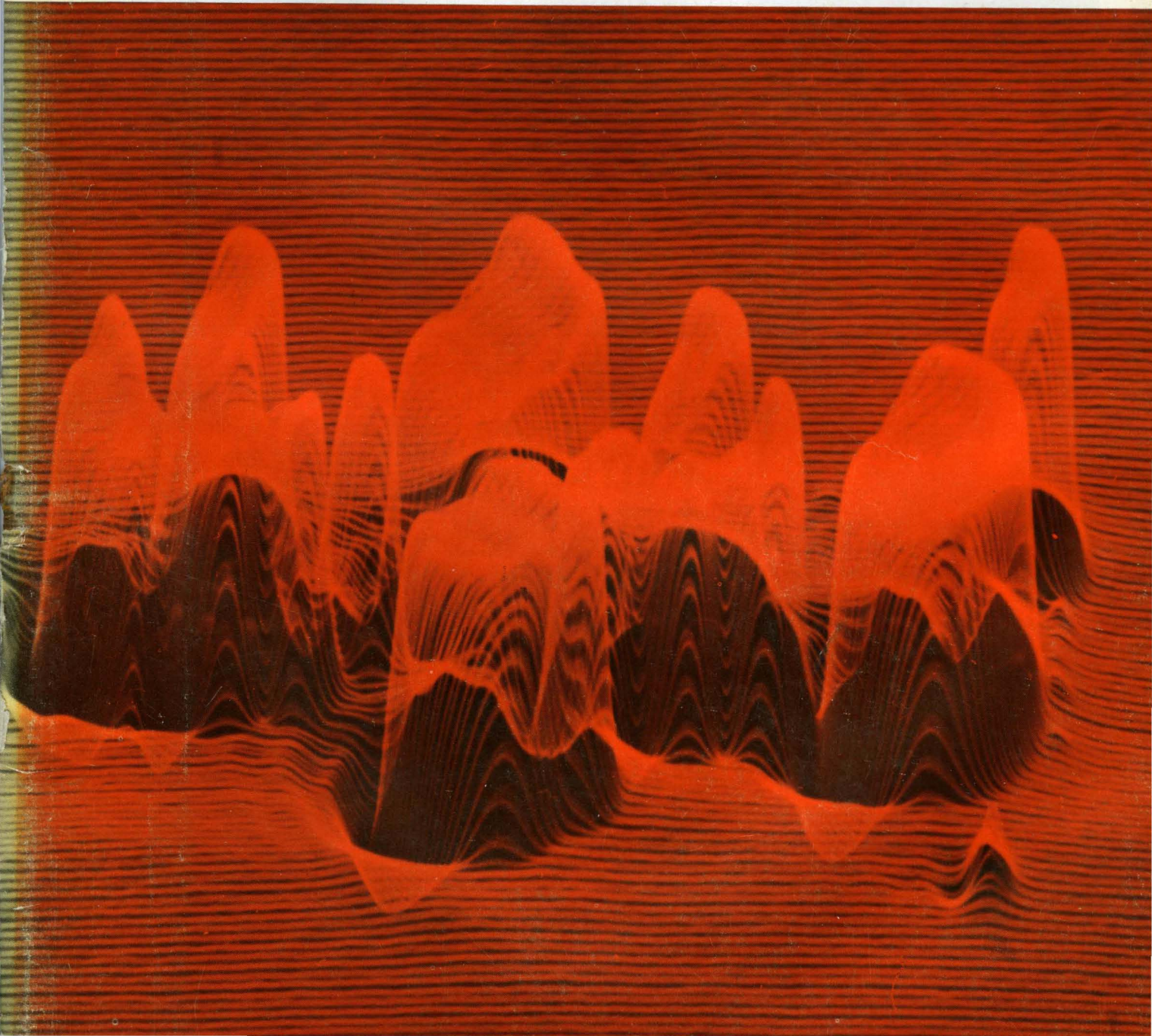
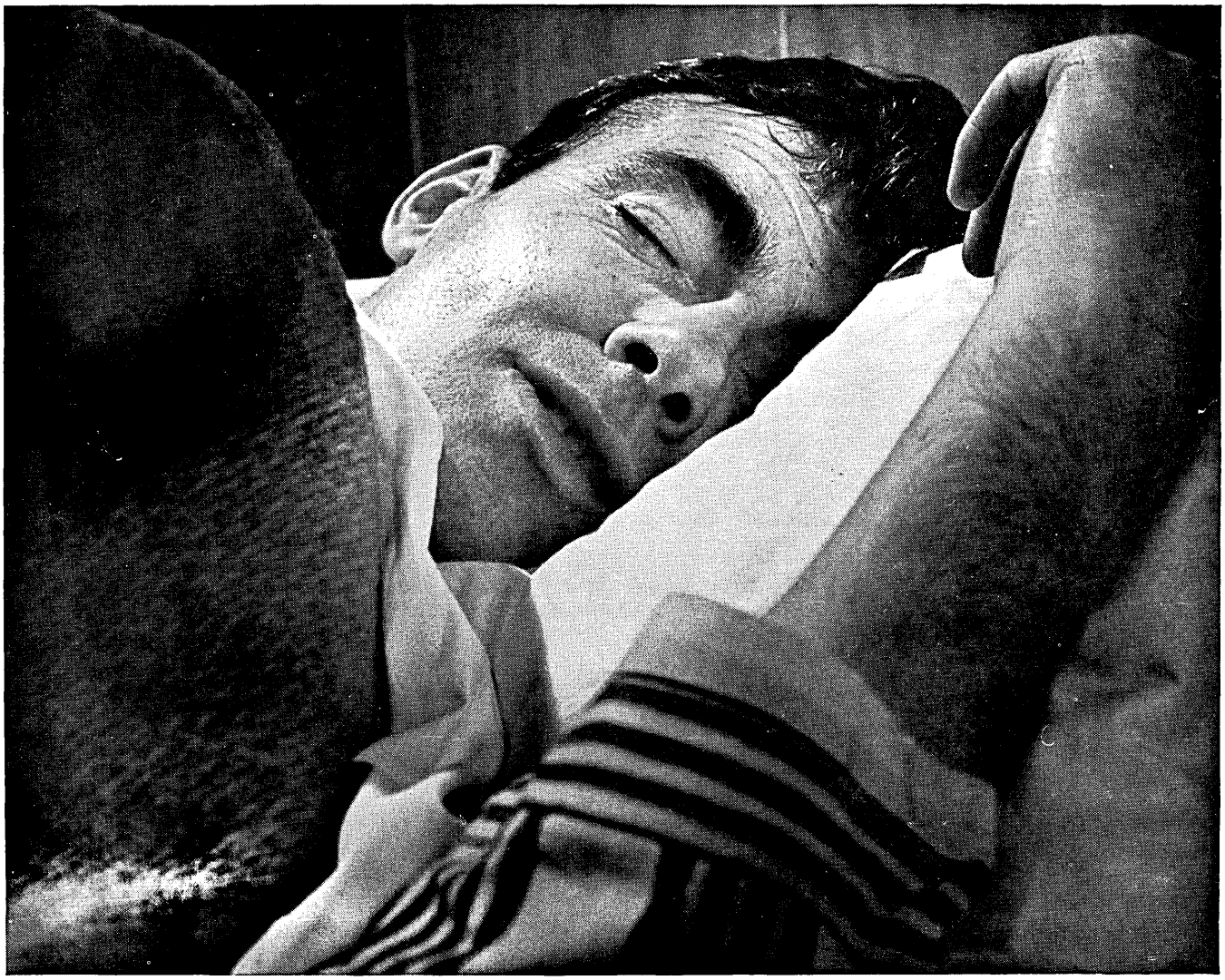
January, 1963

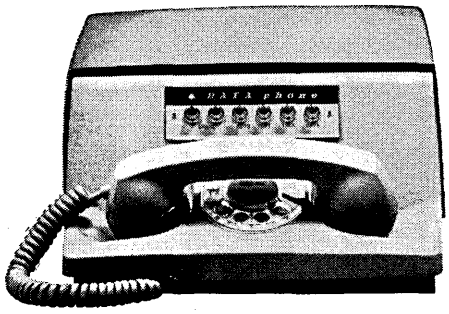
computers and automation

A Portrait by a Computer As a Young Artist





How to telephone a million words while getting eight hours sleep



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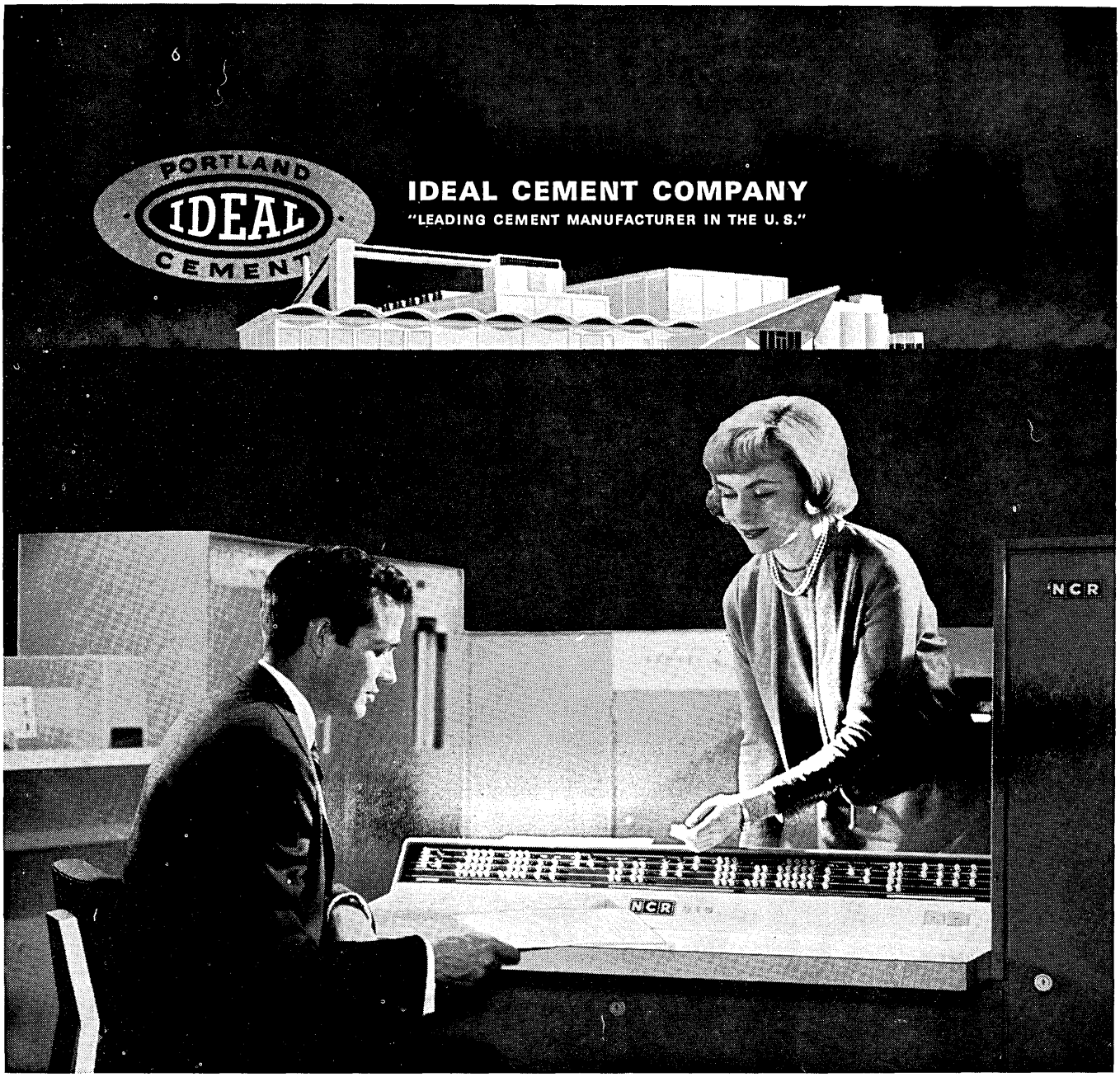
Bell Telephone System



"Why we chose the NCR 315 Computer."

— IDEAL CEMENT COMPANY, Denver, Colorado

"In these days of sharpened competition, maintaining an adequate return on investment requires current, accurate information quickly and clearly presented. At Ideal we are counting on our NCR 315 System to give us much better control over all phases of our operations.

"Ideal operates 17 plants (an 18th is under construction), ranging from California, Oregon and Washington through the Mountain, Mid-West and Southern states to the Atlantic and Gulf Coasts in the Southeast. The control of operating and repair supplies, and the value analysis on these materials are big jobs which the computer with CRAM will permit us to do more efficiently.

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Cris Dobbins

Cris Dobbins, President, Ideal Cement Company

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NCR

The weird group of "electronic stalagmites" gracing our front cover this month were produced by the clever wedding of a TV scanner, a computer to transform coordinates, and an oscilloscope. Its purpose: Art for Art's Sake.
Story and more pictures on page 8.

computers and automation

JANUARY, 1963 Vol. XII, No. 1

computers and data processors: construction, applications, and implications, including automation

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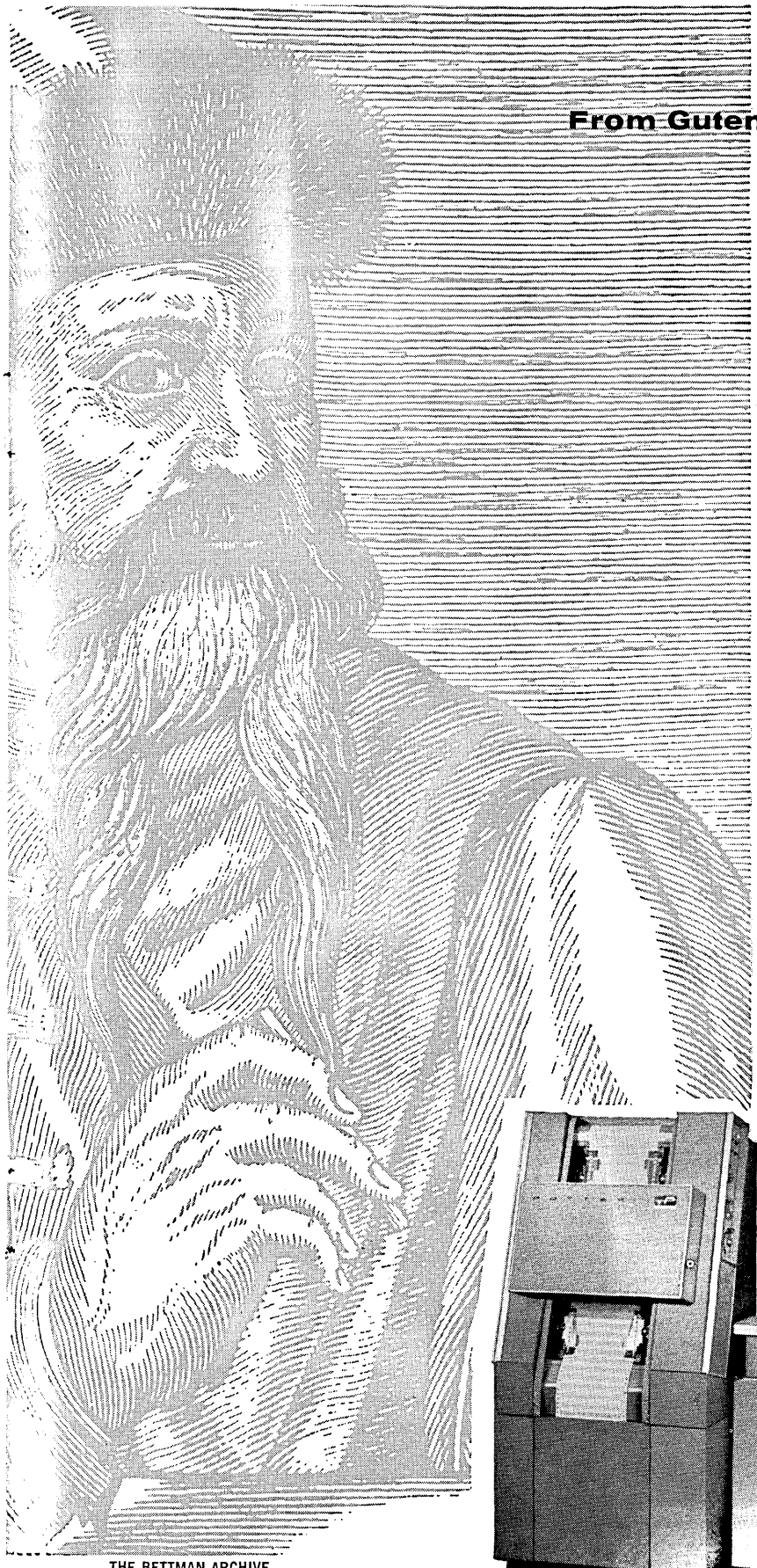

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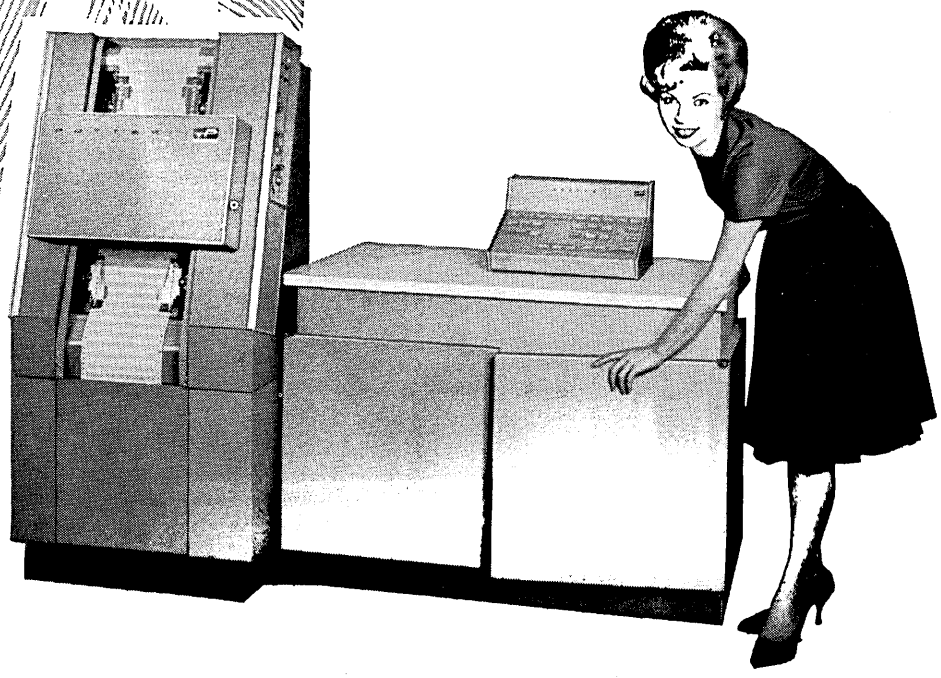

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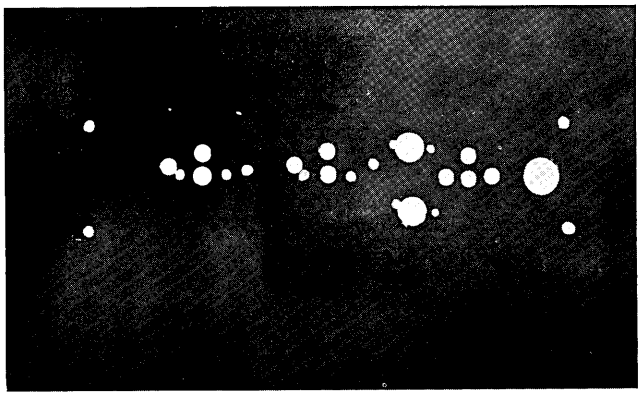
*T.M.

Readers' and Editor's Forum

FRONT COVER: COMPUTER ART

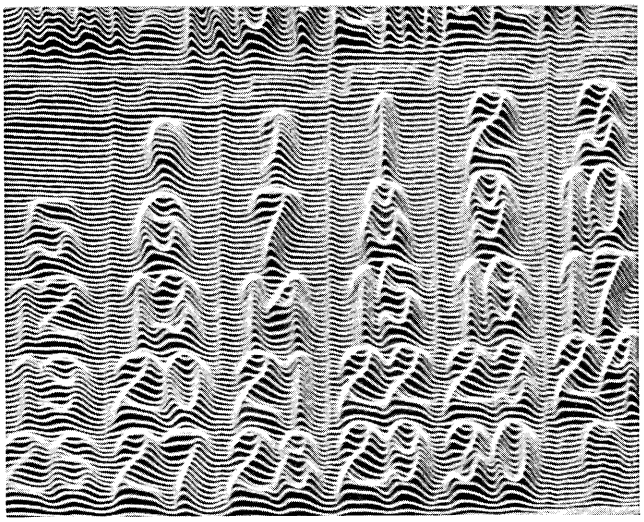
The brush is an electron beam; the canvas, an oscilloscope; the painter, an electronic computer. The result: an intriguing form of "electronic surrealism."

What is the set-up that transformed the light shining through holes in a metal plate into the weird group of phosphorescent "stalagmites" on the front cover? It involves a digital readout television camera similar to the one developed for the Orbiting Astronomical Observatory Satellite. This camera scans like an ordinary TV camera, but instead of constant readings, it gives a series of discrete readings indicating intensity as well as horizontal and vertical position. These readings are fed into a computer which combines the intensity and vertical position measures for any one point. When the computer plots the resultant information on a oscilloscope screen, intensity is displayed as distance above the horizontal axis. In effect, the initial coordinates x, y, and I are transformed to $x' = x$, and $y' = y + I$.



Raw material for the front cover picture—light shining through the holes in a metal plate.

The work was created by Ebram Arazi, a junior at the Massachusetts Institute of Technology, working under Associate Professor Robert O. Preusser in an "Art For Engineers" course. Mr. Arazi says that the next step in his work to make the computer a skilled companion in artistic creation is to free the computer from the limitations of two dimensions and of monochrome. He hopes to have the computer prepare a tape to run an automatic milling machine so that the computer can make a three-dimensional shape as an impression of what it has seen. Then the computer will be a sculptor as well as a painter. He also intends to continue work with the present set-up, but in color. He expects to photograph objects through three different colored filters, then presenting the different pictures to the special camera separately, photographing each output through the colored filter with which it originally was taken, and then combining the three. The resulting scenes are, understandably, expected to be very striking.



A calendar page is turned into an undulating mass of digits by the computer guided oscilloscope.

BEMA DISCUSSES EDUCATION FOR CHANGE

The 46th Annual Meeting of the Business Equipment Manufacturers Association attracted a record size group of business machines corporation executives and leading national educators to the Waldorf-Astoria Hotel in New York City last month.

The theme of the meeting was "Education for Change." The capacity audience heard such men as Charles H. Percy, chairman of the board of Bell & Howell Company, and Dr. Edward H. Litchfield, Chancellor of Pittsburgh University and chairman of the board of SCM Corporation, give their views on the effect technological changes will have on the economy and educational systems of the U. S.

Mr. Percy reminded the audience that despite all the talk about automation and technological change, "the educated individual will never become obsolete. . . . Automation underscores the essential message of education for the future," he said. "The message is clear. Education is destined for a role that transcends its importance in all the centuries past. For only education holds the means for survival and the promise of a future, not only for coming generations, but for our own generation if we are to cope successfully with the complexities and changes of the present."

Dr. Litchfield stated that he saw the "computer sciences as a way of organizing and solving problems in varying fields of knowledge. The science of the computer is a very respectable discipline—next to philosophy in significance." He also mentioned that it is not unusual for doctors and dentists to go back to the university from time to time to catch up to the recent technology in their fields. "Businessmen should be prepared to act in a similar way toward the technological changes that the computer is creating in management practice," he stated.

The Business Equipment Manufacturers Association (BEMA) was formerly known as the Office Equipment Manufacturers Institute, and lists as its members the leading manufacturers of business machines and equipment, and related supplies.

Announced as chairman of the association for 1962-63, is R. Stanley Laing, executive vice president of The National Cash Register Company, who succeeds Emerson E. Mead, president and chief executive officer of SCM Corporation. Mr. Mead will continue to serve as a director.

Within BEMA's comprehensive structure are three groups that were organized to give concentrated attention to specific areas within the industry, the Data Processing Group, the Office Machines Group, and the Office Equipment Group. Each has a chairman who also serves as a board member.

Serving as chairman for 1962-63 of Data Processing is R. G. Chollar, chairman of the International Standards Organization Technical Committee 97; of Office Machines, Richard H. Woodrow; and of Office Equipment, Earl R. Correll.

Reappointed as president of BEMA, is Harry C. Anderson. The association has its headquarters at 235 East 42nd Street, New York City.

COMPUTER CORN

Yes, Virginia, computer people do have a sense of humor! This delightful fact was confirmed by **Computers and Automation's** circulation manager, Virginia Nelson, at the recent Fall Joint Computer Conference in Philadelphia.

The staff of **Computers and Automation** came out in force for the meeting. Editors, publisher, and circulation manager bundled together three thousand copies of the December issue, stuffed in each a special insert containing a guide to the FJCC technical program and exhibits, and carted the whole works in a rented trailer from the editorial offices in Newtonville, Mass. to the Sheraton Hotel in Philadelphia.

From a booth next to the main entrance to the FJCC exhibit area, Virginia found no trouble in distributing the three thousand copies—in fact the supply was exhausted by noon on the third day of the conference, and after that time over three hundred people filled in special slips requesting that a complimentary copy be mailed to them.

And how did Virginia manage to check the sense of humor of computer people? The insert gave the details of Virginia's strategem:

(Please turn to Page 46)

(Based on a radio talk given over the Voice of America program)

computers & decision making

Richard Bellman
The Rand Corporation
Santa Monica, Calif.

One of America's
outstanding mathematicians
and computer experts explains
the computing tools
which are enabling
man
to control systems
even when
he cannot fully understand them.

In examining natural forces such as gravity, electricity and nuclear energy for possible applications, we face various categories of obstacles. First, there is the inherent complexity of systems. Second, although it may be yielding a bit too much to anthropomorphic tendencies to attribute a willful perversity to inanimate objects, nevertheless, it is reasonable to state that there is an innate tendency for devices and programs of all kinds to depart from ideal and planned performance.

Necessarily, then, in connection with activities in all varieties of engineering, in economics, industry, agriculture, biology and medicine, we face the problem of *control.* This is the task of ensuring that devices continue to operate in the way they were designed to operate.

Since there are efficient and inefficient methods, cheap and expensive methods, fast and slow methods of control, a detailed theoretical investigation of the different methods of control is eminently practical. We encounter in this way many interesting scientific questions and thus, inevitably, fascinating mathematical questions.

In this examination of methods we meet every type of problem: ensuring that a motor run at a constant speed, guiding a space ship on its way to Mars, keeping an automated factory in production, correlating supply and demand at a stocking depot, destroying an insect pest without disturbing the over-all ecology, applying radiation to the treatment of cancer without causing further damage, etc.

Basic Principles: Choose an Optional Policy

In analyzing a number of processes of this type, we face no mystery concerning basic principles. It is "merely" a matter of choosing feasible policies or optimal policies from among millions or hundreds of millions of alternatives. It is decision-making on a large scale, and on an expensive scale.

In the study of other activities, there are difficulties of graver aspect. Sometimes we do not understand the nature of basic interactions, nor indeed even know of them, and the objectives themselves may be clouded. Nevertheless, we are called upon to make decisions, to exert control. What do we do?

More Research?

An immediate answer might well be: "Return to your laboratory and engage in ceaseless research until you have uncovered the missing facts." Unhappily, some realities of existence preclude this unhurried approach to pressing problems. We are often forced to take action on the basis of the best information currently available.

The scourge of cancer is an illustration. Here the human system suddenly behaves in an unstable and erratic fashion. A colony of cells, for reasons we don't wholly comprehend, begins to grow wildly, a cannibal group out of control, threatening the existence of the whole body. Presumably, with sufficient understanding, we could correct this behavior by reinstructing the cells as to their appropriate duties. At the moment, we must attempt to cure the condition without understanding its cause. On the basis of insufficient knowledge, and in a situation where

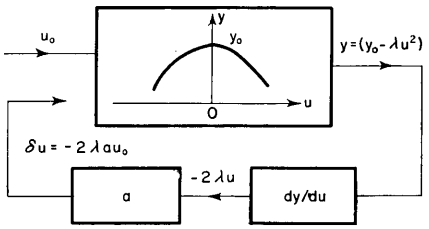
experimentation is difficult and costly, we must make decisions which affect human life. Since we are face to face with the enigma of the living cell, there is little reason to believe that we shall rapidly increase our knowledge, despite the vast effort that is being devoted to these questions.

Control Without Complete Understanding

This then is a basic challenge. Can we control a system without complete understanding? Clearly, total control requires total knowledge. There is, however, the possibility that sophisticated mathematics plus modern technology will permit us to obtain a limited, but essential, mastery on the basis of limited knowledge. Furthermore, we have the possibility of improving decision making on the basis of further experimentation and improved theory. This brings us to the exciting new field of adaptive control processes, processes in which we learn while doing.

In order to understand the scope of adaptive control, let us first discuss some simple but powerful mathematical concepts which permit us to use electronic computers to treat many significant classes of decision processes.

A remarkable feature of the mathematical approach, an abstract method not particularly concerned with facts per se, is that it enables us to apply particular techniques developed in one part of the scientific domain to the solution of problems arising in all parts. For example, a sampling method devised to speed the production of reliable electronic components can be used to improve diagnostic and medical laboratory techniques; a mathematical shortcut originating in the computational solution of chemotherapy equations can be applied to the calculation of trajectories; an ingenious way of designing nuclear reactors can be used to study the effect of radiation upon cells; and examples could be multiplied indefinitely. The point is that mathematics is a universal translator permitting us to convert ideas originally expressed in one scientific language into all other languages.

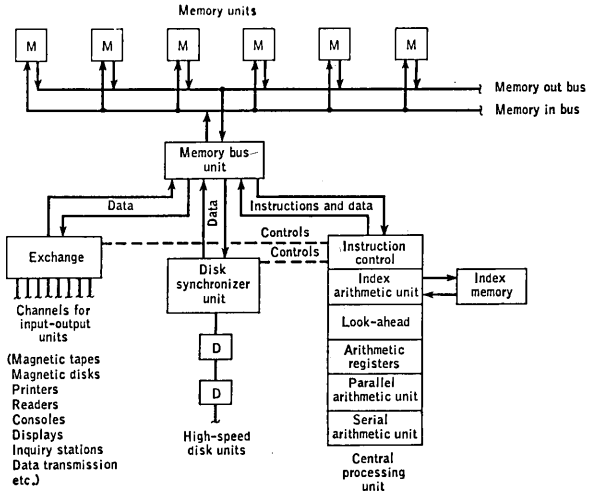


Electronic Computers

A most important tool in this conversion of intellectual energy is the electronic computer. The development of the computer, this Sorcerer's Apprentice, has drastically influenced scientific research in all fields. This is at first sight remarkable, since this instrument, stripped of the flashing lights and the Sunday supplement prose, is only a sophisticated device for carrying out one of the most primitive of all mathematical operations, addition, and thus multiplication.

Yet, since a computer can perform these operations unerringly and rapidly, it has made possible the complete solution of problems which as recently as twenty years ago were considered beyond the confines of scientific study. They could be formulated, the equations could be analyzed to some extent, but we could not take the crucial step of obtaining numerical answers to numerical questions.

The computer, however, is severely warped in its capabilities. Therefore an enormous amount of preliminary research and preparatory effort must be carried out before it can be used in the study of a particular problem. This apparent drawback has had a very fortunate effect. The skill of the computer in some tasks and its clumsiness, or even impotence, in the performance of others, make it obvious that enormous benefit is to be derived from the proper formulation of scientific questions. A paradoxical



statement which has been well known in some quarters is now becoming universally accepted: A good question is worth far more than a good answer.

The computer is ideally suited to the carrying out of repetitive operations. It is designed for the repetition of simple instructions—up to certain degrees. But it does not do well in situations in which an enormous number of alternatives must be examined in a routine fashion, say 10^{40} possibilities; nor does it possess any innate judgment. The mathematician, aided and abetted by the scientist, must therefore carefully phrase problems so as to fit the abilities of the computer.

Evils of Decentralized Approach

Even now, we see a situation in which a physicist or engineer uses broad scientific training and experience to formulate a problem, and then translates it into mathematical terms on the basis of the usual limited and stilted mathematical training given scientists. If the equations transcend his abilities, he hands them over to a mathematician who analyzes them on the basis of equal broad mathematical training and equally limited scientific training. If the mathematician cannot obtain an explicit analytic solution (an event of very small probability), the equation is then given to a computer group with the request that a numerical solution be obtained, a statement which he often feels absolves him of further responsibility. The numerical analysts usually have no grasp of the original physical problem, and have a natural tendency to fit the problem to routine techniques rather than devise new methods for new problems.

That any problems are resolved by this sequence of poor impedance matching is remarkable. That there is great loss of time and effort is not at all remarkable. Specialization and compartmentalization necessarily lead to a loss of perspective which produces individuals not particularly competent even in their narrow specialty.

Unified Approach

More and more, it must be recognized that the only correct approach is the unified approach. There is one problem with many phases: recognition, scientific formulation, mathematical formulation, numerical solution, comparison of predictions with observations. These different phases are so intimately intertwined that to treat one phase alone without the others is a severe handicap to success.

Particularly in the presence of the computer which for the first time allows us to carry out this integrated program is the over-all point of view essential. It is thus remarkable that a device designed only to do arithmetic has so stimulated the field of scientific philosophy and forced a reorientation in so many areas.

Control: A Sequence of Decision

We have previously pointed out that automation leads necessarily to control and that control involves decision making. Furthermore, control is not a "sometime thing"; it requires a sequence of decisions. Consequently, automation leads us directly to the study of multistage decision processes.

Dynamic Programming

Having thus arranged the background scenery, let us bring on stage one of the principal players, the theory of *dynamic programming*. This is a mathematical theory specifically designed to handle multistage decision processes in all respects, conceptual, analytic and computational.

Mathematically, a control process is conceived of in the following terms. First of all, there is a system, an abstract system, whose condition at any particular time is described by a set of numbers, the state variables. Thus, for example, the state of a rocket ship on its way to Venus might be its position in space, its velocity and the quantity of fuel remaining. The state of a chemical manufacturing process might be the quantities of different chemicals present, and their temperatures. On the basis of the information contained in the set of state variables, and also information tacitly contained in known physical laws, a decision is made which affects the system and transforms the old state into a new one. For the case of a rocket ship, a decision might be to increase the burning rate of the fuel and also to change direction; for the chemical process, it might be to add a quantity of a catalyst and to vary the temperature.

Efficiency of Control

The over-all control problem is that of making sequences of decisions in an efficient fashion, where efficiency is measured in terms of the history of the process and its ultimate outcome. The questions are seldom trivial since it is usually required to balance two factors: the utility of allowing the system to operate in some unregulated fashion and the cost of exerting control.

If we design and direct a rocket ship in some haphazard fashion it may not get to Venus because the increases in weight due to the control apparatus results in excessive fuel needs. Adding more fuel may add more weight in such a way as to accentuate the deficiency. Furthermore, additional gadgetry can lead to additional possibilities of error and malfunction. How do we compromise? How do we balance advantages and disadvantages? These and many similar questions represent the real scientific difficulties of automation, difficulties often concealed in the glowing reports of the Sunday supplements.

The Concept of a Policy

To study these questions mathematically, we introduce some terminology. Let us begin with the concept of *policy*. This is a rule for making decisions which tells us what to do in terms of where we are. Thus, a quarterback has to decide whether to run or pass on the next play; in poker, a player makes up his mind to call a bet or not; and so on. A policy which is best according to a preassigned criterion is called an *optimal policy*.

For a rocket ship, a policy would consist of a set of steering directions and burning rates for all possible positions and velocities, which is to say for all possible states of the system. An optimal policy would

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EXAMPLE: 160-A FORTRAN PROGRAM

```
1  Format (8H CDC160A/5F10.8)
   DIMENSION A(5,5,5)
2  READ INPUT TAPE 1, 1,
  X(((A (I,J,K), I=1,3), J=1,3), K=1,5)
   SUM = A(2,1,5) + 4
   B = 11111.0
   DO 3 I = 1,1000
3  SUM = SUM + B**2
   WRITE TAPE 2, A SUM
   GO TO 2
   END
```

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be one which minimized the time, or the total amount of fuel required, to get from the Earth to Venus, or conceivably the total cost of the project. Since there are many possible criteria associated with a given process, there can be equally many different optimal policies, each dependent upon what it is that we wish to accomplish.

The Principle of Optimality

The problem of control is thus equivalent to the problem of determining optimal policies in multistage decision processes. Fortunately, we can characterize optimal policies in the following simple, intuitive fashion:

Principle of Optimality. An optimal policy has the property that whatever the initial state and the initial decision are, the remaining decisions must constitute an optimal policy with regard to the state resulting from the first decision.

This can be considered to be the essence of the concept of *feedback control,* one of the fundamental concepts of science with particular relevance, as it turns out, to contemporary developments in biology and psychology.

What is rather surprising is that the foregoing statement concerning optimal policies, a rather straightforward and obvious remark, can be translated into mathematical formulas which provide powerful analytic and computational techniques for the solutions of particular control processes. These processes range from the thinning of forests to the operation of nuclear reactors. The iterative nature of an optimal policy, the repetition of decisions, is ideally suited to the peculiar makeup of digital computers. With this new theoretical approach and with the speed and accuracy of computers, we can resolve many problems which we could not even formulate heretofore.

The concept of a policy is a basic one. In the first place, it is the intuitive and natural approach to decision making. The result is that we can use the intuition gained from years of experience in dealing with actual processes to provide us with excellent first approximations to the solutions of the mathematical equations. Standard methods can then be applied to sharpen these approximations, and thus determine better policies. We also possess systematic techniques for testing any given policy to determine whether it is an optimal policy or not.

Secondly, a solution in terms of a policy, what one does in terms of where one is, is well suited to the study of multistage processes involving chance events and uncertainty. In dealing with these situations, rigid and inflexible prescriptions can be costly and even disastrous. In many cases, furthermore, we must adjust to new situations and learn about them as we make decisions. These are *adaptive processes,* processes which in recent years have assumed greater and greater importance.

Medical Diagnosis

A particularly interesting example of an adaptive control process is medical diagnosis. Here the doctor starts with the information, usually given to him directly by the patient, that something is wrong with the human system. He makes some preliminary tests and prescribes some preliminary treatment. If the system persists in malfunctioning, further tests are made, further information is gained, and further treatment is ordered.

Experimenting

This is, of course, the basic problem confronting the experimentalist. In studying the properties of an unknown, or partially known, system, he makes some initial tests and is led to some initial assumptions concerning the nature, or at least the behavior, of the system. On this basis, he makes further tests, is led to further conclusions, and so on. If he is lucky, he finally arrives at some worthwhile results. In other cases, perfectly reasonable a priori conjectures can lead to the expenditure of great amounts of time and effort with little to show for it all.

Sequential Analysis

In the field of statistics, processes of this nature lead to the development of sequential analysis (by Wald and others). This mathematical theory, a precursor of dynamic programming, has resulted in significant saving in time and labor in many situations requiring inspection and control.

In many decision processes, two or more groups are involved, as in competitive bidding, or in sports such as baseball or football. Here, dynamic programming and the theory of games of Borel, von Neumann and Morgenstern, merge to provide a treatment of multistage decision processes involving two or more participants.

A particularly interesting application of dynamic programming is to the study and construction of intelligent machines. So much has been written on this fascinating and frightening idea, that it is difficult for the layman, and even the professional, to distinguish between fact and fancy, between the probable and the possible.

Treating Decision Processes

In order to apply mathematical theories to the treatment of decision processes, we must be able to describe the state of the system in precise terms, to describe the effects of decisions upon these states, and to evaluate the worth of a sequence of decisions. In practically any significant decision process that one can think of in the realms of politics, industry, warfare, sociology, in other words, in processes involving *people,* we face grave difficulties in all three of these requirements. The major obstacle to the use of mathematics lies not in the solution of formidable equations, as most people believe, but in the formulation of questions in exact mathematical terms, the very first step.

Lack of Judgment in a Computer

Since a digital computer requires absolutely precise instructions for every step it takes, for every operation it performs, we cannot use a computer to solve any problem which we ourselves cannot state unambiguously. A computer has no judgement!

(Please turn to Page 47)

A SURVEY AND STUDY OF THE COMPUTER FIELD

Industrial Securities Committee
Investment Bankers Association of America
Washington 4, D.C.

The editors are pleased to be the first to publish this informative and interesting report on the technology, economics, and application of computers, and of the history, status, and future of the computer industry.

PART 1

THE computer industry is relatively young in age when compared to most other industries. Measured from the date of the first computer installation in 1951, the industry is a little more than a decade old. The more significant date when discussing the industry's development would be the 1953-1954 period, when mass production techniques were applied to computer manufacture, and commercial electronic computers started to be produced on a large scale.

FROM practically no installations or sales in 1951, the industry has grown to a point where there are now 10-12,000 computers in use, with yearly shipments on the order of $1.5 billion. Within the short period of ten years, this industry now finds ranking among the billion dollar industries. There are no official industry statistics available, but it has been estimated that the computer market has been growing twice as fast as the market for office business machines, and on the basis of a 25% annual growth rate since 1957, is growing twice as fast as the electronic industry as a whole.

(Based on a Report of the Committee at the 51st Annual Convention, Hollywood, Fla., November 25-30, 1962.)

AN estimated cumulative total of 16,187 computers have been installed to date. Based on an average selling price when new, the value of these installations is estimated to be in excess of $4.5 billion. Industry experts are predicting shipments of $5.5 billion in 1970, so that this cumulative value could approach $15-20 billion by that date, or an increase of 350% from present levels.

THE rate of technological improvement has been one of the industry's outstanding characteristics. Despite its short history, two generations of computers, vacuum tube and solid state systems, have already been introduced, and a third generation should be introduced by late 1964 or early 1965. These machines will incorporate such advanced components as magnetic thin films, tunnel diodes, and microminiaturized circuits, and will operate at speeds measured in billionths of a second. These operating speeds compare with thousandths of a second in vacuum tube machines, and millionths of a second in solid state computers. Future computers will perform up to 2 million operations a second.

THESE technological advances are leading to lower costs per calculating operation. Third generation computers will cost 2.5-times more than current equipment, but will operate 10-times faster. The greatest technological advances will come in peripheral equipment. The development of optical scanners, data transmission equipment and video display systems will open up new multi-million dollar industries.

ECONOMIC justification for the utilization of computers is based on the savings effected in such areas as clerical personnel and inventory. Computer usage has led to savings of 10-25% in clerical costs in many cases, and savings of 10-20% in inventory costs. The greatest payoff, however, will be in sophisticated total management information systems, employing such advanced management science techniques as operations research and linear programming. Costly decisions of the past, such as Ford's Edsel model, and General Dynamics' Convair 990, might be avoided with these techniques. There are over 500 areas in which computers are finding an application today, and these are growing every day. Future applications will include income tax processing, weather forecasting, medical analysis and diagnosis, traffic control and automatic classroom instruction, amongst many others.

Competitive Conditions

The computer industry has developed some very definite patterns and characteristics during its ten year life period. Of the nine major companies manufacturing computers, only two are showing any profits. One of these companies is IBM, which accounts for approximately 80% of the computer market. Large capital investments and research and development expenditures are required to remain competitive, and the breakeven point for most companies still appears to be 2 to 3 years away. This profit picture becomes critical in view of the capital requirements necessary for effective competition. Another industry characteristic is that 80% of the computer installations are leased. The huge investment required to carry rented equipment is straining the budgets of even the largest companies in the industry. Stiff competition, the absence of profits, and huge financial requirements could lead to some attrition in this industry within the next decade. The long-term reward for the successful companies, however, will be considerable.

Public Acceptance

As the communications problem between man and machine improves with the utilization of packaged language programs offered by computer manufacturers, the computer could one day become as easy to use as a desk calculator. This will open vast, untapped markets. Computers appear to be today where the automobile was when it generally gained public acceptance. Electronic data processing will lead to a dramatic increase in technological progress as it extends man's capabilities and intellect. Computers will help to channel man's efforts into areas and directions promising the greatest profits and rate of return on investment. These machines will not only aid in the restoration of former profit levels for business as a whole, but will be an invaluable tool in meeting the serious challenge our country faces in international trade competition.

Technological Advances

Tremendous strides have been made in hardware and software technology since the introduction of the first computer in 1944. The term "hardware" includes the computer itself and its tape transports, printers, card punchers, automatic typewriters, and other accessories. "Software" includes all the programming systems required for the effective utilization of the hardware of a computer. A brief look at these areas will show the tremendous progress being made in the field.

The first general-purpose automatic digital computer was the Automatic Sequence-Controlled Calculator, a machine introduced in 1944 under the joint development of Harvard University and IBM. This machine handled numbers of 23 decimal digits, stored them in 72 storage registers, and performed additions in approximately ⅓ of a second and multiplication in about 6 seconds. This machine was followed by the Eniac (Electronic Numerical Integrator and Calculator) which was completed in 1946 at the Moore School of Engineering at the University of Pennsylvania. The Eniac contained 20 registers, where numbers of 10 decimal digits could be stored. It could add numbers at the rate of 5,000 additions per second, and could carry out from 360-500 multiplications per second. The prodigious development since these early machines is indicated in the operating characteristics of today's machines. Addition speeds have gone to more than 100,000 additions per second and multiplication speeds have risen to more than 10,000 per second. The amount of storage capacity accessible to the computing unit has gone from 72 storage registers to literally millions of registers. Some of these registers are accessible to the calculating unit in less than a millionth of a second. Today the most powerful machine can take in information, remember it without forgetting it, at the rate of about 100,000 characters per second. As a common or convenient length of word is twelve characters, a speed of 96,000 characters per second is the same as a speed of 8,000 words per second. Although the ability of machine and man is different, it might be noted that human beings could not take in even one twelve-digit number in one second. In this light, it might be fair to say that computers have an input advantage over the human being by a factor of 1,000:1. In terms of output, a computer can record on magnetic tape at the rate of 100,000 characters a second. It can control a paper tape punch which punches tape at the rate of 100,000 characters per second, or a card punch which punches standard punched cards at the rate of 30 per second. High speed printers print 17 lines of 80-120 characters a second, or over 1,000 lines a minute. A fairly representative ratio of computer output speed would be about 8,000 words a second, while the top output of human beings is approximately four words a second. This gives the computer an advantage factor over a man of 2,000:1. These statistics provide ample evidence why computers are displacing human beings in handling repetitive types of data.

Reliability

Not only speed and capacity, but reliability of automatic computers has also been multiplied by a factor of tens of thousands. Reliability has increased to a point where a billion to ten billion operations take place without errors. It is not uncommon for computers to be operating at uptimes in excess of 95%. In addition, automatic checking has been built into computers, so that the release of wrong results is virtually an impossibility.

Software

The importance of software development to computer users is illustrated by the fact that investments in program development amount to over one-half of the total rental expenditures for machines, and at the current rate of program development, these costs could equal the total ma-

chine rental cost by 1965. Computer users, consultants, and manufacturers have invested hundreds of man-years of work and millions of dollars in packaged programs and systems in order to simplify the task of using electronic computers. One of the facts contributing to this cost is the lack of compatibility between different types of digital computers. Programming dollars are spent on duplicate development due to differences in equipment and methods of documentation. A great turmoil is currently going on in the software area in search for standardized computer programs and languages. Improved software packages, or ready-made programs that come with almost every computer now made, have reduced programming costs, but it has been estimated that U. S. business and government computer users have invested over $2 billion in privately developed programs since 1950. These programs are both general and specialized. The general programs are written to represent general management problems common to all industry, such as linear programming, sales forecasting, scheduling complex projects and balancing production lines. More specialized types of programs cover such areas as demand deposit accounting in banks, hospital accounting, and automobile rating for insurance companies. Some of the more common general automatic programming systems include ALGOL, COBOL, FORTRAN, FACT, GECOM, and JOVIAL. Each of these programs is inadequate as a standard language, because it lacks a complete range of expression. More computer programs are written in FORTRAN, a scientific language, than in any other programming language due to the fact that IBM has such a considerable investment in its processors and programs. FORTRAN processors have been implemented for 26 machine types. For business purposes, however, FORTRAN involves great technical detail, and is difficult to learn. For scientific purposes, it lacks the power and flexibility of ALGOL or JOVIAL. COBOL, COmmon Business Oriented Language, developed by the Department of Defense, is being implemented for 35 machine types by 15 manufacturers. ALGOL has been described as a more powerful and general language than FORTRAN, since it allows the user to write more comprehensive problems in source language. However, ALGOL compilers are in existence for only three machines. The greatest advantage of these programs will come with one truly high level programming language, saving users many years of systems and programming efforts. This could conceivably be a combination of ALGOL, COBOL, and a third language suitable for systems programming. The day may come when all we have to do is to present the data and general problem to the computer, and it will figure out how to find a solution and write a program.

Software is available from both computer manufacturers and computer user groups. IBM has the largest library of computer programs in the industry, containing close to 6,500 programs, some of them with up to 120,000 instructions. It has been estimated that over 725 man-years of programming efforts would be required to duplicate the programs in this collection. No value has been placed on the collection in this library, but original programming can cost from $2.00 to $20.00 per instruction. In addition to computer manufacturer programs, computer user groups collect and distribute programs developed by its members. Any member gets access to a great deal of programming done by other members, thus saving much duplication. The largest program collection of any computer user group is that of SHARE, for the IBM 704, 709, and 7090 computers, with over 1,800 programs. Other computer user groups include EXCHANGE (Bendix), CUBE (Burroughs), CO-OP (Control Data), GET (General Electric), and USE (Univac). Not only do users groups correct defects in specific programs, but they are helpful in organizing and stimulating ideas for new programs. Computer users have found ways of using the machines that the manufacturer never imagined.

Computer Economics

The computer, the industrial revolution and the automation of factory processes have been described as the three most important events in the development of Western business. Computer development has emerged from two main trends in the growth of our country. One is the explosion of scientific and engineering knowledge, and the realization that long laborious calculations could not be handled in ordinary, symbolic mathematical ways. The other trend is from the business world, with enormous quantities of records and calculations required for businesses to function. Our civilization has not only grown complex engineering-wise and technologically, but also business-wise and industrially, so that it has produced an enormous growth in the information to be handled. This has provided the impetus behind the great development of automatic handling of information, expressed in computing and data processing systems.

Economic Justification

Three primary factors are leading to structural changes in businesses today: (1) the availability of computers to any size of business; (2) the fantastic quantities of internal and external data generated by government and business reports; and (3) a structural change in the economy itself.

Formerly, wrong decisions were not fatal to a company's existence, as illustrated by Chrysler's square automobile design, Lever Brothers' decision to stay out of the detergent field, General Dynamics' decision to build the 990, and Ford's marketing of the Edsel. Today, businesses vitally need data to prevent making a wrong decision or being locked in a situation. The focal point of many of these decisions revolves around a computer.

Computer utilization is justified in situations where greater speed in processing data is required, or where the complexities of data processing cannot be simplified without electronic assistance, or when the investment in computer equipment is substantially offset by both quantitative and qualitative benefits. With the exception of scientific and military applications, computers are usually purchased for the direct savings which they effect. The urgent need to displace human beings performing clerical and accounting tasks is illustrated by the fact that during the last ten years, the number of clerical personnel has grown 29%, and salaries have been increasing at an average rate of 3% a year. On an annual basis, wages for clerical personnel alone are in the area of $392 billion.

Clerical Savings

Company after company can cite huge clerical savings through the use of data processing machines. McDonnell Aircraft, in completely automating its purchasing cycle, estimates it will save $100-200,000 annually, mostly accounted for by clerical savings, with a machine renting for $6,400 a month. Sylvania Electric estimates that it will save approximately $400-500,000 annually in such areas as

clerical and inventory reductions through the use of machines renting for an estimated $325,000 a year. Nationwide Insurance has produced savings of about $200,000 a year in the area of Renewal Billings, with a machine which rents for an average of $9,000 a month. Most of this is the result of clerical reductions. Nationwide has projected saving in excess of $1.0 million over the next seven years. Reductions in both the level and carrying costs of inventories have also justified the utilization of computers. Many cases could be cited for savings of 5-30% annually in this area. American Cyanamid expects its computer-controlled finished-goods inventory system to yield savings of at least 10-15% of its annual cost. Annual savings are estimated in the area of $200-340,000 a year. Martin-Marietta expects inventory levels to be slashed by more than 60% when its IBM 7070 data processing system goes into full operation. In addition to clerical and inventory savings, a faster flow of vital information and the elimination of paper work delays and duplication will save companies like Lockheed $2.0 million annually, with the annual rental cost of the system involved about a third of these annual savings.

In addition to cost savings, a number of other important contributions are being effected by computers. Some of these include: increased speed and accuracy in preparing management reports, better customer service, lower costs to the consumer, and improved control over the operations of the business. The full potential of the computer has not been realized yet, and the greatest potential payoff appears to be in sophisticated areas which have been out of man's reach to date, such as totally integrated management information systems.

Urgent Business Problems

Two very urgent problems are facing businesses today: (1) the need for increased profitability; and (2) the ability to compete in international markets.

The cost-price squeeze which has characterized our economy during the past decade has steadily decreased after-tax profit margins from 9.1% in 1950 to 5.8% in 1961. One of the major cost items for business has been wages. Manufacturing weekly earnings have increased from $63.34 in 1951 to $95.75 in 1962, or a 50% increase during this period. In comparison to other countries, the United States has lagged substantially behind many countries in terms of growth in Gross National Product, Industrial Production and Manufacturing Productivity per person over the past decade (see Table 1). In addition, our arch rival, the Soviet Union, plans to increase industrial output by 150% within ten years, thus exceeding the level of U. S. industrial output. It plans to increase industrial output 500% in twenty years, and raise the productivity of labor 300-350% during this time. This is to be accomplished by a mass scale of comprehensive automation, with primary emphasis on fully automated shops and factories. Cybernetics, computers, and control systems will be widely used to meet these goals. The Soviet spent $180 million for developing computers in 1958, and plans to spend between $800-850 million by 1965.

Selecting a Computer

A recently completed independent survey of computer users[1] indicated the following factors as influencing the choice of a computer: 1) the computer which offers the greatest anticipated pay-off in clerical savings, 2) reputation of the manufacturer, 3) maintenance factor, 4) comparison of costs, 5) purchase prestige, 6) product support, 7) compatibility with existing systems, and 8) error-checking characteristics. The same report stated that 90% of the users reported they had realized the savings estimated in the original computer study. It is not uncommon for computer feasibility studies to run up to 12 months, since such a large investment is involved. The factor of prestige has not always been beneficial to users, however, for when prestige superseded efficient systems engineering, ineffective computer utilization has been the result. Systems application or engineering has not only been the key to successful computer utilization, but has also been the reason for success or mediocrity on the part of computer manufacturers.

Determining the type, size, capacity and competency of a computer is not an easy task. Compromises must be made in most instances, with systems application the dominant factor. If a computer fits the requirements of a particular application, then the aforementioned benefits usually follow automatically. Prospective computer users must analyze many computer characteristics in relation to the job to be done and the cost involved.

Computer feasibility studies must also consider the question of lease versus purchase. The industry is currently favoring the lease method, with approximately 80% of machine installations on a rental basis, with an option to buy. Typical rental costs are misleading if taken at face

Table 1

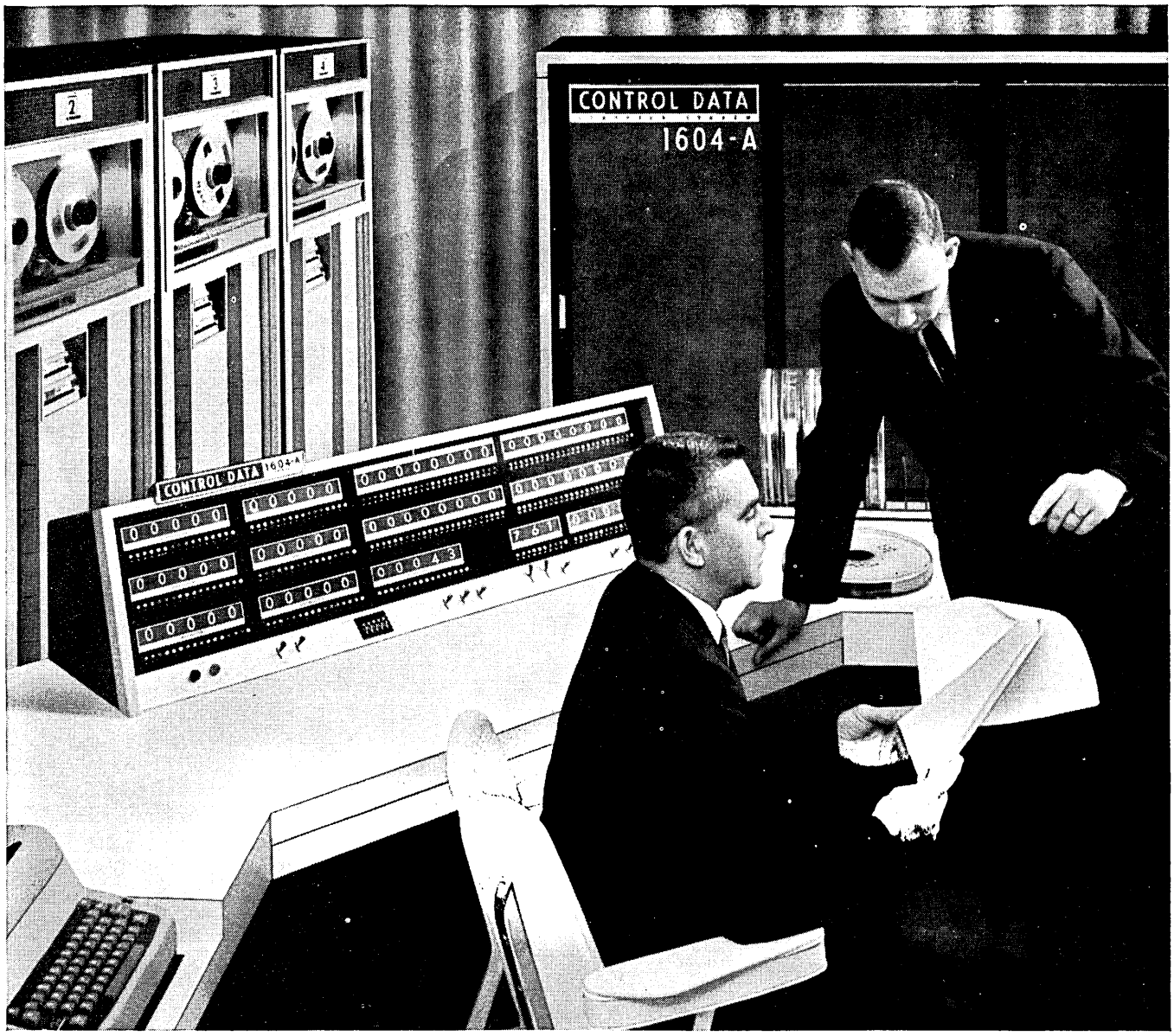
A. Average Annual Rates of Economic Growth in Eight Countries, 1951-60 (in Percent)

Country	Real GNP (Gross National Product)	Industrial Production
U. S.	2.9	3.2
Canada	3.6	4.3
France	4.2	6.6
Germany (F. R.)	7.2	8.8
Great Britain	2.7	3.2
Italy	5.8	8.5
Japan	8.7	14.5
Sweden	3.7	3.7

B. Percent Increase in Output and Manufacturing Productivity in Eight Countries, 1951-60

Country	Real GNP per Capita	Mfg. Productivity per Person Employed in Mfg.
U. S.	12	22
Canada	9	28
France	33	62
Germany (F. R.)	70	50
Great Britain	22	24
Italy	58	85
Japan	92	151
Sweden	31	33

Source: Bureau of Labor Statistics, Monthly Labor Review



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value. For example, rental costs usually account for approximately one-fourth to one-third of total annual operating costs, so that a computer which rents for $200,000 a year could cost $600-800,000 annually in direct operating costs. In addition, start-up costs usually range between one and two years' operating costs. Taking all of these costs into account, therefore, a computer which rents for $200,000 a year could conceivably have resulted in operating expenditures of $1.2-2.4 million by the end of the first year. The government has approached the problem of lease versus purchase by setting up a cost advantage point. This is a point in time when one-time expenditures for purchase and accrued maintenance will equal cumulative rental payments for a particular machine. In situations where the cost advantage point is reached in six years or less, and the computer still fits the requirements of the job without major modification, a set of conditions exist which warrant purchasing the equipment. These policy guidelines should lead to a substantial proportion of purchased computer equipment by the government in the future. This approach, plus the slowing down of technological obsolescence and the ability of computers to vary in speeds and capabilities through the building-block modularity of central processing hardware, could lead to a higher ratio of sales than at present.

Unit Cost Per Calculating Operation

One of the most important factors in the cost of a computer is the unit cost per calculating operation. As the price of a computer goes up, the cost per calculating operation goes down. For the most expensive computers, the cost is least. For example, an IBM STRETCH, which rents for $300,000 a month, and performs an estimated 500,000 calculating operations per second, will during the period of a month perform calculations at the rate of 100,000 operations for 2½¢. It would cost $10,000 to perform a certain computation on a desk calculator, $10 to perform the same computation on an IBM 650 and about 50¢ to perform the computation on a STRETCH system. Using the same machines on a time basis, it would take approximately 1,000 hours to perform the sample calculation with a desk calculator, 6 minutes with the IBM 650 and only 12 microseconds with the STRETCH machine.

Tremendous increases in the ratio of computing power per dollar have been made in the last two years. The total rental of current machine installations is in the area of $73.9 million a month; and these machines in total can perform 108 million operations per second. When the operating ability of the installed machines is divided by total rental costs, a measure of computer power is available which can be used as a basis for comparing the advances made in computing power per dollar. On the basis of statistics, today's theoretical computing power per dollar ratio is 1.46, which is a 155% increase over the ratio of .57 in 1960. Expressed in another way, through-put speeds have increased at the rate of over 40% a year. As computing power per dollar continues to increase, more and more companies will find it economically feasible to invest in million dollar computers. A typical example is Sylvania Electric, which has found that its current machines operate at three to four times the speed of previous machines, while rental costs have been reduced by approximately 25%.

Areas of Computer Applications

The degree to which computer technology has become more specific and complex is illustrated in the fact that today there are over 500 areas in which computers are finding an application. Computer manufacturers have had to gear their marketing efforts to specific user problems, but in the process have opened up even more areas for the utilization of computers. A long list of some of the functions computers are performing in different areas has been published.[2] A number of these areas will be reported in more detail, in order to determine the significance of computer application to this area or industry, and to discuss the importance of these markets in light of computer usage trends.

Commercial Banking

Data processing firms have a business potential of some 5,400 commercial banks out of the 14,000 in this country. These are banks with over $75 billion in total deposits. The banks which have installed computers have found that they not only have better reports and tighter audit and control procedures, but are now able to offer new customer services and improve their competitive position. The major breakthrough in the banking industry with EDP did not come until 1959, when the final specifications for printing of checks coated with Magnetic Ink Character Recognition (MICR) numerals were approved by the American Banking Association. An estimated 68.3% of all checks cleared through Federal Reserve Banks now contain magnetic ink symbols, compared to 36.1% a year ago. The volume of checks processed in 1951 was 2.1 billion, but is expected to reach 22 billion in 1970, and 29 billion in 1975. By this time, most of these checks will be coated with magnetic symbols, and will be processed by computers.

EDP will have its greatest impact on the demand deposit sector of bank employment. About 20% of all bank workers doing work related to demand deposit bookkeeping will be seriously affected by the advent of automation. One major bank indicated that computers have led to an 80% decline in the number of bookkeepers in demand deposit activity over a four-year period, despite a 10% rise in demand deposit accounts.

One of the newest developments in the banking industry is the use of on-line computers. On-line, or real-time systems process transactions individually as they arrive at processor inputs, and usually return a result to the point of origin immediately following processing. In other words, this will make every bank office a main office for every customer, regardless of its location. Three banks in the East—Howard Savings, Union Dime, and Society for Saving (Hartford)—have installed on-line systems. The benefits from these systems have been a 90% reduction in back office teller work, and a 30% reduction in transaction processing time. The Howard Savings Institution expects to save over $100,000 with its system over the next five years.

The smaller banks which cannot afford computers are joining together in a cooperative movement. For example, six upstate New York banks are cooperating in three new computer centers equipped with $3.8 million worth of computing equipment. This movement could assume major proportions among smaller banks in the near future.

The value of total computer installations in banks through 1962 is estimated at $176 million. It is estimated that shipments to this industry will total $80-90 million a year between 1963-1965, so that a total cumulative market in the area of $450 million is possible by 1965. Computer

companies which will share this field include IBM, GE, NCR and Burroughs.

Communications

As the applications for computers increase, and as the requirement for up-to-date information grows, there will be a greater demand for data transmission equipment. Data transmission systems perform such functions as tying together a production line and a data processing center, sending the latest marketing and production facts from the field to a data processing center, and providing management with up-to-date information for more accurate forecasting, inventory control, and money savings. The most common medium used for data transmission is telephone lines. The method of transmitting over this medium is either punch card to punch card, paper tape to paper tape, magnetic tape to magnetic tape, or computer to computer. IBM and RCA are two major computer companies who have made contributions in the communications area. The importance of data transmission is indicated by the fact that AT&T expects that as much digital data will be carried by its wires as voice communication by 1970. RCA has estimated that the annual market for data transmission equipment will be over $300 million by 1965, and that the growth rate for this equipment will be roughly 30% a year. By the mid-60's, one-third of all electronic data processing sales will include communications equipment. Within 20 or 30 years, we could have an international information network operating via Telstar, with communications service on the order and scope of world-wide telephone networks today. IBM has experimented with low-power microwave transmission, and this could extend the capabilities of its Tele-Processing system for long-distance computer-to-computer communications to areas where common carrier facilities are not available, or where customers wish their own facilities. The linking of advanced communication devices with advanced data-processing systems will provide the big breakthrough in real-time total management information systems.

Education

New developments in computer technology are leading to increased automation in our public schools and universities. More than 200 school districts and departments of education in 45 states already use electronic accounting machinery to process business, pupil-personnel, and administrative data. On the university level, hardware valued at more than $115 million is currently in use in colleges and universities. Universities are not only good customers for large-scale computation facilities, but also are in a position to apply and teach techniques developed in other areas. Many colleges with computers have introduced computation courses, so that a large fraction of the students are exposed to programming at some stage of their undergraduate career. One of the most rapidly developing applications of computer technology to education is the use of computer-based teaching machines. A number of institutions are exploring the potential of the computer for controlling instruction of individual students on the basis of differences in learning rate, background and aptitude. The University of Illinois uses a computer to control a teaching system consisting of slides, TV displays and a student response panel. Answers to questions are transmitted to the computer through a response panel, and the computer judges the answers, indicates whether the student is right or wrong, and selects simpler material if the student commits an error. If this type of research is applied to school systems in general, then education is in for a major renovation.

Government

The Government is the largest single user of computers, with a total of 1,006 installations as of June 1962, excluding special military computers. Operating costs in 1961 (rental, amortization, personnel, etc.) were approximately $597 million, and probably in excess of $1.5 billion with the inclusion of military operational applications. Today there are over 45,000 employees in positions related to management or operation of computers in the Federal Government. The Bureau of the Budget has estimated that by 1966, 1,500 computers will be installed by the government.

Computers are being used for a number of new applications by the government in the non-military field. The Internal Revenue Service has turned to computers to process its 95 million tax returns. These tax returns have grown from 20 million two decades ago, and could reach 135 million in 1980. The only logical means to handle all this paper work is high-speed electronic equipment. The system will be in full effect in 1965, and should prove a very effective means of catching up with tax evaders. The Social Security Administration is using computers to speed the processing of claims for social security benefits. District offices transmit data via AT&T's Data-Phone system to a computer center in Baltimore. Information is produced on magnetic tape, which can be fed directly to the computing center for further processing. The government is also using computers to cut administrative costs in the federal farm program. The utilization of computers will cut out 241 jobs and save a total of $1.5 million a year when the plan is fully in effect by 1964. The government is keenly aware of the cost savings apparent in computers, and is employing them in very sophisticated applications to increase its efficiency.

The military has been the largest developer and user of computer technology to date. The military value of improved computer characteristics has led to the support of government-sponsored research projects which the computer industry would not have undertaken on its own. Due to the requirements of space, speed, and reliability, military control and command systems are far more sophisticated than commercial systems. However, many of the techniques developed by the military are adaptable to business systems. This could prove particularly applicable in on-line, or real-time systems. Advances made in the peripheral equipment area, especially advanced display techniques, could form the basis of a new multi-million dollar industry in itself. The space program has also opened up a huge market for computers. Four large digital computers form a network during an orbital mission, and provide a running display of important launch, orbital and re-entry information. Computers, with the help of radar, will be used in achieving orbital rendezvous during the first U.S. lunar landing mission late in this decade. The importance of the military market to the computer industry is indicated by the fact that annual shipments to this segment of the market will reach an estimated $2.5 billion by 1970.

Insurance

The first computer was installed in this industry eight years ago, and since then it has been one of the nation's biggest users of electronic data processing equipment. No

large life insurance company could operate competitively today without an electronic data processing installation. More than three-fourths of the nation's 120-million policyholders are now on tape. It is estimated that more than 75 large-scale computers, approximately 200 medium-size machines and many hundreds of small units are now operating in life company offices. These numbers are growing every day. In addition to its normal functions, computers will be used increasingly as an analytical tool in providing life companies with marketing analysis and financial forecasts. Operations research techniques will be used to provide life companies with scientific reports. Nationwide Insurance is a good example of what insurance companies are doing with computers. It installed an IBM 650 to calculate Renewal Billings, and in this one application produced annual savings of $200,000 as a result of clerical reduction. An NCR 304 was installed to create an integrated processing system, and to produce better and more accurate management reports at a minimum cost. With the help of these machines, Nationwide has projected savings in excess of $1 million over a seven-year period. In addition to the large companies like Nationwide, medium and small insurance companies will also need computers in the future. The insurance industry has installed machines valued at $400 million through 1962, and expects shipments of $100 million a year during the period 1963-1965. This would lead to a cumulative market of $700 million by 1965.

Investment Banking

In the financial community, computers are used in such applications as payroll, margin and cash accounting, customer statements, trade confirmations, commissions, dividends, and a host of allied management reports. Computers are also used to speed up such routine work as figuring portfolio market values and yields, and making records of company earnings, dividends and profit margins. A number of firms are experimenting with these machines for security analysis work. At this point, computers are supplying the various mathematical formulas and ratios which analysts use in judging the value of a security, and are providing the necessary statistics which determine the relative attractiveness of stocks. There is a limitation in the ability of a computer to recommend the sale or purchase of a stock, but current applications should improve the over-all quality of investment decisions.

Computers are also widely used in the various stock exchanges. The Midwest Stock Exchange is developing an electronic centralized bookkeeping service which will reduce back office expenses by more than 70% per order, and will save member firms an estimated $3 million a year in labor and machines. The NYSE's Stock Clearing Corporation uses computers to verify and clear thousands of transactions each day. A computer system which will automate the Exchange's ticker and quotation service is expected to go into operation early in 1965. This system will run the 3,800 stock tickers in the U.S. and Canada, and will provide a voice recording to announce prices over its telephone quotation service. A computer is used by one Wall Street firm to perform calculations required in bidding on serial bond issues, and to handle the mass of information involved in maintaining up-to-date files on all bonds.

Process Control

The use of computers for process control applications in factory automation appears to be on a level where general-purpose computers were in 1952. With increasing computer speeds and advanced programming methods, the control computer is taking over as a dynamic optimizer, readjusting plant operations to achieve continuous optimization of performance, rather than serving merely in a supervisory capacity. With increasing applications in the power and chemical industries, sales of digital computers for process control are increasing at the rate of about 50% a year. The power generating industry is first in the number of digital process control systems on order, which is estimated at 200. The rest of the market is comprised of the chemical, petro-chemical, petroleum, paper, glass and cement industry. As automatic process control is still in its infancy, the potential size of the market for computers is still a question. Some sources have indicated a $500 million market in this area by 1970. Computer companies which should share in this market include GE, IBM, RCA and Thompson-Ramo.

Production Control

Manufacturing companies are using computers for off-line production control in such applications as shop scheduling, assembly line balancing, scheduling labor utilization, and numerically controlling machine tools. Advanced management sciences, such as operations research, will find increasing use with computers to optimize decision-making on inventory policy, long-range market strategies, plant and warehouse locations, and capital investment programs. Simulation techniques will reveal unprofitable or inadequate courses of action in advance, thus avoiding costly errors in judgment. Competitive pressures are forcing industry to take advantage of these techniques, which should provide a sizeable market for computers. This area could account for a $2-3 billion cumulative market through 1970.

Retailing

The potential for computing equipment in the retailing industry is considered very large, but will not attain fruition until three elements are more fully developed—optical scanners; methods of inexpensive data transmission; and larger, less expensive random-access memory devices. A number of retailing firms have installed computers to handle accounts payable, payroll, sales audit and accounts receivable. Notable savings are being achieved in these areas alone. For example, Stix, Baer and Fuller of St. Louis is projecting a five-year savings of $400,000 primarily in clerical savings, by employing two computers. The extension of computers into merchandise control, inventory control, and market analysis could prove to be even more significant in terms of savings. In this respect, retailing firms could very well follow the pattern set by such apparel companies as Bobbie Brooks, which is speeding up its inventory turnover by 30-40%, and expects to save over $1 million in the process over the next five years. As extensive improvements are being made in optical scanners, communication equipment and memory devices, it is conceivable that computer installations in the retail industry could reach $1.5-2.0 billion by 1970. NCR and Burroughs appear to be in favorable positions in this industry.

These are just a few areas in which computers are finding applications today. In addition, there are a number of areas with large, but relatively untapped potential, which appear to be ready markets for computers. These include: service organizations (hospitals, hotels), the transportation field (airlines, trucking, traffic control), local government, information retrieval, medicine, advertising, and law. The uses for computers appear limited only by man's imagina-

tion. Eventually, computers could become as commonplace as the office telephone.

History and Development of the Industry

History Since 1952

The years between the building of the first computer in 1944 and 1952 were years of experiment by universities, government departments and small businesses. At that time, major business machine, electric and electronic manufacturers became convinced that machines which could compute and process data automatically were important, and they entered the field on a big scale. Sperry Rand had a big jump on the field when they acquired Eckert-Mauchly Computer Corporation in 1950 and Engineering Research Associates in 1952. The founders of the former company were the designers of the Eniac, and their Univac I was the first general-purpose electronic computer designed for business data processing. This machine was complemented by a machine for scientific computations built by the Engineering Research Associates group. Sperry Rand embarked upon a vigorous marketing of both machines. The first commercial computer installation was in 1951, when a Univac was installed at the Bureau of Census. The first large-scale electronic computer to process business data, the Univac I, was delivered to General Electric in January, 1954. IBM turned down the Eckert-Mauchly Corporation because it felt that the greatest market potential for computers was in scientific rather than business applications. IBM did have twelve installations of its 701 in 1953, primarily for scientific work. The company's 702, a business version of the 701 meant to compete with Univac, was a failure. A crash program followed at IBM to replace the 701 and 702 with the 704 and 705, respectively, by January, 1956. In the meantime, IBM was making the most of Sperry Rand's mistakes. Sperry Rand failed to see the importance of service, customer education, and the development of high-speed output equipment. IBM sales strategy was not to deliver a machine until the customer had been completely educated and could utilize the equipment fully from the date of installation. This sales strategy paid off spectacularly, and the five-year lead which Sperry Rand once had on the field was erased by the end of 1955, when IBM was ahead of Sperry Rand in orders booked. By mid-1956 it had $100 million worth of its 700 series machines installed, against $70 million for Univac. Burroughs looked like a strong contender in the computer race when it acquired the Electro-Data Corporation in 1956. The company's Datatron computer proved excellent competition for the IBM 650 at the time. RCA made a huge initial investment of over $25 million to get into the computer field and sold its first Bizmac in 1956 for $4 million. This was the industry's biggest single installation to that date. There were four companies making large-scale computers in 1957, and industry sales were $350 million. By 1959, nine firms had made heavy commitments in the field, and industry sales were an estimated $500 million. Machine introductions were made by Bendix in 1955, General Precision in 1956, Minneapolis-Honeywell in 1957, Philco and Monroe in 1958, General Electric in 1959 and Control Data, National Cash and Packard Bell in 1960.

Industry Characteristics

The computer industry, when compared to other industries, is relatively young in age. Measured from the date of the first computer installation in 1951, the industry is a little more than a decade old. In terms of development, the years 1952-53 would be more appropriate in defining age, as this was the period when mass production techniques were applied to computer manufacturing. From virtually no sales or installations in 1950, the industry has grown to an estimated sales of $1.5 billion in 1962, with an estimated 10-12,000 computer installations. Today there are over 20 companies manufacturing electronic digital computers, with more than 200 companies making peripheral and accessory equipment. There are now over 150,000 persons employed in the manufacture, programming, operation and maintenance of computers. Despite a relatively short history, the industry has developed some very definite patterns and characteristics. One is the noticeable absence of profits.

With the exception of IBM and Control Data, no other major factor in the industry is making money on computer operations. This may be attributed to the fact that these two firms derive a great majority of their revenues from computers. In almost every other company, computing is a side line or a division at most. This factor of concentration, together with the excellent sales strategy and sales force of IBM, which accounts for approximately 80% of the computer market, has led industry spokesmen to believe that it will be a minimum of two or three years before most companies will begin to show profits from computers. Large companies like GE, RCA and Minneapolis-Honeywell have adequate finances to sustain these losses until profits are shown. Smaller companies, however, will not be able to absorb these losses from year to year, so that the field may narrow down through mergers or drop-outs in the near future. The computer industry has estimated that the total cumulative loss in its ten-year life history already approaches the sum of the two biggest corporate losses in business history, i.e., Ford Motor's Edsel model and General Dynamics' Convair 990. This profit picture becomes extremely critical in light of the capital needed to finance computer operations.

Heavy Outlays

The production of computers involves very heavy outlays. For example, RCA and Minneapolis-Honeywell have invested over $100 million each in their computer business, and for both companies it might be a minimum of two years before they realize any return on this investment. A good measure for financial requirements is the capital: sales ratio of the two profitable companies in the industry. IBM had a gross income of $1.69 billion in 1961, and total invested capital of $1.61 billion, or a ratio of almost 1:1. Control Data had invested capital of $23.4 million at the end of its 1962 fiscal year, on a sales volume of $41 million. Recently, however, the company issued $15 million in convertible debentures, bringing invested capital up to $38 million, for a ratio of almost 1:1 in terms of capital to sales. These financial requirements are staggering even to the budgets of the largest companies in the country, but are necessitated both by heavy research and development costs and by the methods of financing computer purchases.

The very nature of the computer industry makes heavy outlays on research inevitable. Producers must keep up with competition, and this requires heavy research expenditures, which cut sharply into profits. As it is relatively new, the computer field involves many very costly problems in developing new products. The advantages of long experience which is available in older industries are not present in this field. As an indication of the magnitude of these research expenditures, Control Data spent approximately

$2.6 million, or 6.3% of sales, on research and development last year. The company-sponsored portion of the research and development program was supplemented by $5.9 million, primarily from government research and development contracts, so that total research expenditures amounted to 20.7% of revenues. IBM spent $100 million on research in 1961, and will spend an estimated $115-120 million in 1962. With the exception of Sperry Rand, IBM research and development expenditures alone exceed the revenues of any company in the industry. These outlays have made possible a carefully-planned program of new product introductions. The result has been a forced obsolescence of previous IBM machines. This has not always been to the benefit of computer users, but has shown amazing results for profit-oriented IBM.

Time Lag

Another basic reason for large capital requirements is the time lag between the development of a computer and its sale or lease. In a typical case, it takes three years to develop a computer. The machine is usually announced before it is finished, and at that time, a customer may either decide to purchase or lease. After an order is placed, the delivery time before installation is usually around 12 months. It then takes about 3-5 years to get invested funds back from leasing, so that the total cycle time is around 8-10 years. When a company leases a machine, it usually incurs a net loss for two years subsequent to installation due to heavy research and development, selling, installation and accelerated depreciation charges. Gross profit from leasing a computer approximates gross profit from outright sale in about the fourth year. After that, leasing is far more profitable than selling, assuming a machine stays leased long enough. The problem facing manufacturers is that, with the technical life of most machines increasing to 5-8 years, technological obsolescence is becoming less a factor. The former favors manufacturers under leasing conditions, but the latter encourages more outright purchases by users. The leasing method, however, should still remain the principal method of computer financing in the next decade. This will not help the immediate profit picture of most companies, but will be most remunerative in the long run.

Continual Flux

The rapid growth and the extremely competitive nature of the industry keeps it in a state of continual flux. The magnitude of the industry's potential continually attracts new firms, both large and small, into the field. Small companies like Advanced Scientific Instruments and Scientific Data Systems could survive by concentrating on a small area or special application. Ultimately, many of these companies will become good buy-out candidates. Larger firms, like Hughes and Stelma, which have recently announced their entrance into the field, will find competition very stiff. This proved to be the case wth General Mills, Royal McBee and Underwood, all of whom have dropped out of the industry. It is interesting to note that such firms as Motorola and Westinghouse have not become directly involved in computer manufacturing, even though they have the finances and electronic capabilities. One other area of change in the industry has been management. With such tremendous stakes involved, a wrong management decision could easily obviate many years of development, and postpone projected profits further into the future. Companies have been shifting managements in an attempt to find the road to profits more quickly, and this has been evidenced in such companies as Sperry Rand, RCA and Philco.

Buyers' Market

The growth of the industry has not been without its problems. All manufacturers are aware that computers are offered today to a buyers' market. This has led to a very close working relationship of user and manufacturer. Price has not been the only consideration in a computer purchase. Potential users now demand more detailed programming, want technical assistance after installation, are seeking guaranteed repayments of any losses resulting from system changeovers, and are interested in other services which are very costly to the manufacturer. A problem from the user's point of view is that the computer industry, much like the auto industry, has been engaged in a race for horsepower. One of the results has been that some computers in business are not being used to their fullest capacity. These problems, however, are considered minor in view of the over-all progress being exhibited by the industry, the savings being effected by users and the huge market potential facing manufacturers in the next decade.

There are a number of factors which spell the difference between success and failure in the computer industry, but the key ingredients required to compete successfully in this industry seem to be: (1) a realistic product pricing; (2) thoroughly proven equipment and software programs; (3) equipment designed to meet specific market requirements; (4) marketing management experienced in the computer field, along with skilled salesmen and systems engineering backup; (5) farsighted and determined top-management support, willing to forego present profits, and accepting risks for long-term gains; and (6) adequate finances.

Present and Potential Computer Market

There are a number of methods of expressing the size of the computer market. Three of these would include: (1) factory sales or shipments per year, (2) factory sales plus rental income, and (3) the total cumulative value of machine installations. Each of these methods has its own merit in presenting a different perspective of the industry. From an industry point of view, this study will concentrate on both factory shipments and cumulative installation value. As annual shipments and particular machine installation information is considered proprietary information by many of the computer companies, the computer market will be the total cumulative value of machine installations when discussing individual computer companies.

Present Market

Computer and data processing equipment have been classified under the industrial products section of the electronic industry by the Electronic Industries Association. Computing, data processing and industrial control and processing equipment account for approximately 50% of the industrial product group sales. Sales of this equipment have been growing at the average annual rate of 25% a year since 1957, compared with an average growth rate of 17.5% annually for the industrial products group as a whole, and 13.5% a year for electronic industry sales. Computers and data processing equipment are one reason why industrial products are the fastest growing portion of this market. The rapid growth of industrial products could

serve to achieve a better balance in the electronics industry, since 59% of total industry sales is currently for military and space applications. In terms of shipments, the market for business and scientific general-purpose digital computers and special military computers has been as follows:

Year	*Business & Scientific*	*Special Military*
1960	$ .5 billion	$ .6 billion
1961	1.1 billion	1.0 billion
1962E	1.5 billion	1.3 billion

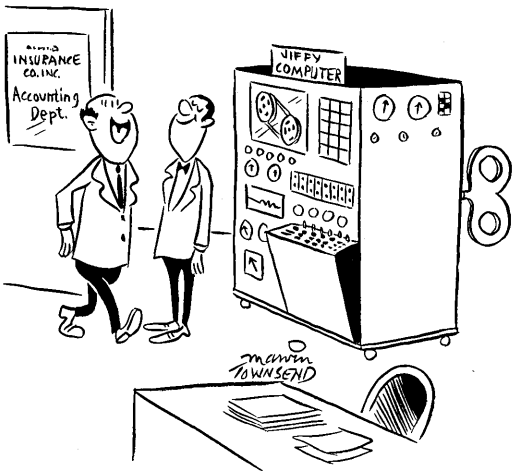
An analysis of 1961 sales shows that 39% of sales was made to industrial and commercial users, 22% went to agencies of the Federal Government, 11% each went to utilities and aviation, 10% was sold for scientific purposes, 2% for educational purposes, and 5% went to miscellaneous users. The total domestic market, including computers, peripheral gear, software and services is expected to reach $2.8 billion in 1962, representing a 20% increase over 1961. The market for peripheral equipment from independent makers is expected to approach $300 million in 1962, with magnetic tape transports ($80 million) and electromechanical printers ($50 million) accounting for almost one-half of these sales. As a measure of magnitude, sales of peripheral equipment will be close to four times 1962 sales of analog computers, which is estimated to be an $80 million market. An examination of the digital computer manufacturers will indicate which companies are leaders in terms of installations, and what future relative positions could be based on present backlog figures.

1 See "Big Five Computer Vendors Face-to-Face" by Patrick J. McGovern, in *Computers and Automation*, August, 1962, p. 38.

2 "Over 500 Areas of Application of Computers" by Neil Macdonald, in *Computers and Automation*, June, 1962, p. 140 ff.

[To be continued in the February issue]

The Key to Computer Economy



"So this is the computer you managed to buy at such an unbelievably low price?"

THE THEORY OF COMPUTABILITY

By John Norman, Rockville, Md.

The author of this paper is a young junior from Walter Johnson High School in Rockville, Maryland who attended an extra-curricular course entitled "Introduction to High Speed Digital Computation I" given at the school in the 1961 fall semester. The course was organized under the sponsorship of the Education Committee of the Washington, D. C. Chapter of the Association for Computing Machinery and consisted of sixteen two-hour sessions which included the running of a computer program written by the students for the IBM 709 computer.

As the instructor for this course, I asked Jack Norman to address the class for about 15 minutes on a subject related to computing that he was interested in and which would be of benefit to the students. He chose the subject of this paper, "The Theory of Computability," which he delivered so well that I thought it would be of interest to the experienced people of the profession to see the kind of product that can come from a junior in high school. It is in this spirit that this paper is being published.

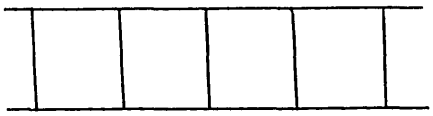
I would like to add that the computing course was Jack Norman's first exposure to the field.

A. Robin Mowlem, Chairman, Subcommittee for Curriculum Development, Washington, D. C. Chapter, ACM.

The theory ot computability and non-computability is concerned with the existence (or non-existence) of purely mechanical procedures (algorithms) for solving various problems. For example, an algorithm for adding two integers can be found in any arithmetic book. If no algorithm exists for solving a problem, the problem is said to be unsolvable. It is not as simple as one might think to determine if an alleged algorithm actually is an algorithm; this problem of verifying an algorithm has actually been proven to be unsolvable.

There are many results in the theory of computability which are of great significance to mathematicians and philosophers. For example, the famous Goedel's Proof states that in any arithmetic system, there will *always* be statements which are completely true, yet are absolutely unprovable. Goldbach's "Theorem," for example, states that every even integer is the sum of two primes. As far as we know, this always holds true, but it has never been proven for all even integers. Since it was first offered as a conjecture in 1742, it is suggested that the failure to find a proof for more than 200 years is evidence for believing that the theorem is true but unprovable.

If an algorithm for solving a problem exists, then it is possible in principle to build a machine that could follow this algorithm and solve the problem. These "machines" are known as Turing machines, after the logician A. M. Turing, who originated them. A Turing machine consists of a finite number of instructions, which will be explained later. The machine is capable of assuming a finite number of internal states (an internal state on an adding machine, for example, could consist of one particular arrangement of the gears). Its input, output, and storage appear on a long tape, infinitely long, and divided into boxes.



In each box could appear any one of a finite number of symbols (O, 1, B, *, etc.). The machine is capable of reading one box (one symbol) at a time. Each instruction is arranged as follows. If the machine is in internal state q_l, and if it is reading symbol S_j on the tape, it will then change S_j to S_k, change its internal state to q_m, and read the box immediately to the right (R) or left (L). In other words, each instruction is of the form $q_l S_j \blacktriangleright S_k q_m$ (R or L). The next operation can be a halt, if state S_k is defined as the halt state. It can be shown that a Turing machine can be constructed to determine any computable function.

One very important result of the theory of computability is the existence of universal Turing machines. A universal Turing machine is a Turing machine which can solve any problem that any conceivable Turing machine can solve. Though it sounds incredible, such machines have actually been designed, using as little as approximately two dozen states and half a dozen symbols. A universal Turing machine sounds more plausible when one considers that in the input (the symbols on the tape) not only the problem, but a description of a Turing machine which can solve that problem, is included. Then a universal Turing machine temporarily "becomes" that other Turing machine. This has practical applications, for it would seem to indicate that a single all-purpose digital computer could be constructed on which any problem can be programmed that could be programmed on any digital computer.

As a rather interesting example of a Turing machine, consider the game of Bucky Beaver, first introduced by Tibor Rado of Ohio State University. As the rules of this game are explained, it can be seen how BB (Bucky Beaver) is in reality a Turing machine. The playing board consists of a tape, as explained above. In addition, there are a certain number of cards used, the number of cards being determined by the particular variation of BB (BB-1 uses one card, BB-7 uses seven cards, etc.). In a BB-n game, there are n cards numbered successively from 1 to n. The cards can all be the same, or they can contain different instructions. Each card consists of four columns and two rows, as shown:

Card No K

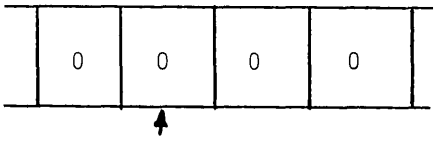
	Col 1	Col 2	Col 3	Col 4
Row 1	0	a	c	e
Row 2	1	b	d	f

Column 1 always contains a 0 and a 1 in the first and second rows, respectively. Columns 2 and 3 contain random patterns of 1's and 0's, depending entirely on the whim of the player. Column 4 contains random numbers ranging from 0 to n.

The tape is assumed to be full of 0's at the beginning of the game, and the object is to place as many 1's as possible on the tape.

The moves are as follows:

1. A box on the tape is arbitrarily picked (since the tape is infinitely long and every box contains a 0, it makes no difference which box is picked).



2. The first move is always with the 1 card. Take, for instance, a BB-2 game with the following cards:

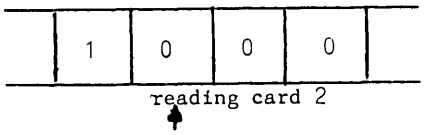
1

0	1	1	2
1	0	0	1

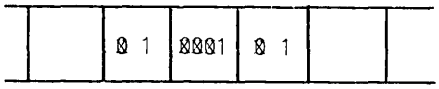
2

0	1	0	1
2	1	1	0

We are now concerned with card 1. Since the symbol in the box being read is a 0, we look at the zero row (row 1). (The 0 and 1 rows are determined by column 1). The next number on card 1 (row 1, column 2) is a 1; so we change the 0 on the tape to a 1. The next number is a 1, so we move one box to the right (if it had been a 0, we would have moved to the left). The final column tells us what card to go to next. The tape now reads:



3. By using card 2, we see that the 0 is changed to a 1; we move 1 space to the left, and go back to card 1. On card 1, we are now in row 2 (the box we are on has a 1). By following this process, two moves later we are told to go to card 0. Since there is no card 00, we stop and the game is over with the following result:



The end result is three 1's, thus a score of 3. By definition, for a score to count an order to go to card 0 must be obtained, thus if a pattern which will merely add 1's *ad infinitum* were produced, an automatic score of 0 would be given. What is the maximum score? It is not known for sure, but one guess is that for a BB-n game the highest possible number of 1's is 2^n-1, and this total is obtainable if 2^n-1 or n is prime.

It is now clear that the Bucky Beaver game is a Turing machine. Each card is an instruction; given state q_i (card number k) and symbol S_j (1 or 0), change the symbol to S_k, change to state q_m (card 1), and move one square.

Now, does an algorithm exist for determining the optimum set of cards for a BB-n game? Or, given a certain set of cards, can an algorithm be made to determine whether this set will ever stop printing 1's?

The answer to the last question is no, for if such an algorithm did exist, a Turing machine could be made to solve it, and it has been proven that a given Turing machine cannot predict if another Turing machine will ever stop (or, it is impossible for a computer to determine whether a given program is void of loops). As for the first question, I do not know of an answer, and to my knowledge, no answer has yet been given. It remains one more interesting problem in the theory of computability.

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The index this year for Volume 11 contains over 1800 entries. This index includes all the issues of Volume 11 (1962). Each item printed has been indexed under author, title, and main words of subject. The last part of each entry gives: volume / number (month of issue), page number.

If any reader finds any errors in this index, we shall be glad to publish corrections.

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Computing and Data Processing Newsletter

"Across the Editor's Desk"

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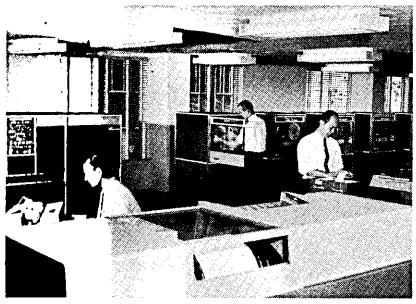
NEW APPLICATIONS

DELINQUENT ACCOUNTS DUNNED BY COMPUTER

Tidewater Oil Company, Los Angeles 5, Calif., is applying a computer to one of business' oldest problems -- writing "personalized" letters to delinquent credit accounts. This imaginative use of the IBM 1401 computer has significantly speeded collections of overdue balances owed by Flying A credit card holders.

In March, 1962, initial tests got under way, with the computer automatically sending out one of three different letters to retail customers whose accounts were two months overdue. From these tests, Tidewater logged customers' payment histories. By September, 1962, enough credit history had been accumulated to permit the collection-letter program to go into full operation on a nationwide basis, handling delinquent account activities for all Tidewater customers.



The computer analyzes and evaluates 50 different conditions for each delinquent customer's account. Examples of the conditions analyzed are amount of debt, length of delinquency, current balance, amount overdue, and amount currently owed, in relation to prior history of purchases. The computer, having compared the information, automatically chooses the appropriate letter from a selection of more than 25. The high speed printer then automatically prints the customer's name, address and the chosen letter, incorporating into the body of the letter the exact amount owed -- so current that it reflects payments received the day before! This entire procedure takes about two seconds.

-- A personalized collection letter to a delinquent Tidewater customer can be issued every two seconds by this IBM printer, which operates at 600 lines a minute over continuous-form stationery.

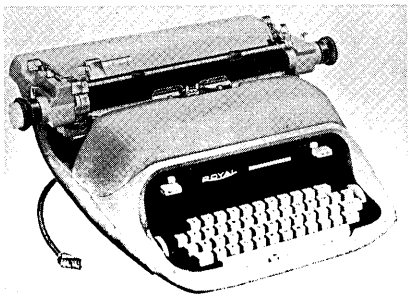
This use of the IBM 1401 and its engineering resulted from an idea generated by Tidewater's data processing and credit staffs back in August 1961. "It isn't often," said an IBM spokesman, "that one of our customers has to show us how to use our own equipment."

COMPUTER AIDS IN NEW TYPEWRITER DESIGN

The Royal Electress, a new electric typewriter produced by Royal-McBee, New York, is claimed to have been mathematically designed by a computer. This use of an electronic computer is said to have resulted in the elimination of 1100 parts, and a retail price almost $100 less than other office-sized electric machines.

Royal McBee's research and development staff at Hartford, Conn., programmed a mathematical model of the Electress on a computer before a single typewriter part was made. More than a million calculations gave a complete history of the motion, stress force, and deflection of every part at one millisecond intervals

throughout the entire drive time. A single cam that eliminates 645 parts in typebar linkages was first described mathematically by the computers.



— Computer designed Royal Electress Typewriter

Previously, typewriter design has been achieved over a span of several years through the time-consuming and uncertain process of attempting to diagram or draw the complex movements of each working part as well as the shape of static sections.

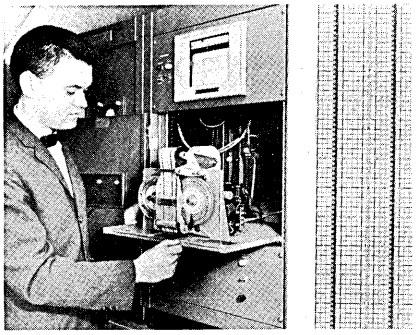
USPHS AIR POLLUTION STUDIES USING COMPUTER

The U.S. Public Health Service, in cooperation with local air pollution control agencies, is incorporating a computer into its air pollution control studies. Air monitoring stations sample the air to determine the concentrations of seven biologically and commercially important pollutants. These stations are located in eight of our largest cities: Chicago, Cincinnati, Detroit, Los Angeles, New Orleans, Philadelphia, San Francisco, and Washington.

The great mass of analog data, gathered at each station by seven specially designed automatic sampler-analyzers, are converted by Fischer & Porter ADR's (analog-to-digital recorders) into digital form. Every five minutes a timer automatically actuates each ADR, causing it to punch holes in a 2 1/8-inch wide paper tape. The holes represent the digital value of the concentration in parts-per-million of the pollutant at that instant.

Weekly tapes, carrying a total of 112,896 readings from all stations, are sent to the Robert A. Taft Sanitary Engineering Center (USPHS), in Cincinnati. There the information on the tapes is automatically transferred to punched cards. The 14,112 readings from each station can be translated in about 35 minutes, and the information is then immedially available to the computer.

The computer in turn, provides the statistical summaries of air pollutant levels which are essential for the understanding and early reduction of urban air pollution.



-- Walter E. Jackson, shown checking the ADR which records the nitric oxide present in the the air, is in charge of the Philadelphia station. On the right is a section of the punched tape record that each ADR instrument supplies for a specific air pollutant.

The use of these modern techniques of handling data, saves money while allowing the detailed study to be carried out on an unprecedented scale. Altogether, the computer will receive 5,870,592 separate readings in a single year. The data will be correlated with medical studies over a continuing period, with the goal of safeguarding human health.

NEW CONTRACTS

OAK RIDGE TO HAVE LARGE CDC COMPUTER SYSTEM

Control Data Corporation has received a contract for a large-scale computer system from the Union Carbide Nuclear Company. The system is built around the 1604-A computer and 160-A computer and has fourteen of the new Control Data 606 magnetic tape transports. Delivery of the system in early 1963 will be made to the Oak Ridge National Laboratory, Mathematics Division, Oak Ridge, Tenn. The system will be used in basic research on complex scientific problems.

CALIFORNIA TO USE COMPUTER FOR AUTO REGISTRATION

California's Department of Motor Vehicles and Philco Corp. have signed a rental contract for a Philco 210 computer system to be used to automate the registration of automobiles. The system will include a model 210 central processor, 8000 words of memory capacity, and seven magnetic tape transports on-line. Off-line hardware will include two other magnetic tape units, two Model 280 universal buffer-controllers, two high-speed printers, a card reader and a card punch. In addition to the 210 system, Philco is providing the state agency programming and other software support.

SDC RECEIVES CARNEGIE GRANT

A $150,000 grant for "Research on Learning and Thought Processes" has been awarded the System Development Corporation, Santa Monica, Calif., by the Carnegie Corporation of New York.

Major project goals include (1) the development of improved techniques for predicting the behavior of organisms, and (2) the use of these techniques to produce machine behavior that would be called intelligent if displayed by humans.

The work will be performed by SDC's Artifical Intelligence Research Staff, headed by Dr. Frank Marzocco.

U.S. NAVAL RESEARCH LABORATORY ORDERS ASI-210

Advanced Scientific Instruments, Inc., Minneapolis, Minn. has received an order by the U.S. Naval Research Laboratory, Washington, D.C. for an ASI-210 Computing System. The system will be leased by the Atmospheric and Astrophysics Group at the Research Laboratory.

LOUISVILLE TRUST ORDERS GE BANKING SYSTEM

The Louisville Trust Company has contracted for a GE-225 computer. The unit will be leased by the bank and represents the first GE banking system in the State of Kentucky. It will be used in the Commercial Banking and Trust Operations of the company.

PENNSYLVANIA STATE UNIVERSITY ORDERS DDP-19

A $173,000 contract has been awarded Computer Control Company, Los Angeles, for a DDP-19 by the Ordnance Research Laboratory of Pennsylvania State University, Pa. The high speed on-line computer will process raw data from a torpedo test device via a special magnetic tape and prepare it for further analysis by a larger computer. The DDP will convert the magnetic tape input to either analog, magnetic tape or digital plotter outputs. It will also serve as a general-purpose computer for the Laboratory.

CONNECTICUT BLUE CROSS ORDERS TWO-WAY COMMUNICATION NETWORK

An EDP system combining data processing and communications has been ordered by the Connecticut Blue Cross, Inc. The two-way communication network is to be centered around an IBM 1410 computer linked to 1310 random-access disc storage devices. When the new system is in operation, it will offer the 35 member hospitals direct, two-way communication with the Plan's home office in New Haven and is expected to eliminate any manual handling of hospital admissions. In addition, the computer will perform a variety of business data processing functions.

BELL & HOWELL ORDERS SDS 920

Scientific Data Systems, Inc., has received an order for an SDS 920 computer from Bell & Howell Corp., Pasadena, Calif. The computer, with an expanded memory of 8192 bits, will be used for lens design.

BRITISH PETROLEUM REFINERY TO USE TRW COMPUTER

British Petroleum has purchased a TRW-330 process control computer to be used as a R&D tool in a major control engineering project. The Thompson Ramo Wooldridge Inc. (TRW) computer will be installed in British Petroleum's new refinery, now under construction, at Belfast, Northern Ireland.

CDC RECEIVES $4 1/2 MILLION AWARD

The Office of the Chief of Public Information, Department of Defense, has announced that the U.S. Army Electronic Command, Fort Mead, Md., has awarded a $4½ million contract to Control Data Corporation for classified electronic equipment. The contract work will be done at CDC's Computer Division at Minneapolis, Minn. and at the company's Systems Sciences Division at Beverly Hills, Calif.

AIR TRAFFIC CONTROL COMPUTER PROGRAMS

Computer programs for air traffic control, which will tie in with Air Defense Command SAGE sites, are being prepared by System Development Corporation, Santa Monica, Calif. under a contract with the Federal Aviation Agency.

The system will provide the FAA a capability for furnishing "positive" enroute air traffice control service using the Air Defense Command's "northern tier" SAGE centers in Great Falls, Montana and Minot and Grand Forks, North Dakota. Joint usage of these direction centers will permit FAA personnel to use portions of the existing Air Defense Command equipment.

NEW INSTALLATIONS

UNIVAC 1107 EQUIPS CSC'S SERVICE BUREAU

Computer Sciences Corporation's new facilities in Los Angeles, Calif. have been equipped with a Univac 1107 thin-film memory computer.

CSC's Univac 1107 is said to have the largest total memory capacity ever made available. It has a 128-word magnetic thin-film control memory, 65,536 words of magnetic core memory and 6,291,456 words of magnetic drum memory.

Although thin-film memories have been used previously in electronic computing systems designed for military installations, CSC's Univac 1107 is the first available for commercial use. That is, it is the first such unit on which computer clients can buy time at an hourly rate.

Programing aids for the system will include an assembly system; an executive monitoring system; COBOL, an English language compiler; and the FORTRAN IV compiler.

Computer Sciences Corporation is one of the largest independent data processing service organizations in the United States. The Univac 1107 will be used for the solution of complex business and scientific problems as well as in other major data processing projects. It is operated by CSC's Service Bureau, headed by Daniel R. Mason, General Manager.

WATERTOWN ARSENAL USING RCA 501

An RCA 501 electronic data processing system is being used at the Watertown (Mass.) Arsenal for a two-fold mission -- handling the Arsenal's volume of paperwork and assisting scientists in their search for metals to meet space age stresses.

BENDIX G-20 COMPUTER TO PREDICT WEATHER FOR CANADIAN GOVERNMENT

The Canadian Government has installed a Bendix G-20 high-speed computing system to analyze and predict weather throughout that country. The G-20 is located at the central analysis office of the Meteorological Service of Canada, Montreal International Airport.

FOOD SERVICE MANAGEMENT FIRM TO INSTALL COMPUTER

The Harding-Williams Corp., which operates a restaurant chain, and food service facilities in more than 140 locations from coast to coast from Chicago headquarters, will install a Burroughs B260 electronic data processing system.

The Burroughs B260 will perform office accounting and bookkeeping tasks and will provide accounting and control data for the firm's growing vending business.

UNIVAC SOLID-STATE II SYSTEM REPLACES PUNCHED CARD INSTALLATION

Warner-Lambert Pharmaceutical Company, Morris Plains, N.J., has installed a Univac Solid-State II computer system to replace a large conventional punched card installation. It will be used for business data processing, and scientific and mathematical research questions.

SCHICK WILL USE EDP SYSTEM

Schick Inc., Lancaster, Pa., pioneer manufacturer of electric shavers, will install an RCA 301 computer system replacing punched card tabulating equipment for business data processing.

N. Y. C. GARMENT MANUFACTURER INSTALLS EDP SYSTEM

Aileen, Inc., New York City, manufacturer of women's and children's knitted outerwear, has put into operation an IBM 1401 card system. The new equipment will be used chiefly for business data processing, production planning and, advanced sales projections.

THIRD SDS 910 DELIVERED FOR OGO

Scientific Data Systems, Inc. has delivered the third SDS 910 computer to Space Technology Laboratories for use in the Orbiting Geophysical Observatory (OGO) program. The computer is modified for van mounting so that all parts are accessible from the front.

RCA 301 COMPUTER TO HANDLE COMPLEX ACCOUNTING PROBLEMS

Pettibone Mulliken Corp., Chicago, Ill. (construction and materials handling equipment firm) has installed an RCA 301 EDP system to provide more precise control of the corporation's complex accounting problems. The 301 will be programmed later to keep track of the 30,000 different spare parts contained in inventories in Chicago and the 45,000 different parts in general stores throughout the United States. In a third phase, the computer will provide production control, and marketing information.

NCR 315 COMPUTER SYSTEMS FOR TWO SOUTH AMERICAN FIRMS

A variety store chain and an insurance company in Colombia, South America, have announced plans to install NCR 315 computer systems. Both systems will include four Card Random Access Memory (CRAM) devices.

The Compania Colombiana de Seguros insurance firm will use its computer system to automate the handling of over 200,000 policy records.

The Almacenes Ley, a variety store chain which operates 30 retail stores and five warehouses, will use the NCR 315 system to keep track of over 20,000 different items of merchandise and for stock re-ordering, payroll, and general accounting.

EMERSON ELECTRIC INSTALLS COMPUTER IN METHODS CENTER

Emerson Electric Mfg. Co., St. Louis, Mo., has installed an IBM 1410 computer in its Electronic Methods Center. The Center is being equipped to handle major scientific, engineering, and accounting problems for the company. A new IBM 1301 disk file is scheduled for delivery next spring.

PEOPLE OF NOTE

PERSONNEL MOVES AT IBM

Dr. Emanuel R. Piore, vice president, research and engineering, has been elected a member of the board of directors. The former chief scientist of the Office of Naval Research joined IBM in 1956 as director of research and was elected a vice president in 1960.

J. F. Manning of the General Products Division, received a promotion to systems manager for information storage systems. In his new position he will be responsible for developing new and more advanced products to store or file information, such as is now done on magnetic tape and on random access disks.

Robert V. Woodworth has been named industry manager of application development for IBM data processing operations in the western United States. Prior to his promotion, he served as assistant to the district manager for aerospace activities.

CHANGES AT ITT

International Telephone and Telegraph Corporation announced plans to promote Thaddeus L. Dmochowski to president of ITT Information Systems Division. Mr. Dmochowski (pronounced MO-HOFF-SKEE) has been executive vice president of the Division since October, 1962.

The announcement came from John J. Graham, vice president, who has himself been recently appointed area general manager -- North America. In his new post, Mr. Graham will be responsible for the U.S. Commercial Group, which he has headed since April 1962, and the U.S. Defense Group, which is headed by Charles M. Mooney, vice president.

The Information Systems Division also has announced the appointment of John Paivinen as vice president of operations with offices in Paramus, N.J. Mr. Paivinen will have over-all responsibility for manufacturing the ITT 7300 ADX Automatic Data Exchange System as well as responsibility for programming and systems engineering. He was formerly director of operations for the division which markets the ADX System.

CHANGES AND APPOINTMENTS AT PHILCO

Recent appointments at the Philco Computer Division include:

C. L. Wanlass, previously Vice President, Packard-Bell Electronic Corporation, Anaheim, Calif., as Director of Memory Development.

Norman Fjeldsted, previously Chief Engineer, Airpax Pacific Division, Northridge, Calif. as Assistant Director of Installations.

Robert Turley, previously President Airpax Electric Inc., of California, Northridge, Calif., as 212 Program Manager.

James C. Callaghan, previously Vice President and General Manager, Technical; Packard-Bell Electronics Corp., Los Angeles, Calif. as Director of Installations.

Other Philco organizational changes include:

R. A. Williams, formerly research manager for fundamental devices at Philco's Scientific Laboratory, has been named assistant to the director of engineering, Dr. C. H. Sutcliffe.

Charles Gray, formerly manager of applications engineering for communications devices, succeeds Mr. Simmons as manager, Commercial Engineering Department.

JOHN SAYER HEADS NEW DIVISION

John Sayer, who recently joined the Auerbach Corporation, after serving as Executive Vice-President and General Manager of Documentation, Inc., will direct the new Management Sciences Division. Mr. Sayer has extensive experience in the administration of large-scale projects involving the development and application of integrated information handling techniques to operations and management-control problems. Prior to his position with Documentation, Inc., he spent 20 years with E. I. du Pont de Nemours & Co. in a number of technical management positions. Among Mr. Sayer's technical achievements was the direction of the team that first developed and tested the critical path method (CPM) scheduling technique. He also conceived and directed the development of the plan for the NASA scientific and technical information facility, which he was later responsible for operating.

VICE PRESIDENT APPOINTED

The appointment of John C. Lindley as a vice president of Litton Systems and director of marketing of the Data Systems division has been announced. Mr. Lindley was general manager of the defense marketing division of the Burroughs Corporation, Detroit, prior to joining Litton.

GRANDINE JOINS DATA PROCESSING

Dr. Joseph D. Grandine, 2nd has joined the Waltham, Mass. computer consulting firm of Data Processing, Inc., as a Senior Analyst and Vice President. Dr. Grandine was formerly with United Research Inc. where he was Director of the Computer Applications Division.

EXECUTIVE VICE PRESIDENT OF C-E-I-R, INC.

George W. Dick has been appointed as Executive Vice President of C-E-I-R, Inc. Mr. Dick assumes general management responsibility for all C-E-I-R operations in the United States, Europe and Latin America. He will be a member of both C-E-I-R's Board of Directors and of the Executive and Finance Committee.

NEW FIRMS, DIVISIONS, AND MERGERS

RESEARCH ANALYSIS CORPORATION ESTABLISHES NEW DIVISION

A Computer Sciences Division has been established by the Research Analysis Corporation, Bethesda, Md., as a first step in expansion of RAC's computer capabilities. The new division brings the total number of RAC divisions to ten.

Computer Sciences will be responsible for two new major spheres of activity: a broadening of RAC's present program of computer applications to specific military problems; and longer-range research into the frontier areas of computer science, including hyper-languages, machine translation, man-machine systems, and artificial intelligence.

RAC is an independent, nonprofit organization which applies operations research and systems analysis to the study and solution of global military problems and related political, social, and economic questions.

COMPUTER DYNAMICS MOVES TO EXPANDED QUARTERS

Computer Dynamics Corporation has moved into its own building. The Computer Dynamics Building at 1104 Spring St., Silver Spring, Md., provides the company with a tenfold increase in office space and houses one of the most modern electronic data processing centers. This new computer center is now operational.

This company, organized less than a year ago, has expanded its staff from five employee-owners to more than 100 computer analysts and programmers. The company assists in and handles the design, management, and operation of EDP systems for business, industry, and government. From a start as a consulting firm, Computer Dynamics has branched into many phases of EDP systems including management and operations.

Computer Dynamics developed the system known as IMPACT (IMplementation Planning And Control Technique), which it applies to its projects to provide close and visable control of schedules, responsibilities, and resource allocations.

The company maintains a staff and a computer center at Cape Canaveral for NASA's Launch Operation Center. This work includes precalculation of launch countdown procedures and data processing for the Agency's administrative functions at the center. In addition, Computer Dynamics currently operates five data processing centers in the Washington Metropolitan Area. Branch offices are planned in New York, Boston, Chicago, Los Angeles and San Francisco.

AUERBACH ENTERS MANAGEMENT SCIENCES FIELD

Auerbach Corporation, Philadelphia, Pa., is expanding its activities into the management-sciences area with the formation of a new Management Sciences Division, according to the president, Isaac L. Auerbach. The new division will be under the direction of John Sayer.

The division's services cover the application of modern information science and technology to operations and management-control-and-decision problems. The division consists of four separate technical groups: Business Information Systems, Product and Market Planning, Programmed Teaching, and Computer System Analysis.

MESA FORMS SOFTWARE GROUP

Mesa Scientific Corporation, Inglewood, Calif., has formed a new subsidiary, the Systems Programming Corporation. The two companies have a combined technical staff of 25 senior computer specialists, 15 of whom are senior programmers and analysts with an average of eight years' experience.

The Systems Programming Corporation is engaged in computer systems programming and providing a complete design and development service for computer software packages. Although Mesa Scientific Corporation has been active in computer programming for some time, its activity is primarily in analysis and systems engineering.

FOXBORO ORGANIZES NEW SALES DIVISION FOR DIGITAL SYSTEMS

The Foxboro Company, Foxboro, Mass., has organized a new sales division specializing in digital computer systems. The new division will assist industrial and utility firms in the selection and application of advanced control systems.

HOUSTON HEADQUARTERS FOR MDI

Management Decisions, Inc. has established headquarters in Houston, Tex. The firm applies computer-based analytic and evaluation methods in the solution of managerial problems. According to Dr. Emanuel Singer, MDI president, the service extends computer and data processing techniques into new areas of management decision-making.

GILBERT DATA SYSTEMS ACQUIRES TELE-TABULATING CORPORATION

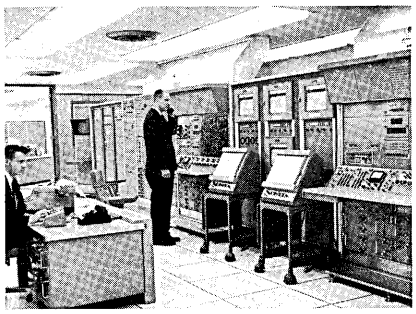
The Tele-Tabulating Corp., Long Island, N.Y. data processing firm, has been acquired through a cash transaction by Gilbert Data Systems, Inc. of New York, supplier of a price and inventory control marking service for the garment trade. As a wholly owned subsidiary, Tele-Tabulating will supplement the data processing operation of Gilbert Data Systems, and at the same time have resources to meet the needs of Long Island industry.

Management of the broader data processing operation will be under the supervision of Harry W. Schestopol, founder and president of Tele-Tabulating, who will continue as president of the new subsidiary.

COMPUTING CENTERS

NEW HONEYWELL COMPUTER CENTER SIMULATES, CONTROLS COMPLEX PROCESSES

A hybrid computer center where simulation studies of complex industrial processes will be conducted is announced at Minneapolis-Honeywell's Special System's Division, Pottstown, Pa. The center is said to be the most advanced analog-digital systems simulation facility to be placed in operation in the U.S. instrumentation industry.

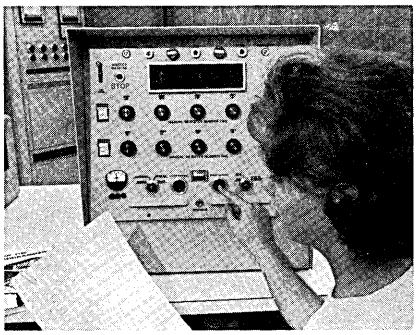


-- Complex industrial processes are simulated and controlled by two Electronic Associates 231R analog computers (foreground) of special design and a Honeywell 290 digital computer (background). Honeywell will use the computers primarily for design, analysis and evaluation of control systems. The center will be made available to industry and government on a rental basis.

The center is expected to make it possible for the division's control analysts and computer specialists to:

-- Determine whether a manufacturing process can be controlled by a computer system or other means of instrumentation, and the economic feasibility of such a system.
-- Mathematically analyze and design control systems for optimum efficiency, stability, reliability and safety.
-- Evaluate the operating economics of such systems.
-- Simulate and checkout complete process control programs and their hardware.
-- Provide specifications for the automatic devices to be included in control systems.
-- Familiarize and train user personnel in systems operation prior to installation.

The digital computer can perform supervisory functions over the analog computer under the hybrid mode of operation. It can start, stop, and reset any part of the analog machine, properly position its servo-set potentiometers, and automatically vary coefficients by using high-speed multiplication channels. A high-speed linkage system provides twelve channel information transfer in each direction between the analog and digital computers at rates up to 1200 words per second. An additional twenty-four channels in each direction permit scanning at rates up to 200 words per second.



-- Control programs for industrial processes simulated on high-speed analog computers are checked out on a H290 digital computer.

Rental of time in the computing center will be available to industry and government under seven different equipment options. Whenever the facilities are rented, an authorized operator, responsible for proper use of the equipment, is provided.

EAI TO OPEN EAST & WEST COAST ELECTRONIC PLOTTING SERVICE CENTERS

Electronic Associates, Inc., Long Branch, N.J., will establish electronic digital plotting centers on the East and West Coast this month.

Each center will be equipped with the EAI Universal Input Model 3440 DATAPLOTTER system which automatically draws charts, curves, graphs, or maps from digital data stored on magnetic tapes.

The East Coast Center will be located at the EAI Princeton, N.J., Computation Center. The West Coast Center will be located in San Francisco, Calif. The new service will be available on a time-rental basis.

NEW PRODUCTS

Digital

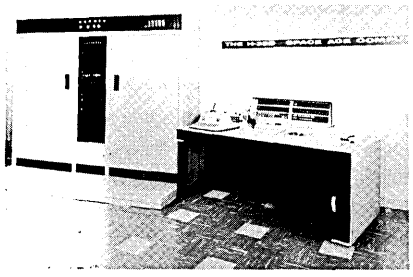
HUGHES COMPLETES REAL-TIME GENERAL PURPOSE COMPUTER

Hughes Aircraft Company
Ground Systems Group
Fullerton, Calif.

This company has developed a large scale, real-time computing system called the H-330. The general purpose system, the first commercial computer to be produced and marketed by Hughes, is claimed to be one of the most high-powered real-time computers in production.

The input-output system accepts data from thirty-two channels, fully automatic and buffered. Program interrupt, program protection, modular high-speed memory, look-ahead and real-time clocks also characterize this computer.

The H-330 will be available with either a 24, 30, 36, or 48 bit data word length. Sixty-five thousand words each of data and program memory can be addressed. Basic memory cycle time is rated at 1.8 microseconds with an access time of 0.7 microseconds. It operates in an overlapped mode to give an effective cycle time of 0.9 microseconds. The program word length is fixed at 24 bits. A 128-word, 32-bit control memory having a 0.45 microsecond cycle time and an access time of 0.15 microseconds is used to store basic control registers.



-- The H-330 Computer has internal organization permitting independent and simultaneous program and data flow.

The high-speed buffered input-output system operates concurrently with and independently of the main program. Data rate over the 16 bi-directional channels is 520,000 words per second. Each input or output channel operates in a block recycling mode.

HAP (H-330 Assembly Program) allows complete program writing in symbolic language. A monitor is available as well as library and diagnostic routines. Appropriate compilers are planned.

"COMMON LANGUAGE" COMPUTER

Packard Bell Computer
1095 Armacost Ave.
Los Angeles 25, Calif.

A "common language" computer which uses existing program libraries without reprogramming, duplicates the commands and formats of other computers, and allows programmers to create problem-oriented command lists, has been developed by this company.

The computer, called PB440, uses a Dual Memory Stored Logic concept which stores commands in the form of microcommands in a Logic Memory. Commands can be changed as required. In addition to the Logic Memory, the PB440 uses a conventional Main Memory operating on a 5 microsecond cycle time. The PB 440's memory capacity is 32,000 words. The input/output system has a standard transfer rate of 400,000 characters per second; a rate of 800,000 is optional. Operating characteristics include: add time of 1 to 11 microseconds; multiplication in 23 to 38 microseconds; and divide in 47 to 57 microseconds. Word length is 24, 36 or 48 bits standard, or variable to match desired commands or formats.

A Fortran Compiler supplied by Packard Bell permits the PB440 to run Fortran program libraries from other computers and to generate programs which may be run on other computers. The company also supplies a real-time systems-oriented command list and another set of instructions optimized for scientific or engineering computation.

PHILCO 4000'S DESIGNED FOR SMALL-TO-MEDIUM COMPUTER MARKET

Philco Corporation
Computer Division
Philadelphia 34, Pa.

Dr. S. Dean Wanlass, vice president and general manager of this company, has announced a new 4000 series designed to capture a share of the small-to-medium computer market. The first system of the new series will be known as the 4100. Dr. Wanlass said, "The 4000 series will have the flexibility of large-scale systems, the speed and power of medium-scale systems, and the price of small-scale systems."

The Philco 4000 is a family of solid-state, stored program computer systems which process variable-length data on a character basis. These high-speed data processing systems perform input-format functions, verification, file search, card-to-tape and tape-to-printer conversions, and editing of output for printing.

Two Philco 4000 central processors may be included in any 4000 System, each with magnetic core memories from 4096 to 32,768 characters. Each central processor is equippped with its own magnetic core memory device. Each character consists of 6 bits plus a parity bit. Memory speeds for a 4096 character memory are read/write cycle time of 5 microseconds per character; less than 3 microseconds for memories of 8196 characters or larger. One or two central processors may be connected to an Input-Output Switch which permits sharing of up to eight different types of input-output devices.

The Philco 4000 is available with an optional Binary-Decimal Conversion device or an optional Decimal Add, Subtract, Multiply, and Divide Unit.

A Philco 4000 Series system may include the following: one or two central processors; input-output switches for four or eight channels with up to 64 devices on a channel including: magnetic tape units with speeds of 6000, 16,650, 90,000, or 240,000 characters per second; other manufacturers' tape units; card readers

at 600 or 2000 cards per minute; card punches at 100, 200, or 250 cards per minute; line printers at 150, 300, or 900 lines per minute; paper tape readers at 1000 characters per second; paper tape punches at 60 characters per second; and software.

NEW "STORED LOGIC" COMPUTER

Thompson Ramo Wooldridge Inc.
8433 Fallbrook Ave.
Canoga Park, Calif.

A new digital computer for scientific and engineering use, the TRW-230, has been developed by this company.

The TRW-230 has a 6-microsecond memory cycle time, an 8192-word core memory expandable to 32,768 directly addressable words, and 11 interrupt lines that allow the computer to "interleave" computation with input-output operations for maximum efficiency. Instruction code includes 82 microcommands with 8500 combinations. Two cables are used for a 30-bit parallel word transfer at an input rate of 33,300 words per second and an output of 20,800 words per second.

A magnetic drum provides storage for 65,280 15-bit words plus parity. It contains 256 tracks of storage, each track having 256 words. Reading or writing is by block transfer with drum access time to first word of a block averaging 8.5 milliseconds.

Speeds include: add, 12 microseconds; multiply, 57 microseconds; divide, 57 microseconds; match or sort, 18 microsecond setup and 12 microseconds per 15-bit word element; branch or skip, 12 or 18 microseconds; and block transfer, 18 microsecond setup.

A FORTRAN II algebraic compiler will be provided for general purpose scientific and engineering computations. Special purpose, tailor-made subroutines, or macro-instructions, can be merged with FORTRAN II programs.

Peripheral equipment includes a magnetic tape system, and a number of individual input-output devices.

Memories

MICROFERRITE MEMORY SYSTEM

Radio Corp. of America
30 Rockefeller Plaza
New York 20, N.Y.

This company has begun production of its new ultra-high speed computer memory systems. The new RCA microferrite memory systems will enable computers to perform a complete memory cycle in 375 nanoseconds (less than ½ millionth of a second). The systems can handle up to 80 million bits of information per second. They are available to computer manufacturers on short delivery cycles, according to T. R. Hays, Semiconductor and Materials Division Marketing Manager.

The company's recently announced microferrite array is the core of the new memory system. First versions of the high-density system will be available with 32 to 1024 word capacity, and up to 72 bits per word. These new systems can be used in scratch-pad or buffer memory applications.

MICROSTEP RANDOM ACCESS DISC STORAGE

Anelex Corporation
150 Causeway St.
Boston 14, Mass.

Two random access disc storage units, the 800 and the 4800, have been developed by this company.

The Anelex 800 is a medium capacity random access memory with a maximum storage of 160 million bits. There are up to eight recording discs each with a capacity of 20 million bits. There are four recording zones per disc surface. Each zone is accessed by an air bearing read-write-erase head. There is a nominal track density of 50 tracks per inch. Position addressing selects the track. Average positioning time is 125 milliseconds. Head addressing and switching selects the appropriate disc surface and zone.

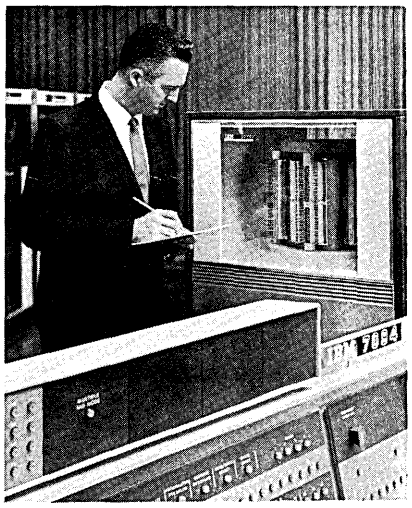
The Anelex 4800 is a larger capacity disc unit with a maximum storage of 624 million bits. The 4800 has up to 48 recording discs each with a capacity of 13 million bits. There is one recording zone per disc surface. Track accessing is controlled by position addressing. Primary and fine movements are executed simultaneously and in parallel, with an average positioning time of 65 milliseconds.

NEW IBM MAGNETIC DRUM TO SPEED PROGRAM STORAGE & RETRIEVAL

IBM Corporation
Data Processing Division
White Plains, N.Y.

A new random access magnetic drum storage device, designed primarily to speed storage and retrieval of computer programs in the IBM 7090 and 7094 computers, has been developed.

Any character may be selected from as many as 1.1 million characters stored on the new IBM 7320 drum, and moved into the computer to which it is linked, for processing in an average of 8.6 milliseconds. The 7320 helps bridge the gap between high speed internal computer storage and relatively low speed but higher capacity external random access storage devices.



-- New IBM 7320 random access magnetic drum -- shown behind IBM 7094 console -- can be used as a common storage device to interconnect two computer systems or as many as ten 7320 drums can be connected to a single computer.

The drum mechanism is based on the use of versatile new read-write heads which "float" over the drum surface on an invisible, wafer-thin layer of air. The drum spins underneath the stationary heads at the rate of approximately 3500 rpm. There are 200 head as-

semblies, each with two independent read-write heads, and 400 "tracks" on which information is stored in the form of magnetic impulses. Each track, therefore, has its own read-write head and the time required to read or write a character of information is limited only by the time it takes the drum to complete one revolution -- a maximum of 17.5 milliseconds.

Data is transferred serially to and from the drum. No special character sizes or bit combinations are required or prohibited by the 7320.

FILM MEMORY SYSTEM

Fabri-Tek, Inc.
Minneapolis, Minn.

A new magnetic film memory system, the FFM-101, has been demonstrated by this company. This is an experimental system which operates at a cycle time of 500 nanoseconds. The FFM-101 system is self-contained, except for power supply. It includes address register, in/out register, control and timing circuitry, and drivers and sense amplifiers. Also included are a counter for sequencing addresses and self-checking error circuitry. A word-organized transverse rotational mode is used for fast switching speeds, and wide operating margins.

The experimental FFM-101 is helping to establish functional specifications for a larger, faster magnetic film system expected to be in production in 1963.

NEW BIAX MEMORY

Aeronutronic
Ford Road
Newport Beach, Calif.

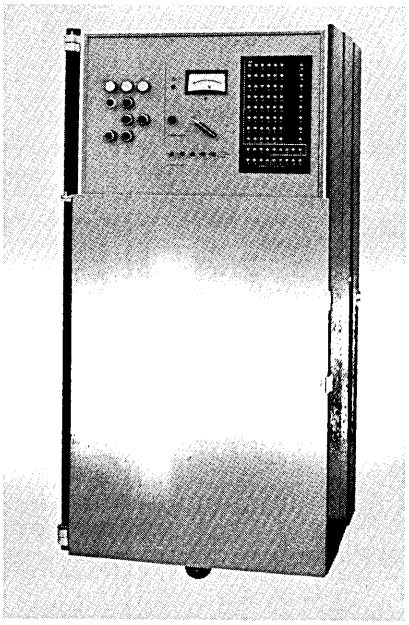
This company, a division of Ford Motor Company, has announced a new line of BIAX ferrite memories capable of 2 megacycle continuous readout with an access time of 0.25 microseconds. The standard 2 megacycle BIAX memory sizes will range from 128 words to 1024 words with word lengths up to 48 bits. Other size memories will be available on a "built to order" basis.

TWO NEW CORE MEMORIES

Ampex Corporation
934 Charter St.
Redwood City, Calif.

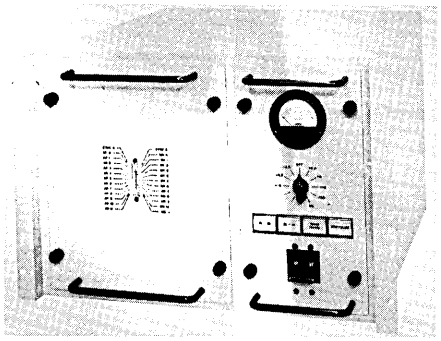
Two new memories have been introduced by this company -- one, the Model LZ, a large capacity ferrite core memory and the other, a new military core memory, the RM-3.

The Model LZ is able to perform a complete memory cycle in 1 microsecond. It is said to store twice as much data in half as much space as its predecessor, the 1.5 microsecond Ampex LQ. Like the LQ, the LZ is compatible with current computers for data processing and control applications.



The LZ has a storage capacity of 4096 to 16,384 words with word lengths of 18 to 72 bits. Operational modes are read-restore and clear-write. Control signals are read-request and write-request. Along with its complete cycle time of 1 microsecond, its read access is 0.5 microseconds after read request.

The new military core memory, the RM-3, is available in 128, 256, 512, 1024, 2048 or 4096 word sizes, with 4 to 36 bits per word in two-bit increments. The RM-3 has a memory cycle of 3 microseconds and a buffer cycle of 2 microseconds. Split-cycle operation can be performed in 4 microseconds.



A special temperature stabilizing enclosure chamber allows operation at temperatures from 85°C. to below 0°C.

Input - Output

SERIES 500 PAPER TAPE READERS AND PUNCHES

Royal McBee Corp.
850 Third Ave.
New York 22, N.Y.

A paper tape reader, Model 550, developed by this company, is a mechanical pin-sensing machine, capable of bi-directional operation at speeds up to 50 characters per second. The device reads 5 to 8 level perforated chad or chadless tape. The mechanisms for semi-automatic tape insertion allows the operator to load the machine by simply placing the end of the tape in the throat of the head assembly. A capstan roller automatically engages and drives the tape to the read station, correctly positioned to received read commands. The reader also handles loop tapes.

A punched tape perforator, Model 500, uses parallel wires. Its operating speed is up to 50 characters per second (500 words/minute). The perforator feeds in either forward or reverse directions at the same speed. The holding power of small electro-magnets is used in combination with off-center springs to engage the selected punches.

The perforator and reader are used in such applications as message relaying, data collection, and business machine input/output. The reader is also used in machine tool or plotter control.

NEW DIGITAL TAPE SYSTEM

Information Storage Systems, Inc.
222 Wanaque Ave.
Pompton Lakes, N.J.

This company has developed a new digital tape transport and storage system. The new system, in place of tape reels, uses two 7" x 9" box cartridges, each capable of storing over 5 million alphanumeric characters. The one-inch tape forms a series of random loops in the enclosed metal cartridge. Tape exits through a sliding door and a plastic leader eases tape loading into the transport.

The device (called DK-3) has a very high density. Although the device's transport and head are designed for use as tape system components, the system uses phase-modulation in a serial (one-track) format. The seven bits of an alphanumeric character are written sequentially on a single track at a density of 1000 bits (143 characters) per inch. With 32 individually addressable tracks, the total information density is 4576 characters per linear inch.

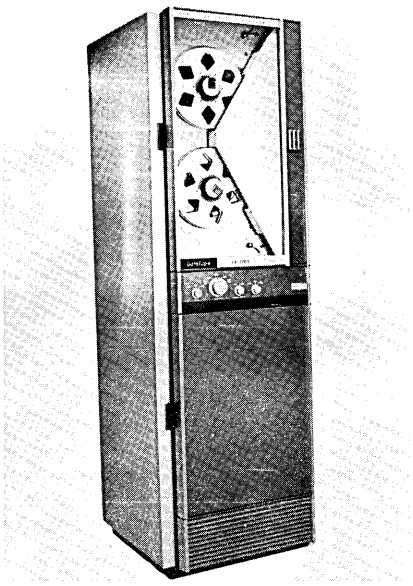
A reading system based on phase modulation reduces errors. Drum-like access to any one of 32 tracks provides average access of 6 2/3 seconds to a 5 million character file. Start-stop time is 5 milliseconds.

DIGITAL TAPE TRANSPORT

Consolidated Electrodynamics Corp.
360 Sierra Madre Villa
Pasadena, Calif.

This company has designed a digital tape transport, the DR-2700, for use in a broad range of computer, control, and laboratory applications. The transport is a high-performance, vacuum-buffered device providing forward and reverse speeds of 150 and 75 inches per second through a two-speed capstan motor. Start and stop times are less than 3.5 milliseconds.

There are no programming restrictions up to 200 commands per second at any speed up to 150 ips with commands spaced no less than 5 milliseconds apart. Command circuits are interlocked to prevent response to contradictory commands.

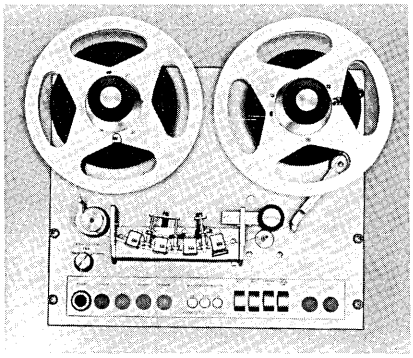


A dual vacuum chamber augmented by servo arms keeps an adequate supply of tape for any and all cycling conditions. The device will accommodate 1.0 or 1.5 mil Mylar tape in 1/2 or 1 inch widths.

PRESTO 800 SERIES TRANSPORTS

Lear Siegler, Inc.
Bogen Communications Division
Paramus, N.J.

A series of low-cost Presto instrumentation tape transports has been designed by this company. The Presto 800 Series transports can be easily modified and are almost unlimited in industrial application.



The transports have a four-head plug-in assembly; seven tape speeds ranging from 15/16 to 60 inches per second; selectable tape width; separate cue and edit controls; balanced braking; illuminated "feather touch" controls; and remote control on all modes. Available heads with 1/2 inch tape can record up to 14 different phenomena simultaneously.

MT-36 MAGNETIC TAPE TRANSPORT

Potter Instrument Co., Inc.
151 Sunnyside Boulevard
Plainview, N.Y.

A new digital magnetic tape transport has been developed by this company, the MT-36. It is designed for medium tape speed application (36 inches per second standard tape speed). Data transfer rates may be obtained up to 86,000 alphanumeric characters per second using Potter high-density recording techniques or up to 20,000 alphanumeric characters per second using IBM 556 bits per inch method of recording. The MT-36 has no program restrictions up to 200 commands per second at 36 inches per second. An improved pinch-roller circuit offers fast start time (3 milliseconds or less) and short stop distance (0.050", maximum). Solid-state electronics are used throughout.

UNIVAC OPTICAL CHARACTER READER

Univac Div. of Sperry Rand Corp.
315 Park Ave. So.
New York 10, N.Y.

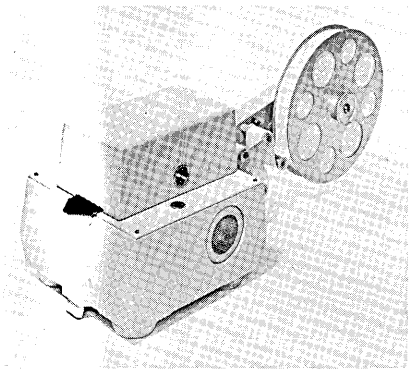
The new Univac Optical Character Reader converts printed information directly to magnetic tape for computer input. The device is capable of processing documents ranging in size from 2 3/4 by 2 5/8 inches to 6 by 8 1/2 inches. Tapes may be produced for input to: Univac step computer; Univac solid-state computer; Univac solid-state II computer; Univac I; Univac II; Univac III; Univac 490 real-time system; and the Univac 1107 thin-film memory computer.

In a demonstration the device read the customer portion of public utility and insurance documents at a rate in excess of 300 per minute. The Univac Optical Character Reader converted English language information printed on the document directly to magnetic tape for computer input. This reader will be useful in applications requiring high input of "turn around" documents, as occur in public utility billing, mortgage loan accounting, etc.

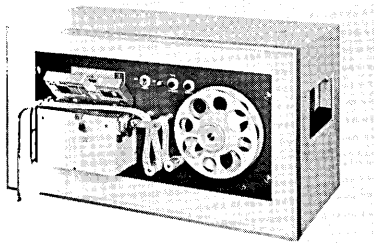
FACITAPE, TAPE HANDLING EQUIPMENT

Autonetics Industrial Products
3400 E. 70th St.
Long Beach 5, Calif.

Three new pieces of high speed perforated tape handling equipment have been announced by this company. The new equipment, named "Facitape" is produced in three models; Model 151, high speed perforated tape punch; Model 110 high-speed perforated tape reader; and the Facitape Console, a compact tape punch/reader console device.



The Facitape Model 151 punch (shown above) provides operating speeds of 0 through 150 ch/sec. and will idle indefinitely if required by the application. It accommodates 5, 6, 7 or 8 channel tapes and can punch any desired code.



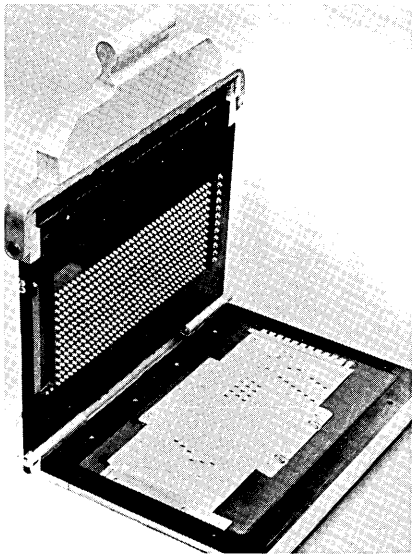
The Facitape Model 110 reader (shown above) has a capacitance read head, which is unaffected by ambient light conditions, dust or lint on the read heads, or other environmental hazards. Speeds up to 600 characters per second are obtained and the reader will stop within one character through its entire operating range. All 5 through 8 channel tapes may be read in any desired code.

The Facitape console combines the features of the Model 151 punch and the Model 110 reader into a single punch reader console unit.

NEW TAB CARD READER

Varifab, Inc.
High Falls, N.Y.

An economical, compact tabulating card reader has been developed by this company for accurate implementation of card programs for industrial and other machinery. The new Varifab 610 Tab Card Reader is designed to handle standard or plastic tab cards containing up to 960 holes. The Vari-Fab 610 allows easy insertion and withdrawal of cards. There is an interchangeable front panel for row or column selection. All terminals are on the rear stationary panel to permit quick electrical connection.



The reader will not function if a card is inserted incorrectly.

ELECTRONIC PRINTER

General Dynamics/Electronics
P.O. Box 2449
San Diego 12, Calif.

A high-speed message printer has been developed by this company, for use in electronic data processing and digital communication systems. The printer, denoted SC-3070, can operate on-line or off-line with digital computer systems, and is compatible with most available data transmission terminals. It asynchronously prints a character at a time, upon receipt of signals from a digital computer, a high-speed teletype terminal, or other data-handling devices.

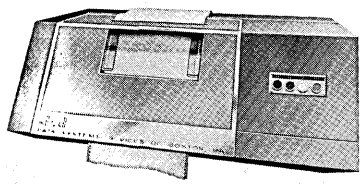
The printer uses an electrostatic process to produce legible permanent copy, that can be handled without smudging or smearing. It will operate at a speed up to 83 words per second. It has modular design and readily replaceable circuit boards.

NEW FIRM ANNOUNCES HIGH-SPEED PRINTER

Data Systems Devices of Boston, Inc.
343 Western Avenue
Boston, Mass.

A High-Speed Printer, for use with EDP systems, is the first product to be announced by this new company. The device has a printing speed of 1200 lines per minute with 132 printing positions, an paper advance at either one of two speeds.

The new drum type printer, Model 1-132, is constructed to offer improved print quality in high-speed operation. Actual printing is done with a ballistic striker designed to lessen character ghosting. It performs with a guaranteed maximum of .015" deviation in character-to-character vertical alinement.



The printer's design allows for full non-synchronous operation, making the paper advance possible immediately after a full line is printed and allowing resumption of printing after the paper advance cycle is completed.

NEW DATA STORAGE AND DISPLAY SYSTEM

Laboratory for Electronics, Inc.
1079 Commonwealth Ave.
Boston 15, Mass.

A new data storage and display system capable of generating one half million characters per second has been developed by this company. It is called the SM-IIA and is for use in such applications as military command and control systems. The device, including memory, provides a bright flicker-

free image using a standard cathode ray tube (CRT). Any combination of alphanumeric characters, abstract symbols, schematics, logic diagrams, graphs, charts or maps can be displayed.

A new technique in solid-state character generation enables formation of up to 500,000 characters per second. Each is composed of from one to 25 individual line segments.

An LFE Bernoulli Disk memory device is used as the storage element in the SM-IIA. The Disk, at rotational velocity, repeats the presentation 50 or 60 times per second for a flicker-free image. Any part of displayed information may be changed or updated at any time. Information can be stored on the disk indefinitely.

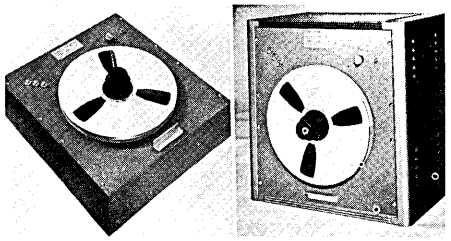
The full range of normal digital inputs are compatible with the SM-IIA, including computers, data links, paper and magnetic tape and manual keyboards.

NEW MAGNETIC TAPE ERASER AND TESTER

General Kinetics Inc.
2611 Shirlington Rd.
Arlington, Va.

This company has developed a magnetic tape bulk eraser, called the Model K-80, and a solid-state magnetic tape tester called the Model 7-A.

The magnetic tape bulk eraser, has been designed for continuous operation without overheating. It has a complete erasure cycle of one minute per reel. The unit will handle any standard reel diameter from 3" to 15" and can accommodate tape widths up to 2".



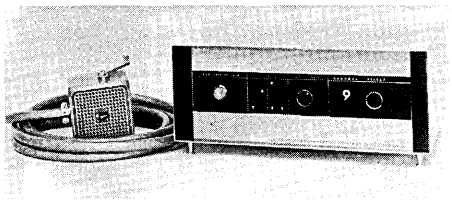
The Model K-80 accomplishes erasure by rotating the tape reel through a gradually-reduced, high-flux density alternating magnetic field employing three separate magnet coils. Erasure level is 80 to 95 decibels, depending on the method of measurement.

The magnetic tape tester is fully solid-state. It is designed to locate dropouts, noise pulses and time-displacement errors in magnetic computer tape. It performs both signal and noise tests in a single pass of the tape and permits manual error correction at a built-in work station. The tester is equipped with seven-channel heads for standard IBM-format tape, and can be modified to accommodate tapes used in other computer systems.

COMPUTER TIME CLOCK

Electronic Engineering Company
of California
Santa Ana, Calif.

A computer time clock, called Datachron, has been developed by this company. It operates under computer program control without permanent connection with the computer. Two models are available,



the EECO Datachron 790 for 24-hour clock time operation (shown in the photo) and the EECO Datachron 791 for elapsed time operation.

The clocks measure computer running time and facilitate comparison of the efficiency of programs and subroutines. Timing data is processed through the computer for direct printout on a report.

Both clocks can be connected to any IBM computer with an unused tape channel and can be assigned and tape-unit-select channel. A tape-read command is given for the assigned channel. The Datachron simulates the IBM tape response and sends the accumulated time data to the computer. Shutting down the computer by switching the power on or off does not affect the accumulated time in the Datachron. Real time data is interrogated from the clock and when obtained is sent to computer storage.

Components

"FLEA" MEMORY FOR USE IN MICROELECTRONIC COMPUTER SYSTEMS

Radio Corporation of America
30 Rockefeller Plaza
New York 20, N.Y.

An experimental, low-cost electronic memory, for use in future generations of microelectronic computers, has been developed by this company. The device, called a "Flux Logic Element Array" or FLEA memory, is smaller than a pack of book matches and is capable of processing 100,000 computer words per second.

The FLEA memory differs from standard computer memories in its use of permalloy "transfluxors" for memory cells rather than ferrite cores. These transfluxors are formed and interconnected on a single sheet by a series of photographic processes. To complete the memory, these sheets are stacked one atop the other and interconnected vertically. A prototype, delivered to RCA's Surface Communications Division, Camden, N.J., for evaluation in tactical military equipment, contains a stack of eight such sheets giving it a total storage capacity of 1024 bits of information.

The FLEA memory is word-organized, 8 bits per word. The drive current is 120 ma; read-write cycle is 10 microseconds; and it has a temperature range of -60°C to 150°C. The high information capacity per unit of volume, the inherent low cost, wide temperature range and adaptability to automatic production are major advantages over conventional devices.

PHOTOELECTRIC DIGITAL CLOCK AND CODE CONVERTER

Invac Corp.
Waltham, Mass.

A new photoelectric digital clock, Model 200, has been introduced by this company. It provides serial character output plus three serial functions of fixed information. The coded signal output is parallel by bit and serial by character. The device weighs 9 pounds.

The company has also developed a photoelectric code converter, Model 190, said to be able to convert at 20 characters per second any 5 to 8-bit code by interchanging code discs. The converter weighs 9 pounds.

Data Transmitters and A/D Converters

DATARAY 401 DATA TRANSMISSION SYSTEM

Raytheon Company
Communications & Data Processing
Norwood, Mass.

The DataRay 401 data transmission system is now able to process alphabetic as well as numeric information. The new alphanumeric devices, sold and serviced by The Standard Register Company and manufactured by Raytheon, will provide greater flexibility and versatility.

The new unit can transmit all alpha-numeric data from punched cards although the keyboard can only be used for numeric coding and for checking purposes. The new 401 unit provides for separate fields within a card to be checked individually instead of the one field length per output card. It can also transmit from one reader into two key punches simultaneously.

DIAL-O-VERTER SERIAL CARD TERMINAL

Digitronics Corporation
Albertson, N.Y.

A Dial-o-verter D515 serial card terminal has been developed by this company. The D515 terminal transmits 80-column punched cards over telephone lines at a speed of 100 cards per minute. It is fully compatible with the Dial-o-verter D505 and D506 paper tape terminals, the D510 bi-directional card terminal, and the D520 magnetic tape terminal. It also includes an option which permits it to be used as an off-line punched card-to-paper tape converter.

The D515 serial card terminal includes a serial card reader, a converter module which includes a 1024 character memory, translation and limited editing facilities, and a coupler module. Cards are read narrow end first, so that each character is read sequentially and translated into either

Teletype or any desired 7-bit parity code. Characters are stored in the core memory and transmitted over the telephone line by the coupler.

CMC DIRECT COUNTING CONVERTER

Computer Measurements Co.
San Fernando, Calif.

An all solid state device for extending the frequency range of electronic counters to 100 megacycles with 10 cps resolution is now in production by this company.

The device, CMC Model 740A Direct Counting Converter, has a 100 Mc octade prescaler which includes the input amplifier and shaper, an octade time base divider, and self-contained power supply.

Software News

HONEYWELL EDP ADDS "SCOPE" SOFTWARE PARALLEL PROCESSING ABILITY BOOSTED

A new software package to extend the parallel processing ability of the Honeywell 800 and 1800 computers has been announced by Honeywell EDP, Wellesley Hills, Mass.

The software system, called SCOPE, (System to Coordinate the Operation of Peripheral Equipment), is a utility package designed to coordinate the use of peripheral equipment. It is said to be capable of operating up to seven different peripheral devices simultaneously -- including card readers, card punches and printers.

SCOPE consists of two parts: a monitor and a set of macro routines to control the operation of each piece of equipment. The macro routines are in the ARGUS macro library and are used to construct a specialized program for a particular configuration of peripheral equipment. SCOPE software permits the combination of a series of peripheral routines into one program, allowing up to six other programs to operate in parallel with it, under the control of the ARGUS Executive system. ARGUS (Automatic Routine Generating and Updating System) is an assembly system developed by Honeywell EDP in 1961.

Analog

TR-48 OFFERS TWO NEW COMPONENTS

Electronic Associates, Inc.
Long Branch, N.J.

Two new components have been developed by this company that expand the high-speed repetitive computational abilities of the EAI TR-48 medium-size general purpose analog computer. The components are an integral repetitive operation display and a solid state high-speed comparator.

The display device can be used to display up to four variables simultaneously, eliminating the need for an external oscilloscope. The device will also be available in a modular package which can be used as a repetitive operation readout for the TR-10 desk top size computer, and the TR-48 computers now in use.

The second TR-48 component is a high-speed comparator. It is a completely solid state device that can perform high-speed switching and logic operations at speeds high enough to permit high-speed repetitive operations with the computer.

FJCC EX POST FACTO PROFILE

What?: Fall Joint Computer Conference

Where?: Sheraton Hotel in Philadelphia, Pa.

When?: December 4-6, 1962

What was the theme?: "Computers in the Space Age"

Who was there?: Over 6000 registrants and visitors.

What did they hear?: Thirty technical papers, a keynote and banquet address, and three panel discussions.

What did they see?: Over $10 million in computing equipment displayed in 160 booths by 80 exhibitors.

Who sponsored it?: The American Federation of Information Processing Societies (AFIPS) which is composed of the Association for Computing Machinery, the American Institute of Electrical Engineers, the Institute of Radio Engineers, and the Simulation Councils, Inc.

Where can I get a copy of the Proceedings?: Mail order requests for a copy of the 62 FJCC Proceedings should be sent to: Spartan Books, 6411 Chillum Place, Washington 12, D.C. Price per copy: $4.00 to members of affiliated societies; $8.00 to others.

PRESIDENT KENNEDY CONGRATULATES COMPUTER SCIENTISTS

"It would be difficult to imagine how the government and industry could work effectively today without the help of electronic computers," said President Kennedy in a telegram to Dr. Willis H. Ware, chairman of governing board of the AFIPS at the recent FJCC.

"...I am pleased to greet you on the occasion of this...conference, the tenth anniversary of the first installation of a commercially manufactured electronic computer at the Bureau of the Census," he added. "During the past ten years, the government and the country as a whole have learned to rely on computers for many essential tasks, ranging from processing large quantities of data to making rapid calculations that can immediately affect the safety and welfare of the nation..."

"...Computers have expanded our horizons and have demonstrated to the world important advances in American technology," President Kennedy continued. "The meeting of the American Federation of Information Processing Societies will help to improve the development and applications of computers and their contributions to the quality of American life..."

Dr. Ware, on behalf of AFIPS, had sent President Kennedy an earlier message noting the following significant contributions of the computer scientists: The ten year old industry now employs more than one million people and has an annual business volume of more than one billion dollars. Today, our commercial computing power can be measured as the ability to perform 110,000,000 operations per second, 95% of the world's power, or more than 10,000 general purpose computers.

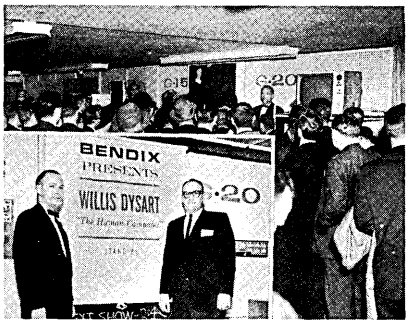
The role of the government in encouraging the growth of this technology was noted and Dr. Ware said in part, "...The electronic computer is a United States development and one that we can take great pride in. We feel that it is the strongest single weapon that this country has in extending the abilities of its technical people, in helping business adjust to today's demands and pressures, in reducing the waste of our resources, and in making fuller use of our inheritance of knowledge from the past..."

Contributions of computer technology to business, industry, and government were noted. "We feel the computer community has served the country well," Dr. Ware continued. "In the past ten years the cost of mathematical computation has been reduced from $300 for 1,000,000 operations to $1 for 1,000,000 operations; speed has increased from 2,000 operations per second to 200,000 operations per second; costs have been lowered to bring them within reach of the average business and the size has been expanded to enable the accomplishment of vital Atomic Energy Commission calculations..."

Dr. Ware concluded, "...This country is in a technical and economic squeeze that computers are helping to alleviate; they are the tool by which we are able to get into rhythm with our times. We are proud of our record. But under the urgency of today's demands we can do more. We are rededicating ourselves to this task."

HUMAN COMPUTER A POPULAR FEATURE AT FJCC EXHIBIT

Overflow crowds filled the Bendix Computer booth at the Fall Joint Computer Conference in the Philadelphia Sheraton as Bendix presented the earliest known type of computer -- the human brain.



Willis Dysart, (on left in photo insert) the famous mental arithmetician, assisted by Bendix supervisor Howard Mark, astonished conferees with 23 performances of mathematical wizardry in square and cube root problems. Then, using his "braincell memory" and "decimal system of unprogrammed problem solution," Dysart invited guests to write multiple-digit numbers on a blackboard for him to add or multiply at split-second speed. To demonstrate his "20-20 optical scanning device," Dysart glanced at assorted dollar bills, retaining their serial numbers in mind until asked to repeat them later, when he would also pick two serials from memory and call off their sum. Dysart also, upon learning of a guest's birthday, would tell him how long he had lived in days, hours, minutes, and seconds. An estimated 1500 viewed the Bendix exhibit during the 3-day conference.

BUSINESS NEWS

RCA SAYS EDP DIVISION "ON SCHEDULE"

RCA has reported that its earnings and sales set records in the first nine months this year. Net income jumped 44% to $34.3 million, from $23.8 million, or $1.29 a share, a year earlier. Sales rose 16% to $1,265,500,000 from $1,090,100,000.

Elmer W. Engstrom, president, said the gain in earnings this year from 1961 would be sharper than the increase in sales. He attributed this to increased operating efficiencies, cost reductions in developing and producing data processing equipment and other factors.

Rental and sales income of the EDP division have more than doubled those of last year, Mr. Engstrom said. He noted that by year's end more than 250 commercial computers will have been shipped to business and government users here and abroad. About two-thirds of those are the lower-priced 301 systems, and the other one-third, medium-priced 501 machines. That compares with 125 business computers installed in customers' offices at the end of 1961.

Mr. Engstrom said electronic data processing costs, which reached a peak last year, have been sharply cut this year. "We see a further cost reduction in 1963," he predicted. "At some time, not too remote from the end of next year, we hope to approach a break-even level in the computer operation," he said. "We are on schedule."

ANELEX NOTES DOUBLING OF SALES

Consolidated 1962 net sales of $12,523,572, approximately twice the 1961 total of $6,641,728, is reported by Anelex Corporation, Boston, Mass.

Consolidated net income, the annual report states, was $520,273, compared to $270,473 or, with inclusion of a special $35,500 tax credit, $305,973 in 1961.

AMPEX BOASTS RECORD SALES

Ampex Corporation, Redwood City, Calif., has reported that sales, earnings and incoming orders for the six months ended October 31 set new company records for any first half year. Sales totaled $43,120,000 up 18 per cent from $36,480,000 a year ago. Net earnings increased 347 per cent to $2,197,000 compared with $492,000 for the first half of fiscal 1962. Incoming orders for the six months totaled $50,148,000, up 32 per cent from $37,139,000 in the previous year.

Research and new product development expenditures charged against the first six months of the year amounted to approximately $4,250,000. During this period a total of 13 new Ampex products have been introduced. Ampex says it will spend in excess of $9,000,000 for research and new product development during the current fiscal year.

CONTROL DATA LEASES NEW BUILDING IN LOS ANGELES

Dr. Robert E. Fagen, General Manager of Control Data's System Sciences Division, has announced the leasing of approximately 6,000 square feet of a new building in Westchester, California located in the hub of Los Angeles' space-age industrial development. Control Data will occupy the entire building by January, 1964.

The recently completed structure will serve as the headquarters for the System Sciences Division and will house all of its Los Angeles staff.

The System Sciences Division is engaged in military and commercial projects involving system analysis, design and development of computer complexes, mathematical research and computer programming research and development.

At a later date, Control Data will install a computation center in the new building. This is expected to serve as a scientific center for the military and aerospace industries in the Los Angeles area and also afford the System Sciences Division the opportunity to expand its research and development program.

TECH/OPS UPS PROFITS 91%, SALES RISE

Technical Operations, Inc., Burlington, Mass., reports net earnings of $285,700 for the year ended Sept. 30, 1962, representing a 91 per cent increase over the $149,500 recorded the preceding year. The earnings include a $36,000 tax credit.

Sales of $10,187,800 in the year rose more than 21 per cent from fiscal 1961's $8,380,700. The 1962 sales include a $400,000 disputed receivable claim by a Tech/Ops subsidiary with a prime contractor.

LOWER CASE FIRM GETS NEW CASH

Erwin Tomash, president of data products corporation, Culver City, Calif., has announced the completion of a $1,400,000 long-term financing program for the company and its subsidiary, Informatics Inc. data products corporation is a recently established, independent, publicly held company servicing the data industries with concentration on equipment to perform data input, data output, and data storage tasks. Its products are the DISCfILE manufactured in St. Paul, Minnesota, and the LINE/PRINTER manufactured in Culver City, California.

A portion of the funds will be used to reduce current short-term bank borrowings, and the balance will be added to working capital.

COMPUTER USAGE REPORTS SALES, INCOME AT NEW HIGHS

Computer Usage Company, Inc., New York, has announced record sales and income for the fiscal year ending September 30, 1962. Total sales from services reached a peak of $2,022,156, up 55% from sales of $1,299,700 a year ago, while net income after taxes totaled $61,421, up 65% from $37,234 for 1961.

Mr. Kubie, president, also disclosed that CUC's backlog for services was approximately $1,342,000 on September 30, compared to $669,000 the year previous.

Now in its eighth year of operation, Computer Usage Company, Inc., is a firm specializing in computer analysis, programing and operation. Branch offices of CUC are located in Washington, D.C., and Los Angeles.

MONTHLY COMPUTER CENSUS

The number of electronic computers installed, or in production at any one time has been increasing at a bewildering pace in the past several years. New vendors have come into the computer market, and familiar machines have gone out of production. Some new machines have been received with open arms by users -- others have been given the cold shoulder.

To aid our readers in keeping up with this mushrooming activity, the editors of COMPUTERS AND AUTOMATION present this monthly report on the number of American-made general purpose computers installed or on order as of the preceding month. We update this computer census monthly, so that it will serve as a "box-score" of progress for readers interested in following the growth of the American computer industry.

Most of the figures are verified by the respective manufacturers. In cases where this is not so, estimates are made based upon information in the reference files of COMPUTERS AND AUTOMATION. The figures are then reviewed by a group of computer industry cognoscenti.

Any additions, or corrections, from informed readers will be welcomed.

AS OF DECEMBER 20, 1962

NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS
Addressograph-Multigraph Corporation	EDP 900 system	Y	$7500	2/61	9	11
Advanced Scientific Instruments	ASI 210	Y	$2850	4/62	5	4
	ASI 420	Y	$12,500	12/62	1	1
Autonetics	RECOMP II	Y	$2495	11/58	132	7
	RECOMP III	Y	$1495	6/61	28	18
Bendix	G-15	N	$1700	7/55	348	5
	G-20	Y	$15,500	4/61	20	6
Burroughs	205	N	$4600	1/54	87	X
	220	N	$14,000	10/58	58	X
	E101-103	N	$875	1/56	170	X
	B250	Y	$4200	11/61	40	34
	B260	Y	$3750	11/62	15	42
	B270	Y	$7000	7/62	10	30
	B280	Y	$6500	7/62	5	16
	B5000	Y	$16,200	-	0	10
Clary	DE-60/DE-60M	Y	$675	2/60	73	8
Computer Control Co.	DDP-19	Y	$3500	6/61	1	2
	DDP-24	Y	$3000	-	0	1
	SPEC	Y	$800	5/60	8	2
Control Data Corporation	160/160A	Y	$2000/$3500	5/60 & 7/61	215	55
	1604	Y	$35,000	1/60	40	15
	3600	Y	$52,000	4/63	0	2
	6600	Y	$120,000	-	0	1
Digital Equipment Corp.	PDP-1	Y	Sold only about $175,000	12/59	34	10
	PDP-4	Y	Sold only about $75,000	8/62	5	5
El-tronics, Inc.	ALWAC IIIE	N	$2500	2/54	32	X
General Electric	210	Y	$16,000	7/59	59	20
	225	Y	$7000	1/61	65	95
General Precision	LGP-21	Y	$725	12/62	3	30
	LGP-30	semi	$1300	9/56	400	20
	RPC-4000	Y	$1875	1/61	64	20
Honeywell Electronic Data Processing	H-290	Y	$3000	6/60	11	3
	H-400	Y	$5000	12/60	34	52

NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS
Honeywell EDP (cont'd.)	H-800	Y	$22,000	12/60	49	5
	H-1800	Y	$30,000 up	-/63	0	2
	DATAmatic 1000	N	-	12/57	6	X
H-W Electronics, Inc.	HW-15K	Y	$500	3/63	0	1
HRB-Singer, Inc.	SEMA 2000	Y	$700	1/62	17	18
IBM	305	N	$3600	3/62	925	X
	650-card	N	$4000	11/54	735	X
	650-RAMAC	N	$9000	11/54	262	X
	1401	Y	$2500	9/60	3850	4380
	1410	Y	$10,000	11/61	78	430
	1440	Y	$1800	4/64	0	480
	1620	Y	$2000	9/60	1350	320
	701	N	$5000	4/53	4	X
	702	N	$6900	2/55	5	X
	7030	Y	$300,000	5/61	3	X
	704	N	$32,000	12/55	89	X
	7040	Y	$14,000	6/63	0	35
	7044	Y	$26,000	6/63	0	5
	705	N	$30,000	11/55	160	X
	7070, 2, 4	Y	$24,000	3/60	245	260
	7080	Y	$55,000	8/61	38	28
	709	N	$40,000	8/58	45	X
	7090	Y	$64,000	11/59	213	144
	7094	Y	$70,000	12/62	1	4
Information Systems, Inc.	ISI-609	Y	$4000	2/58	20	3
ITT	7300 ADX	Y	$35,000	7/62	6	4
Monroe Calculating Machine Co.	Monrobot IX	N	Sold only-$5800	3/58	160	7
	Monrobot XI	Y	$700	6/60	210	150
National Cash Register Co.	NCR - 102	N	-	-	30	X
	- 304	Y	$14,000	1/60	30	0
	- 310	Y	$2000	5/61	20	40
	- 315	Y	$8500	5/62	32	130
	- 390	Y	$1850	5/61	275	230
Packard Bell	PB 250	Y	$1200	12/60	130	25
Philco	2000-212	Y	$68,000	-/63	0	6
	-210, 211	Y	$40,000	10/58	21	27
	1000	Y	$7010	-/63	0	12
Radio Corp. of America	Bizmac	N	-	-/56	4	X
	RCA 301	Y	$6000	2/61	159	330
	RCA 501	Y	$15,000	6/59	83	11
	RCA 601	Y	$35,000	11/62	1	6
Scientific Data Systems Inc.	SDS-910	Y	$2190	8/62	8	12
	SDS-920	Y	$2690	9/62	2	5
TRW Computer Co.	RW530	Y	$2500	8/61	14	7
UNIVAC	Solid-state 80, 90, & Step	Y	$8000	8/58	528	152
	Solid-state II	Y	$8500	9/62	2	34
	490	Y	$26,000	12/61	4	12
	1107	Y	$45,000	10/62	1	16
	III	Y	$20,000	8/62	2	65
	LARC	Y	$135,000	5/60	2	X
	1100 Series (except 1107)	N	$35,000	12/50	32	X
	I & II	N	$25,000	3/51 & 11/57	62	X
	File Computers	N	$15,000	8/56	77	1
	60 & 120	N	$1200	-/53	912	27
	1004	Y	$1500	2/63	0	950
				TOTALS	12,882	8,899

X -- no longer in production

READERS' AND EDITOR'S FORUM

(Continued from Page 9)

WIN A BRAINIAC

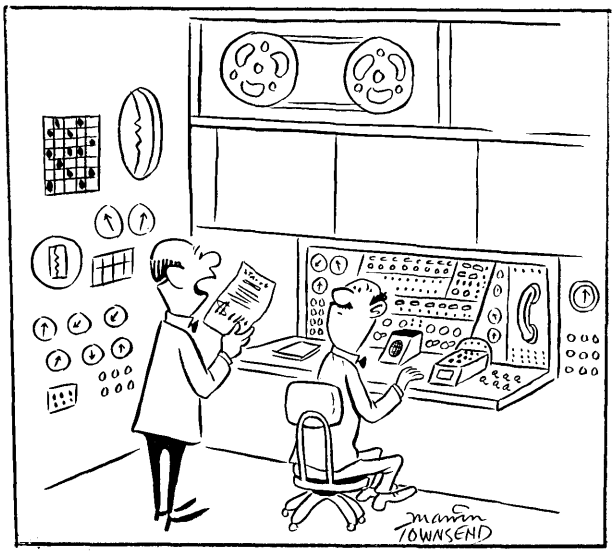
The Famous Electronic Brain Construction Kit
The Perfect Christmas Gift for the
Bright Young Man or Woman

FIVE WINNERS: HERE'S HOW

Choose a caption for the cartoon below. Submit it at the **Computers and Automation** booth.

The best five captions submitted, in the opinion of the editorial staff, will be selected. The author of each will receive a gift-wrapped BRAINIAC, in time for Christmas, and ready to introduce a delighted young person to the world of computing machines.

The Cartoon:



Over forty people submitted entries from the absurd to the hilarious to the unprintable. The winning entries and their authors are:

"Wow! This month's electric bill is larger than the salaries of the five girls this thing replaced."

K. J. Cohen
9710 Jeanes Street
Philadelphia 15, Pa.

"Diagnostic report—MAIN PROBLEM . . . CONSOLE OPERATOR."

Don Sabia
E. J. Bettinger Co.
20 S. 15th Street
Philadelphia 2, Pa.

"We appreciate your suggestion, Klauss, but our budget does not include red and green indicator lights for Christmas."

Robert N. Brown
2775 Franklin Drive
Columbus, Ind.

"It says, 'YOUR LAST GAME OF TIC-TAC-TOE COST THE COMPANY $57.23.' "

Vincent Buckley
401 Colwyn Avenue
Colwyn, Pa.

"Switch on the automatic monitor routine, Higgins —and incidentally you'll be retrained to take care of the air conditioning."

Edward T. Killelea
501 University Boulevard
Glassboro, N. J.

So you see, Virginia, more than an ordinary bit of wit is to be found among people who handle bits automatically.

ALGOL LABELS APPROVED

To the Editor:

With reference to the article "ALGOL—A Simple Explanation" by Dr. Clippinger in the November issue, I was surprised to see the following erroneous ALGOL statement in Example 1:

declare: *real* p, q, SUM;

To the best of my knowledge, the ALGOL—60 specifications do not allow declarative statements to be labelled. Dr. Clippinger's reasons for labelling the above statement were readability (and presumably documentation). It would seem to me that if labels were allowed for declarative statements, they would provide a method less awkward than *comment* statements for delineating blocks of data for documentation purposes. In short, the usage above is incorrect, but I would like to see it allowed.

Yours truly,

STEPHEN F. GRISOFF,
IBM Data Systems Division
Cambridge 38, Mass.

NEW COMPUTER TV SERIES

"The industrial revolution effectively released man from being a beast of burden; the computer revolution will similarly release man from a dull, repetitive routine. . . . "

Dr. Richard Hamming, **Computers and Automation** advisory editor and research mathematician at Bell Telephone Laboratories, makes this comparison and this prediction of a bright tomorrow during a new National Educational Television series entitled "The Computer and the Mind of Man."

The six-program series, underwritten by a grant from International Business Machines Corporation, premiered last month across the country on the N. E. T. network of 67 affiliated, non-commercial television stations. KQED, San Francisco's non-commercial television station, has produced the series for N. E. T.

As the television series unfolds, viewers will be introduced to the variety of routine tasks in government, industry, and general business that electronic computers can control automatically—the computer

can process millions of bits of data in seconds, can run manufacturing plants, and can simulate the firing of rockets.

During "The Computer and the Mind of Man," viewers will also find themselves surveying the world of the computer—from the first mechanical calculator in the seventeenth century to the first electronic computer in the 1940's, from the variety of programming languages now being used to instruct computers to once unthought of methods of using these mathematical marvels.

In regard to the question of machines becoming more and more like human beings, Dr. C. R. DeCarlo, director of education for IBM, comments during the filmed series, "I'm persuaded that no matter how deeply we probe, no matter how arduously we try to duplicate—and are successful in duplicating certain parts of the life process—there will always be some new level of fineness or resolution beyond us. In other words, the enigma will always be there."

And J. Presper Eckert, co-inventor of the first electronic computer and vice president of the UNIVAC Division of the Sperry Rand Corporation, wryly adds, "If we are able to make a machine which is capable of emulating human thinking and is capable of self-reproduction, I hope that the man who does this has the presence of mind to kick the plug out of the socket before he starts running."

THE BENDIX G-15: SEVEN YEARS OLD AND STILL SELLING

The face pace of computer technology has a way of obsoleting equipment almost before it gets out of the prototype stage. In the November issue, **Computers and Automation** reported on the used compu ter market in which several three- or four-year-old computers have recently been traded for newer equipment. An apparent exception to this trend is the small Bendix G-15 general purpose computer, first marketed seven years ago—and still being ordered.

New orders for the G-15 are still coming in to the Los Angeles headquarters of Bendix Computer. Litton Industries, for example, ordered five systems during the past year, the most recent order arriving in September for a new machine to be used with a special simulation system.

This year the G-15 countered another industry trend when Bendix Computer general manager Charles Edwards announced that more than 50% of the machines had been converted from lease to sale basis.

Bendix reports accessory orders for fiscal year 1962 were about $500,000.

About 370 of the G-15 systems have been manufactured by Bendix which credits three features of the computer for its continued popularity: reliability, versatility and strong users' support.

G-15 #2 was delivered to Humble Oil's Research Center in Houston in 1955. Up to 1961, when Humble acquired the larger Bendix G-20, the system had recorded 48,180 hours of operation with 96.5% uptime.

Similarly a G-15 at Eastman Kodak in Buffalo, N. Y., recorded up-time of 100% for more than a year. The average this past year for all G-15s was 97%.

This high reliability has also led to a number of uses with special military systems such as the missile impact prediction system on Kwajalein Island. Its general ruggedness has sent eight of them rolling on the high seas with U. S. Navy ships.

Versatility has been afforded by a range of peripheral equipment for the G-15, including multicode paper-tape readers, magnetic-tape units, punched-card coupler and tabulator, digital differential analyzer, universal code accessory, plotter and other special-purpose devices.

More than 1,000 programs are contained in the G-15 Users Library. About 200 companies are members of the Users Organization which has met regularly for the past seven years.

Most recent addition to the body of computer programs for the G-15 is the CPM/PERT system which can be used with any G-15 configuration including the minimum computer/typewriter system. Other programming aids include Intercom 1000, Intercard, Autocard, ALGO, AUTOPOINT 24 and a full complement of general, interpretive, compiler and service routines.

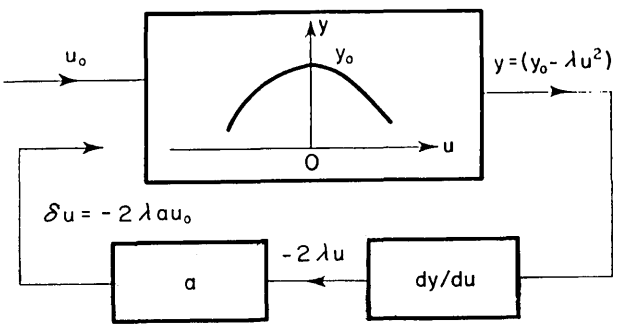
COMPUTERS AND DECISION MAKING

(Continued from Page 14)

As a matter of fact, it has none of the abilities we customarily associate with human intelligence. It has no power to recognize or formulate problems. Its ability to store and recall information is so primitive as not to be classed as "memory." It is incapable of making decisions on the basis of incomplete, ambiguous and inconsistent data, a characteristic ability of the human mind. As far as computers are concerned, Cagliostro and Barnum may be leading the band and taking care of the press reviews, but Frankenstein is not in the wings waiting to come on stage.

The working of the human mind remains an amazing mystery. How do we process and store so much information so accurately? If we understood even a small fraction of these truly magic powers, we could construct computers that might help us unravel the scientific riddles of the universe.

The challenge is there. For those who like cryptograms and puzzles, for those who want to make fundamental advances in science, for those who want to heal and help, and, finally, for those who want to understand themselves, here is the opportunity!



CALENDAR OF COMING EVENTS

Jan. 22-24, 1963: Ninth National Symposium on Reliability and Quality Control, Sheraton-Palace, San Francisco, Calif.; contact A. R. Park, Librascope Division, General Precision, P. O. Box 458, San Marcos, Calif.

Jan. 27-Feb. 1, 1963: 1963 Winter General Meeting of the American Institute of Electrical Engineers, Statler and New Yorker Hotels and Coliseum, New York, N. Y.; contact Dr. D. R. Helman, ITT Federal Laboratories, 500 Washington Ave., Nutley 10, N. J.

Jan. 30-Feb. 1, 1963: 4th Winter Convention on Military Electronics, Ambassador Hotel, Los Angeles, Calif.; contact IRE L. A. Office, 1435 La Cienega Blvd., Los Angeles, Calif.

Feb. 4-8, 1963: ASTM Committee Week, Queen Elizabeth Hotel, Montreal, Canada

Feb. 11-15, 1963: 5th Institute on Information Storage and Retrieval of the School of Government and Public Administration of The American University, International Inn, Washington, D. C.; contact Dr. Lowell H. Hattery, Director, Center for Technology and Administration, The American University, 1901 F St., N.W., Washington 6, D. C.

Feb. 20-22, 1963: International Solid State Circuits Conference, Sheraton Hotel and Univ. of Pennsylvania, Philadelphia, Pa.; contact S. K. Ghandi, Philco Scientific Lab., Blue Bell, Pa.

Mar. 6-7, 1963: Disc File Symposium, Hollywood, Calif.; contact Dr. Walter F. Bauer, Informatics Inc., 8535 Warner Dr., Culver City, Calif.

Mar. 15-16, 1963: Pacific Computer Conference, California Institute of Technology, Pasadena, Calif.; contact Dr. E. J. Schubert, Systems Division of Beckman Instruments, Inc., 2400 Harbor Blvd., Fullerton, Calif.

Mar. 19-21, 1963: Symposium on Bionics, sponsored by Aeronautical Systems Div. of the Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, Biltmore Hotel, Dayton, Ohio; contact Commander, Aeronautical Systems Div., Attn.: ASRNEB-3, Lt. Col. L. M. Butsch, Jr., Wright-Patterson Air Force Base, Ohio

Mar. 25-28, 1963: IRE International Convention, Coliseum and Waldorf-Astoria Hotel, New York; contact Dr. D. B. Sinclair, IRE Headquarters, 1 E. 79th St., New York 21, N. Y.

Apr. 17-19, 1963: Southwestern IRE Conference and Elec. Show (SWIRECO), Dallas Memorial Auditorium, Dallas, Tex.; contact Prof. A. E. Salis, E. E. Dept., Arlington State College, Arlington, Tex.

April 23-25, 1963: The Eleventh National Conference on Electromagnetic Relays, Student Union Bldg., Oklahoma State University, Stillwater, Okla.; contact Prof. Charles F. Cameron, Technical Coordinator of the NARM, Oklahoma State University School of Electrical Engineering, Stillwater, Okla.

April 24-26, 1963: Power Industry Computer Application Conference, Hotel Westward Ho, Phoenix 4, Ariz.; contact E. J. Lassen, 453 E. Lamar Rd., Phoenix 12, Ariz.

May 17-18, 1963: Symposium on Artificial Control of Biology Systems, Univ. of Buffalo, School of Medicine, Buffalo, N. Y.; contact D. P. Sante, 4530 Greenbriar Rd., Williamsville 21, N. Y.

May 20-22, 1963: National Telemetering Conference, Hilton Hotel, Albuquerque, N. M.; contact T. J. Hoban, NTC Program Chairman, Sandia Corp., P. O. Box 5800, Albuquerque, N. M.

May 21-23, 1963: Spring Joint Computer Conference, Cobo Hall, Detroit, Mich.; contact Dr. E. Calvin Johnson, Bendix Aviation Corp., Detroit, Mich.

June 11-13, 1963: National Symp. on Space Electronics and Telemetry, Los Angeles, Calif.; contact John R. Kauke, Kauke & Co., 1632 Euclid St., Santa Monica, Calif.

June 19-21, 1963: Joint Automatic Control Conference, Univ. of Minn., Minneapolis, Minn.; contact Otis L. Updike, Univ. of Va., Charlottesville, Va.

June 23-28, 1963: ASTM 66th Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

July 22-26, 1963: 5th International Conference on Medical Electronics, Liege, Belgium; contact Dr. L. E. Flory, RCA Labs., Princeton, N. J.

Aug. 20-23, 1963: Western Elec. Show and Conference (WESCON), Cow Palace, San Francisco, Calif.; contact WESCON, 1435 La Cienega Blvd., Los Angeles, Calif.

Aug. 27-Sept. 4, 1963: 2nd Congress, International Federation of Automatic Control, Basle, Switzerland; contact Dr. Gerald Weiss, E. E. Dept., Polytechnic Inst., 333 Jay St., Brooklyn 1, N. Y.

Sept. 9-11, 1963: 7th National Convention on Military Electronics (MIL-E-CON 7), Shoreham Hotel, Washington, D. C.; contact L. D. Whitelock, Exhibits Chairman, 5614 Greentree Road, Bethesda 14, Md.

Oct., 1963: 10th Annual Meeting, PGNS 2nd International Symposium on Aerospace Nuclear Prop. and Power

Nov. 4-6, 1963: NEREM (Northeast Research and Eng. Meeting), Boston, Mass.; contact NEREM-IRE Boston Office, 313 Washington St., Newton, Mass.

Nov. 10-14, 1963: 9th Annual Conference on Magnetism and Magnetic Materials, Chalfonte-Haddon Hall, Atlantic City, N. J.

Nov. 12-14, 1963: Fall Joint Computer Conference, Las Vegas Convention Center, Las Vegas, Nev.; contact Mr. J. D. Madden, System Development Corp., Santa Monica, Calif.

Nov. 18-20, 1963: 1963 Radio Fall Meeting, Manger Hotel, Rochester, N. Y.; contact EIA Engineering Dept., Room 2260, 11 W. 42 St., New York 36, N. Y.

Nov. 19-21, 1963: Fifth International Automation Congress and Exposition, Sheraton Hotel, Philadelphia, Pa.; contact International Automation Congress & Exposition, Richard Rimbach Associates, Management, 933 Ridge Ave., Pittsburgh 12, Pa.

Feb. 3-7, 1964: ASTM International Conference on Materials, Sheraton Hotel, Philadelphia, Pa.; contact H. H. Hamilton, American Society for Testing and Materials, 1916 Race St., Philadelphia 3, Pa.

Mar. 23-26, 1964 (Tentat.): IRE International Convention, Coliseum and Waldorf-Astoria, New York, N. Y.; contact E. K. Gannett, IRE Hdqs., 1 E. 79 St., New York 21, N. Y.

Apr. 22-24, 1964: SWIRECO (SW IRE Conf. and Elec. Show), Dallas Memorial Auditorium, Dallas, Texas.

Apr. 28-30, 1964: Spring Joint Computer Conference, Statler Hotel, Boston, Mass.

BOOKS AND OTHER PUBLICATIONS

Moses M. Berlin
Allston, Mass.

We publish here citations and brief reviews of books and other publications which have a significant relation to computers, data processing, and automation, and which have come to our attention. We shall be glad to report other information in future lists if a review copy is sent to us. The plan of each entry is: author or editor / title / publisher or issuer / date, publication process, number of pages, price or its equivalent / comments. If you write to a publisher or issuer, we would appreciate your mentioning **Computers and Automation.**

Cooke, Nelson M. / Basic Mathematics for Electronics, second edition / McGraw-Hill Book Co., Inc., 330 West 42 St., New York 36, N. Y. / 1960, printed, 679 pp, $10.75

This edition of a text originally published in 1942 includes numerous additions which reflect the progress in the field of electronics over the last twenty years. The author, who prepared much of the text from lecture notes for courses given in the U. S. Naval Research Laboratory, reviews the principles of arithmetic and algebra, proceeds to explain the slide rule's usefulness. Other chapters include: "Ohm's Law: Series Circuits," "Fractional Equations," "Exponents and Radicals," "Kirchhoff's Laws," "Elementary Plane Vectors," "Vector Algebra," "Logarithms," and "Applications of Logarithms." An appendix includes mathematical tables, abbreviations, the Greek alphabet and answers to even-numbered problems given in the text. Index.

Pullen, Keats A., Jr. / Theory and Application of Topological and Matrix Methods / John F. Rider Publisher, Inc., 116 West 14 St., New York 11, N. Y. / 1962, printed, 96 pp, $2.50

The application of topology and matrix methods to electrical circuit theory is here discussed. In the first of four chapters, the author, Adjunct Professor of Electrical Engineering at Drexel Inst. of Technology, introduces the basic concepts of applying topological methods, pointing out that Kirchhoff first recognized the usefulness of such application, and showing how others developed the application. The remaining chapters discuss, "Matrix Procedures," "Active Networks," and "Typical Examples." Four appendices include, "Symbol Definitions," "Topological Definitions," "Matrix Operations" and a bibliography. Index.

The BEAMA Directory, 1961-2 / Distributed by Pergamon Press, Headington Hall, Oxford, England / 1962, printed, 496 pp, $10.00

This edition of the guide of the British Electrical and Allied Manufacturer's Association contains information about the association, a directory of British manufacturers, a buyers' guide and numerous advertisements. In addition, a five language buyers' guide to electrical and allied equipment is included. Russian, German, French, Spanish and Portuguese are the languages, and each guide is cross-referenced.

Von Foerster, Heinz and George W. Zopf, Jr., Editors / Principles of Self-Organization: Transactions of the University of Illinois Symposium on Self-Organization / Pergamon Press, Inc., 122 East 55 St., New York 22, N. Y. / 1962, printed, 541 pp, $15.00

The Symposium, sponsored by the Information Systems Branch of the U. S. Office of Naval Research, brought together specialists in mathematics, physics, engineering, psychiatry, biology and industrial management. Twenty-three papers and the accompanying discussions at the gathering are published. The papers provide a "concise introduction into the epistemology of self-organization," analysis of complex systems, methods for making complex systems "immune against errors" and information about the technology of self-organizing systems. Among the titles: "Some Self-Organizing Parameters in Three-Person Groups," "On Error Minimizing Neural Nets," "A Proposed Evolutionary Model," "Orderly Function with Disorderly Structure," "An Approach to Automatic Theory Formation," and "Thresholding and Micro-Miniaturization with Semiconductors." Index.

Bernard, Eugene E. and Morley R. Kare, Editors / Biological Prototypes and Synthetic Systems, volume I / Plenum Press, Inc., 227 West 17 St., New York 11, N. Y. / 1962, offset, 397 pp, $12.50

The Proceedings of the Second Annual Bionics Symposium, sponsored by Cornell University and the General Electric Co., and held at the university during Aug. Sept., 1961, are here published. This symposium emphasized contributions from biologically-oriented persons, thus many of the papers discuss subjects under the category of "life" sciences rather than the "physical" or "mathematical" ones. The forty-eight papers include: "Bio-Logic," "Ultrasonic Interaction of Bats and Moths," "A Model of Visual Space," "Design of an Analog Ear," "Electronic Simulation of the Biological Clock," "Machine Interpretation of Radar Displays," "Design Studies of Conditional Probability Computers," and "The Imitation of One Form of Life by Another —Biomimesis."

Lodge, Oliver / Pioneers of Science / Dover Publications, Inc., 180 Varick St., New York 14, N. Y. / 1962, printed, 404 pp, $1.50

This readable book discusses some of the men who illuminated the world of science with imaginative and important discoveries, and discusses as well, the discoveries. The text, taken from a series of lectures on the history and progress of astronomy, begins with a section on Copernicus; other sections discuss, "Kepler and the Laws of Planetary Motion," "Galileo and the Invention of the Telescope," "Galileo and the Inquisition," "Sir Isaac Newton," "Herschel and the Motion of the Fixed Stars," "The Discovery of Neptune," and "The Tides, and Planetary Evolution." 120 illustrations accompany the text.

Galler, Bernard A. / The Language of Computers / McGraw-Hill Book Co., Inc., 330 West 42 St., New York 36, N. Y. / 1962, printed, 244 pp, $8.95

This useful and fascinating book explains and illustrates fundamental methods by

which problems are solved using computers. A number of problems are stated (for example, the problem of "giving change" for a purchase), and then solved by initially devising a method for solution and utilizing the language which would make the problem explicit for the operations of a machine. For the most part, the author is concerned with developing algorithms and devising a means of communication with the computer; he does not discuss any particular computer, but does use the Michigan Algorithm Decider (MAD) language in his solutions. The chapters are: "The Change Problem," "Expressions, Conditional Statements and Iteration Statements," "The Social Security Problem," "The Secret-Code Problem," "Monte Carlo Methods," "A Sorting Problem," "The Correlation Coefficient," "A Program to Produce Programs," "Simultaneous Linear Equations," "The MAD Language," "Other Computer Languages." The final chapter discusses generally other computer languages than MAD and gives some information about FORTRAN and ALGOL. Three appendices include: "Summary of the Rules of the Language," "Translation to FORTRAN," and "The ALGOL Language." Index.

Fulks, Watson / Advanced Calculus: An Introduction to Analysis / John Wiley & Sons, Inc., 440 Park Ave., South, New York 16, N. Y. / 1962, printed, 521 pp, $9.75

This text introduces the subject of mathematical analysis, and uses a technique which emphasizes analytical proofs backed by geometrical intuition, while minimizing reliance on geometrical arguments. The author is a Professor of Mathematics at Oregon State University. The first part covers "Calculus of One Variable," including, "The Number System," "Functions, Sequences, and Limits," "Continuity and Differentiability," and "Limits and Continuity." Part Two, "Vector Calculus," includes, "Vectors and Curves," "Functions of Several Variables—Limits and Continuity," "Differentiable Functions," and "Transformations and Implicit Functions. Extreme Values." Part Three, "Theory of Convergence," includes, "Infinite Series." "The Taylor Series," "Gamma and Beta Functions. Laplace's Method and Stirling's Formula," and "Fourier Series." The final section of the text includes elementary differentiation and integration formulas, answers, hints for solving and solutions to problems given in the text, and an index.

Clarke, Emerson / How to Prepare Effective Engineering Proposals—A Workbook for the Proposal Writer / TW Publishers, River Forest, Ill. / 1962, printed, 214 pp, cost?

This book explains methods for preparing effective engineering proposals "documents designed to sell a potential customer on the ability of an organization to furnish supplies or to perform services of a technical nature." The author advises on proper outline construction, selection of suitable topics, utilization of information, and other related elements of the successful proposal. Part One, "The Form and Content of the Proposal," includes: "The Elements of the Proposal," "The Proposal Outline," "Facilities and Capabilities," and "Importance of the Proper Approach." Part Two, "Methods for the Efficient Production of Proposals," includes: "Organizing for Efficient Production," "Doing the Job—Time and Money Savers," and "Producing the Proposal—the Mechanics." Part Three includes a "Pre-Mailing Check List" and a second check list with which to evaluate the proposal. Tables, illustrations, and index.

McCluskey, E. J., Jr., and T. C. Bartee, Editors, and 7 authors / A Survey of Switching Circuit Theory / McGraw-Hill Book Co., Inc., 330 West 42 St., New York 36, N. Y. / 1962, printed, 205 pp, $7.75

This book contains eleven tutorial papers, useful and informative, presented at the Fall and Winter (1959 and 1960) General Meetings of the American Institute of Electrical Engineers. In all, eleven papers are published which "provide an introduction to switching theory." Many will be satisfied with the "nodding acquaintance" that can be gained; others "will have their curiosity aroused" (two bibliographies are provided for the latter). Among the titles are: "Introduction to Switching Algebra," "Formulation of Switching Problems," "Design Using Computers," "Introduction to State Tables," "Simplification of State Tables," and "Mathematical Structure of Sequential Machines." Bibliographies for combinational and sequential circuits are included. Index.

Bogoliubov, N. N., and Y. A. Mitropolsky / translated from the Russian / Asymptotic Methods in the Theory of Nonlinear Oscillations / Gordon and Breach Science Publishers, Inc., 150 Fifth Ave., New York 11, N. Y. / 1961, printed, 537 pp, $25.00, academic and students' edition: $15.00

This English translation (published originally in India) of the Second Revised Russian Edition consists of six chapters. "Natural Oscillations in Systems Close to Linear Ones," "Method of the Phase Plane," "Influence of External Periodic Forces," "Monofrequency Oscillations in Non-linear Systems with Several Degrees of Freedom," "The Method of Averaging," and "Foundations of Asymptotic Methods." There is a bibliography, mostly of Russian references.

Pontryagin, L. S., translated from the Russian by Leonas Kacinskas and Walter B. Counts / Ordinary Differential Equations / Addison-Wesley Publishing Co., Inc., Reading, Mass. / 1962, printed, 298 pp, $7.50

This attractively printed book stresses the ordinary applications of differential equations to the theory of oscillations and the theory of automatic control. It purposely omits some standard topics in order to give more room to some very modern subjects of considerable interest to the applied mathematician and engineer. The author is an outstanding topologist at Moscow State University. The behavior of Watt's regulator (theory of Vyshnegradskiy) and of Andronov's vacuum-tube circuit is fully discussed. Chapters include, besides an introduction: "Linear Equations with Constant Coefficients," "Linear Equations with Variable Coefficients," "Existence Theorems," "Stability" (containing an introduction to Lyapunov's classical theorems) and "Linear Algebra." Certain engineering problems are also included to test the reader's understanding.

Hamilton, Norman T., and Joseph Landin / Set Theory: The Structure of Arithmetic / Allyn and Bacon, Inc., Boston, Mass. / 1962, printed, 264 pp, $7.75 (college list price)

This is the first in a series of three volumes, "evolved from lecture notes for a course intended primarily for high school mathematics teachers." It discusses clearly and with examples many basic facts about fundamental mathematical topics, such as, numbers, equality, sets and arithmetical operations. The authors, professors of mathematics at the University of Illinois, build their text on the foundation of set theory. After the chapter, "The Elements of the Theory of Sets," then discuss: "The Natural Numbers," "The Integers and the Rational Numbers," "The Real Numbers," and "The Deeper Study of the Real Numbers." This last chapter discusses ordered fields, roots of real numbers, the isomorphism of complete, ordered fields, and the complex numbers. Index.

Redish, K. A. / An Introduction to Computational Methods / John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N. Y. / 1962, printed, 211 pp, $5.75

This book is written for the person who computes occasionally and for students of science and engineering who need a knowledge of numerical methods. The purpose of the book is to aid the human being who wants to solve arithmetical and mathematical problems efficiently and accurately. The author is Lecturer in Computing at the University of Birmingham in England; the book was printed in England. The introductory chapter discusses and illustrates common sources of errors, and some aids to computation. The remaining nine chapters include: "Simultaneous Linear Algebraic Equations," "Finite Differences," "Interpolation," "Differentiation and Integration," "Ordinary Differential Equations," and "Miscellanea," which covers approximating functions, LaGrange formulae, singularities and summation of series.

Hall, J. A. P., Editor, and 21 authors / Computers in Education / Pergamon Press, Headington Hill Hall, Oxford, Eng. / 1962, printed, 122 pp, $7.50

The proceedings of a conference on "The Computing Laboratory in the Technical College," held at the Hatfield College of Technology, May, 1960, are here published. Twenty of the twenty-two papers are included. Among the titles: "Applied Mathematics and Computing Machines," "Computer Courses for Colleges," "The Organization of a Computation Centre," "The Technical College Computing Laboratory and the Schools," and "Financing a Technical College Computing Laboratory." The editor's conclusions are given. Two appendices include a proposal to secure a computer for the Hatfield school, and the names of the participants at the conference. Index.

Sprague, Richard E. / Electronic Business Systems / The Ronald Press Co., 15 East 26 St., New York 10, N. Y. / 1962, printed, 168 pp, $7.50

This volume is subtitled "Management Use of On-Line—Real-Time Computers." It assumes no particular background in electronic data processing. It offers guidance in the solution of managerial and technical problems raised by total electronic systems.

It utilizes eleven chapters to state and develop its unifying thesis, that "by 1970, nearly all electronic data processing systems will be of the on-line—real-time variety." These chapters are: "Definition and Status of On-Line—Real-Time Systems," "Fundamental Pressures," "Relationships Between Pressures and System Requirements," "Data Processing Hardware Developments," "Communications Hardware Developments," "Point-of-Origin Input-Output Devices," "Current On-Line—Real-Time Systems," "Potential Considerations" and "Impact on Organization Structure and Importance to Top Management." The book includes schematics of hardware systems, and an index

Halacy, D. S., Jr. / Computers / Harper & Row, Inc., 49 East 33 St., New York 16, N. Y. / 1962, printed, 279 pp, $4.95

Teen-agers, in particular, may be interested in this non-technical excursion into the history, workings and applications of computers and computer systems. An indication of the level of presentation may be gathered from a retailing of the table of contents: "Computers—The Machines We Think

With," "The Computer's Past," "How Computers Work," "Computer Cousins—Analog and Digital," "The Binary Boolean Bit," "The Electronic Brain," "Uncle Sam's Computers," "The Computer in Business and Industry," "The Computer and Automation," "The Academic Computer" and "The Road Ahead." Photographs, cartoons and diagrams are included in the text. The author has worked in the aircraft industry and teaches at Phoenix Evening College.

Gill, Arthur / Introduction to the Theory of Finite-State Machines / McGraw-Hill Book Co., Inc., 330 West 42 St., New York 36, N. Y. / 1962, printed, 207 pp, $9.95

One can find the ideas and techniques of the theory of finite state machines employed in such seemingly unrelated problems as the investigation of the human nervous activity, the analysis of English syntax, and the design of electronic computers. The basic model of the finite state machine is the multiterminal black box. The purpose of the book is to investigate the "black box" approach to many different systems and system theory. The author, who is an assistant professor of electrical engineering at the University of California, Berkeley, Calif., emphasizes what he terms, "techniques of analysis," and does not discuss synthesis aspects. Among the seven chapters are: "The Basic Model," Equivalence and Machine Minimization," "State Identification Experiments," "Machine Identification Experiments," and "Input-Restricted Machines." Each chapter includes problems. Bibliography and index.

Bibby, Dause L. / Your Future in the Electronic Computer Field / Richards Rosen Press, Inc., 13 East 22 St., New York 10, N. Y. / 1962, printed, 159 pp, $2.95

This small volume, part of the "Careers in Depth" series, is written by the president of Remington Rand, a Division of Sperry Rand Corporation. It is a guide for the high school student and a reference for his career counsellor. This elementary survey of the computer field may serve as a guide to the student who has just begun to consider a career in computers. The book is divided into four parts: The Influence of Computers, Applications of Computers, Career Opportunities, and Becoming a Part of an Industry. The first part contains a very brief historical sketch and a rudimentary outline of how computers work. Appendices include: listings of vocational information sources, universities with computers, data processing centres; a glossary; and a bibliography,—all geared to the general purpose of this book, vocational guidance.

Technical Education and Management, Inc. / Computer Basics, Volume Six, Solid-State Computer Circuits / Howard W. Sams & Co., Inc., Indianapolis 6, Ind. / 1962, printed, 223 pp, $4.95

This useful paperback book complements the first five volumes of *Computer Basics* which grew out of a course designed to train Naval personnel in the maintenance and operation of computer systems. No prior knowledge of computer systems is required, but a working knowledge of trigonometry and algebra, and some familiarity with basic electronics theory are assumed. Chapters include: "Computer and Building-Block Circuits," "Circuits Common to Analog and Digital Computers," "Analog Computers," "Operational Amplifiers," "Servo Amplifiers," "Digital Computers," "Logic Circuits," "Flip-Flops," "Counters and Shift Registers," "Tunnel Diodes," "Transistor-Driven Magnetic Cores," "Packaging and Mechanization" and "Computer Module Maintenance." Review questions are found at the end of each chapter, with answers in a special appendix. A table of contents for the other volumes in the series is also given. Index.

Enslein, Kurt, Editor, and 18 other authors /Data Acquisition and Processing in Biology and Medicine / Pergamon Press, Headington Hill Hall, Oxford, Eng. / 1962, printed, 191 pp, $7.50

The Proceedings of the 1961 Rochester Conference on the subject are here published. The 17 papers approach the subject, "not from the standpoint of specific instrumentation, but rather in a more philosophical sense." The five sessions were "Computers in Biology and Medicine," "Computers and Psychiatry," "Pattern Recognition," "Clinical and Research Instrumentation for Biological Systems," and "Instrumentation for ECG, EEG and EPG." Among the titles are: "The Development of National Biomedical Computing Capability," "The Mathematics of Medical Diagnosis," "Electronic Features of Some Psychopharmacological Compounds," "The Mathematical Model of the Neuron," "Problems in Obtaining the Fetal ECG," the discussion following the papers is also included amounting to a dozen pages in total for the 17 papers. No index.

Kent, Allen / Textbook on Mechanized Information Retrieval / John Wiley & Sons, Inc., Interscience Division, 440 Park Ave. South, New York 16, N. Y. / 1962, printed, 268 pp, $9.50

This book is based on courses given by the author and by a colleague to fifth-year graduate students in library schools; it hopes to acquaint the librarian and others with new and rapidly advancing mechanical methods for data retrieval. The author is Assoc. Director, Center for Documentation and Communication Research, at Western Reserve University's School of Library Science. The text is arranged in two parts: eight chapters of text and illustrations, and supplementary reading lists, exercises, field trips, audio-visual material, and a sample examination. An introductory chapter discusses computers and how they may be applied to literature-searching problems. Other chapter titles include: "Words, Language, and Meaning in Retrieval Systems," "Principles of Searching," "Manipulation of Searching Devices," "Codes and Notations," and "Systems Design Criteria." An appendix includes the supplementary information. Author and subject indices.

Kuo, Franklin F. / Network Analysis and Synthesis / John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N. Y. / 1962, printed, 413 pp, $8.50

This book is an interesting introduction to electric network theory, and deals with the response of a network, given the excitation and the network. The text was originally prepared as a set of notes for a second course in network analysis at the Polytechnic Institute of Brooklyn. The first two of thirteen chapters discuss signal representation and certain characteristics of linear networks. Chapters three to six discuss transient analysis in terms of differential equations and the impulse response. The chapter, "Network Analysis (II)," contains a classical treatment of network functions. The final five chapters deal with network synthesis. Three appendices include: "Elements of Complex Variables," "Introduction to Matrix Algebra," and "Proofs of some Theorems on Positive Real Functions." Bibliography and index.

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NEW PATENTS

RAYMOND R. SKOLNICK

Reg. Patent Agent

Ford Inst. Co., Div. of Sperry Rand Corp., Long Island City 1, New York

The following is a compilation of patents pertaining to computer and associated equipment from the "Official Gazette of the U. S. Patent Office," dates of issue as indicated. Each entry consists of patent number / inventor(s) / assignee / invention. Printed copies of patents may be obtained from the U. S. Commissioner of Patents, Washington 25, D. C., at a cost of 25 cents each.

October 30, 1962 (Continued)

3,061,819 / Edward Rogal, Scituate, Mass / Universal Controls, Inc., New York, N. Y., a corp. of Maryland / Information Storage and Transfer Structure.

3,061,820 / Cravens L. Wanlass, Woodland Hills, Calif. / Ford Motor Co., Dearborn, Mich., a corp. of Delaware / Gating Circuit.

3,061,821 / Maurice Woolmer Gribble, Romiley, Stockport, and David Rushton, Burnley, England / Ferranti, Ltd., Hollinwood, Eng., a company of Great Britain and Northern Ireland / Information Storage Devices.

3,061,822 / Darrell L. Mitchell, Charleston, N. H. / Ex-Cell-O Corp., Detroit, Mich., a corp. of Michigan / Magnetic Data Storage Device of the Drum Type.

November 6, 1962

3,062,438 / Leo E. Farr, Jr., Vestal and James P. Hammer, Endicott, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of New York / Data Storage and Transfer Apparatus.

3,062,440 / Martin J. Kelly, Endwell, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of New York / Multistable Magnetic Core Accumulator.

3,062,446 / John Ronald Womersley and Ralph Townsend, Letchworth, England / International Computers and Tabulators Ltd., a British company / Serial Adder for Binary Coded Numbers with Radix Correction.

3,062,971 / Robert L. Wallace, Jr., Warren Township, Somerset County, N. J. / Bell Telephone Laboratories, Inc., New York, N. Y., a corp. of New York / Negative Resistance Diode Building Block for Logic Circuitry.

3,063,015 / Gerald T. Moore, Bedford, Ernest Herzberg, Peabody, and Herbert P. Grossimon, Arlington, Mass. / Giddings & Lewis Machine Tool Company, Fond du Lac, Wis., a corp. of Wisconsin / Rate Control for Data Processing Systems.

3,063,036 / Roy W. Reach, Sudbury, and William M. Kahn, Brighton, Mass. / Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., a corp. of Delaware / Information Handling Apparatus.

3,063,039 / Hugh M. Taft, Springfield, Vt. / Ex-Cell-O Corp., Detroit, Mich., a corp. of Michigan / Magnetic Data Storage Device.

3,063,042 / Raymond Bird and John Robert Cartwright, Letchworth, England / International Computers and Tabulators Ltd., London, England / Data Storage Systems.

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3,063,629 / James P. Beesley, Poughkeepsie, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of New York / Binary Counter.

3,064,241 / Herbert A. Schneider, Millington, N. J. / Bell Telephone Laboratories, Inc., New York, N. Y., a corp. of New York / Data Storage System.

November 20, 1962

3,064,889 / Ross E. Hupp, Los Angeles, Calif. / Eldorado Electronics Co., a company of California / Decimal Readout for Binary Numbers.

3,064,894 / Charles A. Campbell, c/o Radiation Inc., Melbourne, Fla. / ——— / Decimal to Binary and Binary-Decimal to Binary Converter.

3,064,895 / Arthur W. Heineck, Jr., and James R. Wood, Poughkeepsie, N. Y / I.B.M. Corp., New York, N. Y., a cor[illegible] of New York / Sensing Instruction Appa[illegible] for Data Processing Machine.

3,065,459 / Lloyd P. Hunter, I[illegible], Netherlands / I.B.M. Corp., New [illegible], N. Y., a corp. of New York / Cryogenic Memory Circuit.

3,065,461 / William Aronis, Mount Marion, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of New York / Magnetic Recording Apparatus.

November 27, 1962

3,066,281 / Gerhard Merz, Rommelshausen, and Sieghard Ulmer, Stuttgart-Zuffenhausen, Germany / International Standard Electric Corp., New York, N. Y., a corp. of Delaware / Method for the Reading-In and the Reading-Out of Informations Contained in a Ferrite-Core Storage Matrix.

3,066,282 / Wijnand Johannes Schoenmakers, Eindhoven, Netherlands / North American Philips Co., Inc., New York, N. Y., a corp. of Delaware / Magnetic Memory Element.

ADVERTISING INDEX

Following is the index of advertisements. Each item contains: Name and address of the advertiser / page number where the advertisement appears / name of agency if any.

American Telephone & Telegraph Co., 195 Broadway, New York 7, N. Y. / Page 2 / N. W. Ayer & Son, Inc.

Anderson Taylor & Associates, 1406 Chestnut St., Philadelphia 2, Pa. / Page 50 / Albano Advertising

Benson-Lehner Corp., 14761 Califa St., Van Nuys, Calif. / Page 49 / Lynn-Western, Inc.

Control Data Corp., 8100 34th Ave. So., Minneapolis 20, Minn. / Pages 13, 19 / Erwin Wasey, Ruthrauff & Ryan, Inc.

Electronic Associates, Inc., Long Branch, N. J. / Page 55 / Gaynor & Ducas, Inc.

International Business Machines Corp., Federal Systems Div., Bethesda 14, Md. / Page 52 / Benton & Bowles, Inc.

LFE Electronics, Inc., 305 Webster St., Monterey, Calif. / Page 25 / Fred L. Diefendorf Agency

Litton Systems, Inc., Guidance and Control Systems Div., 5500 Canoga Ave., Woodland Hills, Calif. / Page 51 / Ellington & Co., Inc.

National Cash Register Co., Dayton 9, Ohio / Page 3 / McCann-Erickson, Inc.

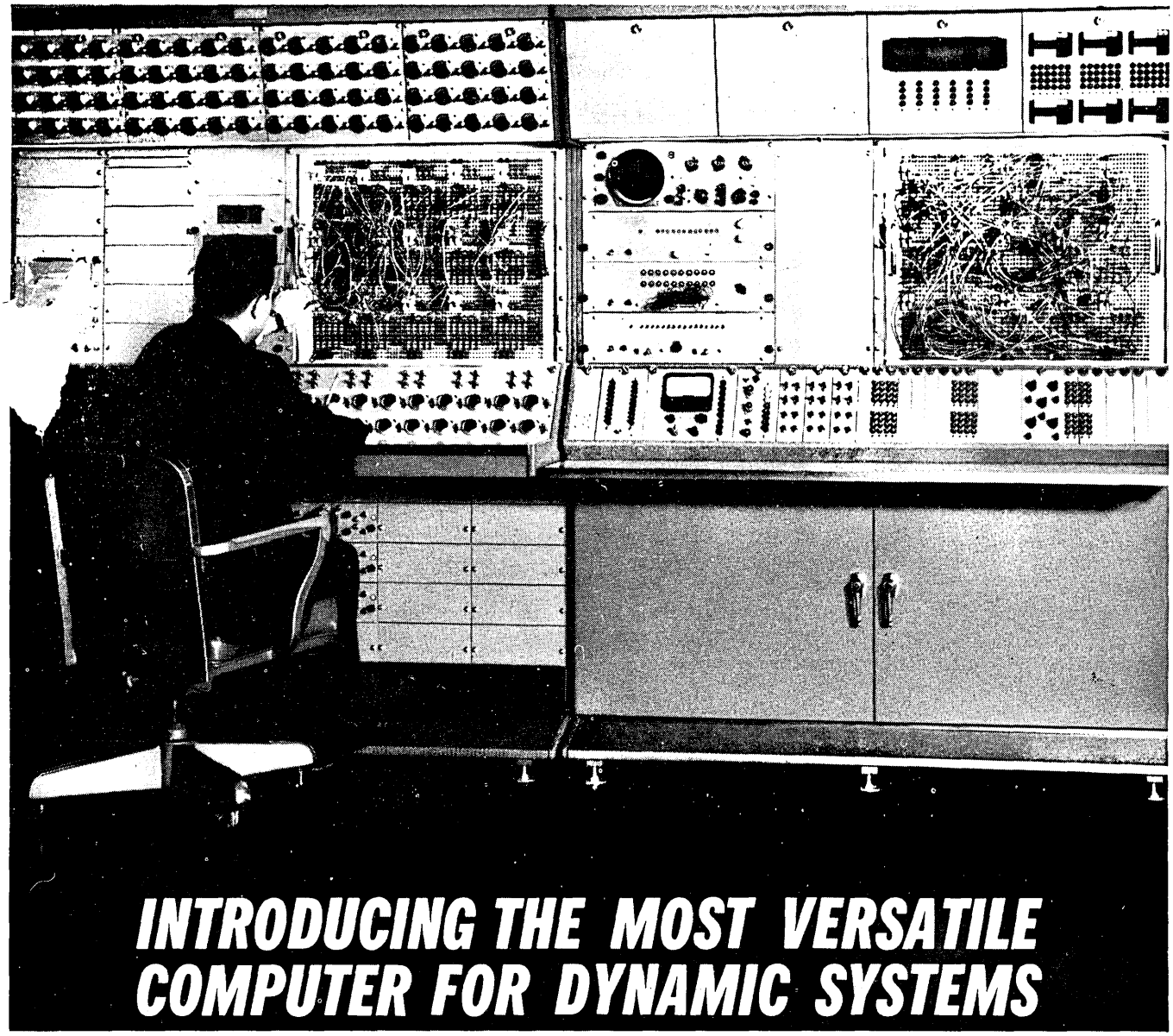
Philco Computer Div., 515 Pennsylvania Ave., Ft. Washington, Pa. / Pages 6, 7 / The Harry P. Bridge Co.

Philco Techrep Div., P. O. Box 4730, Philadelphia 34, Pa. / Page 53 / B. K. Davis & Bro.

Potter Instrument Co., Inc., E. Bethpage Rd., Plainview, N. Y. / Page 4 / Gamut, Inc.

Reeves Soundcraft Corp., Great Pasture Rd., Danbury, Conn. / Page 56 / Wexton Co.

Technical Operations Research, 3600 M St., N. W., Washington, D. C. / Page 9 / Edwin F. Hall



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