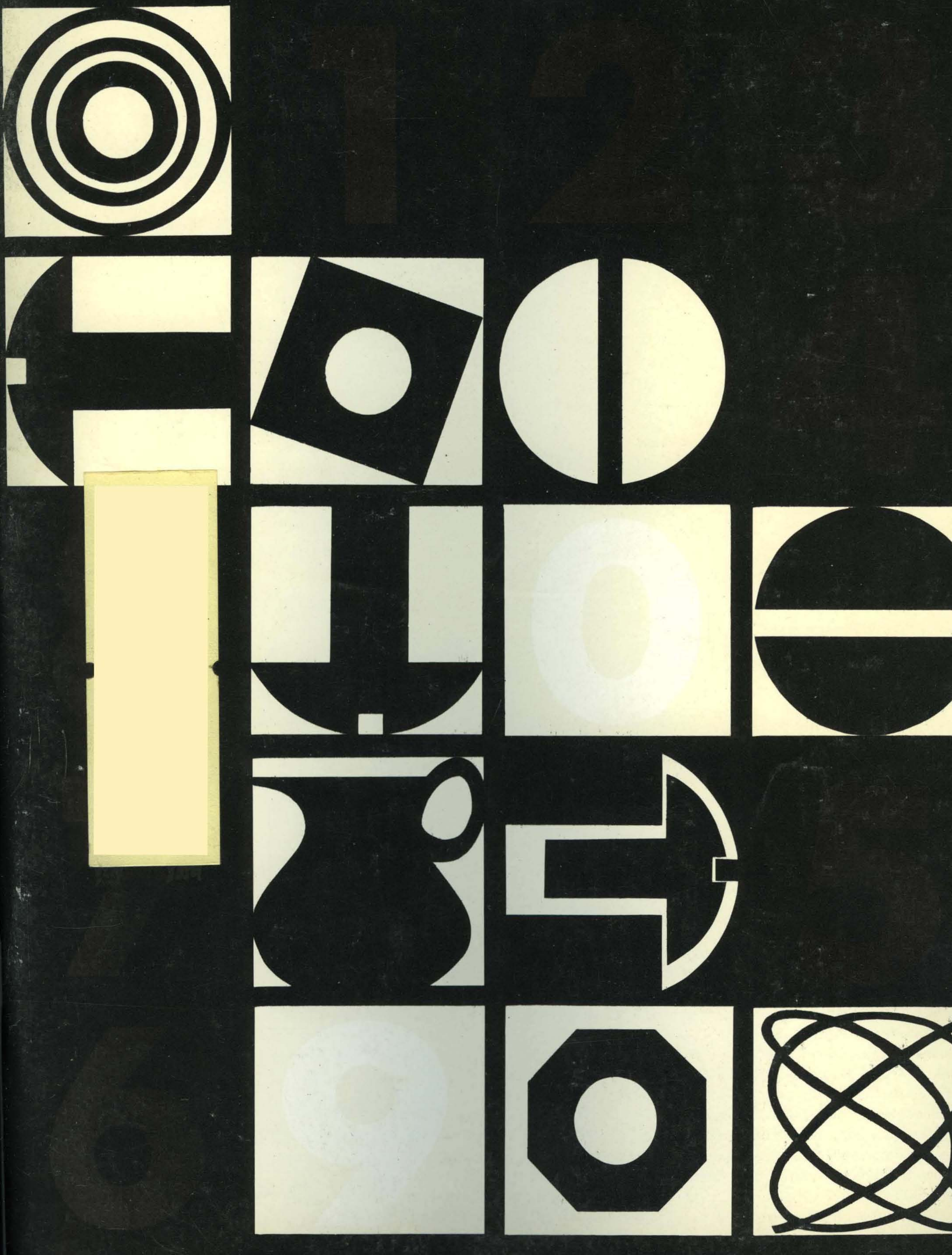
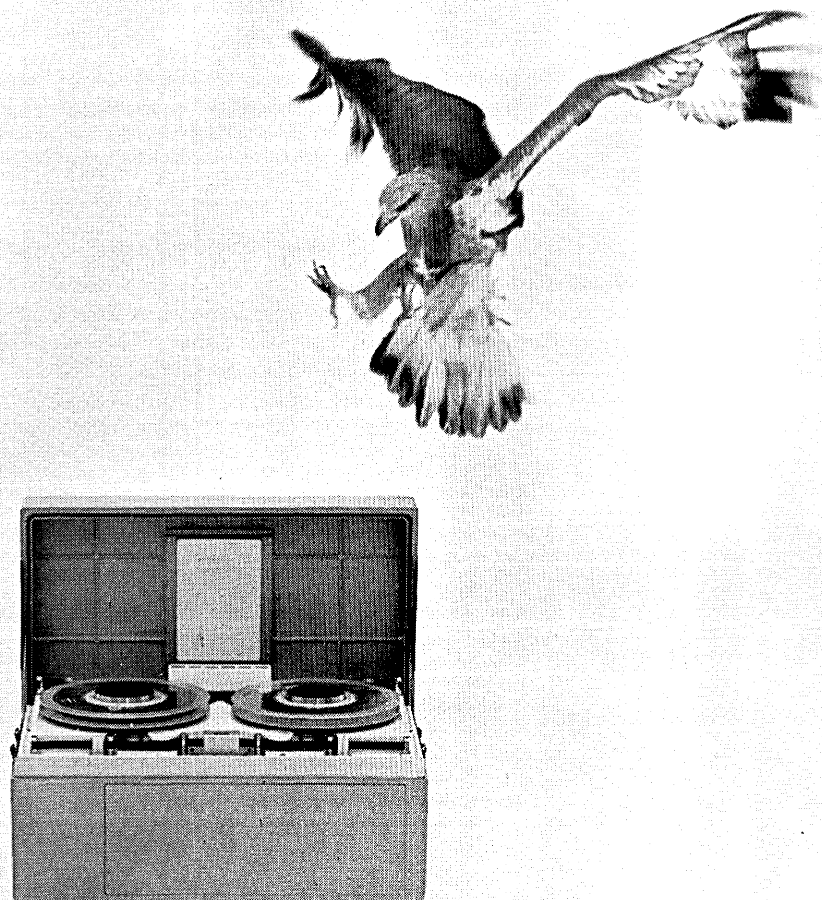
DATAMATION ®

66

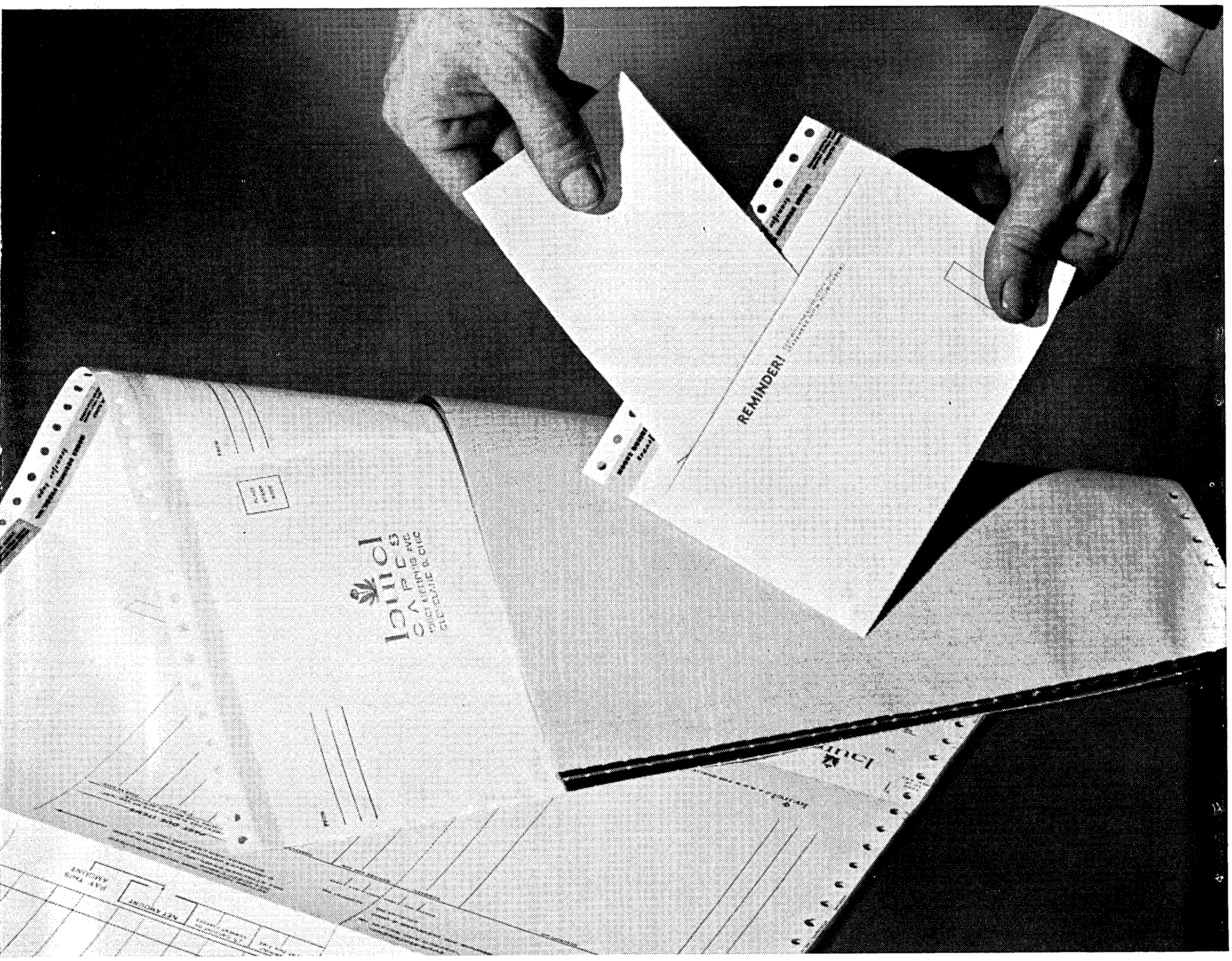
May



Computer Graphics



MOORE 'EXTRA FUNCTION' FORMS PUT TOTAL VALUE IN YOUR FORMS-SYSTEM



PASTED POCKET ENVELOPES—flexible in construction, can be part of a continuous Speediflex, or of a Speediset, with pressure-sensitive tape or remoistenable glue to seal the envelope.

Need a form with special features? One that performs multiple functions to cut machine time and handling costs?

For example:

Moore can give you a multiple-part continuous form containing a self-sealer return envelope as an integral part of the set.

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Or a Moore Pasted Pocket form to provide invoices, with a self-addressed envelope as an integral part of set, with control copies for accounting, credit use, etc. Pocket forms provide pockets for storage of tapes, cards, original or supporting documents, with the printed form.

Or forms that permit direct input from original document—bypassing keypunching and verifying—for direct reading by scanners.

Your form will be better because of the value we build into it—experience, design know-how, years of system background, unequaled manufacturing facilities.

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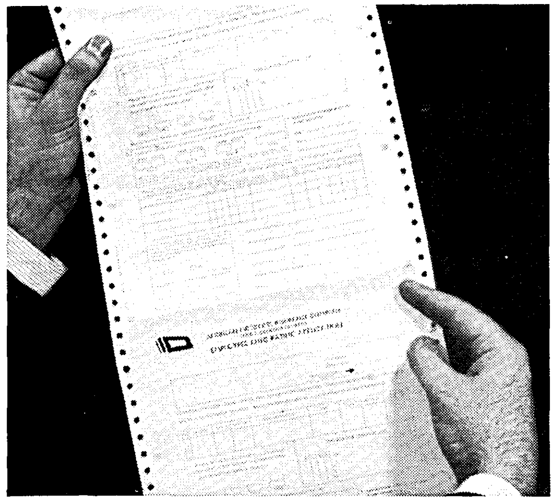
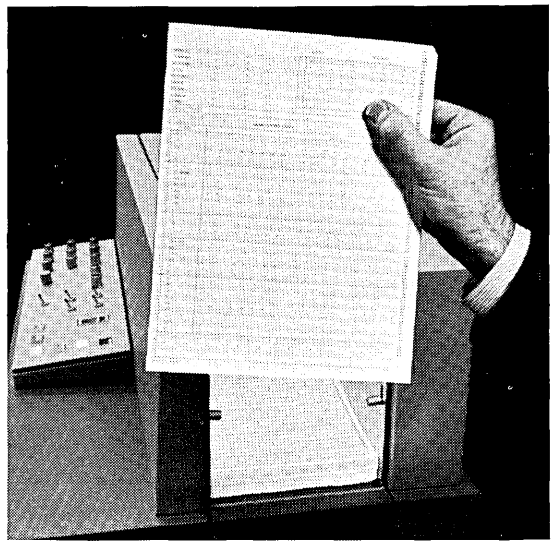
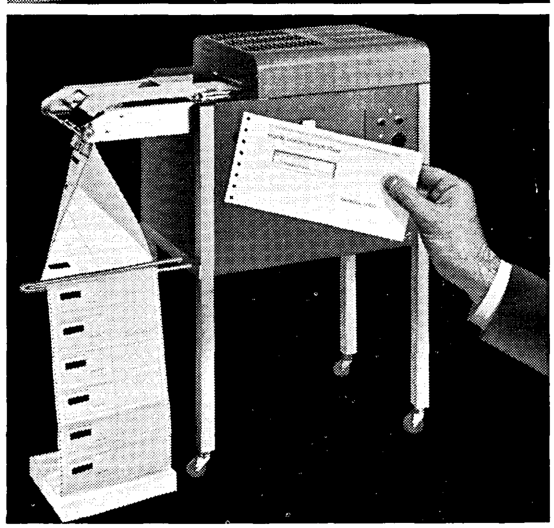
CIRCLE 5 ON READER CARD



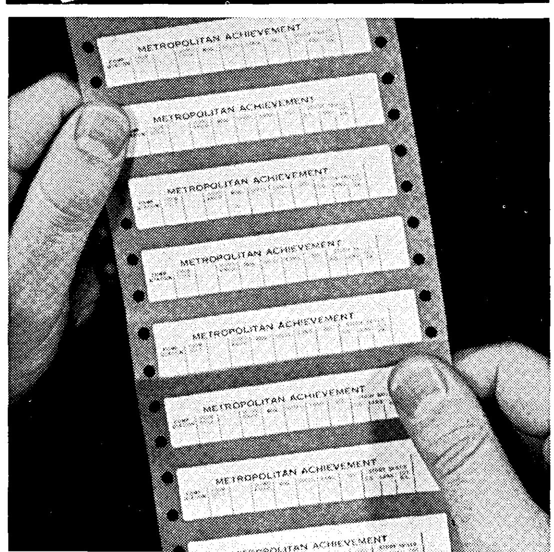
FORMS can be made in continuous style to be later folded and sealed to form an envelope with remoistenable glue, similar to gummed flap of envelopes.



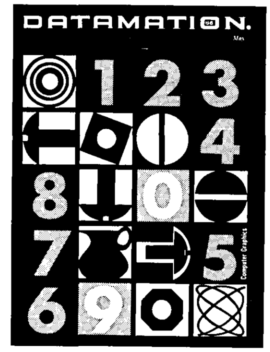
FOR PAGE READERS
Moore forms help provide direct input and selective line reading by OCR scanners. Eliminates keypunching and verifying.



HEAT-SEAL FORMS
for 'one-pass' writing, machine-folded and heat-sealed on three open sides to form envelope, die-cut for name, address, etc. Perforations and margins strip off to open the sealed envelope. For paychecks, invoices, statements, bills, etc.



LABEL FORMS
are available to run on high-speed printers in a wide variety of sizes and materials.
Can be applied to other documents, etc., without remoistening.



may
1966
volume 12 number 5

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CIRCLE 7 ON READER CARD

Forget it!

Once you remember to buy Computape and put it in use, you will probably forget it again almost immediately.

That's the way it should be.

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DATAMATION®

may
1966
volume 12 number 5

datamation departments

automatic information processing for business industry & science

calendar

- Joint spring conference of the Univac Users' Association and the Univac Scientific Exchange will meet May 25-27, Royal York Hotel, Toronto, Canada.

- Data Processing Cards and Forms Manufacturers Assn. will meet June 1-2, Grove Park Inn, Asheville, N.C.

- American Bankers Assn. national automation conference will meet June 6-8, Palmer House, Chicago, Ill.

- Simulation software meeting of the Central States and Midwestern Simulation Councils will be June 13-14, Honeywell Corp., Minneapolis, Minn.

- Conference on dp and automation will be held June 14-16, Sheraton-Chicago Hotel, Chicago, Ill., sponsored by the National Rural Electric Cooperative Assn. Fee: $125.

- C-E-I-R, Inc.'s Applied Research and Management Sciences Div. will sponsor a conference on management information systems, June 15-17, Marriott Twin Bridges Motor Inn, Arlington, Va. Fee: $145.

- National symposium of the Federal Government Accountants Assn. featuring edp papers and exhibits will meet June 15-17, Radisson Hotel, Mineapolis, Minn.

- Congress of the International Federation of Automatic Control will be held in London June 20-25. Sponsors are U.K. Automation Council and Secretariat of the IFAC and National Member Organizations. Fees: delegates, $60; authors of papers, $50.

- International conference of the Data Processing Management Assn. is scheduled for June 21-24, Hilton Hotel, Chicago, Ill.

- Symposium on mathematical and computational methods in the social sciences will be held at the International Computation Center in Rome, July 4-8. Fee: $25.

● The users group for small IBM computers, COMMON, will meet July 6-8, Denver Hilton Hotel, Denver, Colo.

COURSES:

June 6-10, Chemical and Petroleum Applications of Analog Simulation, Princeton, (N.J.) Computation Center. Sponsor: Electronic Associates Inc. $250.

June 13-14, Filmed Data and Computers, Sheraton-Boston Hotel, Boston, Mass. Sponsors: Society of Photo-Optical Instrumentation Engineers and USAF Electronic Systems Div.

June 13-14, Organization of Reliable Computers, Univ. of California, Los Angeles, Engineering Extension. $300.

June 13-17, Bio-Engineering Applications of Analog Simulation, Princeton (N.J.) Computation Center. Sponsor: Electronic Associates Inc. $250.

June 13-14, Advanced Digital Computer Programming, Moore School of Electrical Engineering, Univ. of Pennsylvania, Philadelphia, Pa. $300.

June 20-24, SIMSCRIPT: Modeling and Simulation, Southern Simulation Service, Tampa, Fla.

June 20-24, Feedback Control System Fundamentals, Ohio State Univ., School of Engineering, Columbus, O. $175.

June 20-July 1, Advanced Applied APT Workshop, IIT Research Institute, Chicago, Ill.

June 20-July 2, Digital Design Principles, Ohio State Univ., School of Engineering, Columbus, O. $275.

June 27-July 1, Modern Methods in Analog Simulation, Illinois Institute of Technology, Chicago. Sponsor: Electronic Associates Inc. $250.

June 27-July 1, Computer Graphics, Ohio State Univ., School of Engineering, Columbus, O. $150.

June 29, Data Link Seminar, IIT Research Institute, Chicago, Ill.

July 11-15, Dynamics and Control of Process Systems, Princeton (N.J.) Computation Center. Sponsor: Electronic Associates Inc. $200.

July 11-22, Modern Theory of Communication, Ohio State Univ., School of Engineering, Columbus, O. $275.

July 11-22, Computerized Simulation of Market and Competitor Response, Sloan School of Management, MIT, Cambridge, Mass.

letters

programming the 360

Sir:

The article, "System/360 Assembly Language Programming" by Martin E. Hopkins (Dec., p. 73), is surprisingly rather erroneous . . .

The equivalencing of the hexadecimal numbers 150 and E261 to the decimal numbers 320 and 57943, respectively, is incorrect. (See Feb., p. 14). The explanation of the example S 10,25(3,6) reads that 3 is the base and 6 the index. Machine instructions of the RX format (as S is) are represented in assembly language as OP R1, D2(X2, B2). Accordingly, in the example, 6 is the base and 3 the index.

The discussion of ENTRY and EXTRN usage states that an ENTRY symbol *is to* appear in the EXTRN list of another program or programs. The falsity of this statement lies in its rigidity. ENTRY symbols may be defined, which need *never* appear in the EXTRN list of another program or programs. Immediately following is another blanket statement to the effect that the programmer begins his program with the START instruction. This is not a requirement, but an option.

The explanation of why the four bytes of data generated by AL4-(PARAM) did not skip over two bytes is not necessarily true. The BAL instruction, as are all instructions, is *always* assembled on a halfword boundary. A full word boundary is also a halfword boundary. Therefore, if the BAL was placed on a halfword boundary which was also a full word boundary (not all halfword boundaries are full word boundaries), the use of the explicit length (L4) as is stated in the example has no effect. On the discussion of boundary alignment via the CNOP instruction, CNOP 2,8 does not put you on the *second half* of a double word, but rather the *second half word* of a double word.

Following the assembler statement using LOCXYZ,6,8 the discussion states that the value of LOCXYZ and LOCXYZ+4096 *are in* registers 6 and 8, respectively. Also, the last paragraph of your article reiterates that the registers involved in a USING statement are already loaded at the time the USING statement is issued. This is very far from the truth. USING merely informs the assembler what registers to use as base registers in address calculations, and what values to *consider* as being in these registers. The user may or may not put these values in the registers. To force the user to load these registers as his intent states in the USING statement would be to remove a major employment of the DSECT statement.

ALBERT B. SINOPOLI
Univac, Systems Programming
Blue Bell, Pennsylvania

Author's reply: I want to thank Mr. Sinopoli. In early documentation (most of this book was written in 1964), there was some confusion over which was the base and which the index in RX instructions. I am afraid that the fact that such an error only rarely resulted in incorrect execution gave me a sense of false security. My thanks also for noticing that "word" had been left out of the description of the statement CNOP 2, 8. By the way, it is an "assembly instruction," not an "instruction." Other errors were reported earlier in DATAMATION. A number of other small errors in the first printing have been corrected in the second; an errata sheet is available.

Some of the other points which Mr. Sinopoli raises are a result of misunderstanding the purpose of this chapter. Its purpose is not to define the assembly language rigorously but to "familiarize" so that the examples which occur later in the book can be understood. The preface to the book from which this chapter was extracted states, "The reader should be generally familiar with programming in a symbolic language and he should have available to him a manual describing one of the System/360 assembly languages."

The difficulty of obtaining short descriptions which are completely accurate can be seen in Mr. Sinopoli's correction of my discussion of ENTRY. His statement, ". . . an EXTRN symbol must appear in the ENTRY list of another program or programs," is wrong on two points. Appearance of a name on the ENTRY list of more than one program is an error. Also, appearance on an ENTRY list is not necessary since the name might have been defined as a CSECT or START name.

In explaining the alignment of AL 4 (PARAM), I used the term half-word boundary. This loose usage is current among experienced programmers and generally results in no confusion. The (L4) was used in this case to force alignment on the next address which "may" be an unnatural boundary. If it was a natural boundary, no rounding would take place, as Mr. Sinopoli points out. This is the desired result since the object here is to eliminate "slack bytes."

As stated, the USING assembly instruction is fully discussed in Chapter III, including methods for loading bases and handline DSECT assembler instructions. It is beyond the scope of this chapter to describe ways to "fool" the assembler. Mr. Sinopoli assumes that there exists a DSECT address which could be loaded. A DSECT is a set of addresses which are relative to one another but for which no space is allocated by the assembler; hence, their "location" in storage can vary. Therefore, it is most unlikely the name in the USING for a DSECT and the address which is loaded into a register to address the DSECT would ever be the same.

The length of both Mr. Sinopoli's criticism and my reply reflect the difficulty and complexity of these subjects and demonstrate that explanations of nuances in statements about the programming systems of third-generation computers are a function of both the audience and frame of reference.

cold, cold batcave

Sir:

On page 15 of your February issue is a rendering that might be classed as a humorous cartoon if it existed only in the mind of its creator. But it is not (see photo). Not to be confused with the Batcave, which is equipped with

the same brand computer (see *Life*, March 11, p. 22), in this room are Mary Hawes at the controls, Gerald Licht, Lew Reinwald and Gil Rollins in the back, and Charles Greenberger and Dick Schubert at the auxiliary heating plant. With his back to the camera: Goldfinger (Roy).

CLAUDE A. ROICHEL
Pennington, New Jersey

computers & law research

Sir:

The story in the February issue (p. 79), which describes the legal citation service planned by Law Research Service Inc., refers to Western Union as "partner to the firm." This is not correct. Law Research Inc. has the full business and legal responsibility for the service; our responsibility is to provide the computer and computer services including the on-line computer programming necessary to mechanize the citation service which, incidentally, we expect to announce around May 1.

WILLIAM H. WATTS
Western Union Telegraph Company
New York, New York

checkless society

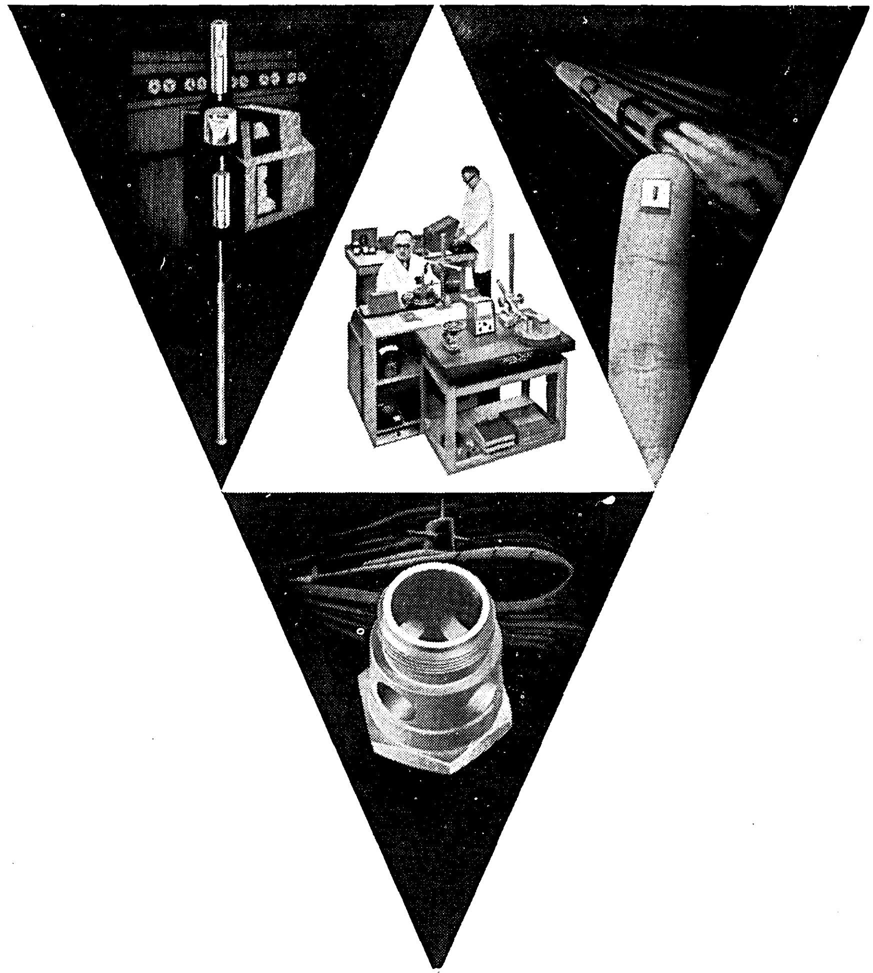
Sir:

Recent articles on the checkless society, more speculative than analytical, tend to focus on what *can* happen rather than what *should* happen. Using such an approach, one could also speculate and write imaginatively about a bookless society where all volumes are recorded on microfilm and all homes and businesses have inexpensive microfilm readers—then formulate the libraries of the future and the benefits to society . . .

Mr. Zipf's article (March, p. 121), was a departure from this speculative school, and contains significant and useful observations on the checkless society. On the other hand, Mr. Head's article (March, p. 22) was considerably less interesting; his speculations, while imaginative, are of no practical use to those responsible for long-range automation planning.

In addition, I single out Mr. Head's article because his approach to this subject is weakened by his deterministic view of history; namely, he sees the checkless society as inevitable. Based on this conviction, he selects favorable evidence of the "irresistible" trend toward the checkless society and rejects counter-evidence as reactionary.

Before anybody should make any



letters

specific attempts to plan for the checkless society, these questions must be analyzed:

- Will the check and the check settlement system evolve and improve (and if not, why not)?
- Are banks today handling their check volumes better than ever before with MICR automation devices (and can they continue to handle future volumes)?
- Will bank customers (commercial, as well as individual) press for the development of a checkless society?

Evidence seems to point to these conclusions:

1. An automatic credit transfer system (of the type described by Mr. Head and others) is a highly plausible development in the long-term future. But there is no sense of urgency for this automatic credit transfer system, nor does this development imply the death of the check.
2. The check settlement system, through over-draft banking, broader encashment privileges and other features, will be strengthened in the near-term future.
3. The American economic system can support and may need more than one debt settlement mechanism.

What is now required is definitive research into each of these three areas. Until this is done it would be arrogant and irresponsible to consider the checkless society as inevitable and to make automation plans accordingly.

CHARLES BLOCK
Chase Manhattan Bank
New York, N.Y.

Mr. Head's reply: If I am to be tagged as "arrogant and irresponsible," not to mention "deterministic," by people like Mr. Block, I can at least take solace in sharing this opprobrium with the keynote speakers for the last two automation symposiums of the American Bankers Association: Messrs. Sarnoff of RCA and Watson of IBM. And I thought we had a *friend* at Chase Manhattan.

What I don't understand is why Mr. Block recommends "definitive research" on the subject, since he has so obviously made up his own mind that the status quo is pretty comfortable and is going to be around for quite a while. If Mr. Block is a representative spokesman for the banking community, I am forced to conclude that some of the entrepreneurial interests mentioned in my article will be able to move fairly rapidly into the vacuum created by the bankers' inertia.

Sir:

It is not at all uncommon for the average person to have eight or more credit cards in his possession. If, then, the major banks in the community (and in all probability it will only be the major banks) issue consumer credit cards and proceed to sign up most of the merchants to participate in the plan, does this not start the trend toward the one-identification-card-per-consumer system that Mr. Head and others are predicting for the not too distant future? I can't believe that Mr. Head would be so naive as to think that the transformation to a one-card society will take place overnight.

Incidentally, today's credit cards represent more than just "prima facie evidence of credit based upon prior verification of credit status." Not only are they used for identification purposes in check cashing services, but because they are machine sensible they can be used on-line for automatic verification and updating of accounts or for various data gathering applications. Off-line the cards may be used to create very accurate source documents for direct or semi-direct input into computer systems.

I am beginning to wonder if the one-card "checkless" society will ever be sold to the American public. As anyone can tell you, a three-foot-long string of credit cards is an infinitely loftier status symbol than a roll of bills or one measly identification card.

T. W. KOFOD
Addressograph Multigraph Corporation
Cleveland, Ohio

Sir:

In the Forum (March, pp. 121-122) on the subject of universal credit, Mr. Zipf states his opinion that there is limited potential for profit in the universal credit system, this opinion based on the experience of BankAmericard. This conclusion may well be true from the standpoint of banking. Quite the opposite is true for the other organizations who will set up the credit systems if the banks fail to do so. The profit potential for these organizations is tremendous—it is the profit to be derived from taking the consumer credit business *away from the banks.*

THOMAS R. JENNINGS
Banco Popular de Puerto Rico
Hato Rey, Puerto Rico

The author replies: "It was not the intent to compare the profit potential of BankAmericard with that of a "universal credit system," but rather to point out that the application of these "glamorous techniques" clearly increases operating expenses without clearly adding a measure of compensating "value"—even for a credit system controlled by one organization.

"The universal system—as popularly discussed —refers to one commonly shared, nationwide

letters

card but, as we pointed out, it is naive to assume that an organization would yield its proprietary interests and incur the expense of promoting a system which shares benefits with competitors without the expectation of a substantially better return. We will not be in a hurry to give up our card, nor would others in favor of ours."

our mistake

Sir:

In your report on the Control Data "press conference" (March, p. 69), there is a gross error. On re-reading the remarks made by President William Norris at the press meeting, I do not find a single comment to the effect ". . . that building the 6600 in remote Chippewa Falls was a mistake." In fact, he never made any reference to "the facility", which, you quote him as saying, "lacked proper control, and the first four machines didn't work properly." Nor did Mr. Norris say that "the 6600 series is now being made in Minneapolis and the manufacturing problems ironed out." Furthermore, I know from conversations with Mr. Norris that he has the highest regard for the 6600 achievement accomplished by the Chippewa Falls laboratory.

GORDON V. WISE
Corporate Public Relations
Control Data Corporation
Minneapolis, Minnesota

Our apologies for publishing the erroneous report, and our thanks to Mr. Wise for setting the record straight.

time-sharing terms

Sir:

Mr. Colilla's definitions ("Time-Sharing and Multiprocessing Terminology," March, p. 51) of *multiprogramming* and *multiprocessing* are contrary to those of the ASA's current Proposed American Standard Vocabulary for Information Processing, which follow:

Multiprocessing—Pertaining to the simultaneous or interleaved execution of two or more programs or sequences of instructions by a computer or computer network. Multiprocessing may be accomplished by multiprograming (sic), parallel processing or both.

Multiprograming—Pertaining to the interleaved execution of two or more programs by a computer. Contrast with parallel processing.

Parallel Processing—Pertaining to the simultaneous execution of two or more sequences of instructions by a computer having multiple arithmetic or logic units. Contrast with multiprograming.

Further, ASA defines a multiprocessor as "a computer capable of multiprocessing." . . . The definitions say that as long as you are processing multiple jobs, you are multiprocessing . . .

VAN B. THOMPSON
Burroughs Corporation
Detroit, Michigan

The author replies: The definition for *multiprogramming* is very close in spirit to the one I proposed. For reasons discussed in the article, I strongly suggest the substitution of the word *processor* for the word *computer*. Further, I think the word *interleave*, although very suggestive of what goes on in a multiprogramming environment, would have meaning only to those already familiar with the concept of multiprogramming. To others, interleaving would have to be explained somewhat along the lines of my suggestion for *multiprogramming*.

Multiprocessing can subsume many things, but I do not think it can subsume multiprogramming, as the proposed ASA definition suggests. From my study, writers who have defined their terms have never incorporated the notion of multiprogramming within multiprocessing. Also, all characterize multiprocessing as requiring more than one processor. It is true, however, that *multiprocessing* is sometimes used in a very general and vague sense which could encompass multiprogramming. It is this kind of use, however, that I feel should be eliminated. This does not mean that there is no place for a word to describe any kind of multiple-job operation. It is just that the word should not be *multiprocessing*.

Sir:

Mr. Colilla's definitions . . . leave something to be desired. Perhaps this can best be exemplified by the following questions:

1. What is the distinction between a processor and a computer?
2. Is "divided job processing" a hardware or software function?
3. Doesn't "real-time" imply the ability to process a task, as well as receive and transmit, at rates commensurate with the I/O rates of the system?

LT. CARL J. KUEHNER
Communications/ADP Laboratory
Fort Monmouth, New Jersey

The author replies: To briefly answer your questions: (1) A computer may contain one or more processors; (2) Software—at least initially; (3) Clearly, yes.

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

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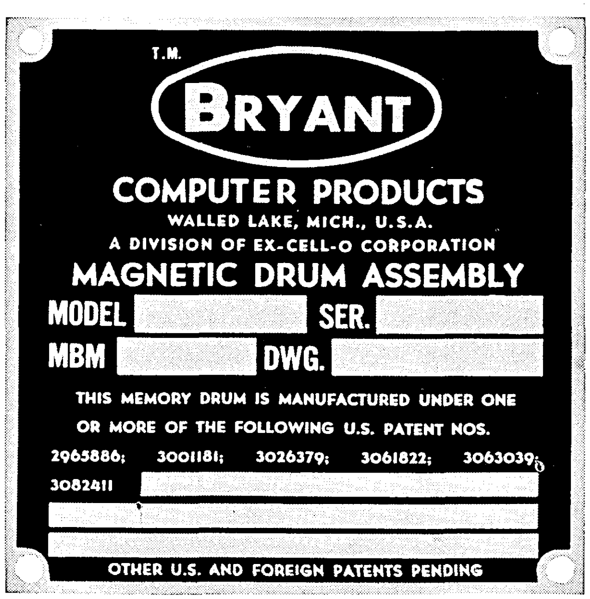
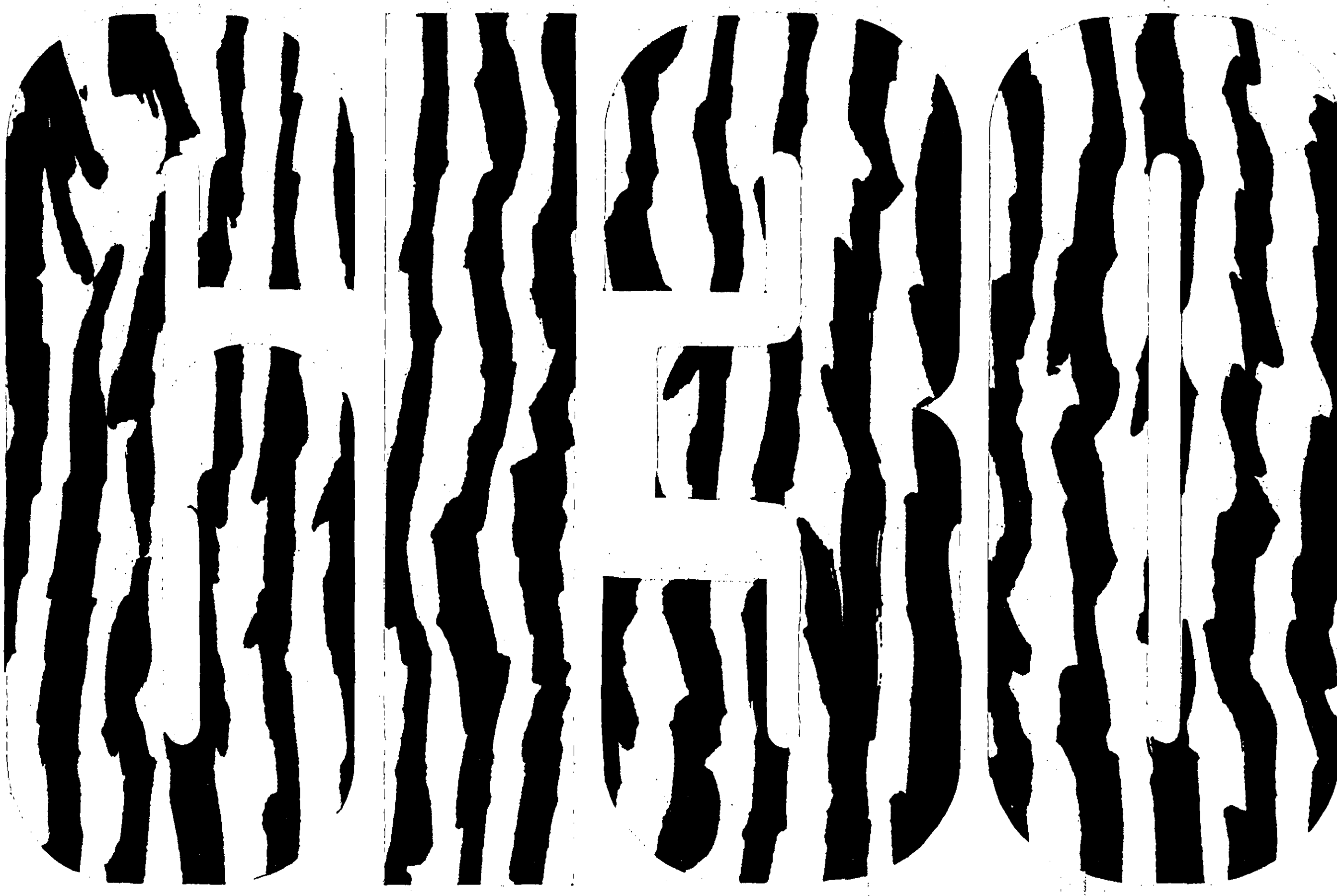
You'll see it on Bryant Auto-Lift® memory drums being used in all types of EDP systems. Because the unique Auto-Lift fits any computer, it has become commonplace product line equipment with major manufacturers. Just as important, every unit is backed by Bryant's reputation for proven reliability. As the leading independent maker of drum and drum systems, Bryant maintains the best Product Assurance group in the field. It checks equipment from design through production to final acceptance testing. And Bryant's top management makes sure the product meets customer requirements. The whole story is in our free brochure #BCPB-108-5-65. We'll be glad to send it. Meanwhile, keep an eye out for our labels. You won't have to look far.



CIRCLE 15 ON READER CARD

ASI Computer Division-EMR, announces the first in the ADVANCE 6100 Computer Series



the paper tiger with teeth...

The new 6130 computer system from the ASI Computer Division of Electro-Mechanical Research, Inc. is not available for immediate delivery. Some will call it a "paper tiger." This computer, however, is a formidable one, fully equipped for data acquisition systems and other industrial applications. It's designed to out-perform <u>all</u> competitive machines in the low-cost area.

Check some of the features of the ADVANCE 6130 and you'll see it's worth waiting for—

- 16-bit data word plus parity and memory protect bits.
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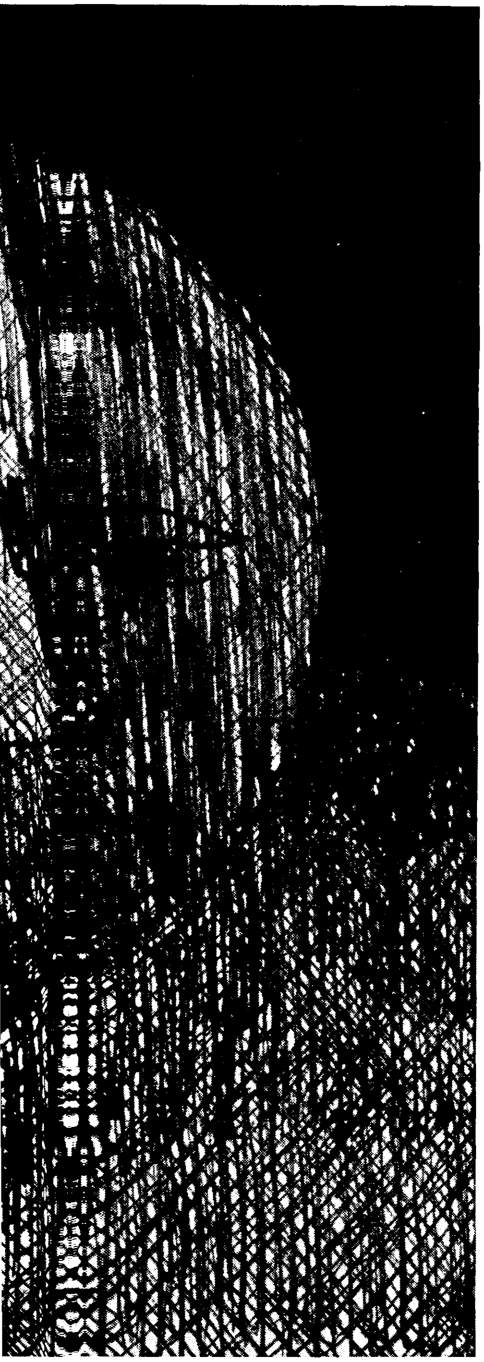


look ahead

BIG BUGS PLAGUE
BIG MACHINES

It appears that IBM isn't the only manufacturer with big machine hardware and software problems. Control Data, for instance, is beginning to recover from a passel of problems with the early 6600's made in Chippewa Falls. Some of the early models (delivered as long as 18 months ago) are still not operating as well as units installed a month or so ago. One machine installed last spring has only recently been tuned to the point where it can begin acceptance tests. One user, getting 80% uptime, is paying 3600 rental rates. Later models with faster modules, made in Minneapolis, are sounder: one user reports his machine was up in less than a month; he's getting 95-97% uptime.

The CDC software story is similar: an early system made available with the first machines was produced by a small crew of Seymour Cray's people. Labelled the Chippewa system, it was supposed to give way to an elaborate and sophisticated software system -- SIPROS -- to be produced by the Systems Sciences Division. But SIPROS was scratched a few months back, and a revised and enhanced Chippewa system seems to be working satisfactorily at most installations.

It's a little early to assess big GE systems, only now beginning to be installed. Some deliveries have been delayed, though, and GE has reportedly failed to bid or withdrawn bids of 600's in some cases. They're quoting deliveries of 12-14 months up; CDC has quoted as little as two months, but says it's sold out through this coming December on the 6600.

The only conclusion seems to be that making big systems causes big headaches.

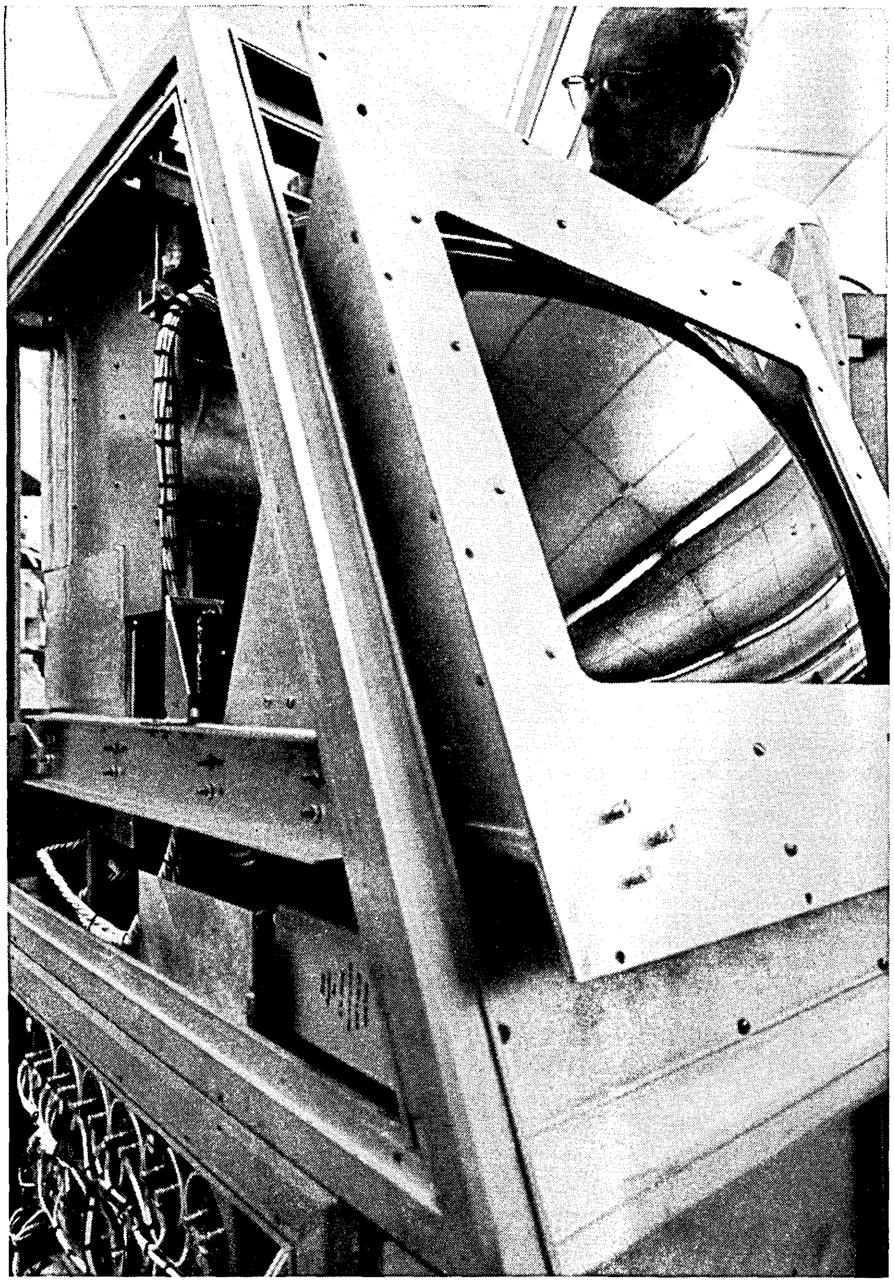
CONTROL DATA
BREAKS THROUGH

Aerospace (El Segundo), evidently tired of IBM delays and software problems, has cancelled an order for 360/65, /40, and /30, will get a 6600 in May; a 6400 scheduled for August will replace two 3200's. On the way out: a direct-coupled 7094-II/7040. The 6600 won on delivery, and on benchmark performance. Reportedly, the 6600 compiled 10-12 times as fast as the 7094 mod II, using the Chippewa software, including Fortran and a 7094 simulator. This first dent CDC has made in the IBM aerospace stronghold was followed swiftly by a Boeing 6600 order.

LIVERMORE TAMES
AN OCTOPUS

Phase I of Lawrence Radiation Labs' ambitious plans to tie its armada of big computers into one network is operational: 48 mod 33 Teletypes are on line to a 6600. Phase II will see the terminals switched over to a PDP-6, which will serve as the master to slave twin 6600's, a Stretch and other computers. Included in the system is a trillion-bit photostore, due from IBM in mid-'67. Thus, hopefully, a time-shared system within a direct-coupled system will offer the advantages of both T-S and batch processing.

A Lab official says that the system (appropriately named Octopus) will pay for itself -- including



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the 6, photostore, discs, etc. -- because new peripherals won't have to be added as new cpu's are installed. (The Lab will replace the 6600's with a pair of the new version of the 6800, probably in '68.)

MORE SOFTWARE COMPANIES IN THE RUNNING

Census takers should note two more software outfits. Applied Data Systems Inc., San Francisco, is a two-year-old firm headed by Peter Harris and markets ADPAC, a gp, 2-address, commercial programming system said to be the only 1401 language fully transferable to the 360. And with new generators, source programs would run on virtually any machine. It also offers faster (than Cobol) assembly and test times at a lease price of $15K plus $1K per year. ... In Hackensack, N.J., Realtronics has been formed by three ex-ITT men. Specializing in real-time systems, the firm has contracts with ITT and Western Union.

RUMORS AND RAW RANDOM DATA

We hear the State Dept. is encouraging sales of older U.S. computers in eastern Europe, though none with faster than 3.5 usec cycle times. Look for IBM, RCA, others to start pushing second generation machines in Poland and Czechoslovakia. ... CDC is getting $1200/hr. for use of its 6600 in L.A. But this sometimes includes patching, changing of control cards, etc. And if the job doesn't run at the rated performance, price adjustments or negotiations follow. ... IBM is supposed to release multiprogramming (they call it multitasking) software in December. Looks like they will scrap the E level assembler. ... Latest IBM software slippage is the F level PL/I, now due (four months late) in August. Seems that as the compiler now stands, if one codes erroneously, some of the errors slip through into the object program, creating havoc when the programs are run. ... Univac has won a $3 million order for an 1108 at the Naval Ordnance Test Station in China Lake, which had been a solid IBM customer for 15 years. Losers were the 360/65 and the 6400. GE withdrew earlier. ... The AEC has given SLAC (Stanford Linear Accelerator Center) permission to negotiate with IBM, presumably for a /91 or /92. Looks like CDC loses out. ... Westinghouse has ordered six more B 5500's to go with the two they now have. Meanwhile, the belief that big W will bid to build gear for Livermore (Feb., p. 17), encourages rumors the company may enter the computer biz by buying CDC. ... Harlan Anderson, SJCC chairman, has left DEC. He was a vp and one of the founders. ... RCA says it has over 300 orders for the Spectra 70. ... Standards fans are upset over an Air Force spec calling for a nonstandard Cobol. ... Another new firm, a time-shared service bureau using eleven 1440's and 1460's, is being formed in Washington. The name: VIP Systems Corp. ... Howard Bromberg is leaving CEIR to set up his own consulting operation in San Francisco. ... Two more Sigma 7 orders have been received since the first from Wadley Research Institute; they'll go to Johns Hopkins physics lab and Bolt Beranek and Newman. ... Computer Usage gets the contract from IBM to do command language for the Model 67. The company has opened a suboffice in Washington to concentrate the scientific programming talent in one place. ... Haverly Systems, Inc., Denville, N.J., is announcing linear programming software for the Honeywell 120, 200, 1200 and 2200. ... Datamation definition of a third generation computer: one that's incompatible with a second generation.

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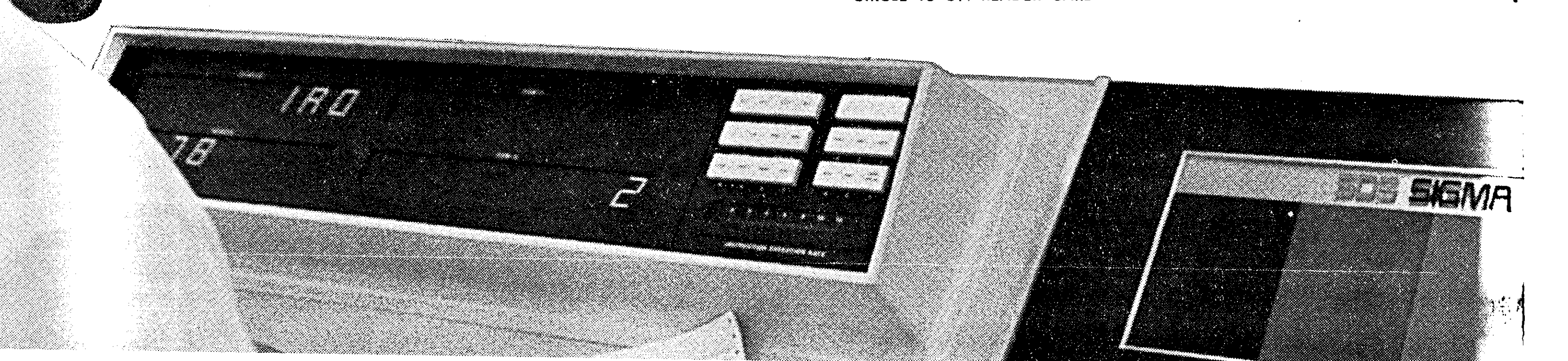


editor's readout

THE FUTURE STRIKES BACK

Last month, the *Los Angeles Times* carried an article reporting a talk by a professor from UCLA, who predicts that in a century or two science will be able to "re-create the exact duplicate of men and women who have been dead for thousands of years." The reconstruction will be based on the genetic codes preserved in dried tissues of mummified bodies.

Quoting the professor, Elof Carlson, the article hints at some of the benefits of such activity: "For example, once the genetic code of great musical genius is determined, hundreds of thousands of his duplicates can be created for the world's benefit."

Ever-alert to the implications to our industry of advanced scientific thinking, *Datamation* offers here its interpretation of how such scientific sleight-of-body might affect information processing.

In the year 4096, for instance, we might find the head of programming at All American Aviation poring over some programs which exhibit strange characteristics: they don't work. Tracing the evolution of the program, our hero finds in the archives an ancient, yellowed coding sheet dated April 1, 1966. Barely visible on it is the scribbled name of the coder, Fred Garbage.

A call to the programmer's crypt reveals the identity of the culprit, whose genetic code is isolated and used to produce a duplicate of Mr. Garbage, who now recodes the program, creating the documentation he failed to produce before, thus enabling AAA to salvage one sick program. Whether Garbage (mod II) will be retained to create new problems for future generations of programmers—or be fired—is not clear.

The implications of the duplication of long-goners for manufacturers looms large also. It would seem possible to create a sales force of duplicates of 100 percenters. Or the company might want to duplicate salesmen who *never* met quota and try to get them hired by competition. Univac might try the same trick with the people who made the 90-column card decision.

The possibiliy of duplicating Great Programmers is enough to make the successors of Elmer Kubie and Fletcher Jones drool in anticipation. And it would seem that tomorrow's employer might be able to offer each GP an exact replica of Marilyn Monroe or Sophia Loren as a secretary. For companies with access to the mummifying process, *that* would seem to be an attractive fringe benefit. After all, it *does* border on immortality.

At computer conferences, facsimile Herb Grosches and Jackson Granholms will regale luncheon audiences, while copies of the same old faces which run the shows, give the papers and fall asleep at the sessions will be seen as usual. This, of course, will be by design: manufacturers and users will send the umpteenth generation of conference goers off to trade shows (and standards meetings), leaving the workers behind to produce.

The fertile imagination of our readers will undoubtedly supply many other possibilities inherent in the re-creation of the dead. We have tried here merely to stimulate your imagination, and to suggest that for those of today's firms which can survive another century or two, the future is unlimited.

COMPUTER GRAPHICS

ten unsolved problems

by IVAN E. SUTHERLAND

Computer graphics, the use of computers to generate and interpret pictures, is an extremely broad subject. A complete discussion of computer graphics would include such areas as pattern recognition, display equipment, and schemes for plotting results from numerical computations, as well as a discussion of the on-line use of computer-generated pictures. The articles in this issue cover a part of this subject area. This article, concerning the on-line use of computer pictures, discusses a representative sample of the topics of interest to today's researchers in on-line computer graphics.

Because there are very good people working on each of these unsolved problems, I expect that the next few years will see interesting solutions to many of them. As our use of on-line computer graphics improves, we gain new capability to visualize and thus understand complex processes. I feel that the gain will be worth the research costs.

hardware characteristics & cost

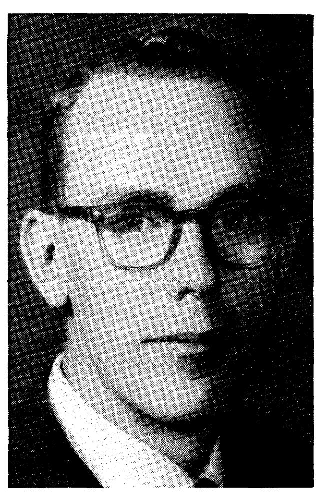
The first problem is to get more people involved in on-line graphical systems. The only way to involve many more people is to bring the cost of on-line display devices down to a more reasonable level. The first and the biggest unsolved problem, then, is to build a low-cost display device suitable for on-line graphical use. The solutions to all the other problems may depend on solving this first one.

But the "ideal" low-cost display must have at least the following characteristics, outlined by Roberts at the 1965 IFIP Congress[1] (see Table). First, a display device must have a certain minimum standard of quality. A mathematician working on a geometrical problem might draw three lines on his display as shown in Fig. 1. If there is a little triangular space between the three lines he may wonder, "Do those three lines really meet at a single point?" Too many of today's displays have line generators that produce slightly curved lines. Such errors in display equipment undermine users' confidence in what they see.

The second characteristic is flicker rate. There is a lot of debate about what flicker rates are acceptable in a display. No one, however, will debate that refreshing a display once every five minutes is not acceptable. Flicker rates in the range of 15 to 45 cps are useful.

The third characteristic is modification time. People who have been waiting for three hours or three days for a result from conventional computing centers get impatient if they have to wait three minutes for trivial results from an on-line system. There is a point, between five and 20 seconds, where instead of waiting at the console ready to do the

[1] Roberts, Lawrence G., "Graphical Communication in a Time-Sharing Environment," *Proceedings of IFIP Congress '65,* New York City, 1965.



Dr. Sutherland is director for Information Processing Techniques at the DOD's Advanced Research Projects Agency, Washington, D.C. He received his PhD at MIT, where he wrote his thesis on the sketchpad system. He also holds a BS and MS in EE from Carnegie Tech and Caltech, respectively. During his work at MIT, he was associated with the MIT Lincoln Laboratory, moving then to the National Security Agency prior to joining ARPA. He is a member of the IEEE, ASME, and the ACM.

next thing, you will get up to stretch your legs, or have a cup of coffee. A display system must respond to modification quickly.

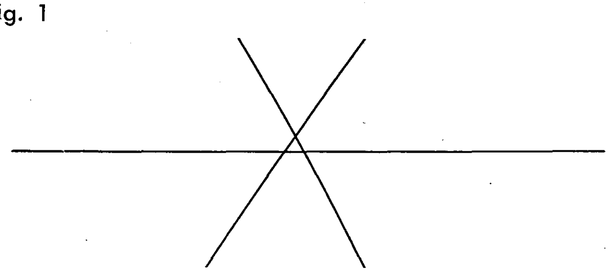
Fourth, there must be some kind of stylus input. You have learned over years of experience to take your pen in hand and sign your name. Any other way of signing is unusable. A display must have some kind of device that you can take in your hand and which tells the computer *where* you are writing. DAC-I's[2] voltage pencil stylus plate and the RAND Tablet[3] give this capability directly. A light pen can give position inputs with appropriate pen-tracking hardware or software.

The final and very important capability is pointing. You must have some kind of device which lets you talk about a picture in pointing terms. You have to be able to say to the computer, in effect, "I want to erase *this* letter," by pointing to it. The light pen gives this ability directly. A RAND Tablet or DAC-I's voltage pencil stylus plate must

Table

- Quality:—How accurate is the picture produced?
  - Character legibility
  - Line straightness
  - Focus
  - Uniformity
  - Resolution
- Refresh rate—How flicker-free is the picture?
- Modification time—How long does it take to get a new picture?
- Stylus coordinate input:—Where is the stylus?
  - Direct from:
    - RAND Tablet
    - DAC-I voltage pencil stylus
  - Light pen requires tracking
- Stylus pointing input:—What is he pointing at?
  - Direct when light pen "sees" character
  - Position coincidence detector required for:
    - RAND Tablet
    - DAC-I voltage pencil stylus

Fig. 1



be augmented with coincidence detecting circuits[4] or software to provide this information.

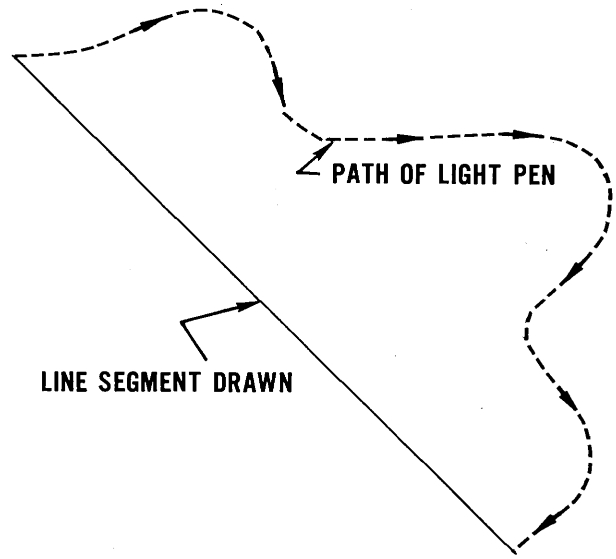
How we are going to get a low-cost display that has all of these characteristics I haven't the slightest idea. It is an unsolved problem. Nevertheless, I feel sure that the next year or two will see a solution in one form or another.

problems of technique

There are a large number of little gimmicks that make the difference between a highly-usable and a difficult-to-use on-line system. People will approach difficult-to-use on-line systems only if the advantages are immediate and obvious. If on-line systems are to be used for simple tasks, they must operate smoothly enough to be useful. A draftsman, for instance, with a choice of using a computer system or his old familiar paper and pencil will choose to use the computer only if it actually makes his job easier. It will be some time before we learn to use enough techniques to make the on-line systems as smooth in operation as they should be.

Here are a few known techniques. In SKETCHPAD,[5] I used a technique which we can call "Rubber-Band Line." As you draw a line, the line stretches like a rubber band between where you left its starting point and wherever you have your stylus. What gets left in the computer is not the path of the light pen, but a single straight line as shown in Fig. 2.

Fig. 2



Another technique I used in SKETCHPAD we can call the "Pseudo Pen Location." When you bring the light pen near an existing line in a drawing, the little bright dot, which is the "point of your pencil," jumps to sit on the line. Anywhere near a line, the point of your pencil sits exactly on the line with mathematical precision. Pseudo Pen Location proved to be a useful little feature.

The RAND Corp. is pioneering a technique in which characters are recognized as they are drawn on a RAND Tablet. I think this is going to be a very important technique because you cannot type while holding a stylus in one hand. In systems which involve a little lettering, as well as other operations, it will be very useful to print the letters you want directly where you want them.

We need not be limited to recognizing letters. For instance, it should be possible to erase a curve in a picture by making some little wiggly "erasing" motion over it, instead of finding and then pushing the erase button. In editing text, we should be able to use motions familiar to typesetters such as ~, which says, "transpose those two characters." The characters should instantly interchange. We should be able to draw balloons around sentences with little arrows to say, "Take out all *this* junk and put it up here." These balloons would be recognized by a computer.

Timing and rate functions are important on-line. For example, a rather simple timing technique can vastly improve the "feel" of a knob. I want to move a cursor around on a cathode ray tube, to position it on top of a letter. A good way to position the cursor is to connect a couple of knobs to the x and y coordinates of the cursor. The cursor will move around on the screen when I turn the knobs. Such arrangements are common.

I tried a program which moves the cursor quadratically with the speed of the knobs. You naturally give the knob a good healthy twist whenever you want to move the cursor

[2] The Design Augmented by Computers system at General Motors Research Laboratories.
[3] Davis, M. R., and Ellis, T. O., "The RAND Tablet: A Man-Machine Graphical Communication Device," *RAND Memorandum RM-4122-ARPA*, 1964.
[4] Hornbuckle, Gary D., "Display System Specifications," Project GENIE Document 20.60.10, Computer Center, Univ. of California, Berkeley, 1965.
[5] Sutherland, I. E., "Sketchpad: A Man-Machine Graphical Communication System," *Proceedings of the Spring Joint Computer Conference*, 1963, and *MIT Lincoln Laboratory Technical Report No. 296*, 1963, reissued 1965.

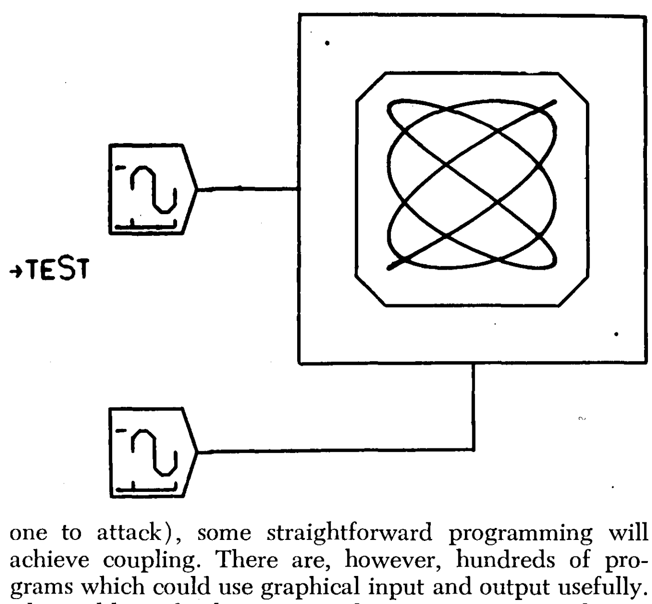
a long way. Because of the quadratic connection, the cursor moves extra rapidly. You will naturally turn the knob slowly when you are close, and then the cursor moves slowly and smoothly. This quadratic technique makes the cursor seem to "understand" what you want.

coupling problems

The third unsolved problem is how to connect computer graphic devices and systems to substantive computation. It is easy to draw a circuit or a bridge or a diagram of a part with a graphical device. It is not nearly so easy to make use of that drawing in doing computations about the thing that you have drawn. For instance, I should be able to draw a circuit diagram, and then observe the operation of the circuit as shown by some waveforms. I should be able to draw a complicated part, apply "forces" to this part by drawing them, and observe the stress distributions in the part. We have some computer programs which can do the computations. We have computer programs which can generate the drawing. But we don't have these separate computer programs put together. That is the problem of coupling.*

For any specific system you can think of (electric circuit diagrams and stress analysis are just two of the most obvious one to attack), some straightforward programming will achieve coupling. There are, however, hundreds of programs which could use graphical input and output usefully. The problem of achieving coupling in a very general way, so as to apply to a wide variety of tasks, will require much thoughtful effort.

Fig. 3
A drawing as input to a simulator. Two sinusoidal oscillators were drawn and connected to a scope. Different frequencies were specified for the oscillators. The simulation was run, giving the Lissajous figure shown inside the scope.[7]



Let me mention a place where coupling does exist and where it will be useful. It is possible to draw shapes in two dimensions with computer systems rather well. It proved to be very easy to take the descriptions of those shapes and turn them into commands for numerically-controlled machine tools. Marvin Ling[6] from GE provided me with the part shown in Fig. 5, which was actually produced from the computer-made drawing shown in Fig. 4. It is exciting to think that a light pen can, in effect, carve metal.

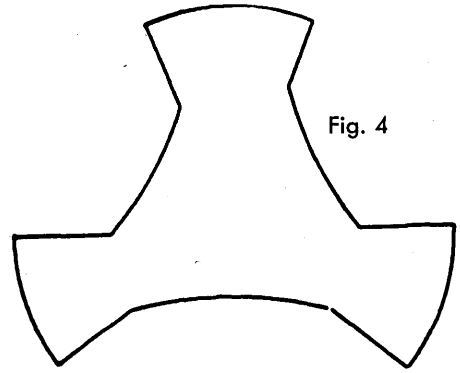


Fig. 4

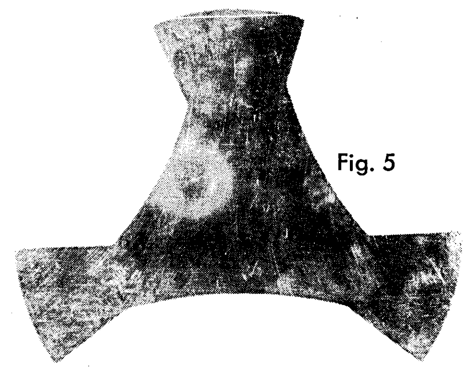


Fig. 5

There are many unsolved problems having to do with the language of discourse between human beings and computers. Although we speak English every day, we don't often think of it as a "language" in the same sense that we think of FORTRAN as a language. In the computer business when we talk about languages, we usually mean the languages of written symbol strings. But whenever you interact with a computer, the commands you can give the computer and the cues that the computer gives you back, whether they are simple written strings or noises or flashes of light or clicks or presses of buttons or motions of the light pen,—whatever they are, they constitute a language. It is sometimes a little more difficult to recognize complex drawing languages as languages than it is to recognize and talk about the symbol-string languages. There is a lot of theoretical work to be done in understanding the more esoteric languages such as Culler-Fried,[8] SKETCHPAD[5] and the better ones to come.

describing motion

There is one thing which does not exist in any of today's interactive graphical languages: a way to describe motion. Bell Telephone Laboratories has several computer-produced movies. One of these shows the motion of two masses interacting through gravity.[9] In it you can see the two masses rotating about each other to form orbits of different kinds. The computer traces the path of the masses so that you can see the shape of the orbits.

The amount of information required to specify such a movie is really very small. For instance, the movie shows

* This problem is near solution (see Fig. 3).

[6] Ling, Marvin, "The Logical and Analytical Structure of the Computer-Aided Design Process as Applied to a Class of Mechanical Design Problems," Univ. of Michigan, 1964.

[7] Sutherland, William R., "The On-Line Graphical Specification of Computer Procedures," MIT Lincoln Laboratory Technical Report No. 405.

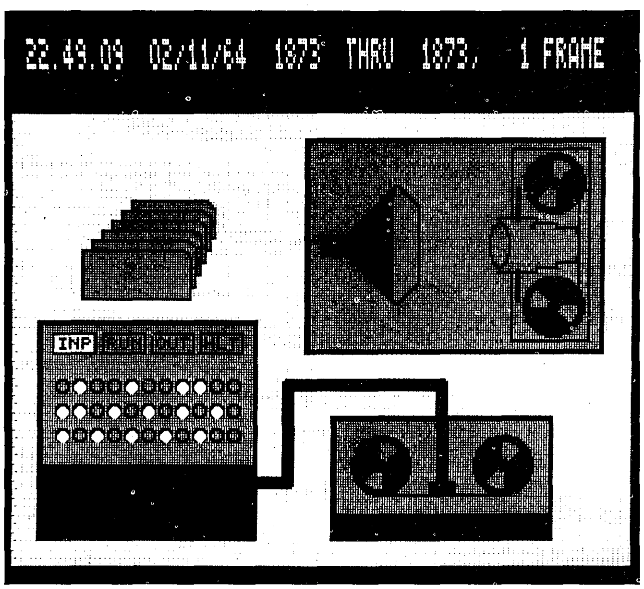
[8] Culler, Glenn J., and Fried, Burton D., "The TRW Two-Station On-Line Scientific Computer," *Proceedings of the Symposium on Computer Augmentation of Human Reasoning*, Washington, D.C., 1964.

[9] Sinden, F. W., "Force, Mass and Motion," Bell Telephone Laboratories (movie).

the motion of a mass under just the influence of a downward force. The mass starts at the bottom of the screen, moving up. The mass slows down because of the downward force. The movie shows that the mass is moving in a parabola because each second it leaves a mark behind. When the mass gets right up to the vertex of the parabola, the force is turned off. Without the force, of course, the object continues in a straight line.

To make this scene, the computer must be told "Draw me an object which observes F=MA. Apply a downward force to it. Give it initial velocity like *this.* When it reaches *here,* remove the force. I want velocity and force indicators like *this.*" We could express that in FORTRAN, but I should be able to express it more easily graphically and on-line. Knowlton's movie language[10] lets you describe moving figures of the kind shown in Fig. 6, but only in a written language. You can make animated cartoons of a type now

Fig. 6



made by hand, at a cost which is comparable to conventional means. The hard part of using Knowlton's language is figuring out what the picture is going to look like as you write. Since you want an artistic picture, you have to make a little sketch ahead of time on graph paper. You then pick off the coordinates from the sketch and jot the coordinates down on a piece of paper to give to the computer. Knowlton's language has the motion capability but it doesn't have the on-line characteristics. I should be able to sit at the console and draw what I want. I should be able to adjust it until it is artistic. I don't care about the exact coordinates and I shouldn't have to write them down.

halftone capability

Any computer display that you look at today will be 90% blank space. The lines or characters will occupy only a tiny part of the display area. Most of the display area on that cathode ray tube will be unused. Today's displays characteristically produce the same kind of drawings that I can produce on a blackboard: drawings composed of narrow lines and little dots. There are many interesting things which computers could represent if they had some half-tone capability. Knowlton's movie language produces half-tone movies, but it cannot show them in real-time. I would like to see a half-tone display change as I watch. It should be possible to build hardware for such a display, perhaps even in color.

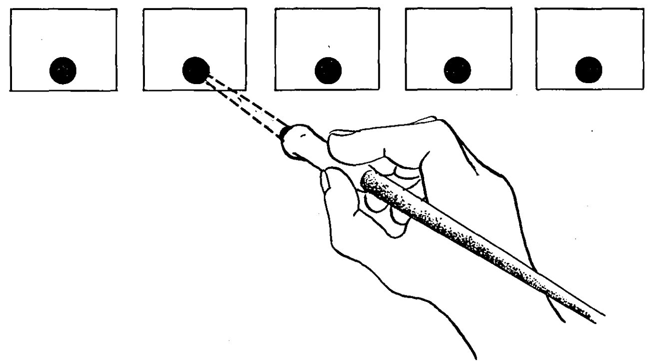
If I had such a gadget there would be a whole host of unsolved problems in graphics about how to use it. The entities that I would have to talk about would no longer be just simple lines or characters, but things with body: a shaded rectangle, or a rectangle outlined in dark and shaded in the middle, or shaded dark on one side and lightly shaded in the middle, or shaded dark on one side and lightly toward the other side. We haven't even begun to have languages that are capable of describing such things.

structure of drawings

The sixth unsolved problem has to do with the structure of drawings. We human beings are able to look at drawings and detect symmetry in them. For example, the drawing shown in Fig. 7 has a rather obvious structure or symmetry to it.

Now suppose that a man who is using an on-line system points his light pen or his RAND Tablet

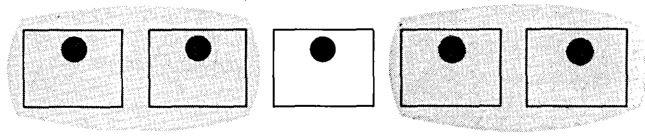
Fig. 7



stylus at this drawing as shown in Fig. 7, and then says, "delete." The correct computer response to the "delete" command depends upon the real underlying structure of the drawing. If the drawing is intended to represent five independent boxes, the correct response might be to erase one of them. Or the correct response might be to erase the dot from each box. If, however, the underlying structure of the drawing is really two groups of two boxes each, with an additional box in the middle as shown in Fig. 8, then the correct response might be to erase the righthand dot in each pair.

For people, the underlying structure is made clear by context. In fact, we usually do not even think explicitly about the underlying structure. But if a computer is to make good use of the underlying structure of drawings,

Fig. 8



then we must have languages powerful enough to explicitly represent the structure of pictures. Moreover, the languages must represent the structure of pictures. Moreover, the languages must represent the structure naturally enough so that it doesn't get in our way. We must represent the structure so users can see it. In Fig. 8, a dotted line around the groupings shows the structure, but that would not be appropriate in every case. We must learn how to represent structure for human consumption.

We must also build languages which can construct structure. Dialogue may help. If you, for instance, tell an electrical draftsman, "Remove the gate," while pointing to one of a parallel set of gates, he will immediately ask you,

[10] Knowlton, K. C., "A Computer Technique for Producing Animated Movies," *Proceedings of the Spring Joint Computer Conference, 1964,* Spartan.

"Do you want me to remove them all or just that particular one?" A computer could ask that same question too, given an appropriate program. We have much to learn before it will be possible to write such a program.

hidden lines

There are three more problems, which have to do with the computations involved in using computer graphics, rather than the graphics themselves. The first of these is the hidden line problem. When we look around the world we see opaque objects and we don't see what is behind the opaque objects. It is hard to make objects displayed by a computer look similarly opaque. It is easy to make a perspective presentation of any individual point in space. It takes a few multiplications and a division or two to implement the coordinate transformation from the three-dimensional space coordinates to the two-dimensional display coordinates. By programming this transformation you can easily display transparent or "wire frame" views of your object, as shown in Fig. 9.

It is much harder to decide whether a point ought to show or not. It is a major task to eliminate hidden lines from the drawing. For instance, in the display of a cube I ought

Fig. 9

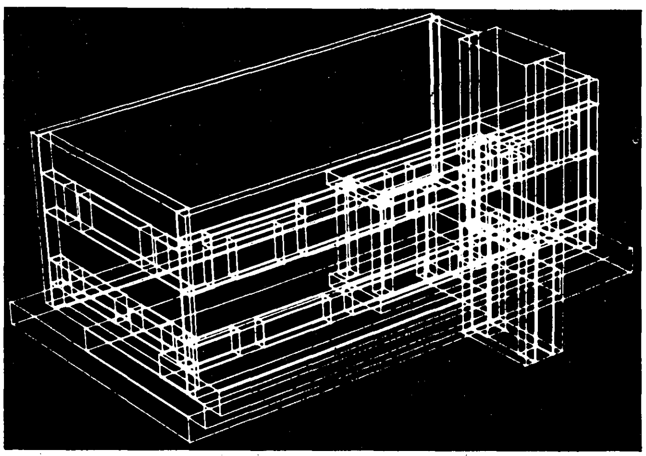
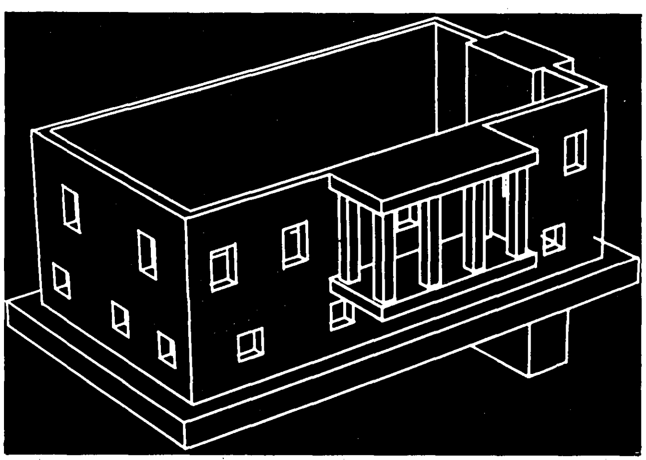


Fig. 10



either to see the rear lines dotted, or I ought not to see them at all. It is not too hard to eliminate the hidden lines for a single cube. You merely show all parts of any face of the cube that faces the viewer. It is much harder to eliminate parts of lines from one object that is partly hidden by another. You must decide how much of each edge, if any, to show for partly-hidden objects.

It is conceptually easy to eliminate hidden lines by brute force. You represent each line as thousands of little points and you eliminate any point hidden by any of the thousands of objects which might be in front of that point. Unfortunately, the amount of computation involved gets rapidly out of hand. A more elegant solution is possible. Roberts of the MIT Lincoln Laboratory generates views of solid three-dimensional objects with all the hidden lines removed[11] (see Fig. 10). Roberts' technique, which uses a method of linear inequality, is limited to plain-faced objects. Applying Roberts' technique to surfaces more complex than plain faces—to the conics or cubics, for instance—is going to be quite a difficult task. It is essential to do this task if we intend to look at displays of "solid" objects.

program instrumentation

The eighth problem has to do with making computer programs less inscrutable. You can see all the pieces of a clock you have taken apart. Each has a characteristic shape. You can look at a gear and easily pick out the only other gear it could possibly match with by just looking at the size of its teeth. Because you can see what the parts do, you can look at a fairly complicated mechanical gadget, and understand it.

Have you ever tried to pick up somebody else's computer program and understand what it does? It ought to be possible to display whatever it is about a computer program that makes it unique. It ought to be possible to represent whatever it is that makes an individual computer program individual. I want to look at a display of a computer program and recognize that *this* part must go with *that* part just as I can match up the gears of a clock.

I ought also to be able to see a computer program running. I want to get a display of information about how the computer program is running and what it is doing. For instance, I might use a special program to count how many times each branch is used. I could look at these counters and know what parts of the computer program are used a lot and what parts are not used very much.

I could make a graphic presentation of such information. Imagine, for instance, a flowchart or a block diagram drawn in three dimensions. Two dimensions might show the diagram and the third dimension might show the number of times that this part has been used. All of the parts that have been used a lot would stick way up.

I am not suggesting that three-dimensional flowcharts are the answer for program instrumentation. I merely suggest them as an example. Only when we have actually had experience with several dozen such examples will we have any idea which kinds of presentations help. With such presentations, computer programs would be more scrutable.

The last two problems are unlike the others because they will be with us forever.

logical arrangement

Problem number nine has to do with the logical arrangement of drawings. When we draw an organization chart, we draw organizations of similar function or responsibility beside each other, rather than sprinkled all over the page. In drawing an electrical circuit we may use a convention that relates dc voltage level to position on the page. If I draw a block diagram of a multiplier, I try to show the different parts of the multiplier lined up together. If there is a register that consists of a bunch of flip flops, I try to line them up in a row. If there is a set of gates that enter information into the register, I try to show them below

[11] Roberts, Lawrence G., "Machine Perception of Three-Dimensional Solids," *MIT Lincoln Laboratory Technical Report No. 315*, 1963.

the flip flops. If there is some other logic net, I try to show it collected together by function.

All of these things have to do with the logical arrangement of the drawing. They have nothing to do with its topology, which would be the same no matter how the drawing was arranged. By arranging the parts of the drawing in a "sensible" or "logical" way, the meaning of that drawing can become much more apparent. The ninth unsolved problem in computer graphics, then, is to get computers to make drawings with logical layouts.

Although there have been some fine attacks on this problem, each is limited to a particular area, and falls down in some cases. Because for each particular case, "logical" takes on a different meaning, we may never find a complete solution. Perhaps the best we can expect is an interactive system in which a man and a computer, together, can come up with an arrangement that satisfies the man.

working with abstractions

The tenth and final problem has to do with abstractions. In all fields of scientific endeavor, the man who makes the scientific progress is the man who understands. Such a man has either a mental model, or a notation, that lets him represent and, therefore, think about a mass of complexities that nobody ever understood before. In one or two words he is able to say, "This is the way it is." He puts together a beautifully simple little "theory" which explains all the complexity.

For instance, we can think about a "bell-shaped curve." The heights of people probably form a pretty good "bell-shaped curve." But the bell-shaped curve isn't anything that exists in nature. It exists only because somebody chose long ago to represent heights in Cartesian coordinates and his graph came out with a characteristic shape. A lot of other things represented in Cartesian coordinates came out to have the same shape. People started to talk about the properties of the shape and useful predictions resulted. The "bell-shaped curve" is a fiction. It isn't anything that exists in nature. It is a description of the fact that certain things which do exist in nature come in different sizes: people come tall and short, but most people are of medium height.

What are some other examples of abstractions? We can speak of a "sawtooth oscillator." A sawtooth oscillator doesn't produce sawteeth (I can just see a sawtooth oscillator spitting out teeth!). It produces an output voltage that looks like sawteeth only when you graph it as a function of time. Another abstraction might be useful in representing an automobile sale in a computer. If you buy an automobile you have a choice of getting either white wall tires or black wall tires. Let me call that the "tire option." The "tire option" has properties. For instance, one of its properties is a price differential of $30 or $40. When you buy a car you also have an "engine option." You can either get a "six" or a "big V-8." The "engine option" also has a price differential associated with it. I can ask some questions which have nothing to do with automobiles at all but which ask you about these abstractions. I can ask, for instance, "is the engine option bigger than the tire option?"

I have some of my own useful abstractions. When I think about electric circuits, I represent dc voltage as a position on the page. I also represent ac voltage as a position on the page. I visualize an operating circuit as wiggling up and down. I think of resistors as springs, and wires as pieces of string. I think of transistors as containing a little bell-rope puller who doesn't care how much rope he has let out. All he cares about is pulling on his string; he is a current source. This abstract model helps me to analyze simple circuits instantly.

Unfortunately, my abstract model tends to fade out when I get a circuit that is a little bit too complex. I can't remember what is happening in one place long enough to see that is going to happen somewhere else. My model evaporates. If I could somehow represent that abstract model in the computer to see a circuit in animation, my abstraction wouldn't evaporate. I could take the vague notion that "fades out at the edges" and solidify it. I could analyze bigger circuits.

In all fields, there are such abstractions. We haven't yet made any use of the computer's capability to "firm up" these abstractions. The scientist of today is limited by his pencil and paper and mind. He can draw abstractions, or he can think about them. If he draws them, they will be static, and if he just visualizes them they won't have very good mathematical properties and will fade out. With a computer we could give him a great deal more. We could give him drawings that move, drawings in three or four dimensions which he can rotate, and drawings with great mathematical accuracy. We could let him represent all kinds of very complex and very abstract notions, and we could let him work with them in a way that he has never been able to before.

I think that really big gains in the substantive scientific areas are going to come when somebody invents new abstractions which can only be represented in computer graphical form. As he begins to work with his new abstraction, he is suddenly going to discover something brand new and really exciting which may revolutionize the world. How do you go about inventing new abstractions? I am afraid I really don't know. ■

CANADIAN DP CONFERENCE

computers & users

If the selection of Las Vegas as the site for a computer conference kept you from getting authorization to attend, you might as well forget this one too. It's the fifth national conference of the Computer Society of Canada, being held May 29 to June 1 at the Banff Springs Hotel in Banff, Alberta. If it isn't "one of the finest conference sites in North America," as it's billed, it is one of the most attractive.

Among scheduled activities are two panel discussions. Moderating the session, "Social Implication of Computers," is Prof. Leslie Mezei of York Univ. And "Computing and Big Business in the Next Five Years" will be headed by Dr. Harvey S. Gellman of DCF Systems Ltd. and past president of the society.

The conference committee, under general chairman K. R. Marble of Imperial Oil Ltd. and program chairman B. A. Hodson of the Univ. of Manitoba, has set as the theme "Computers and You, the User," and has solicited papers from non-members of the society. Accordingly, authors from the U.S., Canada, Europe, and Australia have reportedly been heard from. Papers accepted cover computer graphics, time-sharing, assessment of programmers and analysts, statistical techniques in the oil industry, and a paper by a nurse: user's appreciation of a real-time system.

The Computer Society of Canada is that country's representative to the IFIP. It consists of 10 geographical Sections, and the president is Prof. J. W. Graham of the Univ. of Waterloo, Waterloo, Ontario. ■

COMPUTER GRAPHICS—WHERE ARE WE?

improving man-computer communications

by DR. FRANK D. SKINNER

The computer-man interface has long been the limiting factor in computer productivity. New applications and tighter schedules have increased the need for faster, more convenient methods of user-computer intercommunication. Multi-tasking and time-sharing requirements have underlined this urgency. Computer-linked graphic devices promise a breakthrough comparable to the introduction of data processing itself.

It has been estimated that displays and graphic I/O devices, virtually unused as recently as 1963, will constitute approximately 13% of the information processing equipment cost for a typical manufacturing company by 1973.[1]

This article will report on the use of display consoles —cathode ray tube displays with versatile entry devices— now and in the near future. The many display devices now available range from small alphanumeric units to fairly sophisticated terminals which permit the display of graphic images with points or lines.

A display presents information from the computer to the user. The operator uses a light pen, a light-sensitive device, to indicate to the computer that a selected segment of the displayed information has been seen. With the addition of a tracking capability (either through hardware or programming), the light pen can also be used to feed in a continuous stream of two-dimensional, coordinate information to the computer.

Other data can be fed to the computer with alphanumeric keyboards, function keyboards (where the meaning associated with each key is determined by the user's program), switches, or knobs. These are only a few of the features available to users.

potential applications

The flexibility inherent in displays can best be illustrated by examining some potential applications. Six classes of applications will be explored. The first two relate to information generally associated with commercial data processing, the next two cover both commercial and scientific areas, and the last two are primarily engineering or scientific oriented.

Customer Service. Customer service applications gener-

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[1] Diebold, John, "What's Ahead in Information Technology," *Harvard Business Review*, Sept.-Oct., 1965.

ally require rapid access to large files of alphanumeric data, to provide answers to an inquiry. Since the inquiry typically arrives by telephone, the response must be provided within seconds. Inquiry data fed through a keyboard can be used by a digital computer program to access files of information. Responses can be fed back to a CRT display at rates which range from hundreds to thousands of characters a second (depending on whether the display is attached to a local or remote computer). Also, a light pen can be used to select inquiry options shown on the CRT display. Updating of the file may take place during—or as a result of—the inquiry. Examples of customer service applications include: airline reservations, customer billing of telephone inquiries, utility or retail inquiries, telephone mail ordering, and insurance claim servicing.

Management information system. A system for disseminating management information has requirements similar to those of the previous application. Here, however, there is a greater need for analyzing and formatting the data obtained from the file prior to its display. As with the customer service application, inquiries can be made with a key board or light pen. In some cases displayed data can serve as keys for further inquiries. For example, a display on the current status of a development project may contain an item related to the project budget. Selection of this budget item with a light pen could serve as an inquiry to display additional budget information. While a purely alphanumeric display may handle some applications in this area, there usually will be a need for a graphics capability as well. There is no obvious requirement for files to reflect continuously the up-to-date information needed for management review. A display console provides a very convenient method of handling such file maintenance.

Information Retrieval. The retrieval of information from a large file is a variation of the previously described applications. Some management information systems will have only an information retrieval capability. Information retrieval is listed as a separate area, however, since it can encompass categories of data outside of those required for customer service or management review. Examples of this would be an information retrieval system established to permit access to files of legal information, or to permit the review and selection of standard mechanical or electrical parts.

Programming. Programming applications include program writing, debugging and documentation.

A display console provides a convenient means of preparing program statements, whether in an assembly language such as FORTRAN, COBOL or PL/I. Language statements in card-format form can be collected in a file for input in batch form to an assembler or compiler. Alternatively, a "conversational" language capability provides for immediate assembly or compilation and—to some extent—combines the functions of program writing and debugging. In addition to being useful for debugging programs written in higher level languages (i.e., assembly), display consoles can also be effectively used to accomplish program debugging at the machine instruction level. The status of selected machine registers and memory locations can be rapidly reviewed and modified.

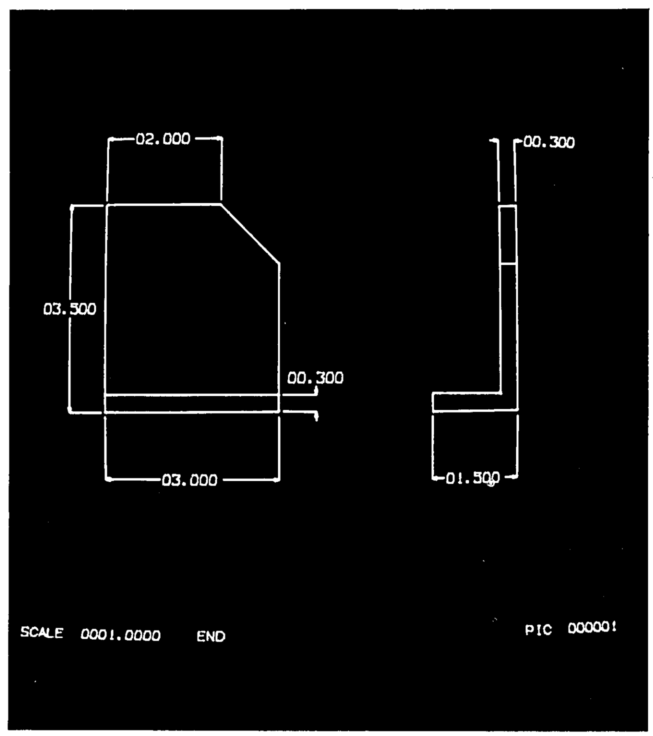
One aspect of program documentation is the preparation of flow charts. This involves organizing and interconnecting a variety of graphic symbols and associated alphanumerics—an easy task at a graphic display console with a light pen and a function keyboard.

engineering and mathematical analysis

Examples of engineering and mathematical analysis are electrical circuit analysis, structural analysis (individual mechanical component or an entire frame structure), analysis of the response of a feedback control system, weight determination, analysis of aerodynamic response, statistical correlation, system simulation, and mathematical function analysis. Input and output data for these applications usually fall into three categories—mathematical (either equations or numerical values), schematic, or geometric (both two-dimensional and three-dimensional). Programs of this type frequently are used in an iterative fashion. The output response to one set of data determines input data for the next computer run. A program user traditionally requires days or weeks to obtain an optimum solution to a problem. By using a graphic display console with keyboards and a light pen to supply input data and view program responses, an optimum solution often can be obtained in a few hours.

Engineering Design. Design can be broken down into two categories: (1) an extension of analysis applications into the conceptual stage; (2) the preparation of design documentation including detail drawings, assembly drawings, parts lists, bills of material and similar documents. The first category requires more creativity by the engineer, scientist or mathematician, while both require fairly sophisticated graphic data processing equipment and analytical techniques.

Part drawing generated by an experimental 2-D program. The lines, drawn by a light pen, have been straightened, dimensioned, and oriented by the computer program.



These application categories are not mutually exclusive. Also, many application areas have not been included (for example, computer-assisted instruction and medical display applications). New applications are continually being discovered. The categories given, however, should indicate the enormous range of potential display applications.

feasibility of using displays

The recent use of graphic displays at numerous university, research and industry locations has demonstrated that applications in the above areas are feasible. The key question which must be answered for any single application is, "Is it economical?" There is no general answer. It must be asked and answered for a given application in a given environment. For example, the design of an electronic circuit involving considerable computer analysis may be allotted a completion time of a few weeks in one situation, a few days in another. The economics of supporting some device, such as a graphic console, which can radically change the access of the circuit designer to the digital computer, is entirely different in these two environments.

While no universal answer exists concerning the economics of using displays, their use offers potential in three major ways: (1) time savings, (2) dollar savings, and (3) a more thorough job. A graphic console on-line to a digital computer can reduce turnaround time substantially, particularly for applications requiring many successive computer runs. In some industries, rapid response to customer demands or market needs is critical, and any equipment or procedures which can save time must be exploited thoroughly.

While a reduction in elapsed time may have an economic value, dollars can be saved in other ways. For example, in many engineering analysis applications it is common practice to submit a computer run containing many sets of input data which bracket the expected area of interest. Only a small portion of the output results are expected to be significant. If an input data set is supplied to the computer through an on-line graphic console which then monitors the progress of the analysis operation, the user can abort a given run at any time and supply a new set of input data. In this way, the total number of input data sets required for the analysis should be lower, as should the average amount of computer time spent per data set.

In some cases, an on-line graphic console might be used not to save time or dollars directly, but to permit the exploration of many more parameter variations, whether these represent decisions in a management information system or physical parameters in an engineering design operation. This ability to perform a more thorough job analysis can be reflected in better operating procedures, or lower costs for manufacturing, installation and maintenance. Admittedly, this factor is difficult to measure and will take longer to properly realize.

Many of these advantages can be realized, at least partially, by other on-line user terminals. The value of displays, however, lies in the extent of some of their advantages, such as flexibility of formatting and variety of user-computer interaction techniques. Also, advantages such as speed, selective updating (only a portion of the display need be modified during any given update) and quietness should not be overlooked.

experimental programs

During the past few years, I have participated in the Kingston Laboratory. This work has not been associated with the production of release programs but, rather, with the exploration of techniques for using and programming graphic equipment. Some of these experimental programs have dealt with problems such as:

Generation of circuit schematics,
Circuit analysis,
Indexed file retrieval,
Simulated management information retrieval,
General manipulation of two-dimensional geometric data.
General perspective viewing of three-dimensional wire frame figures,
Three-dimensional geometric construction,
Program debugging.

Experience with these programs, plus a knowledge of other experimental work, indicate that some techniques can be shared in a variety of applications, and, therefore, are at least partially application independent. For example:

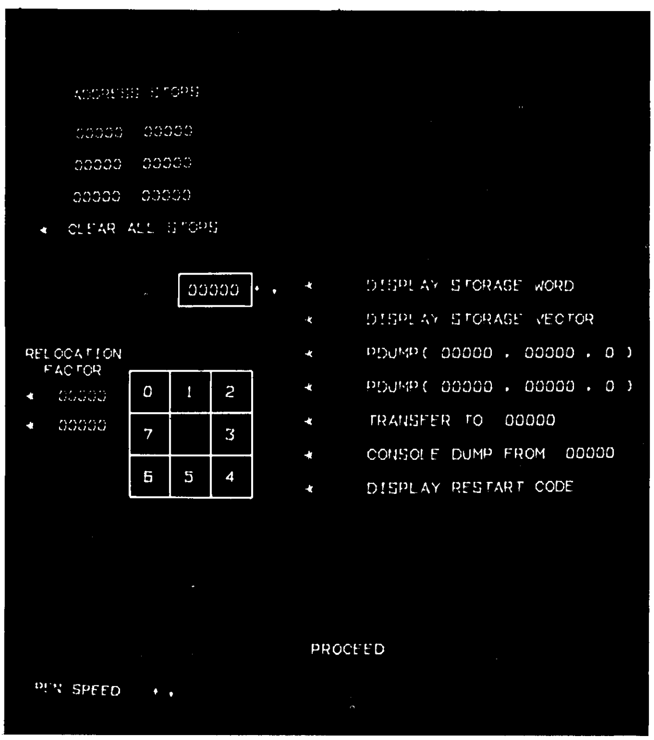
- *Operating System Support*—This is the most obvious example, and one which is certainly not restricted to graphic devices. It includes the capability to send data to and receive data from an I/O terminal, and to accept and sort attention signals requiring further action from the user's program. The initial processing of a signal received from a light pen or a keyboard requires no knowledge of the significance of this action. Programs operating at this level are entirely application independent and may even be device independent.
- *Data Plotting*—The capability to plot data, including the generation of plotting axes and their associated labels, can be shared by a number of applications (for example: plots of statistical data, transient circuit responses, and sales trends).
- *Point, Line, and Arc Generation*—In generating a graphic display, it is necessary to perform a data translation from some application model form in the computer memory to the actual orders which will drive the display. While the model may contain higher-level elements (the representation of a resistor, for example) there is a level in the data translation process at which most, if not all, of the graphic elements can be represented by points, straight lines and circular arcs (a resistor would be displayed as a sequence of straight lines). A further reduction of circular arcs to straight lines or points and of lines to points may be required, depending on the capabilities of the display hardware. A point can be defined in two dimensions by two pieces of data, a straight line by a minimum of four and a circular arc segment by a minimum of six. A general line display subroutine can accept four pieces of data and generate the appropriate order or orders to drive the display whether the line represents an axis on a data plot, the edge of a steel beam or the connection between two boxes on a flow chart.
- *3-D Projection*—The mathematics of projecting an arbitrary three-dimensional point onto a two-dimensional viewing plane—while cumbersome to perform manually—are easily accomplished within a digital computer (an experimental subroutine to perform this task contained fewer than 100 instructions). Since a straight line in three-dimensional space remains straight when projected onto a two-dimensional viewing plane, the projection of a 3-D wire frame figure is accomplished easily. Once the projection has been performed, the procedures described for graphic element display, window positioning and scaling can be used for the actual generation of display orders. The simple projection of a 3-D wire frame figure does not include the determination of hidden lines, and hence this procedure would not be suitable for complex 3-D shapes. Even with this limitation, it can be used to display such items as simple 3-D mechanical parts, tool paths, data from a surveying operation, and contour plots. Different application programs are required for each example but the generation of projected views can be accomplished in an application-independent manner.
- *Alphanumeric Page Formatting*—This does not imply the capability of accepting an arbitary conglomeration of data and automatically determining a suitable display format, but rather the capability to permit the user to specify the positioning of data along a line of the spacing between lines. Such procedures are totally independent of the information content of the alphanumeric data being contolled.
- *Light Pen Selection*—The information detected on a CRT display by a light pen can be used by the program in at least three different ways. First, the light pen can be

used to select items from a displayed keyboard, which might consist of numerals, a complete set of alphanumerics, entire words or graphic symbols. Second, the light pen can be used to select one of a series of possible actions being displayed on the CRT. The selection of a given item must cause entry to a particular subroutine in the user's program. Third, the light pen can be used to select a display item which is to be modified in some fashion. In this case, merely changing the display is not sufficient. The requested action must be reflected by appropriate changes in the problem model housed in the computer memory. Thus, the light pen selection must be related somehow to an item in the problem mode.

These examples can each be described as the light pen selection of an arbitrary *n*th item from a total displayed set of *m* elements. A routine to permit this type of correlation can be shared by all six of the application areas described earlier.

- *Program Debugging*—This refers to debugging at the machine instruction level and not to conversational language capabilities. A subroutine, permitting the display and modification of machine registers and memory locations, can be entered from suitably placed calls in the program being debugged or, alternatively, through the use of an attention signal from the display console. Various levels of assistance are possible, such as the handling of relocation arithmetic or the ability to call for printer dumps which can

Display used in program debugging. The display is presently set up for light pen selection from a numeric keyboard (3x3 box) to put a value in the location counter (five zeroes into in box).



be carried away for further study. Such a debugging subroutine is clearly application independent and even could be used for the debugging of programs which otherwise have no connection with display consoles.

- *Data Structuring*—This category is more nebulous than the preceding ones, and lies in the middle ground between what can be clearly defined as general purpose and what requires further exploration. The distinction between a data structure and a problem model is important. A problem model is housed within a data structure. This structure may be nothing more than a series of tables, but usually consists of a sequence of small storage blocks interconnected in some logical fashion (such as lists or rings) and capable of housing alphanumeric data. A particular model is formed by the actual alphanumeric data housed in the blocks and by the meanings associated with various block interconnections. Consequently, it is helpful to consider data structures and problem models as separate entities. A data structure capable of housing a circuit schematic model in which nodes are interconnected by circuit elements should also be able to house a model of a frame structure in which joints are interconnected by beams, or a flow chart model in which the block interconnections provide a means of tracing the flow of program control. While a truly general purpose model does not exist, there does appear to be a general approach to data structuring techniques which can be adapted to individual problem areas.

- *2-D Graphic Procedures*—This item also belongs in the middle ground between those which can clearly be defined as being general purpose and those which require further exploration. Many different procedures for manipulating 2-D geometric figures have been used experimentally, ranging from fairly rigid construction procedures similar to those used by draftsmen to the comparative freedom introduced by Ivan Sutherland in his Sketchpad work.[2] It is unlikely that any single procedure for manipulating 2-D graphics can satisfy all applications. There is a clear distinction, for example, between schematic information—where the meaning of the diagram is primarily topological rather than geometric and where visual alignment may be suitable—and the information found on some engineering drawings, where dimensional accuracy is essential. Nevertheless, some generality is possible. For example, procedures suitable for manipulating a circuit schematic should also be useful for manipulating the elements of a program flow chart, or a block diagram representing a feedback control system.

This list undoubtedly is incomplete. It is sufficient, however, to indicate the existence of a broad range of graphic techniques which can be adapted to many different application areas. The initial adaptation should be made in those areas in which procedures for processing the application data already exist. The usefulness of such applications will already have been proved, and operating experience against which to measure the impact of a display console will have been obtained. While examples of such applications can be drawn from each of the six application areas described at the beginning of this article, the following three offer the most potential for the next two years:

- *Customer Service*—Many applications in this area will be operational in the near future.
- *Programming*—Console debugging has been demonstrated, as well as manipulating the geometric data and alphanumerics required for flow charts.
- *Engineering and Mathematical Analysis*—A large selection of analysis programs already exist. Experience has shown that such a program can be adapted to include the use of a display console in six man-months or less. The resultant program may not make the most efficient use of the graphic console, but it will provide that all-important first step.

The computers of today and our knowledge of how to use them represents a few orders of magnitude of improvement over what was available 10 years ago. Similarly, the graphics equipment and the techniques for its use in 1975 will be vastly superior to that now available. Our progress must be evolutionary, however, and will be profoundly influenced by the practical experience gained during the next two years, using the tools of today. ■

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[2] Sutherland, I. E., "Sketchpad: A Man-Machine Graphical Communication System," *Proceedings, AFIPS*, Spring 1963.

COMPUTER GRAPHICS AND INNOVATIVE ENGINEERING DESIGN

the super-sculptor

by STEVEN ANSON COONS

It is rapidly becoming clear that graphical communication with a computer is of very great importance in man-machine interactive systems. At the beginning of an innovative engineering (or scientific) investigation, graphical modes of thought are natural; the engineer instinctively draws a sketch of a mechanism, or a diagram of a circuit, or possibly a flow diagram of a computational procedure, or a block diagram of transfer functions for a system. Indeed, graph theory itself is a study of graphs and their application to all of these abstract information structures.

The engineer's sketch serves as a mnemonic device that greatly assists him in fixing and focussing his ideas. It is superfluous to point out, for example, that an incidence matrix, while completely describing a graph, is a poor substitute when it comes to being an aid to human intuition and understanding. A similar reflection applies to tables of values that describe functional relationships; a graph is immediately clear, while numbers are not.

The early stages of innovative engineering activity in design are largely unstructured; there is no detailed algorithm that describes the heuristic, unpredictable process of creative engineering, or creative thought, for that matter for the same reason that there is no universal algorithm for constructing algorithms to solve problems, and it is certain that there never will be. This is not to say that certain intellectual procedures that men perform today by an exercise of art cannot in the future be formalized and subsequently mechanized, but it is to assert that there will always be an indefinitely extended hierarchy of intellectual procedures that remain above the boundary of mechanizable tasks, no matter how far we succeed in expanding the boundary. It is at the interface between art and algorithm that the man-machine interactive computer system has meaning and potential. And one of the important modes of manipulation of ideas by mutual action of man and computer is the graphical mode.

As is no doubt well known, the actual physical implementation of computer graphics usually involves a cathode ray tube or 'scope, a light pen or equivalent device for drawing and manipulation of the graph, an associated keyboard, and possibly an array of push buttons and toggle switches for designation of certain frequently used subroutines and macro instructions, all of this peripheral equipment being tied to a computer. The state of the art is one of vigorous change, improvement and growth, and there are many human engineering problems yet to be resolved about the best, simplest, least expensive, and most convenient console configuration that produces ideal coupling between man and machine.

the sketchpad system

The classic step toward graphical communication with a computer was, of course, Ivan Sutherland's SKETCHPAD program,[1] written for the MIT Lincoln Laboratory TX-2 computer, completed in 1962 and probably familiar to most computer people. Sutherland, far beyond merely modeling his graphics capabilities on traditional paper and pencil methods, introduced many transcendental notions into the system. SKETCHPAD is not a passive drawing system, an expensive and precise replacement for traditional devices and methods; it is instead a system that actively participates and assists the user.

For example, the notion of applying a set of constraining relationships between elements of a graph, and the subsequent automatic relaxation of the geometry of the graph or drawing until these constraints are satisfied or until the discrepancies are at a minimum, makes it possible to perform many very sophisticated constructions with SKETCHPAD that would be quite difficult or at best tedious and confusing by conventional geometric or graphical processes.

For example, it is possible in principle to perform graphical field-mapping, the delineation of the potential field of ideal fluids (like electrical flow in conducting plate or magnetic fields, or heat flow, or water flow through earth). Briefly, this consists of sketching an array of flow curves within some flow boundary, and an orthogonal array of equi-potential curves, and modifying and resketching these curves until the resulting net consists everywhere of small squares.

In practice, this graphical procedure is extremely tedious and confusing; if the two families of curves are kept orthogonal, the small rectangles will not at first be geometrically similar. Some will be square, but others will be

Mr. Coons is associate professor of mechanical engineering at MIT, where he is also supervisor of the Computer-Aided Design project in the Design Div. of the Mechanical Engineering Dept. Prior to joining MIT in 1948, he was a design engineer for Chance Vought Aircraft Div. of United Aircraft, where he devised mathematical methods for airplane fuselage lofting by computer. He is a co-author of a textbook on graphics.

[1] I. E. Sutherland, "Sketchpad, A Man-Machine Graphical Communication System," Lincoln Laboratory Technical Report #296, 30 January 1963.

long and narrow, while still others will be short and wide. This violates the requirement, and further readjustment must be done until the square condition is met. With SKETCHPAD, the computer maintains the constraints on all the small quadrilaterals automatically, and eventually achieves a proper map. Of course, such a procedure is not a very efficient way to solve such problems on a computer, but it is illustrative of the power of the notion of constraint satisfaction.

compound constraints

Again, in SKETCHPAD we see the germ of the idea of building compound constraints out of what might be called primitive or atomic constraints. Furthermore, such compound constraints are constructed graphically by a process that could be called "ostensive definition;" that is to say, the computer is shown how to do something for a special case, and then it is possible to copy the picture of the definition of the procedure and apply it to other cases.

For instance, suppose we wish to make six lines parallel and also equal, by pairs. We set aside temporarily the drawing of the six lines, and start with a fresh "sheet of paper" on which we draw two lines. These will serve as dummy variables. We now call for the constraint that makes lines parallel. This can be caused to appear as an abstract symbol or ikon, on the scope, and consists of a small circle containing the letter P, with four radiating lines or tentacles.

We attach the ends of the tentacles to the four ends of the two lines. The computer has been instructed to apply the "make parallel" constraint to the lines. Next we call for the "make equal" constraint. This also appears as an ikon, and resembles the "make parallel" constraint. When we attach its tentacles to the four end-points of the lines, the computer has been instructed to perform a compound operation on the lines. In Sutherland's system, no action will be taken to satisfy these constraints until the operator specifically commands that it be done, by pushing an appropriate button.

We now store the ikon of the applied compound constraint, and recall the drawing of the three pairs of lines. We can now call for an instance (loosely, a copy) of the ikon of the compound constraint, and can "merge" or attach it to each of the two lines of each pair. In this operation, the computer replaces the dummy lines of the ikon with the actual line of the problem. When finally the constraint has been applied to all three pairs of lines, a push of the "satisfy constraints" button will cause the lines to become parallel.

SKETCHPAD deals entirely with geometry; although by artifice, it is possible to solve some problems that are not inherently geometric, there are many cases where it is either very awkward or even impossible to communicate meaning. William Sutherland (Ivan's brother) addressed himself to the broad problem of computer graphics, with the aim of making it possible to communicate abstract procedures of any kind to the computer, including not only the geometric ones of SKETCHPAD, but others that the user may in the future define for himself, either through the keyboard or by construction from a base of primitive operations already in graphical form.

In this program, a graph or diagram can be drawn composed of any constituent elements whatever; the meaning of these elements can then be defined and the diagram can then be "activated." For instance, one can draw a diagram of the arithmetical procedure for extracting the square root of a number, and then can introduce a specific number at the input terminal of the procedure graph on the 'scope of the computer, and obtain the result at the output terminal of the diagram if one wishes, by causing the computer to halt after each step; in this case, the various elements of the graph blink as they perform an operation on information. This makes it quite easy to "debug" the graphical procedure diagram. This graphical technique has already been used with a programmed electrical network simulator, so that a sketch of an electrical network is sufficient to provide machine code for the simulation computations.

Computer graphics differs from pencil and paper graphics in another extremely important aspect; it permits dynamic behavior of the graph. The moving parts of a mechanism can be shown in motion, and such motion adds immeasurably to the information content of the drawing as far as the observer is concerned. It is possible not only to design and delineate a device, but one can actually "make it work" and observe its behavior. In principle we might not only watch the moving geometry of a mechanism, but we might also observe the deformations of the parts of the device under the influence of varying inertial forces superimposed on the static loading.

free-form design

The design and subsequent detailed description of the objects with doubly-curved free-form surfaces is a very important and fruitful field for implementation by computer graphics. Airplanes, ships, and automobiles are examples of such free-form or "sculptured" shapes, and traditional methods for the design and production of such shapes are extremely tedious and slow. Sculptured shapes also occur around us in the small as well as in the large; the hand-set on a telephone is such a shape, as is the cream pitcher on the table, the differential housing on an automobile, and the walnut stock on a shotgun.

Small objects usually are produced by artisans who sculpt models or patterns or sink forming dies based upon drawings furnished by the designer. These drawings usually consist of a few definitive design curves that depict and define the important aspects of the shape the designer has in mind, and leave to the artisan the job of interpolating the surface that will contain and agree with the intent of these curves. Of course the artisan and the designer can be in frequent communication with one another, so that if the designer has failed to be explicit enough about his intentions, he can add information, or can correct a misinterpretation in case the artisan goes astray.

In the case of the large sculptured shapes like airplanes, ships, and automobiles, such a procedure *is* of course out of the question; the designer must in some way define the surface explicitly and completely to a sufficient degree of detail that further interpolation is mechanical and hopefully unique. Traditionally this has been done in the shipbuilding industry by an extremely long and tedious graphical process called "lines fairing" or "lines lofting," in which the ship is essentially drawn full size in several views or projections, and represented by a large number of plane sections or contours, somewhat like a topographic contour map. In lines fairing, it is by no means a simple, straightforward process to draw the section contours at intervals along the hull and thus generate a smooth "fair" surface. Instead, it requires many weeks or even months of drawing, cutting trial longitudinal sections, and smoothing of these sections by readjustment of points along the curves before the shape is free of unwanted bumps and hollows.

In the aircraft industry these traditional shipbuilding techniques were employed up until about 20 years ago, but have since been replaced by certain mathematical techniques that remove all of the older graphical trial-and-error procedure. But even so, the delineation of an airplane fuselage is a fairly complicated and time-consuming operation.

The design, or "styling" of an automobile body is done by still another technique. Usually the designer creates sketches of a proposed new automobile, the best sketch is selected, a full-size drawing is prepared in color, and then a full-size clay model is made, with scrupulous attention paid to surface quality and overall authenticity. After changes are made on the model and it is finally approved, it is measured by elaborate and tedious processes and converted into section contours on a full-size drawing or "body draft." The measurement of the model and subsequent conversion to contour curves inevitably introduces errors into the information, and this "noise" has to be smoothed out by a process resembling roughly the fairing procedures of the ship loft. Eventually the body draft furnishes information to enable dies to be sunk to form the panels of the body. This entire process is one-dimensional and very long and articulated, and at every joint of the articulation the information is contaminated as though through a leaky pipe. It is remarkable that the finished automobile resembles as closely as it does the original intent of the designer.

the sympathetic pattern-maker

In all of these instances of shape design and description, traditional methods are long, tedious, and subject to error. Computer graphics will, in the near future, permit the designer to create the shape of an automobile body, a ship's hull, an airplane fuselage, or a tobacco pipe with consummate ease. This computer will behave like a skilled, sympathetic and experienced pattern-maker, or like an incredibly fast loftsman, or like a super-sculptor, working from meager information furnished by the designer at the computer console. This potentiality has come about fairly recently through the development of very general and powerful methods for the design and description of the entire class of sculptured shapes with the aid of the computer.[2] It is now possible for the designer to draw a few salient design curves and to have the computer automatically fit a surface to these curves. If the first computer interpretation of the designer's intention is not satisfactory, the designer can modify the curves already drawn, or he can add new curves to make his description more explicit. The computer will then automatically modify the original surface to accommodate the new information. The computer can calculate sufficient information about the surface to enable the shape to be displayed to the designer on the 'scope in somewhat less than a second, and subsequent modification of the shape takes comparably short computation time. Once the shape has been defined, it can be displayed in perspective rotated into any position, and moved about in space in real time.

The same shape-descriptive algorithmic structure in the computer can be used not only to produce the graphical display, but can furnish much more detailed information to run a plotter to draw the shape to any desired scale on paper, or to carve a full-sized model of the shape in some soft plastic, like styrofoam, or to run a numerically-controlled machine to sink the dies for the final fabrication of the parts. At present it is fairly standard practice to calculate points on such surfaces to a precision of about 21 bits, or about seven decimal places. This is entirely adequate precision for virtually all engineering purposes. Of course the precision of the arithmetic could easily be increased.

The shape-descriptive information also forms the data base for other geometric calculations. It is possible to cut plane sections through the object, to obtain projected areas, surface areas, volumes, and to calculate the curve of intersection of two arbitrary shapes. The same data base also can furnish input to special programs for fluid dynamics calculations, three-dimensional stress analysis, and other analytical processes that require shape description and environmental description as inputs.

There is also a class of information structures which might be called quasi-graphical, consisting of mixtures of abstract symbols like words and numbers, but arranged in some familiar array or pattern. Matrices are excellent examples; we can cite also another example so common to us that it might be overlooked: the positional notation of our decimal number system itself, in which the geometry of position of digits is a means of conveying meaning concerning magnitude. The conventional integral sign with the appended upper and lower limits, followed by the integrand, followed by the differential operator and the independent dummy variable, is still another example of a quasi-graphical structure in which the array is a device for conveying meaning to the eye. Much of text-book mathematical notation has this quasi-graphical character, and it is important to preserve this structure when we are using a computer.[3]

The keyboard with its one-dimensional input-output string and its rigidly limited set of characters is certainly not well adapted to such forms of communication; a large encrustation of circumlocutions and makeshift techniques has formed around computer languages in an attempt to make them compatible both with people and with machines. The reason that quasi-graphical arrays on the printed page are easy for people to understand is probably that they make it easy for the human information processing system to construct efficient data structure models of their content, and these data structures are easy to manipulate and to remember. It is possible that similarly the two-dimensional array on the computer console can lead to a more easily constructed information model within the computer; this implies an enhanced transparency at the interface between man and machine. The man can more easily look into the computer, and the computer can more easily look back. We often use the expression "problem-oriented languages." It might be appropriate to say instead "people-oriented languages" to emphasize the goal of making communication with the machine truly natural. A measure of the degree to which some form of communication approaches the ideal is the degree to which it is understandable weeks or months after it is written, not statement by statement, but in the structure of meaning that it reveals or conceals. Graphical communication is inherently structural; it seems likely that a truly fundamental effort toward implementation of such a way of man-computer conversation is the most important step to be taken in computer technology. ■

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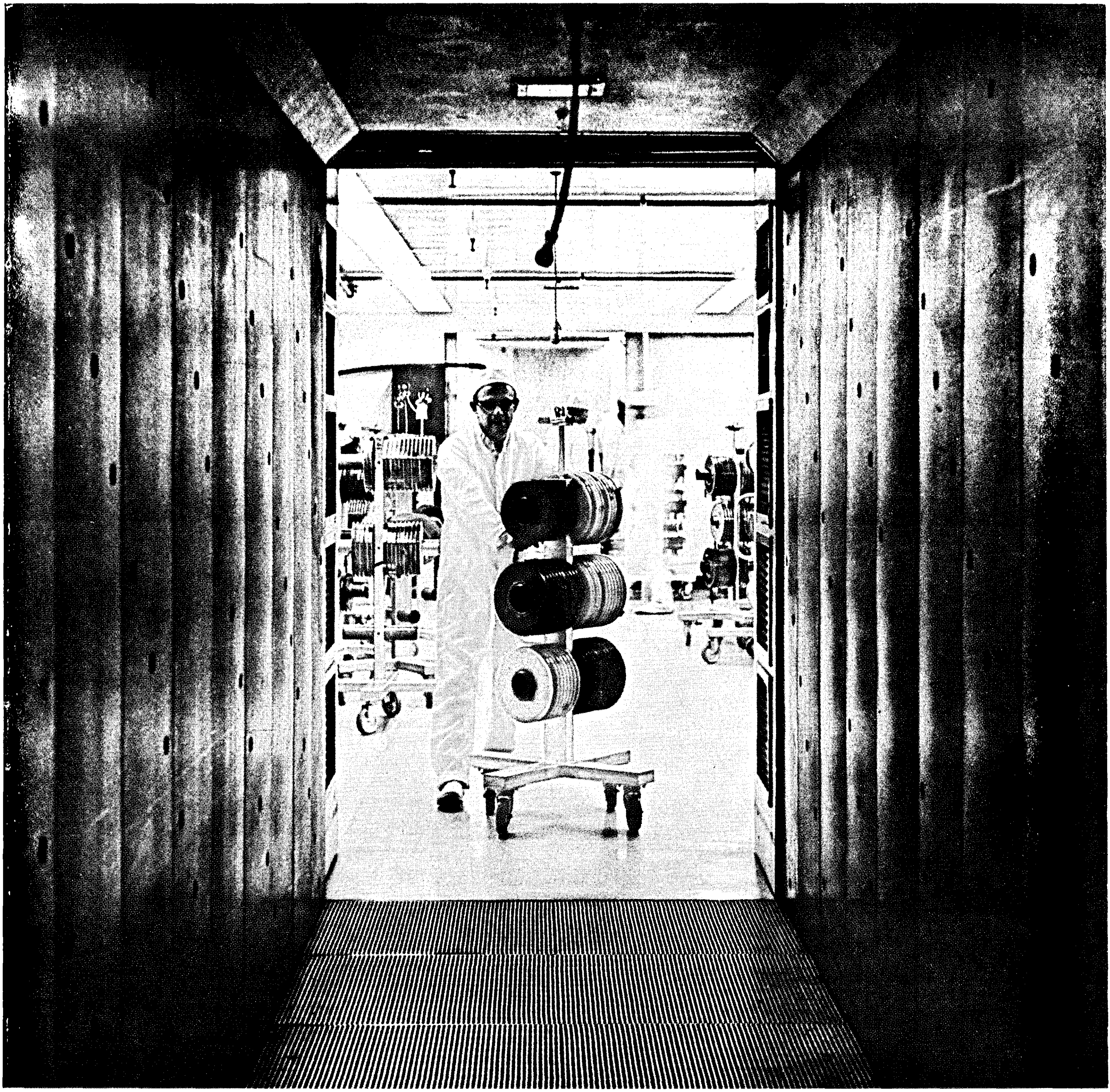

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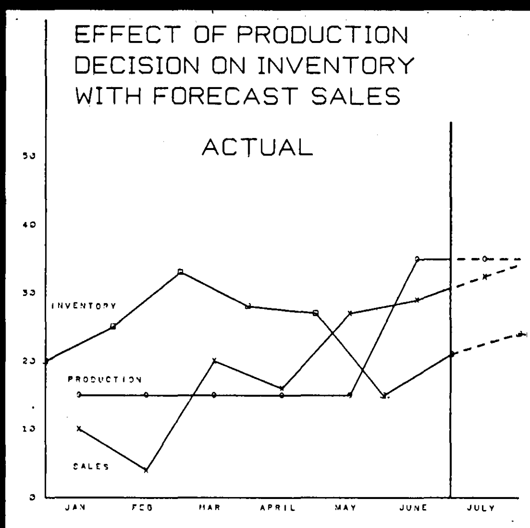
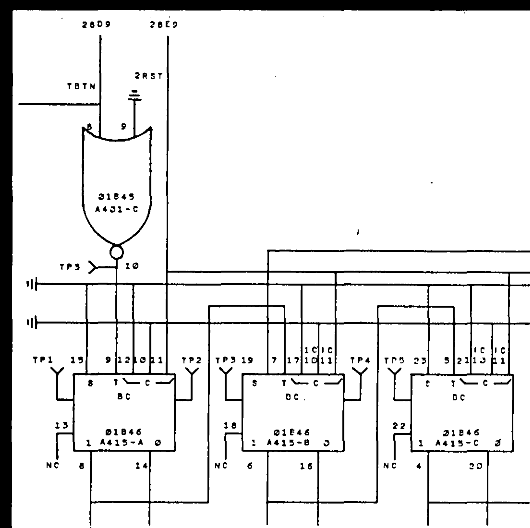
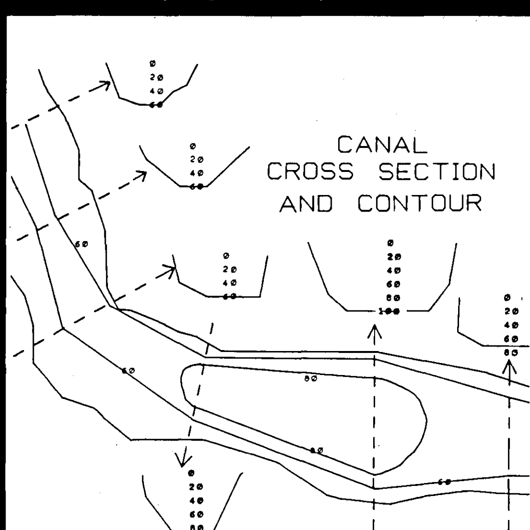


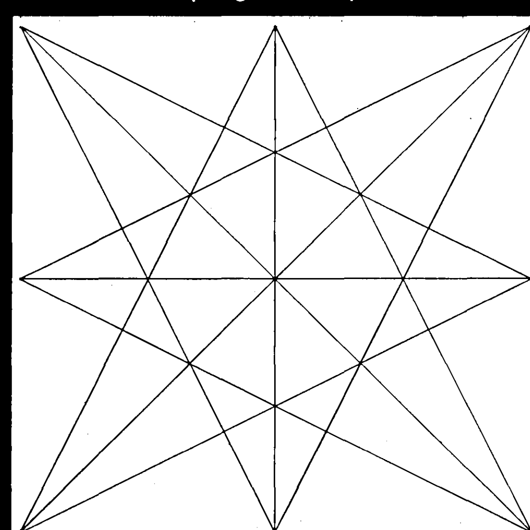
Before: 450 program steps. **Now:** 300



Before: 1000 program steps. **Now:** 700



Before: 600 program steps. **Now:** 500



Before: 54 program steps. **Now:** 14

CIRCLE 69 ON READER CARD

PROGRAMMANSHIP

a gamesman in the machine room

by THURSTON E. WOOD

It did not require a lengthy period of time for the writer to realize that his chosen field, computer programming, a game played with incredibly fast and accurate machines for large sums of money, was almost ideally suited to the exercise of the principles of Gamesmanship and Lifemanship. It was with a poignant awareness of lost opportunities that I suddenly realized that while I had, of course, been practicing Gamesmanship and Lifemanship (but only after they were first used against me) in the infrequent leisure time activities allowed by the press of my programming duties—tennis, polo, motor racing, and sailing, mainly—I had completely overlooked an easy and natural way to enhance my sense of job satisfaction.

It is hard to explain why this realization was not immediate—my first supervisor and the machine room supervisor with whom he maintained an uneasy truce were obvious Lifemen. Perhaps I felt that programs alleged to be "necessary and vital to the national defense" should be taken seriously. Or perhaps I was put off by the unreasonable attitude of management, whose constant harping on trivia like making the scene before ten and clamping lunch to two hours stifled my creativity. In any case, since my retirement from programming is imminent (I am preparing to open a chain of sailboat rental agencies), I thought I would set out my thoughts, in the hope that they might be of some interest to the data processing community.

It should be noted that while what follows was written by an employee of the General Foods Computer Division, General Foods assumes no responsibility for its accuracy or completeness. All inquiries should be directed to the author.

Finally, I would like to emphasize that I feel that every Lifemanship situation poses a grave moral question. Techniques as powerful as these should not, I believe, be used without extreme provocation, and then only in carefully measured amounts. The indiscriminate or habitual use of Lifemanship can only lead to chaos.

the programmer's initial state: one down

It must be admitted right away that a programmer is, after all, little more than a sophisticated, though often noisy, device for converting problems into a form suitable for entry into a digital computer (but see *The Analog Gambit*, below). Thus many programmers feel ill at ease in the company of engineers, physicists, and most especially Ph.D. mathematicians. This *malaise* is compounded when they ask, "Don't you program computers, or something like that?"

The best reply to this question was suggested by a footnote in Stephen Potter's pioneering, but scarcely definitive, book "Anti-Woo." The correct answer is, of course: "Yes, but not the sort of computers *you're* familiar with, I'm afraid."

Since your actual work as a programmer is relatively trivial, something must be done—the question is what. But

Mr. Wood is a programmer for Wolf Research and Development. His experience includes work with American Univ. and George Washington Univ., Melpar, Inc., and Avco Research and Advanced Development Div. He has a BA in mathematics from Rutgers Univ. and has been a graduate student at New York University.

avoid the common mistake of attempting to make your actual work appear difficult or obscure. Speak of your program, be it accounts receivable or filtering by Chebychev polynomials, in a casual, offhand manner. Never make any representation that it has been fully debugged, but rather, when questioned about some special case, reply with a puzzled "Gee, I'm not really sure *what* it would do in that case." Promise to look into it, then dismiss the discussion from your memory. You'll have moved on before that improbable case occurs and, in any case, they can, and will, type his check by hand, as they should have planned on doing originally. It is a waste of machine time for a program to constantly test for improbable situations.

Remember this, too: no matter how incomplete and outdated your documentation, no matter how many subroutines you enter from only one point, and no matter how unpronounceable the labels you use, there is somebody, somewhere, who could, given enough time, figure out what your program actually does. It is for this reason that I do not recommend attempting to be a "black art" practitioner.

Rather than claiming his work is difficult, one should, I think, have a special interest. Information theory and the theory of finite-state machines are good, if rather obvious. Personally, I like self-reproducing machines. Suggest that what you would really like to do is work full time on your subject—but you have to pay the rent, after all. It is no bad thing to belong to several professional societies not particularly related to your job—the American Medical Association, for example.

the analog gambit: basic hardwaremanship

Hardwaremanship grew out of the analog gambit, which in its original form consisted of always insisting that the job could be done cheaper and faster, and with more than adequate accuracy; by an analog computer. While this assertion is no doubt equally true today, it is now better to plunk for a hybrid system. This gambit is good because they're not going to get you an analog machine for any given problem, so your ignorance of analog techniques will never be exposed.

Frequently, you will see misguided programmers insisting that the existing machine is too small, too slow, etc. for their problem. This is of course a mistake; good Hardwaremanship dictates the use of the smallest, slowest, and oldest machine available. The ideal machine for general-purpose use is probably the CPC, but unfortunately few of these are still available. However, with imagination, a lot can be done with a 402/602A system, or even a 1401 model H.

One latent advantage of Hardwaremanship is that in later years and jobs you can speak of your early work on machines few will have heard of. Indeed, one of the most important considerations in your semiannual search for a more challenging position should be the type of equipment available. Why load your resume up with equipment that is taken for granted? Table 1 is a tentative ranking of manufacturers.

But Hardwaremanship is but one side of the coin. The more advanced reader may have anticipated our next subject.

two-tape autocoder: softwaremanship example

Readers familiar with projective geometry will recall the principle of duality, in which lines become points and points, in turn, become lines. Softwaremanship is actually nothing more than the application of Hardwaremanship tactics to software.

Table 1

Tentative Ranking of Computer Manufacturers

A. Recommended:	Bendix General Foods Machines Bull
B. Intermediate:	Alwac Librascope Packard-Bell (battery-operated models only)
C. Not Recommended:	Control Data International Business Machines Remington Rand Univac

Two-Tape Autocoder has been chosen as an example of Softwaremanship because most readers will have some familiarity, however inadequate it might be for writing a really efficient program, with the 1401. Two-Tape is a good language for programming the 1401 because its use runs counter to current trends towards higher-level languages, it is not officially supported by the vendor, and it is in fact a far more efficient tool than the package supplied by the vendor, when used by an experienced programmer. To be sure, it has some limitations—diagnostic messages are scarce and vague, and the use of certain characters in instructions can cause an incorrect assembly. Nor is the use of recursive literals allowed, but one can program around this.

However, one must sometimes use an unsuitable language, such as FORTRAN. Languages of this type are unsuitable because:

1. Debugging is more difficult as the programmer is one more step removed from what is actually happening.
2. An engineer can easily learn enough about FORTRAN to think he's qualified to evaluate your work, or even (shudder) do his own programming. The following section will require extensive rethinking if the current trend for engineers to hang around the machine room continues.

some thoughts about machineroomanship

The basic gambit is, of course, to spend about four of your five hours in the machine room. In all too many organizations, an unimaginative management may let it be known that they'd rather you remained at your desk, programming, but there are many ways to get around stupid restrictions of this type, while your resume circulates.

Hanging around the machine room contributes to professional development in many ways. We'll just list three:

1. It makes it easy to remain on friendly terms with the keypunch operators. Many keypunch operators are, away from their machines, pretty swinging, but in any case turnaround time is usually reduced where interdepartmental relations are cordial.
2. It affords an opportunity for practice in Consolemanship—which is simply the ability to throw switches and depress buttons with blinding speed.
3. One can monitor the output of other programmers at his facility, thus learning valuable new techniques, perhaps. Most valuable, though, is probably the opportunity to run a quick cross-correlation between the observed performance of other peoples' programs and their remarks in the last progress report. Automation has certainly had its effect, but employee morale still demands an occasional laugh. ■

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CIRCLE 20 ON READER CARD

THE COMPUTER AND THE SCHOOL OF TOMORROW

or the day after

by JAMES ROGERS and DONALD COOK

The school of tomorrow is going to rely heavily on computers for the performance of tasks which are today the function of teachers and others on our school payrolls. The schools will *have* to use computers for their routine paperwork, because all projections indicate both that teachers' time will be in even shorter supply in the future than it is today, and that paperwork will increase as more students attend school. Even now—in early 1966—a few scattered school districts are successfully putting computers to work to relieve their staff of routine, time-consuming clerical tasks. Such jobs as scheduling of students, classrooms, and examinations, attendance reporting, grade reporting and analysis, preparing health notices and summaries, etc., are today being handled with dispatch by relatively small computer systems. Before many more years, every U.S. school district which serves an area of growing population will have to choose between automating and drowning in unavoidable paperwork.

The United States Office of Education is sponsoring a number of such projects. A brief summary of these will be found in a recent issue of *American Education.*[1] An attempt to provide a wide range of computer services, covering a large geographical region from a central location, is currently in progress in the NEEDS (North East Educational Data Systems) Project.

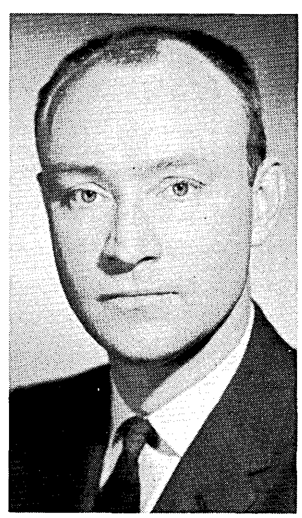
The mere avoidance of routine paperwork, however, is hardly to be regarded as an advance in education. Administrative problems may be eased, but pedagogy remains the heart of the problem. The important innovation in the education process itself will be the use of computing systems in at least part of the instructional transaction: that is, some of the time that the student spends in learning will be spent in interaction with a computer, or with materials assembled for him by a computer.

Ever since Skinner's 1954 paper describing the advantages of having students learn by interacting with a program of instructional steps (called "frames") it has been obvious that, at least theoretically, the computer—with appropriate input and output devices—is the ultimate teaching machine: its storage capacity and speed, its ability to handle many input stations, and its potential flexibility in recognizing and responding appropriately to many different kinds of inputs, all suggest that the computer is the tutor whose flexibility and responsiveness cannot be exceeded.[2] Computer manufacturers, universities, and other organizations with available hardware were quick to set up computer-assisted instruction experiments, and the literature is full of their reports. However, going through these reports can often leave the reader with the impression that we are already there—that as soon as a few refinements are made, a few bugs worked out of already-existing systems, we can present these electronic teaching machines to the educators, and get on with our other work.

Unfortunately, the solutions aren't as simple as some of the current reports imply. To identify and discuss the shortcomings which characterize much of the work published to date is beyond the scope of this article. The reader interested in state-of-the-art reports is referred to Coulson[3] and Glaser[4]. Instead, we will describe an alternative approach (Fig. 1) to computer-assisted instruction which seems to offer an effective answer to the mounting problems of teachers and schools.

the district computer

The school district of tomorrow will include a central computing system, located at the districts' administrative offices. Each of the schools in the district will be connected to the computer, and each will contain a terminal equipment station, with devices for reading and transmitting information *to* the processor, and devices for printing



James Rogers is Los Angeles district manager for Basic Systems, Inc., now a division of the Xerox Corp. Formerly with the Burroughs Corp., he was manager of systems documentation and director of education for the small-computer program. He has an MA in philosophy from the Univ. of Michigan.

[1] Wayne O. Reed, "The Data Link," *American Education*, Vol. 1, No. 6, June 1965, pp. 31-32.

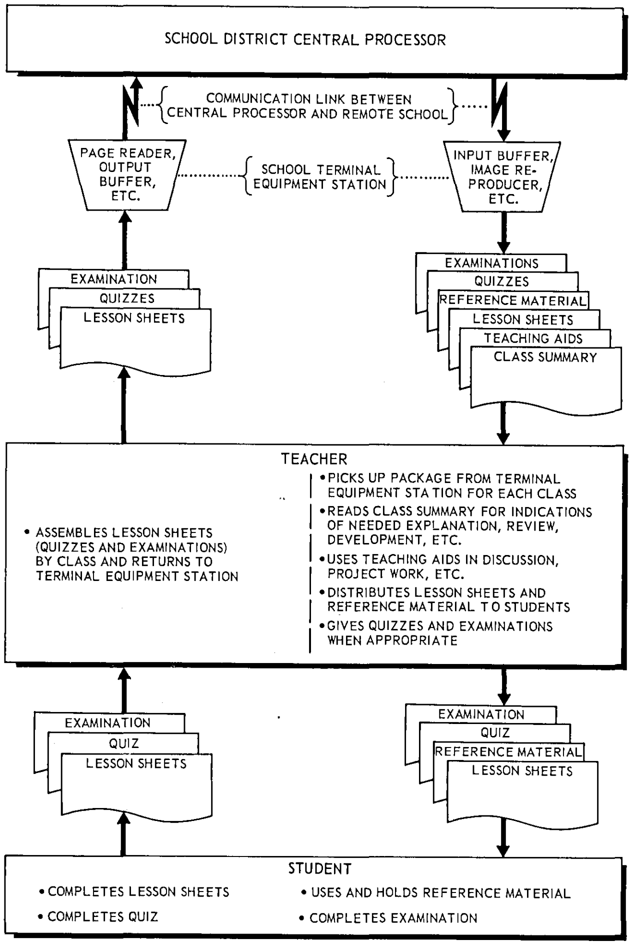
[2] As an assist to educators for whom data-processing concepts may be new, there are texts which employ educational applications as examples. See A. Grossman and R. L. Howe, *Data Processing for Educators*. Chicago: Educational Methods, Inc., Aldine Publishing Co., 1965.

[3] J. E. Coulson, *Programmed Learning and Computer-Based Instruction*. New York: John Wiley & Sons, 1961.

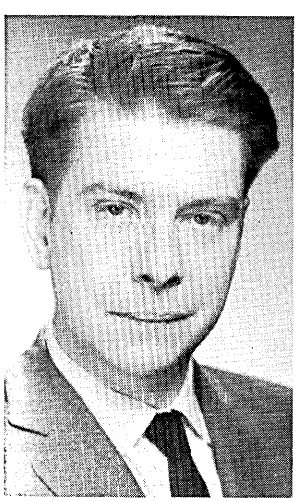
[4] See L. Stolurow and D. Davis, "Teaching Machines and Computer-Based Systems," and also B. N. Lewis and G. Pask, "The Theory and Practice of Adaptive Teaching Systems," in R. Glaser (editor), *Teaching Machines and Programmed Learning, II: Data and Directions*, Washington, D. C.: Department of Audiovisual Instruction, National Education Association of the United States, 1965.

and image reproduction *from* the processor. The system will be used for all the routine operating and accounting paperwork, as well as the administrative decision-making

Fig. 1. Information flow in school computer-assisted instruction system.



of the kinds mentioned above. In addition, the system will be able to retrieve information relating to the subject matter content of many courses, and transmit images, from storage, for reproduction in specified quantities at individual school terminals. Materials such as lesson pages (containing the frames of instructional programs), worksheets, diagrams, tables, graphs, maps, photographs, etc., can be selected by the computer and the images reproduced in the form and at the location where they are needed.



Dr. Cook is director of educational planning for Basic Systems and has been a member of the faculties of Columbia Univ., Barnard College, and Fairleigh Dickinson Univ. His consulting assignments have included work for the President's Committee on Juvenile Delinquency and Youth Crime and the President's Task Force on Poverty.

During a class meeting, the teacher may hand out sets of lesson sheets to each student. A lesson is part of an instructional program and is designed to be completed in anywhere from 15 to 45 minutes. Each lesson sheet is reproduced with the identifying information—school, teacher, subject, class, student, and lesson, page and frame numbers—across the top, in a man- and machine-readable character set. Upon completion of the class, the teacher collects the lesson sheets, returns them to the envelope, and drops off the envelopes for all of his classes at the terminal station at the end of the day.

The afternoon shift at the terminal station is supervised by one of the school district's full-time machine operators, and staffed by students themselves (students who need financial assistance in getting through school, and those enrolled in computer science programs get first priority in assigning the part-time work). They unload the envelopes, feed the sheets into the scanner, and replace the sheets in the teacher's in-box.

The lesson sheets for each student in each class—anywhere from 5 to 20 sheets per student per class—are read by the scanner and stored in the buffer. The computer empties each of the terminal buffers at each of the schools upon signal that the buffer is full. "Buffer ready" signals are stacked during peak loads, and handled on a first-in-first-out basis. Each student's work on each lesson—the answers he provided to the questions he encountered in the frames—are graded for accuracy and completeness.

The results go into each student's record and onto the teacher's class summary, and are also noted on course performance summaries, so that the curriculum design and instructional program writing groups will have continuous information by course, lesson, and frame of any deficiencies in any program's performance.

Together with the lesson sheets, the computer provides the teacher with a class summary sheet, which lists by student any errors, ambiguities, or uncompleted frames which occurred in the previous lesson. If a student misses the lesson due to absence, that, too, is noted. The class summary also lists the cumulative history of progress in the course by student, including total number of frames completed, quiz and examination grades, frame error rate, and frame completion rate. High, low, and average figures for the class as a whole also appear in the class summary.

computer checking and selection

When it has digested the results of each class's performance, the computer composes the next lesson: it notices that a concept which had been adequately mastered by the class two weeks ago was not thoroughly understood in its relation to the concept presently being taught. So the computer selects for inclusion in the next lesson frames which sharpen the generalizations and discriminations comprising the relationship between the two concepts, then it goes ahead with frames on the new work. That the class needs this more careful review and covering of this material is, of course, noted for the benefit of the teacher on his class summary sheets (the fact also appears in the program-performance information for the program design groups).

The frames selected for the next lesson are assembled from storage into pages, and the identifying information is added to each page. Included with the lesson pages for each student are whatever ancillary material—diagrams, tables, photographs, etc.—he may need for this lesson, or

may want to keep for future reference. In addition, whatever material is designed for the teacher's use—visuals for class display, descriptions of relevant experiments, questions for quizzes, etc.—is included with his class summary sheets.

Once all the material is assembled, the computer then connects the storage unit to the long-distance image reproducer at the school terminal, under control of the selectors it has chosen and stored. The lesson pages, reference material, teacher's aids, and teacher's summary sheets are then reproduced, where the terminal room staff pick them up, and do whatever collating and stapling is required. The class package is then placed into an envelope and dropped in the teacher's box for pickup prior to the next class meeting.

The system described above has many appealing features: it avoids the cost of providing individual student teaching consoles; it allows the teacher complete choice of and control over how much of the instructional program he wants to use, and when he wants to use it. If a student misses a class, he can make up the basic lesson work before the next class. If the teacher is absent, the substitute knows precisely where the class is in the course, and the lesson is "prepared" in advance. The teacher has a public record of each student's performance, and can devote his time more effectively to his role as model, counselor, and diagnostician.

The gains resulting from the reduction of lead time and inventory problems produced by such an arrangement may have even greater impact upon the effectiveness of educational management than that experienced in industry and business.

the need for natural-language processing

Any computer-assisted instruction system worth its cost must be able to read handwriting, and interpret lengthy statements in natural language. This requirement is inherent in minimal educational goals. While we can always make things easier for systems designers by compromising these goals, the informed and skilled citizen capable of functioning in the world of tomorrow will be called upon to measure up to goals which the student cannot learn to meet by pushing multiple-choice buttons, or writing one-word answers in blanks. He must not only be able to answer properly questions like

" 'Whales' are fish.' True or false?"

He must also be able to answer properly open-ended questions, such as

> "Someone says to you that whales are fish. Explain to him why he is wrong, including in your explanation at least two similarities and three differences."

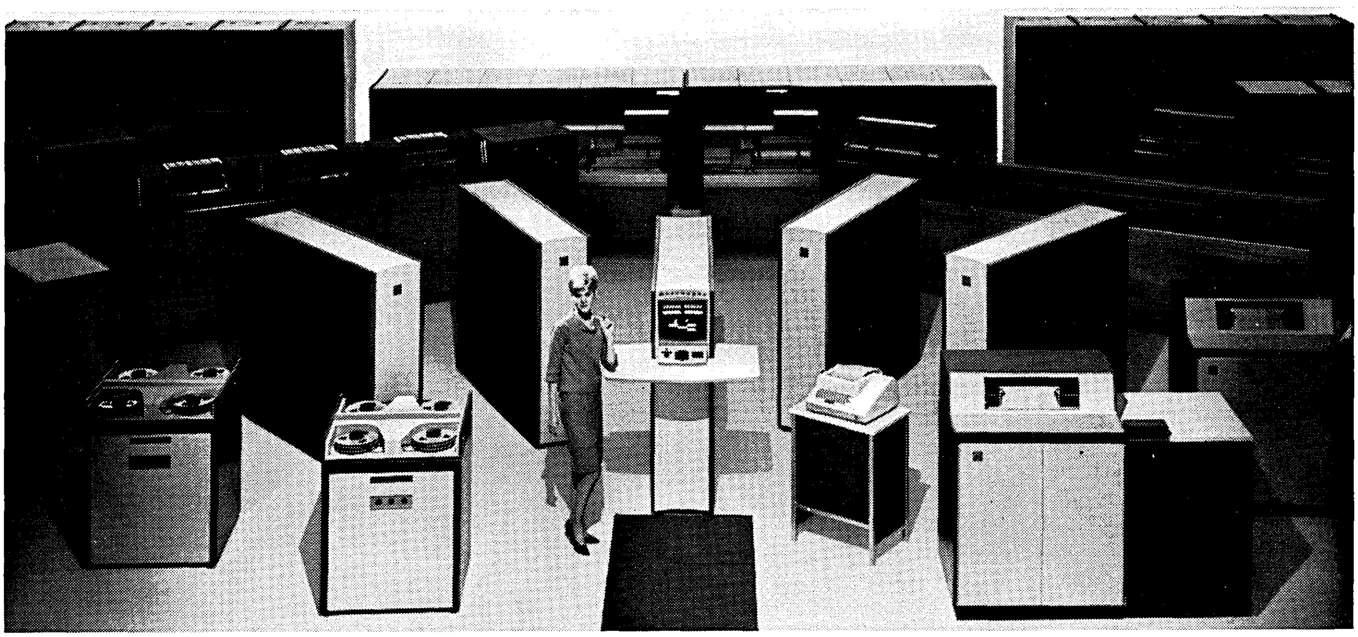
The design implications of these differences in educational goals are discussed by F. Mechner in "Behavioral Technology and Science Education," in Glaser.

It will require sophisticated compilers to process and evaluate such answers, and this requirement represents the major technological obstacle standing between the experiments of today and effective computer systems for instruction in the schools of tomorrow. For the fruition of the prospects here sketched, a no-less-formidable task must be undertaken in the field of educational science: that of specifying the pedagogical rules which control the computer in its decisions and selections.

For most rapid progress, these two tasks should not be addressed separately. Evidence is heartening that the required forms of cooperation between the educational and computing sciences are beginning to emerge. ■

Introducing two new Burroughs 500 Systems:

B 2500 and B 3500



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1 Extremely fast hardware speeds, some measured in billionths of a second.

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3 An unprecedented degree of self-regulation in low-cost computer systems via a choice of two operating systems: the Basic and Master Control Programs.

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8 From 4 to 20 input/output channels (all of which may be active simultaneously and still leave ample time free for computation) plus multiplexors and exchanges that allow great flexibility and simultaneity of input/output operations.

9 Monolithic integrated circuit design which produces greater speed and reliability and reduces size and costs.

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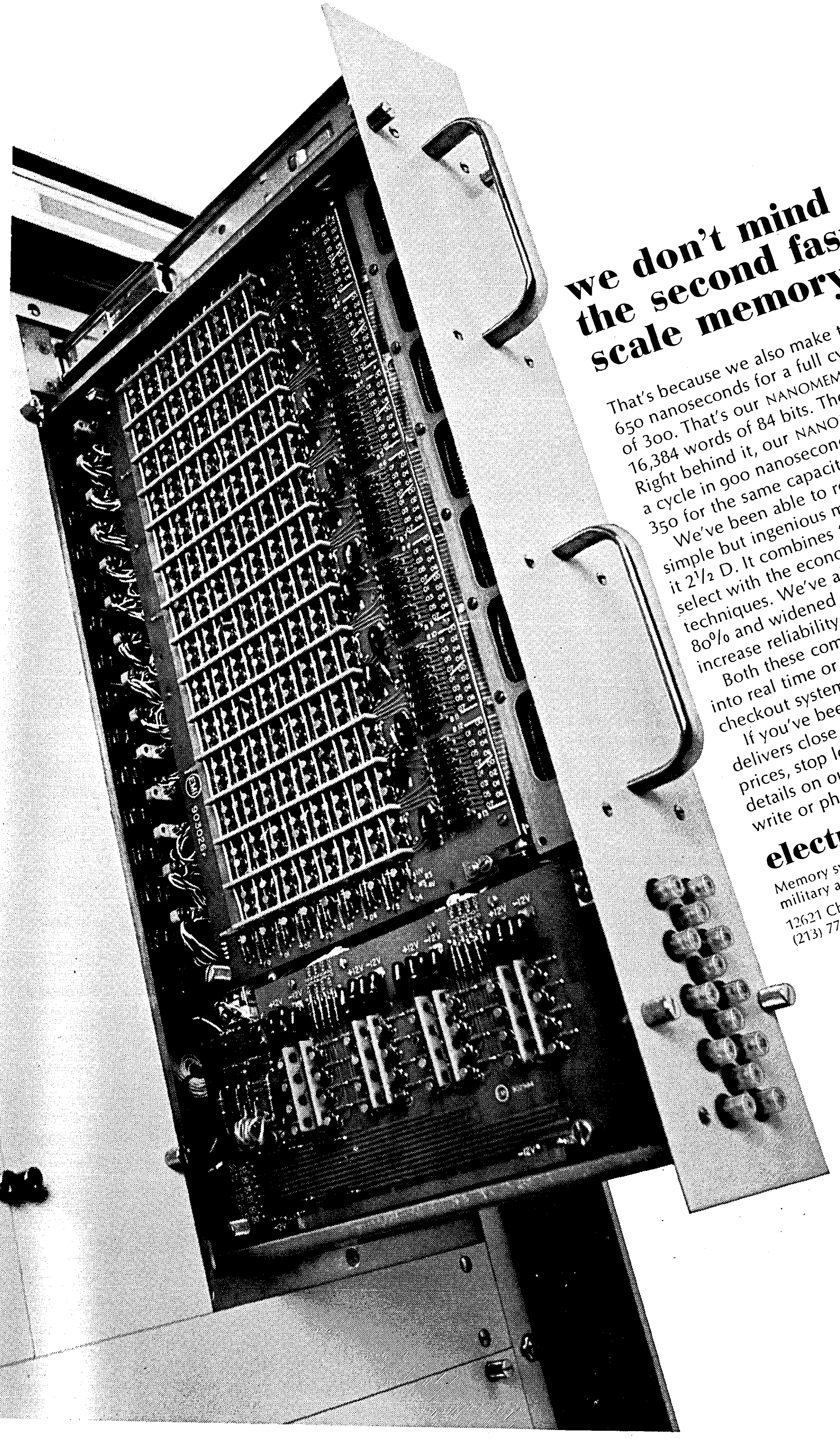

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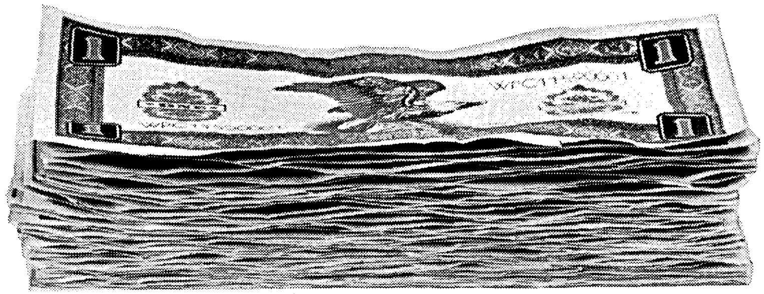

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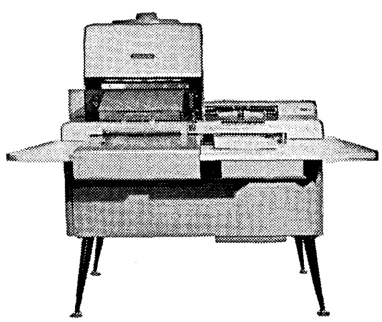

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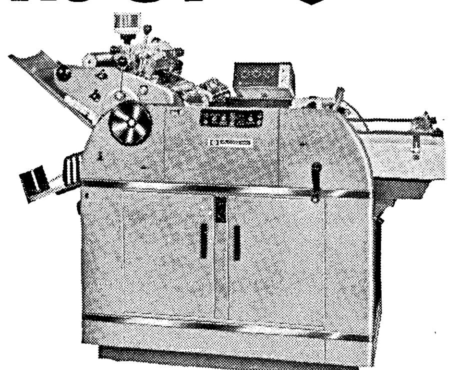

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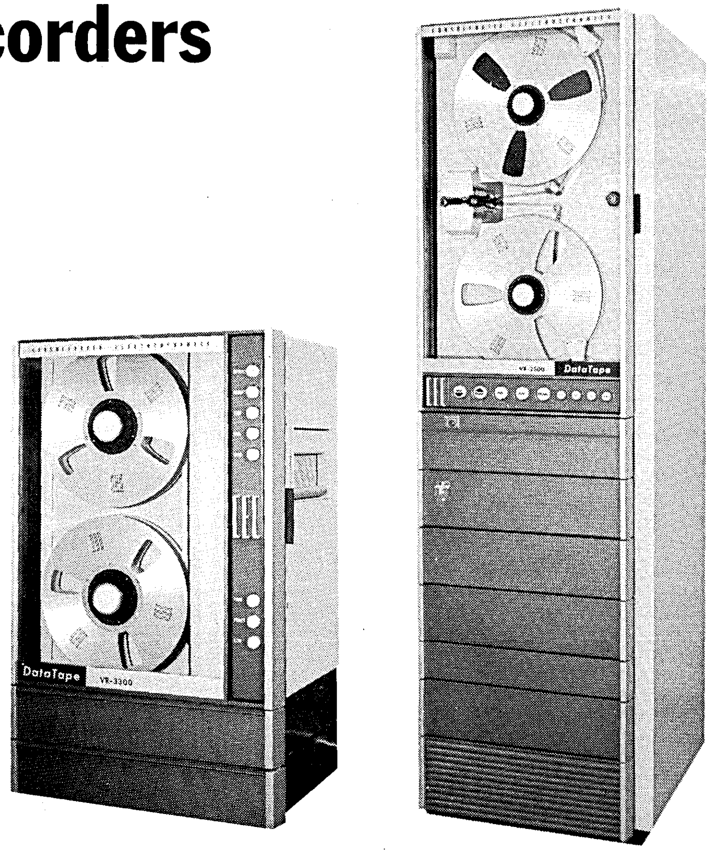

CEC's multipurpose VR-2800 and VR-3300 Magnetic Tape Recorder/Reproducers now offer an extended frequency range of 100 cps to 300 kc. Most significant, this increased bandwidth was accomplished *without* the use of head drivers or reproduce preamplifiers, using field-proven heads and electronics.

Reason: the advanced capabilities of CEC's exclusive all-metal-surface magnetic heads.

Result: greater simplicity, performance and reliability at considerably less cost.

CEC magnetic heads are so reliable that many have logged more than 10,000 hours — and are still going strong.

As you may know, the six-foot VR-2800 laboratory recorder (right) and compact VR-3300 portable recorder (left) are among the recorder/reproducers most in demand in industrial and military use today. Although they differ in dimensions and applications, both share the same basic performance advantages and incorporate *interchangeable* electronics.

Other outstanding features:

- Complete 7 or 14 channel record/reproduce systems.
- Six speeds from 1⅞ to 60 ips.
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From the original painting by Neil Boyle

DPMA CONFERENCE

1966

The 15th International Data Processing Conference and Business Exposition of the Data Processing Management Assn. will be held at the Conrad Hilton Hotel in Chicago, June 21-24. Registration fees for the conference are $75 for DPMA members; $85, non-members.

The keynote speaker, H. I. Romnes, president of AT&T, will address the opening session on: "Managing the Information Revolution."

The conference program will focus on four seminars in the areas of information management panoramas and techniques, data management guidelines, and special sessions.

The Bell Data Transmission Workshop will be included in the seminar on information management techniques. The workshop will feature live demonstrations of existing data communications equipment and techniques, and will be presented at the Bell Seminar Center. Harry J. Goettel, seminar program supervisor, will review the latest in communications devices and discuss proposed changes in terminal equipment and new types of communication channels which are capable of transmitting millions of bits per second.

Eight special sessions are designed to assist data processing personnel in preparing for information management systems. Discussions are planned on the motivation of administrative personnel, and the introduction of computers in small businesses and educational administrations.

information management panoramas

"Total Systems for Profit," the first of five information management panoramas, will bring together speakers from the Pillsbury Co. and GE. Pillsbury's many divisions today transmit all original entry data on materials received, ingredients processed, and shipments initiated to a GE-225 computer complex in Minneapolis, soon to be enlarged by the installation of a GE 635. Speakers will discuss optimization, simulation, management situations that have evolved, and software plans.

Terrance Hanold, executive vice-president of Pillsbury, will take to task, in his opening remarks, both schools of management by exception and management by objective. The only adequate management system under conditions of complexity and change is management by perception, he says.

R. J. Taylor and Jerome Tagg of Honeywell EDP will enlarge upon management information and control systems in a case study. Under scrutiny: Honeywell's Micro-Switch division. Initially aimed at inventory control and sales order processing, the division's dp system now encompasses virtually all aspects of material allocation, fabrication, order and shipping functions, costing, and market forecasting, the spokesmen will report.

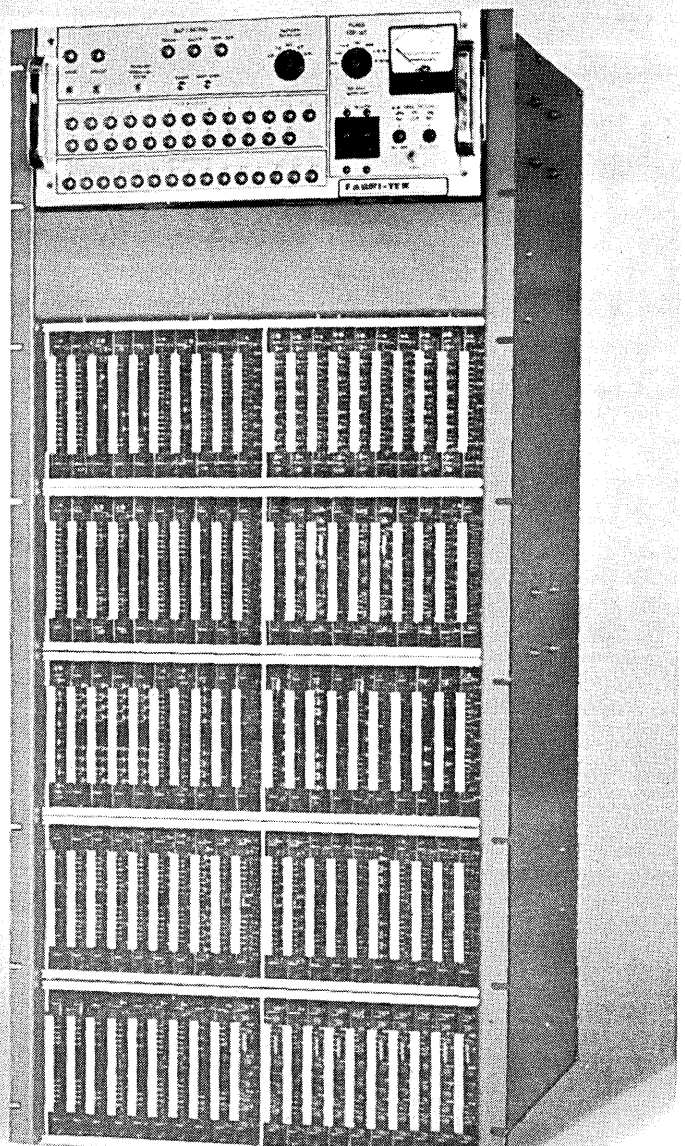
They will detail the master file concept that forms the backbone of the system, sales order processing, materials planning and control, production scheduling and dispatching, financial control, and management planning (including sales forecasting, product stocking and budgeting.

RCA and Chrysler Corp. will team in the presentation, "A Nationwide Real-Time Warranty System." Representing Chrysler will be Frank A. Kros, manager, Data Processing Development, and from RCA will come William L. Bones, branch manager. Chrysler management believes that its return to significance in the automobile market is largely a result of its decision, in 1962, to offer a warranty of five years or 50,000 miles. While an important impetus to sales, the warranty posed a monumental problem in determining the continuing eligibility of cars under warranty.

A warranty edit and inquiry system was then developed and processing now includes the editing, coding, and updating vehicle histories, editing transfers and mechanical reports and handling inquiries. The RCA Race files contain vehicle serial number, body style, production date, option codes, sales data, selling dealer, color, trim, and certain special codes on all vehicles built. From this system, the firm can inquire as to the status of as many as eight million cars an obtain an answer in about six seconds from an inquiry from any one of 46 regional offices or local marketing offices.

Reporting on an airline's plans for a $56-million information system will be John W. Porter, manager of Organization Planning for United Air Lines, and L. E. Johnson, vp, Univac. It will be built around a centralized complex of three Univac 1108 computers that will be accessible by some 2,000 CRT input/output devices on a nationwide basis with a one-second response time. Alpha-numeric capability, multi-processing, shared core and high-speed mass storage, and visual display devices all were considered in the up-dated system. With these advanced technologies at their fingertips, United found that in addition to the passenger reservation system required, they could add an electronic information system. Thus, four current computer systems are expected to be merged into the future system. The four include the Instamatic system, an electronic switching system for administrative communications, automatic flight planning and monitoring, and performance statistics. Eight other manual operations, such as schedule and tariff information, ticket printing, routing, menu planning, etc., are headed for computer processing, the spokesman will explain.

"The Evolution of a Management Information System"



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will detail the dp system developed for the Gray Co. Inc., a Minneapolis manufacturer of air-powered lubricating, spraying and cleaning equipment. Grayco's IBM 1401 presently serves the manufacturing, marketing, and finance areas of the company. The engineering phase will be converted to computer processing when the company installs an IBM 360/40 this year. Presenting this review of a computer's capability in the manufacturing process will be Eugene J. Laguban, Jr., systems manager for Gray, and two IBM marketing representatives, Thomas B. Long and John D. Walker.

information management techniques

Eight seminars have been scheduled for the Information Management Techniques segment of the Conference. A popular feature on the agenda, these seminars offer an important exchange of ideas and developments for the data processing analyst.

Optical Scanning. A progress report on "Optical Scanning for Information Management" will bring together Herman Phillipson Jr., president of Recognition Equipment Inc. and Thomas Janning, manager, Field Engineering, The Standard Register Co.

In reviewing the evolution of computer processing, Phillipson will review the advantages and disadvantages of remote, time-shared terminals, voice recognition and magnetic ink character recognition before concentrating on the status of optical character recognition. After a discussion of cost, he will explain reading techniques, vocabulary, paper handling, format definition, and on-line processing as functions of an OCR system. Five existing applications of optical scanning will be presented.

Standard Register's field engineer will explore the COR equipment in use, study some of its applications and list some of the field's drawbacks. Department store and utility billing are two illustrations he will draw upon. He will also discuss recommended paper stock for this equipment, ink specifications, and forms design.

Data Display. "New Techniques for Data Display" will be the topic shared by Robert Petersen, chief of systems, Stromberg-Carlson Div. of General Dynamics; and Michael Noll, Bell Telephone Labs.

Admitting that the development of data displays has been slow compared with the rapid evolution of computers, Petersen will discuss new hardware and techniques.

Instant access to information. Guy Dobbs, manager, Computer Center Dept., System Development Corporation; and William Emmons, executive vice president, KEYDATA Corp., will explore "Man-Machine Interaction: Instant Access to Information." A case history of a time-sharing system now in use in the research and technology laboratory of SDC will provide the theme of Mr. Dobbs' remarks. In describing the center's operation, he will detail plant layout and operations, time delays for requested information, accuracy and security of records, communications, and output. He will also review managerial aspects of operations and management aids.

Data Communications. Speakers from Chrysler, Ampex, and Clark Equipment Co. will head the seminar, "Data Communications Information Management Systems."

Describing data communications as the nervous system of information management, seminar leaders will enlarge upon the problems involved in the organization and functioning of data communications systems in both large and small business and manufacturing operations. They will also describe the latest equipment and techniques available for efficient data communications. Representing Chrysler will be Robert Franklin, general supervisor of Data Communication Planning. Paul Hickey, manager of advance Systems, will speak for Ampex, and Don Dantine, director, Management Services, will represent Clark.

Effective use of simulation. Three men will share the rostrum in this seminar's investigation of simulation. They are Kenneth J. Soderstrom, manager, Operations Research, U.S. Div., Corn Products Co.; Donald H. Ross, manager, Management Sciences, International Minerals & Chemicals Corp; and Samuel M . Syverud, manager, Management Science Div., John Deere Co.

Describing how operations research and, in this case a simulation study can be of help in management decision making, Soderstrom will take as his example a manufacturing and distribution problem a company was faced with when sales forecasts predicted that product demand would soon outstrip production facilities. His paper will explain how a simulation program enabled management to arrive at optimum use of existing manufacturing facilities and helped plan the location and capacities of proposed plants.

Rounding out the Information Management Techniques seminars (with the exception of the Bell Data Transmission Workshops reported elsewhere on these pages) will be a discussion of "The Place of Design Engineering in the Total Systems Concept," and a seminar devoted to "Computers in our Space Program."

data management guidelines

Highlight of the conference will be eight separate discussions of management guidelines developed—as official association principles—to help managers in the control of systems, procedures, programming and data processing. The first seminar, "Intermediate and Long Range Systems Planning," will be presented by Irwin T. David and Henry S. Moss of Touche, Ross, Bailey and Smart.

Much is known about the developments of the next five years, and the systems planner will have little difficulty in predicting requirements, say, in display technology and direct access storage, according to the speakers. But certain disciplines will be required when the planner moves out of the short range picture. "It is extremely important that an attempt be made to project an organization's

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systems capability out as far as 10 years and to give recognition to major trends and forces that may have an impact over that period."

The planner cannot neglect the environmental considerations of the firm's future business life, the speakers add. Purchasing and consumption of goods, strategies of competitors, and the rate of new product introduction must all be examined for the long term.

Haskins and Sells will send three consultants from the firm's Management Advisory Services Dept. to discuss, "Defining an Organization's Information Requirements." The speakers will be Richard G. LeRoy, Vito G. Petruzzelli and Frederick S. Marks Jr.

This panel will review the structuring of a management team to study data requirements. "The study team's obligation should be to document the study objectives through a review of the organization structure. All major subsystems of the company should be investigated. Possible changes in organization should be noted for possible incorporation into the new design," the speakers recommend.

"Machine Selection" will be presented by Cecil Taylor, manager, Management Controls, Peat, Marwick, Mitchell & Co. Whether the machine study is approached on a team or committee approach, all areas of susceptibility must be uncovered so that the objectives of the study will be accomplished, Taylor says. These areas may include clerical functions, presently mechanized functions, or procedural changes. "Whatever the area involved, consideration should be given to the ease of converting an application and its effect upon the system as a whole.

Information needed by the vendor will include systems concepts to be followed, application areas to be considered, source documents required, a record index telling what data fields apply and how large they are, report volumes and requirements, data volume statistics, data flow charts, and report formats.

When evaluating proposed systems, an operating schedule should be made for each systems. Another screening level may be possible from the standpoint of timings or requirement discrepancies. "A final evaluation should verify compliance with proposal requirements. Numeric weights will then be assigned criteria within these requirements. After establishing an evaluation scale, ranking requirements, and assigning numeric weights to requirements, the system can be evaluated against the proposed criteria."

In documentation, an economic analysis of the resulting system should be prepared by developing non-recurring and operating costs, he concludes.

control systems and programming projects

Greater control and flexibility in systems work is being accomplished today by utilizing the project form of organization, attendees will learn from a team from the Management Advisory Services department of Price Waterhouse & Co. Seminar speakers P. A. Christensen, W. T. Meyers and J. F. Moynihan will list the five important characteristics of the project approach that cover the goals, cost commitments, measurable results, a set of events that assures prerequisites for adequate control, and a review in the form of a post audit.

"Establishing project goals in sufficient detail and determining interrelated activities comprising the project jointly form the basis of a task called "scoping the project," according to the team. "Scoping also provides for assigning responsibilities and checkpoints."

A seminar prepared by Stanley L. Cornelison and William E. Ellingson, both managers of the Administrative Services Div. at Arthur Andersen & Co., covers "Program-

ming Conventions and Procedures." Types of documentation to be discussed will include: Decisions made and agreements reached, standard conventions, detail design of the system, and operating procedures. Under the first, the documenting of memorandums prepared in the planning stage and the necessity of written decisions and agreements will be emphasized. Standard conventions are the rules associated with the detail design of the system as well as the manner in which the programmers develop and document the computer programs in the system.

"Once the details of report layouts, data record layouts and processing functions have been finalized, these facts must be available to systems analysts and programmers alike to insure that these individuals always have ready access to correct information," the speakers emphasize. In documenting operating procedures, care must be taken to spell out both computer operating instructions and manual procedures.

Two managers from the Management Consulting department of Lybrand Ross Bros & Montgomery will tackle the question of "Making EDP Controls Work for You." Jerome D. Baker and William A. Kane will discuss potential reliability in the control of information systems. The theme is that control concepts, properly applied, will work for data processing managers, systems men, programmers and operators.

The speakers will call for serious involvement on the part of executive management in assuming responsibility for planning data processing controls. Under discussion will be input controls, programmed controls, operating controls, and internal checks. Controls over the processing and conversion of media must be accomplished under somewhat flexible rules and must be governed in the degree of controls by the importance of the data. The volume of transactions will also determine the degree and type of control to be esablished, they say.

"Procedures, such as key verification, batch totals, sight verification, or printed listings should be used only when they meet the criteria of reasonableness, in light of the degree of control required and the cost of providing control in relation to the importance and volume of data involved."

operation & personnel evaluation

Arthur Young & Co. will be represented by Ernest W. Kosty and George Holthus, both associate consultants in the firm's Management Services department. This seminar will explore "Data Processing Department Operation and Personnel Evaluation." Work measurement techniques will be investigated and standards reviewed to evaluate personnel performance, manpower requirements and equipment utilization. This discussion will highlight the characteristics of a methods-measurement program. Time study, work sampling, rated actual time and predetermined time standards will be among the techniques described.

The speakers will also scrutinize the areas of quality control checks, production standards and manpower staffing. For purposes of the methods-measurement program, the dp department will be broken down into the input output group, the data input group and the machine sections. The discussions of work-measurement techniques will cover the forms normally used, the mechanics of measuring activity, setting production standards, and reporting performance on the basis of these standards. Techniques to establish manpower budgets for each dp group will also be reviewed.

Closing these guideline seminars will be a discussion on

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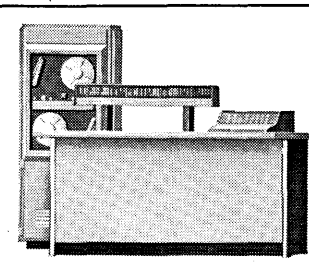

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CIRCLE 36 ON READER CARD

the structure of a data processing function. Three representatives from Ernst & Ernst, led by David A. Woellner, will participate. Assisting him will be William S. Nebe and Robert L. Anderson, both managers in the company's Management Services department.

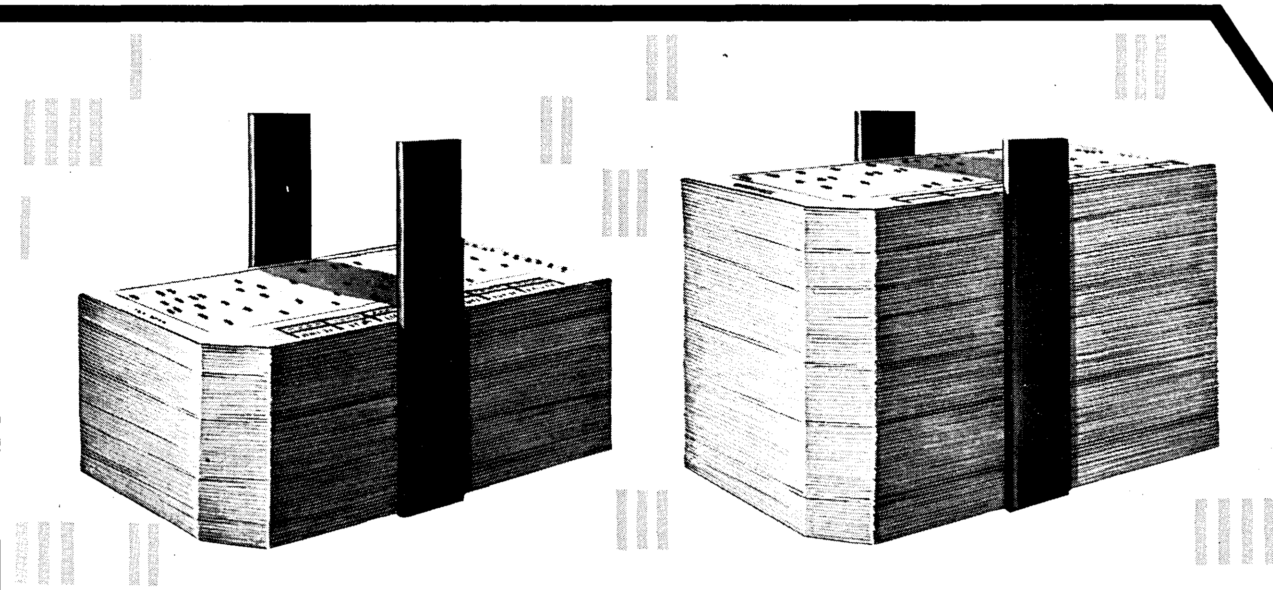
Here, the tasks will be one of defining the functions, natural subdivisions or facilities in the term, "data processing activity," and then relating them to the varied attiudes in the business world, to the many different operating objectives, and finally to the organization necessary to standardize an ideal structure.

Within the management environment, Ernst & Ernst recommends two broad guidelines. The first states that if data processing is not considered a corporate or entity wide function, then each recognized function should have its own structure of the dp activity. The second holds that the four major functions of dp—systems, programming, operations, and control—should report to one executive regardless of environment or level of organization.

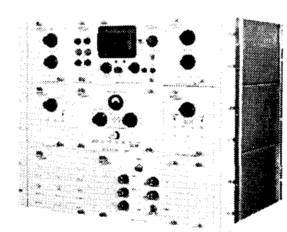
A third guideline to be reviewed concerns the recommendation that the dp activity be considered a corporate function if computers are to be used effectively at the senior executive level. "Organization and deployment of data processing functions must then be based on the degree of sophistication comprehended by each of the major functions served and all of the people in it whether directly involved with data processing or not. The corollary is that data processing personnel need to know as much about the business functions served as they expect the operating function personnel to know about the data processing function," the report concludes. ■

ARE YOUR COMMUNICATIONS FACILITIES GAGGING YOUR COMPUTER?

RIXON USERS HAVE INCREASED THROUGHPUT FROM 200 to 360 CARDS PER MINUTE; YOU CAN BOOST YOUR OWN THROUGHPUT BY 80%...OR MORE!



If line speed is slowing up the processing of data at your central site . . . if the information you need in a hurry is being delayed . . . you need the only data set now available that doubles your line speed: The Rixon 48M! Present users in government, the military, and private concerns report throughput increases **as high as 88%.** It increases efficiency . . . it decreases costs, for it minimizes or eliminates completely the need for extra circuits, extra terminal equipment, extra shifts . . . and it frees your computer to handle extra jobs. No compatibility problem. FCC approved, it utilizes standard telephone data lines (boosting their bit per second rate from 2400 to 4800), and interfaces with any computer manufacturer's equipment. Find out how much it can do for **you.** Write today for specifics:



RIXON ELECTRONICS, INC.
2120 Industrial Parkway/Silver Spring, Maryland 20904

CIRCLE 39 ON READER CARD

THE ADVANCE 6130

The EMR-ASI Computer Div. has announced the first of a series of 16-bit (plus parity bit and memory protect bit) computers—the ADVANCE 6130. A fully monolithic IC model with a 0.9-usec cycle time, it sells for about $34K. The add time is 1.8 usec (including indexing), multiply time is 4.2 usec, and the double-precision add time is 2.7 usec.

For the Computer Div.—formerly the Advanced Scientific Instruments Inc., Minneapolis, acquired in 1963 by Electro-Mechanical Research Inc.—it's a chance to penetrate the low-cost digital systems market. Specifically, data acquisition and process control. Other machines in the 16-bit series are expected to be announced this fall.

As reported last month (p. 17), features of the 6130 include 16- and 32-bit instructions, 4-32K of core, three hardware index registers (single or double indexing), 6-and 8-bit I/O channels (programmed, multiplexed, or word/byte), multilevel priority interrupts, and hardware multiply and divide. The several addressing modes are indirect, indexed, doubly indexed, relative, and immediate. And the special instructions include double-precision (add, load, store), normalize, increment memory, as well as a variety of jumps and skips.

Included in the software package is a Real-time Executive, with a batch processing monitor that operates under real-time control, a Batch Process Operating System, an assembler, and an ASA basic FORTRAN IV that operates in a 4K configuration.

A rack-mounted computer, the 6130 is an addition to the company line that consists of the ADVANCE 6020, 6040, 6050, and 6070—all 24-bit machines. ■

CIRCLE 160 ON READER CARD

Magnetic Media Corporation develops a fourth generation computer tape... 829,440,000 bits on an 8½" reel

MICRO MEDIA 25

One 8½" reel of 'Micro Media 25' stores 829,440,000 information bits — as much as two standard 10½" reels. You get 4800 ft. of tape in one-fourth the storage space you now use.

MICRO MEDIA 25 is the most advanced computer tape available. **MICRO MEDIA 25** is a new development which one day will make all other tapes obsolete — and it took the technical capability and precision equipment of Magnetic Media Corporation to produce it.

Magnetic Media Corporation has dedicated itself to solving tomorrow's problems today by constantly extending existing parameters. Innovation is our key activity — only by performing in unexplored areas can the standards of the industry be raised. All products which bear the Magnetic Media trademark reflect those high standards. Try **MICRO MEDIA 150** today — insist on **MICRO MEDIA 25** tomorrow.

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news briefs

HONEYWELL BUYS COMPUTER CONTROL COMPANY

Honeywell's $29 million acquisition of Computer Control Co., Inc. marks the addition of many new dimensions to the firm's data processing capabilities. CCC, sold for 345,000 shares of Honeywell common stock, is a 1300-man digital systems firm based in Framingham, Mass., and operating three manufacturing plants. Its sales for the last two years have been in the $20 million range, with almost half of that reportedly stemming from logic modules sales.

Honeywell has said 3C will operate as a separate unit, maintaining its personnel, plants and product lines. The new and supplementary capabilities 3C provides include first, a well-established market in digital subsystems and modules, such as i.c. logic modules, i.c. core memory systems, and magnetostrictive delay line memories. Major computers in its line are the DDP-116, 124 (its first i.c. system, announced last May), and 224; the price range is from $28.5K to $120K. All these products are primarily sold to systems-building firms for use in such areas as process control, railroad traffic control and aircraft simulation; 3C also produces complete special systems for graphic arts, machine tool control, communications, and other industries.

Honeywell, although its major market is business dp, does manufacture process control systems (H-20 and 21) at its Industrial Division in Fort Washington, Pa.

CCC also manufactures some of the monolithic integrated circuits for its equipment; Honeywell does not have this facility (although it has three i.c. research and development centers), and the larger systems in the H-200 series uses these circuits. Honeywell resources that could aid 3C computer sales are its extensive line of peripherals and its marketing rights to Bunker-Ramo 200 and 400 displays. An area 3C has not explored, although its computers are qualified, is the general scientific market; a larger marketing force is needed, to enter the fray, but the Honeywell group is business-oriented and doesn't seem likely to provide that power.

Both firms have overseas marketing staffs, but only Honeywell has manufacturing plants abroad; conceivably some of the 3C line could be produced there. The agreement which permits Bunker-Ramo to use 3C hardware and technology on a worldwide basis is still in effect.

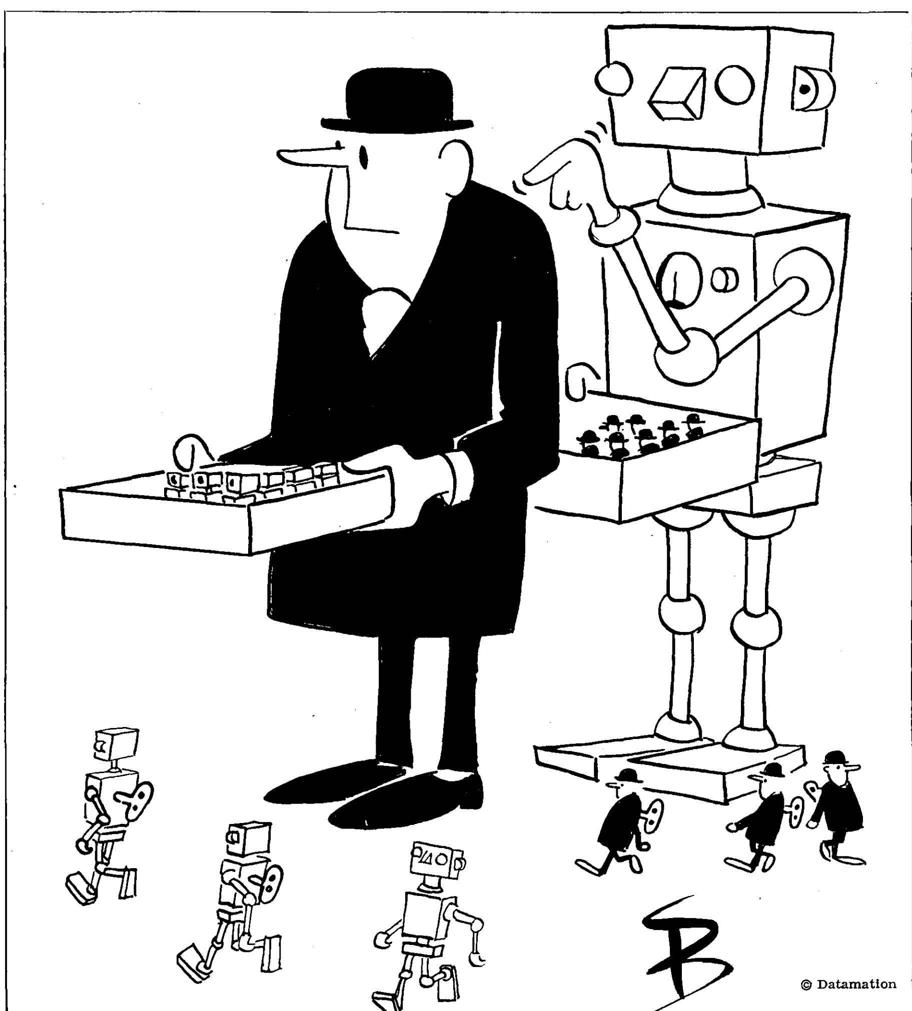
Financially, 3C's earnings were down in fiscal '65, due, said the firm, to an "unusually high concentration" of new product announcements. Sales in '65 were almost $24 million with earnings of $388,000, compared to $19 million in sales and $525,900 in earnings in '64. The prospect is brighter for '66, as first-quarter sales hit $6.6 million with a net after taxes of $339,000.

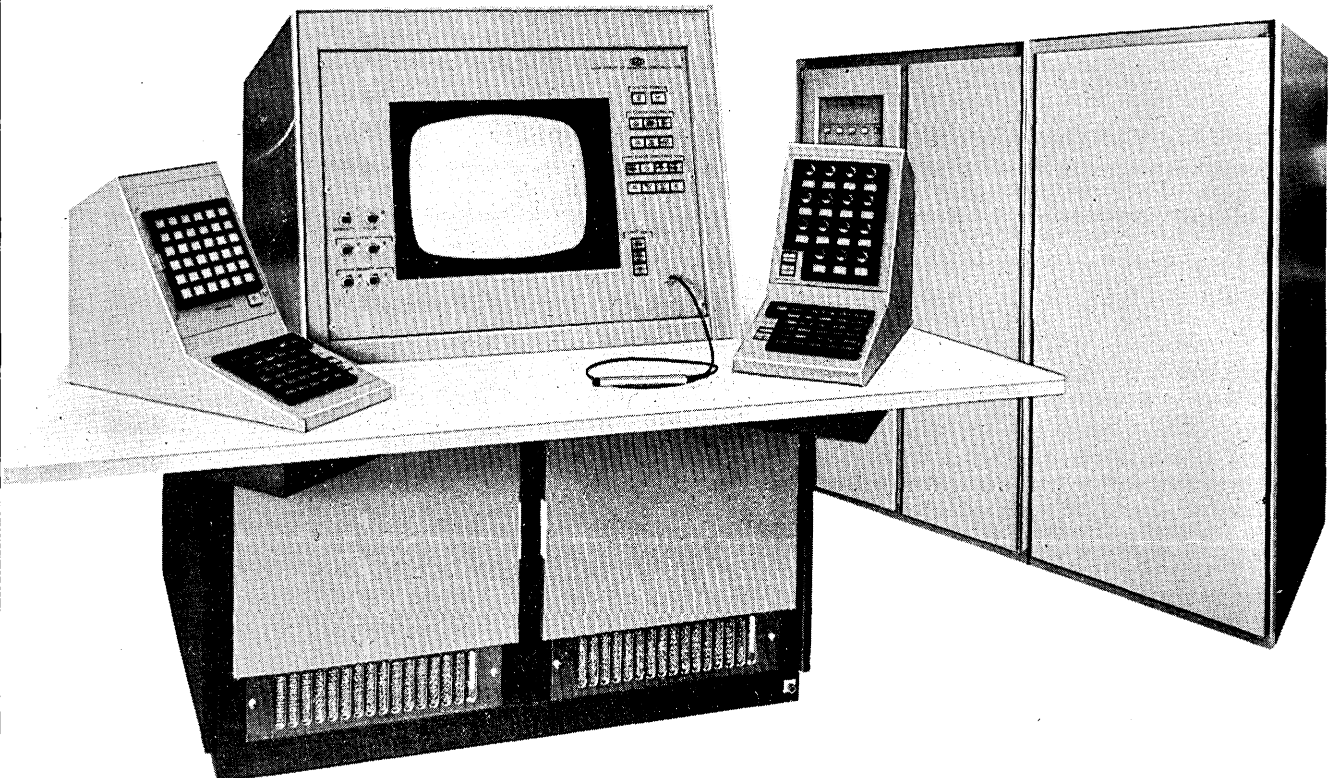
GROSCH SPEAKS ON DEACON DATA BASE SYSTEM

A small-scale data base system called DEACON (Direct English Access and Control), being developed by a 24-man group at General Electric TEMPO in Santa Barbara, Calif., was described recently by the project manager, Dr. H.R.J. Grosch. Addressing the Los Angeles chapter of the ACM, Grosch said the project is an attempt to: (1) enable the user and system software to structure data to reflect the "world view" and semantic preference of the person who put it in and will be taking it out (same person), and (2) allow the use of unrestricted, open-ended English—in its free and redundant form.

Currently operating, for example, is a data base "world" that consists of 12 ships moving in and out of six ports. If the user were to ask, "What ships are in Boston Harbor?" the system would list not only those ships in the harbor but also all ships whose home port is Boston; DEACON is thus not able to distinguish which listing is desired by the way the question is phrased. However, by asking, "In what port is the carrier Forrestal?" the interrogator would get the correct answer.

Drawing an analogy, Grosch said the system resembled an executive secretary who didn't understand the





Picture above shows display console with its associated scanner and control cabinets.
Link Waveform Display/Analyzer is used on line with 7040/7094 computer at Ballistics Systems Division, USAF.

New LINK Waveform Display/Analyzer– precision film reading and recording with one machine.

Here is a new graphic input/output device that can help reduce computer time and programming costs significantly.

The Waveform Display/Analyzer allows real-time access to information and immediate updating and analysis.

You can change the display with a light pen and keyboard and request further action from the computer without the assistance of a programmer.

The light pen lets you alter, add and delete data. You can move, enlarge and reduce images, plot graphs, and label displayed information. Problems can be altered for further analysis. It is not only a problem-solving tool—it's a system for producing new designs.

The light pen saves time and cost by eliminating the need for an output record, thereby cutting down on equipment and producing answers more quickly.

AND THESE OTHER FEATURES–

- Scan a film image or waveform and digitize the data.
- Display data and images on a high-resolution CRT.
- Store computer output data on film in black-and-white or a 16-level gray scale.
- Handle large amounts of information by film scanning—(1024 x 1024-bit matrix with 16,380 x 16,380 also available).
- Buffer system storage capacity 1024 words, 36 bits each.
- All solid-state circuitry.
- Utilizes interchangeable film transports making it possible to use 16mm, 35mm and 70mm film in both the read and record mode.

The Waveform Display/Analyzer can operate as a single unit with one small binary computer or as one of several time-shared units on a large host machine.

For an informative brochure, write to Advanced Product Sales, General Precision, Inc., Link Group, 1451 California Ave., Palo Alto, Cal.

GENERAL PRECISION INC
LINK GROUP

CIRCLE 44 ON READER CARD

business. With some training, however, she would be able to find the information her boss seeks on the basis of a terse word or two. DEACON is an attempt to develop this type of relationship; thus the importance of the man seeking the information being the same one who put it in.

Some 200 grammar rules are in the system, a mere one-tenth of what's needed, he said. And only 80 to 90 are in the system at any one time. Currently being added is negation. While about 3,000 words are stored so far, the capacity is 400,000 words. Other improvements contemplated are a computer faster than the GE 225 now being used, and the construction of a system having several data bases—e.g., ships at sea, personnel, etc. Delivery of the system to a user might be in two or three years, Grosch said.

DESIGNERS DEBATE SERIAL VS. PARALLEL PROCESSING

The April meeting of the Orange County, Calif., chapter of the IEEE Computer Group featured a debate on the subject of "Serial Versus Parallel Processing." Moderator was Gerhard Hollander of Hollander Associates. Other participants were Dr. Richard Fuller of Librascope, Dr. Gene Amdahl, IBM, and George West, SDC.

It was agreed at the outset that definitions were required before the debates could get under way and Dr. Fuller offered four definitions of parallelism:

Operand parallel—today's conventional computer structure with one arithmetic and control unit and, for purposes of this debate, a serial computer.

Array parallel—a structure with many, perhaps thousands, of identical processors but with a common control unit.

Overlapped control sequence—a structure with some multiplicity of control and arithmetic elements operating on a single instruction stream, commonly known as a program look-ahead implementation.

Parallel program sequence—a set of independent processors, each with its own arithmetic and control capability, commonly known as a multiprocessor configuration.

The discussion showed that no one was defending the serial processor but Fuller supported the array parallel type, Amdahl the overlapped control sequence (which he called "pipeline architecture,") and West favored the parallel program sequence concept.

Debate ultimately centered on two of Amdahl's graphs, which purported to show that pipeline processors tended to be better than array processors (even an infinite number of them) for realistic problems, typically less than 75% parallel. Fuller vigorously questioned the basis for such a low estimate of intrinsic parallelism for certain classes of problems, while West felt that pipeline processing did not recognize the frequent requirement for graceful degradation. Hollander declared a three-way tie.

GPL SHOWS COLOR DISPLAY USING BLACK-AND-WHITE FILM

A technique for projecting displays in full color using a single frame of black-and-white film and a banded filter has been devised by the GPL Div. of General Precision, Inc. Developed for use in the Navy Bureau of Ships' C&C display system, OPCON-CENTER, the technique is still 30 seconds away from achieving "real-time," but a significant development nevertheless.

Dubbed LentiColor by GPL, it uses lenticular film, which has a black-and-white emulsion on one side of the film base and parallel lenticules on the other. Color-separation images can reportedly be made from full-color material, as well as pre-selected synthetically created colors from b&w material. Recorded in register on the film, they remain in register despite film dimensional changes. The initial exposure and subsequent projection are made through a filter that has parallel bands of blue, green, and red.

Operating with an on-line CRT, a single-lens camera with the lenticular film can photograph the face of the scope, which bears background information superimposed over computer-generated data. In the 30-second delay time, this image can be displayed in full color.

SPEECH RECOGNITION SYSTEM DEVELOPED BY RCA

Voice control of computers, extremely low-power transmission of processed speech from spacecraft ground stations, and transmission of multiple telephone conversations over one telephone wire are benefits hoped for from a Speech Recognition System being developed by RCA for the Air Force. Use of a phoneme technique is said to be the basis for greater accuracy. This is identification of the smallest units of speech (phonemes) distinguishing one utterance from another, such as the "p" in "pin" or the "f" in "fin".

The Air Force, which wants to

news briefs

decrease power needed in deep-space voice communications, notes that digitizing a voice for transmission requires 30,000 bps; the phoneme method, which extracts key features, requires only 100 bps. The symbols are reconstructed into words at the receiving end, being typed out or verbalized through use of a voice reply system.

The experimental system recognizes phonemes by parallel processing, using 600 identical circuits which function like neurons, performing both binary and analog operations. These artificial neurons are now able to identify, with 90-99% accuracy, 29 of the required 40 phonemes.

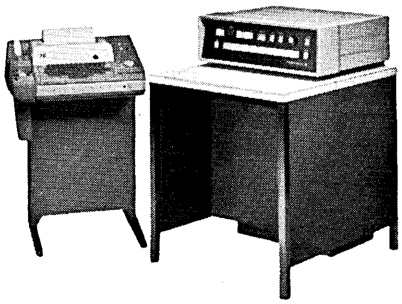
● Development of a technique that will lead to automatic, "intelligent" program segmentation is being pursued by Celestron Associates under a contract with Rome Air Development Center. Intended for multiprogram or time-shared installations, the system is planned to be capable of accepting programs written without regard to segmentation requirements and rearranging them to fit optimally into fixed length memory segments. The system will also compute segment running time and report to the programmer on segmentation it has produced.

● IBM has developed a console which can be used to take electrocardiogram readings on a hospital patient and transmit the data to a computer. The system, used at Mt. Sinai Hospital and New York University Medical Center, tells the physician only desired measurements and significant changes in the rhythm of the heart. To take an ECG, the technician first enters information about the patient, then connects leads to him. Pulses from each lead are recorded on a stripchart recorder and on the console's tape recorder as well as being transmitted to the computer center. Only points of interest in the ECG waveform are selected, reducing the amount of data to be handled by a factor of 10.

● The English financial community now has an on-line computer service which will calculate and quote prices of equities and stocks on the London and European exchanges. Intinco Ltd. of London is providing the service, called SCAN, using a 32K Univac 418 computer. The firm also hopes to provide New York over a direct computer-to-computer telephone circuit.

Here's how we designed our small, real-time control computer—the H21

FIRST IN A SERIES—



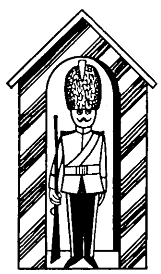
WORD LENGTH — small, scientific computer manufacturing costs are almost linearly proportional to word length. What is the optimum word length? Here are the critical considerations: accuracy and efficiency of data representation; a desirable instruction repertoire; efficient and simplified programming that goes with a directly addressable memory; and suitable architecture for supporting advanced software.

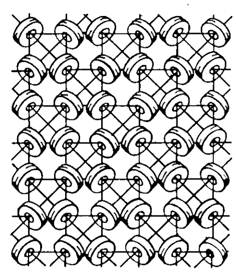
We chose an 18-bit word for our H21 real-time control computer. It gives a data resolution of one part in 262,000—and packs three alphanumeric characters into each word. The extra bits provide for a larger, more powerful instruction set. And a single word instruction directly addresses a full 8192 word core bank making programming straightforward and efficient . . . no cumbersome, memory wasting addressing schemes, such as paging, double word instruction modes, relative addressing, etc. are necessary.

18BitS

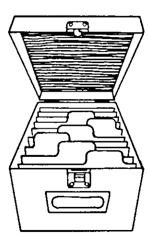
PARITY—it adds a bit to the word length. But it's well worth the investment. Past experience has shown parity to be valuable in ensuring proper system operation and safety. It's also a time-saving maintenance tool. It's a standard feature in the H21.

MEMORY GUARD—a new concept in real-time systems. This feature allows critical system programs (executives, monitors, etc.) to be guarded. Once guarded, a program is protected against accidental modification by undebugged, unguarded programs. Since each word carries its own guard bit, we now have a 20-bit word length . . . and a new dimension in system utility and reliability.

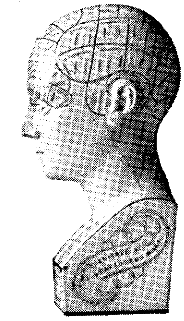




HARDWARE INDEXING—everything an index register can do, programmers can simulate with subroutines. But the tedious and time-consuming programming effort, and the extra memory required, result in false economy. Who cares how much extra memory you have to buy after you've bought the machine? We care . . . we include a "full use" hardware index register to ensure program efficiency.

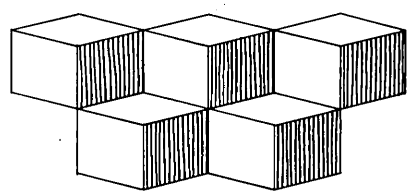


BULK MEMORY—a moving head disc file is cheaper than a head per track. And *less reliable*. And *slower* . . . (moving head disc files have long access times, normally 10 times that of fixed-head discs or drums). In high-performance, real-time systems, fast bulk memory is desirable to simplify system programming. Also core



memory requirements are reduced since fewer programs have to reside permanently in core.

COMPUTER INTERFACE—manufacturing costs could have been pared by building a minimal interface—singular I-O connector, low power bus drivers, etc. But this only defers the cost, multiplied several times, to the user at the time of system tie-in. Therefore, we include multiple I-O connections, husky bus drivers (75ma) and a generous set of clocking and control signals. The H21 interface even packs and unpacks characters into or from memory. The results . . . simple and economic interfaces for real-time systems.

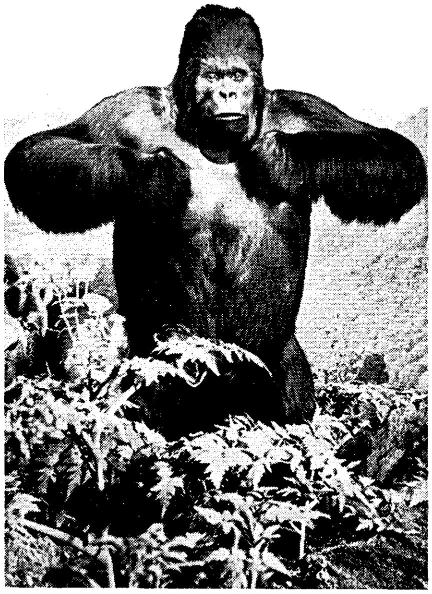


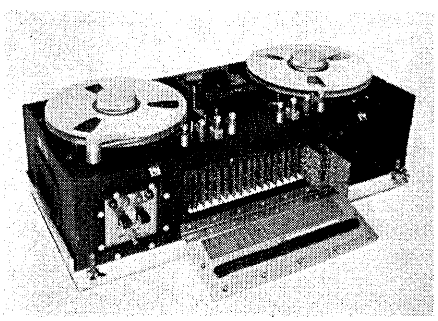
PRICE—the lowest for computers with this capability. For just $21,000 you can get a central processor with 2K memory, and an I-O typewriter with tape punch and reader. An 8K system (that's 8192 words) costs only $32,000. And the delivery is good . . . try us.

If you'd like to get immediate information and complete H21 specifications, call or write to Control Computer Department, Honeywell Inc., Fort Washington, Pa. 215-643-1300.

Honeywell

CIRCLE 48 ON READER CARD





news briefs

Twenty customers are now using SCAN, with up to 100 expected by the end of the year. Teletype terminals are used.

● New England Telephone and Telegraph has signed with Control Data for a joint study to develop an on-line portion of the telephone company's business information system. CDC estimates the study will run about two years and notes that this procedure will allow optimum integration of hardware and programming needs.

● Newly formed ITT Data Services will set up a big west coast service center network, with headquarters in El Segundo, Calif. A System/360 Model 30 has already been installed; it will be joined by a 262K 50 this summer and a 67 sometime next year. Satellite subscriber stations will be set up in the Los Angeles area, tied to the center by high-speed data lines. Plans call for adding centers in San Francisco, then in cities in other western states during the next few years.

● At the annual Memorex stockholders' meeting, president Laurence L. Spitters announced that Disc Pack Corp. of Hawthorne, Calif., will become an affiliate–meaning that Memorex has bought part of the company. Full acquisition is possible later this year. Disc Pack makes the discs themselves in stack form, not the drives, and sells them to IBM and others. President Raymond Stuart-Williams was formerly with Data Products Corp.

● Highest data transmission rates by cable between Europe and North America are claimed by Rixon Electronics of Silver Spring, Md. A rate of 4500 bits/second was reached between the U.S. Weather Bureau in Suitland, Md., and the Deutscher Wetterdienst in Offenbach, Germany. Rixon Sebit-48M data transmission modems were used on each end in duplex mode with error rates below the acceptable limit of 1 in 10^5.

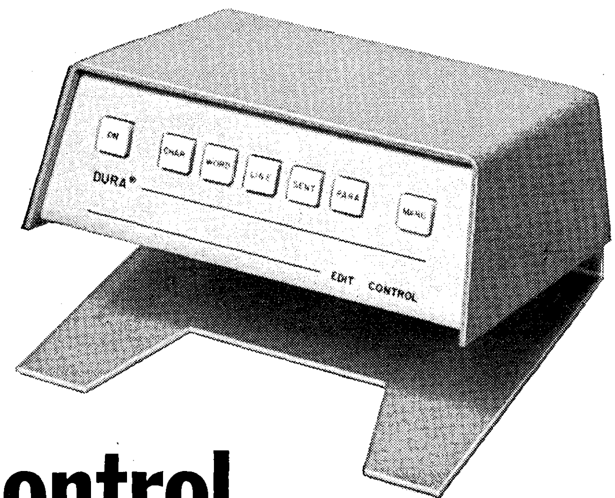
● Univac's APT numerical control program for machine tools is now operational for the 1108 II. The program is said to be compatible with APT for the 1107 and to run four times as fast. The original program and special language was a joint development effort by 40 aerospace companies.

● In spring of 1967, Western Union will complete a 1300-mile extension of its coast-to-coast microwave network which will link it in the northwest with the Canadian National-Canadian Pacific network. The $13 million addition, which will go between San Francisco and Aldergrove, B.C., is being built by Sylvania. The system will also hook into the Comsat facility at Brewster Flat, Wash. to carry satellite communications including television, data, and voice transmission. A complement to the Buffalo-Toronto eastern link, the new facility will provide a wide range of transmission speeds and will have a capacity of 1200 voice grade channels. It adds more than 31 million telegraph channel miles to the 80 million now provided by the present 7500-mile network. Complete electric power back-up will enhance the system.

● The AFIPS report titled "The State of the Information Processing Industry" has now been published, based on the results of a C-E-I-R study completed last year and since updated. The 100-page report covers personnel, hardware, financial statistics, new industries, automation effects, and applications. Some sample findings: there were over 30,000 computers installed at the end of 1965 and projections suggest there may be 85,000 by 1975; non-government use of computers has increased since 1950 from 21% of the total to 84%; a scientific problem that occupied a 1950 computer for an hour could now be handled by present machines in three or four seconds. On the software side, costs—as a proportion of the total spent on computer systems—have been rising steadily and are expected to pass the 50% mark during next year. Programming employment has also grown swiftly, although it seems peculiarly difficult to count programmers: the report says that there were "an estimated 60,000 to 120,000 in 1965."

● The Triangle Universities Computation Center, serving the Univ. of North Carolina, Duke, and North Carolina State, will be supported by a grant of $1.5 million from the National Science Foundation, divided equally among the three schools. The center is getting a 360 Model 40, to be upgraded later this summer to a 75. Each of the universities will also have a small 360 tied to the computation center by telephone lines and several terminals will be added later at each campus. Plans call for eventual extension of the service to 76 other educational institutions throughout the state.

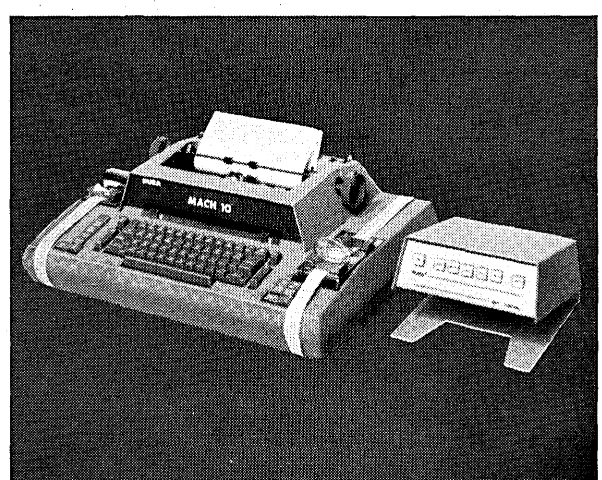
Like having two typists for the price of one!



What is?
....the Dura® Edit Control

It eliminates the costly manual retyping of revised material!

Type copy, change it, paragraph it, update it, polish it... Dura Edit Control more than doubles the production of the average typist. With the Dura® Mach 10®, automatic typewriter, you have a fast, easy and economical way to revise typed data. All unchanged data is retyped at up to 175 words a minute without error from punched paper tape or cards. To make changes, push a button to stop the typewriter automatically after a character, word, line, sentence or paragraph. Then, type in corrections. The right margin automatically adjusts to compensate for new data. Legal documents, catalog and engineering specifications, endless other typing applications are naturals for this Dura combination. For details, call your representative or write Dept. D23-56, Dura Business Machines, 32200 Stephenson Highway, Madison Heights, Mich. 48071.



DURA BUSINESS MACHINES

Division of DC* *dura corporation*

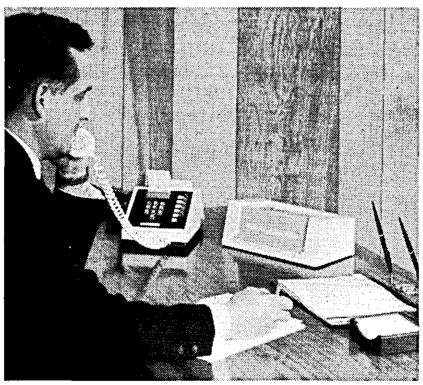
*Trademark Dura Corporation

CIRCLE 51 ON READER CARD

new products

communication printer

The TP-10 is an electronic strip printer that operates with a Touch-Tone telephone to provide a hardcopy record of inquiries and computer responses. Printing speed is 10 cps. While



input is limited to numeric data, output may be alphanumeric and/or special symbols. Message length is unlimited. DATA TRENDS INC., Parsippany, N.J. For information:

CIRCLE 130 ON READER CARD

data communications terminal

The DCT 2000 consists of an 80-column card punch, 250-lpm printer, 200-cpm card reader, control unit, and operator's console. The system can send or receive data (in ASCII code) over voice-grade lines at up to 300 cps. Numerous type faces are available, each type bar containing 63 characters with 80 print positions; 26 special symbols are offered. Deliveries begin early in 1967. UNIVAC DIVISION, SPERRY RAND CORP., New York, N. Y. For information:

CIRCLE 131 ON READER CARD

tape status monitor

The Console Tape Status Monitor gives a visual indication of the conditions of all tape drives on-line to a computer, eliminating the need for frequent manual checks. The information, which is displayed on Nixie tubes or incandescent bulbs includes: tape drive and program select identification numbers, ready status (to accept a command), and drive select. The unit, which is attached to the computer and does not require modification of system circuitry, measures 24⅜ inches by 5 inches by 5 inches. EDUCATIONAL TESTING SERVICE, Princeton, N.J. For information:

CIRCLE 132 ON READER CARD

data collection

The 128 series includes single- and multiple-card reading terminals, online scale adaptors, high-speed line printer, tape drive, and interfaces to computers. There's also a 16K-byte stored-program receiver processor. DATA PATHING INC., Palo Alto, Calif. For information:

CIRCLE 133 ON READER CARD

upper, lower case printer

Operating off-line with its own tape drive, the model 1000 uc/lc is a drum-type printer that can operate at 640 lpm with upper- and lower-case fonts, as well as at 1200 lpm with all upper case. The print drum, of course, must be replaced for this changeover. Features include parity checking, 7- or 9-channel IBM compatibility, and triple density availability. Tape densities can be 200, 556, or 800 bpi. DATA PRODUCTS CORP., Culver City, Calif. For information:

CIRCLE 134 ON READER CARD

keypunch console

Styled to wrap around the IBM 029 keypunch, the 7229 console provides additional work surface and desk drawer storage. The pedestal is designed to reduce noise level, and adjustable glides compensate for uneven floors. Pedestals are available with three box drawers or a box drawer and a file drawer with full suspension. STEELCASE INC., Grand Rapids, Mich. For information:

CIRCLE 135 ON READER CARD

programmable calculator

The portable DAC-512 performs the usual arithmetic functions, and can hold up to eight stored programs, each with up to 64 commands. It comes with a library of such functions as powers and roots, factorials, and evaluation of integrals. Number capacity ranges from 1 x 10^{-49} to 1 x 10^{49}. Arithmetic is floating point with 12-character words consisting of nine decimal digits, sign, and 2-digit exponent. Price is less than $10K. DATA ACQUISITION CORP., Hamden, Conn. For information:

CIRCLE 136 ON READER CARD

data recorders

The Series IV systems include hardcopy/mag tape recorders and trans-

PRODUCT OF THE MONTH

The 1500 is a total system specifically designed for computer-assisted instruction (CAI). It is initially being leased or rented to a limited number of educators for resear development, and operational use. Up to 32 specialized terminal systems can time-share a central IBM 1131 processor. These newly developed student stations can consist of: a 1510 instructional display (640-character capacity) with keyboard and light pen; a 1512 image projector with a 9-by-7 inch screen and the ability to show 1,000 images in any sequence; and/or a 1518 typewriter. Each station can also provide audio instruction and permit student recording; an audio adapter contains and controls transmission from and recording on the audio tape drives.

The 8K 1131 can retrieve CAI courses from a 2310 disc (512K words/cartridge) and analyze student responses. The 1500 operating system includes: an expanded Coursewriter language which will permit a course author (non-programmer) to prepare or modify subject material and communicate with the system through any station; provisions for recording student performance data; utility programs which provide a wide range of student performance data and course listings; and a Mathematical Algorithm Translator which permits students to compose solutions in mathematical notation.

Other equipment includes a 1501 station control with 24K words of core storage, an 1132 line printer, and a 1442 card reader. IBM Data Processing Div., White Plains, N.Y. For information:

CIRCLE 137 ON READER CARD

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

Hydrogen Bonds → Clean Engines + Dirty Oils

One way to keep an engine clean inside is to keep the oil dirty.

Oil additives—dispersants—help to do this. But how?

Chemists have postulated that one way is through a dispersant's ability to form hydrogen bonds with polar oxidation products—products such as acids and solids that result from cooking the oil and burning the fuel during engine operation. But experimental evidence has been scarce.

Now GM Research has evidence that ashless dispersants of both high and low molecular weight do form hydrogen bonds with polar liquids, tying the polar molecules to the dispersants.

Using alcohols as polar molecules—representing oxidation products—one of our chemical engineers studied the effects of adding various concentrations of two ashless dispersants (an aminoalkenylsuccinimide, with low molecular weight, and a high molecular weight methacrylate-pyrrolidone copolymer).

He monitored the interactions, using infrared spectroscopy . . . and found that hydrogen bonds did form between the dispersants and the hydroxylic hydrogen atoms of the alcohols. In an engine oil, hydrogen bonding apparently enables the dispersants to form protective shrouds around the polar oxidation products, keeping any sludge in the oil, preventing sludge deposition.

We knew that dispersants worked. Now we have a better understanding of how. But that's not the end.

From the new understanding may come a better product . . . and even cleaner engines.

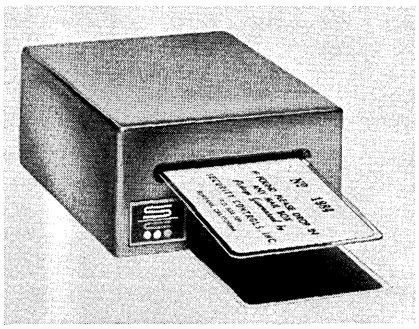
General Motors Research Laboratories
Warren, Michigan 48090

mitter interfaces to 400 series Dataphone subsets. The latter operates at 55 cps, and is available in both attended and unattended versions. The recorders have a 10-column keyboard and cartridge-loading tape deck. Machine cycle is actuated by manual lever operation, but recording is by self-contained power. Recording in bcd format is on half-inch mag tape. UGC INSTRUMENTS INC., Houston, Texas. For information:

CIRCLE 138 ON READER CARD

special-purpose reader

Operating with proprietary, invisibly-coded cards, electromagnetic reader is able to pull off a parallel 25-bit output, which can then be recorded on cards or tapes, transmitted by wire,



visibly displayed, etc. Output signal is rated from 0.6 to 24 volts DC. Code cards, not easily duplicated, can bear holder's photo, fingerprint, etc. SECURITY CONTROLS INC., Burbank, Calif. For information:

CIRCLE 139 ON READER CARD

tape block reader

The 5000 series reads paper tape in blocks of 40 to 320 bits, equivalent to five to 40 8-bit characters. Stepping speeds vary from two to 12 frames per second. ELECTRONIC ENGINEERING CO. OF CALIFORNIA, Santa Ana, Calif. For information:

CIRCLE 140 ON READER CARD

paper tape splicer

The model 5100 enables user to place tape ends on the splicer and never again touch the tape until splicing is completed. Six position pins align the tapes, tabs hold down the coiled ends, and arms maintain pressure on the fresh splice. The unit is all metal, portable, and can be bolted down. DRESSER PRODUCTS INC., Providence, R.I. For information:

CIRCLE 141 ON READER CARD

new products

data collection terminals

Additions to the firm's Transacter line include the 3010 printer, which is an 80-column, 48-character, 150-lpm unit; the model 319 data set adapter, and I/O device that matches the interface of a computer via a communications terminal controller to that of a voice-grade line (up to 1200 bps); the model 328 modem, which operates at up to 1200 bps over schedule 4A facilities; the 329 modem for use with schedule 4B facilities at 2000 bps; and the mod 330 adapter (2000 bps). CONTROL DATA CORP., Minneapolis, Minn. For information:

CIRCLE 142 ON READER CARD

short mag tape

The Mac 600, mounted on 7-inch, solid flange reel, is a 600-foot length of tape full-width tested at 800 bpi. It comes with a Wright Line Tape Seal, a file protect ring, and photo sensing markers. MAC PANEL CO., High Point. N.C. For information:

CIRCLE 143 ON READER CARD

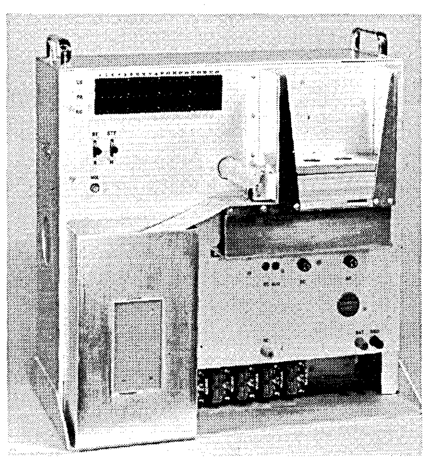
mag tape

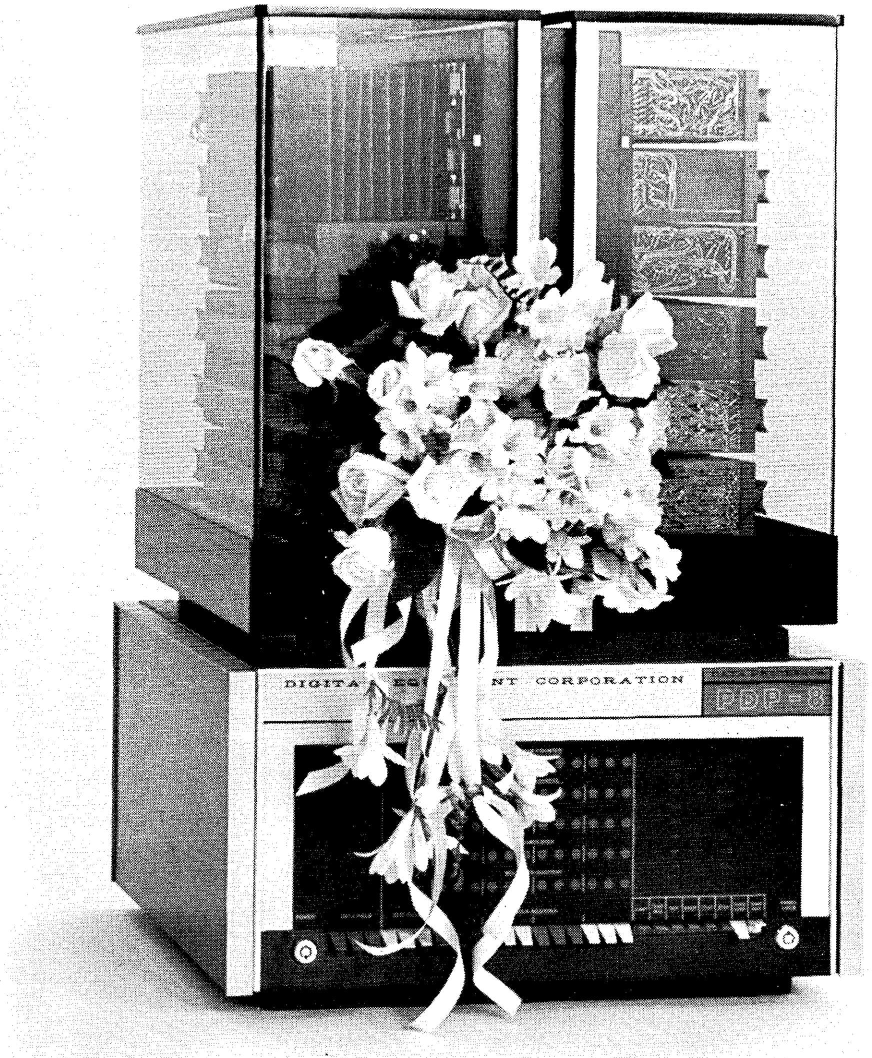
Certified for 1600-bpi use with the mod 2400 IBM tape drives, the Type 227 is also compatible with other drives using half-inch tapes. It is on 1.5-mil base in lengths of 1250 and 2450 feet. REEVES SOUNDCRAFT, Danbury, Conn. For information:

CIRCLE 144 ON READER CARD

card-to-voice reader

The PD 260 is a portable unit that translates numerical data from 80-column punched cards to a voice read-





There once was a PDP-8 that lacked a peripheral mate. A module or two — some rice and a shoe — how simple it is to relate.

Marriage is a serious business, even between an on-line scientific computer and a user's experiment. This union should be easily entered into, quick to adapt to new situations, happy and fully compatible.

The PDP-8 is a compact, high speed, core memory, real time, eminently marriageable general purpose computer. It sits right there on the lab table taking inputs directly from an experiment and pouring out collated, integrated, analyzed data. It can feed, and be fed by, a host of easily attached equipment.

Partly, this is because there are 35 standard plug-in options. A 320 page catalog of standard, readily available modules helps. A 68 page interface manual tells you what to use and how to use it for special inputs and outputs. 85 DIGITAL field engineers are available for counselling. And, of course, the computer itself was designed for marriage.

If the PDP-8 is not perfectly suitable, other eligibles include the LINC-8 and the larger PDP-7.

digital

COMPUTERS · MODULES

DIGITAL EQUIPMENT CORPORATION, Maynard, Massachusetts 01754. Telephone: (617) 897-8821 • Cambridge, Mass. • Washington, D. C. • Parsippany, N. J. • Rochester, N.Y. • Philadelphia • Huntsville • Orlando • Pittsburgh • Chicago • Denver • Ann Arbor • Los Angeles • Palo Alto • Seattle • Carleton Place and Toronto, Ont. • Reading, England • Paris, France • Munich and Cologne, Germany • Sydney and West Perth, Australia • Modules distributed also through Allied Radio

CIRCLE 59 ON READER CARD

out. It features an automatic or manual advance from card to card, audio that can be switched from an internal speaker to a headset, and selective reading of 20 or more bits from each card. The start and repeat-read operations can be controlled with a remote-control switch. AUTOMATION DYNAMICS CORP., Northvale, N.J. For information:

CIRCLE 145 ON READER CARD

tape reader

A photoelectric paper tape reader that operates asynchronously at up to 125 cps, the PTR-60100 has an integral reeler that rewinds at 20-40 ips. The unit handles opaque tapes, but is also available for use with translucent tapes. OMNI-DATA DIV., BORG-WARNER CORP., Philadelphia, Pa. For information:

CIRCLE 146 ON READER CARD

disc file

Unidisc is designed for use with the Univac 1004 and 1005 systems in such applications as billing, order entry, inventory control, etc. Two disc cartridges in the system each store two megacharacters. Access time is 135 msec. Special features are a simplified data search command and a Fastband index track which contains a series of identifiers to locate data and to position the read/write head; this eliminates the need for reading all data serially. Up to three systems—or six disc surfaces—can be accessed by a 1004 or 1005. UNIVAC DIV., SPERRY RAND CORP., New York, N.Y. For information:

CIRCLE 147 ON READER CARD

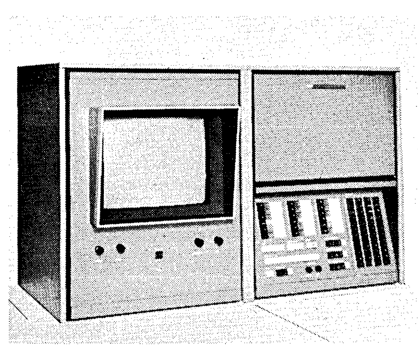
disc storage

The LIBRAFILE 3800 uses six 38-inch discs to store 200-million bits accessible in an average of 17 milliseconds. Transfer rate is up to 42-million bps. Other features include head/track design, two methods of search and retrieval (fixed address or record-content search), and retractable head plates. GENERAL PRECISION INC., LIBRASCOPE GROUP, Glendale, Calif. For information:

CIRCLE 148 ON READER CARD

crt display

The model 8880 is for analog or hybrid problem solutions. With a 16-inch CRT, it permits the simultaneous display of four signal traces from 18 analog inputs. In its three display modes, from one to four traces can be plotted against time, two can be plotted against time while each of the



other two are cross-plotted against two other variables, and three traces can be plotted against the fourth. In addition to full parallax controls, the unit offers three basic sweep ranges and two multipliers. ELECTRONIC ASSOCIATES INC., West Long Branch, N.J. For information:

CIRCLE 149 ON READER CARD

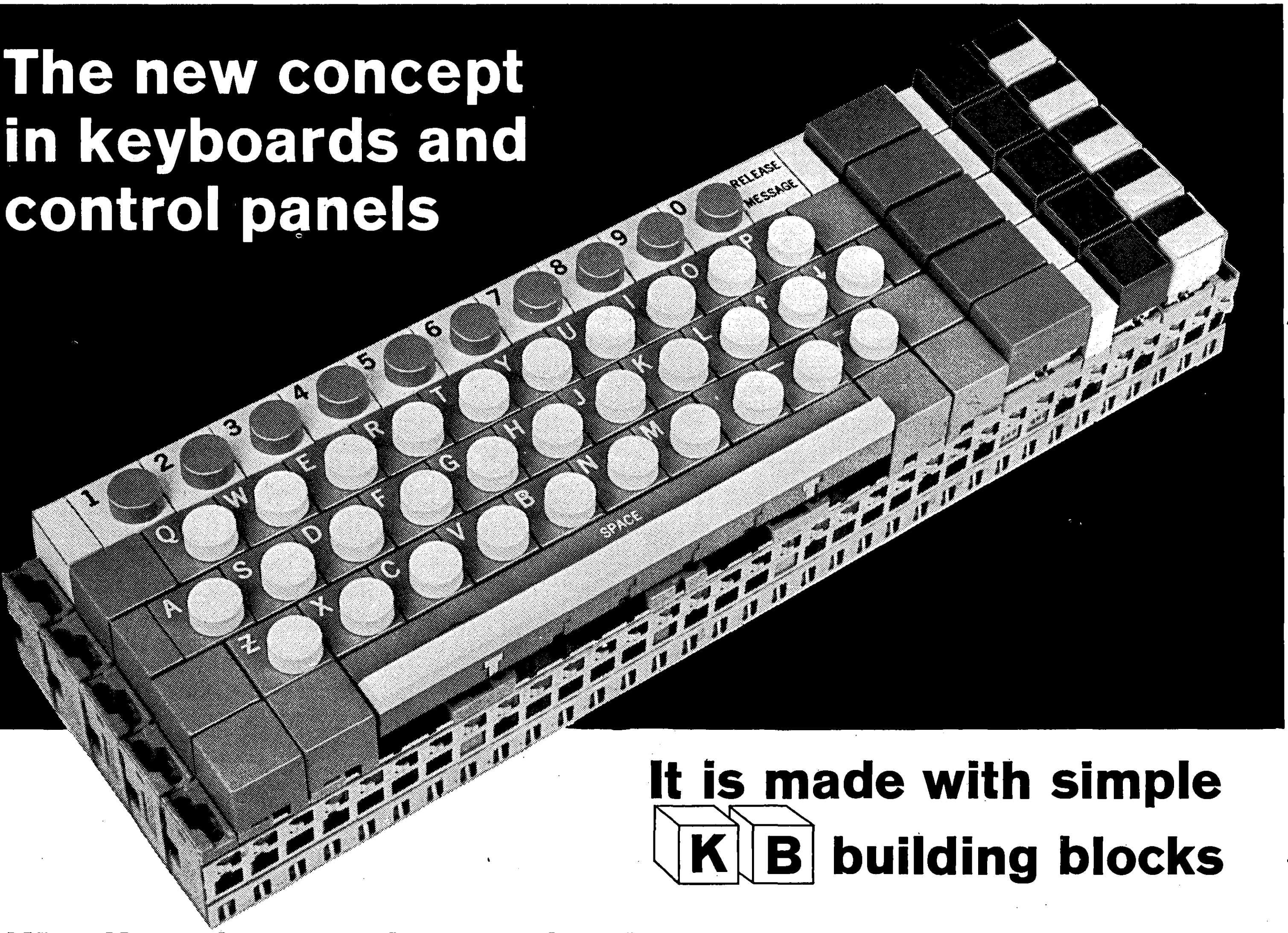
Forms inc
Willow Grove, Pa.

Are you running a billing section or a strip joint?

Only your data processors know for sure. Ask them what happens to those useless strips of paper that run between continuous tabulating cards. They'll show you overloaded trash cans; floors that would make even a litterbug cringe. To make matters worse, this daily strip routine wastes time and can put a real crimp in your processing operations.
In the long run you pay for this wastepaper. All that excess baggage costs you money. Perhaps it's time you were introduced to FORMSCARDS, the only continuous tabulating cards that have no wasteful medial strips. Every inch is workspace; and when you get what you pay for, that's good business. So cut out the strip in your office. Let FORMSCARDS help you keep it clean. Forms, Inc., Willow Grove, Penna. Phone: OLdfield 9-4000 Area Code 215.

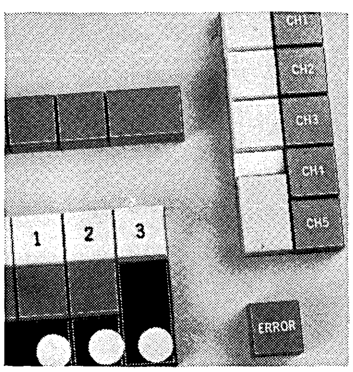
CIRCLE 57 ON READER CARD

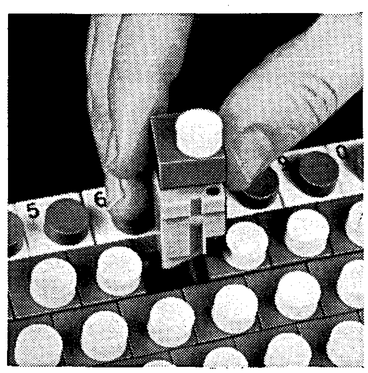
The new concept in keyboards and control panels

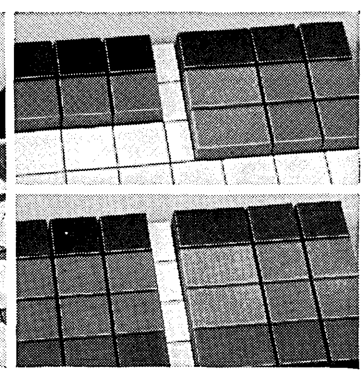


It is made with simple KB building blocks

KB offers these exclusive advantages:







KB allows new freedom of arrangement. Modular construction makes it easy to customize your panels—economical, too.

Switches and indicators available in a wide variety of colors, shapes, sizes. Arrange in vertical columns, horizontal rows, compact rectangles, or individually—all, in a single cutout.

KB allows bench assembly. Assemble a complete keyboard matrix at the bench where the job is easier, faster. Even the wiring is done before the matrix is set into the console.

And only one panel cutout is required because KB forms its own self-supporting matrix—no additional support required.

KB provides plug-in modularity. With KB plug-in switches, simply loosen two screws, lift out the unit and plug-in a replacement—all from the front of the panel.

Store a reserve unit right in the board—or "borrow" one that is not as urgently needed elsewhere on the panel. Downtime is practically eliminated.

KB simplifies expansion. KB modular construction makes planned or unplanned expansion easy, economical. In many cases, you simply remove spacers and plug-in additional switch or indicator modules to up-date your panel. No additional cut-outs, no wiring, no soldering, no behind-the-panel work required.

What is KB? The KB system provides all the components necessary for a complete, self-supporting matrix, including: Power Switches and Indicators with lighted display, Encoding Switches with up to eight output bits, Mechanical Interlock Modules for a variety of sequential functions, and a unique Modular Framework System.

Find out what KB can save you in engineering time, tooling costs, assembly costs, panel space and weight—and how KB can put more sales appeal into your panels.

For a KB demonstration, call a MICRO SWITCH Branch Office (see Yellow Pages). Or, write for literature.

CIRCLE 60 ON READER CARD

MICRO SWITCH

FREEPORT, ILLINOIS 61032

A DIVISION OF HONEYWELL

HONEYWELL INTERNATIONAL • Sales and service offices in all principal cities of the world. Manufacturing in United States, United Kingdom, Canada, Netherlands, Germany, France, Japan.

new literature

GP COMPUTER: SCS 650-2 is described in 10-page booklet which covers basic instruction format, addressing modes, instructions including arithmetic, load, store and jump, list of commonly used microinstructions, operate and I/O instruction format, internal machine organization, optional equipment and areas of application according to industry. SCIENTIFIC CONTROL SYSTEMS INC., Dallas, Tex. For copy:

CIRCLE 150 ON READER CARD

ANALOG BUYER'S GUIDE: Comparative study of performance and operational characteristics of six leading desk mounted analog computers is outlined in four-page publication. Subjects covered are performance, operator convenience, analog computing capacity and capability and hybrid computing capability for Applied Dynamics AD-40, Comcor Ci-150, Computer Products CP-10/50, EAI TR-48, GPS 200-T and Systron Donner SD-40. COMPUTER PRODUCTS INC., Newton, Mass. For copy:

CIRCLE 151 ON READER CARD

LABORATORY COMPUTER: 16-page brochure describes LINC-8, a research-oriented system designed to control experiments, gather and analyze data, and present results in alphanumeric form. Applications include arterial shock wave measurements, in-phase triggering of stimuli from EEG alpha waves, processing of single-unit data from the nervous system, and EKG processing. Other application areas are chemistry, geology, meteorology, oceanography, psychology, radiation, seismology and sound. DIGITAL EQUIPMENT CORP., Maynard, Mass. For copy:

CIRCLE 152 ON READER CARD

BIOLOGY AND COMPUTERS: Papers presented at the Symposium on the Analysis of Central Nervous System and Cardiovascular Data Using Computer Methods held in Washington, D.C., Oct. 29-30, 1964, have been published in a 492-page book. Sponsored by NASA, the symposium received 27 papers devoted to the study of behavior of the mind and cardiovascular systems emphasizing the use of mathematical techniques for analyzing the data. Order No. N65-28750-77. Cost: $4.50, microfiche $2.50. CLEARINGHOUSE, U.S. DEPT. OF COMMERCE, Springfield, Va. 22151.

NUMERICAL DISPLAYS: Two-page brochure describes model E1 and E2, includes applications, specifications and options and lists 10 models which provide choice of incandescent lamps from 1.5 volts to 28 volts, and one neon lamp model of 150 volts. Front and side mounting inserts included on all models. UNITED COMPUTER CO., Palo Verde Industrial Park, Tempe, Ariz. For copy:

CIRCLE 153 ON READER CARD

HISTORY OF APERTURE CARD: Book traces history from their invention and first use in the Office of Strategic Services in Washington in World War II to the present. It notes that 1949 was the year the first aperture card microfilm system was installed for handling engineering drawings. It also describes the first general aperture card application in title and abstract offices in the Pacific Northwest, and other applications of interest. Cost: $1. 3M CO., St. Paul, Minn.

PRESET DIGITAL CLOCK: Two-page bulletin describes model PC16 which features silicon integrated circuits and dual preset capability. Variety of models display seconds, minutes, hours and days. UNITED COMPUTER CO., Tempe, Ariz. For copy:

CIRCLE 154 ON READER CARD

EVAPORATOR CONTROL SYSTEM: Eight-page booklet describes a feedforward control system for automatic control of multi-effect evaporators in paper mills. Included in the booklet is a complete diagram of the system that automatically adjusts input and output of an evaporator though feedforward control. System anticipates changes in output, monitors changes in input, and computes the action necessary to

new literature

match btu input to btu requirements for evaporating the required water. BAILEY METER CO., Wickliffe, Ohio. For copy:

CIRCLE 155 ON READER CARD

MAG TAPE: Sample length of tape with an invitation to "torture" it is attached to four-page folder. Five suggested ways to punish the tape are described, all of which point out the tape's life and oxide bond strength. Burroughs, CDC, GE, Honeywell, IBM, NCR, RCA and Univac computers which use the firm's tapes are noted in another section of the folder. Standard reel sizes and roll lengths also are given as well as test standards. U.S. MAGNETIC TAPE CO., Huntley, Ill. For copy:

CIRCLE 156 ON READER CARD

ANALOG/HYBRID SYSTEM: 12-page brochure details the EAI 680's features, applications including process industries and aerospace simulation, hybrid capability, operator accessibility, components and system support. System set-up is illustrated. ELECTRONIC ASSOCIATES INC., West Long Branch, N.J. For copy:

CIRCLE 157 ON READER CARD

DP & OFFICE EQUIPMENT LEASING: 12-page booklet compares advantages of leasing to ownership. Three tables illustrate cumulative cash costs compared with five year term of the lease, and another chart compares leasing and outright purchase for cash in terms of capital savings and earnings. LEASCO DATA PROCESSING EQUIPMENT CORP., Great Neck, N.Y. For copy:

CIRCLE 158 ON READER CARD

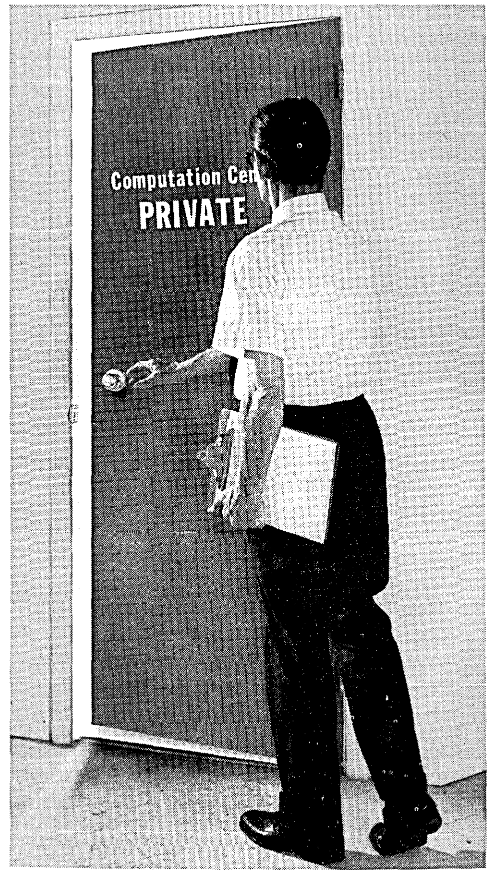
CORE MEMORY COMPONENTS: Individual product sheets describing components, specifications sheet on Aztec arrays and stacks, and a reference index are part of folder. AMPEX CORP., Redwood City, Calif. For copy:

CIRCLE 159 ON READER CARD

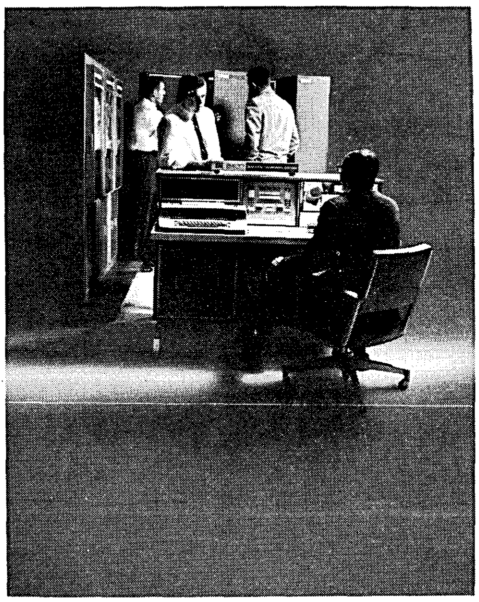
COMPILATION OF ALGORITHMS: Programs in ALGOL, evaluated and certified, consisting of the algorithms appearing in the *Communications* from Feb. 1960-Dec. 1963 are listed in 164-page book. Programs were compiled by Argonne National Labaratory. Cost: $5; microfiche $1. No. ANL-7054. CLEARINGHOUSE, U.S. DEPT. OF COMMERCE, Springfield, Va. 22151.

CIRCLE 63 ON READER CARD

Is the engineer fated to be frozen out of the computer loop?



Not if EAI can help it.



That is why we designed the EAI 8400 Digital Computer.

Often overlooked in digital computation is the battery of people and procedures which stand between the design engineer and the execution of his program. He's working one step away from the machine —and his problem.

This is tough on anybody who is used to the "hands-on" approach to computer usage.

The EAI 8400 fills this gap in man/machine communication.

It's a sophisticated digital computer that brings the engineer and his thinking back into the design loop. Designed to satisfy the stringent requirements of computer simulation, the 8400 lets the creative engineer use the familiar model-building, trial-and-error design process...in real time and faster than real time...in an on-line environment.

We've given the 8400 the power to perform extremely high speed, floating point arithmetic. How important is this? Well, 40% to 60% of all instructions in simulation and real time programs deal with floating point operations.

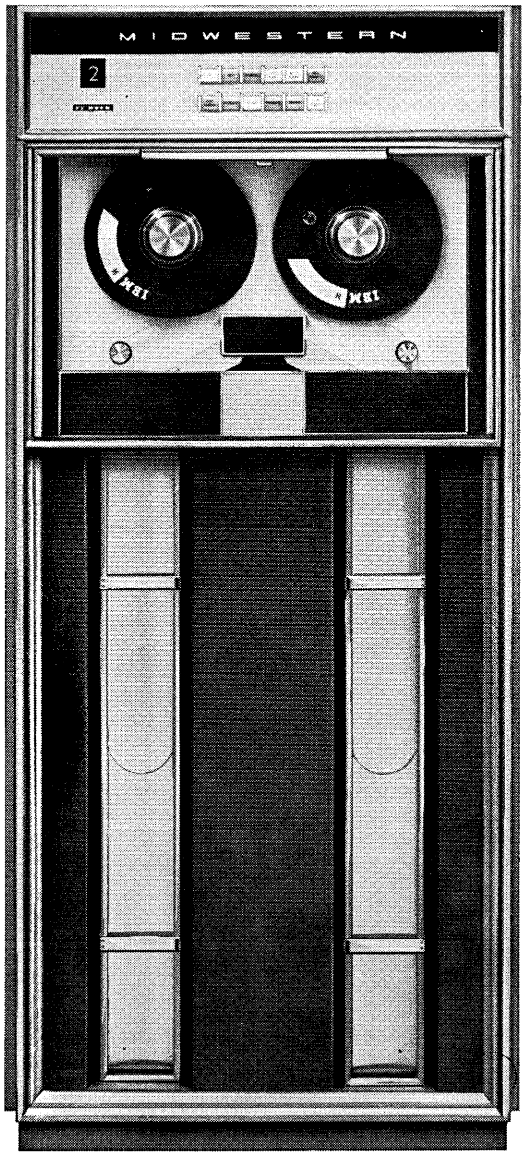
The EAI 8400 offers a new high level of capability in software. Throughout all phases —program preparation, debug and execution. It has a FORTRAN IV compiler and four other powerful languages. You can talk these languages while being interrupted for real time processing—without even knowing it.

You'll also be hearing a lot about EAI's Dynamic Storage Reallocation—a fundamental innovation that allows programs to be reassigned within memory, at will.

We didn't design the 8400 as the computer to do everything. It was designed specifically to expand the creativity of the engineer and the scientist, and it answers the exacting needs of the simulation laboratory. Why not investigate the EAI 8400 for the solution of your engineering problems? Write for detailed information.

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

CIRCLE 49 ON READER CARD



How does Midwestern guarantee data reliability?

M4000
DIGITAL TAPE TRANSPORT

COMBINING UNPARALLELED OPERATING DEPENDABILITY WITH THIRD GENERATION COMPUTER SYSTEM PERFORMANCE FOR ADVANCED DATA PROCESSING SYSTEMS

The M4000 pneumatic tape transport system is guaranteed to read tapes recorded to IBM compatability specifications with less than one transient error per 10^9 data bits; at densities to 800 bpi, and at transfer rates to 120 KC. Every production tape transport is factory tested for a minimum of 100 full reel passes; reading and error checking random record length, variable pattern data tapes under full program control. Actual statistical results of these tests, over a number of transports and many thousand full passes, have shown an average data reliability rate of one transient error in 27.1×10^9 characters read. This safety margin, developed from actual test data, makes Midwestern's guarantee of one error in 10^9 a realistic promise, not just another empty claim.

For more information on the M4000, write or call Ralph P. Bohn, Digital Tape Products Division, P. O. Box 1526, Tulsa, Oklahoma 74101. Our phone number is 918-627-1116.

MIDWESTERN INSTRUMENTS
SUBSIDIARY OF THE TELEX CORPORATION

CIRCLE 64 ON READER CARD

FRENCH SEEK COMPUTING INDEPENDENCE, TOO

Pressure is being brought to bear on the French government to re-establish an independent computer manufacturing industry. The electronics sector is urging that three or four medium size firms should be provided an incentive for the joint development of a series of general-purpose machines. First proposals to be made public have come through a report published by the Conseil Economique et Sociale, an organisation backed by industry and labour. Recommendations are for the government to find ways of regaining national independence in this field to off-set a market dominated by the U.S., meaning IBM and Bull-General Electric.

U.K. NEEDS A COMPILER-COMPILER

A quest for a compiler-compiler, to act as the general-purpose translator for any language, is going on in the U.K. The Ministry of Technology has awarded a $280,000 grant to London's Imperial College for a three-year study. The first project in this field started more than five years ago at Manchester, where Brooker, of the Atlas software team, propounded fundamentals. Work ground to a halt when he took a year out for IBM in the States. But the project is rumoured to be back in good shape since his return.

EDP SCHOOL SET UP IN JAPAN

A new school for teaching computer programming and computer center management will soon start operation in Japan, to be sponsored by FUJI television and Japan radio. First two courses offered are 20 weeks and 40 weeks and a student body of 600 will start May 10, 1966. About 80% of the students are being sent to the school by the company or government organization they work for; the other 20% are paying their own way. When completed, the school will accommodate 3000 students.

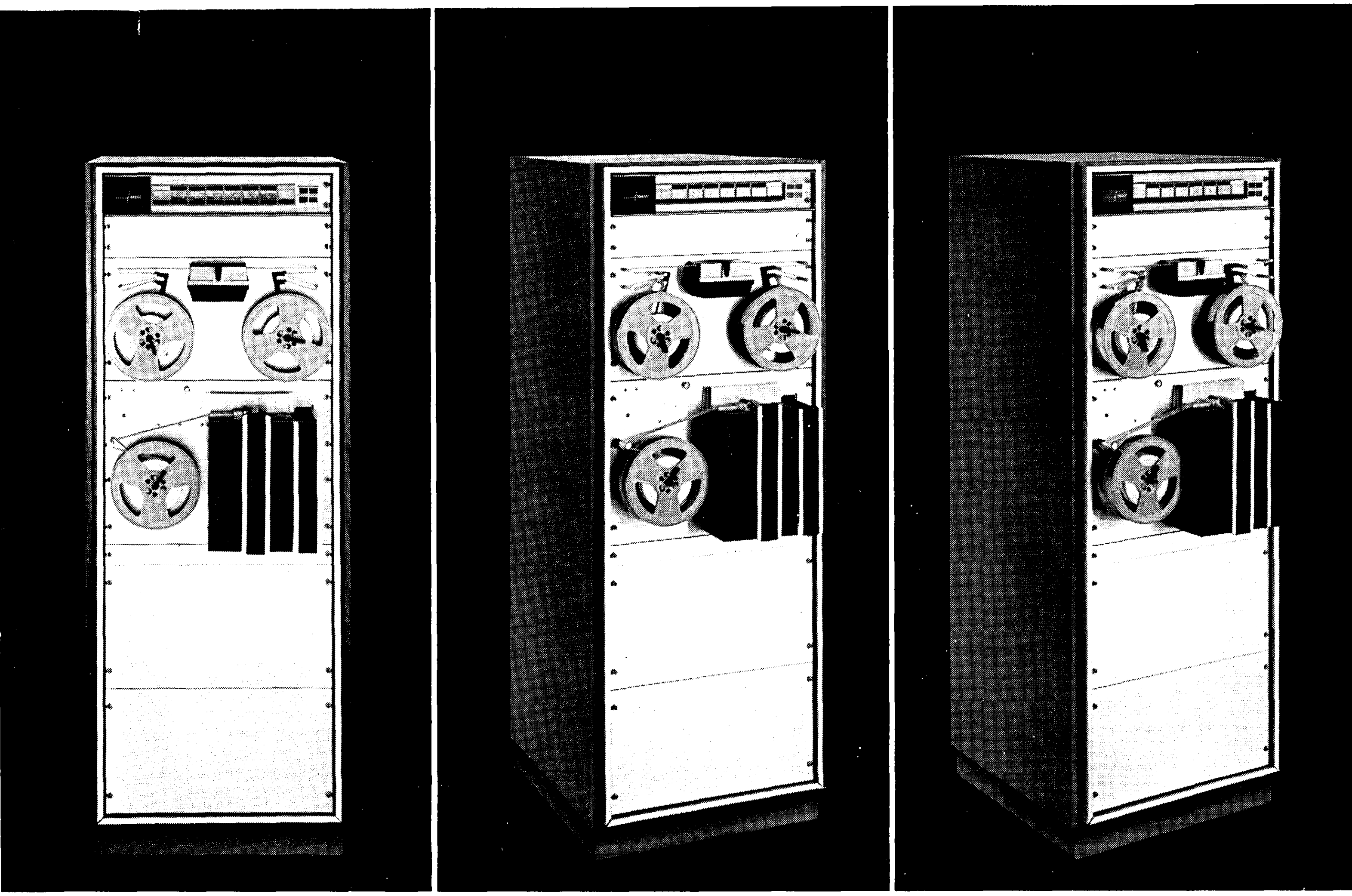
NO DRUM BEATING

With minimum publicity, IBM has pushed a new drum onto the European market. Closing paragraph of its release to users is "it is envisaged that one of the uses will be to provide fast access to peripheral stored programming modules of operating system 360, particularly in real-time." Interpretation among large users is that a big drum is apparently needed to handle the full operating system most efficiently -- a contention that drum-based Univac people in Europe have held for some time.

IBM 360 MANUAL FANS

It's not often that the work of an individual within IBM manages to stand out from the long shadows of the corporate machine. But this seems to have happened with "Management Standards for Data Processing," a manual that has gladdened the heart of many British users with shiny new 360s standing in the corner. It first appeared on duplicated typewritten sheets, (lacking the customary IBM publicity shine) for chewing over by a mixed manufacturers and users confab at a society's private meeting. Slight imperfections in its presentation (more obvious to a

(Continued on page 89)



(Continued from page 87)

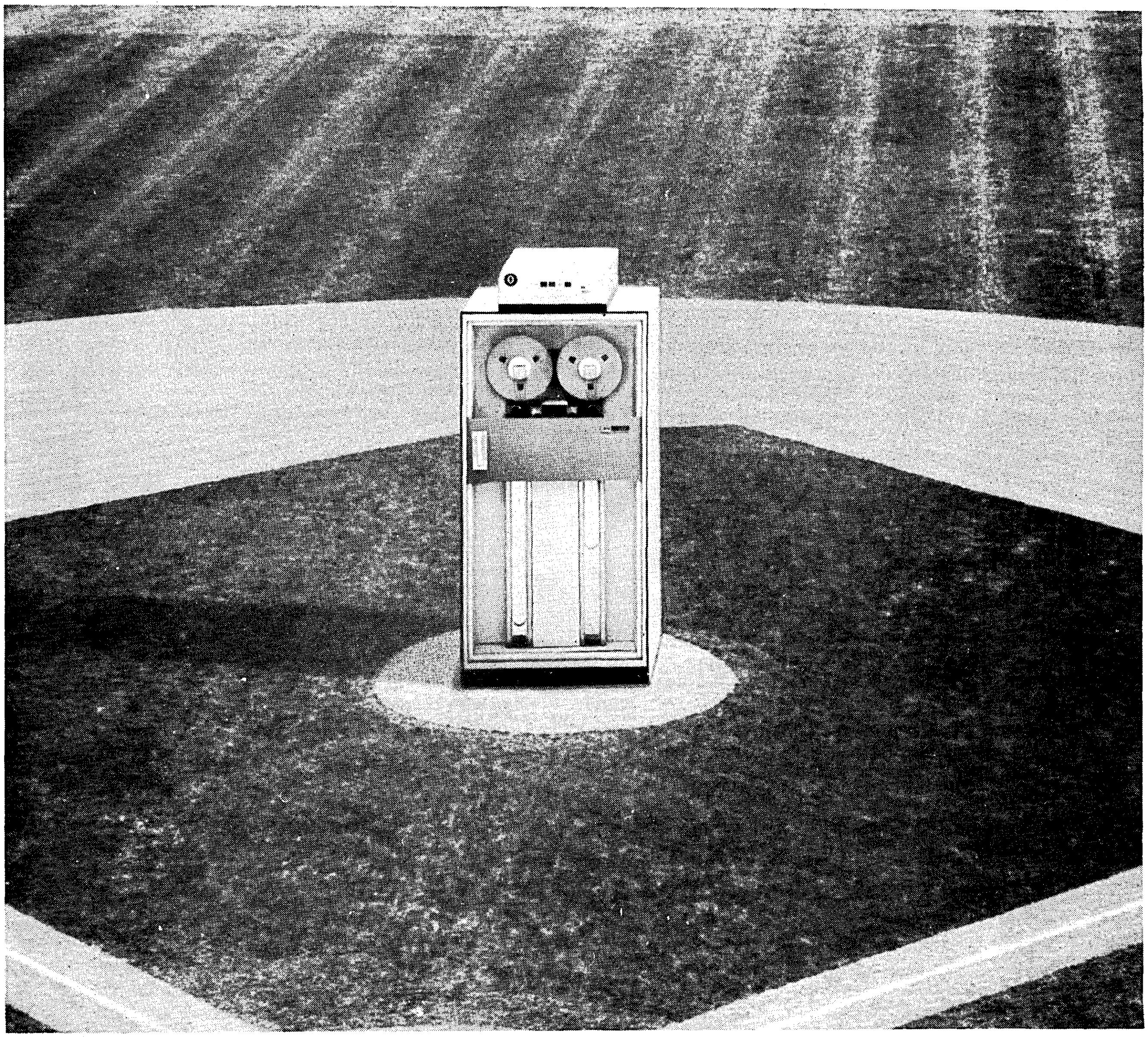
journalist than a user) indicated a personality. George Lowry, of Brandon Computer Services, London, said it heartened him to find that IBM (U.K.) had published their own book, which was, as far as he knew, ahead of the U.S. parent company and also the first from any manufacturer. The standards volume now has a typical IBM public relations cover around it. But Lowry comments that the System 360 prefix should be ignored by the reader and IBM would be well advised to do a re-issue as a generalised manual. There is no author identity on the cover; but one gets the feeling that the programming sheets used as illustration and labelled "programmer Waller" may tell their own story.

NOTES FROM AUSTRALIA

Equipment designed to transmit paper-tape data speedily over long distances by ordinary telephone lines has been successfully tested. The technique appears particularly suitable to rapid data communication between organisations widely spread over Australia's huge land mass. The test was made with the ICT 7000 series Datalink and the Australian Post Office is expected to announce formal approval for use shortly. The 7000 is a paper-tape to paper-tape system that can be used to produce input for computers and certain advanced types of accounting machines. Either the public switched network or private telephone lines can be used for speeds of up to 100 cps ... First remote console service here will link typewriter-like units in various departments to a central computer complex at the University of Sydney next year. Staff and students of departments such as economics and engineering will be able to use the consoles to communicate directly with the equipment in the Basser Computing department with five computers interconnected on a core-to-core basis ... The computer industry in Australia has begun to yield high profits for those companies with the marketing know-how. In the year to November 30 last, Honeywell lifted profit from $13,130 to $432,106 -- after making provision for taxation of $389,972. Honeywell joined ICT and Control Data in reporting increased profits and these are the most successful competitors of IBM in Australia. ICT lifted its profits by $144,886 to $405,032 and Control Data's profit rose from $864 to $102,900. These improvements contrast with IBM's decline in profit by 11% to $1,433,226. It is expected that nearly 200 computers will be installed in Australia this year and these companies are expected to share the major contracts among these.

BITS & PIECES

Elwro Electronic Works, Wroclaw, Poland has introduced the Odra 1013; a 10K bit store with undisclosed speeds ... Sweden's Svenska Flatfabriken has joined with Husqvarna Vapenfabrik to form a joint dp centre with 100 staff called W.Data AB ... With 450 1900 series now on order, ICT has delivered its 100th and is producing at one a day ... Computer Resale Broker's managing director, Allen Hales, expects to land orders worth $3 million for secondhand machines during the International Computer Fair, Prague, May 12.



What's good for the Dodgers is good for ITT.

Walter O'Malley knew what he was doing when he picked Southern California for his ball club. He wanted to move into a fast-growing area so he could have room to make his good East Coast team into a great West Coast Team.
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The name of ITT's West Coast team is the Western Regional Computer Center. It's at 999 Sepulveda Boulevard, in El Segundo.
An IBM System/360 Model 30 is already in operation, doing all a 1401 can do—at up to 3 times the speed.

And this summer (around the time the Dodgers should be sewing up the '66 pennant) an IBM System/360 Model 50 will be moved in alongside the "30."
While the "30" and the "50" are handling your programs, ITT Data Services will be busy opening a complete data service network in the Southern California area. Including high speed data links, and everything else that goes with a complete data processing service.
All these plans are leading up to the installation of a System/360 Model 67 in 1967. With time-sharing and a full range of business and scientific applications.

While ITT is enlarging its operations with bigger and better equipment, don't think that 999 Sepulveda Boulevard is just a bunch of machines. Our Western Regional Computer Center is also data specialists, business experts, problem solvers. People who'll work closely with you to provide top quality, low cost data service. The best data service on the West Coast.

Call John Barrett, at (213) 322-7800. He's sort of our Walter Alston when it comes to data.

ITT Data Services is a Division of International Telephone and Telegraph Corporation.

ITT
DATA SERVICES

SICSAM DRAWS 450

as acronyms escalate

A new stage of maturity in computer science was marked by the well-attended and enthusiastic meeting of the ACM Special Interest Committee on Symbolic and Algebraic Manipulation (SICSAM) held March 29-31 at the Sheraton Park Hotel in Washington, D. C. During the three-day meeting, the presentations and activities included: 27 formal papers, two panel discussions, survey reports of the field, three on-line demonstrations, and two evenings devoted to some 10 concurrent, informal discussion sessions on a variety of topics.

This meeting had a three-fold significance. The first was to demonstrate the size and degree of interest in this cryptically named field of "symbolic and algebraic manipulation." The registration of about 450 people, most of whom were in continuing attendance during all three days of presentations of the papers, and their active discussion during both the formal and informal sessions, gave a vivid demonstration of the interest.

The second point of interest was that the distribution of papers offered at the meeting provides a snapshot of the contemporary activities in this field. As announced by the organizers at the meeting, the papers which were submitted were used to structure the meeting. The best of the submitted papers were selected, and the various sessions were then organized from topical groupings around them. It was interesting to note what did not appear—presumably because no papers were submitted on the topic, or because the topic has a definite discipline, technology, or jargon of its own. There were no papers on the following: artificial intelligence; information retrieval; natural language translation; handling of files; compilers; and of course nothing on accounting applications; nor on the ordinary kinds of numerical "scientific" computation.

There was heavy emphasis on dealing with actual algebraic expressions, but at two levels. The largest group was primarily concerned with practical "applications." They were interested in manipulating algebraic formulas of varying complexity, with the intent of getting out algebraic results of various kinds. Variations upon this theme included problems in finding the greatest common divisor, performing factorization, and other manipulations. The other (smaller) group was also interested in algebraic expressions, but at a symbolic or theoretical level. Comments from this latter group indicated that they felt there was a strong distinction between these two approaches, and that one had to be concerned with various deeper questions (such as computability) which might not be of much concern to the practically-minded group.

Besides algebraic manipulations, there were a number of papers which ranged widely over topics having to do generally with symbol manipulation. Each of these papers seemed to include a discussion of a set of rules, some statement with respect to the degree of implementation (or lack of it) on a computer, and (most characteristic) a name formed from some catchy acronym to give substance to the presentation.

The third point of significance of this meeting was that it was the first to be primarily devoted to applications of computers to a class of problems which are of real mathematical significance, but which are not basically numerical. In this sense, it marks the beginning of an era visualized and hoped for in 1944 by the computer pioneers Mauchly and von Neumann when the electronic engines were still in their conception. The papers themselves did not dip too deeply into these matters, though they did at times allude to some of the problems, such as algorithms for Markov normal forms in such systems as PANON-1B or AMBIT, or in concern with computability in handling of general mathematical expressions. The deepest plunge into these interesting matters occurred in some of the evening discussion groups. These discussions, of which there were a total of 10, were organized informally by various small "coalitions" interested in special topics. One, which dealt with mathematics and metamathematics of algebraic manipulation languages, and which was held at a dinner-displacing 6:00 p.m., was attended by a surprisingly large group of 65 persons. Some of the topics discussed there could be viewed with some alarm by any "hard-boiled" engineer type who thought he knew what computing was all about. In the first presentation, the computer, with its program, was viewed as constituting an "algebra." Another discourse outlined a proof that the general determination of equality of two expressions, each containing only a restricted group of elementary functions, is a problem which is recursively unsolvable. This latter proof was based upon a surprising mixture of steps ranging from analytic properties of sines and cosines, epsilon-delta arguments, and conclusions taken from advanced logic. Yet, the results were of most immediate concern to any not-too-advanced problems in the reduction of expressions —such as those involving nested radicals, logarithms, or the like.

The following clusters of acronyms will compress the reporting for the rest of the meeting. For polynomial and general expression manipulations, the names ALGEM, ALPAC, ALTRAN, AUTOMAST, FORMAC, Formula ALGOL, Grad Assistant, MANIP, PM, SYMBOLANG, and others were mentioned. More general (or other) manipulations were described with papers on AMBIT, CONVERT, FLIP, L6, PANON-1B, and others. Uses of general tool languages such as LISP and SLIP were also described.

Edited versions of many of the papers presented at this symposium are planned for publication in an issue of the Communications of the ACM, under the editorship of Robert Floyd of Carnegie Tech. General chairman was Jean Sammet of IBM. Lew Clapp and Ellen Wax (Computer Research) and their assistants handled local arrangements, and Dan Bobrow, (Bolt, Beranek and Newman), Jim Griesmer (IBM), Paul Abrahams (Information International), Douglas McIlroy (Bell Telephone Laboratories), Max Goldstein (New York University) and Tom Cheatham (Computer Associates) also made major contributions. ■

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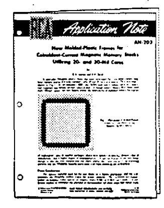

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CIRCLE 72 ON READER CARD

washington report

THE COMMUNICATIONS PLOT THICKENS

Last February, the FCC intimated that Bunker-Ramo Corp.'s Telequote IV time-sharing service would be subject to federal regulation if it carried general message traffic. B-R got that message and decided to move only buy-sell orders and related communications. Now the Western Union situation poses the opposite question: whether dp services provided by communications common carriers should be regulated.

WU has installed a pair of 418's in New York City. Currently, this equipment is storing, switching, and multiple-addressing some customers' messages. The company is dickering with Law Research Systems, Inc., and another, unnamed firm, in hopes of offering a Telex-wide dp service. Four more cities are scheduled to go on-line within the next year. The company is also negotiating with AT&T to combine Telex and TWX into a single system.

In a March 14 letter to the FCC, WU contended that federal regulation of its new "information utility" would be a handicap (because competing dp services are unregulated). But a lot depends on FCC's current study of data communications. A key question is whether Western Union could obtain leverage by offering low rates and recouping any losses from its other activities.

A House small business subcommittee will probably question Western Union about the new venture sometime this month. The subcommittee suspects that data transmission rates are artificially high, and that smaller dp service firms are being squeezed unnecessarily.

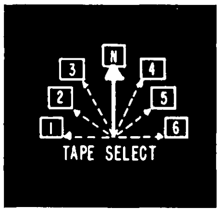
Earlier, the subcommittee loaned a sympathetic ear to John Goeken, president of Microwave Communications, Inc., who has been seeking an FCC license to offer microwave service between Chicago and St. Louis at rates way below those charged by Ma Bell (about 10.5¢ per mile per month, versus approximately $1.10 per mile per month). The FCC has finally agreed to hold a hearing (which Goeken says is unnecessary).

GSA WILL NEGOTIATE LEASEBACK AGREEMENTS

"Within the next 30-60 days," says a GSA official, "we should be ready to negotiate leaseback agreements covering punchcard equipment now rented by VA and the Department of Commerce." GSA believes it can ultimately cut federal eam and edp leasing costs $13 million per year. One possible way would be for a commercial leasing firm to put the money into the revolving fund created by the Brooks bill. GSA admits it's trying to circumvent the non-assignable purchase option welded into federal IBM contracts, but says IBM has "indicated" that it will go along. However, insiders think they will fight the plan.

FEDERAL TIME-SWAPPING PROGRAM GROWS

GSA opened its 14th adp sharing exchange a few weeks ago in Houston. Two others -- in Alaska and Hawaii -- will go into operation soon. This program, launched last June, lets federal agencies or their subdivisions use each other's available machine time, instead of buying it from outside data processors. By the end of fiscal '66, the exchanges will provide $4-6 million worth of time to some 40 agencies.



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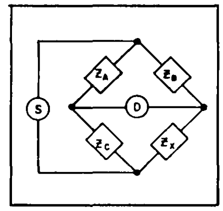

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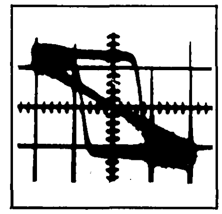

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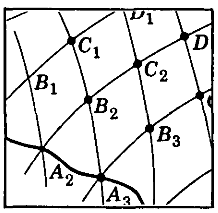

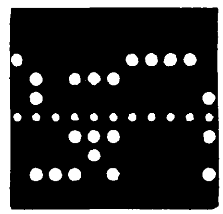

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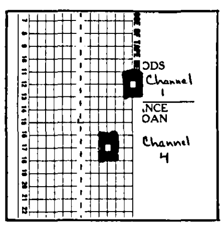

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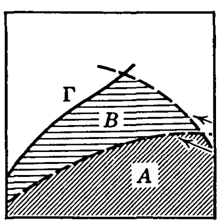

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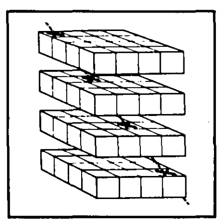

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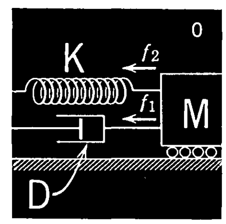

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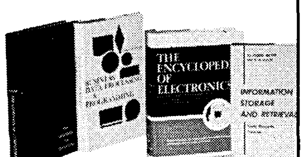

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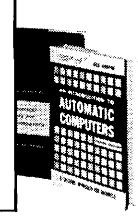

CIRCLE 68 ON READER CARD

the surprising role of programming at Xerox

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The second surprise surrounds the kind of work we'll invite you to do, and the way we encourage you to do it.

To begin with, we've toppled the concept that a lot of people have—that computers are merely data processing machines, no matter how wondrous. We've had the good fortune to participate in (maybe precipitate) a thorough organizational awakening to the fact that a computer in a scientific environment should be used to enhance the *insights* of scientists and engineers—not just be used to *process* a problem they may have. And the same goes for non-technical, decision-making management.

If these be platitudes, they're platitudes in action.

And so you'll find many of our "programmers" acting as *consultants* to managers of fundamental and applied research, advertising, marketing, manufacturing, finance, etc.

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In addition, there's some interesting work in progress on time-sharing systems. The software aspect is a challenge all its own.

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books

Introduction to Boolean Algebra and Logic Design, by Gerhard E. Hoernes and Melvin F. Heilweil, McGraw-Hill Book Company, 1964.

I must preface the comments to follow with the admission that this reviewer has never before studied a "self-instruction" text, which this is, so any inspired comparisons must necessarily be lacking. I am reminded of the good bishop Pontoppidan's chapter on owls in his history of Iceland; he wrote simply that there were no owls in Iceland and that constituted the whole of his chapter.

The authors are described by the book jacket as staff engineers active in IBM education programs, at least at the time the book was published. The book's organization implies that the material presented has benefited by considerable classroom use (four revisions are claimed) prior to its publication. Portions are almost *too* clear, a fact which tends to slow the pace at times so that the reader either skips or risks ennui.

The text is composed of what are called "frames." Each frame, and there are about 500, contains a single concept to be learned by the student, followed by a related question. The answer is given at the start of the next frame. If the student properly answers the question (the use of pencil and paper is suggested by the authors), he goes on. Otherwise, he reads the explanation and may even go back and review until the material is clear. It is expected that the reader will require about 25 hours to read and comprehend the material.

The book is divided into two major sections: Part I. Boolean Algebra, and Part II, Minimization Techniques. The first chapter is introductory and does not contain any frames. The next chapters discuss, sequentially, Boolean Inversion, AND and OR operations, truth tables, block diagram representation, Dr. Morgan's theorem, and translation of English sentences into Boolean functions. Part II continues with equation manipulations to place them in standard form followed by a discussion of minimization by the Quine-McCluskey method and, finally, the more familiar Karnaugh Map. The last chapter just touches on logic implementation with other elements—exclusive OR, NOR, NAND and others. The appendix usefully tabulates a comparison of the various symbols of similar meaning as used by the different disciplines within science, engineering and mathematics. Binary numbers, diode circuits, and relay logic are briefly treated. Problem answers, a listing of several references and a useful cross-index section showing the reader the corresponding pages in the references where similar subject matter is treated completes the volume.

My feeling about the book is that it is *very* easy to read and understand and that its contents can be nicely assimilated by an interested student. I take mild exception to the authors' statement in the preface that it is "... intended for the education of the logic designer ..."; it is misleading to imply the text is written on that level. The serious logician today is writing about such things as, "Chebyshev Approximations and Threshold Functions," "Completeness of Sets of Delayed-Logic Devices"[1] etc. This text, of course, will not remotely prepare the reader for an understanding of logic design in this sense.

As alluded to above, I was a little uncomfortable with the thought as I read that the information density in this type of text is perhaps one fourth what we have learned to expect in texts using standard format and also that after the thing has been purchased and read, it is singularly poor as a reference. Finally, a gentle warning for those of you who have not read one of these self-instruction manuals. Perhaps of necessity, the style and personality of the author are totally lacking. In fact, it is as though the text were written by a—; I wonder if there really are a Hoernes and Heilweil at IBM; did you notice the double alliteration in those names?

—JOHN C. ALRICH

[1] These titles were selected at random from the IEEE Transactions, Electronic Computers, April, 1965. ■

THE SECRETARY FIGHTS BACK

FIFO and LIFO went to sea
In a beautiful pea green boat,
With a subroutine and some
  grenadine,
And a buffer, which they could float.

They sailed away from FORTRAN
  Bay
On a JOVIAL night in June.
They got in a scrimmage with
  Data Image,
And escaped—but none too soon.

A random number of miles they went.
Said FIFO to LIFO, "How many?"
"Every commuter should have a
  computer,"
Said LIFO, "but I haven't any."

So on and on went the pea green boat,
No flow charts recording procedure;
And, after a while, reached Binary
  Isle.
(It just proves where ERRORS can
  leadure.)

Here the octal bird in the printout tree
Sang of love for his Two Twenty-Five.
And an input fish on an output dish
Said naught, for he wasn't alive.

FIFO looked 'round, and to LIFO
  he said,
"Let's tie up the schooner and stay."
LIFO, the duffer, cut loose the buffer,
So that's where they are to this day.

MARY MAYES

people

■ Dr. John L. McLucas, assistant secretary general for scientific affairs in NATO, will become president and chief executive officer of the MITRE Corp., Bedford, Mass., on July 1.

■ Robert V. Head has joined Computer Sciences Corp., El Segundo, Calif., as manager of management information technology. He was formerly associated with Touche, Ross, Bailey & Smart in Los Angeles, and is a contributing editor of *Datamation.*

■ Edwin Gamson, a former vp of Ampex, heads a new Los Angeles company, CERTRON Corp. The organization rehabilitates and recertifies magnetic tape.

■ Samuel S. Brand has been elected vp of systems and procedures, McCrory Corp. A pioneer in retail dp, he will remain a vp of Lerner Stores Corp.

■ At GE computer equipment department, Phoenix: Dr. Erwin Koeritz, former manager of GE metallurgical products dept, in Detroit, is now general manager; Paul Quantz, most recently manager of programming at Philco Corp. in Willow Grove, Pa., has been named manager, programming operations.

■ Brian Middleditch, former director of advanced planning of the corporate staff at Control Data, now directs the product management group at Scientific Data Systems, Santa Monica, Calif.

■ Frank H. McCracken has been promoted to president of IBM's newly-named information records division, formerly the supplies div., Princeton, N.J.

■ Donald L. Stevens will direct Philco TechRep Div.'s new automation advisory and service group, Fort Washington, Pa.

■ Forrest P. Dewey has been appointed director, data processing, Beckman Instruments Inc., Fullerton, Calif.

■ John Thomson has been chosen manager, data processing systems, Consolidated Electronics Industries Corp., New York, N.Y.

■ William B. Dobrusky has been named head of System Development Corp.'s corporate information systems group.

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CIRCLE 107 ON READER CARD

"...I liked my job, but

I felt
more and more
I was just repeating myself.

There was plenty to do.
I was busy.
It's just — I don't know —
it's like that old line
about a specialist
being someone
who knows more and more
about less and less.
That was me.
That was our whole group . . .

Everything was an emergency,
no one seemed to know
what was important —
they were too busy with
"emergencies."

Deciding to leave
wasn't easy.
As I said,
they were a fine group.
But I needed
something different.
More responsibility.
Less red-tape.
And a company that
seemed to be growing.

. . . So I thought about it,
did some reading —
and decided to contact
Honeywell.

It's really amazing —
Honeywell's
figured out
how to keep all the advantages
of working in a small
company
and still be a big
operation.

I don't know how they
do it."

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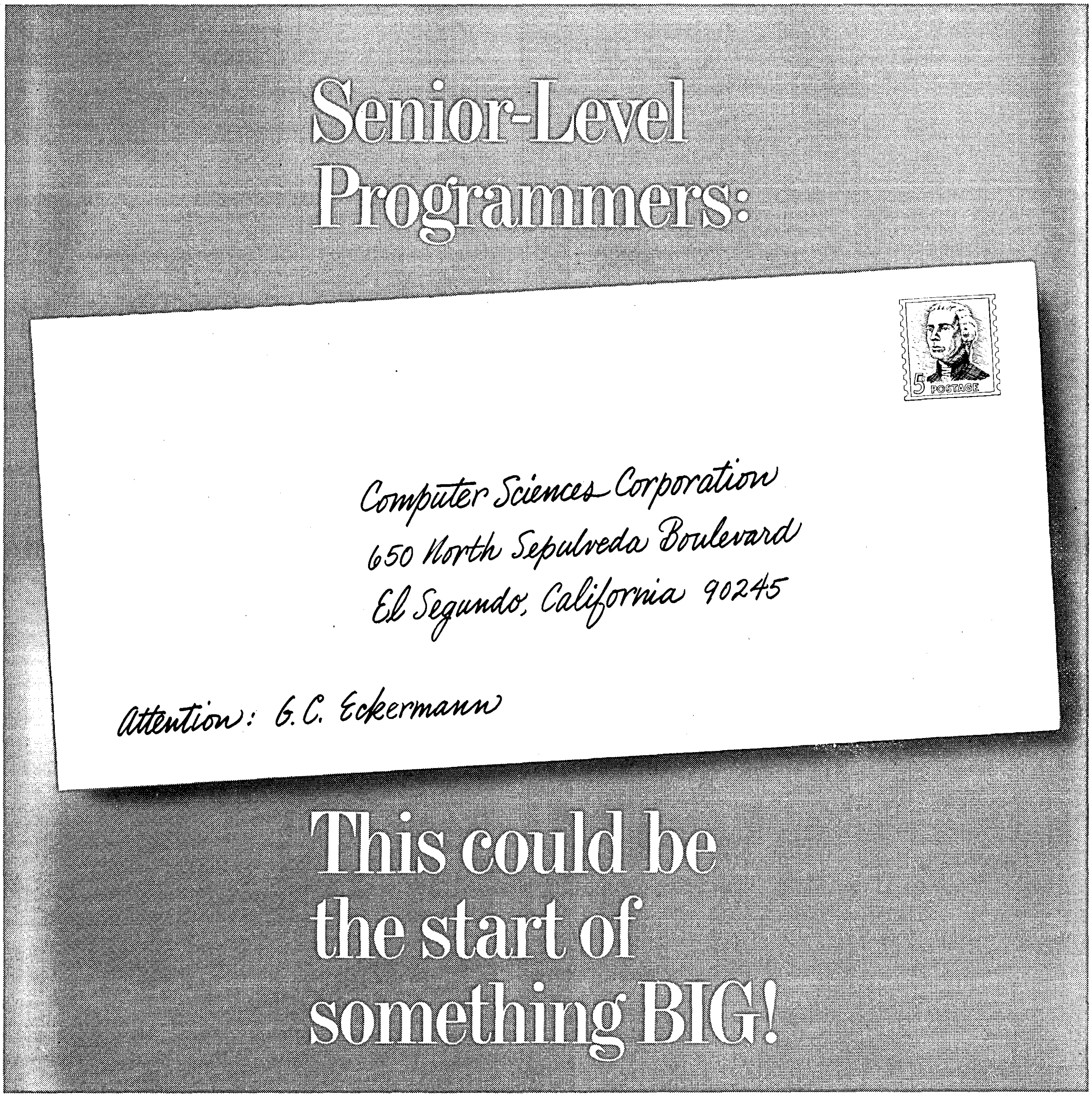

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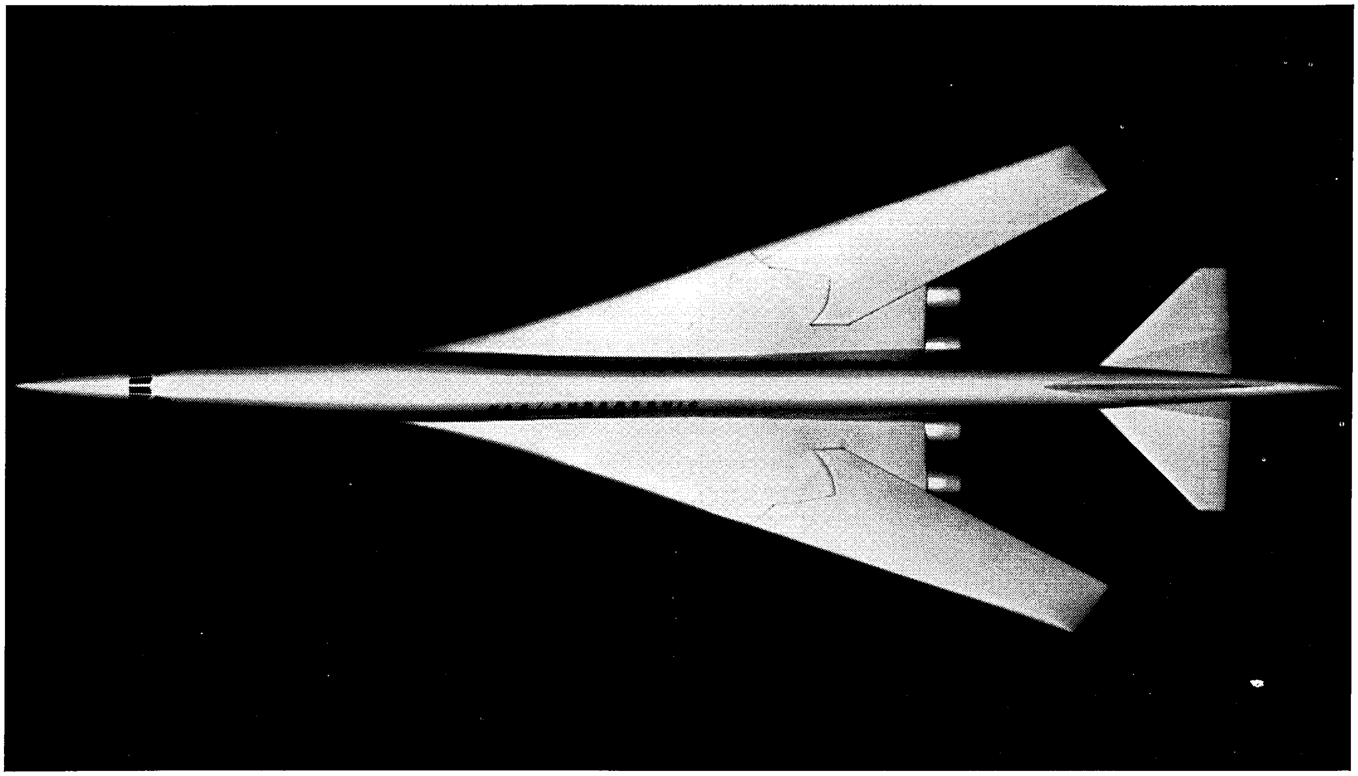

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the forum

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

TODAY'S COMMERCIAL SOFTWARE

has inertia set in?

From 1956-1966, the number and use of computers by industry has increased at least ten-fold. During that time, the software provided by computer manufacturers has not significantly changed in scope or concept. For the benefit of those skeptics among us, I quote from an advertisement that appeared in 1958:

"Software provided with the IBM 7070 includes an assembly system, a sort/merge, FORTRAN, an I/O package, multi-programming and miscellaneous utility programs."[1]

One would expect that over a 10-year period, new software[2] would emerge that would reduce programming costs and/or make programming easier. However, it appears that programming today is more difficult, and the manufacturer is content with providing the same software tools that he previously provided, tools which eventually will be viewed as very rudimentary.

My view of the software proposed by all computer manufacturers is that it is not enough, and it is not the right kind. The manufacturers' emphasis is now on operating systems and new languages . . . but what will they really do for the average user?

operating systems & languages

Many operating systems are now being built for large, as well as small, computer systems. There is no doubt that new and large computer systems are more complex and require sophisticated operating systems. The performance of these operating systems, however, has been penalized because of the compatibility required within the smaller systems in a line of compatible computers. For many of these smaller computer systems, operating systems are not necessary and will not improve the efficiency of an installation or reduce programming costs. I/O packages, monitors and loaders have existed for a long time (since at least 1956); we've just changed the label and put some icing on the package.

PL/I is procedure-oriented, similar to other languages, and still requires a logical solution, coding, debugging and system testing. It is not conceptually new.

The computer manufacturers have progressed only in that they now can build a limited set of software that will function with reasonable efficiency. The software itself, is, in general, the same. These very same software systems were defined and implemented back in 1955 and 1956 by various computer manufacturers. *That is not progress!*

Programming is more complex than ever. Programming costs are as high as they were 10 years ago. The computer user still is required to write programs for most of his applications. There are no more debugging aids now than there were on the first-generation computers. There are still no recognized procedures for organizing a program, debugging a program, system testing and program documentation. Most commercial programming is still done in assembly language.

minimum needs

There are two specific areas where new software should be developed for commercial data processing users.

1. The first area would be programs for reducing application coding, checkout and maintenance costs.

A new computer user currently spends a major portion of his costs not in system design, but in programming, checkout and documentation. Great strides could be taken to reduce these costs. For example, since coding, test data preparation, debugging and documentation is a major part of a programming effort, every programming language (be it assembly or higher level languages) should have the following facilities:

a. Test data generation based on simple parameters.
b. Source language memory and tape dumps, traces, program interrogation during tracing, multiple debugging of program sections, facilities for displaying core during debugging.
c. Automatic flow chart generation of the program.
d. Simple I/O file and work storage data descriptions.
e. Logical generative macros—MOVE, COMPARE, ARITHMETIC, SWITCH, LOOP, etc. which are based on data descriptions.
f. Quick compilation on re-assembly.
g. Load and go facilities.

2. The second area where new software programs should be developed is in the area of general business packages.[3]

Most data processing applications are composed of standard logical functions along with unique data processing logical operations. These standard logical functions are scanning, matching, merging, selecting, validating, sorting, extracting, file maintenance, combining, moving, comparing, performing arithmetic calculations, iteration, rearranging, editing, summarizing, etc. These functions should be available as modules, or segments of code, ready to be tailored to user parameters. They would be tied together during assembly or by a binder at load time. They could then operate as independent programs,

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[1] *Datamation*, Sept/Oct., 1958, p. 38. COBOL and Report Generator were included in the software announced for the IBM 7070, although these software programs did not appear in the advertisement.

[2] The software of 1958-60 was based on similar software developed on first-generation computers, (i.e., Univac I and IBM 705) back in the 1955-57 period. From 1960 to the present, some new software has emerged but these software programs have not, to date, been implemented for most computer systems.

[3] Some attempts in this area are being made: NCR's BEST, Datatrol's OPCON, Informatics' MARK II . . . and Government agencies have built generalized business packages. Computer manufacturers have ignored this area.

as part of a program, in combination to form new programs or combined with special coding written in assembly or higher level languages.

With these logical functions available, simple programs could be developed using check-list forms. Complex programs would be developed using parameters as input to a business package compiler. For both cases, program debugging and documentation costs could be drastically cut and the duplication which now exists in programming would be minimized.

a look to the future

Computer users are currently dependent on computer manufacturers and organized computer user groups for software development. To date, these organizations have not played a large role in developing new software or in making existing software concepts more effective.

The computer manufacturer has developed new software only if he can gain a competitive advantage when marketing computers. Unless the computer manufacturer changes his ways, most of tomorrow's software will be produced by independent programming companies. Even today, programming companies are developing new proprietary software programs for lease to users. The day may come when all software will be produced by programming companies, and the computer manufacturer will be in the position he has always sought . . . manufacturing computer hardware exclusively. Users today are dependent on the manufacturers' software expertise and initiative. Unfortunately, the manufacturer's past performance has left much to be desired.

There is no doubt there is a mammoth amount of new software which can dramatically change computer application concepts and problem solution. From where it will emerge? . . . or when? . . . these are questions unanswered. One thing is certain: when this new software arrives . . . traditional program concepts and procedures will prove to be poor and ineffective, and the power of a computer will be more fully realized.

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Applied Data Research Inc.
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