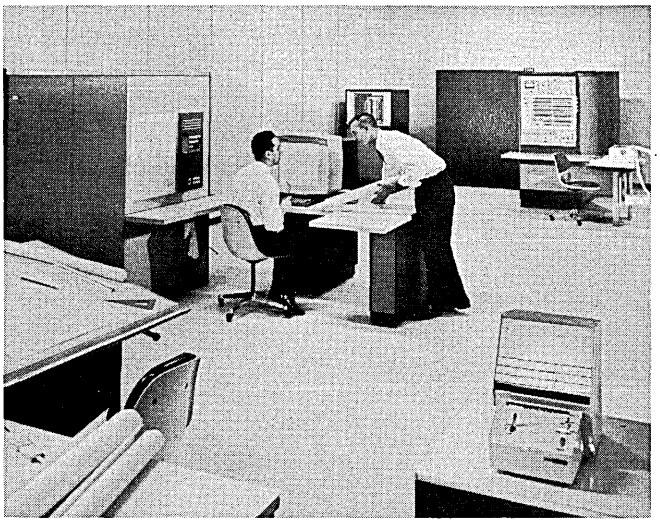
But the significant announcement/demonstration was that of Electronic Associates' first digital computer, the 8400. The medium-scale machine operates normally in a 32-bit floating-point mode, although it also handles 16- and eight-bit bytes. EAI also introduced another analog, the 8800. It features a ± 100 volt operational amplifier and a digital I/O computer for the automatic calculation and setting of pots and static check values.

Philco made it clear that it was remaining in the large-scale, gp computer business, announced its 213, which is compatible with the remainder of the 2000 series, and said it is planning a 214 for delivery about 1968. The 213



has multiprocessing capabilities; up to four processors can be linked, each able to address directly up to two million words of memory. It also has a memory protect feature and an access time of less than 900 nanoseconds. Execution time for a 48-bit add is less than 600 nsec, and floating multiply: 1.48 usec. An exec system handles dynamic job segment rescheduling. An average 32K configuration is priced at 2.7 megabucks, will rent for $60-65K a month, and first delivery is scheduled for the third quarter of '65.

IBM, late in the week, announced and demonstrated a new peripheral device for the 360's—a display and film reading/recording unit. Each is an independent unit operating on-line. The display operates with a lightpen which can be used to draw images and to modify or update displayed images which have been called from the 360's storage or from microfilm. The CRT image can also



be recorded on microfilm and viewed on a separate screen less than a minute later. Not particularly new technologically, the system derives power and appeal from its consolidation into an operating unit. Prices with monthly rentals in parentheses are: display $36,600 ($800); film scanner, $377K ($8,200); film recorder, $230K ($5,600), and a film recorder/scanner, $540K ($11,500).

In a unique demonstration of on-line recording and information retrieval, Stromberg-Carlson (formerly GD-Electronics) linked its new S-C 4400 microfilm printer to a Univac 1050, recording on 16-mm film at 62,500 cps. The exposed film was then taken to the Recordak booth where a Prostar film processor developed it, and retrieval shown with the Miracode system.

In a surprise move, Dartmouth College in Hanover, N.H., had a booth to demonstrate the time-sharing of its GE-235. Some 22 remote consoles reportedly are in operation back home, tied-in by a Datanet-30.

Another unexpected visitor was the Japanese firm of Fujitsu Ltd., Tokyo, showing a mag tape unit and touting its 230 and 231 computers, none of which is being marketed here. The former, the latest and fastest in the firm's product line, will be shown next year at the New York world's fair. It has a 2.2-usec cycle time, and a five-digit add time of 40.7 usec.

A mag tape rehabilitation unit was introduced by Cybetronics Inc., Waltham, Mass. The CS-1 consists of signal testing, buffing, cleaning and work stations, handles 556 and 800-bpi tapes, and is adjustable for signal threshold levels from 20-80% of full signal voltage.

These semi-annual JCC's are getting bigger all the time, though not necessarily better because of it. And no relief in sight. Next year's Spring Joint, which perennially follows the Fall meeting, is being waived so that the sponsoring AFIPS can host the triennial conference of the International Federation for Information Processing, meeting May 24-29 in New York City. Inquiries should go to the IFIP Congress 65 Inc., 345 E. 47th St., New York, N.Y. 10017. This third meeting of IFIP promises to be the largest ever. Gads.

XPOP:
a meta-language processor
A COMMAND & CONTROL PROGRAMMING SYSTEM

The literature on programming systems for the writing of Command and Control (C&C) programs revolves today, as it has for years, around the question: are we ready yet to standardize? The controversy on this point appears to be no nearer resolution today than it was several years ago, and the arguments on the two sides have remained so constant that from them alone one cannot tell a paper dating to the 'fifties from another published last week. These arguments, now as then, go like this:

Pro-standardization: We cannot wait for the appearance of a perfect language before standardizing; we must combine the best features of the languages we have today, produce a processor for the resultant language, and use it for all C&C programming. We will thereby avoid: the expense of maintaining several different processors; the defeatist use of machine language for want of a clear alternative; the confusion attendant upon the use of several different languages for the same application; and the waste that proceeds from our inability to exchange subprograms and programmers freely among various C&C projects. The longer we wait, the harder it will be to take this necessary step. Standardize now!

Anti-standardization: Standardization cannot be forced; it must come, if at all, as a consensus of interested parties. Premature standardization simply perpetuates present inadequacies and discourages the development of better tools. Besides, this would be the worst possible moment for any final decisions to be made; I understand that some very exciting work done over at NOP (NOn Profit, Inc.) is due to be announced any day now, and will revolutionize the field; wouldn't it be tragic if we froze the design just as the real answer emerges from the laboratory? Standardization eventually, of course . . . but not now!

There is clearly some truth on both sides here, and few studies have come out flatly for one or the other; most, after rehearsing the arguments on each side at considerable length, conclude that more research is called for.[1] The subject has begun to sound like one of those stock high school debating team warhorses—"Should we return to the gold standard?"; "Should we abolish the electoral college?"; "Is the jury system obsolete?"—that paralyse the mind with boredom.[2]

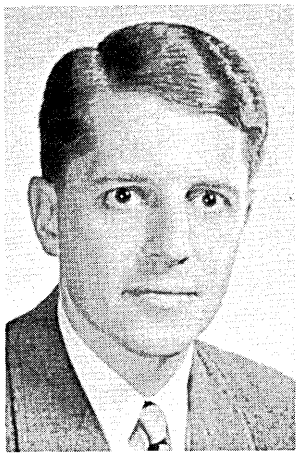
The C&C question must not be allowed to fall into this category; its practical importance is greater now than ever. The biggest C&C systems are yet to be constructed, and they may have to bear responsibilities heavier than any that present systems carry. What is needed is an idea that will at least change the terms of the argument and stimulate some fresh thinking; that is one effect hoped for from this paper.

translating & decoupling

Both positions in the now traditional standardization debate are largely irrelevant because they are equally based on the false assumption that any conceivable C&C programming system must take the form of a conventional compiler. In an earlier article[3] we argued at length that the compiler—a processor designed solely to translate a specific pre-defined programming language into machine language—is an interim form due to be displaced by processors embodying, though not limited to, the macro instruction feature. XPOP is a programming system built on this hypothesis. A general report on it has appeared elsewhere;[4] only those of its features that have direct bearing on the C&C question will be described here. The most important of these is that it is a meta-language processor: a system capable of being introduced, by its users, to an indefinite number and variety of languages, all of which it can then translate. It thus decouples language and translator into independent parts of a programming system, and enables us to consider them separately, measure them by different criteria, and adopt distinct policies toward them. To appreciate the significance of this, notice how many of the traditional arguments for and against C&C language standardization are really concerned not with the language proper but with the processor that translates and otherwise supports it. This distinction has been almost universally ignored because, in practice, every language has been implemented by its own unique processor, and this convention has come to be taken for a necessary condition. XPOP shows that it is not, and exercises an imaginary constraint under which the debate has long suffered. In particular, the decoupling of language and processor permits standardizing on a processor —where standardization offers its biggest and quickest returns—without any commitment thereby as to what language should be used for C&C. Experimentation on language may be carried on as long as desired within the environment of the same system that supports the current operational language or languages. Because the "laboratory" processor and the working processor are identical, successful language developments are immediately available to the operational language.

Beyond this fundamental structural advantage XPOP offers two features that make it especially suitable for C&C programming. One of these is the notational flexibility it offers the programmer using it to create C&C systems; the other, more important, is its ability to provide a command and query language for the military *users* of those systems. An example will make clear what "notational flexibility" means.

Consider a macro, LOGSUM, created to store the



Leader of a group engaged in developing a meta-language processor at Lockheed Missiles & Space Co., Palo Alto, Calif., Mr. Halpern is also acting chairman of an embryonic Special Interest Group on Programming Languages of the SF Bay Area ACM chapter. He is writing a book, "The Craft of Programming," is a member of the ASA X3.4.2 language standards subcommittee, and holds degrees from CCNY and Columbia Univ.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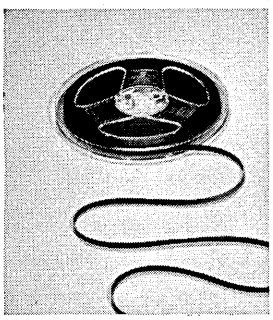

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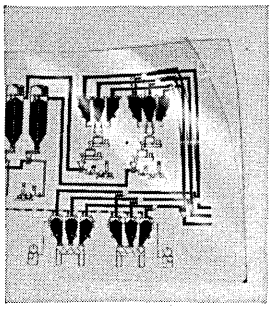
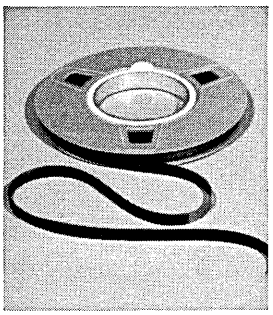
Case in point: The purer the polyester film, the better it processes. To make certain new Celanar is the purest you can buy, Celanese produces it in a sealed-off "White Room" clean enough for surgery. It is by far the most modern in the industry.



Another case in point: Many of our customers felt that undetected environmental changes which might occur in shipment of polyester film could adversely affect their processing operation. As a result, we started shipping new Celanar with temperature recording flags. To the best of our knowledge, the other supplier doesn't.

Other unique examples of the meaningful service that makes Celanar your best polyester film buy include the fact that Celanar is *protected against dust contamination* by use of non-fibrous plastic cores. That it is periodically *shipped with Impact Recorders* to protect you against accepting film jolted and damaged in transit. That its splice-free roll lengths are *tailored to its customers' specifications.*



This is the kind of meaningful service you would expect from Celanese Plastics—whose operating philosophy is that the customer, not the supplier, is always right. Celanese Plastics Company, 744 Broad Street, Newark 2, N. J.

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Celanar® Polyester Film

To ensure maximum purity, new Celanar is produced in a unique, hospital-clean, sealed-off "White Room"—the most modern in the industry. And that's just one of six meaningful service advantages you get when you switch to new Celanar polyester film.

Celanese

CIRCLE 20 ON READER CARD

logical sum of two boolean variables, A and B in location C.*

```
      $LOGSUM MACRO A, B, C
$           CAL     A
$           ORA     B
$           SLW  .  C
$           END
```

Having been defined, this macro may at once be called upon in XPOP's standard form, which requires that the macro's name be immediately followed by the required parameters with commas separating these elements and the first blank terminating the statement. A standard-form call on LOGSUM would have this appearance and effect:

```
$           LOGSUM, ALPHA, BETA, GAMMA
            CAL     ALPHA
            ORA     BETA
            SLW     GAMMA
```

Suppose we find standard-form notation unsatisfactory and want to call upon the function LOGSUM in the following form:

STORE INTO CELL 'C' THE LOGICAL SUM FORMED BY 'OR'ING THE BOOLEAN VARIABLES 'A' AND 'B'

There are, from the XPOP programmer's viewpoint, four differences between the standard and the desired form:

(1) The name of the function is no longer LOGSUM, but STORE.
(2) The order in which parameters are expected by STORE differs from that of LOGSUM
(3) The punctuation recognized by the two forms differs; in standard form, the comma is the sole separator, blank the sole terminator. In the desired form, three kinds of separators are used:
    (a) The one-character string 'blank'
    (b) The two-character string 'blank-apostrophe'
    (c) The two-character string 'apostrophe-blank'
    And one terminator:
    (a) The two-character string 'apostrophe-period'
(4) The desired form contains several "noise words"—that is, character strings present for human convenience but which XPOP is to ignore.

In the following illustration, we use its pseudo-ops to teach XPOP the new statement form, then demonstrate that the lesson has been learned by offering it the new form as input and observing that it produces the correct coding. An explanation of each pseudo-op used follows the illustration.

```
$STORE MACRO   A, B, C
$          LOGSUM B, C, A
$          END
$
$          CHPUNC
$NEW   PARAMETER-STRING   PUNCTUATION
 ADOPTED AT THIS POINT
$
$
$          CHPUNC 3S1 2 '2'     1T2'.
$NEW   PARAMETER-STRING   PUNCTUATION
 ADOPTED AT THIS POINT
$
$          CHPUNC 1S2. .        1T1.
$NEW   PARAMETER-STRING   PUNCTUATION
 ADOPTED AT THIS POINT
$
$          NOISE    4INTO 4CELL 3THE 6LOGI-
                    CA 6FORMED 2BY 6OR'ING
                    6BOOLEA
$          NOISE    6VARIAB 3AND 3SUM
$          STORE INTO CELL 'GAMMA' THE
           LOGICAL SUM FORMED BY 'OR'ING
           THE . . .
$          BOOLEAN VARIABLES 'ALPHA' AND
           'BETA'.
           CAL      ALPHA
           ORA      BETA
           SLW      GAMMA
```

The definition of STORE with which the above illustration begins deals with the first two of the four differences noted between the desired and the standard statements. It causes XPOP to recognize STORE as an operator identical in effect to LOGSUM, and specifies that the parameter expected as the third by LOGSUM will be expected as the first by STORE. The pseudo-op CHPUNC (CHange PUNCtuation) deals with the third difference. Its first use, with blank variable field, erases all punctuation conventions from the system; the comma is no longer a separator nor is the blank a terminator. Having thus wiped the slate clean, CHPUNC is used again to specify the required punctuation. The variable field that follows this second CHPUNC may be read: "Three separators—the one-character string *blank,* the two-character string *blank-apostrophe,* and the two-character string *apostrophe-blank;* also one terminator—the two-character string *apostrophe-period.*" (The additional punctuation specified by the third CHPUNC was introduced because the signal to XPOP that a statement is continued on the next card is the occurence, at the end of each card's worth, of a separator immediately followed by a terminator, and the programmer wanted to use the string ' . . .' for this purpose. A separate CHPUNC was necessary simply because the additional punctuation came as an afterthought). The fourth and last difference is dealt with by means of the pseudo-op NOISE, which permits the programmer to specify character strings to be ignored by the processor. Since strings longer than six characters are taken by noise words if their first six characters are identical to any noise word, such strings as VARIABLE, VARIABLES, and VARIABILITY are effectively made noise words by the definition of 6VARIAB as an explicit noise word.

one to a hundred

With these pseudo-ops given, XPOP has been taught the desired statement form, as proof of which it generates correctly parameterized coding when used as input. That statement was created, of course, only for illustrative purposes; few programmers would care to use so many words to generate three lines of machine-language coding. For an application in which documentation was an unusually important requirement, however, so elaborate a statement might serve a useful purpose—and real XPOP macros average closer to 100 instructions than to three.

The most important property of this technique for describing a notation to a processor, though, is the flexibility with which a notation so specified may be used. All that the XPOP programmer has explicitly defined is a number of individual words and punctuation marks, with no constraints on their combination; they may be used to form any statement that makes sense and conveys the necessary information to the processor. The programmer will often have a particular model statement in mind when specifying the vocabularly he wishes to use in calling for some function, but he will find that in implementing the model he has incidentally implemented a great number and variety of alternative forms.[5]

If we add to our list of noise words the two strings OF and AS, we can use any of the following to generate the required coding:

(a) STORE INTO GAMMA THE SUM OF ALPHA

*The coding examples that follow are transcripts of actual XPOP listings. Lines prefixed by a dollar sign are records output by the processor as comments; these originate either as source-program statements printed out as comments for documentary purposes or as processor-generated messages notifying the programmer of errors or other conditions he should be aware of. Lines not so prefixed represent object-program instructions.

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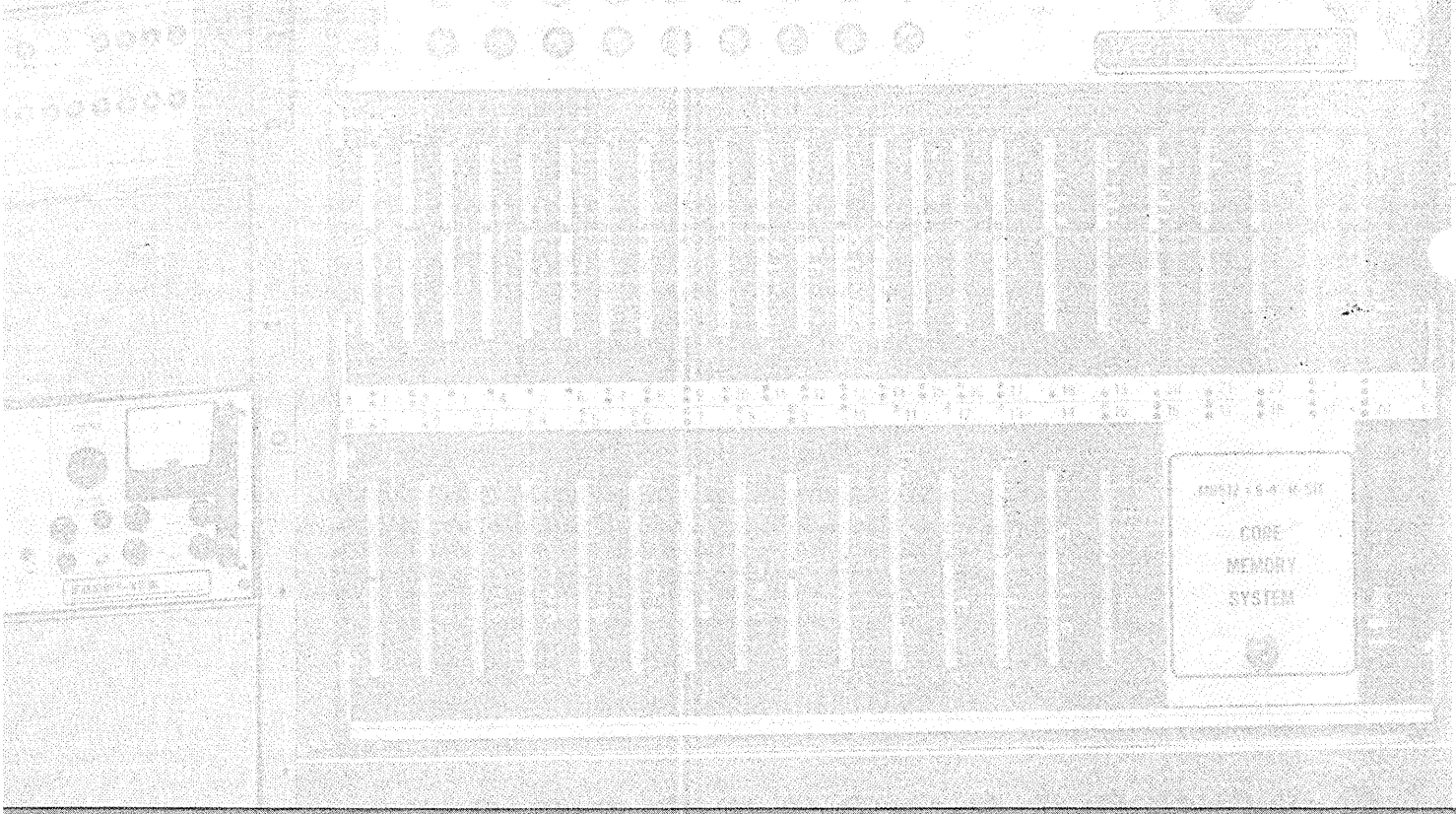
FOR FABRITEK CIRCLE 22 ON READER CARD →



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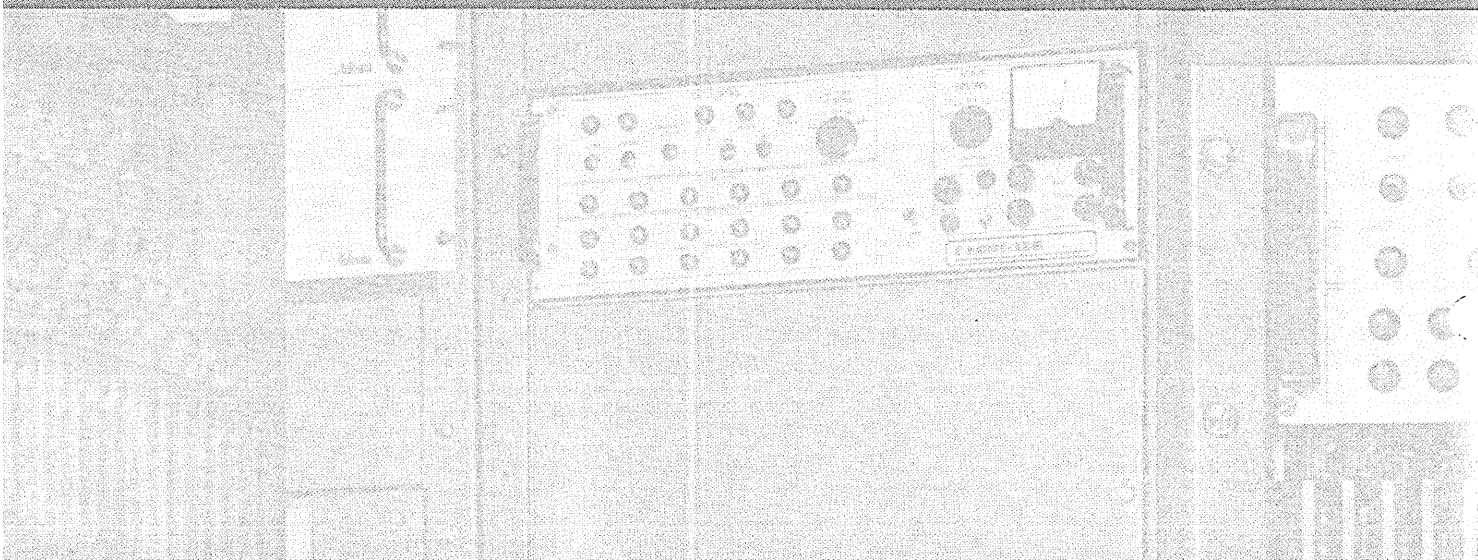

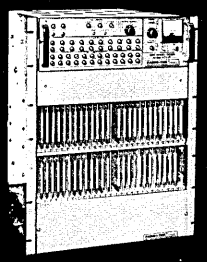

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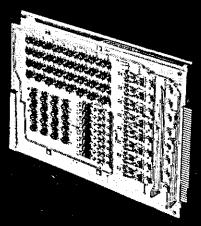

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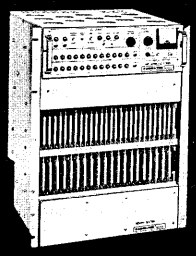

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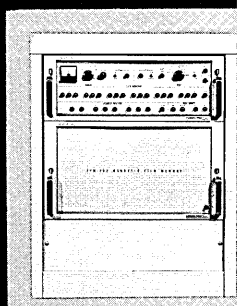

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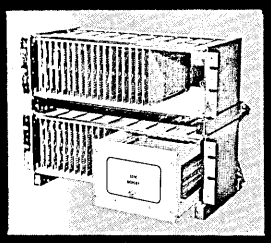

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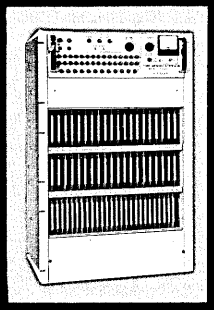

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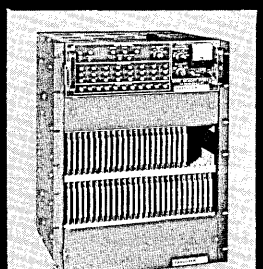

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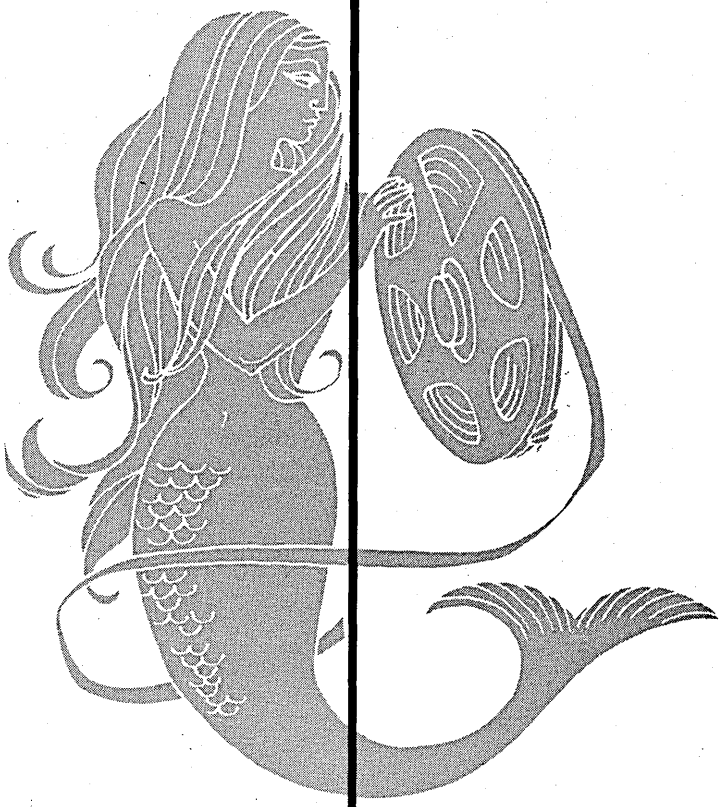

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CIRCLE 19 ON READER CARD

AND BETA.

(b) STORE AS GAMMA THE LOGICAL SUM OF ALPHA AND BETA.

(c) STORE AS LOGICAL GAMMA THE SUM OF THE VARIABLES ALPHA AND BETA.

(d) STORE LOGICALLY INTO GAMMA 'ALPHA' AND 'BETA'.

(e) STORE GAMMA ALPHA BETA.

(f) LOGICALLY STORE INTO 'GAMMA' THE VARIABLES 'ALPHA' AND 'BETA'.

(g) INTO GAMMA STORE THE SUM OF ALPHA AND BETA.

As (f) and (g) indicate, both noise words and operands may precede the operator, provided only that they are not themselves mistakable for operators. If, for example, INTO were an operator as well as a noise word (such multiple roles are possible and sometimes useful), statement (g) would be misunderstood as a call on INTO. Excepting such uncommon cases, the operator and operands in a statement may float freely with respect to noise words, and the operator may float freely with respect to its operands; the sole constraint is that the operands must be given in the order specified when the operator was defined. Even this last constraint will be relaxed when the QWORD feature is fully implemented. A QWORD is a noise word that, like an English preposition, identifies the syntactic role of the word it precedes; its use enables the programmer to offer operands in an order independent of that specified when the operator is defined. Applied to the statement type dealt with so far, the QWORD feature might be used thus:

```
STORE MACRO  $INTO$C,A,B
         CAL     A
         ORA     B
         SLW     C
         END
```

The string $INTO$C informs the system that if the QWORD "INTO" appears in a call on STORE, the first operand following it is to be taken as corresponding to the dummy variable C. The use of the QWORD would override the normal C,A,B order and enable the user of STORE to write, as a further alternative:

(h) LOGICALLY STORE THE SUM OF ALPHA AND BETA INTO GAMMA.

Practically all notation-defining pseudo-ops may be used within macros as well as outside them, and the difference in location determines whether the conventions thereby established are 'local' or 'global.' If such pseudo-ops are given at the beginning of a macro definition that includes some non-pseudo-op lines as well, they are taken as local in effect. They will temporarily augment or supersede any notational conventions already established, and be nullified when the macro within which they were found has been fully expanded. 'Local' notation-defining pseudo-ops will be put into effect in time to govern the scan of the very statement that calls on their containing macro. Such internally defined statements need respect the earlier conventions only to the extent necessary to permit their operators to be isolated. When pseudo-ops constitute the sole contents of a macro, they are taken as applying to the rest of the program in which they appear; the effect of calling on such a macro-ful of pseudo-ops is as if each pseudo-op were given as a separate input statement. Insofar as the notation a programmer requires is regular and self-consistent, then, it may be described in a single macro whose name might well be that of the language itself, and which would be called on at the beginning of any program written in that language. Statement forms that have special notational requirements in conflict with any global conventions would include the necessary local conventions within the bodies of their macro definitions.

As should be evident at this point, it is possible to teach XPOP to recognize an enormous number of logically identical but notationally different statements by means of a few uses of just those pseudo-ops introduced so far. It should be possible, in fact, to define a programming language empirically—that is, to treat a language as a cumulative, open-ended corpus of those statement forms that experience shows to be desirable. The illustrative examples offered here have all been of English statements, since natural language is generally regarded as ideal for use by military personnel in addressing a C&C system, but the statements XPOP can be taught are by no means limited to the verbal type; it can also, for example, be taught FORTRAN's statements.[6]

extended flexibility

The XPOP feature that extends this notational flexibility to a military commander for use in addressing a C&C system is XECUTE mode—a compile-time assembly-and-execution facility. The XPOP processor may at any point in a source program be switched into XECUTE mode, in which succeeding source-language statements are not only compiled but assembled and executed. The programmer switches into this mode by using the pseudo-op XECUTE, and reverts to normal processing by using the pseudo-op COMPYL; the coding between each such pair is assembled as a batch, then executed. XECUTE mode may be used with great freedom. The programmer may enter and depart it within a macro; while in the mode he may use macros (with full notational flexibility), algebraic expressions, and everything else that XPOP normally processes except certain pseudo-ops that would be meaningless at compile time. XECUTE mode was originally implemented by those working on the XPOP processor for their own use in maintaining and developing that program, but it has turned out to have a much more important role in enabling any XPOP programmer to order that any statement in his language be compiled and assembled at nominal "compile time," and the resultant coding executed immediately. This, in turn, means that the designer of a C&C system can use XPOP to any desired degree as an interpreter rather than a compiler. The consequence for the user-C&C system communication problem is that XPOP itself, after serving to translate the programming-language statements that generate a C&C system, can then be used as part of that system to process the orders and questions of the system user. The advantages of so using it would be a wide latitude of expression for the user; relaxed demands on the programmer, who would not need to write an independent scanning and translating routine for user-system communication; and the considerable simplification and abbreviation of the whole complex of linked routines that a C&C system comprises.

The programmers using XPOP as a base for a C&C system would provide the system's users a language with which to speak to it in the form of a body of macros so defined as to call for interpretation rather than compilation. These macros would handle data-base updating and interrogation, display generation, communication-channel switching, format conversion, and other functions requiring immediate response. The military user could then avail himself of all of XPOP's notational flexibility—which, as a nonprofessional at the business of communicating with machines, he needs far more than does the trained programmer. Nor would he be limited to the statement forms

provided him by the macro-defining programmers, since XPOP's notation-defining facilities are so simple that users incapable of defining new functions for themselves could nevertheless extend the notation at their disposal without recourse to programmers.

Since XPOP is permanently open-ended in both functions and notation, an XPOP-based language need never, so far as the processor is concerned, be considered complete. But this is not to say that a C&C or other application language will, in practice, grow endlessly. Since XPOP's notation-learning is (if desired) cumulative, and the number of ways of phrasing a finite set of propositions is, in practice, itself finite, it is clear that the rate at which such a language grows would, after an initial period of explosive growth, diminish rather steadily. As the number of variant forms known to the system grows, the language thereby made available to the users should begin to converge toward a hypothetical definitive one.

Experimentation designed to give quantitative expression to this convergence may succeed in lending some objectivity to the measurement of merit in man-machine language.

These experiments would involve the attempt by several successive groups of non-programmers to instruct an XPOP-based system to perform various procedures for which it contained the appropriate macros; the subjects would be told only what these functions were, and not what notation was available. The conductors of the experiments would, after each such group had made its attempts at communication, use XPOP's facilities to teach the system those statement forms used in the previous trial and not already known to it. As later groups approached the system, they would presumably find its "understanding" progressively better. The statistics collected should eventually enable us to express, with stated confidence level, the probability that future users of the system will find themselves immediately understood by it. Such a course of experimentation is being embarked upon in the writer's organization, and will be reported on elsewhere.

NOTES:

1 One exceptional study (Kroger, M. G., et al., *Computers in Command and Control*, TR 61-12, Institute for Defense Analyses, November 1961) takes the pro-standardization position . . . but recommends more research anyway. It would be exhilarating to find somewhere a recommendation *against* further research, on this or any matter.

2 During one RAND-sponsored symposium supposed to give "special consideration" to C&C programming system standardization (Gruenberger, F. J., ed., *The Fifth RAND Computer Symposium*, Memorandum RM-3324-PR, The RAND Corp., November 1962. Reprinted in part in *Datamation*, October, November, 1962) the symposiasts evidently—and understandably—found the question so dull that they hardly mentioned it. One wonders just what use the U.S. Air Force found for 192 pages of free association on COBOL and ALGOL.

3 Halpern, "Evolution of the Programming System," *Datamation*, July 1964.

4 ————, "XPOP: A Meta-Language without Metaphysics," *Proc. FJCC*, 1964. Thanks are due to the American Federation of Information Processing Societies for permission to reprint part of that paper in the present article.

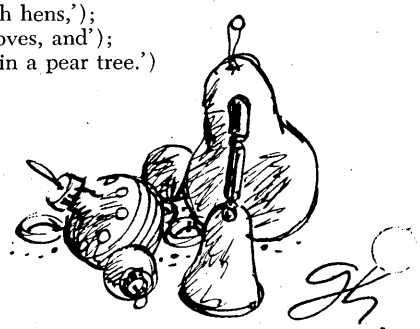
5 This approach to language-description is just the opposite of that taken by the "syntax-driven" processors; not only does the XPOP user not define his entire language as a unified regular structure, he does not even define individual statements as wholes. Peter Ingerman nicely calls the XPOP approach "systematic *ad hocery*."

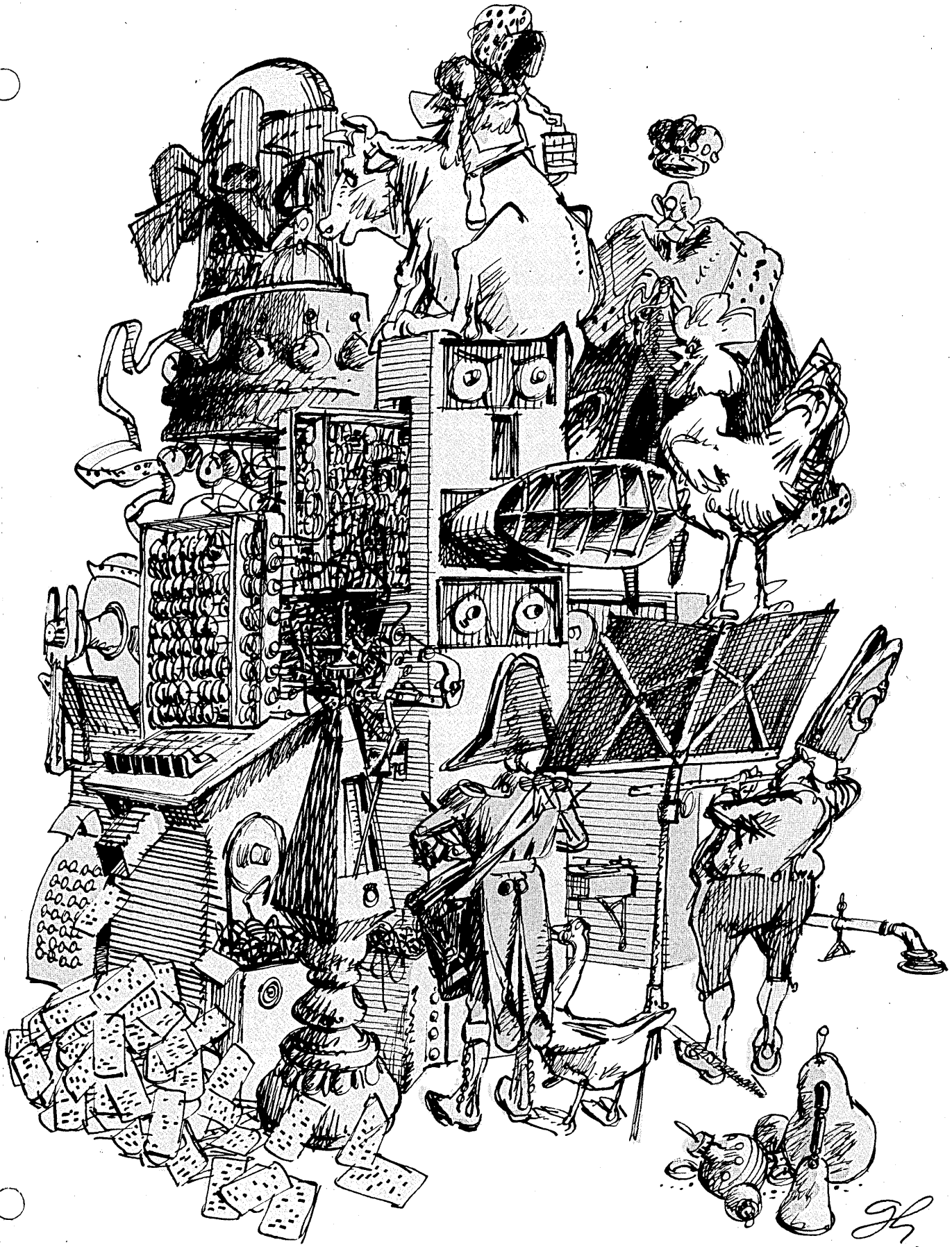
6 On the desire for English in the C&C world, see remarks of Dr. Sproull, ARPA director, before the Congressional Committee holding hearings on the FY65 budget; these include the statement "Our goal . . . is to reach eventually a point that will permit the computer to accept the English language as we speak it." For evidence that XPOP can handle such statements as FORTRAN's see the FJCC paper cited above in note 4.

that old favorite, Apiapt a Christmastime algorithm

by CHRISTOPHER J. SHAW
with illustrations
by GENE HOLTAN

```
procedure Apiapt;
comment This procedure, written in ALGOL 60 Revised and
  slightly extended to allow symbolic, preset arrays, sings that
  old Christmas favorite, A Partridge in a Pear Tree (Apiapt).
  Apiapt employs a machine language procedure, Sing, to pro-
  vide output via a digital-to-analog converter. The resulting
  analog tape can be played on home recording equipment. Sing
  simulates an acappella choir and is an extraordinary procedure
  in that, not only can it sing the words given the text, it usu-
  ally knows the right tune, and when it doesn't, it "fakes" it.
  Altogether, a triumph of heuristic programming;
begin integer i; symbolic array which [1:12] := ('first', 'sec-
  ond', 'third', 'fourth', 'fifth', 'sixth', 'seventh', 'eighth', 'ninth',
  'tenth', 'eleventh', 'twelfth'); switch line := line1, line2,
  line3, line4, line5, line6, line7, line8, line9, line10, line11,
  line12;
    for i := 1 step 1 until 12 do
    begin Sing ('On the' which [i] 'day of Christmas,');
      Sing ('My true love sent to me,');
      go to line [i];
line12:  Sing ('Twelve lords a-leaping,');
line11:  Sing ('Eleven ladies dancing,');
line10:  Sing ('Ten pipers piping,');
line9:   Sing ('Nine drummers drumming,');
line8:   Sing ('Eight maids a-milking,');
line7:   Sing ('Seven swans a-swimming,');
line6:   Sing ('Six geese a-laying,');
line5:   Sing ('Five gold rings,');
line4:   Sing ('Four colly birds,');
line3:   Sing ('Three French hens,');
line2:   Sing ('Two turtledoves, and');
line1:   Sing ('A partridge in a pear tree.')
    end i
end Apiapt
```





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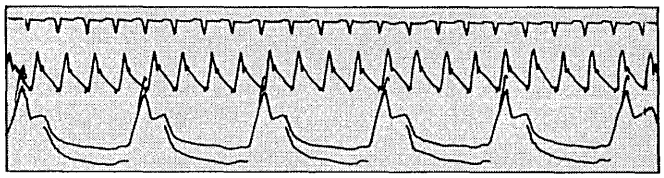

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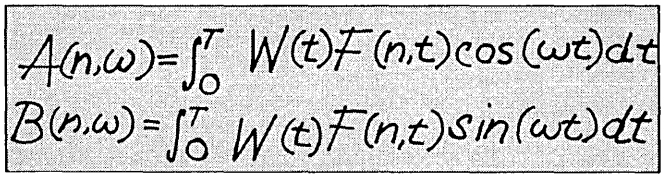
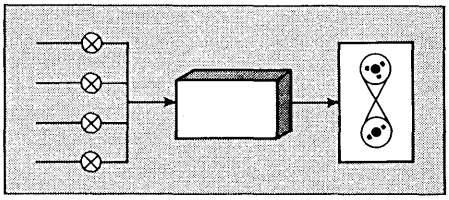


Spectrum Analysis

Parallel hybrid multiplication and summing, 2 microsecond 30-bit digital storage, and a flexible instruction format providing efficient list processing combine to make the AMBILOG 200 powerful in statistical signal analysis techniques such as Fourier transformation, auto and cross correlation, power spectrum density analysis, and generation of histograms of amplitude spectra.



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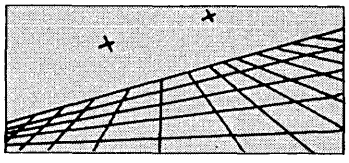
Multiple inputs, from up to several hundred sources, are routed through a multiplexer switch array under stored program control. At no penalty in sampling rates over conventional systems, the AMBILOG 200 converts incoming data to engineering units for recording or monitoring. An analog-to-digital converter performs a complete 15-bit conversion in four microseconds for digital storage, recording or outputing.



Display Generation

Multiple analog outputs facilitate close man-machine relationships in systems involving visual displays. Points of an image stored in memory are rotated through three space angles and projected on a CRT at a 50 Kc rate. Co-ordinate transformation is accomplished simultaneously with digital-to-analog conversion.

For technical reports describing in detail these and similar AMBILOG 200 applications, write I. R. Schwartz, Vice President.

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CIRCLE 24 ON READER CARD

THE SDC TIME-SHARING SYSTEM

part two: service routines & applications

by JULES I. SCHWARTZ

With the commands and functions discussed so far, a user can load, run, and debug programs, as well as have other miscellaneous services performed. It is, of course, necessary that numerous other services also be provided. The functions described so far were performed entirely by the executive system. The object programs were considered to be just code running in response to basic commands. However, the techniques for providing additional services are actually accomplished through the use of object programs. Object programs can be written to provide other necessary services; such programs are called service routines. Since service routines are object programs—and there is no limit to the number or kind of object programs that can be used—there is in effect no limit to the number of services that can be provided.

Service Routines for Producing Object Programs. In some respects, the most common technique for producing object programs is similar to that used in standard computing installations. The program is written in a symbolic language, stored on a magnetic tape (or disc), and then compiled. The output of the compilation is a binary program—in this case compatible with the executive LOAD command—and a listing. When the symbolic programs require modification, the necessary changes, deletions, and insertions are made by using the tape (or disc file) that contains the program, and a new tape (or disc file) is prepared.

File Maintenance

The preparation and maintenance of symbolic tapes and disc files is done with the service routine called FILE. The functions of the routine FILE are:

- *Generate Symbolic Files.* Symbolic files may be stored on tape or disc from teletype inputs or through the card-reader.
- *Update Symbolic Tape Files.* Symbolic files may be updated on-line without destroying the original file. Using the update feature, lines may be inserted, deleted, or replaced via the teletype.
- Merge Symbolic Tape Files. An additional feature of the tape update portion of FILE allows files from a second tape to be merged with files of a first, base tape. The file to be merged may be inserted at any point within a file on the first tape.
- *Print Symbolic Tape Files.* Symbolic files or parts thereof may be listed either on the user's teletype or on an output tape for later printing off-line. This feature may also be used to make extracts or duplicates of symbolic tapes.
- *Survey Symbolic Tapes.* To review the contents of a symbolic tape that contains a number of files, the user may wish to survey the tape. A request for this operation will cause FILE to search the tape and to print the first "*n*" lines of each file on the user's teletype.

Compilers

There are several compilers available in this system. The JTS compiler was designed to provide JOVIAL and SCAMP (machine language) compilations under the time-sharing system. JTS accommodates a subset of the JOVIAL J-2 and J-3 languages as well as a subset of SCAMP. The compiling function of JTS can be performed on-line, in a sense, if the user wishes to wait at his teletype and review any coding errors that JTS outputs on the teletype. In addition, the user can operate his object program immediately after successful compilation. The binary object program produced by JTS is on a tape that conforms to the format requirements for system loading. The user can specify the type of program listing to be output on his listing tape.

A second compiler available to users is called SCMP. It has the same operating characteristics as JTS; however, the language it compiles is the complete SCAMP.

Other compilers, including SLIP and LISP, are either available or are being implemented.

IPL-TS

A somewhat different scheme is provided by the service routine IPL-TS. In this case, the object program (coded in IPL-V), prepared through use of FILE, is assembled by this service routine. The assembled program is then made part of the IPL-TS system, which can be saved (on option) and later reloaded with the LOAD command. When it has been loaded, the program may be executed interpretively by the IPL-TS service routine. This routine also provides a great number of on-line checkout aids to the user during execution of his program.

The service routines and techniques discussed so far permit users to produce and modify both small and large programs in a manner analogous to other kinds of computer systems although they are generally controlled on-line. Techniques more appropriate to time-sharing systems are also available for producing, checking out, and running programs. These techniques provide the capability for coding and executing programs on-line (at the teletype) without going through the various independent steps necessary in the file and compile process. The service routines now available for this purpose are called TINT and LIPL.

With TINT, one may program in the JOVIAL language; LIPL provides the ability to program in the IPL-V language. In both routines, execution is done interpretively, providing many on-line debugging and communication aids that are not available when executing a binary program in the normal fashion. The general description of these programs is as follows:

TINT was developed to provide a vehicle for on-line coding and execution of JOVIAL programs. The applications of the on-line interpreter are:

- Program composition
- Debugging and editing
- Rapid formulation and computation

Functions

- To accept, perform legality (grammar) checks on,

IBM reports to the industry

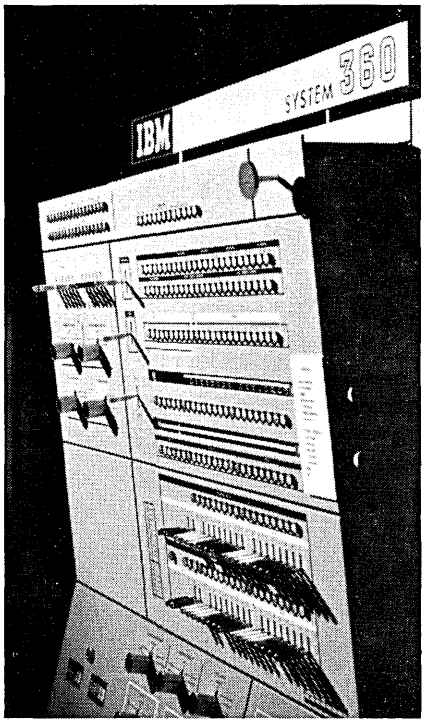
IBM SYSTEM/360 offers modular data communications

IBM's all-purpose SYSTEM/360 offers the widest range of data communication capabilities available.

It can be expanded, in stages, to take input from one to 256 communication lines. You may start with only one line and add as many as you need.

The system allows message data to arrive simultaneously while normal processing operations are underway. Its fast, multiple interrupt plan minimizes the time needed to make a program switch, identify the interrupt, and act on it. Control programs automatically relocate programs when necessary.

Now, data communications with IBM SYSTEM/360 makes advanced management information systems practical for a wide range of businesses. You can tailor your data communications system to fit your problem precisely.



IBM introduces new Graphic Data Processing System

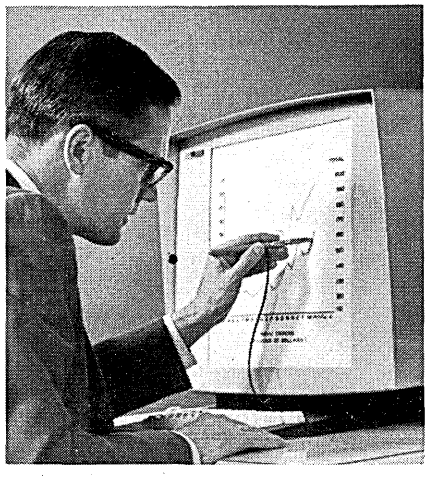
Now you can store maps, charts, graphs, and engineering drawings in your data processing system and reproduce them instantly in their original form.

IBM's new Graphic Data Processing System scans graphic information, converts it into digital form and then stores it. When needed, the data is reconverted to graphic form and displayed on the console screen.

Four units of this new system provide these data communication capabilities. The 2280 Film Recorder takes data from the computer (for example, a digital description of an engineering drawing), and reproduces it in graphic form on 35 mm film. Up to 20,000 lines of alphameric information per minute can be reproduced by the Film Recorder.

The 2281 Film Scanner can scan microfilm images and transmit them, in digital form, to a computer. The 2282 Film Recorder/Scanner combines the functions of recording and scanning in one unit.

The 2250 Visual Display Unit lets you view graphic information on a TV-like screen. With a light pen, available with the unit, you can delete, change or add to the information on the screen. The computer calculated adjustments are displayed while you watch.



New keyboard provides more efficient computer data entry

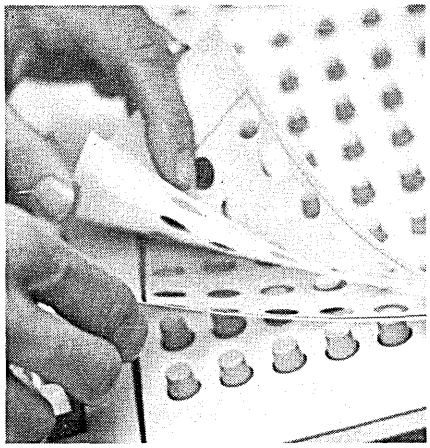
The IBM 1092/1093 Programmed Keyboard comes with unmarked keys—100, 150 or 160 of them, depending on the model.

Over the blank keyboard, you place a keymat. Words printed on the keymat match your business language and your application.

Each key illuminates when you press it...giving you instant visual verification of the data entered.

Attach the 1092 or 1093 to an IBM 1050 Data Communications System and you can transmit data to a remote 1050 or a computer. For operation without a 1050, a 1092 must be connected to a 1093. The 1092 thus connected, or a 1093 used independently, can then be attached to a telephone subset and transmit data to a modified 24/26 Card Punch.

The 1092/1093 is easy to learn and easy to operate. It's especially suitable for these major applications: hospital information systems, bulk station marketing in the petroleum industry, reservation systems, sales order entry, and remote inquiry to processor files.



New unit plots graphs for scientists and engineers

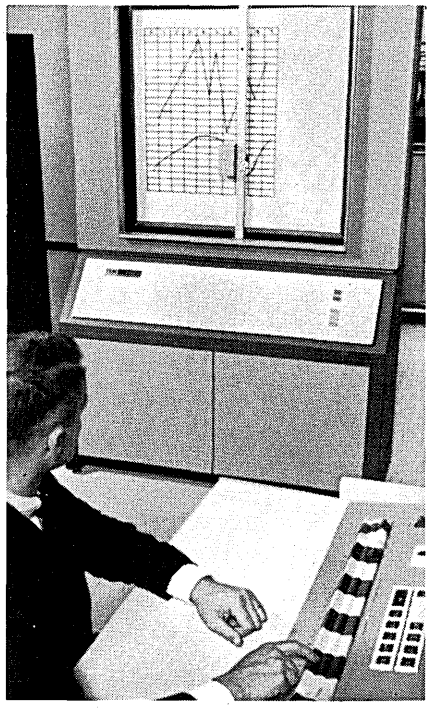
The new IBM 7404 Graphic Output Unit automatically plots graphs, maps or diagrams from computer generated information.

Particularly suited to producing graphic displays of scientific computations and engineering design data, the 7404 may be used in either of two configurations: linked to a computer (the IBM 7040, 7044, 7090, 7094 or 7094 II) or used alone with an IBM 729 or any of the 2400 series magnetic tape units.

It plots points, prints symbols or draws lines (at a rate of up to 280 inches per minute) on a 29" square surface.

In science and engineering, it can be used to evaluate results of wind-tunnel tests, prepare census and weather maps, draw portraits of underground petroleum fields, simulate and test piping networks—and many more.

It can also be used for visual presentation of management data.



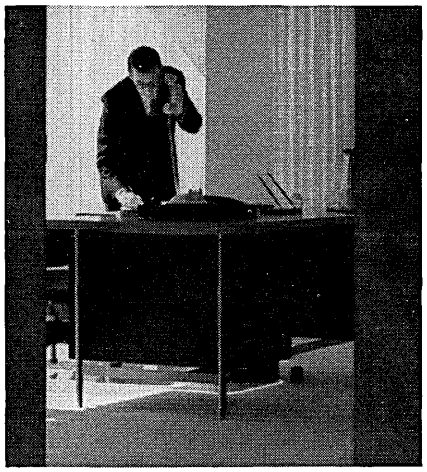
Audio Response Units give spoken replies to inquiries

Pick up a telephone. Dial an inquiry. In seconds, you receive a spoken reply from your computer—via an IBM 7770 or 7772 Audio Response Unit.

With an Audio Response Unit, you determine what it can say by choosing from a wide selection of vocabularies designed to meet your business needs. And you can choose any number of communication lines to fit your exact needs.

These new devices eliminate manual record searching, provides a direct link to vital stored information and greatly reduce the time required to handle business transactions.

These units can be attached to the IBM SYSTEM/360, as well as to any of IBM's 1400 series of computers.



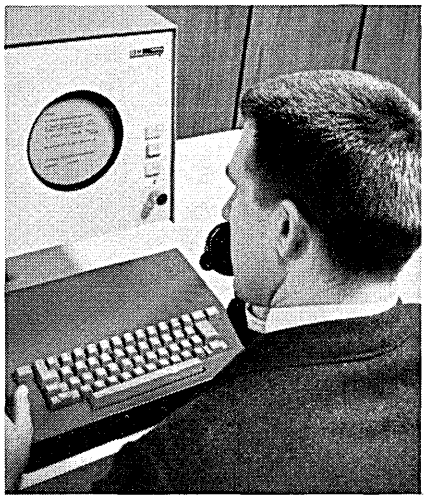
IBM 1015 Terminal to be available to 1410 or 7010 users

It's the IBM 1015 Inquiry Display Terminal that was announced last April as part of the all-purpose SYSTEM/360.

In mid 1965, this same visual communications terminal will be available to users of 1410 or 7010 systems. A new adapter feature for the 1414 I/O synchronizer (model 4 or 5) makes this connection possible. Up to 60 display terminals can be connected to either system.

The 1015 rapidly displays keyboard inquiries and computes replies on a circular viewing screen. By pressing a button, the operator may clear the screen.

The IBM 1015 Terminal is ideal for such uses as information retrieval, inventory and production control, credit checking and customer record status reporting—wherever quick response and much data is needed to answer inquiries.



IBM
DATA PROCESSING

CIRCLE 25 ON READER CARD

and interpret statements to a given subset of the JOVIAL language.
- To permit execution of all or part of small JOVIAL programs.
- To permit dynamic input of variables to a JOVIAL program that is to be executed.
- To permit dynamic output of results obtained through execution of a program.
- To permit on-line symbolic corrections to be made to existing code.
- To permit storage of symbolic code composed with TINT and then transferred to tape so that it may later be compiled or re-executed interpretively.

Fig. 10 shows an example of a small TINT program as coded and executed on-line.

The IPL-TS interpreter described earlier also permits the programming and execution of on-line coded programs. In this case, the technique is analogous to that used in programming off-line (using tape input) except that the code is assembled from teletype input. Also, with this routine, programs prepared with the FILE program and assembled from tape can be modified by program input on a teletype. A brief example of a LIPL program is given in Fig. 11.

Fig. 10. Example of a TINT Program

```
$  1 "THE EUCLIDEAN ALGORITHM"
$  2 "GIVEN TWO POSITIVE INTEGERS A AND B"
$  3 "FIND THE GREATEST COMMON DIVISOR"
$  4 S1. READ A,B;
$  5 X = A; Y =B;
$  6 S2. IF X EQ Y;
$  7 BEGIN PRINT 30H(THE GREATEST COMMON
       DIVISOR OF),
$  8 A,3H(AND),B,2H(IS),X;
$  9 GOTO S1; END
$ 10 IF X LS Y;
$ 11 BEGIN Y = Y-X; GOTO S2; END
$ 12         X = X-Y; GOTO S2;
$PRINT COMPLETE
$ENTER COMMAND
?EX
     A = ? 1024
     B = ? 512
THE GREATEST COMMON DIVISOR OF 1024 AND
  512 IS 512
     A = ? 234
     B = ? 86
THE GREATEST COMMON DIVISOR OF 234 AND
  86 IS 2
     A = ? 234
     B = ? 84
THE GREATEST COMMON DIVISOR OF 234 AND
  84 IS 6
     A = ? 234
     B = ? 82
THE GREATEST COMMON DIVISOR OF 234 AND
  82 IS 2
     A = ? 234
     B = ? 80
THE GREATEST COMMON DIVISOR OF 234 AND
  80 IS 2
     A = ? 234
     B = ? 78
THE GREATEST COMMON DIVISOR OF 234 AND
  78 IS 78
```

A number of other routines exist and are being written for use in the SDC time-sharing system. These include routines whose functions range from information retrieval to tape copying.

applications

Thus far this article has described the characteristics and capabilities of the time-sharing system in use in the Command Research Laboratory. The system has been in operation since June 1963, after an initial development of approximately five months. Currently it is operating eight hours a day and is virtually the only means for using the computer during the day in the Command Research Laboratory.

Fig. 11. Example of a LIPL Program

```
LIPL-READY

RT SO = (AO 10MO 109-3 J100) 9-3 = (40HO J75 J71,J151)
AO = (11MO J50 10MO J68 10PO 709-5,9-1 J60 709-6 12HO 61MO
51MO,9-2 J60 709-3 12HO 52HO 12MO J2 709-2 30HO,9-1)
9-3 = (30HO AO 70 (108.0 21MO,9-13,9-4)
9-4 = (40MO 51WO 20MO,J30) 9-5 = (J4,9-4) 9-6 = (108.0 21MO,9-4)
DT PO = (0 $RED$ $WHITE$ $BLUE$ $GREEN$) MO = (0 C1 C2 C3 C4 C5 C6)
C4 = (0 C1 C3 C5 C6) C5 = (0
C1 C4 C6)
C6 = (0 C1 C2 C3 C4 C5) NL GT SO
```

C1	0232254	21	RED
C2	0236814	21	WHITE
C3	0236869	21	BLUE
C4	0236814	21	WHITE
C5	0236869	21	BLUE
C6	0236848	21	GREEN

An IPL-V "map-coloring" program, written and executed on-line under time-sharing in Linear IPL (LIPL).* This program determines the colors of all countries (symbols C1 to C6) on a map (list MO) such that no adjacent countries are colored alike. The six-country map for this example is configured as follows:

C1 C2 C3 C4 C5 C6

*LIPL was written by Robert Dupchak of the RAND Corporation.

Of some interest are the numerous and diverse applications of the system. These serve to show the possibilities offered by the present and relatively young system as well as to point out the large range of applications and services that a powerful concept such as time-sharing can provide. A list of some of the current applications in the Command Research Laboratory follows:

- Natural Language Processors—used for parsing English sentences, answering questions, and interpreting sentence-structured commands.
- Group Interaction Studies—in which teams of players are matched against each other, and in which the computer is used to measure individual and team performance.
- General Display Programming—in which the programs are used as vehicles for generating and modifying visual displays according to the user's keyboard inputs.
- Simulated Command Post—a realistic simulation of a command post has been produced, and such problems as the display requirements for this organization are studied within this framework.
- Hospital Control—the data for a ward of hospital patients is maintained and retrieved through the system, with access from stations in the hospital.
- Text-Manipulation—a sophisticated text-manipulation program has been developed.
- Police Department Crime Analysis—using some of the techniques found in the studies of natural-language

comprehension, reports of crimes are compared with a complete history of criminal reports to establish patterns and isolate suspects.

- Personnel File Maintenance—personnel records of SDC are maintained and accessed during the time-sharing period.

comments and prospects

The results of the first year's use of the SDC time-sharing system have been encouraging. A considerable amount of work has been accomplished using it, a great deal has been learned about the problems of time-sharing, and a number of applications have had a great deal of exercise which could not have been attempted with more traditional computing center techniques.

The actual development of the system has been in roughly four stages, the first three of which lasted about six months each. These stages are:

- Design and Checkout of the Initial System—During this period the emphasis was on the executive system, with only a slight effort in designing service routines.
- Initial Use of the System—The main concern during this period was making the system "stay alive." (It frequently didn't, causing numerous frustrations and feelings of ill will toward time-sharing). The majority of users during this period were members of the Time-Sharing Project who were writing and checking out service routines. A few of the applications systems were begun during this period. The number of services and conveniences for the user were minimal. The system was in operation between two and four hours a day.
- Full-Scale Use of the System—During this period, the time-sharing period operated eight hours a day. A large number of applications were programmed, checked out, and used. The set of service routines was expanded, and the ones that existed were sharpened considerably. A number of the "little annoyances" of the system were eliminated, and in general the system was made much more reliable and easier to use. During these three periods, a large number of changes to the equipment was made. Probably a significant change was made on the average of once every six weeks. This, of course, did not aid the reliability of software or hardware.
- The Future—We are currently in the fourth phase of this system. Changes to hardware should be relatively few now, so that the software emphasis can be on improvements; there are seemingly an infinite number of improvements possible. They range from such ideas as telling the user his program's status and the time of day when he asks for them to improved executive input-output buffering schemes and techniques which permit a user instantaneous access to a network of programs on other computers as well as the Q-32. (There is currently a list of over 50 such items waiting for implementation).

The fact tnat so much remains to be done might lead one to the conclusion that the concept has not been very satisfactory. On the contrary, we can probably say that our experience so far with time-sharing has proven quite satisfactory, and the true potentials of such a system are now becoming clear and realizable.

When "discussions" of time-sharing (and on-line computer usage) are conducted there is generally agreement on the use of the concept for a number of applications, but there is considerable debate concerning the "economics" of it—whether more traditional computer systems make more efficient use of the computer. Like many such questions, the answers cannot be found easily. Time-sharing permits many runs on a computer and instantaneous response to all users. It also encourages techniques which are quite valuable but not practical otherwise (e.g., solutions by trial and error, use of displays, on-line debugging, single-shot retrieval of information, etc.). In some respects, it makes excellent use of a computer. For example, since there is almost always "something" going on, time to mount and demount tapes is never wasted time.

On the other hand, it can be pointed out that in the "worst case" of time-sharing today—where big programs must be swapped frequently—the efficiency of time-sharing is low. (This applies primarily to efficiency of throughput, not response time, which is another measure of time-sharing efficiency). For certain kinds of programs—those which require long periods of compute time and where human interaction cannot help the process—time-sharing is of no direct value.* Time-sharing and on-line computer use tends to discourage or make difficult retrieval of large quantities of printed output. Although time-sharing assists man-machine interaction by letting users use the computer on-line, it also frequently requires humans to be present at jobs they would be quite happy to let run without them.

In the system at SDC, certain of these arguments are recognized. However, at the present time, they do not represent serious difficulties. The throughput and response time for the system are quite adequate for a reasonably heavy load. If the capacity of the system were to be increased (primarily by increasing the size of the drums), there seems little question that, without considerable improvements in the system, the economic factors would be more serious. Thus, although we have been able to tolerate a close to "worst case" scheduling mechanism in the early phases, areas of unoverlapped swap and input-output will have to be eliminated with a larger average load. Also, the running of programs in a "background" fashion, so that humans aren't required and long computations don't unnecessarily degrade the system, is an item of high priority in the future.

In conclusion, one can view the present system and the experience so far and have a great feeling of optimism for the future. Emphasis from now on will be in areas that will stress significant improvement in the techniques and tools available to the user. The problems of hardware modification, hardware and software reliability, and others due to lack of experience or haste in production are diminishing. Even with these various areas of growing pains, a surprising amount has been accomplished.

Time-sharing seems to hold a key to much that has been bothering the computer using community. The computer can be brought close to the user. Problems not heretofore solvable can be pursued. The problems of economy in some areas are better now with time-sharing, and in others no impossible problems seem to exist. Large-scale use of computers on-line seems to be with us to stay.

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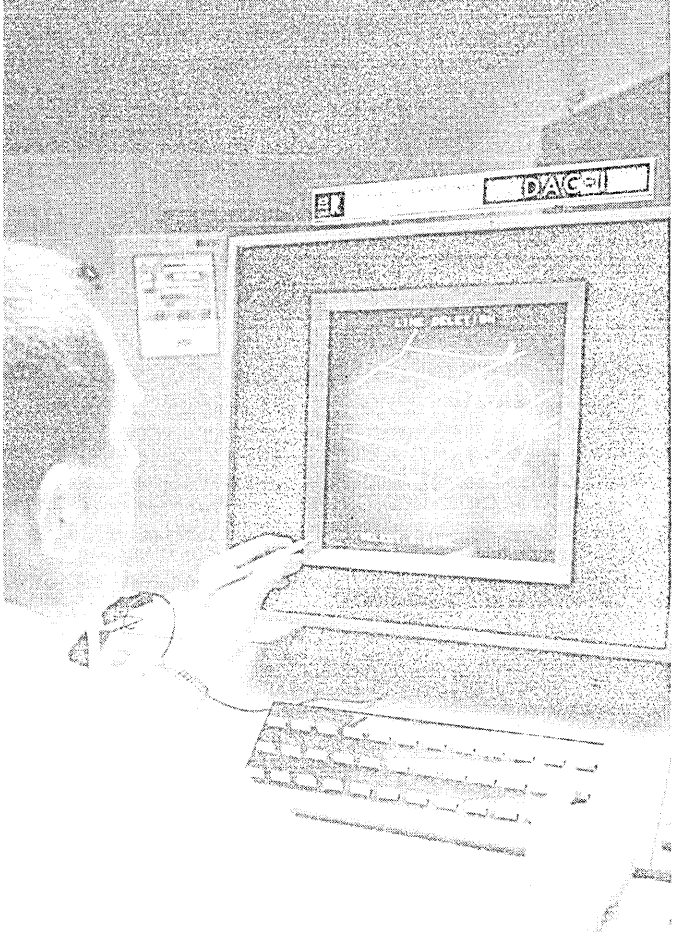
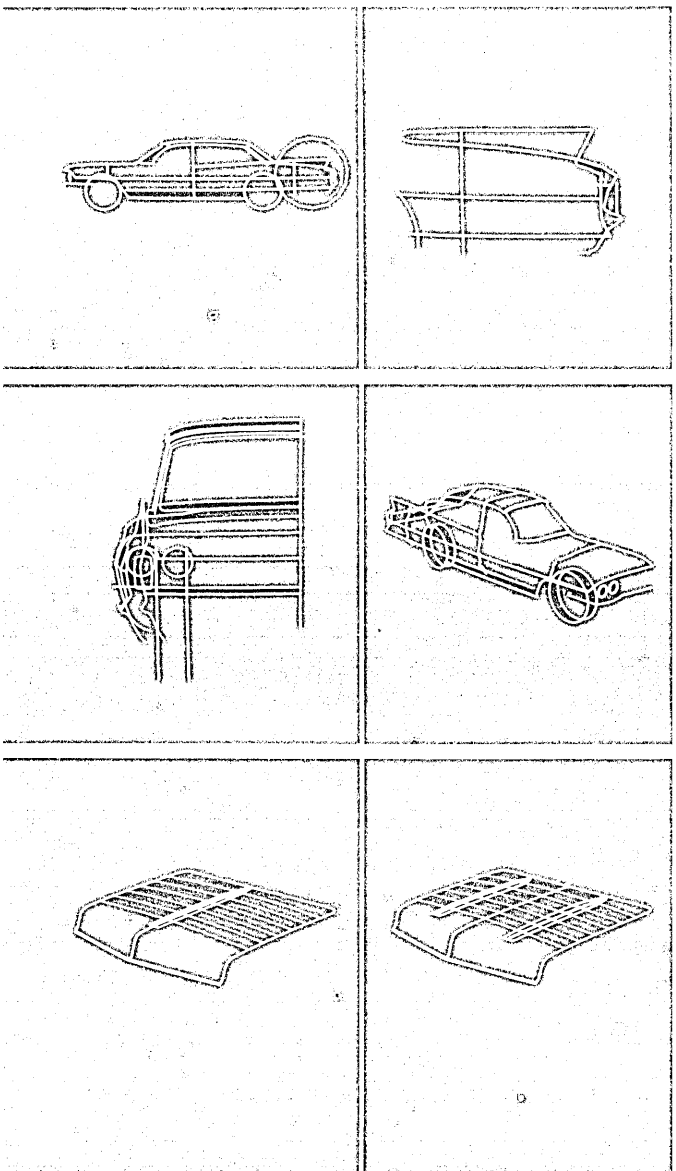
*There is the possibility that the compute time can be cheaper when shared than when alone.

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





Design Augmented by Computers

. . . is a current important focus of research at the General Motors Research Laboratories. Recently, for example, we announced our experimental GM DAC-I system (Design Augmented by Computers), a large computer complex under development since the late 1950's.

Still in the prototype stage, this new design system enables the designer to walk into our man-computer communication laboratory with a drawing . . . work on a design problem using an immense reservoir of programs and data stored in the computer . . . and walk out with one or more new drawings under his arm.

These amazing capabilities have come from a string of noteworthy advances in computer hardware and software tied neatly into an operational on-line system. For example, a program-controlled image processor can read free-form curves from drawings directly into the computer. A graphic console permits dynamic two-way "conversational communication" of graphic information between designer and computer. Intricate programming systems permit efficient time-sharing of the computer's central processing unit and space-sharing of its core memory. Permanent photographic copies of new designs are available within 30 seconds.

The General Motors DAC-I system is currently being studied by GM's Fisher Body and Styling Staff designers to determine the feasibility of utilizing man-computer teams in the design of automobiles. It's another example of how General Motors is opening the door to a more productive, more creative tomorrow.

General Motors Research Laboratories

Warren, Michigan

Top photo shows a designer at the graphic console of the GM DAC-I system. Underneath are computer-produced displays of what he sees when he enlarges, changes views or modifies a design stored in the computer memory.

CIRCLE 26 ON READER CARD

WHY MUST PROGRESS IN COMPUTER USAGE PLUNGE AHEAD AT A SNAIL'S PACE?

Take on-line or real time systems. You'll find the concentration of these systems in defense, space or critical industrial and business applications. In categories less critical than these, more mundane techniques are condoned. And that's too bad. But there's not a lot anyone can do about it in a hurry.

By Dr. Walter F. Bauer

Much has been said about real time computer operation. A great deal of writing has been done about on-line computer systems. Yet, comparatively little has actually been done to integrate the systems into instrumentation and people-loops. This is very curious, since many computers are suitable for such applications, buffering and display equipments exist, and the techniques for implementation are known and understood. The principles are straightforward. The computer is a wonderfully flexible instrument, which can take over much complex system control and even many of the trivial human tasks. Although experience in on-line systems is limited in the industry, the knowledge of software like real time executive control systems is available to those who need it.

WHO'S AT FAULT?

At Informatics Inc., we are particularly well-suited to solve the problems of on-line systems software. We have done a lot of it. In fact, we are the only independent software firm that specializes in solving real time problems and developing on-line computer controlled systems. It follows that if on-line usage has been slow to evolve, we must shoulder a fair share of the blame. We do. And it bothers us, since there is really no logical reason for there being so comparatively few on-line installations. The problem is not that difficult. There are no longer basic impracticalities to the on-line concept. Real time operation is well out of its experimental stages in most areas. Yet much of the progress of data processing is jammed up behind the on-line road block. There are reasons for this. One of these reasons is the need to understand the potential advantages and to plan the system carefully. Another reason lies in our own organization.

WE CAN'T SOLVE OUR OWN PROBLEMS.

Our only reason for existence is to bring efficiency into our customers' operations. That fact necessitates a measure of inefficiency in our own organization. For instance, we have no salesmen. When you talk to a man from Informatics, you talk to someone who has been directly responsible for the management of successful real time software programs. These are very expensive salesmen. But anyone at a lower level of competence would be unable to evaluate problems properly. Nor could he ask the questions that allow proper evaluation. The techniques are too new. The disciplines still too narrow. The acceptance of on-line concepts still too restricted.

TYPICAL ASSIGNMENTS

Listed here are a few examples of the type of real time software work Informatics is involved in:

PACIFIC MISSILE RANGE: Program design for one of the most complex and critical on-line systems yet developed; tracking, radar target acquisition, data recording, and display involving time requirements twice as strict as currently operational similar applications.

NASA HOUSTON: Programming for mission control, launch abort, orbit, rendezvous and re-entry for Apollo and Gemini missions in the Real Time Computer Complex under development by IBM.

NATIONAL MILITARY COMMAND SYSTEM: Programming and analysis in displays and other on-line aspects for the highest level command and control system in the nation.

UNIVAC: Programming for the Univac computers which automate message switching in the GSA communications system.

OFFICE OF NAVAL RESEARCH: Analysis of the country's hardware and software technology and system planning for Naval Tactical Systems of the 1975 era.

THE SOLUTION: MORE QUALIFIED PEOPLE.

There is a considerable shortage of talent in the general field of software. That is bad enough. But when you further qualify this talent to the specific of on-line systems capability, the shortage is acute. If you canvassed the world for men fully qualified to analyze and solve real time software problems, you'd find them extremely few and far between. We know. We canvass constantly, with the zeal of treasure hunters. We have to. The nature of our work demands that each and every Informatics staff member be qualified to take on problems of the most modern type, involving computers controlling displays, communication devices, and analog instrumentation. It's not unlike staffing a hospital with nothing but neuro-surgeons. But we can find no alternative. This limits our own growth. It limits the number and nature of the assignments we can accept. And it helps to limit the entire progress of on-line systems usage. But we are making progress. Today we're at work on eight large scale on-line systems!

WHY DID WE PRINT THIS MESSAGE?

This advertisement is appearing for three reasons. First, of course, we hope it puts us in contact with people who have software problems that require our level of capability. Second, we'd like to talk with talented people who are qualified to join us. Third, we hope to concentrate more attention on the entire field of on-line systems. From our point of view, even though the swing to optimizing computer usage must, by its very nature, be evolutionary, everything that's published to expose the problems involved will serve to speed things up a bit.

If you would like to discuss our approach to partially or fully on-line systems software, the best way to do so is by telephone. Our number is (213) 783-7500. Ask for Walter Bauer or Frank Wagner, or any of our other non-salesmen. We also have literature on our people and capabilities which we will be happy to send you on request. Address Department E, Informatics Inc., 15300 Ventura Boulevard, Sherman Oaks, California.

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THE EAI 8400

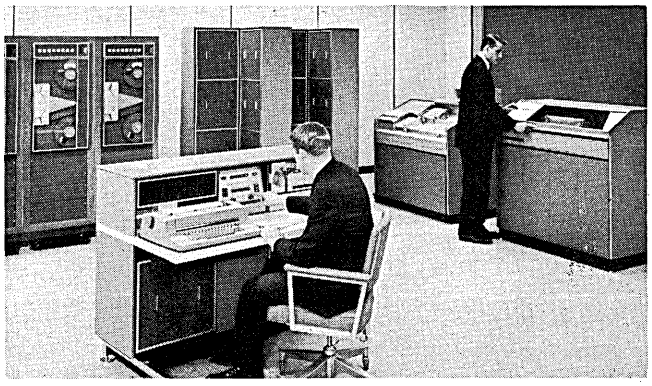
The first digital computer by Electronic Associates Inc., Long Branch, N.J., was announced and demonstrated at the Fall Joint Computer Conference. The erstwhile analog/hybrid firm has fattened its product line with a medium-scale, gp, 32-bit digital machine which it calls the 8400. Its normal operating mode is floating point, and it has a fairly high speed. Floating add time is 2.75 usec, and floating multiply: 5.5 usec.

Core memory is expandable from 4-64K words. A 32-bit floating-point word can be accessed in a single cycle (two usec), but the processor can also handle 16- and eight-bit bytes. Other features: eight I/O channels with up to 15 devices on each, a masked priority interrupt system providing 16 internal and 16 external levels of program, assignable interrupt control, and seven index registers (the accumulator plus six in core).

More than 750 instructions are said to be in the repertoire, including six classes of arithmetic with 10 operations for each, and all 16 logical connectives for handling 16, 8, 4, 2, and one-bit bytes. Software includes FORTRAN IV, a symbolic assembler, a simulation monitor, and an extension of the HYTRAN package developed for the firm's HYDAC 2400 hybrid system. There are also facilities for the dynamic relocation of programs.

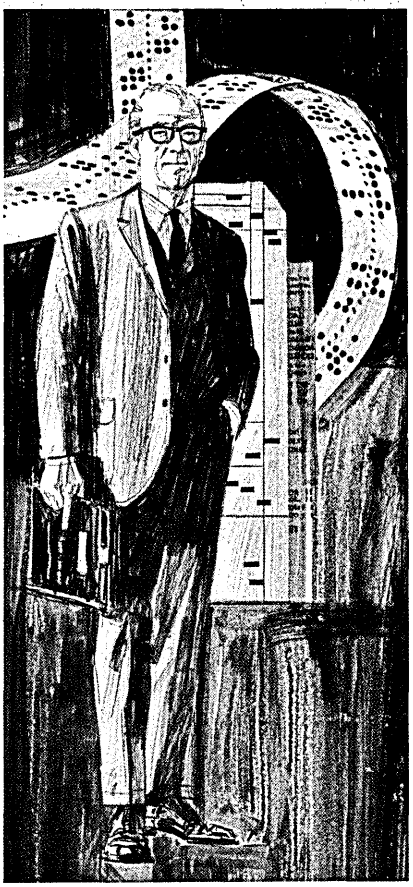
Peripheral equipment includes a CRT display monitor with lightpen, plotters, card and paper tape units, and tape drives with 30, 45, and 75 ips speeds and 200, 556, and 800 bpi densities.

System prices range from $200-300K. ■



MESA MEN NOW COME IN TWO CONVENIENT TYPES:

Software...



and Hardware!

Software Mesa Men and hardware Mesa Men. Long on experience. Senior in technical competence. Integrated into a software / hardware team to do more for you. To reduce software / hardware interface problems to a minimum. To optimize software / hardware trade-offs. This total system competence assures you of more efficient software, and provides reliability and integrity in contract performance in all phases of computer technology.

Total system competence in action: For the Skybolt missile prelaunch computer and astroinertial system, Mesa Men performed mathematical analysis, systems engineering, logic design, circuit design, reliability analysis and system integration. Mesa Men developed test methods for factory checkout, preflight and inflight test; designed the checkout equipment and a missile simulator, developed an automatic checkout language and compiler.

Over 25 projects currently in house include a study of Saturn ground computer programming, a study for an advanced satellite-borne computer, and an ASW study. An Air Force contract for design and operation of a major data processing center. Programs for communications systems, process control, insurance accounting, and automatic typesetting. Development of an automatic checkout compiler, three FORTRAN compilers, and a mathematical model for circuit analysis.

Find out how Mesa's total software/hardware competence can do more for you. Write for your MDMFY (Mesa Does More For You) report. Or call Mesa in Inglewood, Los Angeles, Santa Ana, Washington, D.C. or Huntsville.

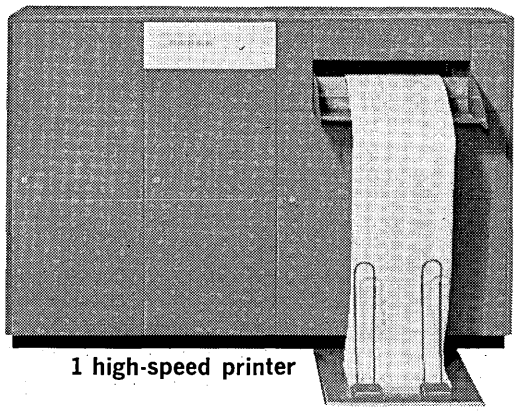
If your level of experience and ability to produce qualify you for service with a senior software firm, write to Mr. Robert Hauk, Client Service Headquarters, 1833 E. 17th Street, Santa Ana, California 92701. An equal opportunity employer.

MESA SCIENTIFIC CORPORATION

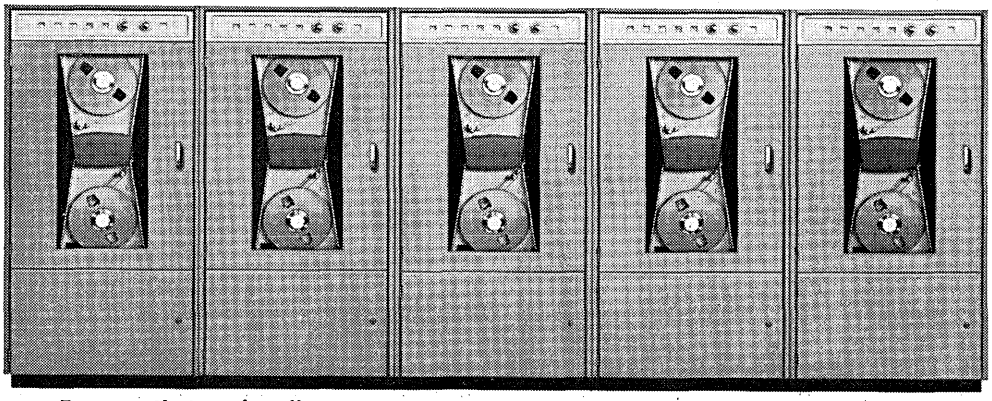
CIRCLE 28 ON READER CARD

Here's a complete EDP System. It's only $3800 a month.

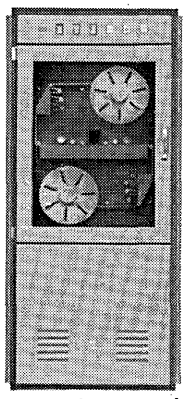
Now, any size business can afford electronic data processing. With the NCR 315 computer system it's only $3800 a month. But the 315 isn't a stripped-down system. It's a complete data processing system that can grow as your needs grow. You can add up to 16 CRAM (Card Random Access Memory) files, up to two magnetic character sorters, up to three more magnetic tape files, and a punched card input-output unit. For full details, call your local NCR representative. Or write NCR, Dayton, Ohio 45409.



1 high-speed printer

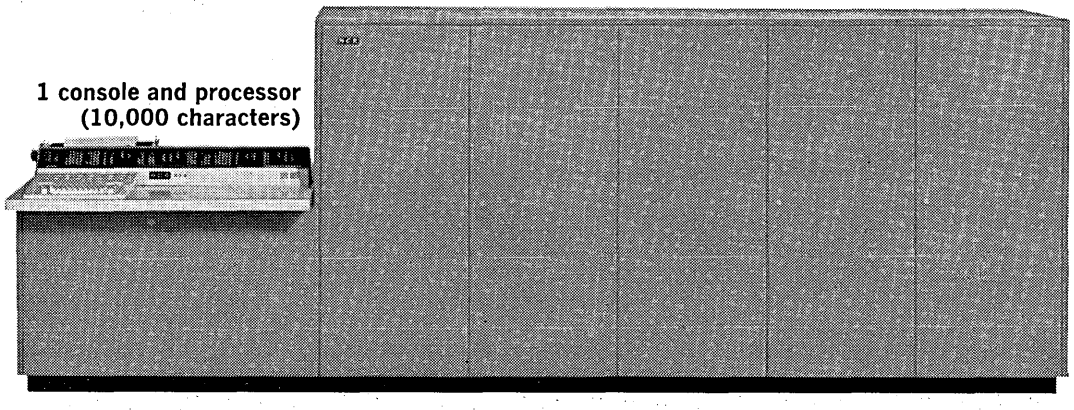


5 magnetic tape handlers



1 paper tape reader

1 console and processor (10,000 characters)

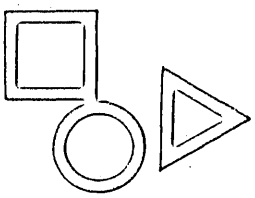


NCR

BE SURE TO VISIT THE NCR PAVILION AT THE NEW YORK WORLD'S FAIR.

THE NATIONAL CASH REGISTER COMPANY ®

CIRCLE 29 ON READER CARD



WORLD REPORT

ENGLISH FIRM PIERCES THE CURTAIN

Elliott-Automation has held a private computer showing in Moscow's Sokilniki Park to demonstrate an Elliott 503, an 803, and an ARCH 1000 control computer. Orders were taken and the hardware delivered on the spot. An order was also received for an ARCH 8000 to be used for on-line control of an ammonia plant. Russian interest in future systems from the firm included requests for quotations.

ITT'S U.K. SUBSIDIARY FORMS NEW DIVISION

Standard Telegraph and Cables Ltd. has set up a Data Systems Division for on-line, real-time record communications and other computer-based systems. They will market the British-produced stored-program 8300 ADX, English version of ITT's 7300 ADX. It now uses Ampex cores and tape, Sperry (U.K.) drum storage. The 8300 has greater capacity and a more versatile command structure than its U.S. counterpart.

SAAB MOVES ON EUROPE FRONT

SAAB intends to move ahead with European marketing plans, both for its present D21 and the new D41, not yet in production. The first D21 was installed in 1962. Seven more have been installed since then and 11 are on order. The D41 has a basic core memory of 8,000 24-bit words which can be expanded. Add time is 10 usec.

CONTROL DATA SCORES WITH U.K. C-E-I-R

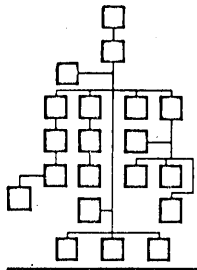
First order for newly established Control Data Ltd. of England is a 3200 from C-E-I-R (U.K.) Ltd., now 60% owned by British Petroleum. The company now has an IBM 7094 and a 1401. The 3200 is on lease -- for about 7,000 Pounds per month.

WRITE AND SEE ROME

There will be an International Symposium on Economics of Automatic Data Processing in Rome during October, 1965, sponsored by the International Computation Centre. Broad subjects will be measurement of profitability; investment analysis; system structure and performance from the economic point of view. Discussions may be general, such as analysis of on-line systems, or specific as with analysis of case studies. They should be written in French or English and not exceed 15 pages, exclusive of charts and tables. A short abstract is requested. Address: Symposium on Economics of ADP, International Computation Centre, Casella Postale No. 10053, EUR-ROME, Italy.

& ODD BITS

Data processing equipment transactions in the U.K. for the first nine months of this year show imports up from last year's $22 million for the period to $33 million. Exports are down from $29 million to $27 million . . . Manufacturers, such as Honeywell, who have set up production facilities for their smaller machines in the U.K. should escape the new 15% tariff increase . . . Scientific Furnishings Ltd. in England has signed with Control Data to market the full line of CDC peripheral equipment there.



people IN DATAMATION

■ Dr. Edwin L. Harder has been elected chairman of the Board of governors, and Homer G. Asmus appointed executive director of the American Federation of Information Processing Societies.

■ Richard Palmer has been elected vp of Data and Information Systems Div. of ITT, Paramus, N.J.

■ Meade C. Camp, vp-Marketing of CEIR, Inc., has been named chief executive officer of the company's southwestern region, headquartered in Los Angeles, Calif.

■ Rex A. McWilliams was named president and John J. Sheehan executive vp of National Computer Analysts, Inc., Princeton, N.J. Mr. McWilliams succeeds Sherman Blumenthal who resigned from the firm.

■ Bunker-Ramo has appointed Robert S. Childs, vp-Field Operations, Michael Flaherty vp and director of Manufacturing, and Milton Sanders, general manager for the Stamford operations.

■ Frank Engel Jr., former manager of the Harvard Univ. computing center, has joined Honeywell's dp div. as manager of the newly formed Applied Science Dept.

■ John G. Simmons has joined the scientific staff of Sperry Rand's Research Center where he will be engaged in research in active thin film devices. He was formerly with Burroughs Research Center.

■ George G. Heller has joined IBM's Data Systems Div. in Poughkeepsie, N.Y., as a member of the technical staff of System/360 in the Programming Automation dept.

■ Joseph A. Ricca has been appointed general manager of Raytheon's commercial computer business. During the past three years he has served as director of Aeronutronics Memory System business operations.

NEW PRODUCTS

automated typesetting

Computer Keyboard consists of a special-purpose computer, keyboard, tape punch, and an optional subsystem for editing raw or justified

tapes. It prepares a six-level TTS code tape for hot or cold typesetting processes, but does not hyphenate. DI/AN CONTROLS INC., Boston, Mass. For information:

CIRCLE 200 ON READER CARD

core stack

Aztec 22 uses 22-mil cores to achieve cycle times from 800 nanoseconds to 1.3 usec, and occupies half the space of a 30-mil stack. Capacities are 4-32K words. AMPEX CORP., Redwood City, Calif. For information:

CIRCLE 201 ON READER CARD

wide-temperature stacks

Core systems operate from −40° C to +80°C without temperature controls or current compensation. Cycle time is one usec, and capacity is 32K (up to 72-bit) words. RCA ELECTRONIC COMPONENTS, New York, N.Y. For information:

CIRCLE 202 ON READER CARD

gp computer

Designed for scientific, process control and simulation applications, the GP-4 has a data bank for 4-8K (26-bit) words, and an instruction bank of sequential or thread memory consisting of 12 blocks of 8K words. Cycle time of the latter is 2.03 usec. Software includes a symbolic assembler, and there's also a range of peripherals. GENERAL PRECISION INC., Tarrytown, N.Y. For information:

CIRCLE 203 ON READER CARD

tape drive

The D3030 writes and reads all three density formats at 75 ips, and has push-button selection of 60, 41.7, and 15KC transfer rates. Bi-directional start and stop times are 5 and 1½ msec, respectively. DATAMEC CORP., Mountain View, Calif. For information:

CIRCLE 204 ON READER CARD

financial software

Program for Allocation of Resources of Savings & Loan Assns. is a 1401 or 1440 package for financial policy decisions, selecting from among large number of alternatives. IBM DATA PROCESSING DIV., White Plains, N.Y. For information:

CIRCLE 205 ON READER CARD

date, time printer

The Identichart attaches to line printers, teletypewriters, digital printers, and is activated automatically by contact closure or can be activated manually. ROYSON ENGINEERING CO., Hatboro, Pa. For information:

CIRCLE 206 ON READER CARD

wide-temperature cores

The SEMS-4R operates from −40°C, to +85°C, and is designed for shipboard, ground, mobile and industrial applications. It is rack-mounted. Access time is one usec, cycle time: four usec. Capacity is 8K (40-bit) words. ELECTRONIC MEMORIES INC., Hawthorne, California. For information:

CIRCLE 207 ON READER CARD

tab card desks

Made to hold card trays and available also with a file drawer, these desks have plastic-laminated work tops and an accessory tray. WRIGHT LINE, Worcester, Mass. For information:

CIRCLE 208 ON READER CARD

records-keeping software

Integrated Data Store automatically combines and organizes business records for processing, storage and retrieval. It is said to simplify handling of data in memory and eliminate duplicate records. Written for the 200 series, it is also being adapted for the 400's and 600's. GENERAL ELECTRIC COMPUTER DEPT., Phoenix, Ariz. For information:

CIRCLE 209 ON READER CARD

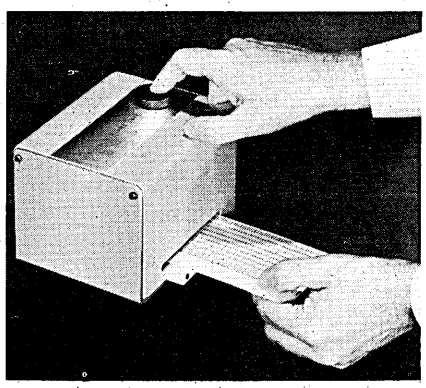
data transmitter

The Mark 10 UA is a data transmitter (via Data-Phone) with unattended answering capabilities. Transmission speed is 600 wpm, using paper tape. TALLY CORP., Seattle, Wash. For information:

CIRCLE 210 ON READER CARD

card reader

The 2900 is a card-at-a-time reader that handles IBM or RemRand cards and has up to 240 inputs (equal to 20 columns of an IBM card). Applications include process control pro-



gramming, remote data entry, material weighing. DREXEL DYNAMICS CORP., Horsham, Pa. For information:

CIRCLE 211 ON READER CARD

card punch

The 415 has a speed of 250 cpm, a 1200-card-capacity input hopper, and a 1500-card-capacity output hopper. The pick, punch, and check-read operations are all performed concurrently within a 240-msec cycle. CONTROL DATA CORP., Minneapolis, Minn. For information:

CIRCLE 212 ON READER CARD

plotter

The 770 mag tape plotting system has 0.005-inch resolution at speeds to 23 ips. Automatic switching from half to whole step reportedly produces smooth-line resolution without

NEW PRODUCTS . . .

sacrificed speed. The system plots up to 15 inches of line per inch of mag tape. CALIFORNIA COMPUTER PRODUCTS, Santa Ana, Calif. For information:

CIRCLE 213 ON READER CARD

tape drive

The 1900 series comes in groups of two, four or six decks and choice of transfer rates from 7,500 to 60,000 cps. Tape and reel are compatible with international standards. INTERNATIONAL COMPUTERS & TABULATORS LTD.. London, England. For information:

CIRCLE 214 ON READER CARD

data transmission

The AE401E transmits alphanumeric data from punched cards over standard, local, long distance, or private telephone by converting data stored on the cards to various audio-frequency codes. At the receiving station, these tones are detected and reconverted into a punch card, identical to the one at the distant transmitting station. This low speed system transmits up to 20 cps. AUTOMATIC ELECTRIC CO., Northlake, Ill. For information:

CIRCLE 215 ON READER CARD

storage cabinet

Cabinet group can be combined in a variety of assemblies to accept many sizes of patch boards and related wiring components. The work top lifts to expose adjustable spaces for storage of wires, jacks, plugs and tools. Doors are equipped with a lock. RECORDS RESERVE CORPORATION, Rochester, N.Y. For information:

CIRCLE 216 ON READER CARD

programmable film reader

PFR-2 system will convert photographic data into digital form and carry out analytical processes on this data. PFR systems consist of a programmable, high precision light source; a basic film reader that contains film holders and optical-electronic systems for processing film reading signals; and a high speed solid state scan control and monitoring unit that controls film reading processing by means of specially-developed film reading programs. PFR is able to resolve more than 268-million data points within the 0.8″ square high precision area. Accuracy assures that no measurements will deviate more than 0.0002-inch, or about 5 microns, over the entire field of view. INFORMATION INTERNATIONAL, INC., Cambridge, Mass. For information:

CIRCLE 217 ON READER CARD

No other tape matches our guarantee. Is there a reason why?

Yes! An exclusive new coating formula makes U. S. Magnetic Tape more durable and wear-resistant than any other computer tape now available.

Its coating surface is smoother—its resistance to scratch greater—and its abrasive quality lower than any other tapes.

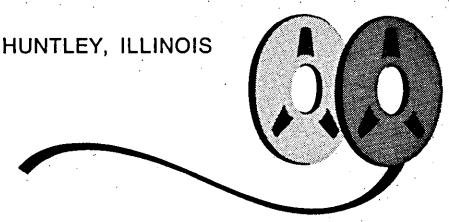
So where other tape makers offer only the customary one "Read-Pass" guarantee, U. S. Magnetic Tape is covered by a special 30-Day additional guarantee—*the longest guarantee in the industry.*

From mixing to coating to slitting to testing, U. S. Magnetic Tape is produced at the MOST MODERN, INTEGRATED TAPE-MAKING FACILITY in the industry. The equipment was designed and built by the leading manufacturer of tape-making equipment in the United States.

Find out more about this revolutionary new tape that lasts longer, reduces costs, and assures you a more dependable and profitable computer operation. Mail the coupon today.

U. S. MAGNETIC TAPE COMPANY

HUNTLEY, ILLINOIS



Mr. A. Gordon Heitman, President
U. S. Magnetic Tape Company
Huntley, Illinois 60142

Yes, I'd like to receive your brochure telling why U. S. Magnetic Tape will reduce my costs, and improve my computer operation.

Name_____ Title_____

Company_____

Address_____

City_____ State_____ Zip_____

CIRCLE 41 ON READER CARD

QUICK REFERENCE GUIDE FOR RCA FERRITE MEMORY CORES

Whatever Your Ferrite Memory Requirements, Select RCA Application-Oriented Cores – Conventional Or Wide-Temperature-Range Types

YOUR SYSTEM CYCLE-TIME	RECOMMENDED RCA CORE TYPE Conventional	RECOMMENDED COINCIDENT CURRENT DRIVE CONDITIONS PULSE CHARACTERISTICS @ 25°C				TYPICAL OUTPUT CHARACTERISTICS @ 25°C				CORE SIZE OD-ID
(Coincident-Current)	Wide-Temp Range	I_m in Ma	I_{pw} in Ma	t_r in μsec	t_d in μsec	uV_1 in mv	dV_z in mv	t_p in μsec	t_s in μsec	(in mils)
1 μsec or less	0178M5	820	410	0.05	0.25	35	4	.10	.18	20/12
	0187M5	820	410	0.05	0.25	35	4	.11	.22	20/12
1 to 1.5 μsec	0175M5	700	350	0.05	0.35	45	4	.13	.25	23/15
1.5 to 3 μsec	0150M5	550	275	0.15	0.4	85	9	.23	.42	30/18
	0146M5	800	400	0.1	0.5	65	8	.22	.43	30/18
	0167M5	625	312	0.1	0.5	52	7	.26	.49	30/18
3 to 4 μsec	0173M5	450	225	0.2	0.8	50	4	.36	.68	30/18
	266M1	650	325	0.3	1.0	60	4	.36	.80	30/18
4 to 5 μsec	237M1	520	260	0.2	1.5	90	9	.40	.80	50/30
	264M1	630	315	0.4	1.5	75	7	.65	1.05	50/30
5 to 6 μsec	232M1	480	240	0.2	1.5	80	10	.45	.95	50/30
	0140M5	480	240	0.4	1.6	60	8	.70	1.35	50/30
6 to 8 μsec	226M1	400	200	0.5	2.0	80	7	.70	1.25	50/30
	0140M5	480	240	0.4	2.0	60	8	.70	1.35	50/30
over 8 μsec	222M2	400	200	0.5	4.0	75	10	1.15	2.30	80/50
	0140M5	480	240	0.4	2.0	60	8	.70	1.35	50/30

RCA WIDE-TEMPERATURE-RANGE CORES

When you specify RCA Wide-Temperature-Range Cores, you can operate your memory system over any 100°C range between the limits of −55°C and +125°C without temperature compensation, air conditioning, or other alternates.

CORES FOR SPECIAL APPLICATIONS

If you need a special core to meet some unusual requirement, RCA can draw on its broad experience and custom-formulate a special core for your application.

FOR MORE INFORMATION

. . . or for additional copies of this Quick Reference Guide, write, wire, or telephone your local RCA office, or RCA Electronic Components and Devices, Memory Products Operation, 64 "A" Street, Needham Heights 94, Mass. Telephone: 444-7200.

CIRCLE 33 ON READER CARD

The Most Trusted Name in Electronics

NEWS BRIEFS

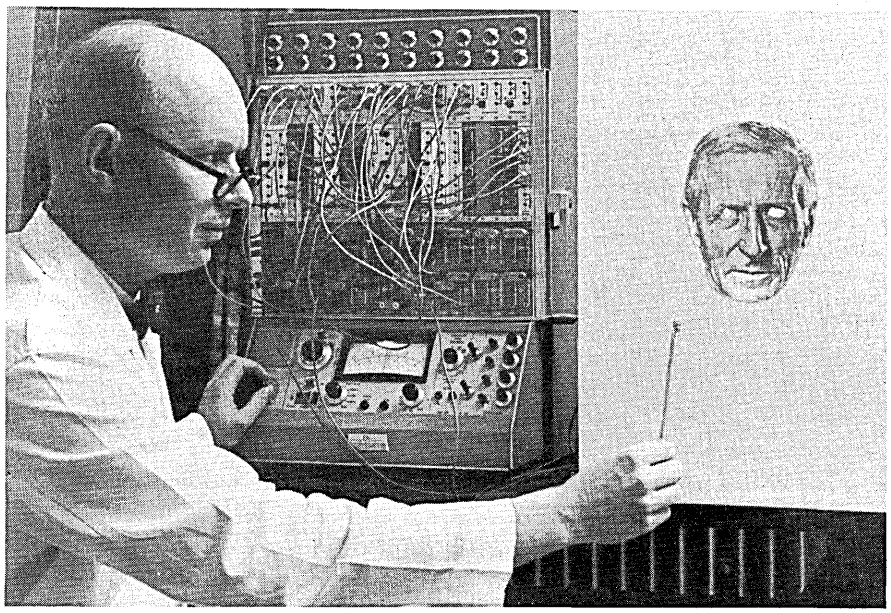
EYE RESEARCH INSTITUTE USES ANALOG SIMULATION

At the Eye Research Institute of the Presbyterian Medical Center in San Francisco, researchers are using an Electronic Associates TR-20 desk-top analog computer to simulate such eye disorders as strabismus, impairment of acuity, and glaucoma.

The scheme is to construct a model that will allow speeding up or slowing down of eye processes so that experimental surgical procedures can be simulated and evaluated before being tried.

Biophysicist Carter Collins is building a working model of the human eye with neurophysiological correlates translated into computer language. He will later add receptors to receive visual stimuli and effectors to duplicate eye movement. A matrix of photo cells or a scanning device will serve as a retina.

At present, the TR-20 is being used for eye muscle studies. For this purpose the computer is connected to a two-channel oscilloscope and an RF generator causes each dot on the display to go in and out of focus as the eye does. The computer can be manually controlled to cause the mechanical eyes to follow a pencil, as shown in the photograph below.



ACM, PIB, AND SID CALLING FOR PAPERS

Speakers are sought for the 20th national conference of the Association for Computing Machinery, to be held at the Sheraton-Cleveland Hotel, Cleveland, Ohio, August 24-26. Complete papers and 100-word abstracts must be in by March 1 to the Technical Program Committee. Maximum length is 7000 words—less if there are illustrations—and submitted in sextuplicate. Address George J. Moshos, Technical Program Chairman ACM 65 Meeting, P.O. Box 4741, Cleveland, Ohio 44126. Topics now being considered range all over the lot, from design through languages to displays.

Polytechnic Institute of Brooklyn's 15th annual international symposium is coming up April 20-22 in New York. Subject is System Theory, meaning mathematical developments and engineering interpretations of mathematical theories which together provide a definition. Sample topics are mathematical representations of systems, dynamic systems, systems with random inputs, and the relation of system theory to science and engineering. Deadline for papers is January 15. Correspondence should be addressed to Symposium Committee, Polytechnic Institute of Brooklyn, 333 Jay Street, Brooklyn, New York 11201.

The Society for Information Display will hold its 5th national symposium in Los Angeles during February. They are soliciting 500-word abstracts in duplicate summarizing papers on the following subjects: displays in space; displays in the post-197-era; displays in simulation; business, industrial, and educational displays. Abstracts go to R. L. Kuehn, Papers Chairman, 1831 Seadrift Drive, Corona del Mar, Calif.

NEW FLYING HEAD SHOWN BY BRYANT

A prototype of an experimental self-actuated read/write head was demonstrated by Bryant at the Fall Joint Computer Conference in San Francisco.

Unusual characteristic is that it automatically provides its own correct loading force to maintain stable flying attitude and small-gap magnetic coupling. It doesn't require a different head pad configuration for varying drum or disc speeds and will cost less to manufacture than existing designs. The head never touches the recording surface, is returned to its starting position when speed of the recording surface is reduced. Bryant believes that it may be suitable for packing densities up to 1500 bits per inch.

CON EDISON TO GET COMPUTER CONTROL SYSTEM

Under a $1.3-million contract from Consolidated Edison, Leeds & Northrup will build a computer-directed control system to dispatch and regulate power from the big utility for nine million customers.

GE will supply the digital computer and L&N the analog control unit. Twelve power stations, covering the five boroughs of New York and Westchester County, will be directed by the system. Besides dispatching power from generating units, the project includes facilities for automatic interchange scheduling between

Con Edison and cooperating utilities, apportions power to key areas during peak load periods, and indicates reserve units to be used in emergencies.

PLANTS IN TWO STATES CENTRALLY CONTROLLED

A computer center in Los Angeles will be used to control production and handle paperwork at two widely separated plants of Baker Oil Tools —one in California and the other in Texas.

Using an RCA 301, the center will be connected to the manufacturing plants by high speed communications lines and handle details down to scheduling work for specific machines. Production operations will be scheduled eight weeks in advance, updated and rescheduled weekly by shift, operation, and machine. The computer will also assign priorities and indicate overtime.

The communications lines will also carry daily exception reports back to the computer center, as well as summarized information for production management. Some 8000 individual work orders are involved, with an average of eight operations per order, for 250 work stations at one plant and 200 at the other.

LIGHT-EMITTING DIODES STUDIED AT AUTONETICS

The possibility of connecting microelectronic circuits by light instead of wires is being considered at North American's Autonetics Division.

Experiments have produced a light emitting diode thought to be three or four times as efficient as previous models. The infrared light is produced by energizing a diode made from a single crystal compound of cadmium and tellurium. They operate at room temperature and produce a wave length of 8000 Angstroms.

NUMERICAL CONTROL MOVES INTO SCHOOLS

First contouring unit to be installed in a public school has been announced by Bunker-Ramo. It's a TRW-3000 coupled to a Gorton three-axis rail-type milling machine and goes to the DeKalb Area Vocational-Technical School in Clarkston, Ga. It will supply experience for students on equipment as advanced as any they will encounter in future jobs.

A 400 character/second tape reader is used, together with data display, manual data input, and sequence number readout. Training on the new equipment will cover programming, operation, and maintenance.

IBM INTRODUCES SMALLEST SYSTEM/360

An addition to the lowest end of the 360's was announced last month. The mod 20 is a card-oriented system with 4-16K characters of core, an access time of 3.6 usec, and the 360's instructions and instruction format. For the latter capability, it uses a read-only storage.

To go with it is a unit, the 2560, that can punch, print on, merge and reproduce cards in one pass. It reads 500 cpm, punches up to 90 cpm, and prints up to 100 cpm. The mod 20 has communications capabilities, can be used as a terminal device. The mainframe rents for $1,280, on up, and purchase price begins at $62,710.

System prices start at $82,550 ($1,715 per month). Deliveries begin first quarter of 1966.

AUTOMATIC EQUALIZER INCREASES DATA RATE

Bell Labs has announced the invention of an automatic equalizer that compensates for line distortion, allowing faster data transmission over voiceband circuits.

In its present form, the equalizer will up transmission rates from the present 2400 bits/second to 7200. Improvements now under way may raise this further to 9600 bits/second. The principles used can be applied to other bandwidths as well.

● A simultaneous voice/data transmission plan has been proposed by ITT's Standard Telecommunication Laboratories in London. Since one pair of wires in a four-wire telephone channel is idle half the time, the scheme calls for slipping in data transmission when no one is talking. To prevent overlap, a magnetic drum is used and a control unit switches the circuit to data when a pause of 100-200 milliseconds occurs.

● Customer testing is under way at Bankers Trust Company with an experimental system that allows tellers to dial into a computer for account information and get a verbal reply. An IBM voice recorder unit has been hooked up to their computer, with the answer coming back over the telephone. Inquiries are made by insertion of a special card, issued to each customer, and manual entering of additional data.

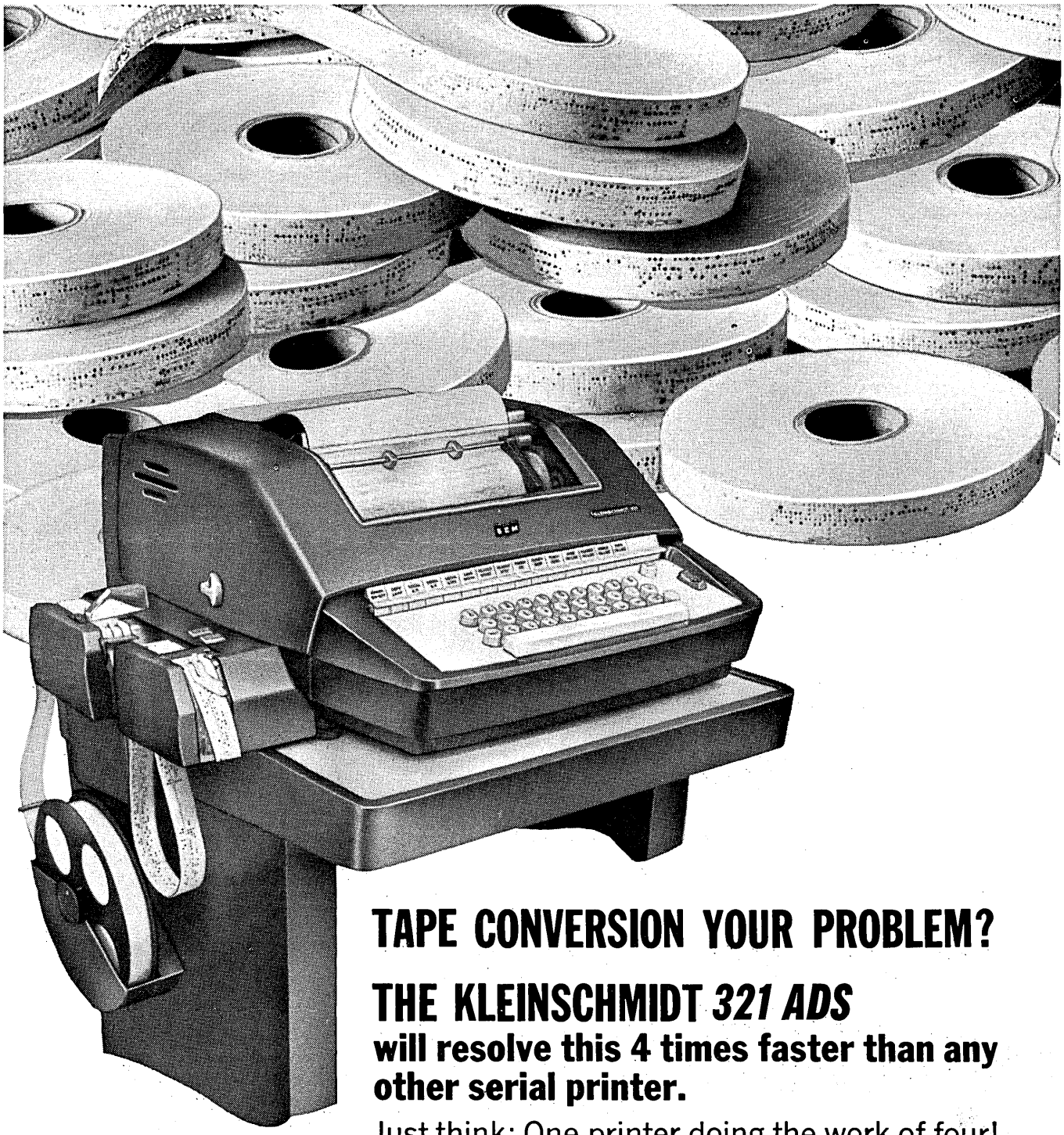
● Bunker-Ramo's Defense Systems Div. has two contracts from Rome Air Development Center for development of machine translation of languages. One is for a program called a syntactic analyzer, the other for application of the same principles to Chinese-English machine translation.

● Univac Division of Sperry Rand has announced a new medium-scale military computer, the 1219, that is fully compatible with the 1218 and more than twice as fast. Up to 32 fully buffered channels are available and it is designed for use under difficult environmental conditions. The 2 usec main memory can go up to 32K.

● Fairchild Semiconductor has announced a family of PNP silicon epitaxial transistors impervious to channeling problems that have bothered users of PNP devices before. Using the new Planar II process, they offer high voltage rating, high gain bandwidth, fast high current switching speed, and uniformly high current gain from 10uA to 500 ma.

● Gamble-Skogmo has begun installation of about 500 optical print checkout registers in its chain of discount stores. Covering 38 stores by the end of this year, they will be tied into an NCR 315, now being added to the firm's computing center. The system will provide records of sales by classifications and specific merchandise items.

● Computer Control Company announces shipment of the first portable computer to be installed in a submarine, a DDP-24P. It consists of four logic bays, a tape reader, tape punch, two power supply cabinets, I/O typewriter, and control panel.



TAPE CONVERSION YOUR PROBLEM?

THE KLEINSCHMIDT *321 ADS*

will resolve this 4 times faster than any other serial printer.

Just think: One printer doing the work of four!

At 400 words per minute, the KLEINSCHMIDT Model 321 provides hard copy from your data tapes four times faster than existing equipment. ■ "On-line" or "off-line," the Model 321 provides complete facilities for local tape preparation — tape duplication — hard-copy print-out. ■ The use of electronic control in the Model 321 Automatic Data Set insures reliable operation in any data-processing or communications system. ■ For information on the Model 321 ADS or other KLEINSCHMIDT Electronic Data Communications equipment, write: KLEINSCHMIDT Division of SCM Corp., Lake-Cook Road, Deerfield, Ill.

SCM® KLEINSCHMIDT
DIVISION OF SCM CORPORATION

CIRCLE 35 ON READER CARD

ADVERTISERS' INDEX

room for achievement at IBM®

After working as an accountant and later as a design engineer, Roderick Ward started looking for more variety. In June, 1961, he began a career as an IBM Data Processing Systems Engineer. Today he works with a wholesale distributor, a meat packer, a toy manufacturer, and an automotive parts distributor. Rod's projects have varied from sales analysis to market forecasting and inventory control.

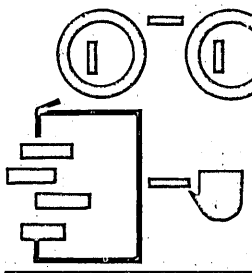
Career Opportunity—Data Processing Systems Engineer: With a degree in Mechanical Engineering (CCNY '60), Rod Ward was well qualified to enter IBM's school for Systems Engineers in New York City. There he learned how to find data processing solutions to a variety of business and industrial problems, make systems studies, define solutions on computers, test the solutions, and assist customers in putting the solutions into effect.

Men and women who have developed an analytical approach to problems and are capable of disciplined thinking in a variety of areas will find a lifetime career in Data Processing. Degrees in Engineering, the Physical Sciences, Mathematics, Business Administration, and even Philosophy provide an excellent background for success in this dynamic new profession.

Other Career Areas: Marketing and Sales, Customer Engineering, Finance and Administration, Development, Manufacturing and Research.

IBM offers recent college graduates exciting assignments with room to move ahead. Broad education programs keep employees up to date in their fields. Personal benefits, all company-paid, are among the most liberal in industry. IBM's 20 engineering laboratories, 17 plants, and over 200 branch offices coast to coast offer a wide range of working locations.

If you seek a challenging and rewarding career, consider Data Processing Systems Engineering—or one of the other areas listed. Go to your nearest IBM branch office or write, outlining your education and interests, to: **Manager of Employment, Dept. 701Z, IBM Corporate Headquarters, Armonk, New York 10504. IBM is an Equal Opportunity Employer.**



NEW LITERATURE

GENERAL PURPOSE COMPUTER: 16-page catalog gives details of the DDP-116 computer. Included are information on internal organization, programming, peripheral equipment, and user services. COMPUTER CONTROL CO. INC., Framingham, Mass. For copy:
CIRCLE 130 ON READER CARD

BANKING IN REAL-TIME: Six-page brochure describes and illustrates an expandable system designed around a GE-400 and explains how compatibility permits economical growth as volume increases. GE COMPUTER DEPT., Phoenix, Ariz. For copy:
CIRCLE 131 ON READER CARD

INFORMATION EXPLOSION: Booklet in question-answer form defines terms and describes information technology. Also, illustrates the scope of the problem caused by the increasing flow of paperwork in government, science, and industry. DOCUMENTATION INC., Bethesda,Md. For copy:
CIRCLE 132 ON READER CARD

BIO-MEDICAL RESEARCH: Six-page brochure describes the first commercial version of the LINC (Laboratory INstrument Computer). Summarized are LINC's hardware specifications, its applications in bio-medical work, and its command repertoire. DIGITAL EQUIPMENT CORP., Maynard, Mass. For copy:
CIRCLE 133 ON READER CARD

COMPUTER ACCESSORES: Eight-page booklet illustrates console desks, card punch console desks, disc pack storage cabinets and tape storage cabinets. Catalog #8 is supplemental to #7. MONARCH METAL PRODUCTS INC., New Windsor (Newburgh), N.Y. For copy:
CIRCLE 134 ON READER CARD

FAULT ISOLATION BY SEMI-AUTOMATIC TECHNIQUES: FIST, explained in a 71-page manual, is a diagnostic tool for rapidly isolating faults without removing the modules from the prime equipment. Designed primarily for the novice technician, it also enables the skilled to isolate rapment being tested. Price: $.55. SUidly a malfunctioning module without reference to technical manuals, and without prior knowledge of the equipPERINTENDENT OF DOCUMENTS, U.S. GOVERNMENT PRINTING OFFICE, Wash., D.C. 20402.

LIST-PROCESSING LANGUAGE: 194-page teaching manual describes DYSTAL, a general language for com-

Who'd have thought this little staple would knock out a million dollar EDP system?

We would.

Because, unless the forms — including the fastenings — are tailored to your machine, the whole system can jam up. A staple in the wrong gauge, size, or position can spell trouble. Maybe the right staple is no staple at all. Perhaps a glued, crimped, or our patented Stanlock fastening might be better for your specific needs. The point is, a Standard Register man can tell you which is best, and why. He's backed by engineers who are continually working with manufacturers of every high-speed printer on the market. So he's in a position to recommend a form which will assure you efficient, trouble-free performance. And guarantee its quality. Proper fastening is one of the reasons only Standard Register can call its forms Machine Mated —they're specifically tailored for your machine, in every way. Ask our local representative for a Machine Mated Forms Specification Chart for your particular high-speed printer. Or tell us its type, and we'll see that you get one free. Write us at Dayton, Ohio 45401.

MACHINE MATED™ FORMS BY STANDARD REGISTER

CIRCLE 38 ON READER CARD

plex programs which is written as a series of FORTRAN subroutines and functions. Manual also lists and describes DYSTAL routines, programs, and FORTRAN listings in the appendix. BROWN UNIV., Providence, R.I. For copy:

CIRCLE 136 ON READER CARD

SURVEYING COMPUTER: 12-page brochure explains software for surveyers, designed to be run on the PDS 1020 computer. PACIFIC DATA SYSTEMS INC., Santa Ana, Calif. For copy:

CIRCLE 137 ON READER CARD

DATA DISPLAY SYSTEM: Information sheet covers the major aspects of the 801 CRT system for on-line applications. TELEMETRICS INC., Santa Ana, Calif. For copy:

CIRCLE 138 ON READER CARD

MATHEMATIC LECTURES: Booklet describes purpose of the visiting scientist lectureship program designed for institutions and industrial facilities. Lecturers, their professional and educational backgrounds, and topics are listed for the 1964-65 lecture series. SOCIETY FOR INDUSTRIAL AND APPLIED MATHEMATICS, Philadelphia, Pa. For copy:

CIRCLE 139 ON READER CARD

TEACHING MACHINES: 16-page article evaluates work to date on teaching machines and programmed learning, includes programs currently available and those being worked on, and enables reader to differentiate between programmed learning and other methods. EDUCATION AND TRAINING CONSULTANTS, Los Angeles, Calif. For copy:

CIRCLE 140 ON READER CARD

DOCUMENT RECORDER: S-C 4400 computer microfilm document recorder is described in four-page illustrated brochure. Alphanumeric output is recorded directly from a computer or computer-generated tapes onto 16mm or 35mm microfilm for use in storage and retrieval systems. STROMBERG-CARLSON DIV., GENERAL DYNAMICS, San Diego, Calif. For copy:

CIRCLE 141 ON READER CARD

INFORMATION TECHNOLOGY IN INDUSTRY: Six-page brochure describes how systems engineering, computer technology, information retrieval, management and learning theory, and related skills can be used to improve the efficiency and effectiveness of various business operations. AUERBACH CORP., Philadelphia, Pa. For copy:

CIRCLE 142 ON READER CARD

PATCHING SYSTEM: Four-page brochure is available on the program patching system for the series 350 digital operations system. Brochure features a photograph of the system with trunks, mode controls and digital/analog switches indicated. ELECTRONIC ASSOCIATES, INC., West Long Branch, N.J. For copy:

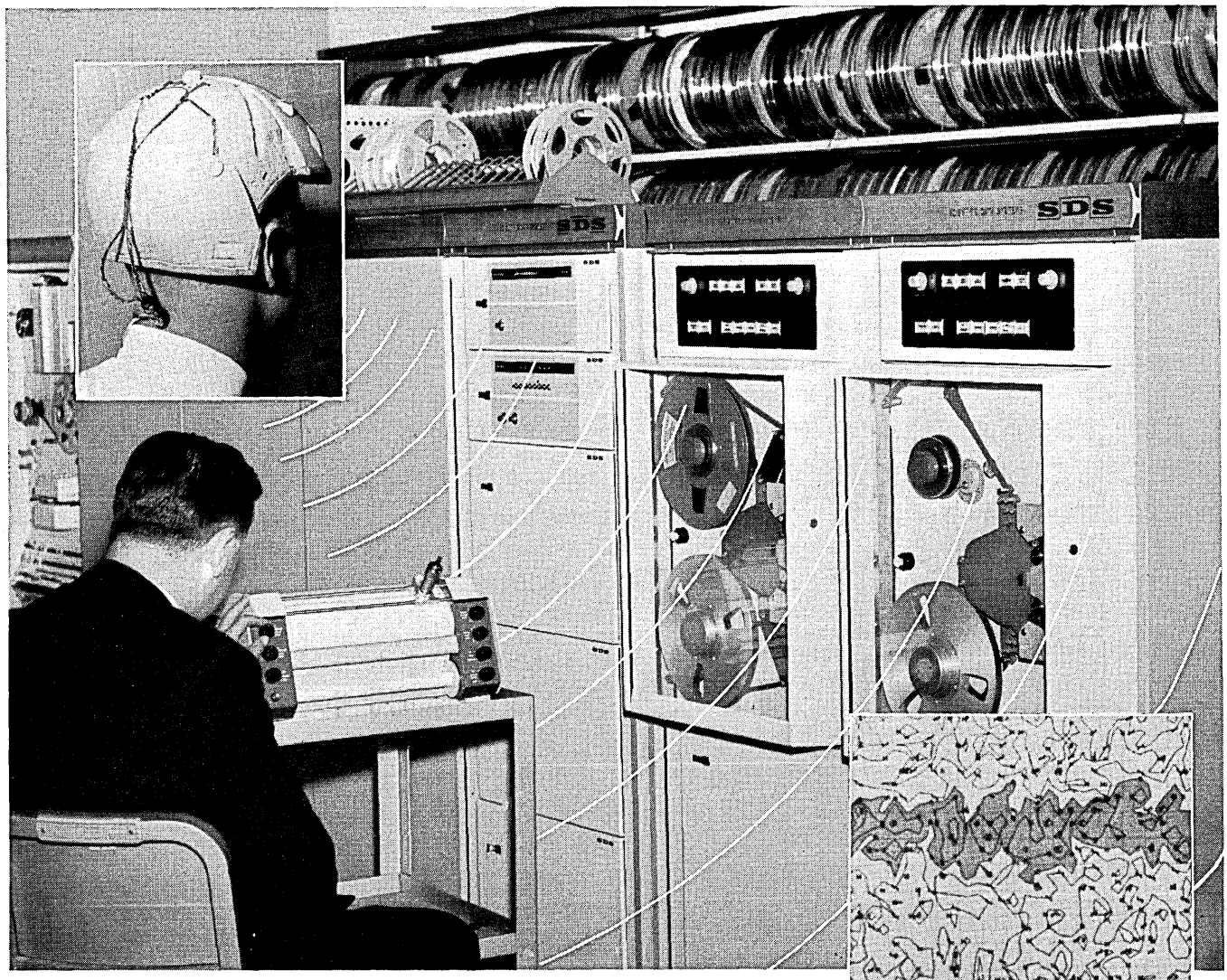
CIRCLE 143 ON READER CARD

DATA MAGNETIC TAPE GROUP: Model 382 is described in brochure. Unit has multi-tape packaging in single cluster, sharing logic and circuitry, offering up to 30,000 cps; Model 382 is compatible with the 10,000-cps model 381. RADIO CORPORATION OF AMERICA, New York, N.Y. For copy:

CIRCLE 144 ON READER CARD

NUCLEAR LAB EXPERIMENTS: Nuclear flight time analyzers based on PDP-5 and 7 computers are described in four-page brochure. Individual channel count capacity is nominally 4K or 256K events. DIGITAL EQUIPMENT CORP., Maynard, Mass. For copy:

CIRCLE 145 ON READER CARD

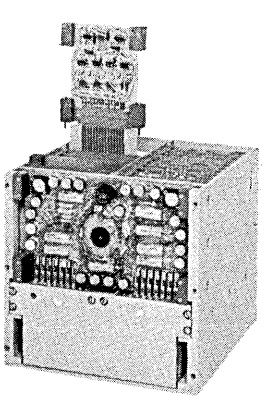


Biomedical Group uses CalComp Plotter and SDS Computer to Display Astronaut Brain Research

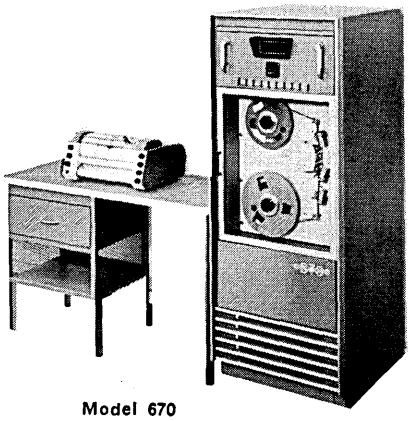
Miniaturized preamplifiers attached to an astronaut's helmet liner gather data expected to bring new insight on human behavior.

The astronaut's brain reactions to stimuli — converted to digital form — are written on magnetic tape by an SDS digital computer and plotted by an SDS 9175 plotter built by CalComp.

This process condenses literally miles of EEG data into revealing and digitally accurate brain contour maps. Biomedical researchers analyzing the maps at a Brain Research Institute, at Los Angeles, are seeking to develop techniques for monitoring man in space. At the same time they are amassing knowledge that will bring better and repeatable measures of human behavior on earth.



GOVERNMENT — Microminiature techniques were used in this pulse code modulated telemetry system for NIMBUS and TIROS weather satellites.



Model 670

INDUSTRY & BUSINESS — Latest CalComp magnetic tape plotting system speeds data reduction, mapping and automatic drafting.

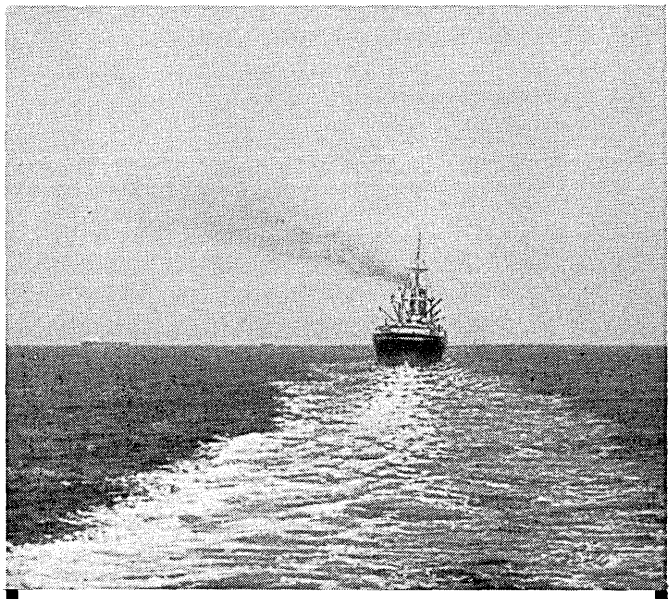
CALCOMP

Specialists in Digital Technology

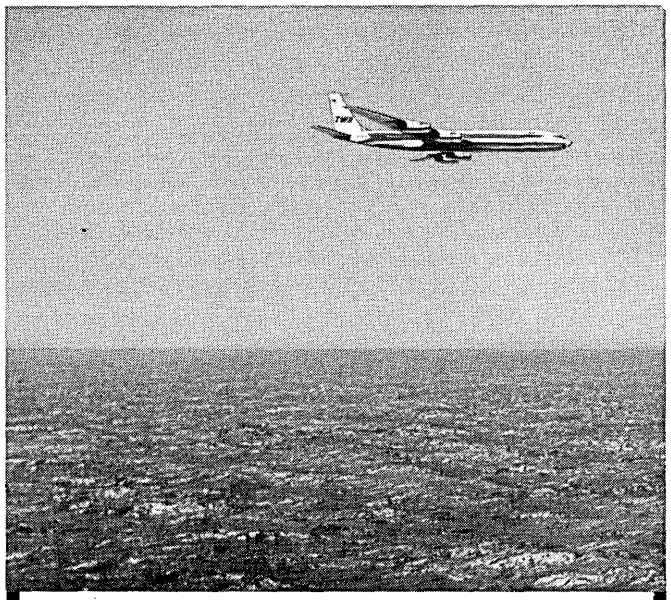
CALIFORNIA COMPUTER PRODUCTS, INC. 305 Muller Avenue, Anaheim, California / Write Marketing

CIRCLE 40 ON READER CARD

Computer shipment: Pittsburgh to Rome



TIME:	15 DAYS
PACKAGING	$ 700.00
INSURANCE	1980.00
INLAND FREIGHT (PITT.-NEW YORK)	428.40
DOCUMENTATION	22.00
OCEAN FREIGHT	476.08
CUSTOMS CLEARANCE	52.00
INLAND FREIGHT (NAPLES-ROME)	281.00
INTEREST CHARGES	1036.00
COST:	**$4975.48**



TIME:	15 HOURS
PACKAGING	$ 20.00
INSURANCE	900.00
DOCUMENTATION	1.00
AIR FREIGHT	1832.80
CUSTOMS CLEARANCE	18.00
INTEREST CHARGES	74.00
COST:	**$2845.80**

$2129.68 AND 14 DAYS... SAVED BY AIR!

This is a shipment of electronic programming computers and parts—net weight, 6200 lbs. It's a dramatic example of how TWA's jet-age distribution works. How sheer speed pays off in big savings, clear profit. How packaging, insurance, inland freight, etc., build up costs and slow down delivery.

Can you or your customers afford the extra expense, costly delay of surface movement?

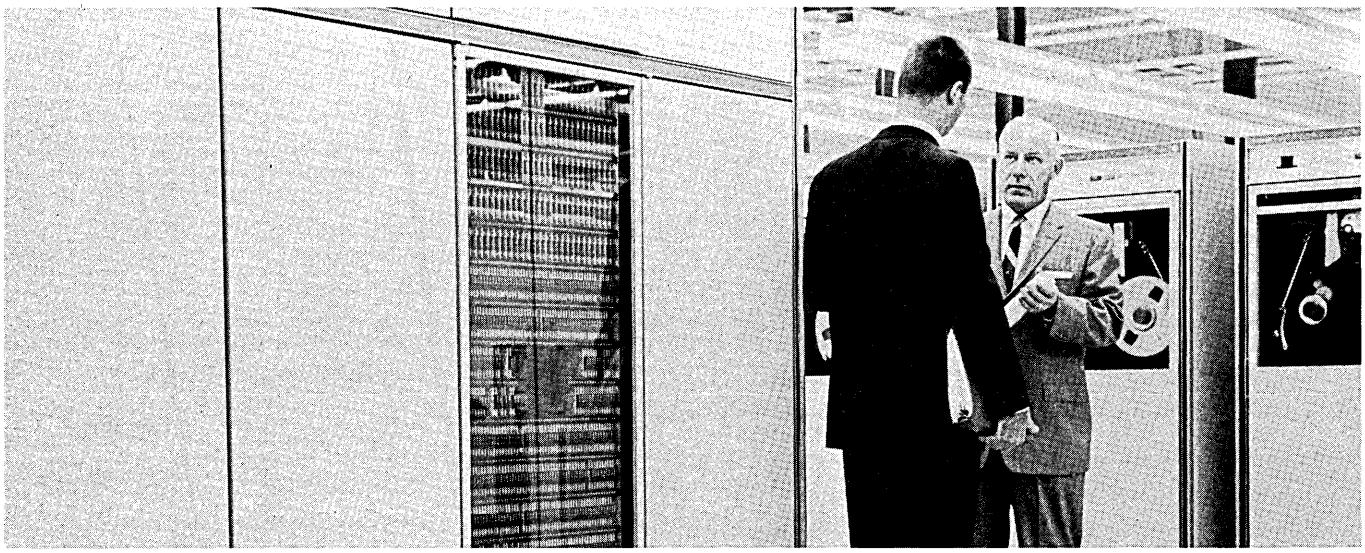
TWA can deliver your product faster, for less money—deliver additional economies in warehousing, obsolescence, capital turnover. And TWA jets connect 70 U.S. cities with 18 world centers abroad. Investigate. Call TWA Air Cargo. Or call your cargo agent or freight forwarder.

Send for free booklet, "Electronics and TWA Jet Age Distribution." Prepared by experts especially for your industry. Tells how you can save money on warehousing, inventories, inland freight, and more. Write: Mr. P. G. Yovanovitch, Vice President—Cargo Sales, Trans World Airlines, Inc., 605 Third Avenue, N. Y., N. Y. 10016.

Nationwide Worldwide depend on TWA AIR CARGO

CIRCLE 36 ON READER CARD

EXTEND YOUR CAREER EXTEND YO



Help us extend our capabilities

A large-scale expansion in computer and data systems development at Collins has opened many ground-floor opportunities for hardware and hardware-oriented people. Positions are in Cedar Rapids, Iowa, and Newport Beach, California.

SENIOR TECHNICAL ADVISOR

A BSEE degree is required, as well as 10 years' experience in design and development of digital hardware, including circuits, memory, logic and systems, and packaging. He must be hardware-oriented but also have programming experience and knowledge. He will serve on the senior technical staff to the assistant vice president and director of the Data Systems Engineering Division to advise in all aspects of computer hardware and system design and development.

DIAGNOSTIC PROGRAMMERS

These men will have a BSEE degree and possibly a master's degree, as well as 2 years' minimum experience in writing factory and/or field diagnostic programs for digital computer hardware. Vast knowledge of digital equipment organization is necessary. These men will write diagnostic programs for factory test and for field maintenance of digital equipment. They will formulate factory and field test philosophy and procedures.

DIGITAL CIRCUIT DESIGNERS

At least 2 years' experience in development of high-speed digital logic circuits is required, as is a BSEE degree. Work includes development of state-of-the-art, high-speed, digital logic circuits. Applications of these and microelectronic circuits to digital functions and equipment, coping with interface problems including interconnects, transmission lines, terminations, etc. are involved.

MICROPROGRAMMERS

A degree in electrical engineering or mathematics is preferred. These men should have one or more years' experience in (1) logic design, particularly arithmetic and control units and/or (2) machine language computer programming. These positions involve development of stored logic routines for advanced microprogrammed computers which execute complete, comprehensive instruction including fixed and floating point operations.

MEMORY DESIGN ENGINEERS

A BSEE degree is necessary with a master's degree desirable, along with 2-8 years' experience in core memory design and/or solid state circuit design. This includes participation in the design, specification, development and test of memory arrays and electronics for high-speed core memories.

LOGIC DESIGNERS

At least 3 years' continuous experience in computer logic design is required, as well as a BSEE degree. The area of endeavor includes the design and development of digital computer equipment.

Send complete resume in confidence to L. R. Nuss, Manager of Professional Employment, COLLINS RADIO COMPANY, Cedar Rapids, Iowa

CIRCLE 79 ON READER CARD

from the bottom drawer

DP DEFINITIONS

• **ARITHMETIC SHIFT**—Preferred apparel of female mathematicians.

• **PROGRAMMER**—Red-eyed, mumbling mammal capable of conversing with inanimate monsters.

• **ACCESS TIME**—The time between the instant at which information is called for and the instant at which management expects the final report.

• **ADDER**—A member of the species which caused the demise of Cleopatra.

• **ASSUMED DECIMAL POINT**—Located two positions to the right of a programmers current salary in estimating his own worth.

• **BLOCK DIAGRAM**—Schematic Gibberish.

• **BIT**—The increment by which programmers slowly go mad.

• **BRANCH INSTRUCTION**—Advice from a district office.

• **CHAINING**—A method of attaching programmers to desks to speed up output.

• **SPECIAL CHARACTER**—A character which is out of the ordinary, different; a resident of Greenwich Village.

• **CHECKPOINT**—The location from which a programmer draws his salary.

• **COMMON LANGUAGE**—The first thing a programmer must forget to be successful.

• **COMPLEMENT**—An antique, outdated form of speech once used to express appreciation.

• **CONSTANT**—A type of pressure.

• **CONSTANT AREA**—The stomach.

• **CORE STORAGE**—A receptacle for the center section of apples.

• **COUNTER**—A device over which Martinis are served.

• **DEBUGGING**—Removing the needles from the haystack.

• **ERROR**—What someone else has made when they disagree with your computer output.

• **EXTERNAL STORAGE** — Wastebasket.

• **FIXED WORD LENGTH**—Four letter words used by programmers in a state of confusion.

• **FLOATING CONTROL**—A characteristic exhibited when you have to go to the rest room but can't leave the computer.

• **FLOATING POINT**—The absolute limit before floating control is lost.

• **FLOW CHART**—A graphic representation of the fastest route to the coffee machine.

• **GARBAGE**—Highly aromatic computer output.

• **HOUSEKEEPING**—Letting the next person clean up your mess in the computer area.

• **INDEX REGISTER** — Constant source of irritation.

• **INPUT**—Food, whiskey, beer, aspirin, etc.

• **INTERNAL SORT**—The stomach, liver and kidneys keep changing position.

• **LIBRARY**—An organized collection of obsolete material.

• **LOGICAL OPERATION**—Getting out of data processing to marry a rich widow.

• **LOW ORDER POSITION** — The programmer's location in the chain of command.

• **MACRO**—The last half of an expression of surprise; for example, "Holy Macro."

• **MATHEMATICAL MODEL** — 42-26-38.

• **MATHEMATICAL CHECK** — Remuneration received by a mathematical model.

• **MEMORY DUMP**—Amnesia.

• **MICROSECOND**—The amount of time needed for a program to hang up.

• **NUMERIC**—42-26-38.

• **OFF-LINE**—Failure to pass a sobriety test.

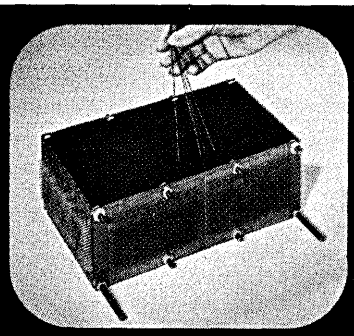
• **ON-LINE**—Full, but not drunk.

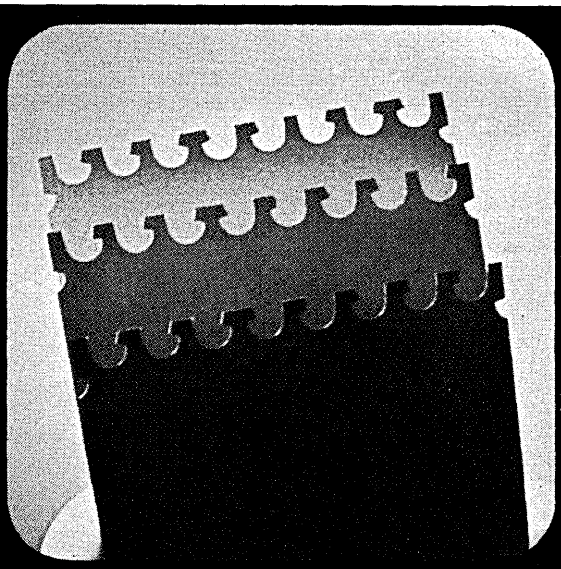
• **OVERFLOW**—Result of being too much Off-Line.

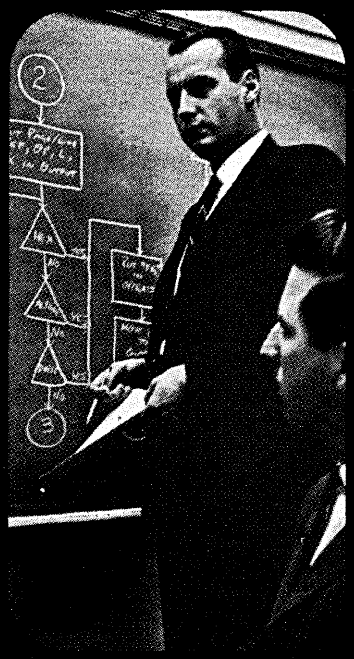
• **PARAMETER**—The absolute limit beyond which the secretary yells for help.

• **PASS**—What one makes at the secretary.

W. S. ROTH







MOVE UP IN DIGITAL SYSTEMS AT NCR, LOS ANGELES

You can step into that bright future *now* at NCR. This division is generating ideas and hardware today for NCR markets in 120 countries. The success of such best-sellers as the NCR 315 EDP system, the CRAM magnetic-card concept in random-access memories and the 420 Optical Journal Reader has tripled the size of the division in three years. Continued success is in store—thanks to the NCR 315 RMC, the first commercially available system with an all-thin-film main memory, advanced studies in integrated-circuit technology and promising work in many other new areas. Here you'll command everything you need in facilities and equipment. You'll match ideas with some of the nation's keenest systems minds. Like NCR equipment, you'll start off fast and have very little downtime. As a result, you'll move ahead as rapidly as your own ideas can take you. All this and Southern California, too.

At NCR, the footing is firm, the direction forward, the progress certain. If your career is stalled, now could be the time to shift gears.

BRIGHT REAL-TIME OPPORTUNITY
AT ALL LEVELS, IN ALL THESE AREAS

ADVANCED COMPUTER DEVELOPMENT
- ☐ MEMORY DEVELOPMENT
- ☐ LOGIC DESIGN
- ☐ CIRCUIT DESIGN
- ☐ MECHANISMS DEVELOPMENT
- ☐ MAGNETIC RECORDING

PRODUCT ENGINEERING
- ☐ PACKAGING DESIGN
- ☐ ELECTRONIC AND MECHANICAL PRODUCT DESIGN
- ☐ COMPONENT ANALYSIS

SYSTEMS ANALYSIS
- ☐ ADVANCED CENTRAL AND ON-LINE SYSTEMS
- ☐ EVALUATION

PROGRAMMING DEVELOPMENT
- ☐ RESEARCH AND SOFTWARE DEVELOPMENT
- ☐ DESIGN AUTOMATION SUPERVISION

If you do not have direct digital-systems experience, but feel that your background and interests would enable you to make a contribution in any of the areas listed above, your resume is cordially invited.

To arrange a personal interview, please send a resume immediately, including training, experience and salary history, to Bill Holloway, Personnel Dept., or telephone collect.

The National Cash Register Company

NCR

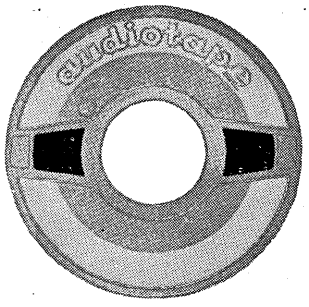
ELECTRONICS DIVISION
2806 W. El Segundo Blvd., Hawthorne, Calif.
Telephone: Area Code 213-757-5111

An equal-opportunity employer

CIRCLE 81 ON READER CARD

"In the mad, mad, mad, mad world of movies, Computer Audiotape plays an important role,"

says Mr. John Fitzgerald, Data Processing Manager for United Artists Corporation **UA**



"In the colorful motion picture business even accounting is unique. For example, here at United Artists we use an IBM 1401 Computer for the sole purpose of processing producers' settlement statements. United Artists circulates as many as 1,000 films throughout the world at any given time. Our computer prepares detailed financial statements for each of these films. To do this job, we use Computer Audiotape. We first tried it two years ago, and it worked out so well we've often recommended it to other companies. As a matter of fact, we now use it exclusively."

United Artists Corporation is another prominent firm that consistently specifies Computer Audiotape. You can "test run" Computer Audiotape on your computer. "Test run" it on your own equipment, at no cost and at your convenience. For complete details write to Audio Devices, Dept. DT.

AUDIO DEVICES, INC., 235 East 42 Street New York, N. Y. 10017

CIRCLE 32 ON READER CARD

Continued from page 21 . . .

its numerical designation and mark it down by 25%, and the effect is the same." The offering of substantial discounts by manufacturers for volume purchases, a boon to the government long sought by the General Accounting Office, is also becoming more common.

COMPUTER-AGE CALL FOR SOLOMON'S SWORD

Some burning questions of control, precedence and even equipment selection are starting to churn up around a number of computers which are operated by state and local governments and paid for wholly or in part by federal funds. Indications are the Budget Bureau will attempt to apply its policy recommendations more stringently to computers in this category.

The problem arises this way: Various programs initiated by federal legislation — for example, unemployment compensation, highway construction, some training courses — are financed by special federal taxes which are allocated back to the states to finance the programs, and to pay for administrative expenses. To administer these programs, a number of states have acquired computers with these funds or used the money to buy time on other state computers.

Up to now, local governments have been dispensing these administrative funds largely as they saw fit, but recently a high-ranking Budget Bureau official told a meeting of state officials, "In regard to federally-financed state and local ADP programs . . . you will be safe in assuming that the government will be taking an increased interest in their effectiveness and efficiency. We will be interested in seeing that policies that apply to federal agencies also are carried out in these particular programs, and we will be taking a closer look at the applications themselves.

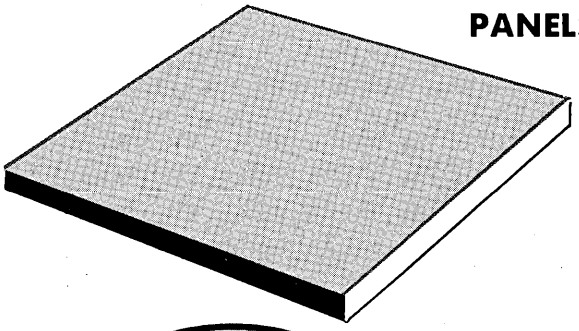
Three principal questions to be resolved are 1) use of state computer facilities to satisfy computer requirements of a federally-financed program, and the price charged for this use, 2) use of federally-financed computer facilities for state programs, and again the price charged for this use, and 3) priorities in scheduling use of either type of facility. The determining of who owes how much to whom seems likely to involve basic considerations of state-federal sovereignty, which may bring computers for the first time into Constitutional jurisprudence.

GE TO SHIP TWO 625'S TO NASA

Two General Electric 625's are headed NASA's way soon, one to the Wallops Island, Va., facility, the other to the Manned Space Flight Center at Cape Kennedy, according to reports, but few other results of the company's vaunted "computer push" are yet manifest. Installation of the 635 at MIT's Project MAC is proving to be an effective talking point for GE representatives, and talk of pending big deals continue to circulate, but most observers have not, as yet, discerned any new swath being cut in the government computer mart by GE.

BEFORE YOU CONTRACT FOR ELEVATED FLOORING

IT PAYS TO TAKE A SECOND LOOK!

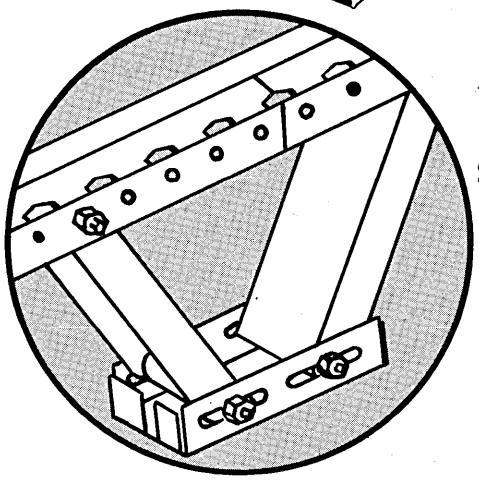


PANELS

Panels available from elevated flooring manufacturers vary considerably in terms of abrasion and indentation resistance.

Sample panels of A, B, and C might look alike. But what does the Taber Abraser (standard test for abrasion) show about elevated flooring panels? It proves the STRATO-FLOOR molded fiberglass panel to be *20 to 30% more mar-and-abrasion resistant and totally free of indentation!* Indentation tests, with compression pressures of up to 5000 lbs. through an individual caster wheel, show that all panels tested, *except STRATO-FLOOR*, had permanent identation.

STRATO-FLOOR panels, of course, are non-conductive and light-weight and are available in plain colors or mottled patterns.



SUB-STRUCTURE

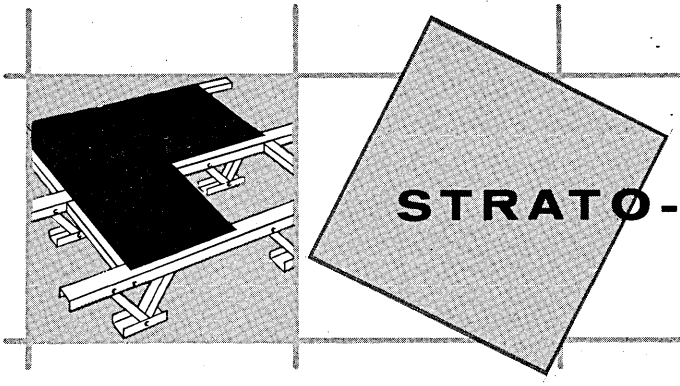
For maximum strength, minimum deflection, the STRATO-FLOOR sub-structure features the patented STRATO-TRI-JACK, which utilizes the strength of the triangle in its design.

Conventional types of jacks in other elevated flooring systems support the stringer and floor at one concentrated point. The STRATO-TRI-JACK distributes support of the stringer over a larger area, increases the load-bearing capacity and provides greater strength and rigidity. Supports a live load of 250 lbs. per square foot and a point load of 1000 lbs. with at least 4 factors of safety. ⅛" galvanized steel channel is the strongest sub-structure on the market.

CONTRACTOR-RELIABILITY

STRATO-FLOOR elevated flooring is sold and installed by STRATO-FLOOR, INC. or by licensed STRATO-FLOOR distributors. They are reputable contractors, carefully selected by STRATO-FLOOR and known for reliable and conscientious work in the communities they service.

This is important. Before you contract for elevated flooring—get full details about STRATO-FLOOR. Write us for further information and the name of your STRATO-FLOOR distributor.



STRATO-FLOOR, INCORPORATED

795 East 152nd Street • Cleveland 10, Ohio

Phone: Liberty 1-4200

CIRCLE 42 ON READER CARD

BOOK REVIEW

LIBRARIES AND AUTOMATION

Proceedings of the Conference on Libraries and Automation held at Airlie Foundation, Warrenton, Virginia, May 26-30, 1963, under the sponsorship of the Library of Congress, National Science Foundation and the Council on Library Resources, Inc. *Edited by Barbara Evans Markuson. U. S. Government Printing Office, 1964. $2.75.*

The state-of-the-art papers on mechanization techniques published in this volume are primarily on the tutorial level; but the discussion, much of which is not related to the formal papers, is of practical value to readers of DATAMATION because the specific problems of librarians were voiced and recorded and computer specialists presented partial solutions to these problems. The discussion also captured the frustrations, uncertainties and current attitudes toward mechanization as expressed by librarians and technologists versed in automation and librarians who are still not convinced about the immediate benefits of the new technology. The superiority of the discussion sections over the formal papers, which were distributed to 100 invited representatives from large industries, government agencies and universities, prior to the conference, is a tribute to the excellent editing of Barbara E. Markuson of the Library of Congress.

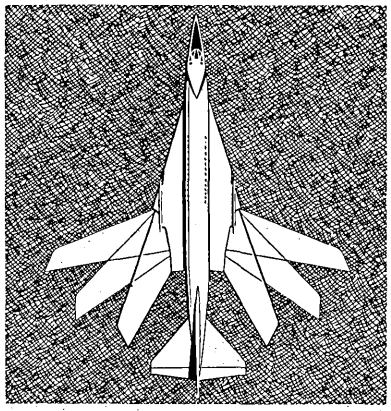
The keynote address of the conference was delivered by Don R. Swanson on the "Design Requirements for a Future Library," which was reminiscent of earlier projections such as Vannevar Bush's MEMEX ("As We May Think," *Atlantic Monthly*, August 1945, p. 101-108) and the more recent library communication network proposed by the American Library Association ("The Library and Information Networks of the Future," – RADC-TDR-62-614). The designs for future libraries presented by Swanson and other participants specified the oft-repeated requirements of indexing in depth, the need for a national network of libraries to achieve bibliographic control, a user-indexed library, a console for remote interrogation and browsing, and some system of wheat and chaff identification of library materials. Working librarians confronted with actual demands of users tend to question the practicality of some of these goals from the user's standpoint, since they have learned through many years' experience that what is wheat to one user is chaff to another, and that indexing in depth can generate linguistic mazes too sophisticated for most users and too expensive even for industrial research libraries.

Other papers covered generic topics of potential application to libraries: file organization and conversion, file storage and access, graphic storage, output printing, library communications networks, and the automation of library systems. A great number of the proposals advocated have appeared in both journal and book literature as well as in government publications, with the exception of the section on library communications which was presented by representatives of Bell Telephone Laboratories, Inc., and American Telephone and Telegraph Co. Mr. J. W. Emling and co-workers advocated that the library, the console, the computer, displays and communications be integrated as part of the complete mechanized library system, if a sound system is to be established.

Another recommendation of special significance to librarians was made by both Robert L. Patrick and Richard L. Libby, who reiterated that library mechanization is most applicable to large catalog files, where the volume is over a million entries. In the discussion of Libby's paper on "Automated Storage and Access of Bibliographic Information . . . ," Patrick also delineated the five major requirements needed to justify a computer installation: high volume application; the need for absolute control; complex applications beyond human capability; the need for fast response time and a situation which demands multiple access to a file that must remain current. It was through such meaningful analyses as Patrick's and that of the librarian of Princeton University, William S. Dix, who asked whether a machine was on the market that could answer the most common kind of library question: "Do you have this book and if so, where is it?" that the conference approached one of its primary objectives—"to develop a common understanding (between librarians and technologists) of the goals of mechanization." It was through such a problem solving approach that the banking industry today has achieved check mechanization through magnetic ink character recognition.

Dix's question and the superiority of the discussion sections over the formal papers indicate that perhaps a conference planned around the state-of-the-art papers on library procedures, problems and goals should be presented by librarians to computer technologists for solutions based on the use of either off-the-shelf hardware or custom-designed equipment.

—Sophia P. White



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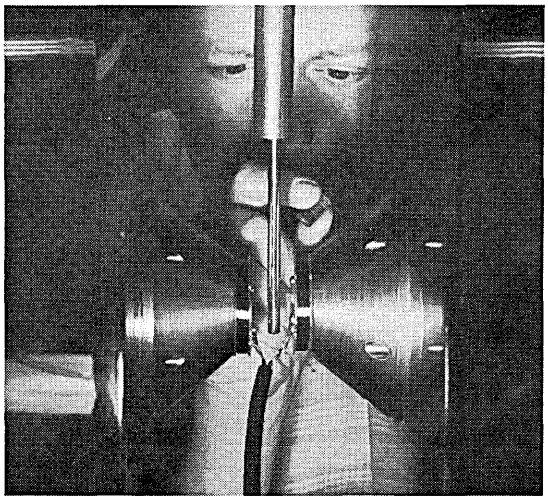
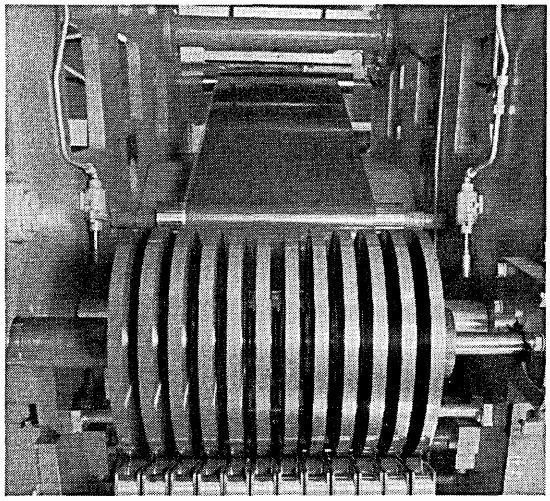
4 WAYS TO IMPROVE COMPUTER TAPE

(And how Memorex did it!)



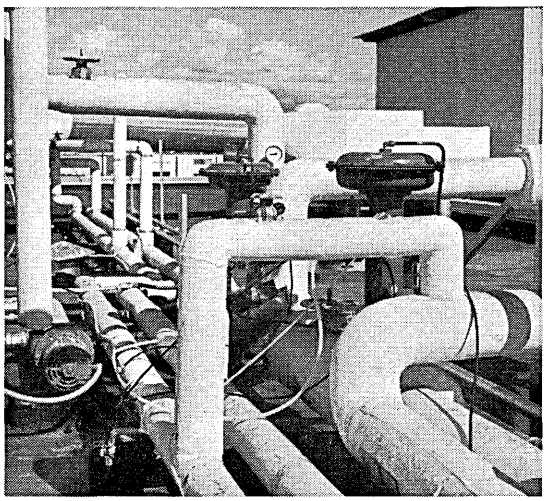
Exercise greater quality control.

The Memorex-designed Vibrating-Sample Magnetometer (VSM) tests basic characteristics of oxide raw material and precise concentration of oxide particles in the tape coating. Extra tests of this kind guarantee the improved performance and reel-to-reel uniformity of Memorex computer tape.



Employ advanced production techniques.

Specially constructed equipment — used to slit Memorex computer tape from jumbo rolls — produces tape with clean, straight edges free from ripples and ridges. A new slitting technique is but one of seventeen manufacturing improvements made to insure superior performance of Memorex tape.



Use a superior production facility.

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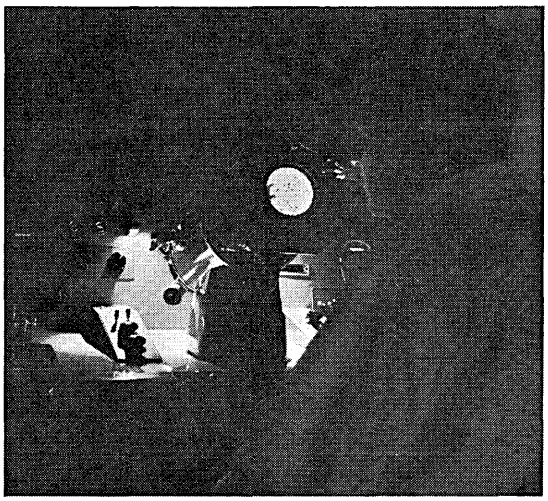

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