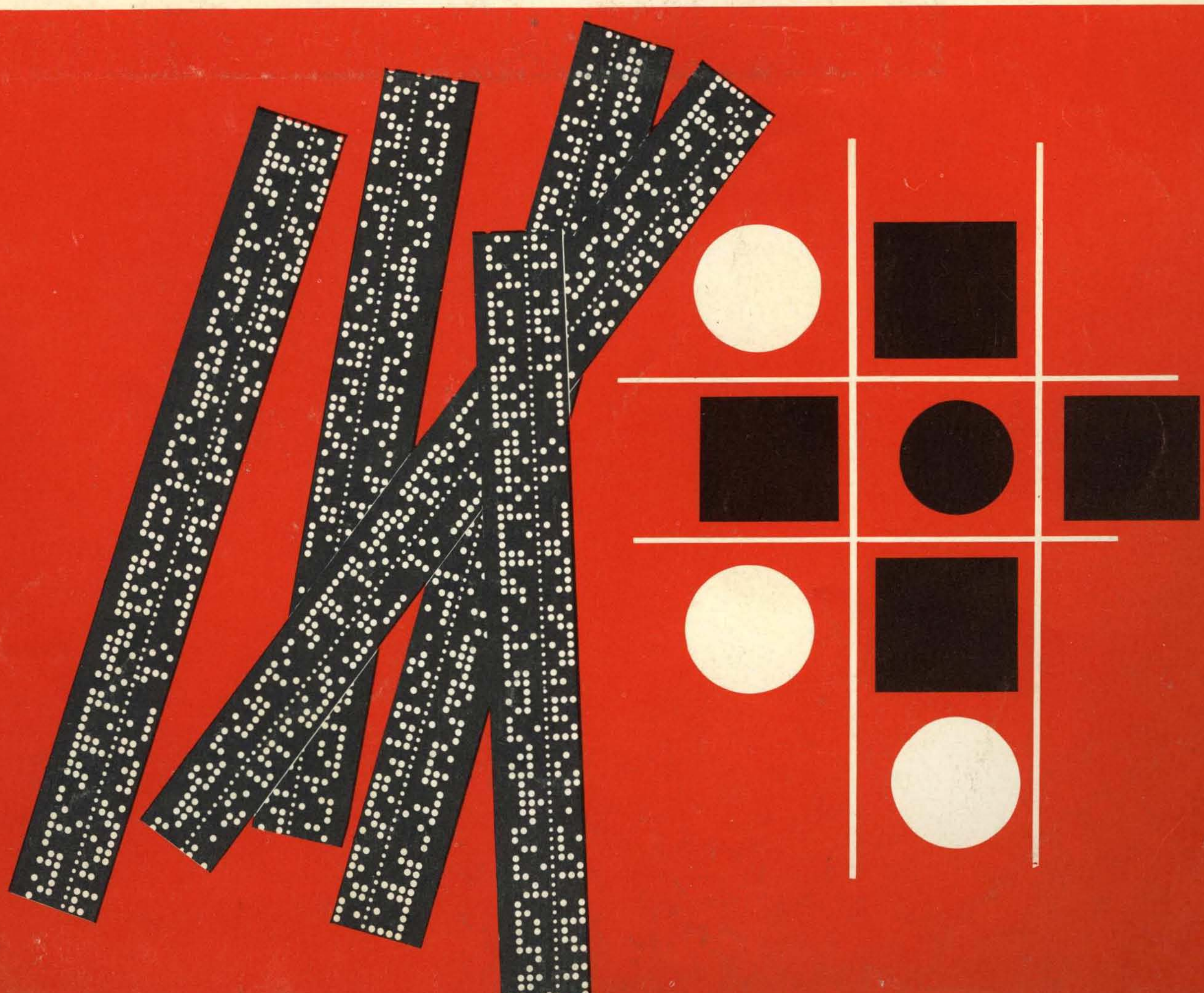
DATAMATION 60

September/October

AN F. D. THOMPSON PUBLICATION

page 10 A PROGRESS REPORT ON MACHINE INTELLIGENCE



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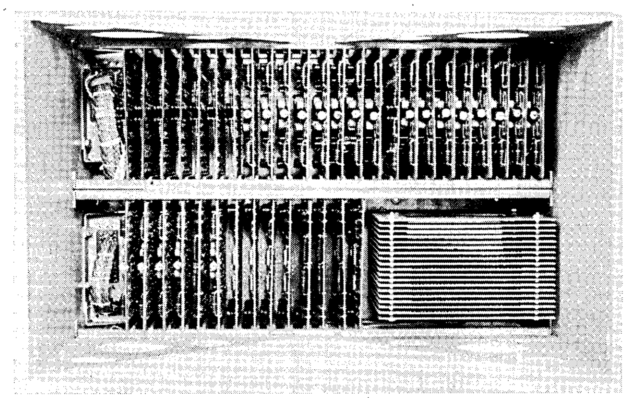

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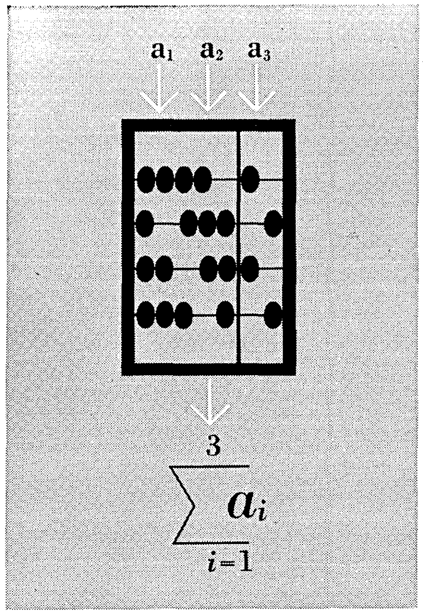

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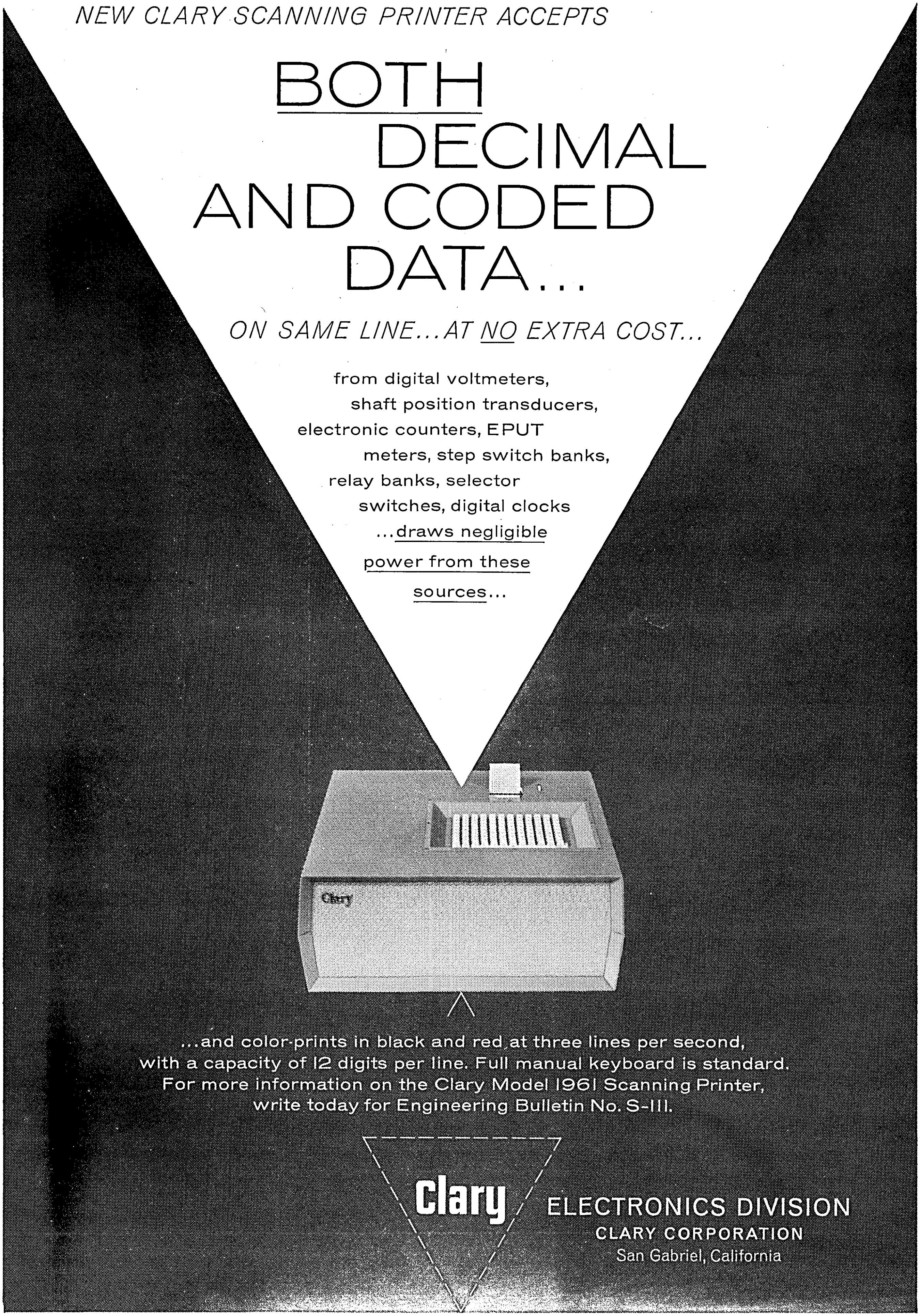

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RCA STIRS SIMMERING COBOL POT

COBOL controversy continues to confound the conscientious computer community. Even after DATAMATION published two letters written by CODASYL's Charles A. Phillips covering what has happened to and what is planned for this initial common business language, the fact remains that there are two distinct points of COBOL view. One sizable group of manufacturers and users are decidedly unenthusiastic while another group thinks of the language as the answer to their programmers' prayers.

The dissatisfied faction say that basic COBOL has yet to be defined. Also, they state, substantial changes in COBOL have reportedly been made since publication of The Manual.

Meanwhile, those committed to and enthusiastic about the language are plowing ahead at full speed. RCA, notably, has garnered the first COBOL headlines and evoked the most wrath. The NEW YORK TIMES on August 26 headlined "Victory is Claimed in Computer Translating Race." The victor, the paper said, was RCA and the TIMES quoted a company official thusly, "We will have a COBOL programming system available certainly by the first week of October. . . ." RCA news releases were a little more specific. They outlined details of an RCA 501 COBOL Narrator and state unequivocally "RCA is the first company to implement the language."

While pleasing to RCA, copy such as this tends to make other computer manufacturers become unglued. These manufacturers (one of which is also known by three letters of the alphabet) say that they could have made the same claims since they are as far along in COBOL development as RCA, that RCA is making publicity capital out of The Sacred Project, and that the 501 COBOL Narrator will never be common with anything. But, perhaps significantly, no one has chosen to protest in public.

So there the situation stands. RCA has made off with the first publicity marbles. Questions: Was RCA premature in announcing COBOL in any form? Which manufacturer will next publicly claim to have COBOL available with equipment? And will programmers ever be able to code in COBOL equally well for a wide range of machines? Next year should tell the tale.

MORE ACTION NOTED ON CODASYL FRONT

In another CODASYL effort, the Systems Group of the Development Committee is attempting to provide a method for conveniently stating a business problem in terms which the committee hopes may readily be interpreted by a programmer or processor as well as being understandable to persons having a restricted knowledge of data processing equipment. The Language Structure Group of the same committee is investigating the feasibility of a problem description language (as opposed to a procedure description language) and may be developing such a language now. A report of the work of the Systems Group is available on a limited basis to those interested and active in business data processing. L. Calkins is chairman of the Development Committee. His address -- U.S. Steel Corp., 525 William Penn Place Bldg., Pittsburgh 30, Pa.

CONSULTANTS THRIVE AS McCRACKEN INC.S

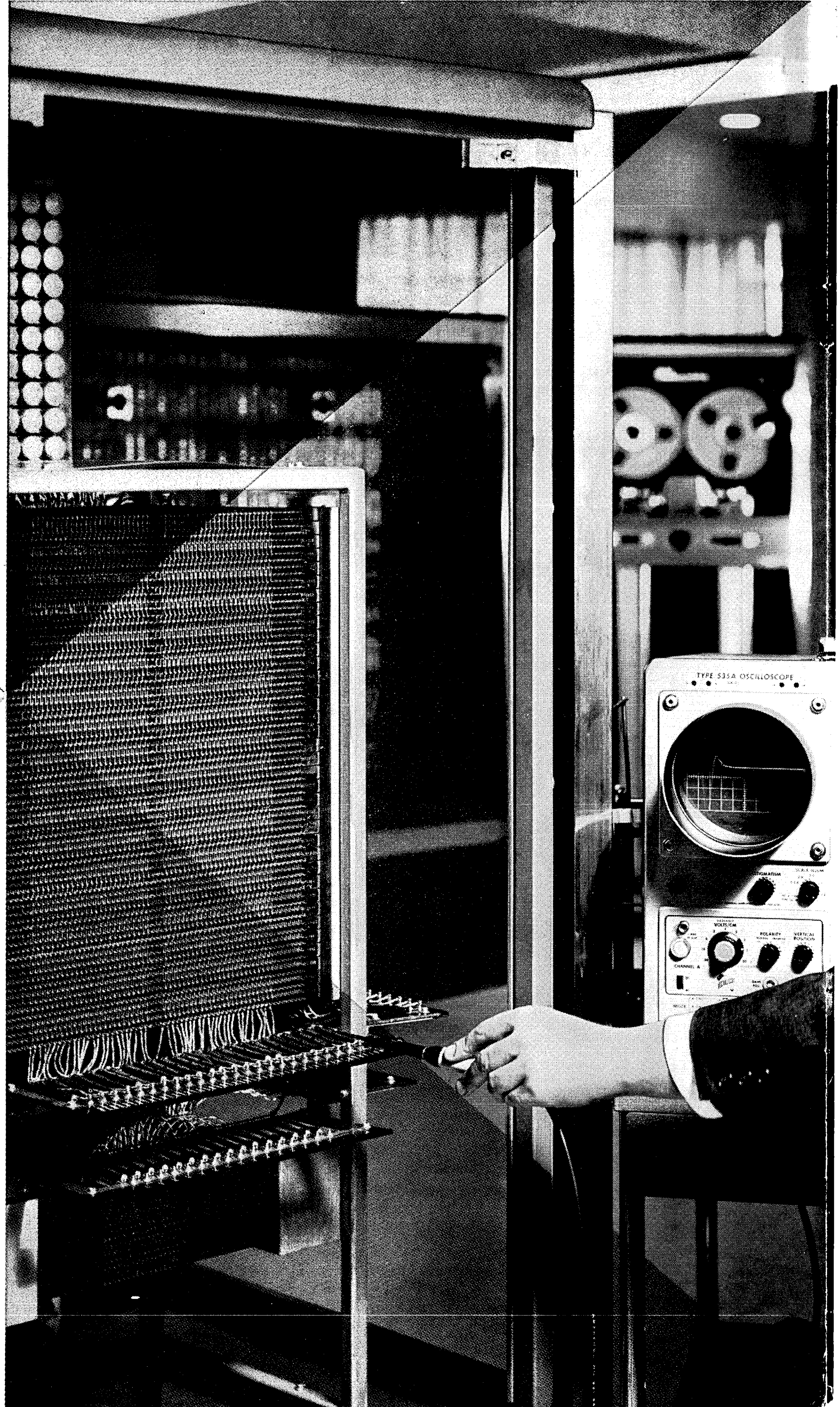
An interesting development is noted in New York. The Lone Wolf of Ossining, Daniel D. McCracken, has incorporated himself. McCracken is the first of a new, revitalized crop of freewheeling, freelance computer consultants. These hardy souls have decided that their talents as computer programmers and equipment experts can best be utilized if they are unhampered by regular pay checks. They usually accept anything from one-shot assignments to long-term contracts and are distinguished by the fact that they might possibly have several jobs going at widely scattered points in the U.S. For a while, McCracken had the whole country to himself. Then, about a year ago, Robert Patrick set up shop in the Los Angeles area. During 1960, Bob Barton, Jackson Granholm and Gene Amdahl have also established themselves in L.A. and Herbert R. J. Grosch has returned to full time consulting in New York City. It will be interesting to watch the fortunes (or lack of same) of these bold and rugged individuals.

PHILCO, RCA, REMRAND, IBM MAKE NEWS

All is not quiet on the machine front. At last count, there were six 7090s in the Los Angeles area. Two at STL, three at North American (Rocketdyne, L.A. Div., General Offices), and one at RAND . . . Remington Rand is set to announce the Univac Real Time, a 30-bit binary computing system known also by the code name M4-90. This machine is based on experience gained from work on the M4-60 military system -- the Countess. Its principal uses will be in airlines reservations, air traffic control and in general data processing . . . The Bureau of Old-Age and Survivors Insurance, keeper of the Nation's social security records, has ordered five 501s and seven 301s from RCA. This is that firm's largest edps sales to date . . . Philco Corp. broke the Mississippi Curtain and made the first sale of a 2000 west of that venerable river. System Development Corp. purchased the huge computer for use in the new Systems Simulation Research Laboratory . . . Packard Bell announces a revised production schedule of two PB 250s a week starting in October.

MORE MACHINE NEWS

More on machines -- a Philco 2000 has been delivered to and accepted by AEC's Knolls Atomic Power Lab in Schenectady . . . IBM is about to announce the 1410 -- a bigger, faster version of the 1401 . . . STEP, Simple Transition to Electronic Processing is Remington Rand's answer to the 1401 B system (cards). STEP's central processor has a 24,000 digit capacity, and up to four additional 6,000 digit memory units may be added (each with 4,000 regular and 2,000 high speed digits). The system has a 450 cpm reader, 150 cpm punch and a high speed printer . . . Bendix announces that Potter Instrument Co. will provide tape handler sub-systems for the G-20. The system will also include Analex printers.



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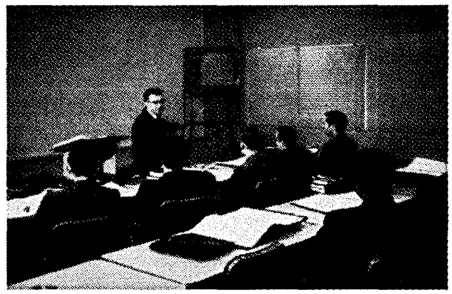

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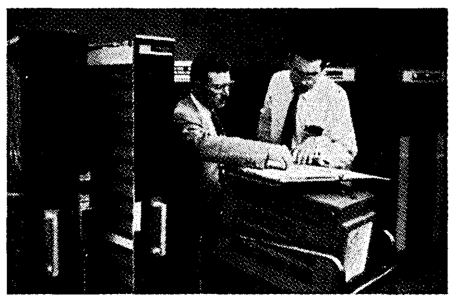

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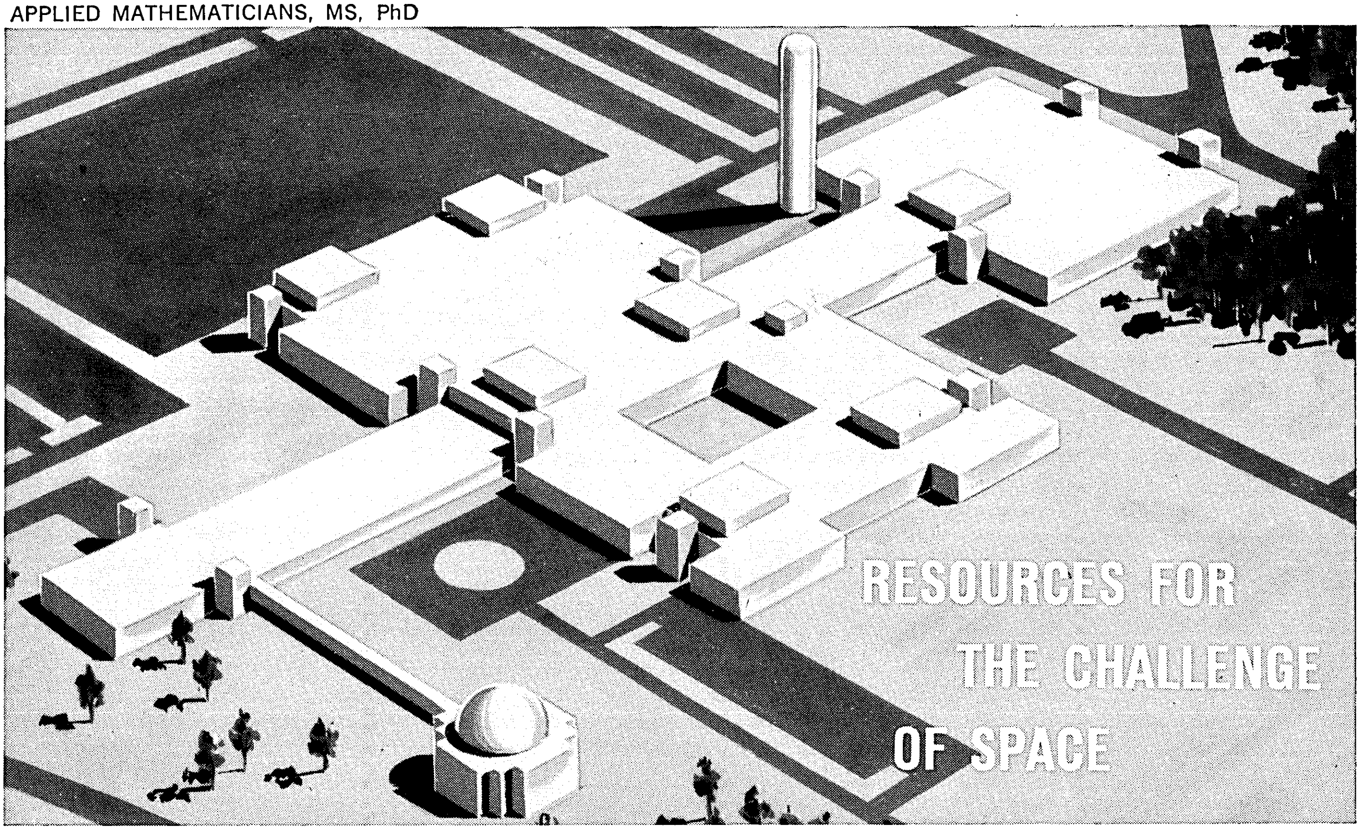

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The Missile and Space Vehicle Department of General Electric—a recognized leader in the development of instrumented re-entry vehicles—is now pursuing a number of even more advanced space programs. Basic to progress in these programs is the solution of a diversity of interesting mathematical problems. These include trajectory and navigation studies and analysis of flight telemetry data and space communications.

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DATAMATION 60

volume 6, number 5

the automatic handling of information

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A Progress Report On

MACHINE INTELLIGENCE

by DANIEL D. McCRACKEN,
Consultant, Ossining, New York

LATE IN 1957, HERB SIMON OF CARNEGIE TECH and Allen Newell of the RAND Corporation predicted that within ten years a digital computer would be chess champion of the world, unless the rules were changed to bar it from competition. There are two types of reaction to such remarks: 1) That's impossible! 2) So what?

In its own way, each attitude has some justification. So far, with three of the ten years having gone by, no chess-playing computer program can beat anybody. Work in related fields, although promising, has not really gone very far toward producing useful results. The programs that prove mathematical theorems have not proved anything that was not already known, and operate only in restricted areas of mathematics.

In order to appreciate the plausibility of Simon's predictions, it is necessary to look not only at the present level of achievement, but also at the rather startling progress that has been made in a relatively short period of time. If the successes that are described below can be continued, useful accomplishment will surely follow in the course of the next decade.

The "So what?" is perhaps more important Who really cares whether a computer can play chess at the grand master level? Is this not a mere intellectual pastime? Are there not more important things for computers to be doing?

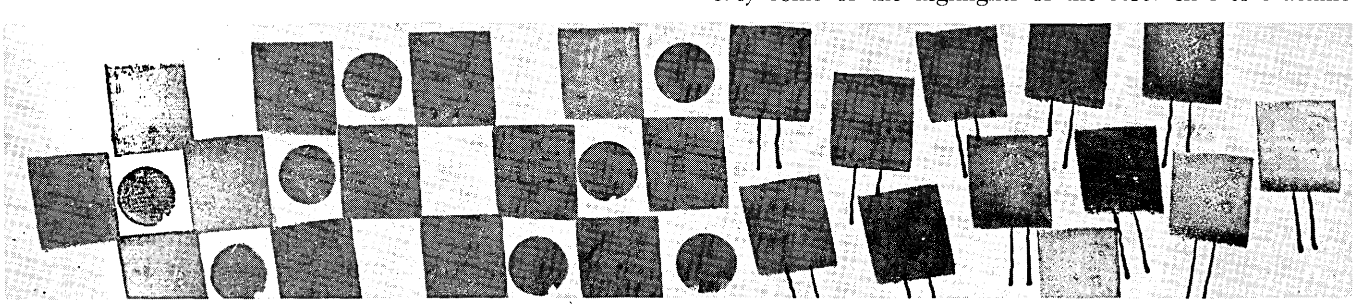
The answer, roughly, is that there are indeed more important things for a computer to be doing, but many of them are so difficult to solve that we must begin the attack on them by investigating something simpler. To be more specific, workers in the field of machine intelligence, or artificial intelligence, or complex problem solving, or whatever you want to call it, generally are working toward one or more of the following goals:

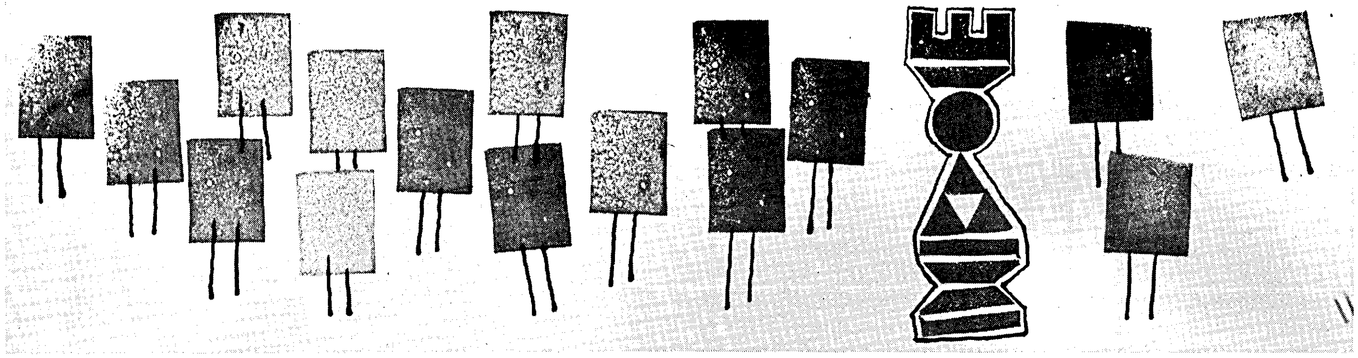
1. Some of them are concerned with the questions of problem-solving and learning **per se.** We do not really understand how we human beings go about solving a complex problem, or whether there may not be better ways than we use. The computer provides one more tool for investigating these questions. If what can be learned by use of the tool leads to better techniques for use by human beings, good; if it leads to combinations of human and machine intelligence, that's good, too, say these investigators.

2. Some people are concerned mostly with finding new ways to use computers. Hardly anyone would claim that the things we now do with computers, valuable as they may be, are the ultimate in what **might** be done. Many problems are still completely beyond the power of computers as we now know how to use them. Some of these may eventually come within our grasp if we can learn more sophisticated ways to organize the computer for work.

3. Some workers feel that we have come far enough to be ready to begin an attack on certain of the important problems themselves. They don't necessarily expect immediate answers to questions that have remained unsolved for centuries, but they hope that some useful results might be obtained within a few years.

The projects which are described briefly below represent only some of the highlights of the research into machine





intelligence. It is not possible to describe all the work being done in each area, or even to do more than mention some of the work.

Samuel and checkers

One of the best publicized studies in machine intelligence was done by Art Samuel of IBM, using the game of checkers as the sample problem. Dr. Samuel, who devoted his spare time to the project for several years, was interested primarily in setting up a computer program that could learn. He chose checkers because the game is complicated enough to be interesting, and yet has definite goals and rules of play. Of course, we would eventually like to be able to use computers in areas where the goals and rules are not precisely known. It seems reasonable, however, to begin with a situation which is at an intermediate level between a problem which we know how to solve completely, such as some mathematical problems, and one which we have only the vaguest ideas of how to solve, such as many of the problems of business. Checkers is such an intermediate problem, because although the goal and rules of play are precise, the strategy is not: no one can say how to play so as to win (or even draw) every game.

Samuel's checkers playing program for the IBM 704 is able to learn in two different ways: rote memorization and generalization. Rote memorization, although fairly successful in some respects, is presently of little theoretical interest. There is no question that with bigger memories, computers can retain more facts on which to base decisions. The learning program based on memorization was able to improve its opening game and some parts of the end game as it accumulated experience in playing, but it didn't improve much in its middle game.

The more interesting part of Samuel's program involved learning by generalization. The program had been provided with a set of routines to evaluate various features of board position, such as control of the center by kings, mobility of pieces, etc. This set of routines is used to determine what moves should be made, on the assumption that each player will always move so as to maximize his chances. Learning came in when the program was asked to adjust the choice of these routines and the importance given to each in choosing moves. If some feature of board position turned out, in the course of play, to have little bearing on whether the machine eventually won or not, it would downgrade that term in the "scoring polynomial" used to pick moves, and conversely. In other words, rather than storing the board positions themselves, the machine generalized on its experience, storing and modifying only an indication which types of board positions could best be used to predict a win.

Using this scheme and no rote memorization, the program learned to play what human players agreed was a "better than average" game. It would seem that with a combination of rote learning for the opening game and some features of the end game, and generalization learning for the middle game, the program could probably learn to beat a good amateur most of the time. (It is interesting to note that this combination of the two types of learning is exactly the same as the human player uses in learning checkers!) However, Dr. Samuel's interest was in learning programs, not in producing checkers champions, and he has not carried out the combination.

chess at RAND

A number of programs have been written to make a computer play chess. Since chess is a great deal more complex than checkers, the progress has naturally been slower, but still impressive. A program for the IBM 704 written by Alex Bernstein of IBM plays an interesting game, even though it uses a method that never looks ahead more than four half-moves. Another chess program, for the JOHNNIAC at the RAND Corporation, was designed by Allen Newell and Cliff Shaw of RAND and Herb Simon of the Carnegie Institute of Technology. At the moment, it has not beaten anyone, but the prospects look favorable that it will soon be able to beat a novice. The only goals presently included in the evaluation of possible moves are the balance of pieces, control of the center of the board, and the development of pieces. This, of course, is a limited set of goals; not included are any attaching features, king defense, etc., etc. Despite these limitations, it plays a game which is definitely interesting. With other goals included and with a faster computer to allow investigation of more possibilities, this program could very possibly become the first to beat a human player. It should always be kept in mind, however, that the goals of the Newell-Shaw-Simon group are primarily to investigate the human problem-solving process and to find new ways to exploit computers, rather than to produce the predicted world chess champion.

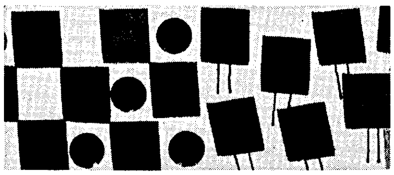
It is interesting to note that the writers of this program often cannot predict what their program will do in a given situation. This should give pause to those who are fond of saying that a computer can only do what it is told to do. Newell, Shaw, and Simon indeed told JOHNNIAC what to do, but what they told it was, in effect, "See if you can play a good game of chess."

The same group of men has also developed a program to prove theorems in elementary symbolic logic, again using RAND's JOHNNIAC. They began by giving the machine the axioms and rules of inference for the propositional calculus from **Principia Mathematica** by Whitehead and Russell. Then they fed the machine the first theorem and asked it to find a proof. It did so. Then they fed it the second theorem and asked it to find a proof, using the axioms and the first theorem, and so on. Proceeding this way, the program produced proofs for most of the theorems in the second chapter of Whitehead and Russell. Some could not be proved, or not proved in a reasonable amount of time, by the particular methods of searching for proofs supplied to the program. In one case, the computer found a proof that required far fewer steps than the text solution!

The basic idea of the method of searching for a proof is worth considering. Faced with solving a problem, one first asks whether there is an algorithm that will guarantee a solution. For example, the formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

is an algorithm for finding the roots of the equation $ax^2 + bx + c = 0$. In a situation like chess, there can be no practical algorithm, because to evaluate every possible



move in a game of chess would take millenia even with the fastest computers imaginable. In other situations there can be no algorithm because of the nature of the problem. In some cases where algorithms can be shown to exist, they would still require more computer time than anyone wants to spend and still not provide much insight into the problem-solving process.

In such cases (and others) one turns to the heuristic method. A heuristic is a procedure which may solve a given problem, but offers no guarantee of doing so. Its advantage is that if it does find a solution it will ordinarily do so much more rapidly than an algorithm. Stated otherwise, a heuristic is a cut-and-try approach in which it is attempted to provide the problem-solver (human or machine) with hints along the way so that only the most promising avenues are explored. In proving theorems, the hints are, in effect, generated by the program itself. The machine works backward from the conclusion of the theorem, hunting for possible lines of reasoning that lead back to the premises. If a line leads to information not supplied, then the line is discarded and something more promising tried.

This general approach, of working backward from the desired result and asking whether the problem-solver is getting warmer or cooler, is at the heart of many of the problem-solving computer programs now being studied.

An incident that happened at RAND a year or so ago provides an interesting sidelight to this discussion. Cliff Shaw one morning called up Fred Gruenberger, who also works at RAND, and asked him to participate in a little game. Cliff explained the axioms of propositional calculus to Fred, who had had no previous contact with the subject, and related to him the aim of the subject. Cliff then gave Fred one of the first theorems and asked him to prove it. Fred sweated for nearly an hour, going down blind alleys, trying little "experiments," occasionally getting hints from Cliff. Finally he found a proof.

At this point Cliff said, "Tell me, Fred, have you been **thinking?**" Fred's reply was that he sure **thought** he had, and as a matter of fact, he hadn't thought so hard for months as he had in the past hour. Cliff's response to this, in essence, was, "That's very interesting, because I have here JOHNNIAC's proof of the same theorem. It went down approximately the same blind alleys, generated pretty much the same hints as I gave you, and produced exactly the same proof."

Herb Gelernter of IBM has developed a theorem proving program to find proofs in plane geometry. It operates on much the same lines of heuristic reasoning as described above, using, among other things, heuristic features of diagrams introduced into the computer in symbolic form. After providing the machine with some of the elementary theorems, Herb asked the machine to prove theorems taken from high school final examinations in plane geometry, which it has been very successful in doing. A sample proof is shown in Figure 1. I can testify personally, as one who has not looked at plane geometry in some years, that at least some human beings would find it most difficult to produce the same proofs – especially with the same limited amount of prior "knowledge" of similar results.

Gelernter's goal in his work is the exploitation of the computer, to find new applications for the computer. These seem not to be far off; the rather surprising success in geometry has led to glimmerings of ideas of how to attack other problems which had been thought to be almost unsolvable.

Wang's inferential analysis

Hao Wang, of the University of Oxford, would like to try to get useful results in advanced mathematics. He emphasizes the use of mathematical logic and suggests developing "inferential analysis" as a sister discipline of numerical analysis. While at IBM in the summer of 1958, he set up a program which proved all of the theorems in not only the second but all the related chapters of Whitehead and Russell, as well as a majority of theorems in a more advanced domain. In one case, the machine proved a theorem by a more elementary method. More recently, he has carried the work further at Bell Laboratories and enabled an IBM 704 to prove all theorems (over 350) of the first ten chapters of Whitehead and Russell in 9 minutes, covering two fields, one of which (the quantifier logic) is potentially very powerful. In terms of results, Wang's work of course goes far beyond the program of Newell, Shaw, and Simon, which however, has interesting implications in a different direction. Newell, Shaw and Simon were primarily interested in studying the problem-solving process and their work is significant for this broader problem.

Wang feels that things have now reached the stage where we can hope in the fairly near future to get real help from the machine in mathematical research. He envisions the possibility that a machine will be able to check and formalize sketches of proofs and at a later stage beat the unassisted mathematicians at proving many interesting mathematical theorems. If it should happen, for instance, that a computer finds a proof (or disproof) of Ferman's last theorem, it should just about mark the end of discussions about whether machines think.

For now, however, it hasn't been done, and the question remains. The standard reply to the question of whether a machine thinks is, of course, "It all depends on what you mean by thinking." The course of the conversation then follows one of two paths. A person who is predisposed to believe that machines do think will say that any organism or device that can distinguish between zero and one can think, ergo, machines think. A person who wants to believe that machines cannot think will define thinking in terms of the very highest abilities of man, and then smile smugly. What such a person forgets is that not very many men meet such tests, either. Of course no machine has the originality and creativeness of a Newton or a Mozart, but how many of the rest of us do?

Turing's dialogs

The big problem is that psychologists have had little to say about thinking independent of the thinker. We therefore try, naturally enough, to define thinking in terms of what we believe we do, and thus get into the type of disagreement noted above. The late A. M. Turing proposed an Imitation Game with which to replace the inevitably ambiguous question "Can a machine think?" In this game, a human questioner would be allowed to put questions to a human being and to a machine, using typewriters to avoid getting information about anything but the answerers' intellectual abilities. After playing the game, the questioner would decide which was the human and which the machine. Turing proposed some sample dialogs, showing only the answers given by one respondent – either the human being or the machine, whichever is being questioned. Here is one of them.

Q: Please write me a sonnet on the subject of the Forth Bridge.
A: Count me out on this one. I never could write poetry.

Q: Add 34957 to 70764.
A: (Pause about 30 seconds and then give as answer) 105621.

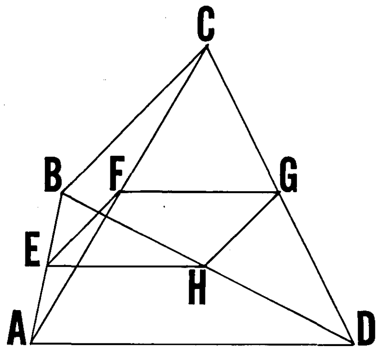


Figure 1. Machine proof of a theorem in geometry. Note that some of the information is an explicit statement of things taken for granted in high school geometry.

Proof
segment DG equals segment GC
  definition of midpoint
segment CF equals segment FA
  definition of midpoint
triangle DCA
  assumption based on diagram
precedes DGC
  definition of midpoint
precedes CFA
  definition of midpoint
segment GF parallel segment AD
  segment joining midpoints of sides of triangle is parallel to base
segment HE parallel segment AD
  syntactic conjugate
segment GF parallel segment EH
  segments parallel to the same segment are parallel
segment HG parallel segment FE
  syntactic conjugate
quad-lateral HGFE
  assumption based on diagram
parallelogram EFGH
  quadrilateral with opposite sides parallel is a parallelogram
total elapsed time – 1.03 minutes

Premises

quad-lateral ABCD
point E midpoint segment AB
point F midpoint segment AC
point G midpoint segment CD
point H midpoint segment BD

To Prove
parallelogram EFGH

Syntactic Symmetries

BA, AB, DC, CD, EE, HF, GG, FH, CA, DB, AC, BD, GE, FF, EG, HH, DA, CB, BC, AD, GE, HF, EG, FH.

Q: Do you play chess?
A: Yes.
Q: I have K at my K1, and no other pieces. You have only K at K6 and R at R1. It is your move. What do you play?
A: (After a pause of 15 seconds) R-R8 mate.

Suppose we imagine another imitation game, along the following lines.

Q: Is it true that the diagonals of a rectangle bisect each other?
A: Yes.
Q: How about the diagonals of an isosceles triangle?
A: That question is not completely sensible: I think you're trying to trap me.
Q: Is it true that parallel lines never intersect?
A: Yes.
Q: You are not aware, then, of the Poincare geometry, in which the statement need not be true?
A: Sounds interesting, but my only contact is with Euclidian geometry.

Except for the subtleties of the English-language phrasing of the questions and answers, a machine could compete successfully in this imitation game right now.

If we take the point of view that, whether we choose to call it thinking or not, machines are becoming more and more useful tools, then more pertinent questions arise. When will a properly programmed computer be able to run a business or plan an optimum national budget or avert a war? The workers in the field are not talking this way, at least not in print, but if the next five to ten years bring even half the success they hope for, such questions will then seem reasonable.

The answer would appear to depend on other factors as much as on the success of the type of work we have been discussing. One point to keep clearly in mind is that all of the work done so far has involved problems which can be clearly defined even if the strategies cannot. In chess, the bishops move along diagonals, the goal is to capture the opponent's king, etc. Furthermore, the goals do not conflict; if the opponent's king can be captured, one is not required to do it in such a way that he won't get so mad as to refuse to play another game.

What is the goal of a business? To make a profit? The biggest immediate profit can be made by selling out to the competition. Well, you say, that's not quite what I meant; let's say making a profit over the next ten years. Well then, to make a profit next year as well as this month, a business should think of labor and community relations as well as profit margins. But exactly how much should one spend on Community Chest contributions and how much on institutional advertising in order to maximize profit over the next decade? And wouldn't most businessmen be willing to contribute something to the community even if they weren't convinced that it would bring in an eventual return?

In other words, it's hard to apply a computer to a problem which is poorly defined. But not necessarily impossible. By making assumptions which simplify the computational problem, a lot can be done right now, and is. It might also happen that some of the work now being done will tell us something about how to define problems as well as how to solve them. It is suggestive that Art Samuel discovered some terms for his scoring polynomial which involved board situations which had never been recognized by checkers experts as having a bearing on the game. It is almost a truism that after an organization has had access to a computer for a while, they learn enough by using it to attack problems in ways that would never have occurred to them without the experience with the machine. We still have not fully exploited the speed of the new tools; too many problems are still solved in the old ways because we have not yet learned to think in terms of what is best for the computer. In Wang's apt phrasing, "We are in fact faced with a challenge to devise methods of buying originality with plodding, now that we are in possession of slaves which are such persistent plodders."

Another uncertainty in the future of machine intelligence is the financing of the research. There are probably not a hundred people in the whole country working on the matter, including graduate students and coders. There is much more interest in such things as language translation and character recognition, which are, of course, interesting in their own right, and which have the added luster of the prospect of a short-term payoff. There can be no question that theorem proving by machine is long-term basic research, with the payoff in the very uncertain future.

And what are the Russians doing? It would be comforting to be able to dismiss them with a joke about how they would probably claim that Pavlov proved theorems on a desk calculator.

However, Paul Armer of RAND, who visited Russian computing centers last summer, says that the Russians appear to have decided that this is a top priority research area. They use the term "cybernetics" to cover this field as well as those of automation, computers and automatic control.

According to Armer, "cybernetics" has become a household word in the Soviet Union because of the large amount of writing, scientific and popular, devoted to it. Seminars in cybernetics bringing together members of the various disciplines that are involved in machine intelligence, have been held at the University of Moscow since 1955; on a weekly basis since 1956. It is not clear what the accomplishments have been to date, but the space and missile field provides evidence of what the Russians can accomplish when they decide to give high priority to research in a particular field.

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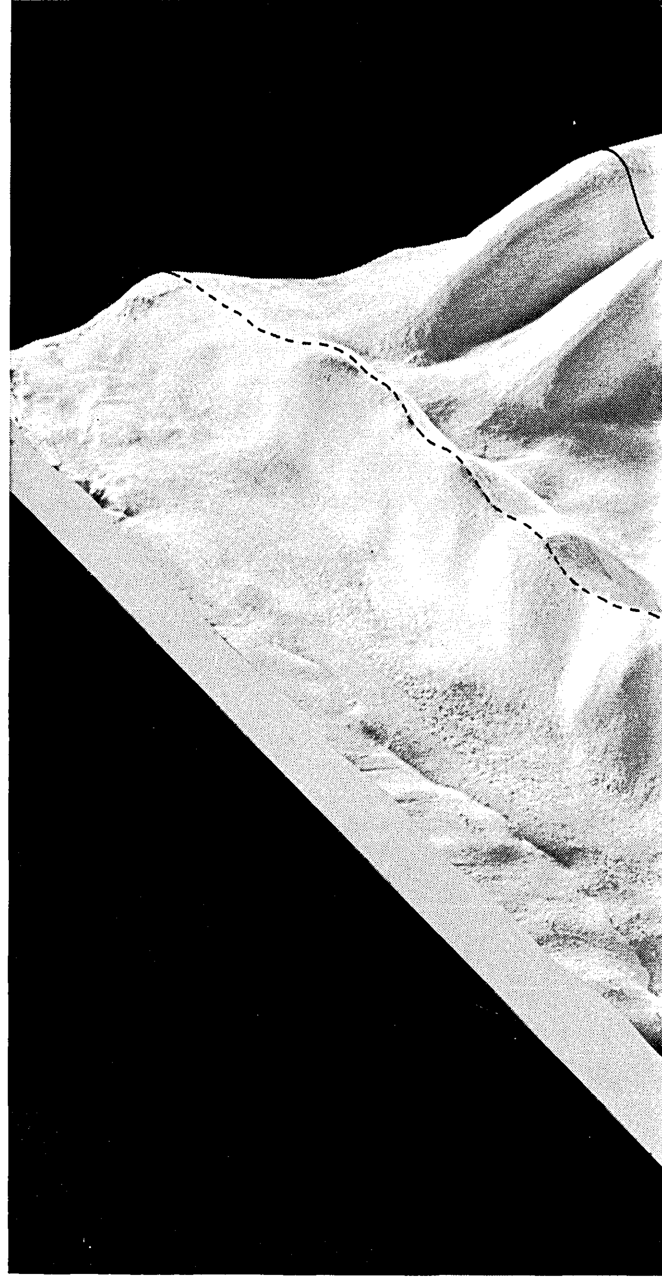

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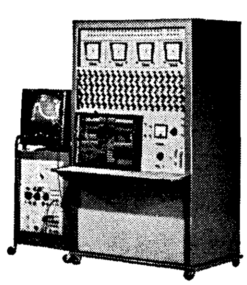

$\left(\frac{\delta a}{\delta t}\right)$ - - - - - - -	This curve describes the design parameters for the entire process, with the maximum design factor occurring at point (1).
$\left(\frac{\delta b}{\delta t}\right)$ ————	This curve describes the profitability of the process. Note peak (2), where maximum profitability occurs.
$\left(\frac{\delta c}{\delta t}\right)$ -·-·-·-	This curve shows the product quality variation. Maximum quality plateaus at point (3).
❶ ❷ ❸ ═══	Optimization for the entire process is achieved by operating along points (1), (2), (3).

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5. FORTRAN II COMPATIBLE COMPILER—Control Data provides the Fortran II Compatible Compiler, which will accept any problems written in Fortran language.

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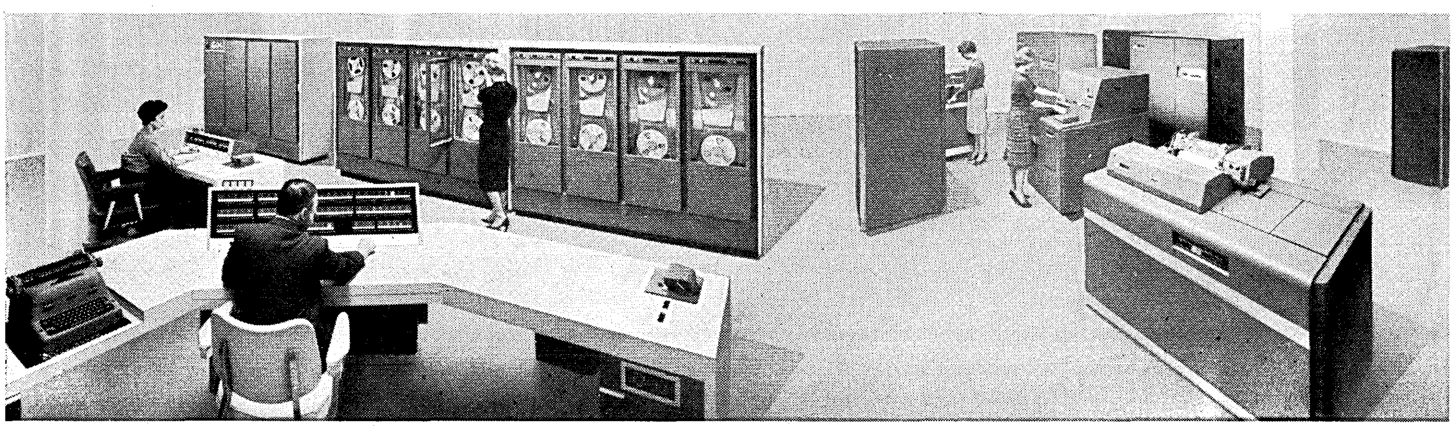

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C-E-I-R Brings STRETCH To Los Angeles

AFTER MONTHS OF NEGOTIATIONS, Corporation for Economic and Industrial Research revealed, late in September, that an IBM commercial STRETCH system would be installed in C-E-I-R's planned Los Angeles research center in 1962. The configuration contracted for involves a monthly rental of $300,000 representing a purchase price of about $13 million.

The Arlington, Va., firm has thus more firmly established its claim that it is the nation's largest independent research and computer service organization. C-E-I-R has opened or has announced plans for centers in several major cities in the U.S.

The STRETCH center in Los Angeles will be equipped with the latest in teleprocessing equipment and data links. These will provide remote access to the computer by customers, a necessary feature when the speed and capacity of STRETCH are considered.

Dr. Herbert W. Robinson, president of C-E-I-R, anticipates that the annual business volume on this machine will be at or about the $10 million level. STRETCH will be operated on an around-the-clock basis with computer time being made available to all commercial and government users. C-E-I-R states that they expect to number among their customers every present computer user on the West Coast as well as many other users elsewhere in the country.

The L.A. center will be staffed with programmers, analysts, applications research personnel, economists, and statisticians to provide complete programming and backup services for the machine. The staff of General Analysis Corp. (now merged with C-E-I-R) will form the nucleus of the Los Angeles staff.

how many STRETCH systems?

The joyous announcement by C-E-I-R and IBM of the first commercial STRETCH installation provided one more part of the answer to a question nagging many a computer professional: How many STRETCH systems will IBM produce?

Three of the giant machines have been formally announced. A STRETCH is being completed for the AEC at Los Alamos, N.M. In July, the United Kingdom Atomic Energy Authority contract signing was disclosed. And the C-E-I-R signing is now public.

It is general knowledge that two more STRETCH systems are committed. The two yet-to-be-announced recipients – the Navy's Bureau of Ships and the AEC installation at Livermore, Calif.

The RAND Corp. is no longer interested in a STRETCH installation of any kind. Representatives of that company negotiated with IBM during the past year with the possibility in mind of establishing a STRETCH co-op in Southern California. The co-op idea is still very much alive, RANDmen say, but they now will wait for a next-generation (post-STRETCH) machine.

Will number five, then, mark the end of the line for STRETCH? DATAMATION's guess is that at least seven machines will be produced and at least one more commercial installation will be announced within six months.

Programming Important Key To STRETCH Future

by WILLIAM ORCHARD-HAYS, Director, Southwest Research Center, C-E-I-R, Inc.

WHATEVER MAY BE the particular scientific or data processing jobs on which STRETCH will be used, the range of its power will be limited or extended by the vision of those who plan programs for it. The art of programming – it can scarcely be called a science yet – has grown concurrently in the past 9 or 10 years with the hardware. The resulting large systems of programs have now reached such a degree of complexity and power as to rival the machines. This "software," as it is currently called, has in itself led to some of the most interesting applications of the hardware.

A computing center must be prepared to handle great varieties of tasks, some not even thought of now, economically and expeditiously. This means, actually, the automation of computing. A few years ago, it is unlikely that anyone comprehended the volume of information which this implies. We have been moving toward it with ever more powerful machines. It appears that with STRETCH we are finally reaching the right order of magnitude. C-E-I-R feels it can supply the know-how to take advantage of this capacity, both in programming and problem analysis.

It is not too difficult to imagine a central processing center with small remote satellite computers feeding into it and receiving results. The initial preparation and editing of input and the final formatting of printed reports are already looked on as sub-tasks, and much work has been done in these areas in the last two or three years. Transmission equipment to tie to already existing small computers is now becoming available. There is also a considerable amount of experience to date operating remote locations tied to a computing center. C-E-I-R is even now developing procedures for tying its research centers and field offices together. This is primarily a matter of transmission equipment. For most applications, distance is no longer the great barrier.

Once a system of satellite computers is functioning, we then have a network for the handling of information and intelligence throughout many parts of the country, almost simultaneously. C-E-I-R is already gearing up for such work on the present IBM 7090's but it presently requires a programmer-analyst on the machine site to represent the remote locations. The increased speed and capacity of STRETCH's memory devices will make possible adequate libraries of control routines in the central computer.

Perhaps the most far-reaching development will be a break-through in data handling processes. As far as we have come in the last five years, there are many time-consuming and irreversible procedures with which present machines must contend. Rather than expending effort to speed up troublesome procedures, it will often be possible to bypass them altogether.

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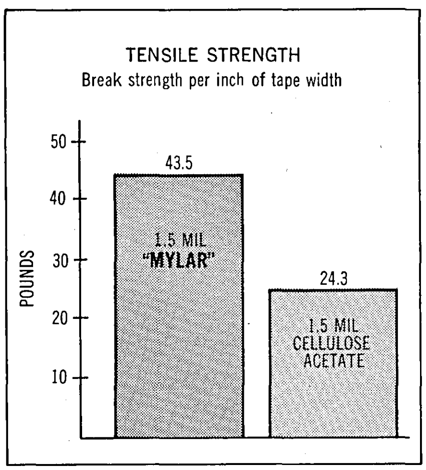
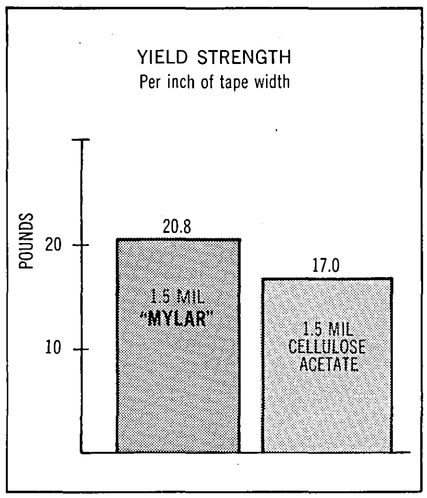
CHART NO. 1



Less tape breakage

Tensile strength of "Mylar" is higher than any other plastic film used as an instrumentation-tape base. Chart 1 compares break strength of "Mylar" and cellulose acetate. And "Mylar" does not lose its strength with age, repeated playbacks or storage, because it has no plasticizer to dry out.

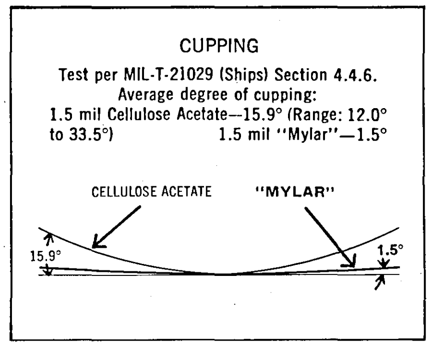
CHART NO. 2



Resistance to stretching

The higher yield point of "Mylar" compared to acetate is shown on Chart 2. Greater resistance to stretching under load minimizes the chance of signal distortion.

CHART NO. 3



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Temperature or humidity change causes negligible change in dimensions of "Mylar". Chart 3 compares cupping of "Mylar" with cupping of acetate due to environmental change. Insignificant change in "Mylar" minimizes possibility of signal dropout due to loss of total contact with the recording or playback head.

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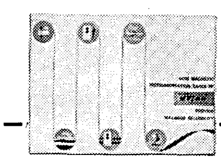

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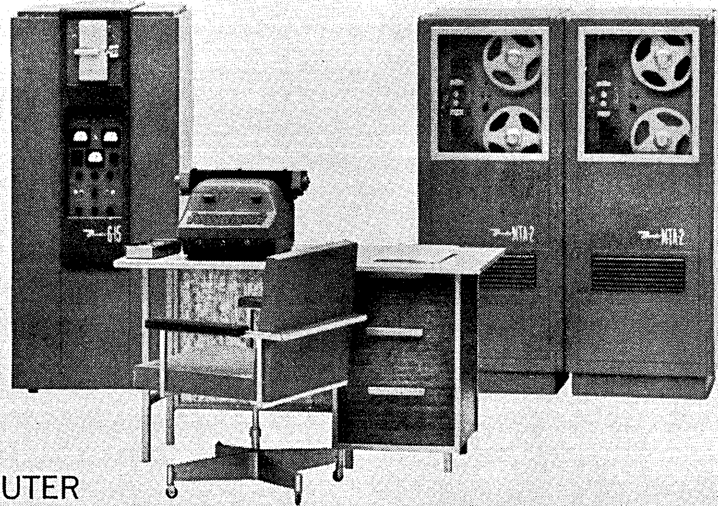

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(For values of R F & L as specified. For values of E ranging from 100 to 300 in increments of 50. For values of C ranging from .00002 to .000021 in increments of .0000001)

COMPLETE ALGO PROGRAM:

```
BEGIN Ⓢ
R = 10 Ⓢ
F = 60 Ⓢ
L = ₒ2 Ⓢ
FOR E = 100(50)300 BEGIN Ⓢ
FOR C = ₒ00002(ₒ0000001)ₒ000021 BEGIN Ⓢ
I = E/SQRT(R ↑ 2 + (6ₒ2832 * F * L — (1/(6ₒ2832 * F * C))) ↑ 2) Ⓢ
PRINT (FL) = E Ⓢ
PRINT (FL) = C Ⓢ
PRINT (FL) = I Ⓢ
```

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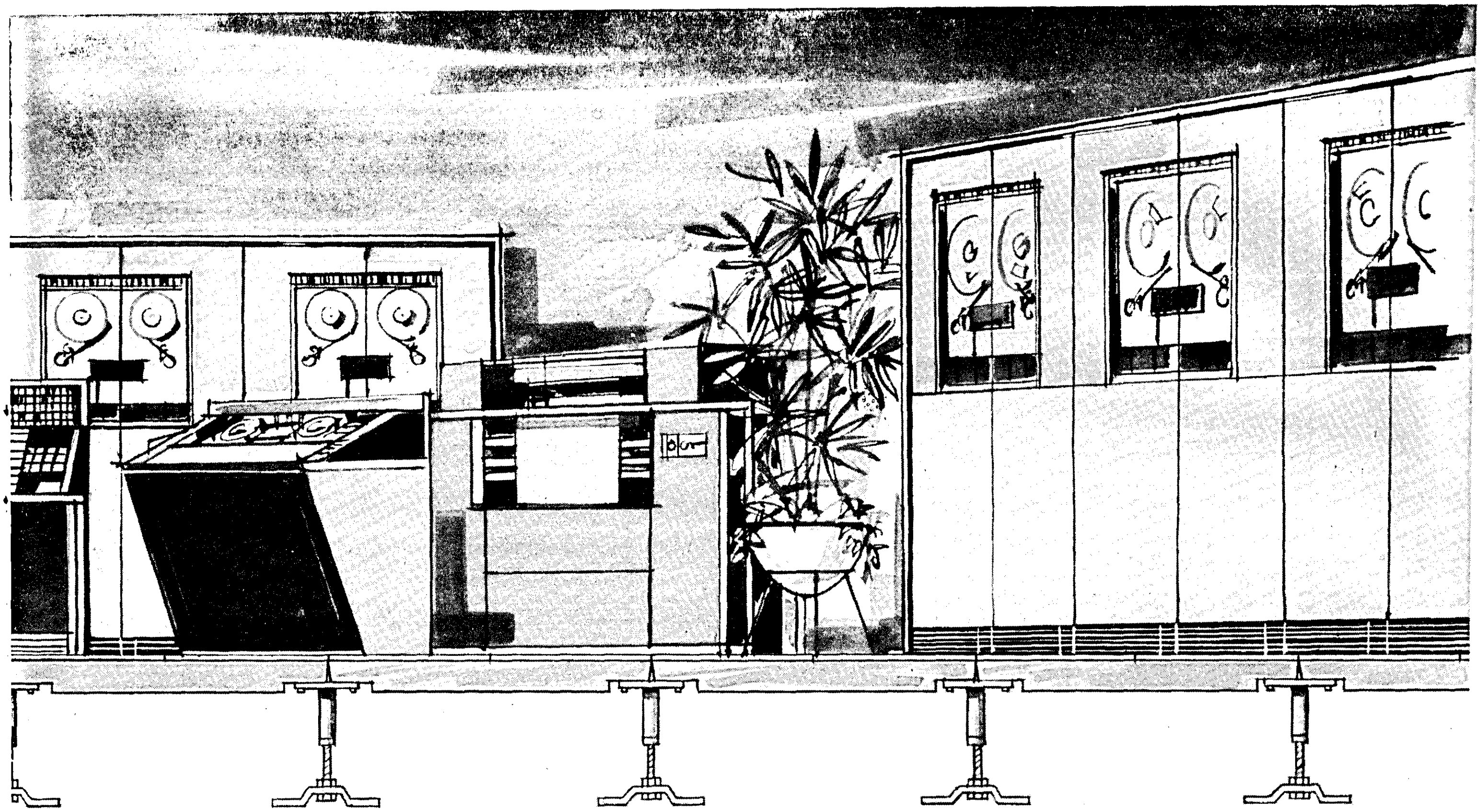

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A NEWS REPORT ON

GERMAN COMPUTING

by PROF. DR. ALWIN WALTHER, Darmstadt Technical College, as reported by Etienne J. Guerin

The assistance of Mr. Arnst of ZVEI—Central Association of the German Electronic Industry of Frankfurt is gratefully acknowledged in the preparation of this report.

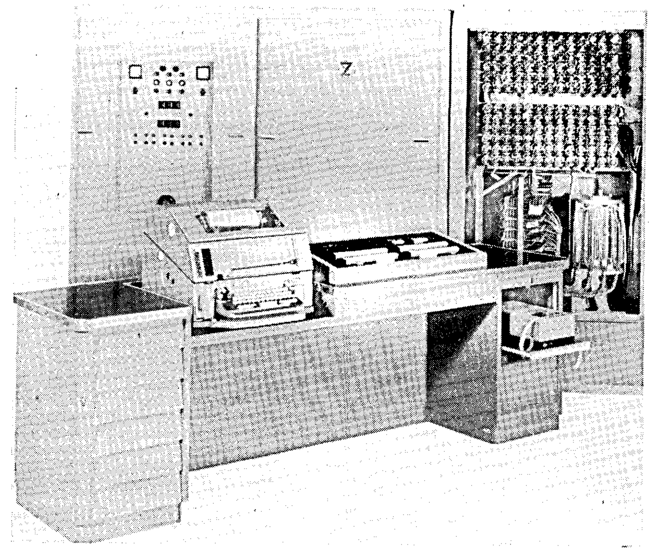
THE BEGINNING of automatic handling of information in Germany dates back to 1936 when K. Zuse designed the first workable digital machine. This development was interrupted by the war and remained slow for the ten years afterwards. In the last five years, experts estimate that German technique in this field has reached the world level.

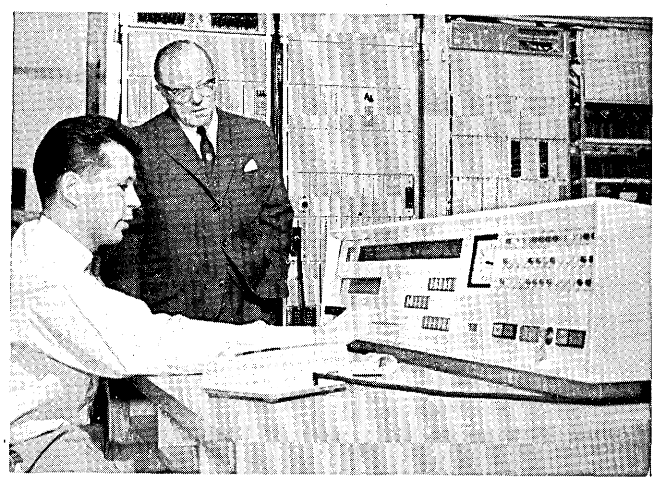
In 1956 Germany produced only two digital computers for a value of about 0.5 million Deutsche Mark. By 1957, eight machines were in use for a value of two million DM. The computer total boomed to 97 pieces in 1958 for a value of 26 million DM. Figures released by the industry for 1959 give 120 digital computers for a value of 30 million DM.

Among the companies presently active on the market are K. Zuse with its Z-22, Siemens & Halske AG with the 2002, and Standard Elektrik Lorenz AG through its Informatik Division (ITT affiliate) producing the ER-56. Telefunken has started recently with model TR-4. Beckman Instruments GmbH of Munich is producing an analog EASE 1100 and Royal McBee GmbH of Frankfurt produces the LGP 30. IBM is also active in manufacturing in Germany, and special analogs are built by Donner Scientific and sold in Munich.

The German Research Council – Deutsche Forschungsgemeinschaft or DFG in short – has rented three IBM 650s installed in Hannover, Darmstadt and Hamburg.

The Darmstadt Technical College is training 230 programmers in a two-hour-per-week course. The class is directed by Heinz Schapprerd. At the same school, Gerhard Hund conducts exercises three hours a week for practical examinations. Students are divided into 15 groups, each composed of 15-17 students. About one hour of their time is spent writing programs which are discussed.





TOP PHOTO—Zuse's Z-22 has a 38 binary digit word length. Speeds claimed are 30 to 35 operations/sec. fixed point and 15 to 20 operations/sec. floating.
MIDDLE—Siemen's 2002 is a single address machine with high speed multiplication and division and floating point instructions with and without normalization.
BOTTOM—SEL's ER-56 is a fully-transistorized, decimal, sequence-controlled computer with built-in floating point. Word length is 7 decimal digits.

ISTVAN FENYO OF BUDAPEST, Hungary, recently took a trip to East Germany under the auspices of the Hungarian Academy of Sciences.

He reported having spent most of his time in East Germany in the Institute for Machine Calculation which belongs to the Technical University in Dresden and which is headed by Professor Lehmann. This institute occupies four complete floors and has nearly 50 workers. Fenyo thought it well equipped. At the institute two fast-operating digital computers and one slow, small-capacity machine for didactic purposes are almost completed. Among the analog computers is an algebraic equation solver designed and built by H. Adler who was trained in the Soviet Union. The elements so far completed can solve eighth degree equations. It is built on the transformer principle and can define roots with a precision of three decimal places. Another analog computer is being built in the Institute which can solve equation systems with 10 unknowns.

Another faculty of the Dresden Technical University has built an electronic integrator which has been produced in several units for industrial enterprises.

A faculty in the Illmenau electrotechnology college has developed an analog, purely electronic, differential analyzer named the "EARI" which makes possible a fast solution of linear and nonlinear differential equations. The operation time of this machine is 25 and 100 microseconds per operation. It uses a repeater and the result curve appears on the screen for a cathode ray tube. This college is also developing a differential analyzer for a German optical factory.

—*E. J. Guerin.*

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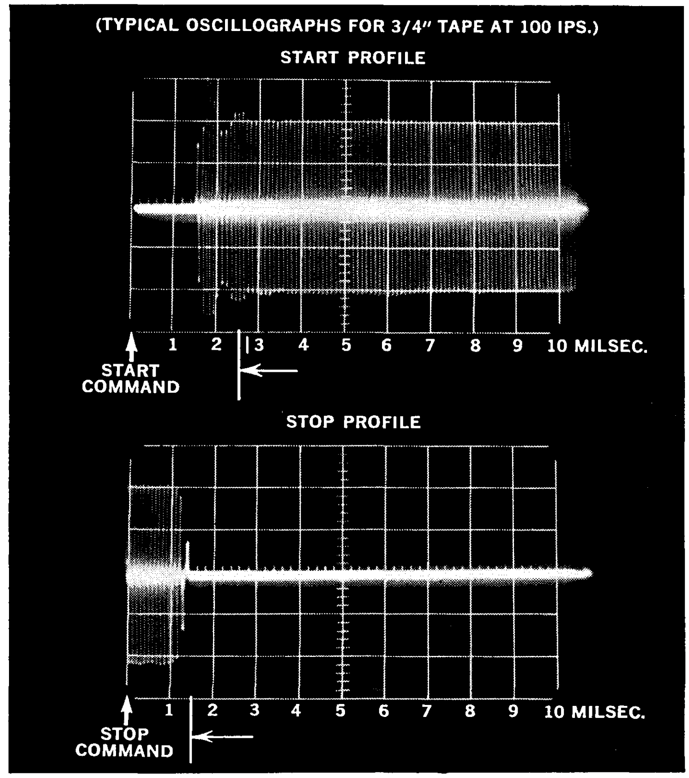
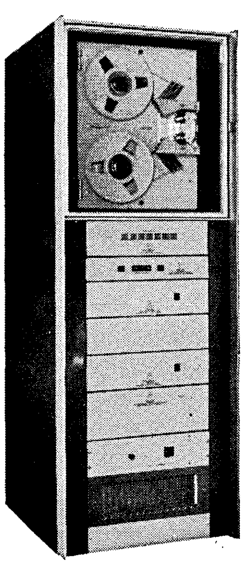


HERE'S PERFORMANCE...

FOR DIGITAL, MAGNETIC TAPE SYSTEMS

The Potter 906 II gives you the highest performance and reliability at savings up to 1/3 the cost of ordinary tape handlers. Potter has been given complete responsibility for tape sub-systems in some of the most widely sold computers. Potter's many years of concentrated specialization in tape system designs assures computer manufacturers of performance and dependability at costs that give them a competitive advantage in today's market. Computer users, too, are specifying Potter tape systems for lower rental costs, fewer service problems, and less down time. The Potter 906 II Tape Handler is being specified by more and more manufacturers and computer users because of the kind of performance proven by the clean Start-Stop profiles above and because the 906 II offers such other advantages as: ○ Full forward-reverse cycling with 1" tape at 120 ips. ○ Low skew tape guide. ○ High density: 450,000 8-bit characters per second can be recorded on 1" tape by using the 906 II with the Potter Contiguous Double Transition System. ○ Transistorized control of all functions. ○ Simplified packaging for easy maintenance. Write for detailed specifications, prices and delivery information on the 906 II and see proof that you get higher performance and greater economy from a tape system specialist.


Potter 906 II magnetic tape transport in the custom designed M 3340 cabinet.

POTTER INSTRUMENT COMPANY, INC.

Sunnyside Boulevard, Plainview, L.I., N.Y. OVerbrook 1-3200

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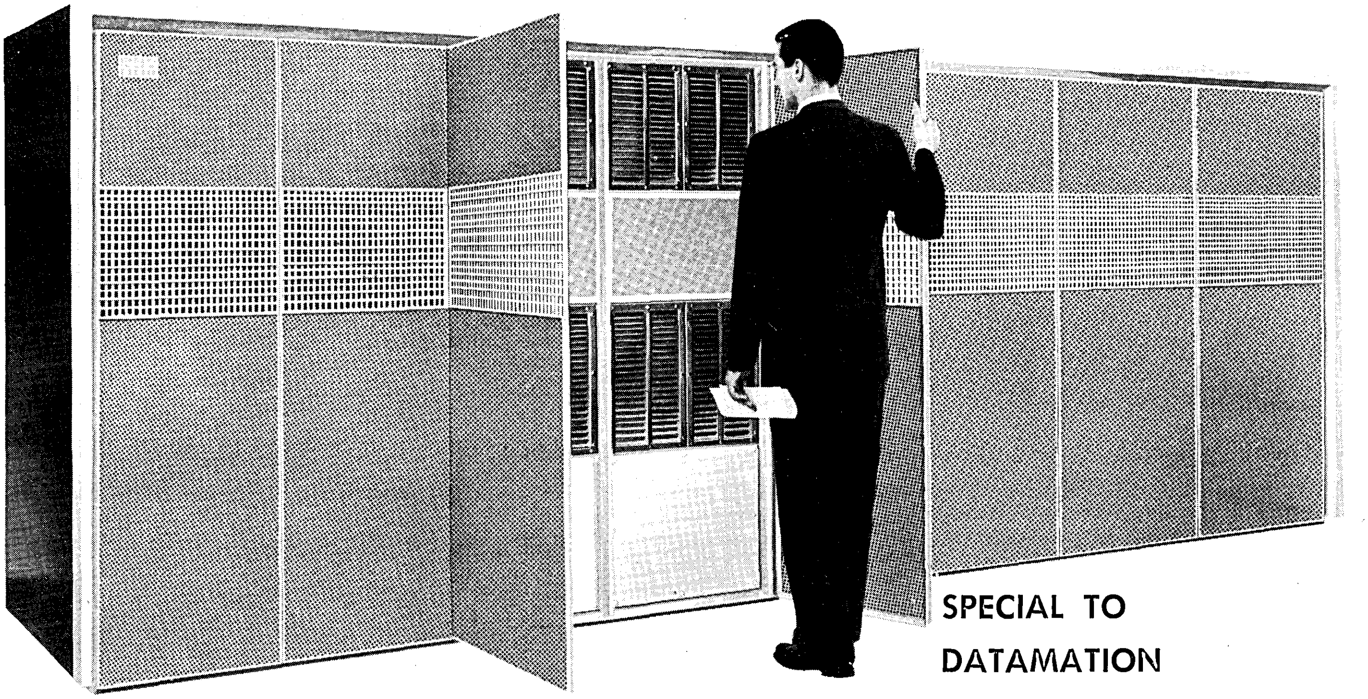


SPECIAL TO DATAMATION

PLANNING THE RCA 601 SYSTEM

WHEN A NEW ELECTRONIC DATA PROCESSING SYSTEM such as the RCA 601, with its new design concepts in modularity, is introduced, it may be taken for granted that its planning and development involved intensive team effort over an extended period of time.

Planning for the 601 commenced in various divisions of the Radio Corporation of America in 1957, with the major effort, as would be expected, contained in RCA's EDP Engineering activity. It was supported extensively by RCA's Semiconductor and Materials Division, the David Sarnoff Research Center, and other activities in RCA.

This support, in the early days, was both direct and indirect. Thus, the RCA 601 Electronic Data Processing System was developed by combining the finest engineering force and progress from each of the many specialized areas available within RCA, which must contribute to the design of a truly modern complex system.

The planning objectives for the RCA 601 System were simple and straight-forward.

First and foremost, the objective was to provide an addition to RCA's product line in the so-called medium to large-scale category. This entry was to coincide as closely as possible with the advent of the RCA 301 System in order to provide for a complete RCA line of data processing systems. This objective was achieved with the announcement of the 601 and 301 Systems in April.

Second, this large-scale entry was to be completely **general purpose,** with the important stipulation that specialized uses required specialized capabilities which were to be provided without penalty to users not requiring those capabilities. This essential objective was met by the unique physical-functional modularity in the 601 System.

A third objective was to develop this system so that changing environment in terms of application capabilities as well as in future enhancements of peripheral equipment could be accommodated "on-site" and in response to users' requirements.

Again, the modularity which is designed into the 601 System to accommodate changes in types of data processing or scientific computation requirements was extended to facilitate a succession of advanced peripheral equipments which the 601 System will be capable of handling without basic change. This objective looks forward to truly all-electronic systems which will incorporate electronic displays, electronic document reading, and electronic printing.

A conventional objective was that this system must be based upon the most complete advances in the state of the art. At the outset this was achieved by exercising the rule that each system parameter must be set on the basis of technological advances tested by design and development standards.

Compatibility with all other RCA data processing systems was an early objective which was met by developments in system design and in programming systems. Logical extensions of this objective to include other major non-RCA data processing systems are also included in planning for the 601 System.

Summed up, these objectives were to develop a large scale system which would bring RCA's capabilities as a completely integrated electronic systems manufacturer to bear on the information processing field. The success of this development is indicated by the extraordinary interest shown in the 601 since its announcement.

system description

Following is a general description of this new system.

The RCA 601 Electronic Data Processing System is a high-speed, general-purpose system. Characteristic features of the 601 such as versatility and expandability are accomplished through a new concept in computer design, the concept of physical-functional modularity.

Each major function in the system is implemented by a module. Modules may be plugged into or removed from the computer with ease; printed circuit boards interconnect the modules with the rest of the system, obviating soldering. Thus, a particular 601 system may be oriented to differing applications by the choice of modules from which the system is built.

As the user's data processing needs evolve, the 601 System can expand with increased demand by the addition

Team effort develops new modularity design concepts

by ARTHUR S. KRANZLEY, Manager
Product Planning & EDP Methods
RCA Electronic Data Processing Division

or replacement of modules affording greater speeds, more capacity, or a shift in functional emphasis. The 601 has been designed with full recognition that the characteristics of an application evolve and change with time, requiring economic shifts in corresponding computer characteristics.

In addition to the concept of physical-functional modularity, the 601 System can be expanded and molded to the users' needs by the more conventional methods. The number and type of peripheral devices which may be directly connected to the computer, and the ways in which the connections can be made vary over a wide range of possible configurations.

For these reasons, those who designed the 601 refer to it as a wide variety of systems.

system features

1. Versatility and Expandability—Made possible by generalized design techniques and physical-functional modularity. Despite the wide variety of equipment and performance characteristics, all 601 Systems are compatible program-wise.
2. Multilevel Simultaneity – A large variety of input-output functions may proceed simultaneously with each other and computer processing. The degree of simultaneity possible is determined by the user through his choice of equipments and their configurations.
3. Multiple Programming – Any reasonable number of programs (limited only by memory capacity) can be run on a priority time sharing basis, taking maximum advantage of the internal speeds of the computer.
4. Multilevel Indirect Addressing – Unlimited indirect addressing levels make it possible to transfer addresses of data rather than the data itself, saving in processing time.
5. Multilevel Automatic Address Modification – Any number of self-incrementing automatic address modifiers can be applied to addresses, making iterative coding techniques rapid and efficient.
6. Variability – The 601 System handles fixed word, fixed field, and completely variable data formats, in variable character sizes, with equal ease.

An RCA 601 System is composed of a combination of equipments from the following classes: Computer, Input-Output Transfer Channels, Input-Output Switching Units, On-Line Input-Output Devices. All elements of 601 Systems utilize transistor and diode logic solely.

computers

The 601 System includes two specific Computer models. The RCA 603 Computer is oriented toward conventional data processing applications, but not to the exclusion of capabilities to accommodate scientific and mathematical problems. The RCA 604 Computer is aimed at these scientific and mathematical problems by virtue of substantially enchanced arithmetic times and fixed and floating point operations with both single and double precision.

The following gross times are indicative of the enhancement. Full-word operands (56 bits) are assumed, and the times cover performing the operation and three accesses to high speed storage. The 603 Computer speeds indicated apply to decimal fixed point operands. The 604 Computer speeds apply to decimal and binary, fixed and floating point operands.

	RCA 603	**RCA 604**
Add	**9 microseconds**	**6 microseconds**
Multiply	**70 microseconds**	**10 microseconds**

As implied, both Computers recognize and execute the same instructions. The difference is the manner and speed in which individual instructions are executed.

Both of these Computers are based upon a combination of sub-units. The basic differences are related to physical-functional modularity, which is evidenced by types of arithmetic units and instruction control units. Each Computer is common in terms of a basic processing unit, high speed storage, console, monitor printer, paper tape strip reader, and console transfer channel.

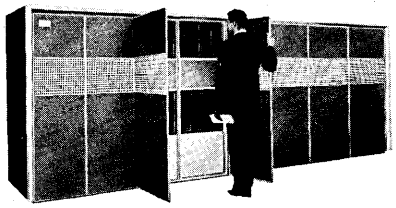
High speed storage for both Computers is random access magnetic core memory in which information is stored and retrieved in 56-bit words or 28-bit half-words. Modules of 8,192 words are provided, with as many as four modules permissible in one Computer for a total of 32,768 words. High speed storage is addressable on a word, half-word, or variable-bit length character basis, affording the Computer the ability to operate on both fixed or variable length data and variable-bit-length characters.

The basic cycle is 1.5 microseconds, during which time a word or half-word may be addressed, transferred into the memory register and regenerated in its original place in storage.

input-output transfer channels

RCA 601 computers communicate with on-line input-output devices through input-output transfer channels. The channels contain logic for execution of input-output inde-

ARTHUR S. KRANZLEY was named *Manager, Product Planning and EDP Methods, RCA Electronic Data Processing Division,* in August, 1960, giving him combined responsibility for the two fields in which he has guided many of the Radio Corporation of America's activities that have helped earn its reputation as a leader and innovator in EDP. Kranzley, who earlier this year was appointed manager, Product Planning, in the RCA Electronic Data Processing Division, joined the Radio Corporation of America in 1953. From his initial assignment with RCA in Bizmac engineering as an applications analyst on RCA's pioneer large scale of EDP system installations, Kranzley advanced to responsibility for all analysis and programming support activities in RCA's EDP Division, following his appointment in 1958 as Manager of EDP Methods. While associated with RCA, from 1953 to 1957, Kranzley was a lecturer at Drexel Institute of Technology Graduate School where he introduced a course titled "Business Electronics" which was the first EDP course in a business administration graduate school. From 1950 to 1953, he was associate Research Engineer in the New Products Division of the Burroughs Research Center in Philadelphia where he was engaged in field studies of potential applications for EDP equipment.



pendent of the basic processing unit in the Computer, and also contain buffer storage for incoming and for out-going information. In general, an input-output transfer channel permits one or more of the appropriate input-output devices to be operated concurrently with other computer operations. The 601 input-output transfer channels can be added to a 601 computer unit at any time without modification of the computer circuits. Transfer channels can be added to permit the possible operation of as many as 16 input-output devices simultaneously.

Magnetic tape transfer channels are provided to permit the Computer to control, write, and read information from tape stations. Simultaneous operation of two tape stations per channel is afforded with one station reading, another writing concurrent with transfer channel and computer operation. Buffering is provided to permit two-level word length storage from which characters are written to or read from magnetic tape for each station. Parity is checked or generated on all data which is received or transmitted.

Two models are provided. The Magnetic Tape Transfer Channel, Model 610, handles Tape Stations of the RCA 500 series, i.e. 22 kc, 33 kc, and 67 kc tapes. The Magnetic Tape Transfer Channel, Model 611, handles the Tape Stations, Model 681, which operates at 120,000 alphanumeric characters per second. This model provides for automatic execution of a read after write check.

The Printer Transfer Channel, Model 612, permits the Computer to operate the On-Line Printer, Model 632, concurrently with other computer operations.

The Card Transfer Channel, Model 613, is provided for operation of the Card Reader or Card Punch on-line to the Computer.

The Paper Tape Transfer Channel, Model 614, permits the Computer to receive data from 5- or 7- level paper tape and to punch paper tape in a 5- or a 7-bit code.

The Inquiry Transfer Channel, Model 617, permits the connection of up to four Inquiry Consoles to the Computer. It provides a path for the transfer of information and command signals. The command signals cause the Computer to initiate a routine that performs supervisory action or that locates desired information which is printed on the associated monitor printer provided with the Inquiry Console.

input-output switching units

One or more input-output switching units can, in general, be connected to an input-output transfer channel, permitting the channel to be shared by a number of input-output devices. Switching units also can be combined in configurations, permitting multiple input-output transfer channels to be shared by a group of input-output devices.

Two Electronic Tape Switches, Models 640 and 641, permit Magnetic Tape Stations to be connected to Magnetic Tape Transfer Channels; the Model 640 to Model 610 Transfer Channels, and the Model 641 to Model 611. Each permits simultaneous operation of up to four from a group of six tape stations (two reading, two writing). Electronic Tape Switches may be interconnected to permit additional groups of six tape stations to be connected to the same two magnetic Tape Transfer Channels, or additional transfer channels to be connected to a given group of tape stations.

on-line input-output devices

On-line input-output devices can be added to a 601 computer unit at any time through appropriate input-output transfer channels and switching units.

The Inquiry Console, Model 607, is an on-line device into which criteria may be entered via a keyboard to initiate a computer search subroutine. When the desired record is located by the Computer, information is typed out on the monitor printer associated with the Inquiry Console. Those are limited only by the particular computer subroutine initiated.

The Paper Tape Reader, Model 621, provides paper tape input for the Computer. This unit will read punched paper tape under command of the Computer at the rate of 1,000 characters per second.

The Card Reader, Model 623, is an on-line computer input device which automatically reads information punched in 80-column cards, at a rate of 600 cards per minute.

The On-Line Printer, Model 632, is an on-line computer output device. It provides the mechanism to print a line of up to 120 characters on edge-perforated paper at a basic rate of 600 lines per minute.

The Card Punch, Model 634, is an on-line Computer output device. It provides the mechanism required to record data in the form of punched holes in an 80-column card at the rate of 100 cards per minute.

The Magnetic Tape Station, Model 681, is a transistorized unit which is used for reading and writing binary-coded characters on magnetic tape in response to applied control signals. Recording is parity checked by reading each character after it is written. Reading and writing are accomplished up to the rate of 120,000 alpha-numeric characters per second.

601 programming features

One vogue in the majority of recently announced computing systems is the relative brevity of program statement, contrasted to systems currently in common use. Factors contributing to these concise programs are said to be powerful, well-integrated order codes, complex address modification capability, flexible addressing schemes, and variable instruction length.

Provision for variable length data has been made since early electronic computers and the similar motivations of efficient memory utilization and the elimination of "filler" material have extended this to include also those bits in memory which direct the control unit of the computer.

In the 601, "variable instruction length" means that instructions may be either one, two, three or four half-words in length. (Input-output instructions are an exception to this rule and may be up to six half-words in length.) A unit data length in the 601 is either a word or half-word or a character. One of these, the half-word of 24 information bits is the unit length for instruction.

There are two general types of 601 instruction half-words, an **operation** half-word and, appended to it, three or fewer **address** half-words. A distinction has to be made between the number of addresses contained in an instruction and the number of addresses utilized as an integral part of the execution of an instruction.

Each instruction type utilizes a fixed number of these address registers. For example, a move utilizes two address registers, multiply utilizes three, etc.; and frequently those are the number of addresses written in that instruction. However, the address registers utilized by an instruction have their contents augmented by one data length unit. This value of the address register is often the appropriate value of the register for the operation of the next instruction. In this case, the latter address need not be written in the program statement.

Three bits in the operation half-word of an instruction specify whether or not an explicit address is written following the operation half-word. Thus, fewer addresses than used by the instruction may be written, and the remaining addresses are said to be "assumed."

Another instance in which explicit addresses are not written occurs when the accumulator is being used in arithmetic operations. Again, three bits in the operation half-word specify whether any or all of the operands refer to the contents of the accumulator.

addressing flexibility

A unique and powerful addressing flexibility is incorporated in the address half-word. The 24 bits of this half-word are divided as follows: an address part of 19 bits (15 to addressing 2^{15} words, a 16th to address half-words, and three bits to address characters within the half word), one bit used to designate indirect addressing, and the four remaining bits used to address any of eight address modifiers.

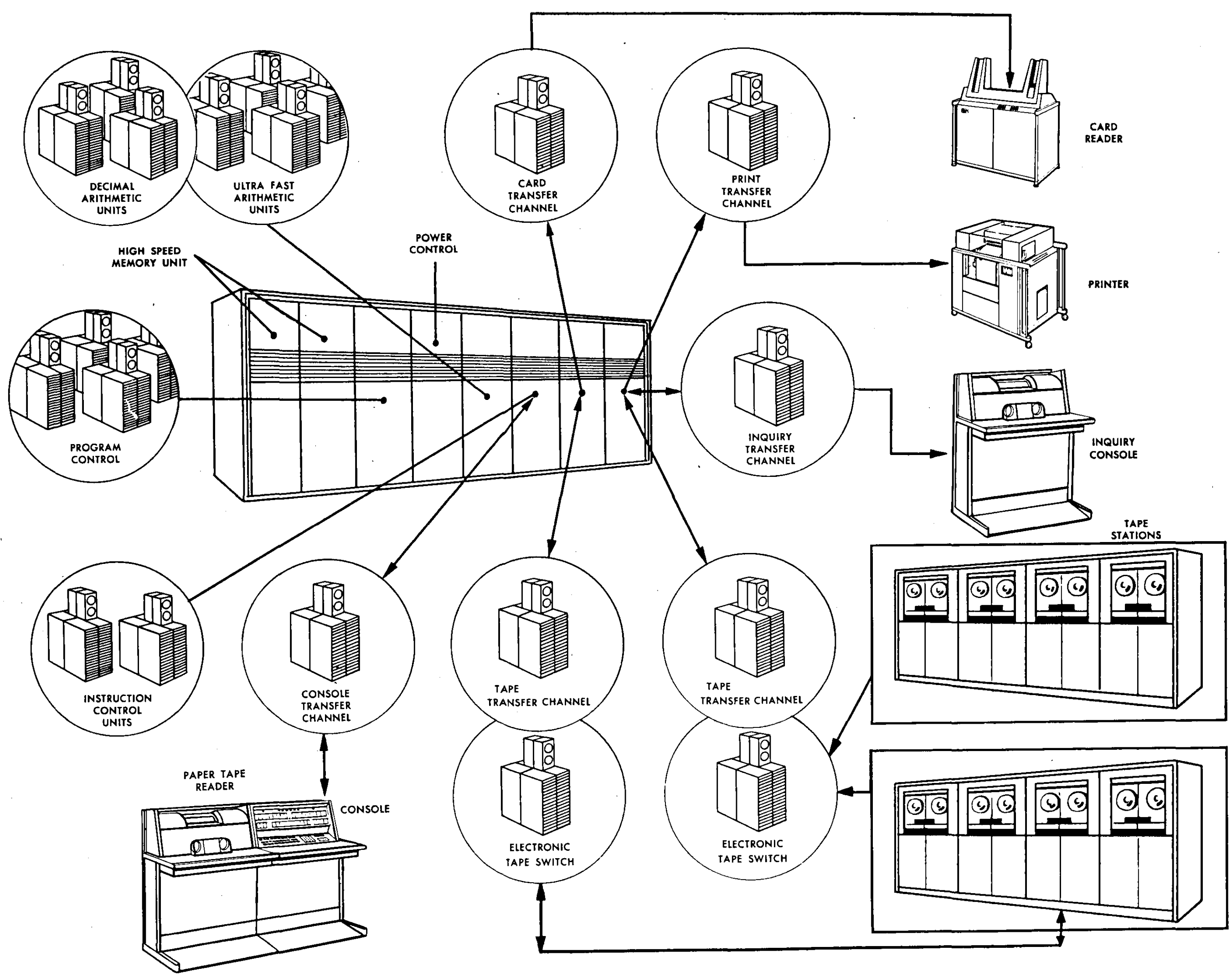
Applying both address modification and indirect addressing to an address would normally require an arbitrary order of precedence. However in the RCA 601, whenever an indirect address is specified, it selects another half-word in which is contained another address. The three bits used for character addressing in this case therefore might be superfluous but are used instead for the following:

1. To control address modification on the indirect and direct level, such as to permit dual address modification on the direct address.
2. To inhibit address modification on the direct level.
3. To inhibit subsequent indirect addressing.

Seven of the address modifiers are a full word in length, where the left half-word is the value part applied to an address when selected, and the right half-word is an increment part selectively added to the value part. This selectivity is gained by providing two addresses for each address modifier, one of which causes an automatic incrementing to take place. This accounts for the generous use of four bits to select eight address modifiers.

Efficient data encoding is carried a step further in the 601's character handling capability. Four different character sizes may be directly addressed and manipulated, namely lengths of three, four, six and eight bits. A character-length register is loaded with the appropriate size with a half-word set register instruction. Until this is reloaded, all subsequent character handling operations will operate on characters of the designated size. Other than character handling operations will not be affected. Thus sequences of decimal digits are normally handled in four-bit characters, alphanumeric data in six-bit characters, etc., making for efficient tape and memory storage.

Sets of indicators are provided in the RCA 601 to provide a parallel decision-making ability concurrently with the running program. Conditions sensed include arithmetic underflow and overflow, error conditions, unsuccessful scanning operation result, positive, negative or zero and a binary indicator specifying whether a logical connective yielded zero, etc. A programmer set mask is associated with each indicator to permit or inhibit an automatic branch whenever the condition is encountered. This feature permits minimizing the length of repetitive loops by eliminating explicit sensing each time for rare conditions.



DATAMATION *news briefs*

DATA TRANSMISSION STUDY BEGUN IN SO. CALIFORNIA

Representatives of seven major Southern California companies in the aerospace industry have formed a private study group to investigate their common requirements for high-speed data transmission (10 thousand to 1 million bits/sec) and source data acquisition. Initially the group will focus on highspeed transmission only.

Objectives of the group will be discussion of a total system approach to data communication problems, development of reasonably uniform requirements for equipment and service, and forecasting of long range needs. Jack A. Strong, administrator of integrated data processing, North American Aviation, was elected chairman. For information contact the study group's secretary Justin A. Perlman, Assistant to the Director of Corporate Industrial Dynamics, Bldg. 6, Mail Station X2025, Hughes Aircraft Co., Culver City, Calif.

G-20 USER GROUP MEETS

The Bendix G-20 Users Group met on July 6, in South Bend, Indiana. Approximately 50 representatives attended. George Brown of the host city was named acting chairman. The meeting was devoted to analysis of programming systems for the G-20 computer. The next meeting will be held in Los Angeles in the latter part of the year.

C-E-I-R, RCA PLAN DETAILED NOVEMBER ELECTION COVERAGE

C-E-I-R, Inc., recently announced the results of its year-long effort with the Radio Corporation of America to prepare the RCA 501 computer to process the 1960 Presidential election returns for the National Broadcasting Company, and to make continuous projections of the outcome as soon as the voting booths close in the first state.

The computer will project the winner of the Presidential race, the electoral vote split, the total popular vote, and the popular vote split. Three projections will be continually updated throughout election eve as each new batch of returns comes in and is fed into the computer.

SAGE COMPUTER PROGRAMS DESIGNED FOR MITRE BY SDC

System Development Corporation has signed a $1.3 million dollar subcontract with MITRE Corporation for the preparation of special SAGE computer programs to be used for advanced experimentation on automatic air traffic control.

The computer programs which SDC will design and produce incorporate new procedures for automatic decoding and error checking of flight plan messages, new logics for air surveillance, and, special, flexible all-purpose conflict detection schemes to sense and warn of any unsafe miss distances between aircraft.

WESTERN JOINT COMPUTER CONFERENCE CALLS FOR PAPERS

Technical papers at the 1961 Western Joint Computer Conference (Los Angeles' Ambassador Hotel, May 9-11) will be presented in the areas of systems, applications and circuitry for both digital and analog computers, C. T. Leondes, program chairman for the annual conference, has announced.

Calling for papers from technical and academic personnel, Leondes cited the conference's theme, "Extending Man's Intellect" to emphasize the role that computers have played in scientific, technical and business advances in recent years.

Leondes expects papers in a wide range of subjects including medical uses of computers, automatic programming, pattern recognition, automation theory, language data processing, thin film memory devices, cryogenic devices, large scale computer systems, neural models and solid state devices and circuits.

Detailed summaries of papers should be submitted by December 15, 1960 to C. T. Leondes, Associate Professor of Engineering, Department of Engineering, University of California, Los Angeles 24, California. Conference chairman is Dr. Walter F. Bauer and exhibit arrangements are being handled by R. H. Hill. Both are employed by Thompson Ramo Wooldridge, Inc., 8433 Fallbrook Ave., Canoga Park, Calif.

MEMORY SYSTEM FOR SPACE DESIGNED BY LOCKHEED'S MSD

A high capacity memory system for space vehicles records one million two hundred thousand bits of information per minute and reads back eighteen times as fast as it is recorded. A memory system of this nature has been used in the Discoverer satellite series. It was designed by Lockheed Missile and Space Division to provide accurate data recording for space probes and satellite flights during those times when direct radio contact with the vehicle is lost.

Circle 101 on Reader Service Card.

BURROUGHS WILL DELIVER 50 SORTER-READERS IN '60

With the U.S. financial industry's new common language program rapidly gaining momentum, Burroughs Corporation will deliver nearly 50 electronic sorter-readers to some 25 banks before the end of the year. Orders are being filled against a backlog of $6,500,000 as soon as banks are ready to receive the equipment. Several institutions will take delivery of two to four units this year.

Circle 102 on Reader Service Card.

AUTONETICS ARMY CONTRACTS TOTAL CLOSE TO $3 MILLION

Contracts entailing more than $2,750,000 have been received from the U.S. Army by Autonetics. This includes a major contract for work on FARAC, whose primary role is that of an automatic computer for quickly solving the gunnery problems involved in enemy targets under variable conditions of weapons and weather. This computer features a simplified control section labeled in the working language of a gunnery problem.

Circle 103 on Reader Service Card.

NYU DIVISION TO OFFER NINE SPECIAL COMPUTER COURSES

The Management Institute of New York University's Division of General Education will offer an expanded program of specialized courses this fall. These nine courses are designed for those who require basic orientation or specific training in programming the computers of leading manufacturers. The Institute will also offer an extension program in the management of punched-card data-processing, as well as courses in control-panel wiring.

✔Valley National Bank, Phoenix, has ordered a General Electric 210 computer to coordinate electronic check-processing equipment to be installed in its recently-announced new operation center. It will be combined with Intelex document sorters for processing bank checks, computing account balances and proofing and transit operations.

Circle 104 on Reader Service Card.

✔The First National Bank of Arizona has become the state's first bank to process checking accounts with an electronic data system using Magnetic Ink Character Recognition. At the same time, it was announced that General Electric Company's Computer Department has opened the nation's first MICR computer bureau.

Circle 105 on Reader Service Card.

✔Bruno-Lenchner, Inc., Pittsburgh, stockbrokers, in conjunction with the Monroe Calculating Machine Co., Orange, N.J., have installed the Monrobot Mark IX, a computer expressly programmed for an investment firm. The new machine computes a trade in fractions of a second, detailing the type of stock traded, the number of shares bought or sold, the price of the trade, the name of the customer, the name of the stock and the tax and commission assessments.

Circle 106 on Reader Service Card.

✔The Systems Division of Beckman Instruments, Inc., Anaheim, Calif., has received a $1,100,000 contract from Lockheed Aircraft's Missiles and Space Division for two high-speed data processing systems which will be used in conjunction with the current Air Force Satellite programs. The systems will control data flow between globe-circling satellites and the earth.

Circle 107 on Reader Service Card.

✔The A. B. Dick Company has opened a new research and development laboratory in Palo Alto, Calif. The expansion was due mainly to the success of a high-speed electronic process, Videograph, capable of translating computer language and printing or displaying the resulting information at rates up to 20,000 letters, numbers and symbols per second.

Circle 108 on Reader Service Card.

✔Recomp computers have been recently leased to the National Aeronautics and Space Administration, Washington; Aerojet-General Corp., Sacramento; John E. Fast Co., a subsidiary of the Victoreen Instrument Co., Chicago, and the Argonne National Laboratories, Lemont, Ill.

Circle 109 on Reader Service Card.

"The Burroughs 220 Computer is a Potent Tool in Advancing Our Technology."

Dr. Charles D. Alstad, *Acting Director, Computations Research Laboratory,* The Dow Chemical Company

Why do it? There are many common denominators between the global Dow of 1960 and the infant Dow of 1897. Perhaps the most important one is a business philosophy stated by founder Herbert Henry Dow. He put it this simply: "If you can't do a thing better than it's already being done, why do it?"

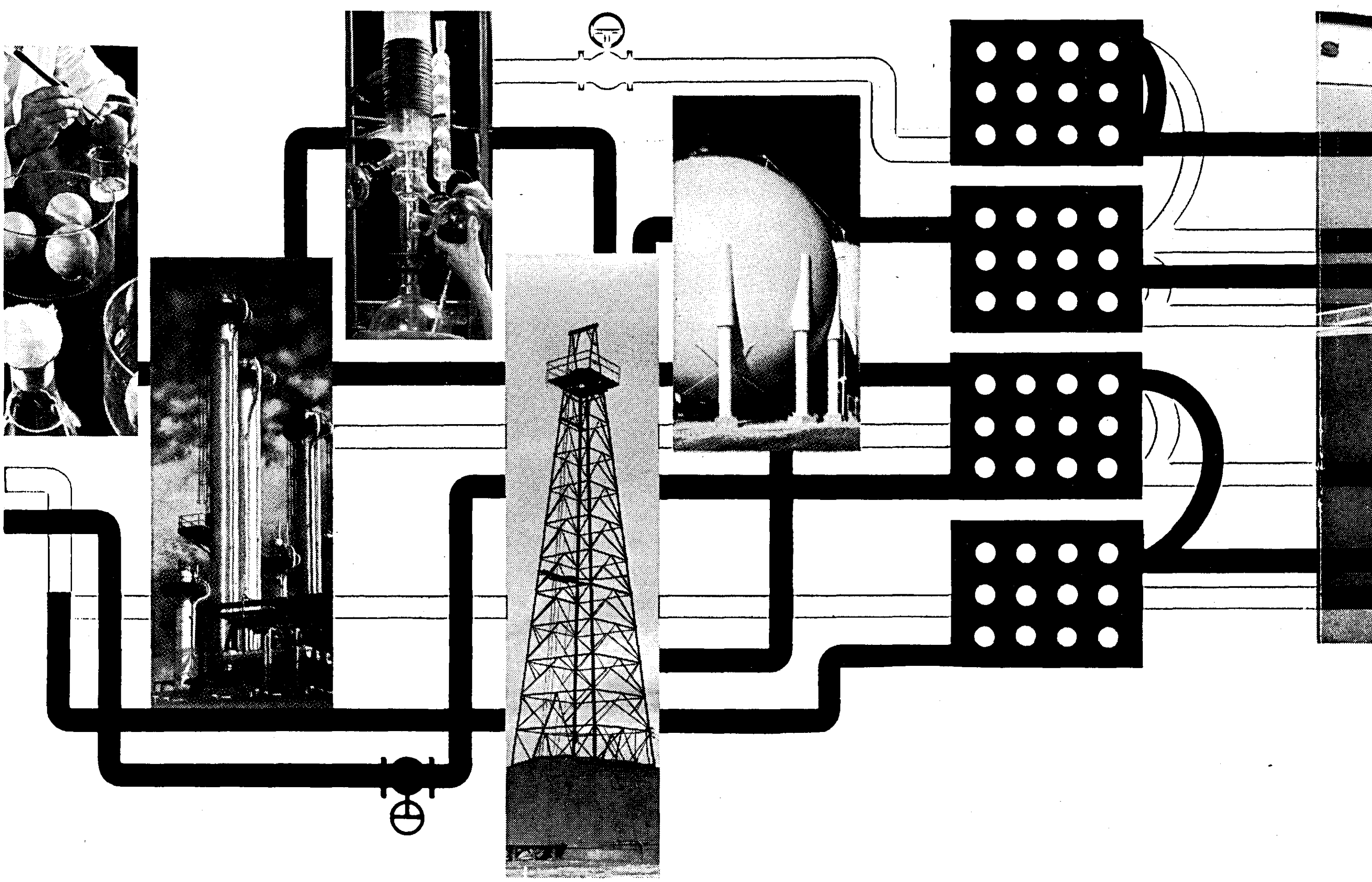
Under this pervading philosophy, Dow places heavy emphasis on new product research and operations research. And to help push advances in these areas farther and faster at less cost, Dow uses a Burroughs 220 Computer System.

THE BURROUGHS 220 AT DOW

This 220 system consists of the data processor with 5,000-word core storage, two supervisory printers, photoreader, two paper tape punches, three magnetic tape storage units, and a Cardatron sub-system for controlling punched card input and output. Selected for its greater capacity and speed, the 220 is one of two Burroughs Computers at Dow. The other: a Burroughs 205 Computer at Dow's Freeport, Texas, operation.

The 220 computer is at work in Dow's Computations Research Laboratory in Midland, Michigan, headquarters for the firm. As Acting Director Dr. Charles D. Alstad puts it, "Our use of the 220 is in scientific and engineering applications, where it is an important adjunct to all the scientific talents available at Dow."

Super screener. For example, Dow uses the computer as a screening tool in the development of higher energy solid rocket fuels under its contract with the Advanced Research Projects Agency. In pursuit of project goals, Dow chemists can envision many fuel combinations. But they can't, of course, subject each combination to exhaustive laboratory tests. Through the Burroughs 220, Dow gets all data necessary for preliminary evaluation of a fuel and gets it in anywhere from two minutes to a half hour. In this way, Dow scientists can select only the most promising combinations for laboratory evaluation, development and testing.



Turbine tamer. In another application, Dow uses the 220 in calculating turbine efficiency tests. The calculations, which were formerly performed by hand, took at least two weeks but now require less than five minutes on the computer.

Designing for profit. Plant design is another function of the 220. In today's hotly competitive chemical industry, it's essential to keep the cost per pound of product minimized. Consequently, a plant must be carefully designed for a specified capacity, minimum capital investment, and efficient operation. The computer is a useful tool in striving for these objectives.

Care and feeding of production. In an extension of plant design, Dow uses the 220 for plant simulation, using either a derived statistical model or a theoretical model to study an existing plant. The information obtained is valuable to Dow in maintaining quality of product and efficient use of facilities.

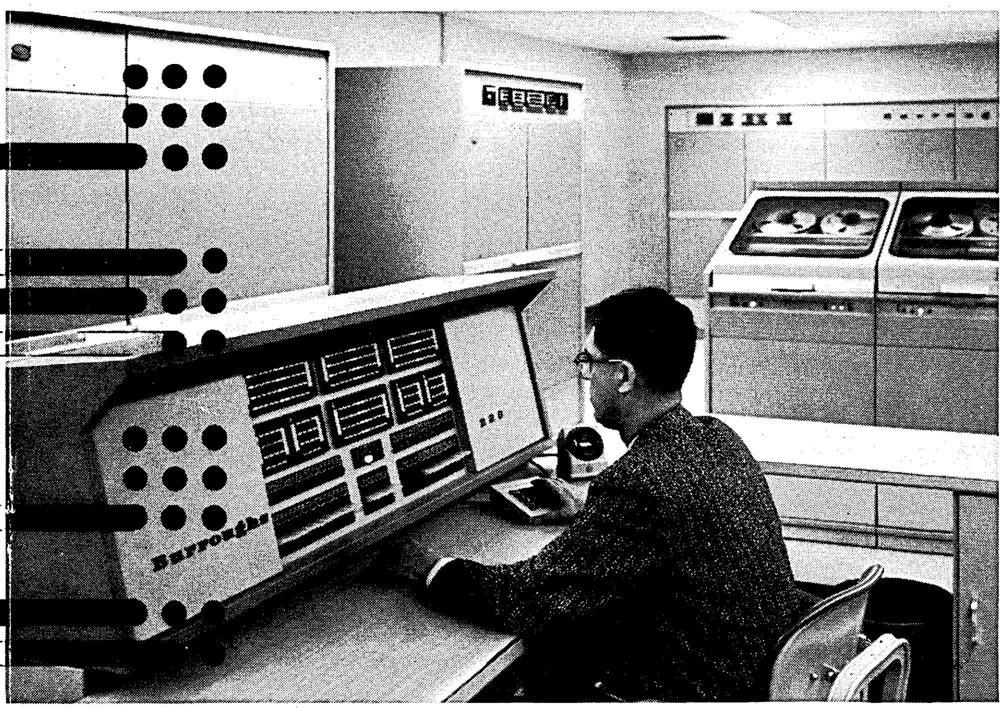
Dr. Charles D. Alstad

Masterminding molecules. The 220 at Dow is busy in pure research, too, where it is helping to advance the frontiers of science. For instance, Dow is investigating the bonding forces and links between the atoms in a molecule. And the Burroughs 220 performs the Urey-Bradley Force Constants Calculations that are required. These studies will supply the knowledge which will allow Dow scientists to make predictions on how a given chemical will behave in a reaction.

Long and short of it. There are many other aspects of the 220's work at Dow, such as its evaluation of pilot plant projects, information retrieval and other routine mathematical calculations. "Fundamentally," says Dr. Alstad, "our Burroughs 220 computer is a potent tool in advancing our technology. From the range of applications, you can get an idea of the computer's value to us. And you can see why we are most enthusiastic about the results and the potential of the digital computer in research and engineering applications."

FROM LITTLE, MUCH

Take five basic raw materials: sea water, brine, coal, petroleum, oyster shells. Add the talents, skills and knowledge of 29,000 people. Add generous helpings of research and progressive management attitude. Apply plants located throughout the world. And you get over 700 products in five categories: industrial chemicals, plastics, metals, agricultural chemicals, textile fibers. That, in brief, is Dow, the nation's fourth largest chemical company (1960 sales: $781 million).



Computer Operator Ray L. Haeusler at console of 220

The hundreds of other scientific and commercial users of Burroughs computers are getting equally impressive results, too. One reason is the capability of the equipment in Burroughs complete data processing line. Another reason is that the equipment is backed by a coast-to-coast team of computer specialists, who are primed to show you how thoroughly and efficiently they can help you. For information, write Burroughs Corporation, Detroit 32, Michigan.

Burroughs Corporation Burroughs *"NEW DIMENSIONS / in electronics and data processing systems"*

Circle 19 on Reader Service Card.

NEWS BRIEFS . . .

✓The Barber-Colman Company of Rockford, Ill., has contracted with Philco Corporation for the lease of a Philco 2000. The computer will be used for business data processing and is scheduled for delivery within the next 18 months.

Circle 110 on Reader Service Card.

✓RCA states that the first data processing center to serve the business community in Chicago will be opened early this fall in the Morton Building. The electronic data processing center will be the fourth in a network being created by RCA.

Circle 111 on Reader Service Card.

✓The U.S. Army Corps of Engineers is installing more than $1 million worth of Collins Radio Kineplex Data Communication equipment as part of a nation-wide high-speed data communication network. The equipment includes five complete Kinetape magnetic tape transmission systems plus 14 additional TE-206 data modems.

Circle 112 on Reader Service Card.

✓Packard Bell Computer Corporation has delivered an analog-to-digital conversion data processing system to the U.S. Naval Shipyard at Brooklyn. The system is used to gather data in real-time and convert it to digital form.

Circle 113 on Reader Service Card.

✓ATCOM, an air traffic compiler designed for compatibility with the Air Traffic Control Data Processor, has been developed by Applied Data Research of Princeton. The system does its compiling operations in two passes on an IBM 709, provides magnetic tape copies of the completed program to be read by an RW 300, which, in turn prepares punched paper tapes in the required ATCDP format.

Circle 114 on Reader Service Card.

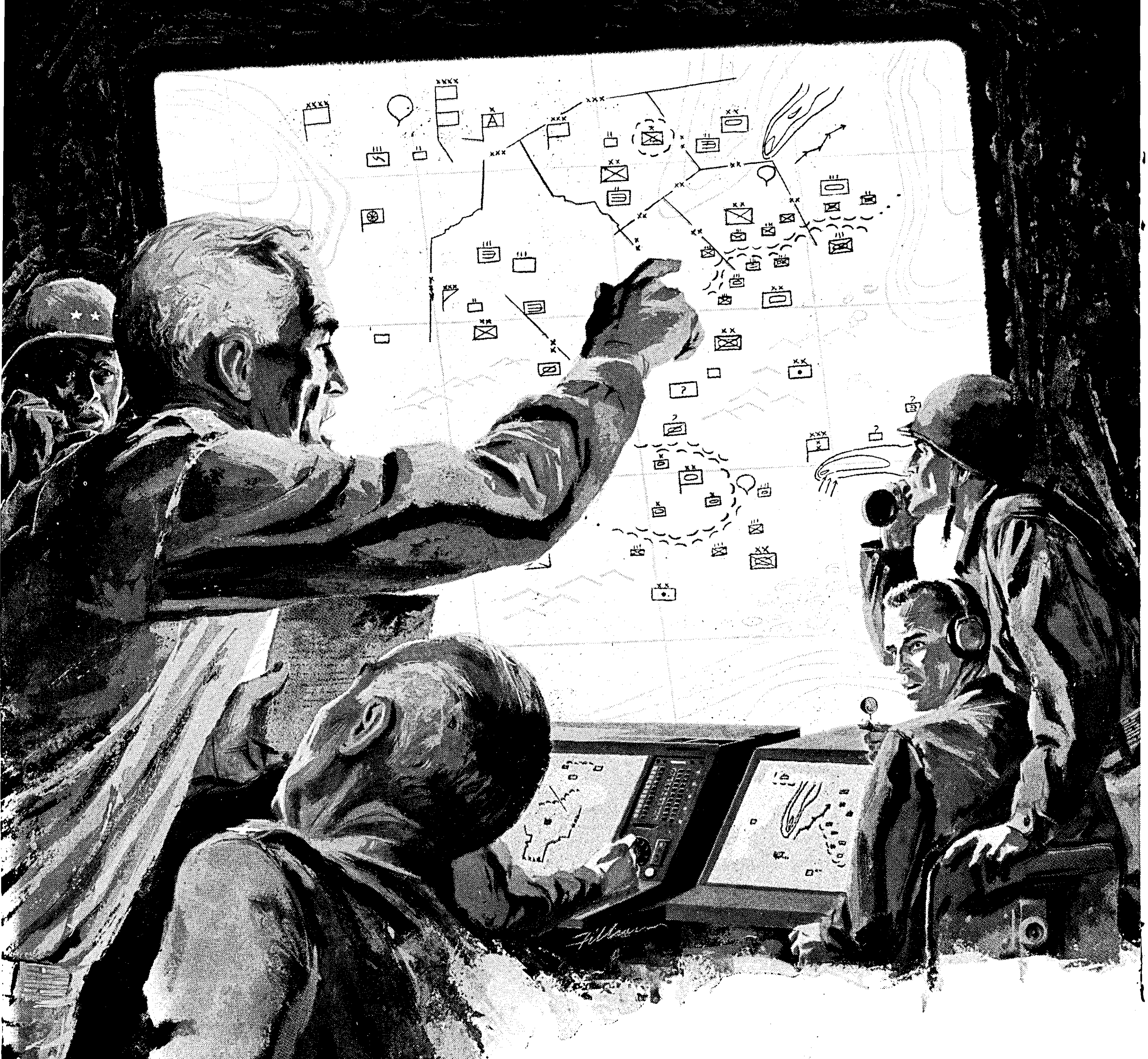
✓The RCA 501 Users Association observed its first anniversary in August. The association, with 36 members, represents such fields as banking, public utilities, government agencies, insurance, manufacturing and brokerage.

Circle 115 on Reader Service Card.

✓An 1105 computer at Armour Research Foundation of Illinois Institute of Technology has started converting the decennial "head count" to facts and figures. This machine is one of several being used in connection with the 1960 census. The task of logging all the decennial census information is expected to take two years, compared with four years of work required for the 1950 census.

ARTOC

THE COMMANDER'S ELECTRONIC ASSISTANT



ARTOC . . . the Army Tactical Operations Center . . . mobile electronic command post geared to the stepped-up pace of tomorrow's battleground. ARTOC . . . a synthesis of the newest techniques in communications, electronics and data processing . . . gives the field commander a comprehensive, up-to-the-minute visual display of the battle situation . . . helps him make the right decision at the right time.

• DATES

• The Institute of Radio Engineers will hold their 13th Annual Conference on Electrical Techniques in Medicine and Biology at the Sheraton-Park Hotel, Washington, D.C. Oct. 31-Nov. 2, 1960.

On Tuesday morning, Nov. 1, a session on digital computers will take place. Papers for this session include: "Introduction to Digital Computers and Automatic Programming," "The Use of Computers in Medical Research at the National Institutes of Health," "Problems arising in the Digital Interpretation of ECG Data," "Recording of Bioelectronic Signals for Digital Computer Analysis," "A Digital Computer Program for Simulating Chemical and Biological Systems," "Computer Simulation of Reactions between Bound Chemicals," and "Automatic Programming to Assist Simulation."

• The 7th International Meeting of The Institute of Management Sciences will be held at the Hotel Roosevelt, New York City, October 20-22. The opening address, "Information Processing and Management Science," will be presented by George W. Brown, Director, WDPC, at UCLA.

First of the six sessions, entitled Computers and Simulation Techniques, will include six papers on: Simultaneous Programming of Computers, Data Flow Model, Optimization and Assembly Line Balancing, A Formal Method for Systems Design, Evaluation of Production Scheduling by Simulation, and Simulation of a Production & Inventory System.

• "Current Developments in Automatic Data Processing Systems" will be the theme of the Seventh Institute on Electronics in Management to be held at The American University, Washington, D.C., from October 31 through November 4. Institute sessions will be held at the Downtown Center of the University from 9:00 a.m. to 4:30 p.m. daily.

• Four hundred and fifty participants are expected for the Third Annual Northwest Joint Computing Conference September 30 through October 1 at the Multnomah hotel in Portland, Oregon. The program will include numerous speakers and a series of workshops.

Exhibits of latest data processing machines and related equipment will be on display throughout the two-day conference, and will be open to the public without charge.

• The 1960 Computer Applications Symposium is scheduled for October 26 and 27 at the Morrison Hotel in Chicago. The symposium, sponsored by Armour Research Foundation, will be divided into two parts: Business and Management Applications on October 26, and Engineering and Scientific Applications on October 27. Common computer programming language for cooperative computing centers will be one of the problems discussed.

Postal System Input Buffer Device

by ROBERTSON OSBORNE, Joe & Gil,

Burroughs Corporation

ALTHOUGH NO PUBLIC ANNOUNCEMENT of the fact has been made, it is known that the United States Post Office Department for some time has been installing Postal System Input Buffer Devices as temporary information storage units on pseudo-randomly selected street corners. Several models are in use; some older ones are still to be found painted a color which may be described as yellow-greenish in hue, low saturation, and low in brilliance, but a significantly large proportion are now appearing in a red, white, and blue combination which seems to provide greater user satisfaction although the associational-algebra value-functions remain obscure. Access to the majority of these devices is from the sidewalk, although a recent modification (including a 180-degree rotation about a vertical centerline) makes some of them accessible from an automobile provided that the vehicle is equipped with either (a) a passenger in normal working condition, mounted upright on the front seat, or (b) a driver having at least one arm on the right-hand side which is six feet long and double-jointed at the wrist and elbow. Figure 1 shows a typical sidewalk-access model Postal System Input Buffer Device.

OPERATION

Most normal adults without previous experience can be readily trained to operate the machine. Children and extremely short adults may find it necessary to obtain assistance from a passerby[1] in order to complete steps 4 (Feed Cycle) and 6 (Verification), or both. The machine is normally operated as described below.

1. Position of Operator. Locate the Control Console (see figure 1). Stand in front of the machine so that the control console is facing you.[2]

2. Initial Setup. Grasp the Multi-Function Control Lever (figure 1). This lever performs several functions, each being uniquely determined by that portion of the Operation Cycle during which it is activated. The lever may be grasped with either hand. With the other hand, position the input in preparation for step 4 (Feed Cycle).

3. Start Operation. Pull the Multi-Function Control Lever toward you until it is fully extended. It will travel in a downward arc, as it is attached to a mechanical But-gate hinged at the bottom. (The But-gate, so named because it allows but one operation at a time, is specially designed to make feedback extremely difficult.) Pulling the Multi-Function Control Lever at this time accomplishes an Input Buffer Reset and Drop-Chute Clear. These actions are of interest only to the technician, but are mentioned here in preparation for the following note.

NOTE: The lever should move freely. If it does not, the memory is full and cannot accept further information until it has been unloaded. The operator may elect to (a) wait for a Postal System Field Engineer (a "mailman") or (b) find another Postal System Input Buffer Device. If choice (b) is elected, refer to Description, above; also see figure 1.

WARNING: **Under no circumstances should the operator attempt to clear the unit**; loss of a ring or wristwatch may result. In extreme cases, some individuals have lost 30 years.

4. Feed Cycle. Visually check to see that the input area is clear. The input area may be recognized because it is totally dark and makes a 90-degree downward turn; obstructions are hence not visible under normal circumstances. While holding the Multi-Function Control Lever in the extended position, start the input feed by manually inserting the information package.[3]

NOTE: One particularly advantageous feature of the Postal Service Input Buffer Device is that, at this stage, the address field may be mixed alphanumeric (including special characters) and may be presented to the unit in normal format (reading left-to-right and top-to-bottom), backward, or even upside down.

5. Transfer Cycle. Release the Multi-Function Control Lever. The machine will now automatically transfer the input to the delay-box memory (delay-bag in some models). The operator will soon become familiar with the typical "Squeak" and "Clank" signals, provided on all models to indicate satisfactory operation of the But-gate. Actual transfer of the information, however, is not signalled unless the information is very densely packed, in which case a "Thump" signal may occasionally be heard.

NOTE: A "Boing" signal indicates that the information is unsuited to the Input Buffer Device and that a programming error has therefore occurred.

6. Verification. Pull the Multi-Function Control Lever again (see step 3), check to see that the Input Zone (figure 1) is clear (see step 4), and release the lever. This completes one full Operation Cycle. Additional cycles, when necessitated by large input quantities, may be initiated by returning to step 1 (above).

NOTE: Step 6 is not actually necessary for machine operation. The Postal Service Input Buffer Device has been designed to permit this step, however, to satisfy the requirements of the overwhelming "Post-Mailing Peek Compulsion" which affects most users of the unit and which has been linked by some writers[4] to the "Unsatisfied Sex-Curiosity" Syndrome.

1. In this context, "passerby" may be defined as a member of the set of human beings having a maximized probability of occupying the event space.
2. The Novice Operator Trainee may prefer to face the console.
3. Perhaps better known to some readers as a "letter" or "postcard."
4. Op. cit.

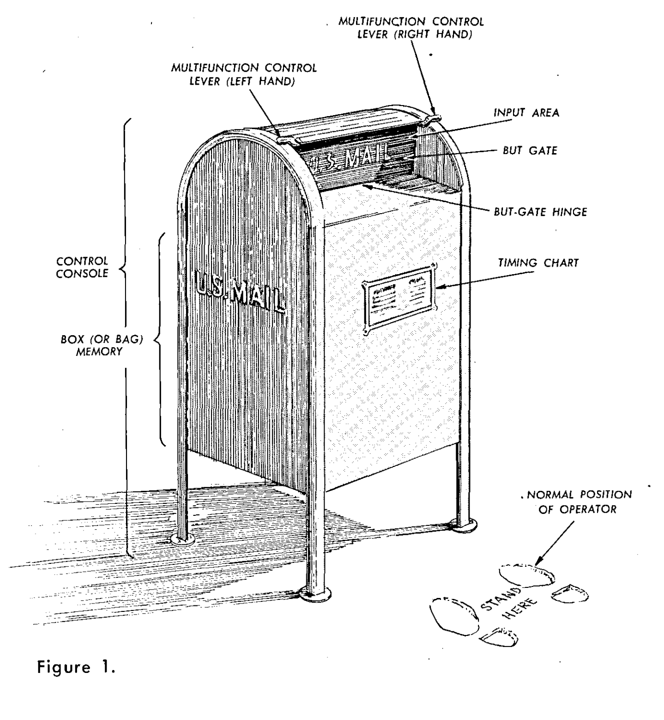
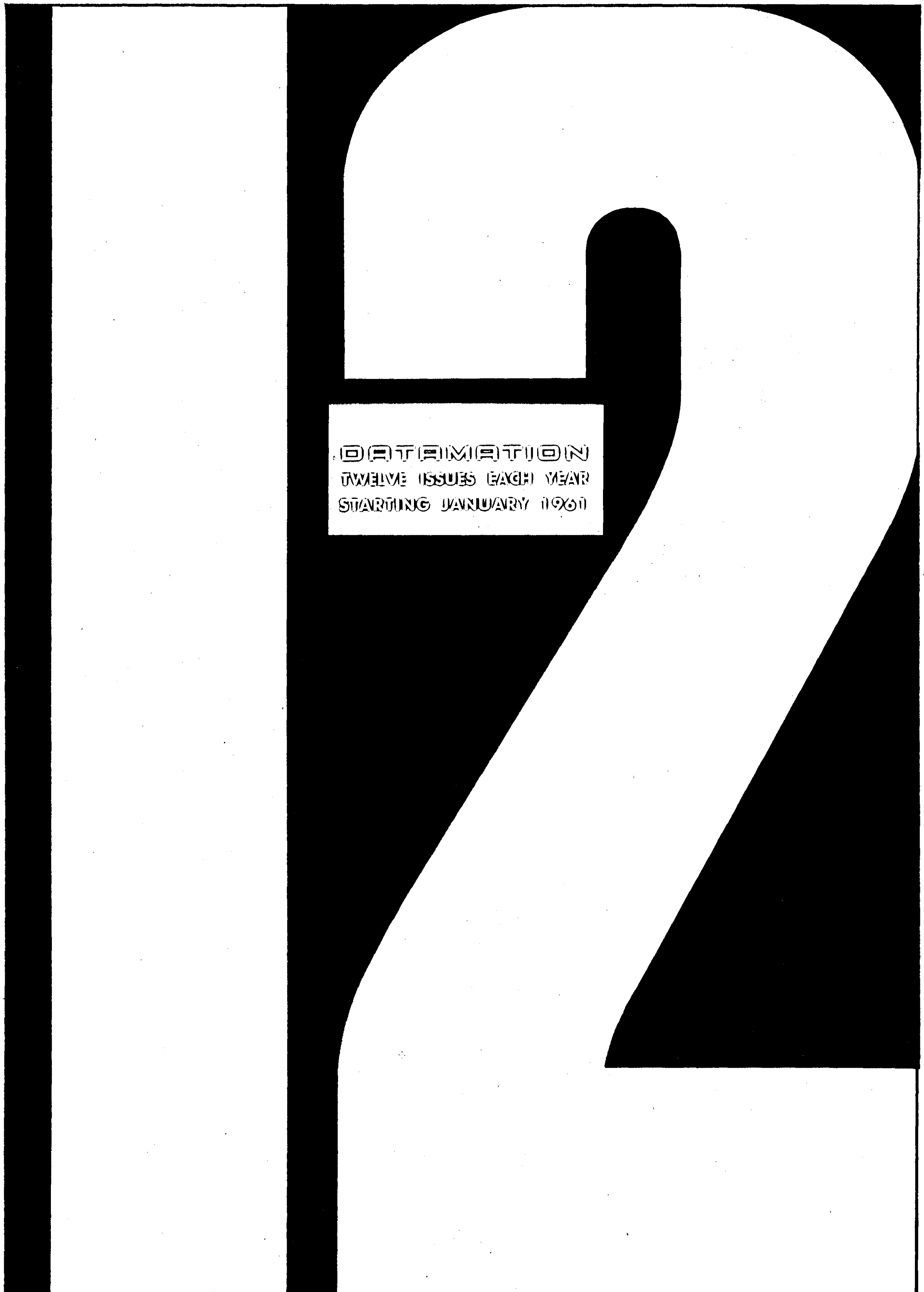


Figure 1.

Circle 24 on Reader Service Card.


DATAMATION
TWELVE ISSUES EACH YEAR
STARTING JANUARY 1961

People Moving Up In Datamation

★ Fortune Peter Ryan has been elected president of Royal McBee Corporation. He was formerly executive vice president and vice chairman of the board of directors of Royal McBee. He was president of the Royal Typewriter from 1951 until its merger with The McBee Co. in 1954.

★ Sigmund Schotz, formerly assistant to the president of the RCA Service Co., has been appointed administrator of staff programs for the Electronic Data Processing Division, Radio Corporation of America. He joined the firm in 1944 as a cost analyst.

★ Dause L. Bibby has been named president of Remington Rand. He succeeds Kenneth R. Herman who has moved up to the Sperry Rand central office. Bibby was executive vp of RemRand.

★ J. Paul Walsh has been appointed director of C-E-I-R's Arlington Research Center. Dr. Walsh was director of the firm's Space and Weapons Systems Div.

★ Donald K. Adams has been named director of liaison engineering for Cook Electric Company's new Trana-Digital Systems division, Franklin Park, Illinois. Prior to joining the firm, he was project engineer for the United States Army Electronics Environmental Test Facility.

★ Reinhard E. Rist has been named manager of computer transistor manufacturing for the RCA Semiconductor and Materials Division. An RCA employee for the past eight years, Rist formerly was manager, computer transistor production engineering.

An Explanation of ALGOL 60

by DR. IVAN FLORES, Consultant
Dunlap & Associates, Inc., Stamford, Conn.

THE COMPUTER ROUTINE MUST, IN GENERAL, perform four functions as shown in Figure 1, and listed below in what is hereafter referred to as The List.

1. The processing information, the machine language coding, must be stored in the computer.
2. The data must be stored in a fashion so that it is available to the computer.
3. The steps of the problem solution must be performed.
4. The answers must be produced in the proper format.

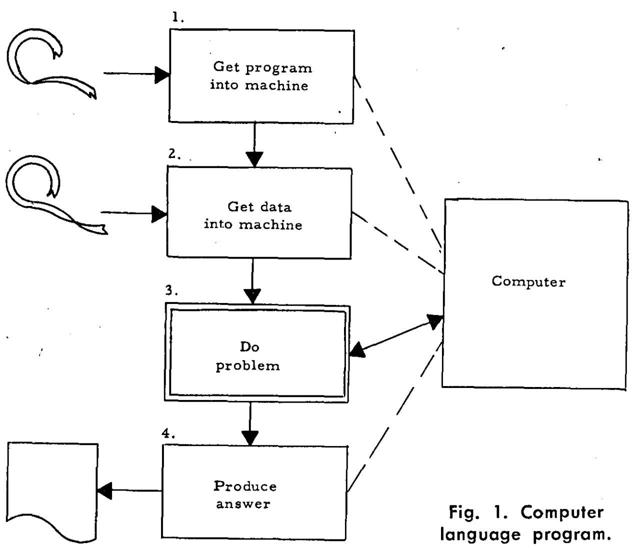


Fig. 1. Computer language program.

Problem solution can be broken down further. In processing information, the operations the computer performs can be classified as:

3a. Arithmetic (e.g., addition).
3b. Transportation of information (e.g., transfer from memory to a register).
3c. Editing of information (e.g., making 00004000 read as $40.00).
3d. Decision making or reflexive operations (e.g., go to a different location for the next instruction).

The kinds of processing to which the reflexive operations (3d) contribute are:

3d1. Looping—performing repetitive operations on more data.
3d2. Branching—doing one of several alternative operations according to one or more criteria.
3d3. Procedure specifying—a sublist of operations may be called forth by indicating a label.
3d4. Nesting— a means for placing loops within loops.

The items which appear on The List above provide a yardstick for comparing both machine languages and problem languages and it will be referred to for this purpose in the conclusions.

The compiler is a computer language routine which translates a problem language program into a machine language coding. The data which is processed is the problem language program as shown in Figure 2.

1. The problem-solving program is written in problem language.
2. The compiler program causes this input to be processed.
3. The computer produces four program output parts.
4. The output is the machine language program consisting of the four parts shown in Figure 1.

The input/output sections of the compiled routine are very similar from problem to problem; it is the processing section of the routine which is variable. Note that for a given problem, different machine-language coders could produce different processing codes. These might differ in several respects.

1. The sequence in which operations are performed.
2. Efficiency—the number of operations performed or the time required to perform them.
3. Flexibility—the ease with which the routine may be changed or adapted to a similar problem set.

For the compiler, a given problem statement will *always* produce a fixed coding. The design of the compiler will determine how close the speed and efficiency of the coding produced will approach or surpass that of the coding of a human coder. Of course, this also depends upon how good the human programmer is!

contents of machine language programs

Figure 3 shows diagrammatically all of the storage of a stored program computer. In the data section we find information which is supplied each time a problem is run, such as the constants, parameters, and range and accuracy of the variables. The intermediate results and the answers are also placed there during and after the calculations.

Almost all of the program material is in the form of commands to the computer to look at or process information in the problem data areas or the working storage areas. Frequently, however, commands themselves are processed as required in non-index-register address modification. Less frequently, an entry in the program storage is used solely for reference. It might be used as a comparand for a cycle criterion; it might be a tally; it might be an initializer (used to replace an already-modified command now called for in its original form).

For most programs, almost all the machine language entries are commands, most of which are used during the typical problem run.

During compilation the storage within the computer is as shown diagrammatically in Figure 4. The supplied data consists of the problem language program commands. The data created by the computer consists of machine language program commands required to run the problem.

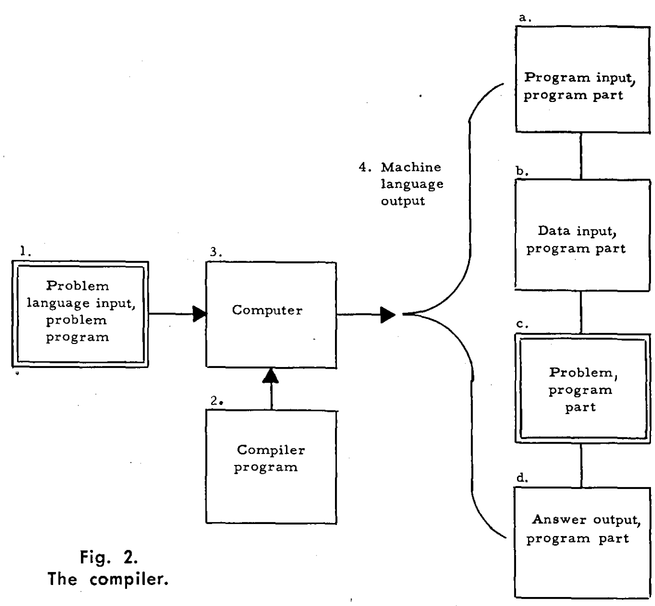


Fig. 2. The compiler.

In addition to the list of operations to be performed, the problem language routine must provide information about the *kind* of data being dealt with. Reference data in the problem language are a much larger portion of the input for the compiler than for a machine language problem. Every time data are to be manipulated, their size and kind are of crucial importance. This information

The purpose of this paper is to discuss the concepts which must be provided for in a problem language, and specifically in ALGOL 60. A problem language is a pseudocode which is intermediate between human language and computer language, thus facilitating the tasks of programming and coding. It should be easier to learn and to use than the machine language.

Programming is introduced and analyzed in the first section. The operation of compilers is then taken up.

The majority of this work is devoted to an explanation of the problem language, ALGOL 60 which is discussed in a tutorially convenient sequence in the next section. An example of coding in ALGOL 60 follows. The paper concludes with indications of the need filled by ALGOL and the areas which require further attention.

This work was performed in partial fulfillment of Contract AF 19(604) 6154 to the Operational Applications Office, Air Force Command and Control Development Division, Laurence G. Hanscom Field, Bedford, Mass. (This is the first of two installments.)

can only be obtained from the reference portion of the problem language coding.

This section discusses the design and use of problem languages and specifically refers to, and uses examples from, the recently-agreed-upon ALGOL 60.

what is ALGOL 60?

The letters of the language name stand for *ALGO*rithmic *L*anguage and "60" indicates that this is the 1960 version. This is a problem language which has met with agreement by both national and international computer groups including the IRE-PGEC,

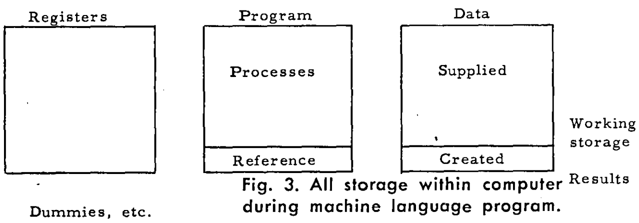


Fig. 3. All storage within computer during machine language program.

ACM, NJCC and GAMM. There are three levels within ALGOL 60 which are described below.

The *reference language* is the one which will be used in the future for writing universal algorithms. It is based upon facility of use and understanding rather than upon specific machine languages for extant computers. It should be the basis for the writing of compilers for both existing and future machines.

The *publication language* differs from the reference language only slightly in that the printers have available a larger set of symbols and so we may write "e^X" instead of "e↑ X," and so forth. The former is easier to read, for it is closer to English (or written language) than the reference language.

The *hardware language* uses the symbol set for a specific computer and differs from the reference language because the computer symbol set may be *smaller* or *different* or both. Thus, to express 3B, in the hardware language we may have to write 3 * B instead of 3 times B, or 3 **times** B instead of 3 times B. The hardware language is a transliteration of ALGOL and vice versa since the symbol sets of each (for any available computer) do not correspond (in form or quantity).

The reference language is universal enough to represent all the hardware languages and yet preserve the basic form of written language.

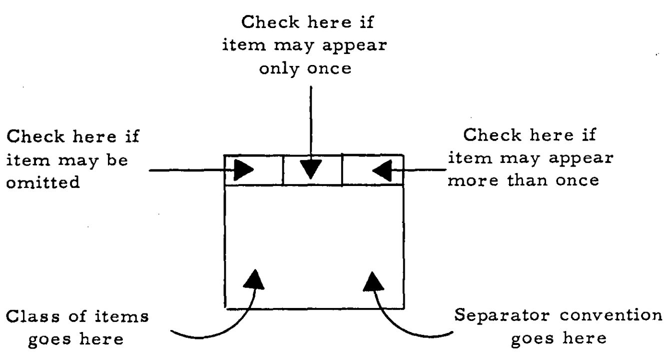


Fig. 5. The symbol box.

kinds of information

ALGOL and other problem languages use two kinds of sentences. Earlier in the explanation of Figure 4 we discussed reference information: we speak of declarations in ALGOL [5].[1] We also spoke of process information; in ALGOL we speak of statements [4]. All ALGOL statements must be terminated with a semicolon or **end,** a distinguishing feature.

Both declarations and statements are composed of expressions [3] and connecting symbols. The expressions are further composed of basic symbols [2] such as letters [2.1] digits [2.2.1] and so forth. We will consider these from the most complex to the simplest.

The way in which the elements of the language may be thrown together to make sense is called "syntax." These are the language construction rules. To make their understanding easier, a block diagram approach is used.

We begin with the symbol box shown in Figure 5. This is used to convey what a list may contain. Inside the box appears the name of the class of objects of which the list is composed. Across the top of the box are a set of three squares. The center square is checked if the box may be replaced by a single representative of the class, $\frac{1}{em}$ the list has only one item on it; the right hand square is checked if the box may be replaced by more than one

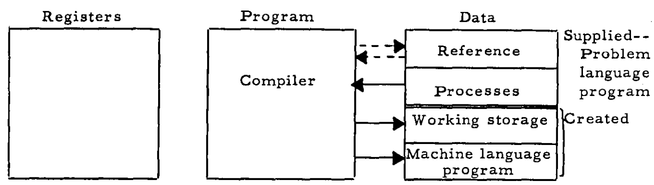
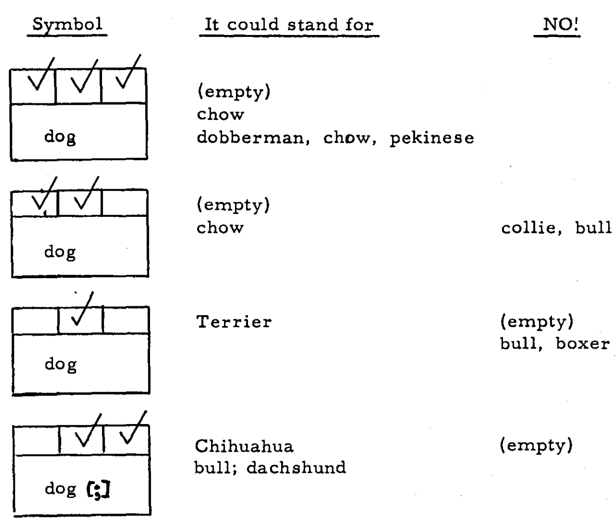


Fig. 4. Storage within computer during compiling.

representative of the class, a list of several items—in the latter case, a separator may be required as discussed below; if the left hand square is checked, the space which the box occupies may be left empty, $\frac{1}{em}$ the list is blank.

Following the class name within the box, a separator may be

[1]The number in brackets refers to the section number of latest publication on ALGOL: Naur, Peter, et al, "Report on the Algorithmic Language ALGOL 60," *Communications of the ACM* V3, No. 5, May 1960. Pp 299-314.



specified. The items in a list may be set off with commas as separators. For instance, if the separator is within brackets in the box, it indicates that the separator follows each class representative except the last; the separator is omitted if only a single class representative appears. Using the class of dogs, a number of simple blocks are shown as examples in Figure 5, together with lists which might be obtained from them.

For each entity which might occur in an ALGOL routine, a syntax block diagram may be devised. It consists of strings of boxes like those described above intermixed with punctuations, and special symbols but following a fixed format. When certain portions of the strings may be omitted or repeated within the main string, the three-square notation indicates this. A square bracket is placed over the string portion; there are three squares below the bracket which, when checked, indicate from left to right, the permissibility, respectively, of none, one, or several occurrences of this bracketed portion.

ALGOL symbols

There are special symbols to be used in the hardware language which stand for words such as "for," "begin" and so forth. These symbols are identified when printing ALGOL by using the **bold face** English language equivalent: **if** represents the symbol for "if." In writing this, the wavy underline may be used: if represents "if." This is often slurred to a simple underline: if represents "if."

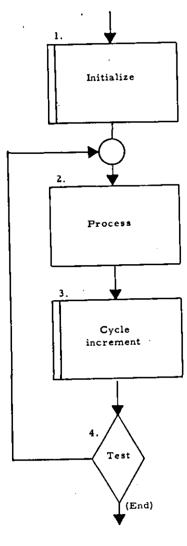


Fig. 6. Simple loop.

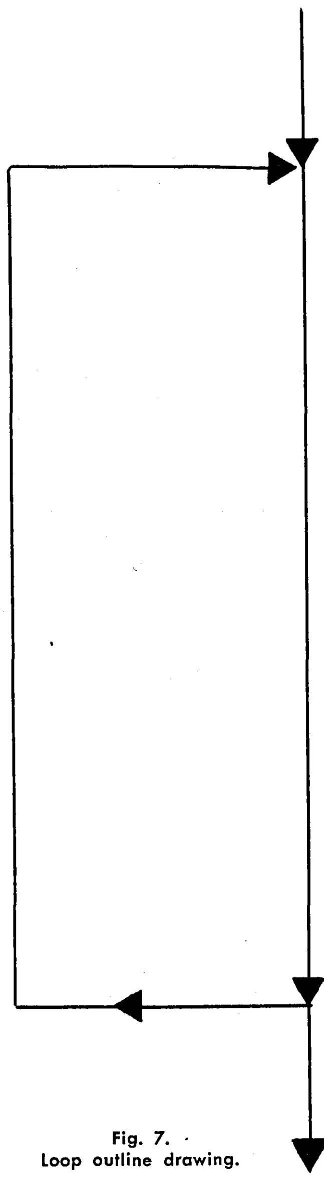


Fig. 7. Loop outline drawing.

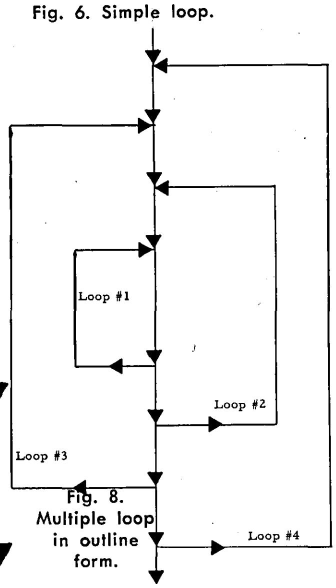


Fig. 8. Multiple loop in outline form.

loops [4.6]

There is nothing which is more important to the coder and programmer than the representation of loops. This is the process which is performed repetitively upon a set of data. The loop is shown diagrammatically in Figure 6. The first box sets the location of the first datum; the second box processes a datum; the third box adjusts the datum location to the address of the next datum; the fourth box determines whether all the data have been processed.

An outline form of the loop is found in Figures 6 and 7. Loops may be nested, one within another, as shown in outline form in Figure 8. The problem language must be able to accommodate such nested loops.

For a single machine language loop one must specify:

1. Initialization, the first datum location.
2. Cycle tally, the amount by which to increase the location, each time around.
3. The cycle criterion, the last datum address.
4. The process.

The syntax for the ALGOL 60 FOR statement is found in Figure 9. Provision is made not only for cycling by index but also by Boolean conditions and functional criteria. There may be none, one, or several labels for the loop (9).[2] This is followed by the symbol **for**. The name of the variable to be processed appears next (b) followed by :=. Next appears the *for list* (f) which contains the initializer (c), cycle tally (d) and cycle criterion (e), each appearing exactly once and interspersed with symbols. A number of lists may be found in a single *for statement*. The process to be done (g) for all *for lists* follows.

The process statement may itself be a *for statement* so that several nestings of loops may be made. Here's an example of that in ALGOL 60.

for j := 1 **step** 1 **until** J **do**
  for k := 1 **step** 1 **until** K **do**
    A[k, j] := B[j, k]

Notice the indentation in writing the lower order loops. This is a visual expedient not necessary for the problem language statement; it is disregarded in compiling. It can be omitted.

The second kind of *for statement* shown in Figure 9 requires looping until a condition stated in Boolean terms (i) is met for a particular arithmetic function of a control variable (h). In a third kind, the process may be performed for specific variable assignments only, (j). Here are respective examples:

for k := 1, V1 × 2 **while** V1 < N **do**
  for j := I + G, L, 1 **step** 1 **until** N, C + D **do**   (1)
    A[k, j] := B[k, j]
for i = I **do** R[i] := Q[i] × P[i] + 17   (2)

The first (1) is a request to do A = B for the values of j of I + G, L, 1 through N and C + D for each value of k starting with 1 and as long as V1 < N. Notice that V1 is doubled each time that loop is performed and looping continues as long as V1 < N.

dummy statements [4.4]

Such statements are void and correspond to "no-op" statements. They are usually labeled and are used to get to the end of a loop so that it may be re-entered from the beginning. In the example below, "H" is the label for the empty dummy statement.

for i = 1 **step** 1 **until** N **do begin**
  if X[i] < R **then go to** H.
  else X[i] := Y[i]
  H : **end**

"go to" statements [4.3]

The purpose of this kind of statement is to direct the computer to another portion of the program—it is an unconditional jump in program language. It consists, as shown in Figure 12A, of a "go to" symbol and a destination. Here are two examples:

go to 35   (1)
if A < B **then go to** 75 **else if** A = B **go to** 76
else if A > B **then for** i = 3 **do** B = C[i];   (2)
go to 76

assignment statement [4.2]

The purpose of this kind of statement is to assign a value to one or more variables as diagrammed in Figure 12B, as

V := r + s   (1)
H := K := R[3, 3] := 0   (2)

[2]The parenthetical letters refer to box labels in the figure.

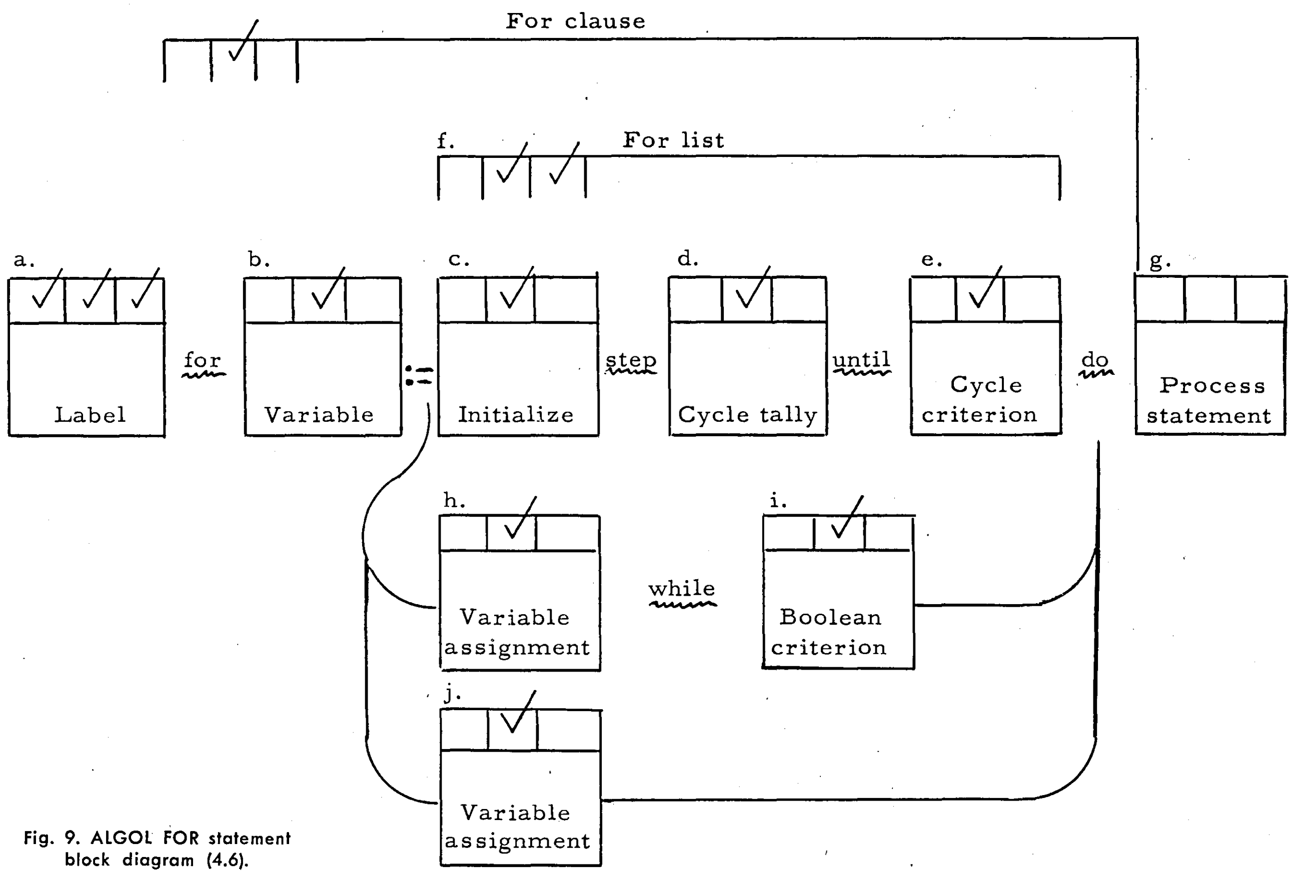


Fig. 9. ALGOL FOR statement block diagram (4.6).

procedure statements [4.7]

Procedures are described and labeled by procedure declarations. They can then be called for in a program by a procedure statement as illustrated in Figure 12C. The procedure statement consists of the procedure followed by one or none actual parameter parts (numbers or variables of the problem). The actual parameter symbol for the dependent variable is placed in parentheses directly following the procedure name. This followed by a list of actual parameters to replace the formal parameters in the procedure. This corresponds roughly to replacing $Y(X) = X^2 + 3$ by $Y(V + 2U)$, say. The actual parameter name, a semicolon, and its values in parentheses make up each entry of the list. The list may also be composed by placing the variable symbols, separated by commas, within parentheses as in (1) and (3) below. Here are some examples:

Transpose (W, v + 1) (1)

This requests a transpose of the matrix W of order v + 1 Spur (A) Order: (7) Results to: (V) (2a)

This requests the spur of matrix A of order 7 with the result placed in location V. It may also be written as Spur (A,7,V) (2b)

Absmax (A, N, M, Yy, I, K) (3)

This requests the absolute greatest element of matrix A of size N by M is transferred to Yy and the subscripts of the element are placed in I and K.

The procedure associated with these statements is discussed in the section on procedure declarations.

conditional statements [4.5]

Next of importance to the programmer is branching ability. Depending upon which of several possible conditions prevail, the computer should go on to one of several possible tasks. This is in truth decision making.

The conditional statement is syntactically displayed in Figure 10. It may be labeled (a). There is exactly one *if clause* (b) which contains just one Boolean expression (c). If this is true for the data on hand, the unconditional statement (see sequel) is performed (d). There may be additionally an *else clause* (e) containing only one statement (f) which is performed if the Boolean expression (c) proves false. Notice that this statement may itself be a *conditioned statement*, so that nesting may take place. In this way multiple conditions produce a choice of alternate paths. A statement with no else clause is called an if statement as in (1) below; with an else clause it is a conditional statement as in (2) below.

if $A > B$ **then** $i := i + 1$ (1)

if $A > B$ **then** $j := j + 1$ **else if** $A := B$ **then** $j := 0$ **else if** $A < B$ **then** $j := j - 1$ (2)

Fig. 10. The conditional statement.

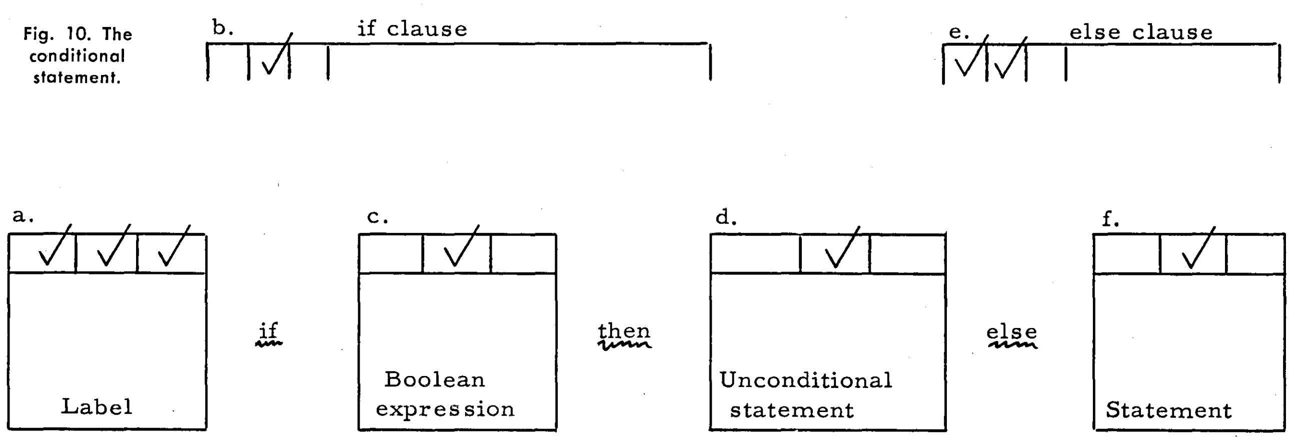


Figure 11 indicates how the final **else** is used to indicate the successor of all the conditional statements. The sentence which is flow-diagrammed in Figure 11A contains a semicolon followed by "E" but does not contain **else.** It is E which is performed if the condition A and C are *not* met. All statements B, D, and E must provide indication of what the next steps are to be. The sentence using the semicolon after the final *else clause* to show the successor of all the conditional clauses is flow-diagrammed in Figure 11B.

blocks [4.1]
The distinguishing feature of the block is that parameters and variables may be defined for use only within the block. A declaration is used to establish that a given identifier is local to the block. Wherever it *appears within* the block it has that meaning; when it *appears outside* the block it has the meaning assigned to it previously outside the block. Since blocks may have blocks within them, several levels of entities may be defined. Thus an entity may have one meaning in the lowest level block; it may have a second meaning within the next lowest level block; a third meaning when used outside the next lowest level block; and so forth. Then:

1. An entity declared inside a block has no existence outside the block.

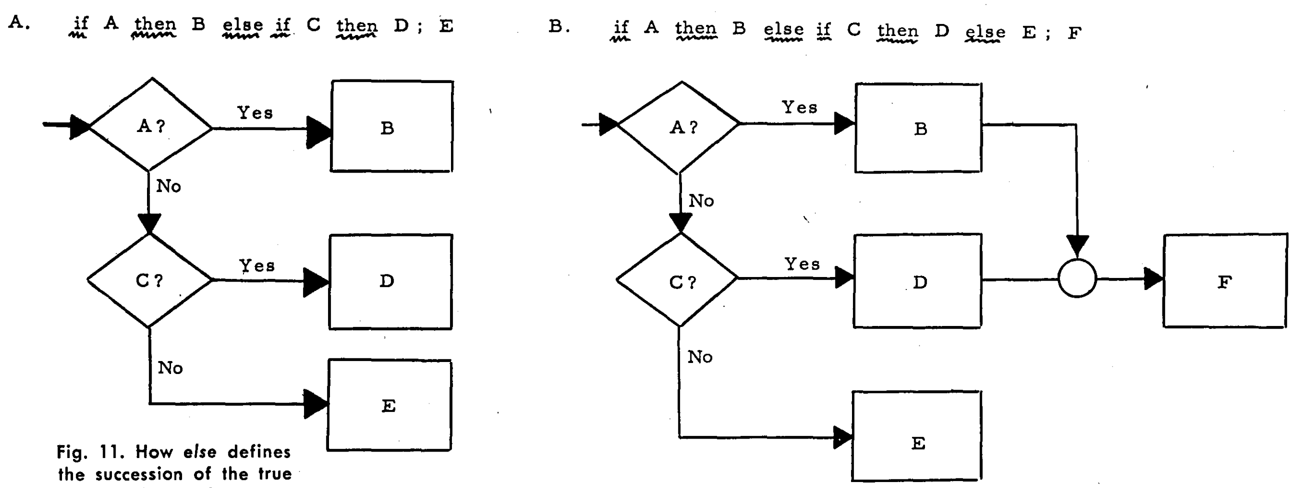


Fig. 11. How *else* defines the succession of the true conditional phrase.

2. An entity represented by this identifier outside the block is completely inaccessible to the block.

When an identifier is not declared in a block, it has the value assigned to it outside the block earlier in the program.

As in Figure 12D, the block may be identified by one or more labels (1). After the symbol **begin** (2) one or more declarations about the variables within the block are made (3). This is followed by one or more statements (4) and the block is ended with **end** (5).

Here is an example of a conditional statement containing a block:

if $s < 0 \vee P < Q$ **then** AA: **begin real** A; **integer** a; } (1a)
  if $q < V$ **then** A : = valence

  else $y = 2 X a$ **end** (1b)
  else if $v > s$ **then** a := v − q
        else if $v > s - 1$ (1c)
  then go to S; (1d)

This is a conditional statement. The Boolean expression, $s < 0$ $P < Q$ is the condition; the unconditional object follows the first **"then"** in line (1a), and is a block labeled AA. The block AA continues to the end of line (1b) and contains its own conditional statement. The *else* clause of the main conditional begins on line (1c) and contains two more conditionals within it, ending with a *go to statement.*

compound statements [4.1]
A compound statement is the same as a block but has *no local variables.* It therefore has no declarations and the syntax appears in Figure 12E. Here is an example:

begin x := 0; **for** y := 1 **step** 1 **until** n **do** } (1a)
  x := x + A[y];

  if $x > q$ **then go to** STOP **else if** $x > W - 2$ } (1b)
  then go to S; Aw : St : W := x + bob **end**

Here (1a) begins with an assignment; this is followed by a *for;* then comes a conditional on line (1b), whose *else clause* contains another conditional; the last is an assignment.

declarations [5]
Declarations are descriptive. They give information about data and processes. They apply only to the block in which they appear. If they are applied to identifiers defined elsewhere those identifiers apply locally (within the block) to different entities. In passing out of a block these identifications lose the local significance and assume the significance defined at the destination block.

When the symbol **own** is added to a declared variable, it has a binding effect. On reentry into the block, such a variable assumes the value that it had when last used in that block.

An identifier in a problem must be declared before it appears in a statement, except for:

labels; formal parameters of procedure declarations; standard functions [3.2.4, 3.2.5].

No identifier may be declared more than once in any block.

(Concluded Next Issue)

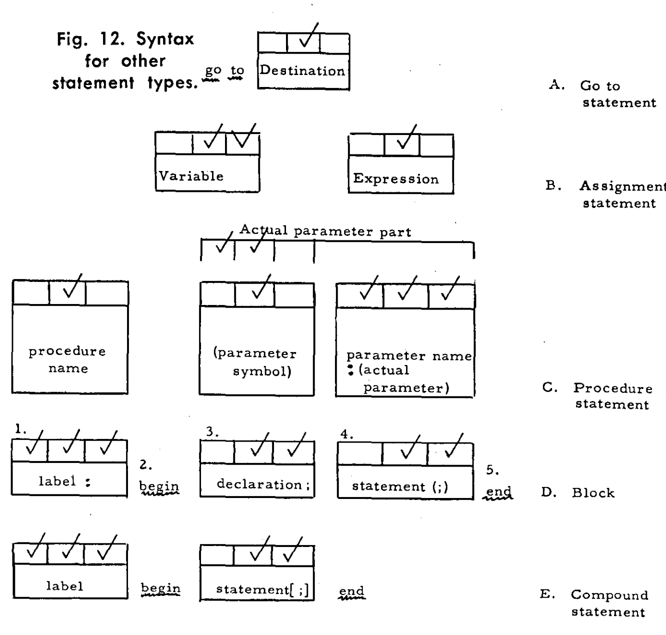
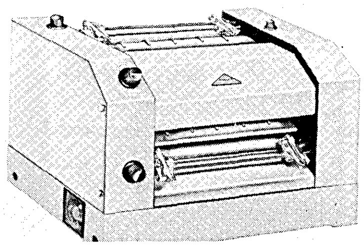


Fig. 12. Syntax for other statement types.

printers

Two new high speed printers for readout from data processing systems are available. One, the series 4-1000-SD, offers normal printing rate of 1000 lines per minute of alphanumeric characters and 2000 lines per minute of numeric printing. The second, the series 4-500-DD, offers 500 lines per minute of alphanumeric characters and



1000 lines per minute numeric. Normal line length is 120 characters, although more or less can be supplied as needed. The series 4-1000-SD offers up to 66 character choice per column, while the series 4-500-DD offers up to 48 character choice per column. For information write ANELEX CORP., 150 Causeway St., Boston 14, Mass., or use reader service card.

Circle 200 on Reader Service Card.

document reader

Recordings on paper or cards are read optically by the 1418 document reader for direct input into a 1401. The manufacturer states that up to 400 documents a minute can be processed. Once in 1401 storage, data is processed and results produced in the form of cards, mag tape or printed reports. The 1418 reads data printed by 407s or 1403s and typewriters equipped with 407 type. It will also read elongated 407 type. It handles documents in size range of 5⅞" by 2¾" to 8¾" by 3⅔". It also processes documents of various sizes and thicknesses (only one size form in one run) and reads letters, numbers and three special characters. Optional features include second reading station (two lines read in one pass), mark reading station (for reading pen or pencil marks) and line selection device. For information write INTERNATIONAL BUSINESS MACHINES CORP., Data Processing Div., 112 E. Post Rd., White Plains, N.Y.

Circle 201 on Reader Service Card.

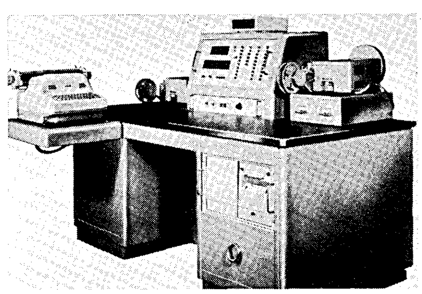
ceramic capacitors

A new line of ultraminiature capacitors is offered in two tolerances. Type EA-J individually precision tuned to capacitance tolerance of ±5% to 125°C, and type EA-K with a tolerance of ±10% to 150°C are now available. Stocked capacitances available with axial leads only range from 47 mmf to 120mmf. Radial-lead models, as well as larger values to 56000 mmf offering extremely high capacitances per unit-volume are available on special order. When tested as rated, these capacitors meet all requirements of MIL-C-11015A and applicable EIA-SMC-1 specifications. For information write ELECTRAMICS CORP., Cliff at Cedros, Solana Beach, Calif., or use reader card.

Circle 202 on Reader Service Card.

recording, control system

A completely transistorized, plug-in automatic digital recording and control system has a capacity of 100,000 channels. Although specifically designed for monitoring and controlling up to 10 analog computers of 10,000 inputs each, it can be used independently wherever data logging, reduction and control are required, such as in process operations. When used in an analog computing facility it will speed up or eliminate problem set-up

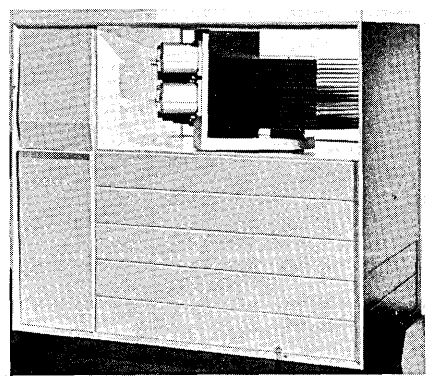


and checkout tasks. It can select a computer, place it into any one of its operating modes, set the computing elements such as potentiometers, with an accuracy of ±0.01%, read back the voltage variables to check settings of computing elements, and then initiate problem solution. Complete circuitry for tape preparation, checking and editing is included in the system. For information write COMPUTER SYSTEMS, INC., Culver Rd., Monmouth Junction, N.J., or use reader card.

Circle 203 on Reader Service Card.

mass memory

A high capacity disc file memory, incorporating multiple read-record heads that "fly" over the surface of storage discs has been designed to provide storage capacities and random access speeds to fit present-day computer capabilities. The model II disc file has a capacity of nearly 100 million characters. Access time has been reduced from the 700 milliseconds needed by present equipment to 150 milliseconds. A key to its performance is the airfoil-like design of the read-record heads

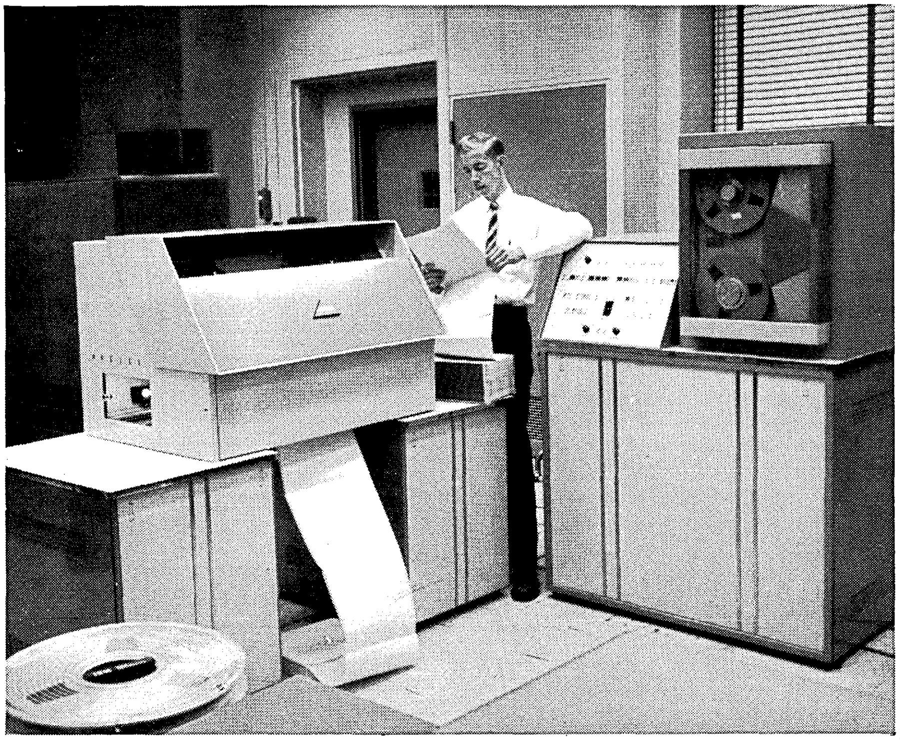


which allows the head to ride on the air boundary layer of the rapidly-revolving discs. The recording discs are spaced on a vertical, motor-driven shaft. It has a capacity of 617,642,752 bits, uses 64 recording discs and head positioners, each with its two pairs of read-record heads. A smaller version, the model I, with 16 discs and smaller storage capacity per recording surface, has a storage, has a storage capacity of 154,409,024 bits. For information write TELEX, INC., 1633 Eustis, St. Paul, Minn., or use reader card.

Circle 204 on Reader Service Card.

multiplex equipment

New data transmission multiplex equipment is capable of transmitting 62,000 characters per second over a microwave relay system. Such systems would be used to transfer data between computer centers or from gathering points to the computer location. Working from a magnetic tape input, the new equipment converts data from parallel to serial form. Bits making up each character are regenerated and transmitted one after another. A timing pulse is inserted after transmission of all bits in a character. The new multiplex equipment utilizes a single wide



band subcarrier channel to achieve the high speed transfer. At the receiver station, a serial to parallel converter stores the individually received bits until a full character is accumulated. For information write MOTOROLA INC., 4501 W. Augusta Blvd., Chicago 51, Ill., or use reader service card.

Circle 205 on Reader Service Card.

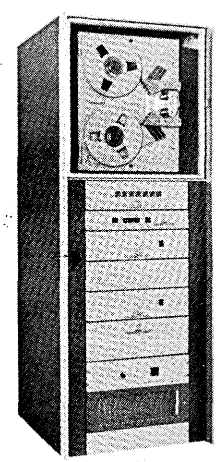
miniature core

A tiny magnetic core, doughnut-shaped and no longer than the period on a typewriter has been developed for use in the memories of digital computers. The core is made of ferrite and its peculiar properties make it possible for such a device to store a piece of information in the form of an electrically-induced magnetic field. The speed with which this field can be established determines how fast the machine can handle information and solve problems. The core will be in commercial production shortly. For information write RADIO CORPORATION OF AMERICA, 30 Rockefeller Plaza, New York 20, N.Y., or use card.

Circle 206 on Reader Service Card.

magnetic tape tester

A magnetic tape tester detects tape defects as small as one bit length at speeds up to 150 ips and packing densities as high as 1500 bits per inch. Faults are indicated by a pilot lamp on each channel and the tape transport stops on the fault, which is accessible for inspection and repair. The tester is composed of standard components plus a special tape tester logic unit



that programs the operation of the various parts. Included in the M 3320 are a M 906II high speed, high performance digital magnetic tape transport; a manual pushbutton control unit; dual record-playback amplifiers; and logic chassis with fault detector

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PROGRAMMERS: BS in the fields of Engineering, Mathematics or Physics. Advanced degree helpful. 2-4 years in military logistics, tactical and field operational applications including real-time interrupt. Development of computer libraries including diagnostics, service and input-output routines and routines and assemblers.

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plug-in cards and space for up to 16 channels. For information write POTTER INSTRUMENT CO., INC., Sunnyside Blvd., Plainview, L.I., N.Y.

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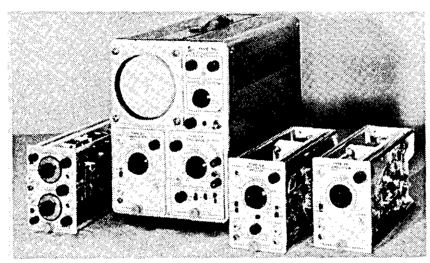
rectifiers

Miniature silicon controlled rectifiers weighing as little as 1/10 of an ounce are capable of directly replacing mechanical relays where load currents of 1 ampere are required. Designated types X1RC2 through X1RC20, their low operating current range enable them to perform highly efficient power switching on computer circuitry applications. These seven units have peak reverse voltage ratings of 20, 30, 50, 70, 100, 150 and 200 volts. All units feature hermetically sealed and all-welded construction. For information write INTERNATIONAL RECTIFIER CORP., 1521 E. Grand Ave., El Segundo, Calif., or use reader card.

Circle 208 on Reader Service Card.

oscilloscope

The type 561, basically an indicator unit, contains a 5 in. crt with 3.5 kv accelerating potential, an 8 x 10 cm viewing area, an amplitude and sweep-time calibrator, and a power supply capable of handling additional contemplated plug-in modules. The indicator unit powers any two of the five presently available modules — which drive the crt deflection plates directly. You can use a time-base module with



any one of the following signal-amplifier modules: (1) simple amplifier (50 mv/cm to 50 v/cm; dc to 800 kc), (2) dual-trace (5 operating modes; 10 mv/cm; dc to 500 kc), (3) wide-band (50 mv/cm to 20 v/cm; dc to 4 mc), and (4) differential-input (100:1 rejection ratio; 1 mv/cm; dc to 300 kc). For information write TEKTRONIX, INC., P.O. Box 500, Beaverton, Ore., or use reader card.

Circle 209 on Reader Service Card.

print-punch equipment

Off-line preparation of Recomp computer data tapes has been speeded through use of new print-punch equipment. The new equipment is completely self-contained. It comes in two table top units. the 10-key input keyboard

NEW PRODUCTS . . .

and the paper tape punch. Verification methods for checking both operating and punching accuracy are built into the equipment and all special coding and spacing are automatically punched. Operating from any standard 115 volt, ac power source, the print-punch program cartridges have various formats which can be easily plugged into the equipment. In addition to punched tape, the equipment produces a printed paper for checking, storing or recording of the tape. For information write AUTONETICS, a Division of North American Aviation, Inc., 9150 E. Imperial Highway, Downey, Calif., or use reader card.

Circle 210 on Reader Service Card.

perforated tape reader

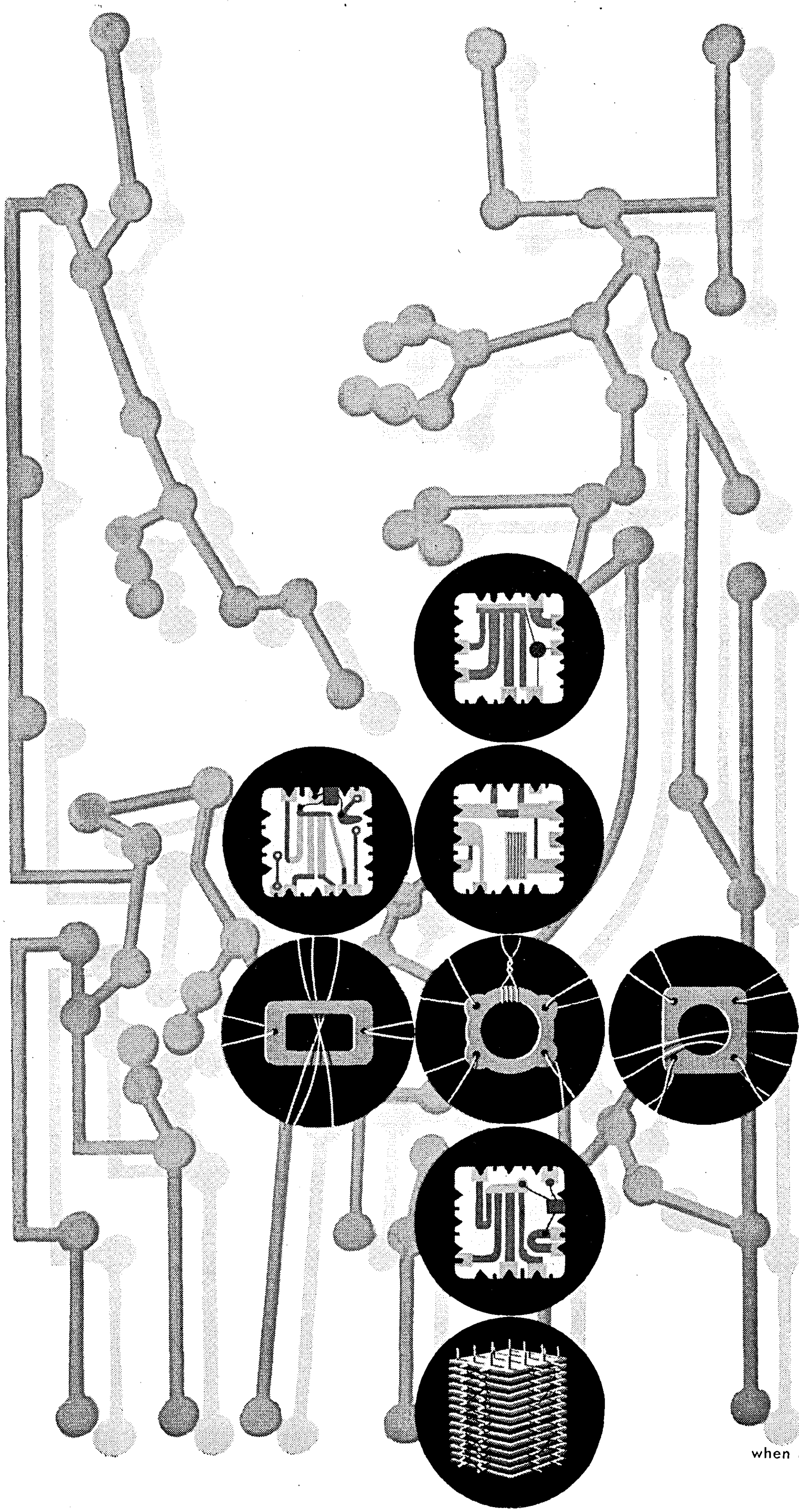
A new bi-directional high-speed perforated tape reader designated model B3500 operates on loops or strips of tape. A bi-directional spooler is available at speeds up to 300 characters per second, with 8 in. reels. Part of the completely transistorized circuits are two flip-flops which provide reliable control of the four solenoids used to control start and stop in either direction. The B3500 enables high-speed search and then reverse to the beginning of the block which can then be read in its entirety. The photoelectric reader senses tape perforations by means of silicon photodiodes which are set permanently in the head, with the diode lens protruding. The self-cleaning effect prevents accumulation of lint

and the possibility of reading errors. The standard unit is complete with an 8 level plus socket reading head, power supply, gating and shaping circuits and amplifiers. For information write DIGITRONICS CORP., Albertson Ave., Albertson, L.I., N.Y., or use card.

Circle 211 on Reader Service Card.

module cage

A new transistor digital circuit module cage, TDC P-4, accommodates 26 plug-in modules per drawer, with four drawers available in a 5¼ in. high x 19 in. wide frame. A total of 104 TDC modules, shift-register bits or shift-register drivers may be contained. Each drawer may be bench-wired and pre-tested before installation. Also, each drawer may be used for one purpose or type of circuit. Such design permits entire circuit changes, as well as allowing functional circuit flexibil-

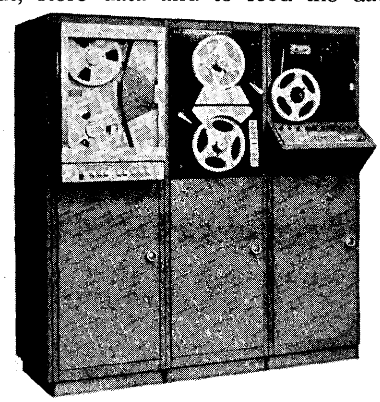


ity within the sub-module. Each TDC cage occupies 5½ in. mounting height on standard 19 in. racks, and required 16⅞ in. depth inside the cabinet. The individual drawers are top and bottom slide-mounted and drawer locks are integral with the pull-handle. For information write EPSCO INC., 275 Massachusetts Ave., Cambridge, Mass., or use reader service card.

Circle 212 on Reader Service Card.

data converter series

An all-solid state data converter, the D300, features full modular construction. In addition to tape-to-tape conversion it can also have card input and card output. It immediately converts information between punched paper and magnetic tape in either direction at a rate of 3000 words per minute. The basic unit contains the circuitry necessary to accept data from the input, store data and to feed the data



out to the output tapes. It can be arranged for conversion in either direction as determined by switch or plugboard selection. Paper tape data may be converted to or from the standard 5, 6, 7 or 8-level configurations. Magnetic tape may be in any code format having up to 6 information channels plus one parity channel with or without sprocket. For information write DIGITRONICS CORP., Albertson Ave., Albertson, L.I., N.Y. or use card.

Circle 213 on Reader Service Card.

analog-to-digital converter

A new solid state analog-to-digital converter performs 3000 conversions per second. It is compatible with the analog signals produced by existing types of industrial and military transducers, and converts these voltages into three decimal digital in digital code format. Accuracy is 0.1% ±5 millivolts. It may be used as an analog-to-digital converter with direct readout on any of several types of displays, or as a building block in a complex data handling or control sys-

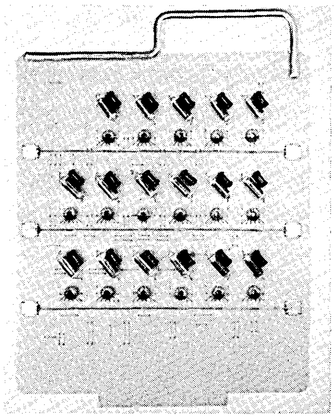
tem. The unit accommodates 5-volt full-scale d-c signals directly, or millivolt signals through a single amplifier. Input impedance is 5000 ohms during the 150-microsecond conversion time, 20 megohms otherwise. The output signal consists of 12 bits, each −10 volts at 50 milliamperes. For information write MOORE ASSOCIATES, INC., 2600 Spring St., Redwood city, Calif., or use reader card.
Circle 214 on Reader Service Card.

transmitter-receiver

An 8-channel code transmitter-receiver provides for the transmission of a single, continuous tape at double the speed of a similar standard model. This is accomplished by transmitting alternately over two transmission channels, each operating at the normal speed of 75 bits per second. It has been designed for operation in either half- or full-duplex systems. In a half-duplex system it is possible to transmit 850 characters per minute in either direction, but not both directions simultaneously. Full-duplex indicates that information may be transmitted in both directions at the same time. A double parity check system is built into it to detect errors caused by bits or transients encountered on transmission circuits. For information write FRIDEN, INC., 1 Leighton Ave., Rochester 2, N.Y., or use reader card.
Circle 215 on Reader Service Card.

magnetic element

A new thin film Parametron is available in individual units or in packaged plug-in card modules containing approximately 18 parametrons. The plug-in card modules utilize printed circuitry to allow the Parametron elements to perform specific logical functions. This model is also available as individual elements in a size of 8 mm diameter, approximately 20 mm in length. This element contains the thin

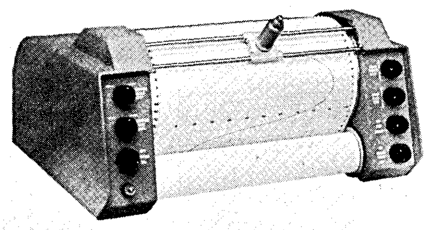


film material and inductive windings encapsulated within the capacitor. A magnetic film of 1 micron thickness is deposited on a copper wire 1 mm diameter. An excitation voltage with a frequency of between 10 and 30 is applied to copper wire which is the primary winding of the Parametron element. Depending upon the fre-

quency selected, clock rates of 150 to 500 KC can be realized. Parametrons are always used in three operating groups, each group being excited at different time intervals by a three-beat excitation source. For information write KANEMATSU NEW YORK, INC., 606 S. Hill St., Los Angeles, 14, Calif., or use reader service card.
Circle 216 on Reader Service Card.

incremental recorder

High speed, precision plotting of computer processed data is made possible with a new X-Y recorder which converts digital information regarding the relative variations of two functions into corresponding incremental motions of the plotting paper and the plotting pen. The model 560-RX-Y plotter can accept data from all digital computers and can be driven by both punched tape and punched card data proces-



sors. Twelve electrical inputs are provided so that either positive or negative polarity signals can be used to drive the recorder in each of the six operating modes, X, −X, Y, −Y, Pen Up and Pen Down. Dependency on absolute input voltage levels is eliminated by employing capacitive coupling of all inputs. For information write CALIFORNIA COMPUTER PRODUCTS, INC., 8714 Cleta St., Downey, Calif., or use reader service card.
Circle 217 on Reader Service Card.

code converter

A new punched tape code converter integrates all systems code variations. Specifically, with the code converter, any 5-, 6-, 7-, or 8-channel code system may be converted, one to the other. Any data in an 8-channel tape being produced by the manufacturer's automatic writing machine can be wire-transmitted by automatically re-punching codes in 5-channel tape on the code converter. At the receiving end of the line the codes may be converted back to 8-channel again, or even 6- or 7-channel, depending on the requirements of the application. By means of a plug-type control panel, consisting of 832 double-outlet hubs or patch points, the code converter is preset at the factory. Indicating lights near the switches atop the converter signal when the power is on and when a parity error has occurred. For information write FRIDEN, INC., 421 University Avenue, Rochester 7, N.Y.

Circle 218 on Reader Service Card.

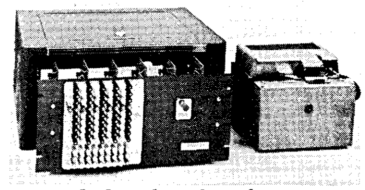
delay lines

A new generation of subminiature lumped constant delay lines are particularly suited for use in missile, airborne and commercial computers and data processing equipment. Employing subminiature inductors and temperature compensating capacitors, the high density, lumped constant delay lines offer the user the greatest stability in electrical characteristics over the temperature range from $-55°C$ to $+105°C$. The DL-130 has a delay time of 2 microseconds, a rise time of .22 microseconds, an impedance of 1,000 ohms and an insertion loss of .001 db max. For information write ALLEN AVIONICS, INC., 255 E. 2nd St., Mineola, L.I., New York.

Circle 219 on Reader Service Card.

tape reader

Up to eighty bits can be read simultaneously at speeds up to six blocks per second on the model 200 photoelectric block-reading tape reader. The solid state rack mounted amplifier section has a simple plug matrix to promote line by line or block reading. Tape motion is controlled by simple photoelectric servo. The stop code can



be provided either by the customer's equipment or from any desired hole in the matrix. Use of the sprocket hole as a stop signal results in conventional line by line operation. It has only one moving part, the PMI printed drive motor. For further information write PHOTOCIRCUITS CORP., 31 Sea Cliff Avenue, Glen Cove, New York.

Circle 220 on Reader Service Card.

selective printer

Sprint, a new selective printer, selects specific data from long files on magnetic tapes and passes it to the Univac high speed printer for preparation of one-time management reports. It is reported to have enabled the preparation of routine stock status reports in two thirds the time previously required. The unit also makes it possible to obtain reports formerly unobtainable because of cost or time limitations. For information write REMINGTON RAND, 315 Park Ave. South, New York 10, New York.

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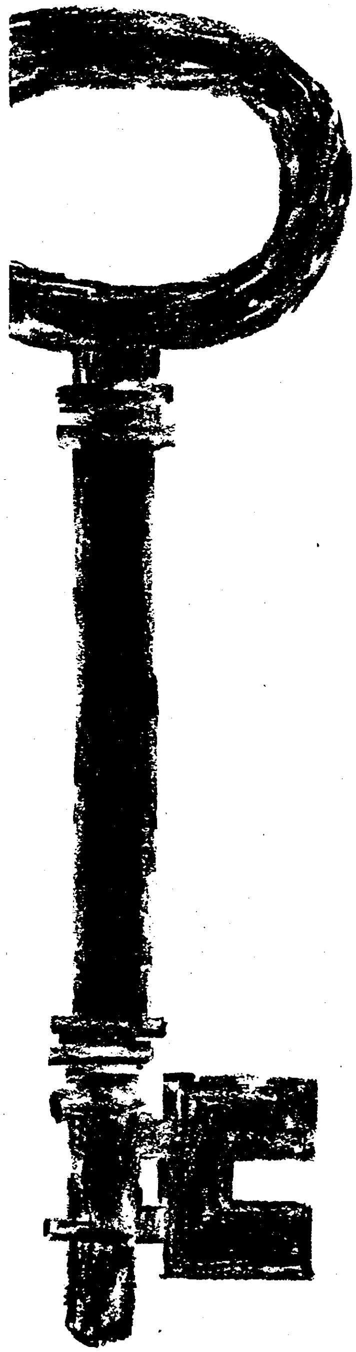

DATAMATION *abroad*

ENGLAND

An international conference on Machine Translation of Languages and Applied Language Analysis is scheduled for September 5th-8th, 1961, at the National Physical Laboratory, Teddington, Middlesex, England. Papers must be submitted by January 31, 1961, to Professor L. Dostert, Georgetown University, 1715 Massachusetts Ave., Washington 6, D.C. Three copies with three abstracts of each paper should be sent.

SWITZERLAND

Two ZEBRA digital computers, made in England, are at the present time operating at the Polytechnic School of the University of Lausanne in Switzerland and at the Emmen Aviation Plant, also in Switzerland. A Swiss-made digital computer ERMETH is operating at the Institute of Applied Mathematics of the Swiss Federal Institute of Technology in Zurich.

U.S.S.R.

V. A. Bygayev, Director of the Central Institute of Weather Forecasters in Moscow in a recent radio interview, commented that electronic computers used by weather forecasters in the USSR included the M-20 which calculates 24 hours in advance of the anticipated distribution of pressure across the whole of the Soviet Union. Synoptic charts compiled and analyzed at Moscow Central Institute of Weather Forecasts are then transmitted by radio to the various parts of the country, where the photographic images are received on special equipment.

Tests have begun in Moscow of the first cybernetic automatic regulating apparatus which, with the aid of electric signals, reckons and remembers how many vehicles have approached the traffic signals and on that basis regulates the speed of traffic movement.

LITHUANIA

The Lithuanian Institute of Physics and Mathematics (in Riga) has widened theoretical and experimental research in the field of digital machines and the use of semiconductor parts in them. A mathematical center equipped with the latest computers is being set up in Lithuania this year.

JAPAN-GERMANY

A G-15 data processing system has been installed by Japan Air Lines to keep track of up-to-the-minute weather and operations data. The computer's chief job will be that of figuring optimum flight plans. It was also announced that a new company called Teldix with headquarters in Heidelberg, Germany, has been established by Bendix.

SWEDEN

Ampex equipment sales in Sweden, now handled by Hans Tharn of Elektronikbdaget in Stockholm, have recorded purchases of five FR-300 digital tape handlers to Svenska Dataregister, one FR-400 to Regnecentralen and three FR-400 to the Swedish Board of Computing Machines.

The Radio Corporation of America has sold its first digital computer overseas in Sweden. The sale of a 501 with six tape stations was made to Sveriges Kreditbank (Sweden's Credit Bank) in Stockholm.

new DATAMATION *literature*

PROCESSING SYSTEMS: A 28-page booklet covers a dozen major data processing systems which are controlled automatically by business machines. Step-by-step illustration and concise explanations of diversified applications are included. The building-block concept is also indicated whereby various auxiliary input-output units may be connected to a Flexowriter to provide varying degrees of automation as the system demands. For copy write FRIDEN, INC., 1 Leighton Ave., Rochester 2, N.Y., or use reader card.
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MAGNETIC CORE DATA: A series of data folders are available providing complete specifications for a line of storage cores. These folders describe both physical and magnetic characteristics with information concerning applications. For copies write TELEMETER MAGNETICS INC., Components Div., P.O. Box 329, Culver City, Calif., or use reader service card.
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TRANSLATOR: A new technical bulletin describes the various types and techniques of code conversion and the relative merits of different numerical codes which may be employed by the design engineer. A discussion on the theory of numerical codes is also included. For copy write HERMES ELECTRONICS CO., 75 Cambridge Parkway, Cambridge 42, Mass., or use card.
Circle 262 on Reader Service Card.

MATHEMATICAL COMPUTER APPLICATIONS: A 16-page technical report details the applications of the DYSTAC computer. Also discussed are sequential calculations through time sharing of computer elements; use of memory to obtain definite integrals for automated, self-solution of optimization problems; and the solution of partial differential equations. Full schematics of computer circuitry illustrate solutions discussed. For copy write COMPUTER SYSTEMS, INC., Culver Road, Monmouth Junction, New Jersey.
Circle 263 on Reader Service Card.

TECHNICAL PAPERS: Copies of any of the five papers below are available from the manufacturer. These papers were presented at the National Telemetry Conference held in May at Santa Monica, Calif.

"PCM Synchronization," W. M. Seaver, 11 pgs. **Circle 264 on Reader Service Card.**

"The Universal Computer Language Recorder – A General Tool for Telemetry Data Handling," J. D. Bassett, 15 pgs. **Circle 265 on Reader Service Card.**

"Data Transmission for Industry," W. F. Kamsler, 11 pgs.
Circle 266 on Reader Service Card.

"Instrumentation System for Psychophysiological Studies," H. S. Goldberg, 9 pgs.
Circle 267 on Reader Service Card.

"Portable Data-Handling System," R. A. Ferrero, 3 pgs.
Circle 268 on Reader Service Card.

For copies write EPSCO, INC., 275 Massachusetts Ave., Cambridge, Mass.

MEMORY CORE HANDLER: Technical bulletin 60-A describes model CH-58 automatic memory core handler, a fully automatic, production type, memory core feeder which grades and sorts standard 80 mil or 50 mil miniature ferrite cores at continuous operating speeds of over 16,000 cores per hour. The 2-page illustrated bulletin also lists optional accessories and full specifications, along with a brief description of models 4021 and 4022 manual core test jigs. For copy write RESE ENGINEERING, INC., 731 Arch St., Philadelphia 6, Penna., or use card.
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TABULAR DISPLAY: A scanner-printer-display unit with optional computer input is described in a 4-page illustrated brochure. Three functions of the unit are: (1) Display of data cards in individual, removable cardholders; (2) High speed scanning (24 cardholders, with 14 bits each, are read in 2 milliseconds); (3) Printing of alpha-numeric data onto an addressed card. Description and applications are included in the brochure. For copy write GENERAL PRECISION, INC., GPL Div., 63 Bedford Road, Pleasantville, N.Y.
Circle 270 on Reader Service Card.

GLOBAL DIGITAL SYSTEMS: Reprints of the paper, "Recent Developments and Applications of Kineplex," are available. This 16-page story describes new systems designed to provide global digital communications via wire line and radio facilities. Description of the problems and requirements for this type of communications are included. The equipment described is either in production, in active development, or is currently being used. Charts and photographs are included. For copy write COLLINS RADIO CO., Western Div., 2700 W. Olive Ave., Burbank, Calif., or use reader service card.
Circle 271 on Reader Service Card.

NEW COMPANY DIVISION: An 11-page illustrated brochure describes the capabilities, accomplishments and staff experience of this company's new TransDigital Systems Division. Text also includes information about the division's facilities with photographs. For copy write COOK ELECTRIC CO., 2700 No. Southport Ave., Chicago 14, Illinois, or use reader card.
Circle 272 on Reader Service Card.

TELEMETERING EQUIPMENT: A new, 8-page brochure describing telemetering equipment gives features, shows typical line costs and line capacities, describes how the telemetering system works in simple terms, and outlines typical systems. Detailed specifications are included. For copy write ELECTRO-MECHANICAL RESEARCH, INC., Sarasota, Fla., or use reader card.
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PROCEEDINGS: This 72-page booklet records the proceedings of the First Users' Conference on Dynamic Digital Logic held March 1960 in California. Topics of the papers include "Application of Digital Techniques in a Meteor Burst Communication System," "Generation of Periodic Pulse Patterns," "A Method of Running Off a Quotient to the Nearest Integer," "Logical Design Simulation Techniques using the IBM 709 Com-

puter," "Serial Techniques in Digital Systems," "Serial Techniques in the Design of an Incremental Computer," etc. Single copies are available. For copy write COMPUTER CONTROLS CO., INC., 983 Concord St., Framingham, Mass., or use reader card.
Circle 274 on Reader Service Card.

MAGNETIC AND DRUM HEADS: Complete specifications covering magnetic recording and reproducing heads and drum heads are contained in Specifications DS 3301a and DS 3400. Included are formulas for determining the correct magnetic heads, playback voltage and turns and gap. For copies write MINNEAPOLIS-HONEYWELL, Industrial Systems Div., 10721 Hanna St., Beltsville, Md., or use card.
Circle 275 on Reader Service Card.

COMPUTER PROGRAM INDEX: A new, 11-page index of the G-15 civil engineering programs contains an extensive listing of applications prepared by G-15 computer users. Programs developed by the manufacturer's application group are also listed. For copy write BENDIX COMPUTER DIVISION, 5630 Arbor Vitae St., Los Angeles 45, Calif., or use reader card.
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CONTROL SYSTEM: The 709/7090 input/output control system is designed to relieve programmers of the necessity for writing input and output routines. The system automatically handles label checking and preparation, blocking and unblocking of records, and overlapping of processing with input and output. This bulletin describes the main features of IOCS in sufficient details that the programming required for use of the system can be accomplished. For copy write INTERNATIONAL BUSINESS MACHINES CORP., 112 E. Post Rd., White Plains, N.Y., or use reader card.
Circle 277 on Reader Service Card.

ROTATING STORAGE DEVICE: A 4-page brochure describes in detail the applications and operations of BD-100 memory disk. The BD-100 is applicable for use in general purpose EDP systems. Because of its small size and weight and its ability to withstand severe environmental conditions, it will also find application in a wide variety of fixed station and mobile digital computers. Specifications are included. For copy write LABORATORY FOR ELECTRONICS, INC., 1079 Commonwealth Ave., Boston 15, Mass.
Circle 278 on Reader Service Card.

MAGNETIC TAPE TRANSPORTS: A data sheet provides specifications on this manufacturer's transports which are available with three or six speeds. Specification DS 3160 also includes a flutter curve. For copy write MINNEAPOLIS - HONEYWELL, Industrial Systems Div., 10721 Hanna St., Beltsville, Md., or use reader card.
Circle 279 on Reader Service Card.

SWITCHES: This new, 4-page data sheet covers three series of basic switches with exclusive gold contacts. The "3SX" series sub-miniature switches, the "SM" series subminiature switches, and "V3" series postage stamp size switches with gold contacts offer a variety of designs for milli-volt milliamp dry circuit switching applications. They may be used in bank automation and computers. For copy write MICRO SWITCH, Freeport, Ill.
Circle 280 on Reader Service Card.

COMMUNICATIONS EQUIPMENT: A 13-page booklet titled "Electronic Digital Data Handling for Communications" describes equipment now available as well as techniques and devices presently in test for flow of information between the computer and remote stations. Savings for the computer user

NEW LITERATURE . . .

by use of "offline" conversion equipment are detailed in a number of case histories. For copy write DIGITRONICS CORP., Albertson Ave., Albertson, L.I., N.Y., or use reader card.
Circle 281 on Reader Service Card.

THIN FILM RESEARCH: A report prepared for the Air-Force "Research on the Pyrolytic Deposition of Thin Films," has been released. This 50-page report was compiled by F. V. Schossberger and others, Armour Research Foundation, Illinois Institute of Technology as a one-year research study. Text is illustrated with 10 tables and 16 photos and drawings. For copy send $1.25 to the Office of Technical Services, U.S. DEPT. OF COMMERCE, Washington 25, D.C.

"BOOK COMPUTER": Prepared on a digital computer, the Book Computer multiplies and divides whole numbers to six significant figures, and because of its tabulated form, produces the desired information at an average of five times faster than logarithm tables. It it for use by engineers, accountants, students, and others who need highly accurate and fast computations without investing in a slide rule or calculating machine. For copy send $15.00 to METRON INSTRUMENT CO., 432 Lincoln St., Denver 3, Colo.

COUNTER TUBE HANDBOOK: Complete description of a wide variety of decade counter tubes is included in a 12-page illustrated handbook. Text covers construction, operation, operating principles, applications data, specifications and circuit information. For copy send 15¢ to SYLVANIA ELECTRIC PRODUCTS INC., 1100 Main St., Buffalo, N.Y., or use reader card.

MAGNETIC CORE MEMORY: A new, 8-page brochure describes a line of random access magnetic core memories which are widely used for information storage in digital computers and other special purpose digital systems. The new catalog contains a general and a detailed description, performance specifications, and illustrations of several different memories. The dimensions of

every memory are shown. For copy write COMPUTER CONTROL CO., INC., 983 Concord St., Framingham, Mass., or use reader service card.
Circle 282 on Reader Service Card.

COMPUTER TUBE: A new 2-color, 2-page bulletin is now available concerning a high-performance computer tube. Designated as the 7719, it is a medium-mu, high perveance, sharp cut-off, general purpose triode intended primarily for use in computer service. Utilizing the 9-pin miniature construction, the new tube is rated at 6 watts plate dissipation. The bulletin lists typical applications and design features. For copy write TUNG-SOL ELECTRIC INC., 200 Bloomfield Ave., Bloomfield, N.J., or use card.
Circle 283 on Reader Service Card.

COMPANY CATALOGS: Three short-form catalogs provide specifications and photos of this company's products. The types of products covered are: semiconductor products; microwave components; and microwave tubes and devices. For copy write MICROWAVE ASSOCIATES, Dept. AH, South Avenue, Burlington, Mass.
Circle 284 on Reader Service Card.

CIRCUIT MODULES: A "Loading Manual for T-Series Germanium Transistor Circuit Modules" contains loading rules and a load chart. The chart can be used to determine the maximum load each T-Series unit can drive and the rules present additional information on requirements and capabilities of the units. This manual supplements the company's circuit module catalog no. 859. For copy write ENGINEERED ELECTRONICS CO., Dept. C, 1441 East Chestnut Ave., Santa Ana, California.
Circle 285 on Reader Service Card.

MICROFILM PRINTERS: Complete description of the company's 4020 printer is contained in a four-page brochure. Included are specifications, applications and operating characteristics. For copy write STROMBERG-CARLSON, P.O. Box 2449, San Diego, Calif., or use reader card.
Circle 286 on Reader Service Card.

MICROWAVE RELAY LINK: The type 420A microwave relay link is featured in a new 8-page catalog in 2-color. It is a 0.1 watt 5 megacycle bandwidth system operating in the 10,500 to 13,200 mc. frequency range for data channels. The small size, ease of portability, and low cost permits its use in linking scattered offices or buildings of an organization economically, permitting the transmission of computer data, remote control functions, and telemetering information. For copy write ELECTRONIC SYSTEMS, 1824 River St., Jackson, Mich., or use reader card.
Circle 287 on Reader Service Card.

VARI-PUNCH: Vari-punch, in a compact form, introduces a new concept in "on the spot" key punching of IBM cards. It is readily programmed for a multitude of specific forms thru a tabbing arrangement. It offers complete visual control and accuracy through printed numbers on top edge of card of punched hole value. Available in two production models, it will punch and print 80 columns, or for customers with only a limited amount of information to record, a 40 column, every other space. Physical size 8 in. long, 5 in. deep, 3 in. high, 5 lb. total weight and standard 115V ac power greatly facilitates its use in numerous applications. For copy write VARIFAB, INC., High Falls, N.Y., or use reader service card.
Circle 288 on Reader Service Card.

. . . From General Mills

A CUSTOMIZED COMPUTER

Sequel to R. L. Patrick's "A Customizable Computer"*

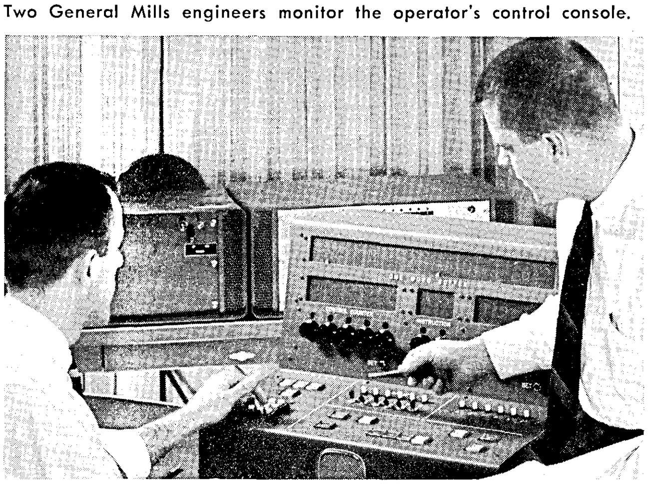
GENERAL MILLS' MECHANICAL DIVISION recently introduced a highly advanced, solid state, parallel, digital computer which may well be the "better solution" to computing problems contemplated in Mr. Patrick's article. The General Mills computer, incorporating adaptability, flexibility and reliability, can be readily customized for a specific application.

Low cost "customization" has been made possible thru development of **universal** units which include arithmetic unit, memory unit, control unit and input-output buffer. All of these are tied together in any desired configuration by **instruction** cards. Instead of having specialized instructions stored on a memory plate of the read-only type, special instructions are formulated by making appropriate connections on one of the instruction cards (plug-in printed circuit cards). Interconnections made on the card essentially order the individual micro-programs in such a way as to formulate a specific instruction.

Up to sixty-four such cards can be used in the General Mills computer. These permit not only standard instructions but also orders such as floating point arithmetic, square root or binary-decimal conversion, and more complex or specialized orders which may be required to be utilized. This means that, if desired, a series of instructions corresponding to another machine's order structure can, within the limits of word length, be drawn up for the machine. This technique serves to eliminate substantial reprogramming costs and enables users to specify orders which are desired for their specific applications.

The basic machine can be described as a medium speed, flexible computer designed specifically for scientific and engineering calculations and for process control. It has a 36 bit (plus sign) word length and utilizes a 4,096-word magnetic core memory. Additionally, the computer contains two 64-word magnetic core buffer memories and a 1-word buffer register for external communications. The buffers permit continuation of arithmetic operations while the machine converses simultaneously with external devices such as typewriter; printer, tape reader, card punch, card reader, magnetic tape units, analog devices, control systems, displays or other digital devices. Since the external devices are addressable, and are commanded by the computer to receive or transmit data, they can be incorporated in a closed system operating under complete control of the computer.

Two General Mills engineers monitor the operator's control console.



The "universal" memory unit uses pluggable core drivers and sense amplifiers, and can be built for any capacity by using the required number of pluggable circuits and core matrices. Memory access time is 10 microseconds.

With a basic clock rate of 50 kilocycles, execution times for common arithmetic operations (including memory access time) are: 80 microseconds for addition, 100 microseconds for subtraction, 820 microseconds for multiplication, and 940 microseconds for division. Most other arithmetic operations require 80 microseconds.

The "universal" arithmetic unit is comprised of pluggable logic unit cards. Registers of any desired precision can be made by employing the required number of cards. Interconnections between the cards are pluggable to permit simple assembly and facilitate modification and expansion.

Additional features of the General Mills machine are enumerated below:

input-output facilities

Photoelectric tape reader: 100 and 150 characters per second; one character, one-word or one-block entry.
Complete alphanumeric typewriter: 12 characters per second, automatic format control and variable codes.
Paper tape punch: 27 characters per second, 5-8 channels; one character, one-word or one-block output.
Magnetic tape: 30 KC; 2,400 feet at 150 inches per second, 200 lines per inch; 5,000,000 character tape capacity; read, write, search and rewind.

number system

Binary, fixed point, fractional. Programmed translation to alphanumeric, octal and decimal systems is provided. Floating point instruction cards are available as an option.

instruction system

Single address order structure with two orders per word. Each order consists of a 6-bit operation code and a 12-bit address code. The computer can contain a repertoire of 64 orders.

automatic program monitoring and control

The operator's console provides monitoring of computation by digital displays and indicators. A program in the computer can be varied automatically by setting sense switches during computation. This facility permits considerable variation in programming without resorting to complete program replacement or halting of machine operation.

console

Simplified controls. Decimal or octal readout displays of principal registers. Sense switches. Four computational modes. Automatic initializing sequence into program control.

indexing

The index counter and various indexed commands provide programming ease and flexibility.

block transfers

64-word block transfer of input, output and internal in-

by FRANCIS J. ALTERMAN, Manager,

Digital Computer Laboratory

Mechanical Division of General Mills

formation can be accomplished with a single instruction.

magnetic tape

Magnetic tape units, operating at 30,000 alphanumeric characters per second, or 60,000 octal digits per second are available with the machine.

environment

The computer is capable of operating efficiently under extremes of temperature and humidity. No air conditioning required in ambient temperatures from 32° to 125°F and in humidity environments up to 100%.

power requirements

1,000 watts. (Plugs into any ordinary wall outlet.)

physical characteristics

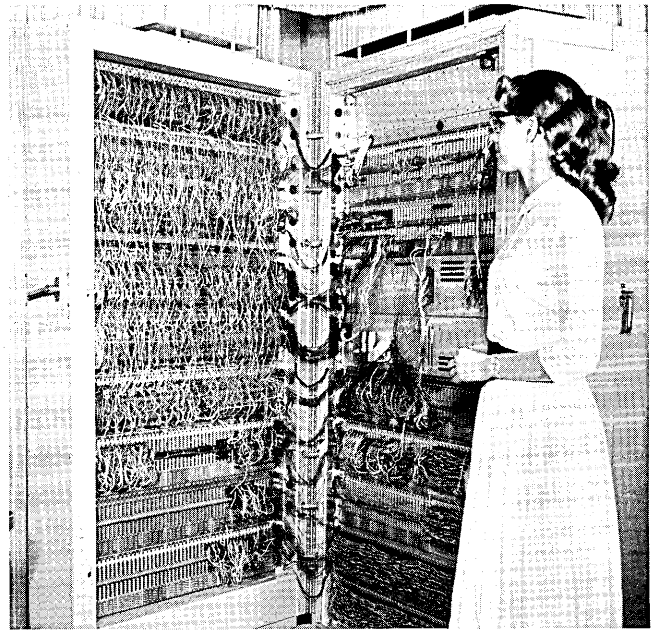
Size: 6.5 ft. high, 3.5 ft. wide, 3 ft. deep.
Weight: 600 pounds.

That a digital computer system incorporating the advanced design features described herein should be a product of General Mills may be somewhat surprising to many in the industry. General Mills is a name not previously associated with the digital computer field. On the other hand, production of complex electronic and mechanical systems, primarily for military consumption, has been the forte of the company's Mechanical Division for the past two decades. The capacity for designing and manufacturing special purpose computers, both digital and analog, has played no small part in establishing General Mills as an important factor in the defense industry. Today, computers developed by General Mills engineers are being used in missile guidance and in bombing and navigation systems, as well as in automatic surveying and control applications.

Several years ago, it was determined that formal establishment of a well equipped competently staffed Digital Computer Laboratory was necessary to support increasing activity in the electronic digital computer field. The Laboratory has been active in developing high speed tape storage systems, a light-beam coded keyboard, optical output devices, many transistorized circuits for computer logic and storage, and transistorized power supplies.

These and other developments have contributed to General Mills' success in producing computers for military use. The "Customized Computer" discussed in this article can be attributed also to General Mills' experience in meeting tough specifications normally associated with military equipment. For example, a General Mills computer developed specifically for military field use has operated for thousands of hours in environmental tests and has maintained an excellent reliability record in the severe temperature and humidity environment of "all-season" field operation. This portable, transistorized machine has a 512 word internal core memory (new model offers core memory capacity of 1,024 words), and an external low-speed, magnetic tape storage system. The packaging configuration used is the General Mills Logic Unit Board. Each board contains 24 logic units which can be used singly or in pairs to form almost any circuit required in a computer.

Alone, a Logic Unit can be used as an "and" or "or" circuit, while in pairs it will serve the functions of a flip-flop, a one-shot multivibrator, a Schmitt trigger, etc. Used in pairs, the Logic Units of one board will provide 12 flip flops which can be interconnected as a 12-bit binary counter or as a 12-bit shift register. Connections between Logic Units are made with short jumper wires and taper pins, and soldering is not required.



Pictured above is section of the General Mills central computer showing the intricate wiring which connects banks of components.

*"A Customizable Computer" appeared in the May/June 1960 issue of DATAMATION, page 44.

Some refreshingly frank statements followed the submission of questions by DATAMATION to General Mills concerning "A Customized Computer." With that company's permission and to answer in advance any questions which may have arisen in readers' minds, DATAMATION forwards the following comments.

General Mills states that they do not wish to imply that they consider their computer the "ultimate" in advance computer design. Mr. Alterman states that his company's computer, with its pluggable instruction cards, does represent a major step toward the proposed "ultimate."

Noting that the hypothetical computer had the ability to prepare automatically new logic plates which, when used in the magazine, would cause the characteristic application of the system to change, General Mills admits their computer cannot prepare new instruction cards.

Also, the magazine of the logic plates gave the Patrick computer the ability to have any one of several characteristic applications (without changing plugboards) in a matter of seconds. General Mills states their computer handles up to sixty-four instructions. Assuming the existence of two or more applications which utilize different order structures with only a few orders in common, up to sixty-four orders can be left in the machine at all times. In such cases, no physical change is required. Different orders will, of course, have different order codes. In cases where additional applications exist, requiring more than a total of sixty-four instructions, General Mills allows that physical substitution of appropriate instruction cards must be made.

In the Patrick computer, the read-only memory was proposed so that the whole micro-programming device could be dense, hence compact, and the speed reduction would be slight. General Mills observes that this is one of the ultimate design features not yet accomplished.

Finally, through automatic coding, Patrick also hypothesized a way that the computer system could improve itself. General Mills admits that their machine lacks this capability.

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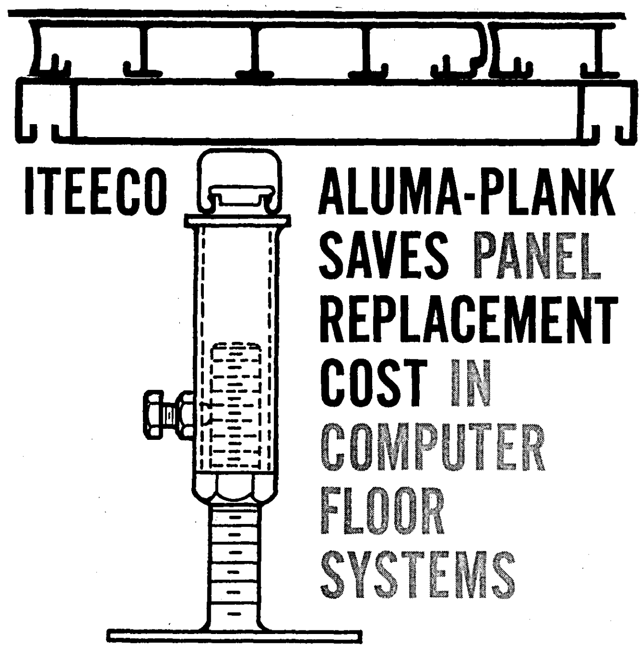

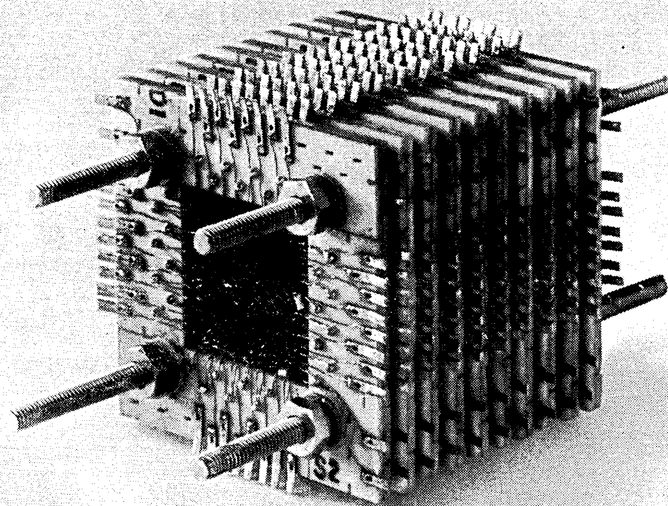

This is the Control Memory, an exclusive feature of the Honeywell 800 Transistorized Data Processing System. It is only 2¼ inches long, 2¼ inches wide and 2¼ inches deep, but its capabilities are heroic. Its design logic empowers Honeywell 800 to run off 8 major jobs simultaneously — each one starting and stopping independently. It supersedes the costly, complicated master programs or schedule of priorities required by conventional transistorized systems. To learn more about its accomplishment (Automatic Parallel Processing) and the many other design "firsts" of Honeywell 800, just write to Minneapolis-Honeywell, Datamatic Division, Wellesley Hills 81, Mass.

Honeywell

H HONEYWELL *Electronic Data Processing*

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