# computers and automation



Integrated Automatic Control Systems—Applications and Frontiers

The Catalytic Power of Business-Decision Gaming in Teaching Management Science

ALGOL—A Simple Explanation

The Case for Buying a Used Computer

The Used Computer Market

Computers Talk Via Telstar

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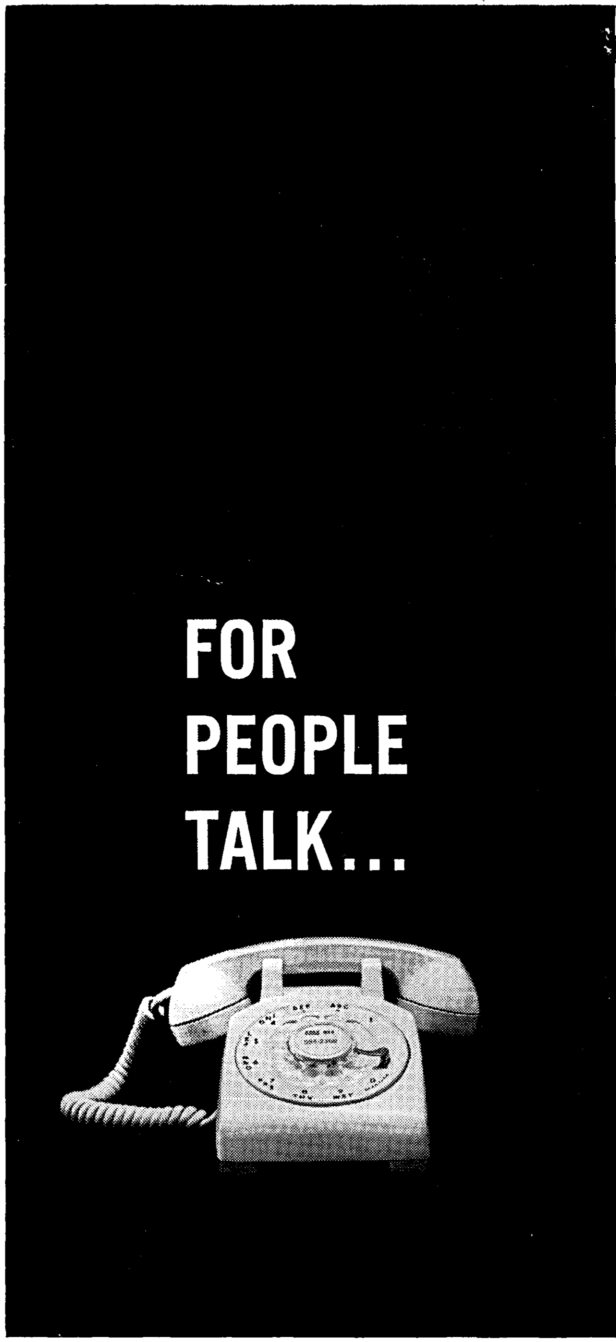


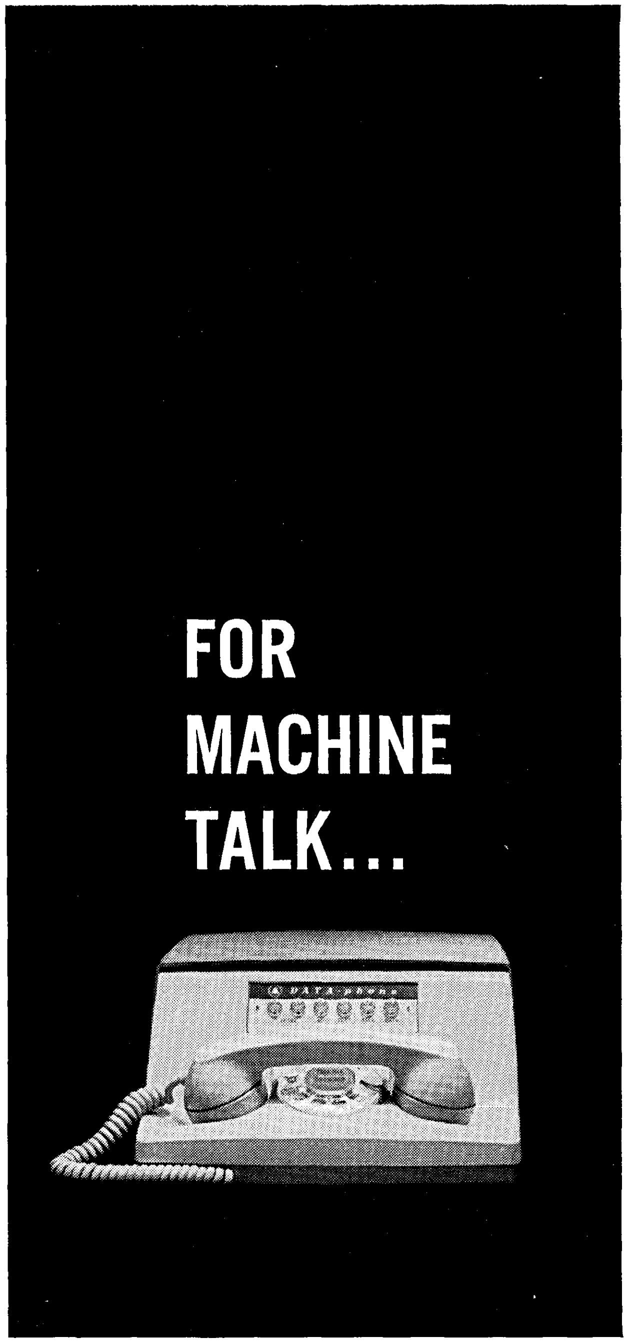


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# COMPUTERS
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COMPUTERS AND DATA PROCESSORS, AND THEIR CONSTRUCTION, APPLICATIONS, AND IMPLICATIONS, INCLUDING AUTOMATION

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# INTEGRATED AUTOMATIC CONTROL SYSTEMS— APPLICATIONS and FRONTIERS

## PART 1

**John R. Moore**
**President**
**Autonetics, a division of**
**North American Aviation, Inc.**
**Downey, Calif.**

***A skilled and significant analysis of the present science of automatic control, and its application to defense, space, and automation. The frontier problems that challenge its application are thoughtfully reviewed.***

This year 1962 is a year which may very well be recognized as the beginning of the first plateau of maturity for the industries that automatic control has helped to create. This is because 1962 has seen the infusion of reality into the financial appraisal of the glamour companies, and the recognition by owners and managers of these new industries that most of the same principles of good management are just as applicable to the industries whose products have a high technical content as they are to businesses whose products are of a much more conventional nature.

Signs of maturity are also evident among the scientists and engineers who created these new industries and who must continue to act as whole partners with management and finance in continuing to create and exploit the new scientific breakthroughs which will firmly establish automatic control in its ultimate position as the greatest servant of mankind. This maturity takes a number of forms:

1. The number of engineers and scientists enrolled in postgraduate or extension courses in marketing and management is testimony that the importance of market and management factors in technical decisions is now widely recognized by the technical experts. The idea of tradeoffs among technical performance, cost, schedule, physical characteristics, and reliability has now become widely accepted as a factor in technical decisions. The cost and time for a development, as well as the accuracy with which these elements can be forecast, are now firmly entrenched as significant parameters in the selection of technical alternatives. Finally, an increasing number of scientists and engineers has come to realize that their technical brilliance is wasted if their ideas cannot be sold, and that it is a hollow satisfaction to be able to prove that something new and wonderful *can be done* unless means are found to ensure that it *will be done*.

2. Electronics engineers and dynamicists have discovered the importance of electrical, mechanical, and field service engineers in the translation of their diagrams and equations into operating realities. We all know of some brilliant idea which was dimmed by the fact that it was based upon unrealistic assumptions (or oversimplifications) regarding the quality of input power; the characteristics of output load; the difficulties with electromagnetic and ground loop coupling; the effects of externally originated disturbances; the basic inadequacies of relays, slip rings, and connectors; or the tolerances of elements and components—particularly under uncontrolled environmental conditions.

3. The overriding importance of reliability in concept, design, manufacture, operation, and maintenance of automatic control systems has been thoroughly recognized. Unreliability of electronic equipment is the greatest deterrent to full exploitation of the theoretical potentialities of automatic control today—far greater than size, weight, or cost. The importance of reliability engineering on both systems and their components will continue to increase as advances in analysis, synthesis, and microminiaturization make increasingly complex equipment feasible.

4. Our new ability to use high-speed, high-capacity digital computers as controllers for automatic control systems, plus the advent of microminiaturization, has provided the flexibility for universal application to systems of almost any complexity, involving almost any combination of scientific disciplines. This new flexibility provides the base from which automatic control can be adapted to applications ranging from space vehicles to automatic factories—from complex air-traffic-control systems to the most microscopic of biological measurements and processes—from the unmanned vehicles of oceanological exploitation to the complex man-machine systems of industry and sociology.

5. In the areas of technology, the automatic control industry has now burst the bonds of sub-audio electronics and dynamics within which it had its birth. Today, because of the broadening application of his industry into all fields, the automatic control technologist must be able to understand and communicate with technologists from almost every field of endeavor. These fields include the whole "hit parade" of modern science—astro, nuclear, cryogenic, and solid state physics; aero-dynamics; thermodynamics; information theory; digital computer logic; process chemistry; oceanology; manufacturing methods; management systems; communication systems; biochemistry; psychometry; and medicine. This universality of automatic control science application has brought about a lowering of the barriers of disciplinary specialty to permit an intermingling of the most widely diversified technologies. As a result, a new breed of technologists has evolved. This is the technical gen-

(Based on a talk to the 1962 Joint Automatic Control Conference, New York, N. Y., June 27-29, 1962.)

eralist. Thoroughly grounded in the basic sciences, he is also capable of specializing as required to perform the marriage of disciplines involved in the complex automatic control systems of today.

From such a platform of blossoming maturity, it is possible to discuss with confidence some of the challenges which face the automatic control industry today, and to predict the course of this technology in the decade of the sixties.

**Evolution of the Science of Automatic Control**

A basic principle of information theory precludes the prediction of the future without the proper processing of information from the past. Accordingly it is appropriate, at such a conference as this, to pause for a short look at where we have been before we attempt to determine where we are going.

The science of automatic control began with the analysis of coupled systems. This analysis involved such devices as steering mechanisms for ships; and regulators of voltage, current, temperature, pressure, and speed. Generally speaking, this analysis took the form of phase-plane plots for on-off ("bang-bang") systems, or the linearization of continuous variable systems so that they could be attacked by applications of the theory of linear differential equations. As an aid to the setting up of multiply coupled systems, the various types of operational techniques were evolved. These varied from the highly intuitive "operational calculus" of Oliver Heaviside to the much more rigorously established Fourier and Laplace transform methods. The more fortunate system analysts even had access to one of the (then) small number of available analog differential analyzers.

During this period, systems were "designed"—not "synthesized." The engineer pre-selected the form of his system elements and then analyzed, through a discrete set of solutions, the effect of those variations of parameters over which he had control to determine a satisfactory (although not optimum) system. It was evident that a system was not satisfactory if it were prone to oscillating continuously or "running away." This led to the recognition of stability as a necessary condition of satisfactory operation. It resulted in much concentration on the use of "damping," both linear and nonlinear. It also led to attempts at inertia reduction by the use of clutches and brake-clutch combinations. These ideas are still good today, subject to the same mechanical limitations that have always prevented the successful application of impact and friction devices to high-rate duty-cycle operation.

The science of automatic control got its first real boost with the intensification of applications just prior to and during World War II. This involved not only the requirements for controlling the radar tracking of targets; the directing of projectiles; and the automatic piloting of aircraft, torpedoes, and missiles—but also the design of long-line communication networks. Indeed, it was in connection with the design of such networks that the first great step toward the development of a cohesive method for linear system synthesis was developed. This first step consisted of the application of what have become known as "frequency response" techniques, and it established relationships between system stability and its response to a spectrum of input frequencies of unit amplitude.

During these same war years, the design of linear filters to optimize the detection of signals in the presence of noise was studied and first revealed in Dr. Norbert Wiener's famous paper (known to all engaged in Fire Control Computer Design, by the name the "Yellow Peril").

As a result of all of the wartime technological activity, a new scientific discipline, "Servomechanism Theory," was born. This discipline began to appear in the curricula of universities and in the training courses both of major companies and of the armed services. The more ardent devotees of this discipline almost constituted a cult characterized by a new jargon unfamiliar to the lesser beings in the outside world. Theirs was a domain of "dead time," "time constant," "overshoot," "settling time," "gain," "phase," "db per octave," "feedback," "equalizers," "gain margin," "phase margin," "gain-crossover," "Nyquist plots," and "Bode diagrams." The really sophisticated members of the cult even spoke wisely of "autocorrelation functions" and "cross-correlation functions."

Meanwhile, scientists and engineers using principles less formally designated were continuing to improve the performance of electromechanical feedback systems by the simple expedient of improving the accuracy of detectors, increasing the rapidity of response of power elements, eliminating sources of unwanted disturbance or noise, and by using nonlinear system elements to obtain better performance from a qualitative or intuitive analysis than could ever be obtained with the best linear systems. Therefore, in retrospect, the real contribution of the war and early postwar years was not so much the development of powerful new tools for synthesizing linear servomechanisms using unimprovable components as it was three other factors:

First, the collection and the formalization of methods for performing the theoretical design of automatic control systems resulted in a great increase in the number of scientists and engineers engaged in automatic control activities. This produced such a flood of papers in technical journals that many were only slight variations of each other and prompted the well-known quip that a technical session on servos was like a group of individuals with the same blood disease giving each other transfusions.

Second, the limitations of control system design using linear methods involving slide rules, charts, and desk calculators caused automatic control engineers to develop much more powerful design techniques. The new approach included the use of simulators and digital computers capable of handling nonlinear, multivariable systems; and permitted introduction of the high-speed electronic digital computer as a real-time control and programming element of the system.

Finally, the large increase in the number of individuals knowledgeable in servo matters permitted a wide extension of applications of automatic control theory to the point where a whole host of new problems was attacked. This resulted in a breakout of the science from its limited single-input, single-output, continuous variable, linear, analog characteristics to its present domain of multivariable, non-linear, discrete valued, man-machine sophistication.

### Automatic Control Today

1. *The Stimulus of the Defense Program.* The Plateau of Maturity which characterizes the automatic control industry of today has been achieved under the intense stimulation of the national defense program. Perhaps I should rephrase that to read the "First Plateau of Maturity" because, although our industry has come of age in an important class of applications, the exploitation of new ideas involving microminiaturization, adaptive controls and bionics during the next decade will make today's proud accomplishments seem as archaic in 1975 as those of the pre-war era seem today.

It is, perhaps, a sad commentary on our society that only the fear of a cataclysmic national catastrophe can provide the economic means for scientific and industrial achievements which promise to make as much progress in three decades as might otherwise have been achieved in a millenium; for what board of directors would have authorized the expenditures required to harness nuclear energy, develop jet aircraft, send satellites into orbit, undertake the manned conquest of space, and develop the pool of scientific manpower and facilities necessary to achieve these and many other technical accomplishments of equal or greater significance? The billions poured into the defense effort have not only sparked fantastic advances on all scientific fronts, but have also developed, apace, the science of complex interacting systems and the science of management required for the integration and full exploitation of the widely-diversified, improved technologies.

2. *Automatic Control at the Center of All Scientific Progress.* The automatic control industry finds itself at the very heart of the modern integration of scientific disciplines into many-element coupled systems. In fact, it might be properly considered the cement which holds many other scientific endeavors together and which has made possible, and which will continue to make possible, many breakthroughs in all areas of scientific activity. This is because automatic control systems contain analogs of the controlling elements of man himself—sensors, reflexes, "muscles" and "brains."

3. *The Automatic Crew.* The comparison of the functions of automatic control systems with the duties of the men whom they serve and replace establishes a basis for classification of present automatic-control-system applications and the key to the avenues of their greater utility in the future. Thus, the first great stimulus to the development of the modern automatic control industry can generally be classified as the mechanization of certain functions previously performed by the crews of military vehicles. These include automatic gunners, automatic bombardiers, automatic pilots, automatic navigators, automatic engineers, automatic vehicle commanders and the often forgotten (but every bit as important) automatic crew chiefs.

Each member of the automatic crew is required to perform functions involving several coupled inputs and outputs, several sensors and usually several power elements. Thus, the progress which brought automatic control to the present technological level also evolved important advances in sensors and power elements as well as the computing and amplifying systems which interconnect them. Moreover, progress has had to be made in the science of man-machine combinations or "human factors," since, in many cases, the human crew member is still part of the system. Four examples of some of the different members of the automatic crew will illustrate how defense applications have spearheaded advances in automatic control.

3.1. *The Automatic Gunner.* First consider the automatic gunner. His is the problem of directing the path of projectiles accurately enough to destroy a target. He requires information to determine that a possible target exists; to identify it as an enemy target; to determine, in a suitable reference frame, the target's three coordinates of past and present position and, insofar as possible, their probable future values. The automatic gunner must also be able to determine the projectile's three coordinates of present and future position; to eliminate, insofar as possible, the effects of unwanted inputs such as angular motion of the position sensing vehicle and projectile launching platform plus background disturbances from false targets. He must also be able to control the projectile's motion to maximize the probability of destroying the target.

One mechanization of the automatic gunner involves the control of an unguided rocket, launched from an interceptor aircraft against a bomber target. Here, the non-linear, multi-variable characteristics of the control system result from the geometrical relations among the reference axes which must be used for the various system elements, plus the dynamics of the bomber, rocket, and interceptor.

3.2. *Automatic Pilot.* A second example of the advance of automatic control technology lies in the general class of systems known as automatic pilots. As the name implies, automatic pilots replace some or all of the functions of human pilots. For example, the sophisticated aircraft automatic pilot today is capable of stabilizing the aircraft against the effect of rough air; maintaining pre-set angle- and rate-of-climbs, a constant air speed or Mach number, a constant altitude and heading; and it may also be coupled into various approach and navigation systems to provide effective flight path control under almost all conditions after take-off and before landing. Indeed, very successful development programs have been carried out which included automatic ground control, take-off and landing of both manned and unmanned aircraft. Some of these developmental automatic pilots have been applied to the complete control of

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# The Catalytic Power of Business-Decision Gaming In Teaching Management Science

**Mark E. Stern**
**IBM Corp. and**
**The Graduate School**
**of Business Administration**
**New York University**
**New York, N. Y.**

***Computers have streamlined business operations in many areas. Now they are being used increasingly to strengthen the education of tomorrow's businessman. Here is a case study on how a computer is being used to help business students integrate the tools of accounting, finance, marketing, and psychology into a balanced decision-making ability.***

The new Management Science program at the Graduate School of Business Administration of New York University contains particular emphasis upon the use of a business game as an integral part of the program. No attempt has been made so far to validate the hypothesis that the gaming sessions impart more knowledge to the students than would an equivalent amount of case discussion or lecturing, but the gaming sessions do rouse interest; however, it should be noted that neither case discussion nor lecturing has been validated, either.

The philosophy of GBA, as well as the Masters' Degree Program for Day Students into which Management Science has been integrated, has a basic premise. This is that managers of tomorrow must combine technical competence and social responsibility with their knowledge of business administration in order to bring breadth and depth to the decision-making process. Implicit in this philosophy is the realization that professional competence requires a thorough grounding in quantitative subjects as well as an understanding of the economic and social forces influencing business action.

### Masters' Degree Program

These principles are embodied in the new Masters' Degree Program for Day Students inaugurated at GBA only last year and principally designed for recent college graduates who will devote full time for four semesters to attaining the MBA degree. The first group of students numbered 43, the incoming class will be over 50, and it is expected that the number of students in the program will grow to about 350 in the next 5 years. Admittedly, the Day Students are a relatively small proportion of our total student body of over 5,000, but they are an excellent group upon which to begin curriculum innovation.

The first two terms of the Day MBA program consist entirely of required courses in the functional areas of marketing, production, management, and finance, as well as in the quantitative subjects of accounting, mathematics, statistics, economics, and human behavior. Of course, in the third and fourth terms the students are able to elect advanced courses such as Econometrics, Mathematical Programming, Decision Theory, Market Research, and Managerial Measurements and Controls. Two aspects of the Day Masters' Degree program are particularly important:

1. 25% of the student's first year core requirements is in the subjects of mathematics and statistics.
2. Students may elect to concentrate in the area of Management Science in order to obtain the MBA.

In other words, Management Science has been afforded the same status as marketing, production, or finance, but this of course is only the first step in developing a meaningful Management Science program.

### Mathematics and Statistics

The next step was to find a way to use to best effect the 25% of the first year student's time that was to be devoted to the study of mathematics and statistics. Which topics in mathematics were most valuable in the training of a future business manager? In what depth could the students be expected to comprehend the material inasmuch as their mathematics backgrounds ranged from a basic knowledge of high school algebra through a competence in calculus and some finite mathematics?

Two Management Science core courses in mathematics and statistics had to be developed; the second

Based on a talk before the International Meeting of the Institute of Management Sciences, University of Michigan, Ann Arbor, Michigan, September 9-11, 1962.

course includes the use of a business game. Although only Management Science students were required to take both courses, the enrollment in each was about 15.

The first course that required development was the mathematics course given during Term I. Its goal was to impart to the students all the non-statistical mathematical knowledge that they would need in their future work. After considering backgrounds of the students, it was concluded that the course would start with some elements of college algebra and analytic geometry and then proceed at a rapid pace through functions and limits, differential and integral calculus, difference and differential equations, matrix and vector algebra, and finally linear programming and decision theory. Throughout, the course was to be oriented to business problems. Now that I have developed and taught the course (and, as a matter of fact, just completed a manuscript of a text that covers the mathematics topics briefly outlined above), I am more thoroughly convinced than before that business students grounded in college algebra can and should be exposed to these topics in mathematics if they are to have the best chance of succeeding in the business world.

Our experiment in Management Science continued into the second term of the school year with the announcement of a course which was not only to provide the Statistics background necessary for business students, but was also designed to give them an opportunity to use quantitative methods in the solution of problems in broad areas of business policy. The first part of this task was relatively easy to accomplish since there are many good texts on Statistics and its application to business. I would add in this regard that the students spent very little time going through tedious arithmetic calculations for correlation coefficients, standard deviations, etc., since most of them had attended a series of no-credit lectures on computer programming and were able to utilize the NYU IBM 7090 computer to help them solve their statistical problems.

However, there still remained the task of providing the students with an environment in which they could draw upon both the qualitative and quantitative knowledge obtained during their first term, in order to formulate and solve business problems; furthermore, it was desired to give the students some experience in business decision-making since most of them had no business experience. Thus, what we were seeking was a catalyst to stimulate the interaction of the ingredients of accounting, economics, marketing, human behavior, finance, management, mathematics, and statistics so as to crystallize them into a business decision-making compound par excellence. I suggest that the catalyst is the business game and I would like to discuss with you its use in the course, as well as comment on some of the game's advantages and shortcomings.

### Selection of a Business Game

Since the NYU IBM 7090 was available, I sought a game programmed for that machine. Among the games considered for use in the course were Mass. Inst. of Technology's Marketing Game, Univ. of Calif. at Los Angeles' Executive Decision Game #3, and Carnegie Tech.'s Management Game. The latter was to be written in FORTRAN in time for the Spring 1962 semester. The criteria used for selection were:

1. The game should permit general business policy decisions to be made as opposed to concentrating on a specific functional area.
2. The number of decisions required per period should be consistent with the 2-3 hours per week that the students had available for that purpose.
3. The game should be sufficiently complex so that it would remain a challenge to the students during the entire 15-week semester (which implies 15 moves).
4. The administration of the game should be possible by one person inasmuch as none of my colleagues familiar with gaming had schedules which permitted their participation.

Now the MIT Marketing Game, as its name suggests, is primarily concerned with Marketing; in fact, a great emphasis is placed on advertising and promotional decisions. Furthermore, judgment by experts is required to quantify the advertising layouts of the competing teams; and this implied a Faculty panel since I was not competent to make these judgments myself. About two dozen decisions were required for each quarter of simulated play, which did not seem too many for the time allotted. Also the MIT Game offered enough complexity so that student interest would be sustained. On balance, I concluded that the special marketing nature of the game and its administrative difficulties made it unacceptable for my purposes. However, the MIT Game would be a useful adjunct to a Marketing course if a Faculty panel could be assembled a few hours a week without too much difficulty. This is the way it is used at MIT.

The Carnegie Game is probably the most realistic of those considered; however, in order to achieve this degree of realism, about 200 decisions per period are required of the teams. Unfortunately, I could not reasonably expect the students to have sufficient time available to do the Game justice and thus it was necessary to cross it off the list.

At this point, it becomes obvious that the UCLA Game #3 was selected for use in the course. Here are some of the reasons why:

1. It requires relatively few decisions (17 per quarter) which was consistent with the several hours per week that the students were expected to have available for this function.
2. The game is concerned with general business policy rather than concentrating on marketing or production or finance. It permits executive decisions to be made in all three areas, without becoming involved too much in any particular one.

3. It is of sufficient complexity so that it would remain a challenge to the students for the entire semester.

4. Administration was easy since Jim Jackson of UCLA sent me the FORTRAN deck, Participant's Manual, Administrator's Manual, initial conditions deck, and decision forms.

### Description of the UCLA Game

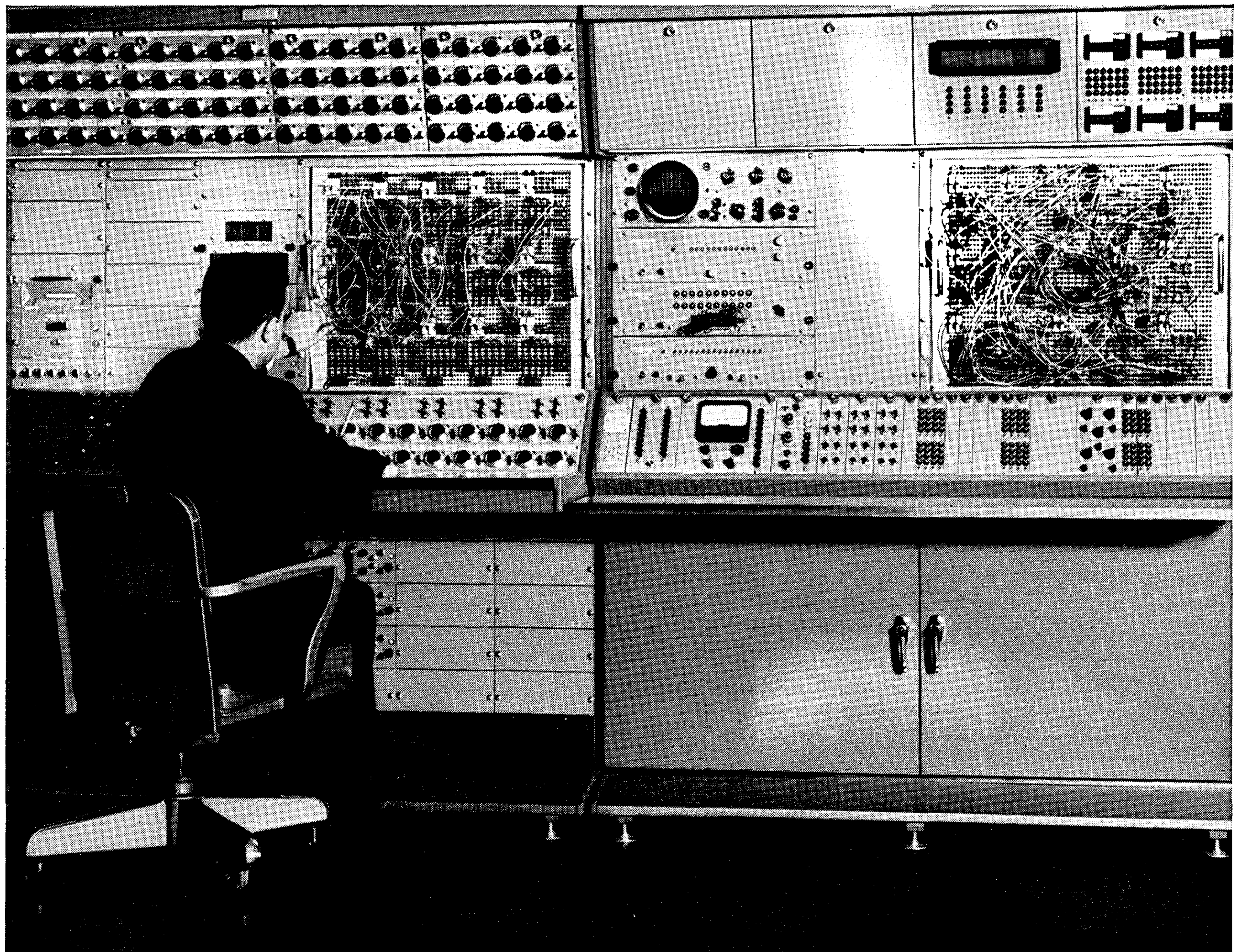
Following is a brief description of the UCLA Game. Each competing firm in an unnamed industry is permitted to manufacture and market between one and three products at various manufacturing costs which measure the quality of the product. The value of plant and equipment determines the total number of units that can be produced on regular time and a limited amount of overtime production is permitted by paying a premium. Plant and equipment depreciate 10% per year so that capital investment is necessary not only to expand but also to maintain capacity. The sales of each product depends upon price and the respective marketing and styling budgets, as well as quality. Securities which earn 6% per annum may be bought with surplus cash or may be sold (for a brokerage charge) when cash is needed. The marketplace is divided into sectors, each with its own peculiarities, e.g., one sector is highly price-conscious but insensitive to quality, while another is quality-conscious and not too sensitive to moderate change in price. All firms compete in all sectors and the resulting sales depend on both the decisions of each firm and those of its competitors. Pervading the entire economy is a general business index with built-in fluctuations which affects the various market sectors differently; in addition, a seasonal demand also exists, but is known with certainty.

For each quarter, every firm must decide whether to buy or sell securities and how much to invest in plant and equipment. Furthermore, for each product, decisions are made on price, marketing budget, styling budget, manufacturing costs (quality) and the level of production. The computer program considers the interactions of all firms' decisions, apportions sales, and prepares a balance sheet, profit and loss statement, plant capacity report, cash flow analysis and sales analysis by product for each firm. Also some competitive information is supplied, but random errors are purposely present. A prediction of the general business index for the next several quarters is also given but that, too, is only an approximation. Clearly, an accurate sales forecast by product is essential to success; also, production smoothing is important since significant variations in the production schedule give rise to high administrative costs. Many other factors such as inventory carrying charges, transportation, obsolescence, warehousing, and debt service must be considered as well.

### Application of the Game to the Students

The fifteen students in the class were divided into three teams of five each, according to their particular fields of interest, i.e., each firm included at least one man concentrating in each of the fields of finance, marketing, production, and management science. Aside from the participants' manual of information, the students were given one year (four quarters) of history of their respective firms. All firms started with the same total assets, but the four sets of decisions constituting the history were different so that more information could be obtained from the reports. Although they were told that the game would probably be played once a week during the semester, the actual number of quarters to be played was unknown since several might be played at the same time in any given week. After a briefing session on the game and a two-hour lecture on planning, each firm was given a bibliography on planning, told to decide within a week on its initial strategies for the coming periods, and then submit them in the form of a written two-year operating plan. At the end of each simulated year, an annual report and revised plan for the next year were submitted by the three firms. The use of operating plans was encouraged as a management tool and, in fact, during the last week of the semester, each firm was required to make four consecutive quarterly decisions during the same session which necessitated the use of their plans since not enough time was available to go through the usual decision-making processes. The exercise of planning coupled with the opportunity to measure results against objectives made the planning process a meaningful experience and got across the important point that certain changes in the business environment can and must be anticipated if business is to operate efficiently. In the two other weekly sessions, one was consistently devoted to Statistics, while the other was used as a seminar in the selected Management Science topics of sales forecasting, allocation of resources, queuing theory, decision and game theory, manufacturing control, investment analysis, and critical path scheduling. Thus, all the firms had available to them the techniques necessary to make quantitatively-based business decisions. Furthermore, they all had easy access to the IBM 7090, and several regression analysis and linear programming problems related to the business game were written for and run on the computer.

Aside from the very important task of accurately forecasting sales, a key consideration in the business game was production smoothing; in fact, the winning firm (in terms of total assets) developed a plug-in model which smoothed production very well. Moreover, they developed a complete model of their decision-making process from sales forecast to pricing to production requirements to marketing and styling budgets to cash flow analysis to capital investment decisions and around the Horn again. They used price changes to control the demand, i.e., when expected sales temporarily exceeded production capacity, price was raised to lower the forecast to an amount that the plant could handle, which then allowed the production facilities to operate efficiently. This concept is often difficult to get across to students, i.e., that production need not always be the slave to the sales forecast because it is sometimes more profitable, and wiser, to purposely lose sales temporarily by raising price. In addition to the importance of their interpersonal experiences, the business game



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ELECTRONIC ASSOCIATES, INC. *Long Branch, New Jersey* also provided an excellent lesson in organization, namely, that wtihout job definitions and delegation of responsibility, the decision-making process becomes overly complex, cumbersome and confusing. For example, one of the firms believed that each man should help the other in making his decisions and that the final decision would be made by majority vote. The result was that their business meetings were disorganized and their decisions inconsistent. Whether by coincidence or not, this firm made the poorest showing of the three.

It is almost trite to say that the fundamental value of the business game was that it gave the students an opportunity to make decisions in a dynamic situation and then attempt to analyze the results of their actions and the interactions with their competitors in an analytic framework so as to learn from experience. Throughout the course, the business game greatly increased the students' motivation to learn because they were continually looking for new techniques and ideas that would help their firm make better decisions. There was an enthusiasm and thirst for knowledge that I am told existed in no other course in the Day Program.

### Changes and Improvements

However, room for improvement still exists. Perhaps, because of the relatively limited amount of data and short period of time during which the game is played, there was little basis for sophisticated mathematical or statistical anlysis. Only the simple tools of least squares curve fitting, graphical analysis, and some algebraic manipulation actually proved useful in making better decisions. Applications of the calculus and linear programming were attempted but proved fruitless; thus, in the important respect of providing a framework in which the students could apply the mathematical techniques already learned during their first term in school, the business game failed. In our post mortem session, suggestions were made by the students to permit more complexity in the decision-making process, thus making it more amenable to mathematical analysis. Specifically, the suggestions were:

1. It was felt that purchasing a unit of production capacity should be more expensive for a high quality (high manufacturing cost) product than for a low one. This implied that the quantity produced of each of the three products would be limited by individual production capacities, rather than the only limitation being that the sum of all items produced could not exceed total plant capacity (without going into overtime). This requires much more careful capacity planning, more closely approximates reality, and doesn't appear too difficult to incorporate into the game.

2. It was suggested that warehousing and inventory carrying charges should be made more significant since all firms were able to ignore them completely without doing themselves much harm. I believe this can be implemented by adjusting certain game constants.

3. One of the teams complained about the built-in stickiness to decreases in price. They had been selling a product at $20 per unit and decided to stop producing it, sell out the inventory, and switch to a three dollar product instead, while leaving the other two products untouched. The game did not appreciate this strategy and (to oversimplify) considered the effective price to be the average of the last period's price $20, and the current price of $3. Of course, sales were well below expectations due to the effective price of $11.50 for a low quality product. This frustration would have continued for another period or two, but I interceded and lowered the effective price on the program deck. However, a stickiness to price decrease is a good idea; the administrator should merely point out the difficulty in switching products.

Although the students spent only about two hours a week in the formal business meetings during which the decisions were discussed, it was very clear that some were spending at least another ten hours a week working on charts and trying to formulate new and better decision-making models. It is the rare teacher indeed who feels badly about his students spending too much time on his course; however, I am still not sure that the benefits obtained from the gaming sessions were worth all the time that some of the students put into it. Thus, another criticism of the use of business games as a teaching tool is that the other edge of the two-edged sword of emotional involvement in the game may have cut too deeply into other courses the students were taking. Personally, I find it hard to make a judgment on how many hours per week a student might justifiably spend thinking about and working on the business game. In the post mortem session several students did state that they had devoted a good deal of time to the game and that other courses suffered; however, they believed that, on balance, this was an efficient allocation of their time.

It is our opinion that the advantages of the use of the business game in the classroom far outweigh the disadvantages. Naturally, we anticipate making changes in the game, as well as in the course, so that our goals will be better met; moreover, we firmly intend to continue to offer the two term quantitative sequence that I have described. It is naive to expect that at present all the students in our business school are mentally and psychologically equipped to absorb the mathematics that I suggest is a necessary part of business education. However, the evolutionary process of preparing students to grasp mathematics has significantly quickened its pace in the last several years and I believe it will not be too long before most of our freshmen and certainly our graduate students will arrive with a thorough grounding in algebra and the elements of calculus. A crucial question is whether we will be prepared to really teach them what Management Science is all about. I suggest that the business game is a catalytic agent that will help us achieve this goal.

# ALGOL — A SIMPLE EXPLANATION

**Dr. Richard F. Clippinger**
**Director of Standards**
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***ALGOL, which stands for ALGOrithmic Language, is a language for describing methods of problem solving in terms a computer can understand. It was developed by an international group of computer people between 1957 and 1960. Since that time it has mustered staunch support for its use as the standard language for scientific programming.***

ALGOL is a language used to describe procedures for solving problems using electronic computers. It can also be used to communicate such procedures to other people. It is known as a scientific language rather than a data processing language because it is not concerned with arrangements of large files of data and the manipulation of such files but rather with the execution of algorithms applied to variables within a computer. For example, it would be well-suited to the solution of differential equations.

The purpose of this presentation is to introduce the reader to ALGOL to give him a feel for it. A deeper knowledge will require studying the original document[1] or one of the courses[2] or primers[3,4] soon to appear.

The ALGOL language takes several forms. The form described here is called the reference language. Different implementers of ALGOL for specific machines have applied various restrictions appropriate to the hardware, and their languages are called hardware representations.

### The Metalanguage

The ALGOL report describes ALGOL using a metalinguistic formalism (the precise rules of syntax and semantics for the proposed language) which we shall not stress but which must be understood to read the ALGOL report. This metalanguage employs four characters which have nothing to do with ALGOL. These are the metalinguistic brackets <and> which are used to enclose names of things about which the metalanguage is talking, :: = which means 'is,' and | which means 'or.' Thus:

<digit> :: = 0|1|2|3|4|5|6|7|8|9

is read 'a digit is a 0 or a 1 or a 2 or a 3 or a 4 or a 5 or a 6 or a 7 or an 8 or a 9.'

Sometimes the thing being defined is mentioned on both sides of the symbol :: =, e.g.

<identifier> :: = <letter> | <identifier> <letter> |
<identifier> <digit>

which says that 'an identifier is a letter or an identifier followed by a letter or an identifier followed by a digit.' This is a 'recursive' definition which is equivalent to saying that an identifier is any sequence of letters and digits which starts with a letter.

### Basic Symbols

The 116 basic symbols of ALGOL are the ten digits, 52 letters, upper and lower case, and 52 delimiters.

The delimiters which the reader may glance at and then skip over are:

The six arithmetic operators:

| | |
|---|---|
| + | plus |
| − | minus |
| × | times |
| ÷ | divided by, giving an integer |
| ↑ | exponentiate |
| / | divided by |

The six relational operators:

| | |
|---|---|
| < | is less than |
| ≦ | is less than or equal to |
| = | equals |
| ≧ | is greater than or equal to |
| > | is greater than |
| ≠ | is not equal to |

The five logical operators:

| | |
|---|---|
| ≡ | is equivalent |
| ⊃ | implies |
| ∨ | or |
| ∧ | and |
| ¬ | not |

The six sequential operators:

go to
if
then
else
for
do

Note that an ALGOL basic symbol need not be a single character. It can be a word or two words.

The eight brackets:

| | |
|---|---|
| ( ) | used in arithmetic expressions, function designators, designational expressions, parameter delimiters, procedure statements |
| [ ] | used in subscripted variables, arrays |
| ' ' | used to enclose strings |
| begin end | used to enclose compound statements and blocks |

The seven declarators:

| | |
|---|---|
| own | we shall ignore this |
| Boolean | designates a variable which has the values true or false |
| integer | designates a variable which has integral values |
| real | designates a variable which has real values |
| array | designates a multi-dimensional quantity like a vector or matrix |

switch — designates a choice of 'go to' points

procedure — designates a section of programs which computes certain outputs from certain inputs.

and the three specifications:

string — designates certain sequences of characters in particular ' and '

value — designates a specific value taken on by a variable

label — designates the name of a statement

ALGOL builds up numbers, variables, statements, labels, blocks, procedures and programs out of these symbols.

Instead of trying to define the concepts of ALGOL rigorously, carefully and completely, let us illustrate the major concepts only by the use of examples:

Example 1:

*real* p, q, SUM; *integer* n; n: = 1; p: = 0.5;
SUM: = 0; q: = 1; loop:
SUM: = SUM + q/n; q: = qxp; n: = n +1;
*go to* loop;

In this example there are ten statements—each terminated with a semi-colon. The first statement, *real* p, q, SUM;, is a declaration. It declares that p, q and SUM are those variables which are real. p, q and SUM are examples of simple variables as opposed to a subscripted variable such as Q [7, 2] which is a particular member of an array Q [i, j] for which i is 7 and j is 2.

The second statement, *integer* n;, is also a declaration declaring that n can only take on the values 0, −1, 1, −2, 2···.

The third statement, n: = 1;, is an assignment statement. It says 'assign the value 1 to the variable n.'

The fourth statement, p: = 0.5;, illustrates a slightly more general form of a number. Other examples of numbers are:

| | | |
|---|---|---|
| $-200.126_{10}-8$ | which stands for | .00000200126 |
| $2_{10}-4$ | which stands for | .0002 |
| $_{10}+5$ | which stands for | 100,000. |

The seventh statement, loop: SUM + q/n; has a name, loop, which in ALGOL is called a label. The label is identified by the colon following it. The ten statements are executed in the order written; however, the effect of the tenth is to cause loop to be the 11th, 15th, 19th, etc. statements executed. In other words statements 7, 8, 9, and 10 become a loop executed indefinitely. The right side of statement seven is a simple example of an arithmetic expression. The statement says 'divide q by n. Add it to SUM. Assign this as the new value of SUM.'

Other arithmetic expressions are:

| | |
|---|---|
| S + (s − t)/V↑2 | $S + \frac{s - t}{V^2}$ |
| (U − W) × (1 − a↑3/k/(a − k)) | $(U - W)(1 - \frac{a^3}{k(a-k)})$ |
| if a > b then a↑2 + b↑2 else 7 | $a^2 + b^2$ if $a > b$<br>7 if $a \geqq b$ |

Note that ALGOL is arranged as a string of symbols on a line without spatial position signals to indicate powers and quotients. This makes it more suitable as input to a computer and less suitable for humans. In order that arithmetic expressions shall be well defined there are certain rules for the formation and evaluation of such expressions:

A few of these are:

1. Do the exponentiations first
2. Do the multiplications and divisions next
3. Do the additions and subtractions last

Spaces have no significance in ALGOL. One can therefore, arrange his ALGOL program in a form easy to read. Thus in Example 1; introducing two more labels and re-arranging the page,:

declare: *real* p, q, SUM; *integer* n;
initialize: n: = 1; p: = 0.5; SUM: = 0; = q: = 1;
loop: SUM: = SUM + q/n; q: = qxp;
n: = n + 1; *go to* loop;

Example 2:

*begin integer* n; *real* h, k, pi; *real array* s [0:180], c [0:180]; pi: = 3.14159; h: = pi/180; k: = h/2: s [0] : = 0; c [0] : = 1; *for* n: = 0 *step* 1 *until* 180 *do*
*begin comment* s [n] is sin n pi/180 and c [n] is cos npi/ 180; *real* y, z, Y, Z;
integrate: y: = s [n]; z: = c [n];
Y: = y + h*z; Z: = z − h*y
s [n + 1] : = y + k* (z + Z);
c [n + 1] : = z − k* [y + Y]
*end* integration step
*end* trig table computation

This example introduces the notion of a block. A block starts with *begin* and terminates with *end*. At the head of the block come the three declarations which are valid for block only. These declarations declare n to be an integer; h, k, pi to be real and the arrays s and c to be real one-dimensional arrays with 181 numbers in each array. These variables could be used for other purposes in other blocks outside this one. The words 'trig table computation' after '*end*' constitute a comment for explanatory purposes. A second block constituting an integration step is part of, and nested in, the main block. It starts with a comment, so labelled, which explains what s [n] and c [n] are. Such comments may be sprinkled freely in among other statements. They are ignored by the computer.

The '*for*' statement used in this example is practically self explanatory. It directs that 'integrate' be performed 181 times with n successively equal to 0, 1, 2, ··· 180.

The computation 'integrate' is the Heun integration procedure for the solution of the differential equations

$$s' = c$$
$$c' = -s$$

which define sin x and cos x.

Example 3:

a. Definition of Step via a *procedure:*
   *integer procedure* Step (n); *real* n; Step: = if $0 \leqq u \wedge u \leqq 1$ *then* 1 *else* 0;

b. Use of function Step:
   *being integer* Step; *real* y, x; *if* Step (x) = $1 \vee$ Step (X − 10) = 0 *then* y : = x *else* y: = −x
   *end*

In this example, Step (u) is a function defined by the procedure named Step. The assignment statement giving Step a value illustrates the use of an *if* clause to give an arithmetic expression a choice of values. It reads 'If u is greater than or equal to zero and u is less than or equal to 1, assign Step the value 1 otherwise assign it the value zero. In this *if* clause '0 = u = u = 1' is a simple example of a Boolean expression. Such an expression has the value *true* or *false* and may be compounded using certain rules of precedence out of relations and Boolean variables and the logical operators:

x = −2    x equals −2
Y WVz q    y is greater than W or z is less than q

### Procedures

In general a procedure has a heading giving a list of formal parameters and a value part specifying that some of these parameters must be given a value before entering and a specification part declaring the type of the variables used. The heading is followed by a procedure body which computes the values of some of the formal parameters as functions of the values of some of the others. Thus:

*Procedure* Spur (a, n, s); *value* n; *array* a; *integer* n; *real* s; *begin integer* k; s: = 0; *fork:* = 1 *step* 1 *until* n *do* s: = s + a [k, k] *end*

In this case a and n are inputs. a is a matrix; n its order. s is the output, the spur of matrix a. a value must be specified for n.

The procedure is used as follows: Somewhere in an ALGOL program the programmer puts the 'procedure statement' Spur (A, 7, V);. This means compute the spur of the matrix A of order 7 and assign V the value of this spur. If procedure Spur had terminated with the assignment statement Spur: = s then Spur (A, 7, V) could be used in an arithmetic expression as a functional value like sin (x). Thus, in example 3b, Step (x) is a function defined by the procedure Step (u).

The interested reader will find that ALGOL is not a difficult language to learn to use. He will, of course, have to learn certain specific extras associated with some hardware version before he can use it on a computer.


[1] Backus, J. W. et al., Naur, Peter, editor, "Report on the ALGOLrithmic Language, ALGOL 60," Comm. A.C.M., May, 1960.

[2] Naur, P., "A Course on ALGOL 60," Regnecentralen, Copenhagen, 1961.

[3] McCracken, Daniel D., "A Guide to ALGOL Programming," John Wiley & Sons, Inc., New York, 1962.

[4] Dijskstra, E. W., "A Primer of ALGOL 60 Programming," Academic Press, New York, 1962.

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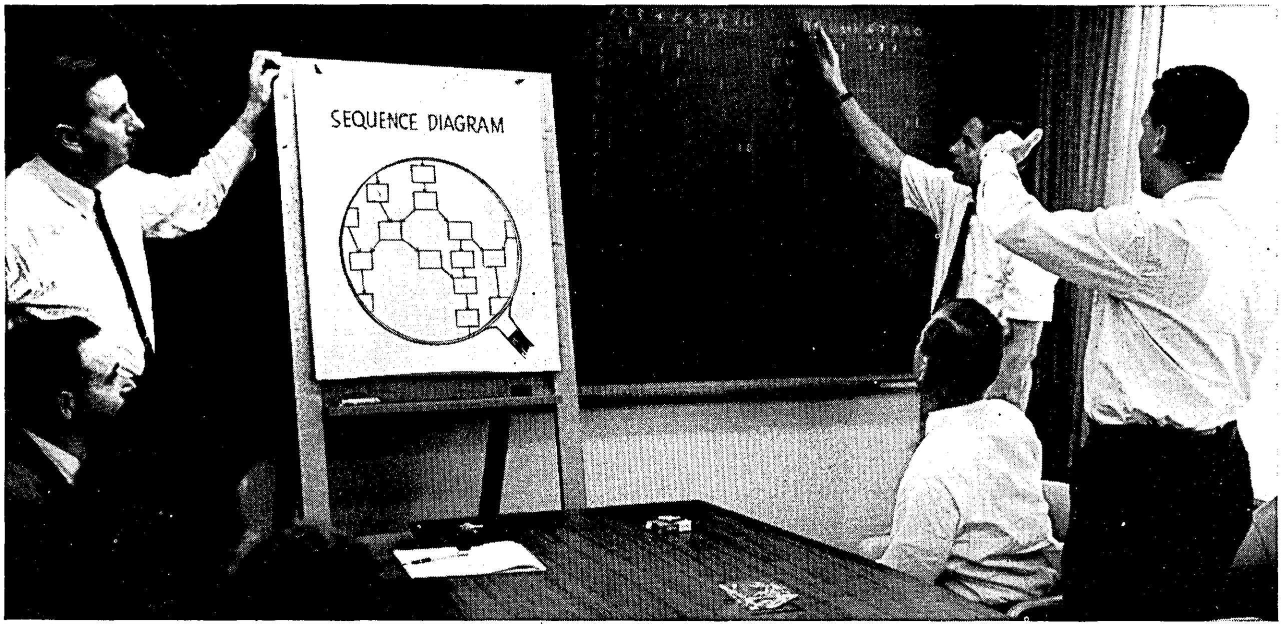


# PROGRAMMERS shape the future of a new technology

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# NEWS of Computers and Data Processors

## "ACROSS THE EDITOR'S DESK"

## NEW APPLICATIONS

### COMPUTERS ON WALL STREET — THE BIG BOARD AUTOMATES

Contracts have been signed by the New York Stock Exchange with International Business Machines Corporation for the manufacture and installation of a computer system, and with the New York Telephone Company for special communications facilities. Keith Funston, President of the Exchange, has announced that the specially designed computer system will completely automate the publication of Exchange trading data by early 1965.

The IBM Tele-processing system will include two devices never before used in an IBM system: an optical "reader", which will take sales and bid-asked information directly from the trading floor to a computer; and a "voice assembler", which will compose messages from a pre-recorded electronic vocabulary and "speak" them over the telephone to member subscribers of the Quotation Service. Another major component, specially designed by the New York Telephone Company, will be a high-speed-access switching system. This will link the computer center with direct private telephone wires of the Quotation Service. The installation will include two IBM 1410 computers and two IBM 7750 programmed transmission control units.

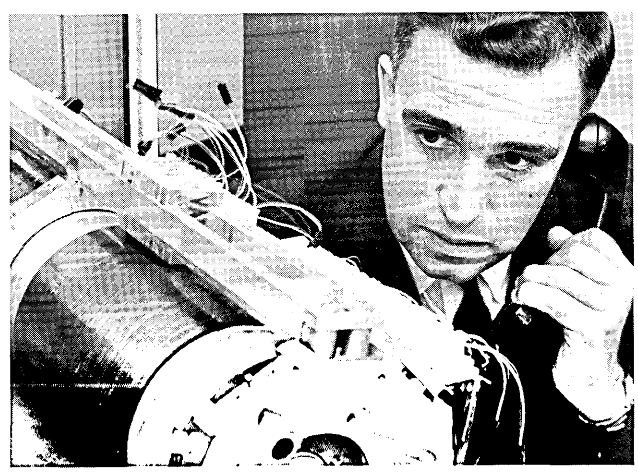
Trading information, now transmitted by pneumatic tubes and voice, will instead be sped to the computer center in the Exchange by direct electronic signals from 19 "data readers" on the trading floor. One reader will be installed at each of the 18 horseshoe-shaped trading posts on the floor, plus one at "Post 30", where less active stocks are traded. They will read cards at a rate of up to 40 a minute. Cards will be pre-printed with the letter symbols of the small group of stocks for which each individual floor reporter is responsible. The reporter at a trading post will mark the details of the transaction by drawing lines with an ordinary lead pencil through boxes designating stock symbol, number of shares and price. (Each card will have spaces for three trades and one bid-asked quotation.) When the marked card is placed in the "data reader", it scans the pencil marks optically and transmits the information to the data processing center in the Exchange building.

-- New York Stock Exchange President Keith Funston feeds a card into a prototype model of the specially designed IBM "data reader" which will transmit trade and bid-asked information directly from the Exchange floor to a computing center.

After the trading information is transmitted to the computer center, the system will automatically:

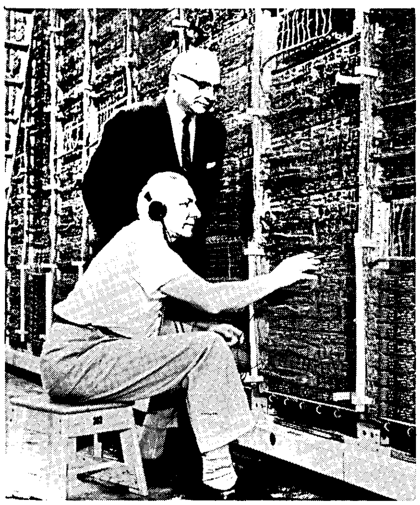
- Print sales on the thousands of Exchange stock tickers across the continent in as little as a half-second after a special reporting card is "read" on the trading floor.
- Compose voice responses to as many as 400,000 phone inquiries a day from Exchange member subscribers to the Telephone Quotation Service.
- Electronically process and store in time sequence all trading information, continually determining total volume, plus volume for each stock, open, high, low, last sale prices and latest bid-asked quote.
- Furnish up-to-the-market reports to the floor and for such operations as the "stock watching" program.

The "voice assembler", a specially designed device that produces



-- IBM Engineer Jerry Dubois listens to a "spoken" message generated by the "voice assembly" equipment which is to be used in the Exchange's fully automated ticker-quotation service.

audio responses, will provide up-to-the-market bid-asked and last sale information to Telephone Quotation Service subscribers via a 1000-line Access Switching System to be provided by the New York Telephone Company. Last sales will be supplied to odd-lot dealers by loudspeakers at the rear of each post. These last sales announcements will be automatically composed and, at the computing center, transmitted to the trading post where a particular stock is traded. Quotes and last sales will be assembled into Quotation Service "spoken" messages when member subscribers question the computer by dialing four-digit code numbers assigned to individual stocks. This device is capable of providing 200 "spoken" messages simultaneously, 50 of which can be broadcast over loud-speakers on the Exchange floor. The "voice assembler" will contain a vocabulary made up of 126 key words, syllables, digits and letters recorded on various tracks of a revolving magnetic drum. Electronic reading heads will "play back" these sounds in a sequence determined by the computer to form an easily understandable voice message which can be delivered in about six seconds.



-- Miles of wires and switches serve as background for Edward DeLaura, Director of Operational Development and Planning for the New York Stock Exchange, as he watches a New York Telephone engineer test crossbar switching equipment similar to that which will be used with the Big Board's new IBM Teleprocessing system. The crossbar, an electro-mechanical device to switch telephone calls automatically, will receive and store dialed information and then select and test the switching paths to complete the call.

The special New York Telephone Company high-speed access switching equipment will link the computing center initially with 1000 direct private wire telephone lines. The equipment will be able to handle calls from 300 member subscribers at one time. Data-Phone equipment (data sets) will be used to convert phone dial impulses into code language the computer center can accept.

The Exchange will lease the components of the system from IBM and the New York Telephone Company at an annual cost of about $1,800,000. The stock ticker activated by the computer will be a new tape printing model capable of operating at speeds up to at least 900 characters per minute -- 80 per cent faster than the present ticker. The new ticker, being developed for the Exchange by Teletype Corporation, is scheduled to go into service early in 1964.

At each trading post, computer-assembled announcements of all round-lot prices for stocks traded there will be broadcasted over loudspeakers to odd-lot dealers at the rear of the post. These transactions will also be recorded there on special printers.

There will also be a number of "inquiry" stations on the floor, where questions may be keyed into the computer system to obtain up-to-the-market printed information on volumes, ranges, last sales, previous sales and bid-asked quotations for all listed stocks.

The two IBM 7750 programmed transmission control units will link the computer to the data readers, tickers, floor printers, audio response equipment and floor inquiry stations and will allow for future direct computer-to-computer communications. Specially developed high-speed magnetic drum files, also housed in the central computing installation, will provide rapid access to all data.

The new system will mechanize virtually all present manual operations in the stock ticker and telephone quotation services. There will be duplicate computers kept in continuous operation so that any technical failure in one system will not impede operations. (For the present, reporting of Exchange bond sales will not be included in the new system.) The new equipment will be capable of handling trading volume in excess of 16 million shares a day.

## NEW NEWSPAPER TYPESETTING TECHNIQUE USES RCA 301 SYSTEM

A new high-speed technique for typesetting news stories and classified advertising with the aid of an RCA computer has been announced by the Radio Corporation of America, New York, N.Y. The RCA computer-typesetting system operates around an RCA 301 Electronic Data Processing System. Specially compiled vocabularies and electronic instructions to compose lines of type adjusted to newspaper column width would be fed into the system.

In the average newspaper composing room, paper tape, when used to activate the line casting machine, must be prepared by specially trained operators who perform the line justification function. The RCA 301 accepts paper tapes prepared by typists without special training, taking over the justification chore. The computer can trim as much as 40 per cent from the time required in a typesetting assignment.

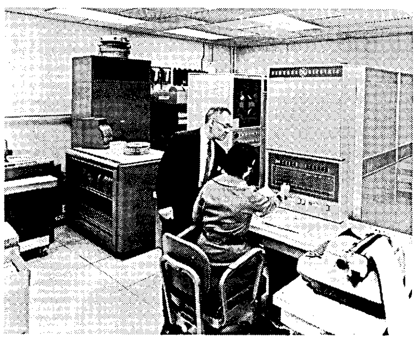
The basic newsgathering process remains unchanged. After the copy has passed the editor's desk, a typist records the story in finished text form, punching a paper tape as a by-product. This tape, with no effort to justify lines, is fed into the RCA 301. The computer, pre-informed of the maximum number of composition units which can fit into a line of type, automatically makes the justification. From this electronic operation emerges a master paper tape, for activating the typesetting machine.

The difference in type faces used for news copy and classified or legal advertising is no problem for the computer system. A Data Disc File, which can be linked directly to the 301, stores composition units tables to conform with any type face used by a newspaper. In handling copy, the shift to the proper table is made and the process continues as usual. The Data Disc File also stores letters, numerals, punctuation marks and other symbols, and a reference vocabulary geared to the needs of the individual newspaper. The information is stored on up to 24 magnetic discs, each 39 inches in diameter.

In addition to the type composition, the computer system can handle payroll, circulation billing, and other data processing.

## NEW ELECTRONIC LIBRARY SYSTEM

It is estimated that 45 per cent of the U.S. dollar spent for research is being wasted, at least in part, because of the inability of experts to utilize knowledge which is being recorded but is almost impossible to get at by old-line library methods. At Western Reserve University (WRU), Cleveland, Ohio, a group of computer and information experts is quietly revolutionizing the science of storing and retrieving information. In the WRU Center for Documentation and Communication Research, part of the School of Library Science, this group is using a GE-225 electronic computer and special programs to bring the speed of electronics to library methods which no longer can cope with the deluge of information the world is producing.



At WRU an electronic information handling system has been pioneered in cooperation with a number of interested groups. The WRU information retrieval system has been or is now being used for such varied applications as gathering military data, electrical and mechanical engineering, medical research and information, as well as for chemistry, physics and geology fields.

Farthest advanced among these programs is the American Society for Metals project which became fully operative in 1961. The metals system was set up by the university and American Society for Metals leaders to meet special needs posed by inquiries sent in by companies and organizations which make up the society. There are now almost 100,000 coded abstracts of papers, books and articles on metallurgy and related fields which have been stored on computer tape. These can be searched in 8 hours, or an effective search time per question of 24 minutes, depending on how many questions have to be answered during the search. A group of librarians sorting through this amount of material to get answers to the same questions would take many years to complete the job.

The pioneering system works in the following manner. New technical articles and books on metals and related subjects are read and abstracted at the rate of 30,000 to 36,000 a year. These abstracts then are automatically encoded into computer language the GE-225 can read, store and select. Questions coming in from subscribers to the service are encoded and run through the GE-225. Up to 30 questions at a time can be asked the computer. In a few hours the system produces numbers of all cogent abstracts which pertain to questions asked. These abstracts, after being evaluated by staff members to make certain they apply to the questions, are then sent to the originator of the questions. To date, the service has delivered more than 75,000 abstracts to a total of almost 300 subscribers.

Other information services which have been or are now being developed by WRU show the versatility of the methods used, and promise to extend the information revolution into many fields.

The WRU Center for Documentation and Communication Research was developed under the direction of Jesse H. Shera, Dean of the School of Library Science, and Allen Kent, associate director of the Center. They feel that the Center is contributing not only to the education of students in the School of Library Science, but also is pioneering for improved methods of data handling for the entire world.

## SIX BANKS UNITE TO AUTOMATE PAPERWORK

Six banks in New York State are planning a multi-million dollar joint program to automate their paperwork.

The program includes the establishment of three new computer centers housing $3.8 million worth of electronic equipment for processing and "remembering" such items as checks, deposits, installment loan and mortgage payments. It will bring about complete automation of bookkeeping and data processing for the six banks' 153 offices.

The plan was announced by the presidents of the six banks: Manufacturers and Traders Trust Company, Buffalo; Lincoln Rochester Trust Company, Rochester; The National Commercial Bank and Trust Company, Albany; First Trust and Deposit Company, Syracuse; The Oneida National Bank and Trust Company of Central New York, Utica; and First-City National Bank of Binghamton.

Equipment for each of the three processing centers will include sorters which "read" and classify checks and other documents, computers which "remember" the information and post it to customers' accounts on magnetic tape, and a printer which prepares bank records and customers' statements from the tape. The equipment will be supplied by IBM on a rental basis.

The computer centers, when in full operation in 1964, will process upwards of 160 million checks per year. Some 400,000 checking accounts and 270,000 installment loan accounts will be kept up to date on a daily basis.

## TO USE COMPUTER IN TRUST ACCOUNTING

The Boston Safe Deposit & Trust Company will use a Honeywell 400 electronic data processing system to handle its personal and corporate trust accounting work. The computer is manufactured by Honeywell Electronic Data Processing, Wellesley Hills, Mass., a division of Minneapolis-Honeywell Regulator Company.

The Honeywell 400's largest assignment will be in the personal trust accounting area. Work currently processed by hand and by use of tabulating equipment is being carefully analyzed so that simplified procedures will be adopted when conversion is made and work assigned to the computer (early in 1964). A staff, about half of whom were recruited from within the bank, is receiving advance training in computer programming and capabilities.

The Honeywell 400 equipment will include a central processor with 3000 words of memory, five magnetic tape transports, a high speed printer and punched card equipment.

## IBM COMPUTER CONTROLS FABRIC QUALITY

Berkshire Hathaway, Inc., New Bedford, Mass., is using an IBM 1401 data processing system in the production of top-quality fabric.

The computer, serving six plants in Rhode Island and Massachusetts, controls the quality of fabric turned out on 9475 looms. Near-maximum efficiency in the production of cotton and synthetic fabrics is being achieved, according to a company official.

The 1401 also has other tasks. It handles the payroll for 5500 employees and controls finished goods and greige goods inventories. It figures billing and accounts receivable; produces labor analyses; and keeps track of loom production and weaving efficiency.

The 1401 can add up to 193,000 eight-digit numbers in a single minute, or perform 25,000 multiplications of six-digit numbers by four-digit numbers in the same time. The system is fed information manually -- by a key-operated console -- or by punched cards containing data in machine language. The 1401, after processing work internally, produces the results as punched cards or in printed form.

### GOP NATIONAL COMMITTEE USES RCA COMPUTER CENTER

The huge task of storing, updating and making quickly available the master mailing list of the Republican National Committee has been taken over by the Radio Corporation of America Electronic Data Processing Center in Washington, D.C. Computers at the Washington Center not only keep the National Committee name files in order, but provide mailing lists, produce the mailing labels and turn out a variety of special reports for the Committee's guidance.

The National Committee mailing list has involved more than 700,000 cards and stencil plates, containing the names and addresses of persons who have been in correspondence with the Committee. When the information on a correspondent has been confirmed, the correct data is fed into the computer by an operator who prepares a paper tape to activate the data processor and, as a by-product, a file card on the individual. The computer stores the basic data on magnetic tape for speedy reference or revision. Up to 400,000 names and addresses can be entered on a single reel of magnetic tape.

Plans are under consideration by the National Committee to extend the computer service to include donor accounting, recording each gift made to the party and how the money is expended. The electronic data processing system will be able to extract from this mass of information the facts and figures needed for filing reports on political contributions as required under the election laws. (The speed of the computer permits an accounting of gifts ranging down to a dollar.)

## AUTOMATION

### AUTOMATIC TELEX SWITCHING CENTER

The American Cable & Radio Corporation, a subsidiary of International Telephone and Telegraph Corporation, has put into operation a new super-speed automatic telex switching center at its New York and San Francisco terminals.

The new system, known as ITT 7-E, was developed by ITT's associate in Belgium, Bell Telephone Manufacturing Company, and was installed by the Federal Electric Corporation, service organization of ITT in the United States, at a cost of almost one million dollars. The switching equipment is housed in a specially constructed dust-free operating center at each terminal.

AC&R subscribers in the United States are able to place and receive telex calls automatically to and from countries where similar switching facilities are in use. A "keyboard selection" permits the subscriber to type out on the teleprinter the overseas number he is calling. This allows the subscriber to check on his printer the number called and it also eliminates the necessity for dial equipment. The number is then analyzed by an electronic computer which connects the call without intervention of an operator.

A memory device in the 7-E system electronically records the identification code of the called and calling subscriber, the length of the call, and other pertinent data. At the end of the call, the information is transferred to tape for billing and accounting purposes.

### BASIC OXYGEN FURNACE COMPUTER CONTROLLED

The Great Lakes Steel plant at Detroit, Mich. will soon have its basic oxygen steel furnaces controlled by a computer. On-line control of the 300-ton furnaces will be accomplished by a TRW-330 digital control computer system supplied by TRW Computers Company, a division of Thompson Ramo Wooldridge Inc.

The quantity and chemical composition of the steel produced also will be controlled by the computer. The computer will determine the amounts and types of additives required from the raw material characteristics, furnace characteristics and finished ingot specifications. Next, it will control the heat generated within the vessel by controlling the flow rate and duration of the oxygen blow. In the performance of these operations, the computer ensures the maintenance of consistent operating practices, minimizes consumption of oxygen and raw materials, and assures maximum production from the furnace consistent with high product quality.

The system's data accumulation abilities permit the computer to relate finished ingot characteristics with the furnace data for specific ingots. The best set of production conditions can then be determined for subsequent batches. This is an "adaptive" control system that allows the computer's control program to be updated automatically as more is learned about furnace operation.

### MERCHANT SHIPS STEERED BY COMPUTER

Norden, a division of United Aircraft Corp., Norwalk, Conn., has developed a new type course computer and steering system which automatically will compute a course to guide a merchant ship. Acceptance tests for the Maritime Administration, U.S. Department of Commerce, have been successfully passed at Norden's plant and laboratories. The Maritime Administration will now select a ship operator and the system will be installed aboard a C4 Mariner ship for evaluation tests at sea.

The new system computes the bearing between one point and another up to 1000 miles away. Destination position, in terms of latitude and longitude, is preset into the computer. The system then takes over steering control. The steering system, centering around automatic pilot electronics, receives the command heading, and keeps the ship on its course to the preset destination. Computer readouts permit continuous monitoring. The only navigational personnel requirements are for occasional monitoring and position fixing.

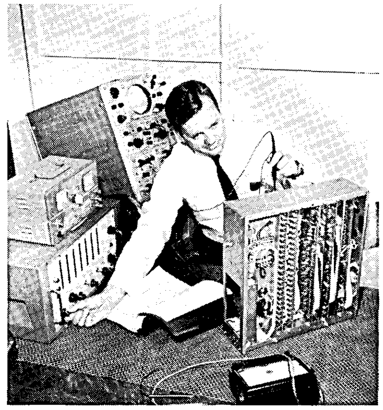
The system is of minimum size and weight and can be applied to new or existing ships. It differs from other navigational computers now in use in that it is not only capable of dead reckoning, but it can be used to estimate present position. Other advantages include the ability to make hull and draft corrections, a built-in capability of correcting for gyro error, and computation of set and drift.

The course computer and steering system will be installed in the ship's wheelhouse. All pertinent data and controls are on a panel measuring only 18 x 10 inches. The computer is only 15 inches deep.

### AUTOMATED SCORING DEVICE FOR BOWLERS

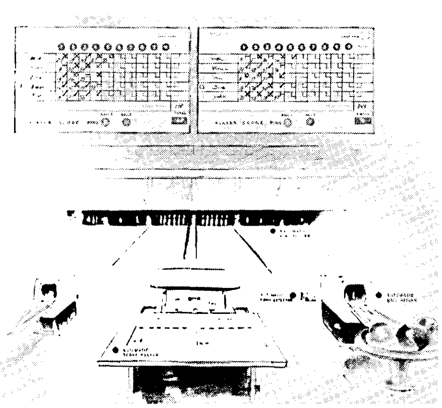
Brite-Lite Corporation of America, Phoenix, Arix., has developed a transistorized computer that automatically records individual or team scores in bowling, provides each player with a printed record, and projects scoring to an overhead screen.

The equipment, known as Score-O-Matic, can be installed with existing automatic pinsetters, foul-line detectors, and ball returners. Score-O-Matic prints each player's record on a 2½ x 5-inch card while projecting it optically onto a 3 x 5-foot screen.



Score-O-Matic's system is contained within a desk-like console unit (shown above in picture at the right). A small, special purpose wired program digital computer is the center of the system. It fits into a box which can be plugged into the console. The computer is easily replaced by the bowling lane operator should maintenance or servicing be required. One Score-O-Matic serves two lanes.

To use Score-O-Matic, a player writes his name on the small score card, inserts it in the machine at the printing mechanism, and selects a corresponding number button. His name and number are then lighted on the console in rotation during play. The computer is connected directly to the pinsetter and it "senses" which pins have been knocked down.



As balls are rolled, a player's card is automatically printed with the traditional Xs, slashes, and a numerical score. This information also is projected onto the overhead screen where it can be seen by audience and participants. Cumulative team scores are likewise projected. Score adjustment can be made manually for individual score handicaps or pins that are re-spotted manually.

The final testing of the computer is shown in the above picture, at the left, being made by engineer Howard Preston. First public tests of the equipment are scheduled in Los Angeles late this month. Score-O-Matic is expected to be available early next year, when it will be leased or purchased through the Brite-Lite Corporation.

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# NEW PRODUCTS

## NEW COMPUTERS

### Digital

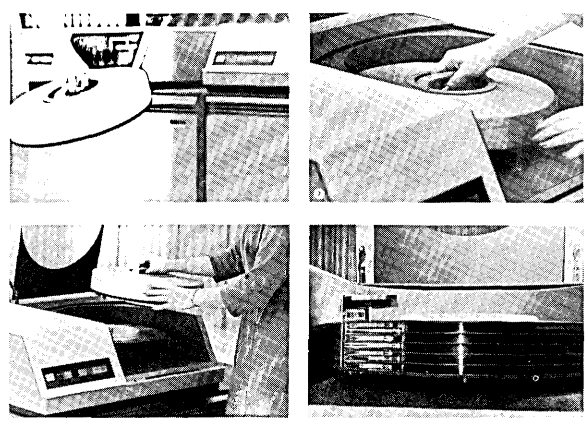
#### IBM ANNOUNCES THE 1440 NEW LOW-COST COMPUTER

International Business Machines Corp.
Data Processing Division
White Plains, N.Y.

A new, low-cost data processing system, with a major advance in memory technology, has been introduced.

The new compact computer, called the IBM 1440, is described as a low-cost computer for small and medium-size business firms. An IBM spokesman said the system will be competing with the Burroughs 270 and the National Cash Register Co.'s 390 systems in price and performance. The price range is approximately $90,000 to $315,000, depending on accessory systems. Monthly rental begins at $1500, and can go as high as $6000.

Five newly developed devices are included in the system. The disk storage drive, the IBM 1311, has six 14-inch memory disks packaged in containers which can be removed and replaced in a matter of seconds. Disk packages can be stored on shelves like books. Each holds six magnetic memory disks with a combined storage capacity of nearly 3,000,000 alphameric characters. As many as five 1311 disk storage drives may be attached to the system



-- Photos show operator loading a memory disk pack. In sequence (1) operator carries disk pack containing six 14-inch memory disks to the 1440 (2) she places the disks on the disk storage drive spindle (3) removes the pack cover and (4) the equipment is ready to operate. Disk packs weigh less than 10 pounds.

providing a maximum on-line capacity of almost 15,000,000 characters of information.

Disk packs are interchangeable and provide the 1440 with a large random and sequential data storage capacity. The 1311 disk storage drive can also be used with other IBM systems, including the 1401, 1620 and 1710.

The 1441 processing unit uses magnetic core storage in which all positions are addressable. Available core storage ranges from 4000 to 16,000 positions. Core storage cycle is 11.1 microseconds.

A new card read-punch device uses the solar cell principle to read information from punched cards directly to the central computing unit. The 1442 card read-punch reads 80-column IBM cards serially at up to 400 cards per minute.

Five interchangeable type bars give the new 1443 printer a variety of speeds, printing up to 430 lines a minute. Each type bar contains the alphabet, numbers and various

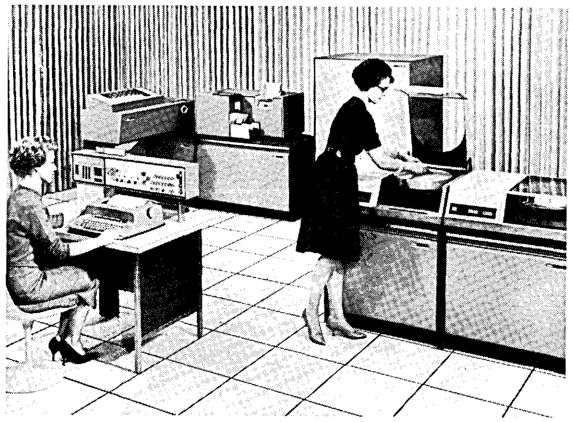
-- An operator holds two of five removable type bars. Printing speeds range from 120 to 430 lines a minute.

combinations of special characters, or just numbers and special characters alone. With the numerical type bar -- all that is required for some jobs -- the printer operates nearly three times as fast as with the combination bar.

The 1447 console contains the operating keys, dials and switches that permit operator control over the system.

Automatic programming aids come with the computer at no extra charge. These include three programs for banks, two for insurance companies, a medical service package for hospitals, and programs for schools, trucking firms, and retail stores.

According to Frank T. Cary, vice-president of the Data Pro-



-- A computer operator (right foreground) is shown loading a disk pack on one of the 1440's disk storage drives. Seen behind the console is the printer; the card read-punch is at the right of the printer; and the processing unit is behind the disk drives. IBM provides a number of application programs to the customer at no cost.

cessing division in White Plains, N.Y., the 1440 system, while tailored to the needs of smaller firms who do not require the speed and power of a larger computer like the 1401, is also expected to be used by large companies interested in decentralized data processing capabilities.

The new general purpose computer will be available on an 18-month schedule.

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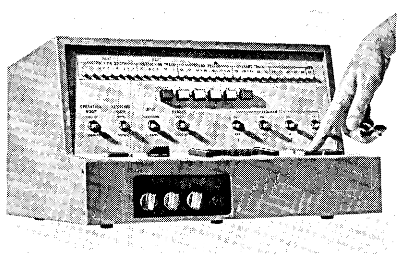
## LIBRASCOPE INTRODUCES L-2010 COMPUTER

Librascope Division
General Precision Inc.
Glendale 1, Calif.

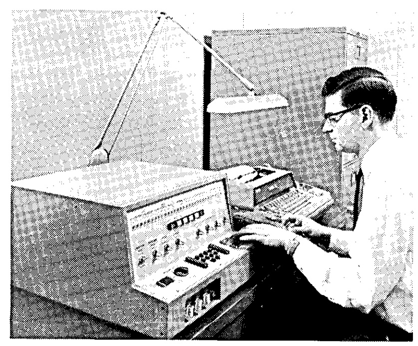
The L-2010 computer has been developed by this company to provide military users with a fast, economical computer to handle the growing number of data-processing and computing tasks that have been considered either too costly to solve with large computers or too complex for existing small, general-purpose computers. This unit is claimed to be one of the world's smallest, high-capacity, general-purpose digital computers. The L-2010 weighs 60 pounds and measures only 2 cubic feet in volume -- it can be portable, rack-mounted, or operated on a desk top.



-- The L-2010 digital computer

The solid-state L-2010 has a magnetic-disk memory capacity of 4096 words. Access time is 78 µsec. with minimal programming. Arithmetic execution times (including minimal access time) are 78 µsec. for addition or subtraction, 156 µsec. minimum to 2.42 msec. maximum for multiplication, and 234 µsec. minimum to 2.5 msec. maximum for division. Internal organization permits direct or buffered communication with input/output devices.

For direct inputs, the L-2010 uses a keyboard and a mechanical or photoelectric paper-tape reader. For direct outputs, the computer uses a 100-character-per-second paper-tape punch, a typewriter, and the control-panel display.



-- Charles Brown, engineer, operates L-2010 general-purpose computer. At right of computer is output typewriter.

Flexibility and simplicity of operation have been achieved in the L-2010. The computer can be operated manually, semiautomatically, or automatically. Input data can be entered manually through the computer's self-contained keyboard. Alternate program modes of operation can be selected manually.

The computer, designed to meet requirements of MIL-E-16400C, has silicon semiconductors and wide tolerances in all circuits.

# What is today's...

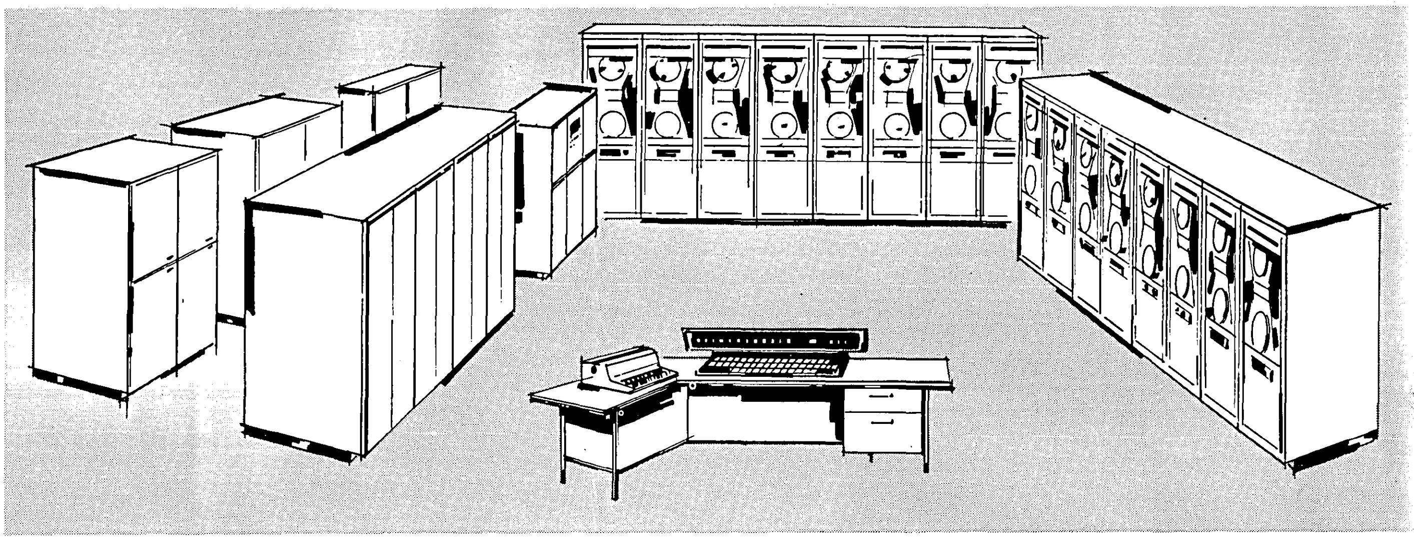
most powerful computer system?

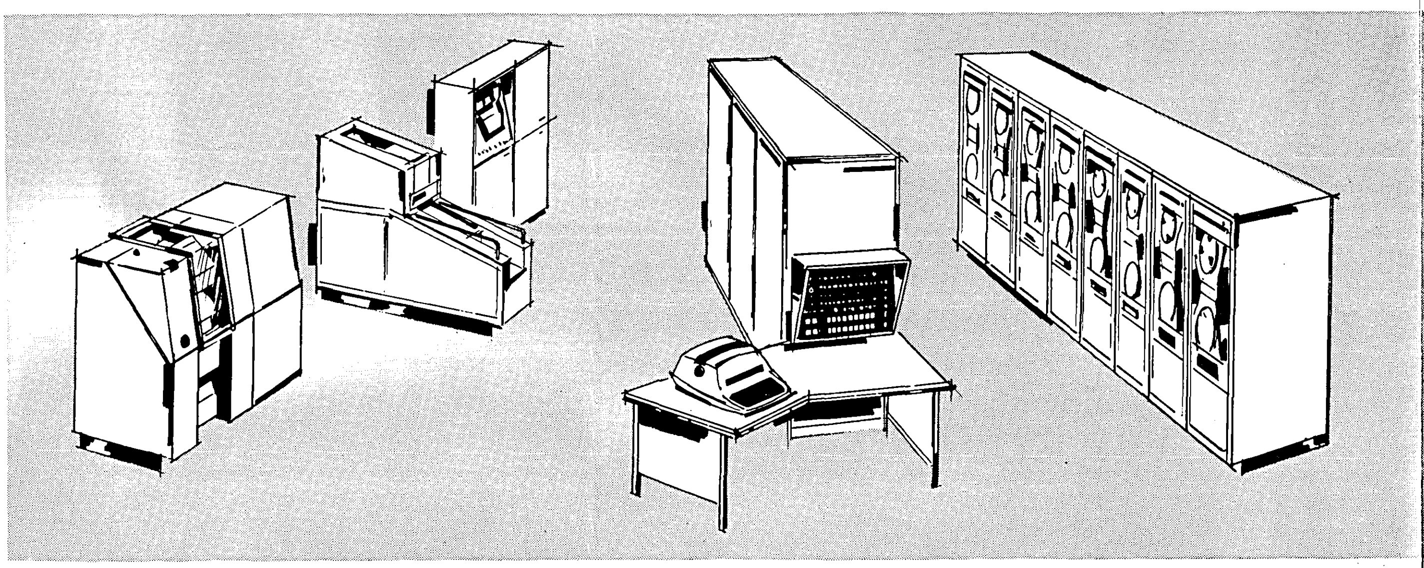
most versatile satellite system?

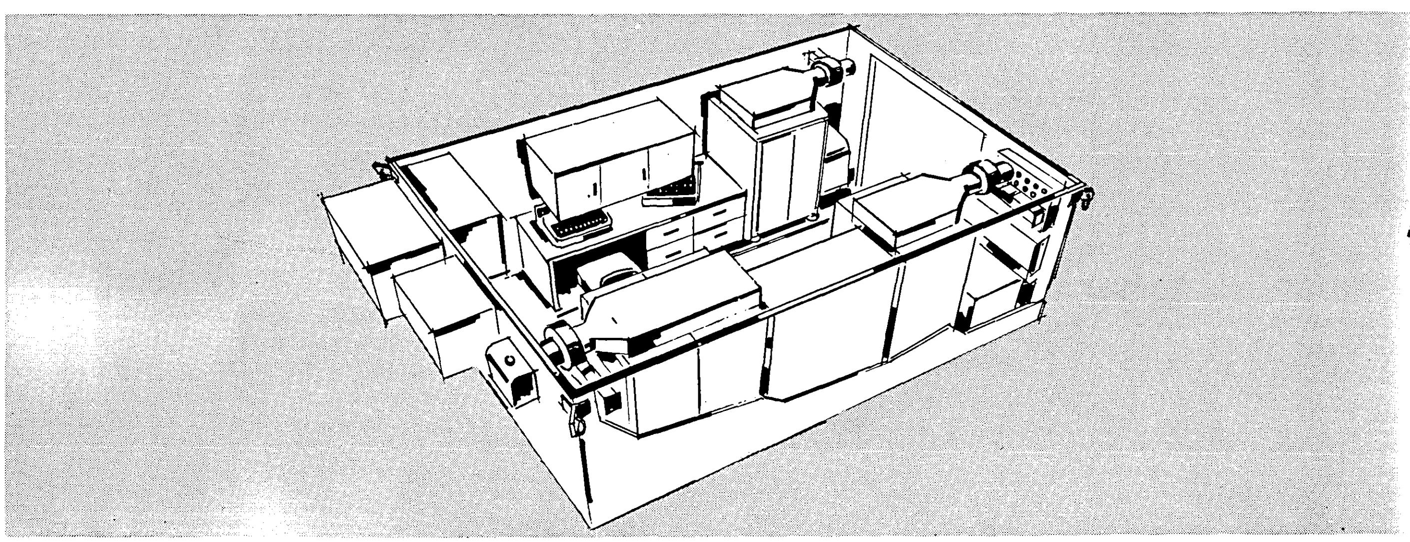
fully accepted medium-scale FIELDATA computer?

*fastest moving computer organization?*

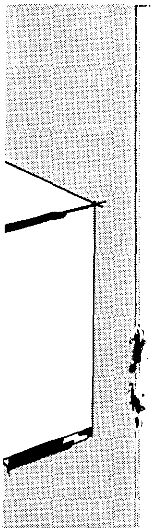
*See them all at the FJCC*







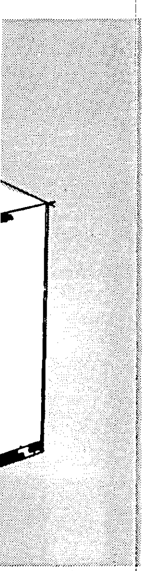
PHILCO'S ON THE MOVE! → PHILCO'S ON T



# THE PHILCO 212

## . . . today's most powerful computer system

**Numbers Game**—When you have a really fast computer with high precision and great capacity, how do you prove it? The Philco 212 System has impressive specifications—a 1.5-microsecond memory cycle . . . 360,000 word-per-second throughput . . . 960 KC magnetic tape transfer from four 240 KC high performance tapes simultaneously . . . asynchronous operation . . . 48-bit word length . . . 112 fixed and floating point arithmetic instructions. **Meaningful?** We don't think so. Actually, our 1.5-microsecond memory has greater effective speed through 4-way overlapped memory access and when we mention our .55 microsecond add for two full operands, people think we're talking cycle time. **Therefore:** Let us measure the power of the Philco 212 where it counts—against *your* present computer on one of *your* problems. Then you can find out what the Philco 212 can do for you. By the way, to date the 212 has been showing at least a 2 to 1 advantage over other available large scale machines.



# THE PHILCO 1000

## . . . today's most versatile satellite system

**Versatility**—The only character oriented computer that combines the advantages of variable word length and fixed word length operation without the disadvantages of either. Operates in fixed or variable word formats without special programming, including 12, 24, 36, 48 or 54-bit word sizes (or any other multiple of 6 bits). Can change between fixed word formats without reprogramming. **Full Satellite Capability**—Can communicate with all types of input-output equipment because of fast 3-microsecond core memory access. Links directly to Philco 212 core memory or tapes. Capable of autonomous action and decision. Can be used as an independent processor in remote locations for scientific *or* commercial application. **Non-obsolescence**—Asynchronous operation allows future developments to be integrated regardless of their timing cycles.

# THE PHILCO BASICPAC

## . . . today's fully accepted medium-scale FIELDATA system

**Mobile**—fly it, truck it, ship it, store it, and five minutes after a power connection is made BASICPAC can be operating. Shelter and computer are delivered as an integral unit. **Rugged**—drop it, bounce it, freeze it, drench it, use it in the Sahara or the Arctic, in a jungle or in mountains, and BASICPAC will still operate reliably. **Expandable**—basic system can be pre-wired for expansion of capability: Add more memory, add input-output, add real-time channels in the field *in hours*. **Real-time**—Communications converter provides up to seven real-time inputs and seven real-time outputs with multi-level priority interrupt. **Powerful**—12-microsecond memory cycle with 38-bit word. 40 instruction order code, expandable to 64.

N THE MOVE! ⟶ PHILCO'S ON THE MOVE!

# QUESTIONS?

Do you want to know more about the Philco 212 computer, the 1000 or BASICPAC?

Or maybe you want information on the other computers in Philco's 2000 Series, the 210 and 211 computers, or information on Philco software and service. We can suggest several alternatives.

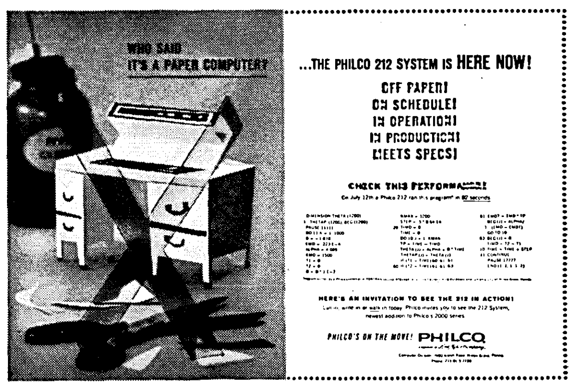
# Make an FJCC date

At the Fall Joint Computer Conference, we will be showing our Philco 1000, BASICPAC and C-3000 computers. And we will have trips to our nearby Willow Grove Computer Center for those interested in Philco 212 demonstration. We will be at booth 65-76. But if you aren't attending the FJCC, call in, write in or walk in for further information.

---

# Remember?

It seems that a great deal of interest was created by our recent ad featuring a Fortran language program we had run on our 212 computer—a program written for our 211 incidentally. If you missed the ad and would like to try the program on your present computer, copies will be made available on request, or at the FJCC.

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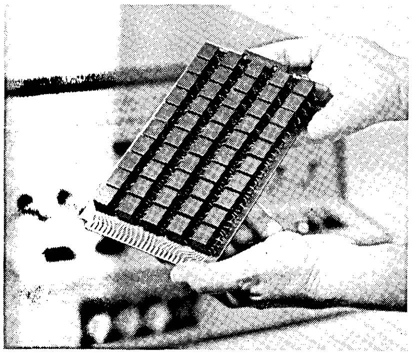
*PHILCO'S ON THE MOVE!* **PHILCO**®

A SUBSIDIARY OF *Ford Motor Company*

COMPUTER DIVISION

3900 Welsh Road, Willow Grove, Pa. Phone: 215—OL 9-7700

Connections in circuit assemblies are welded. All circuit modules are encapsulated in epoxy resin.



-- L-2010 circuit assembly designed to withstand effects of rugged military environments.

Three types of basic circuit modules are used throughout the computer, minimizing both maintenance and spare-parts requirements. No special air-conditioning unit is required because all-silicon semiconductors are used and circuit modules are encapsulated.

The computer's ruggedness allows it to be carried on jeeps, vans, trucks, and other land vehicles. The L-2010 can be used for target-motion analysis, navigation computations, ballistic computations, system simulation, and automatic system checkout. Other ship and ground-based applications include military records keeping, supply depot inventory control, preventive maintenance scheduling, and oceanographic data reduction.

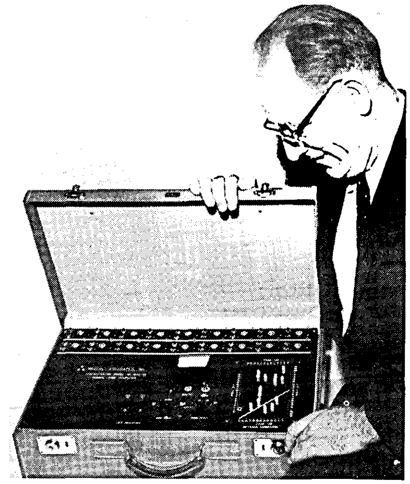
## Analog

### COMPUTER IN A SUITCASE

Mauchly Associates, Inc.
Fort Washington, Pa.

A new computer, small enough to be carry-on luggage when taken on a plane, has been developed by this company. The Model NTC-18 is the second of the series of SkeduFlo computers being designed and built by this company. This computer is a scaled-down version of the larger 100-job SkeduFlo now under development by Mauchly Associates.

The NTC-18 has a capacity of 18 jobs. Problem set-up is simplified since there are no tapes, punched cards, or programs to be considered. It requires no accessory equipment. The flexibility of the device allows the operator to make changes at any time, reflecting changes in the sequence of work to be done, or in the duration of any job in the project. The results can be read out immediately.



-- Dr. John W. Mauchly, president of Mauchly Associates, Inc., sets up a problem on the firm's new computer, NTC-18. This device weighs approximately 50 pounds including carrying case.

Among the features of the new NTC-18 (also to be included in the NTC-100 model which will be available at a later time) are these:

- Critical jobs are spotted immediately from neon lamp indicators.
- All relevant data can be read directly from a built-in meter.
- Project duration, amount of slack or float, earliest job starting times and latest job completion times, are all available for direct reading.
- Late-lights can be coupled into special jobs in the project to signal when any delay or change in any part of the project schedule causes these special jobs to fail to meet a pre-selected target date.

Dr. John W. Mauchly said, "This computer is actually an electronic representation of the modern scheduling system used by both government and industry for the control of complex projects."

The Critical-Path Method (CPM) and the PERT system of project management are now widely used by government and industry. Use of the NTC-18 SkeduFlo Computer for basic training in such methods aids the students to grasp more quickly the meaning of such concepts as "critical job", "slack" and "float" which are fundamental to these methods of planning, scheduling and controlling large projects.

### ANALOG COMPUTER CONTROLS ELECTRONIC COLOR SCANNER

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

The development of an improved and completely transistorized analog computer, as the control unit for one of the printing industry's leading electronic color scanners, has been announced by this company. EAI built the computer under exclusive contract for Printing Developments, Inc. to meet the need for a complete computer element that would have an unusually large capacity.

The project revolved around the problem of converting the present vacuum-tube computer of PDI's Scanner to one made up of transistorized modules incorporating all the flexibility of the basic circuitry, plus the more recent developments of positive scans, differential masking, peaking and simultaneous 35 mm. enlargement.

In making color separation negatives or positives, a ray of light is passed through the color transparency, which carries the exact colors into the color separation unit. Here these colors are separated into their three components, yellow, red and blue, and converted into three electrical currents. The currents are then fed into the analog computer section of the scanner. The computer automatically adjusts for the great contrast range in each transparency, corrects for color deficiencies of printing ink and paper that will be used to reproduce the photo, computes a black printer, and converts the information into four electrical currents. These currents control the intensity of the four lamps that simultaneously expose all four negatives or positives in exact register with each other.

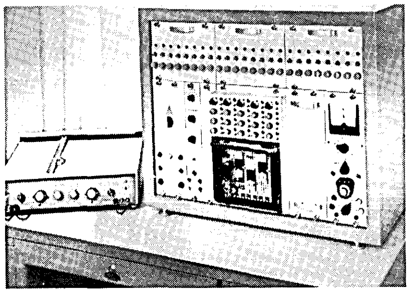
The new computer will be used in PDI's New York Color Center after completion of calibration and quality control tests.

### NEW ANALOG COMPUTERS -- 24- AND 64-AMPLIFIERS

Applied Dynamics, Inc.
2275 Platt Road
Ann Arbor, Mich.

A new 24-amplifier analog computer and 64-amplifier analog computer have been developed by this company.

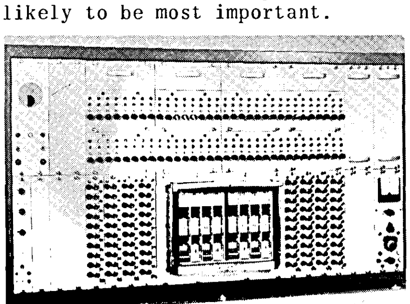
The compact 24-amplifier computer, AD-2-24PB, is expected to find greatest acceptance where a broad range of problems must be solved, but within a restricted budget. Schools and medical institutions are expected to be the major users. A removable patch panel, pushbutton monitoring, and front panel access to coefficient potentiometer fuses, simplify the operator's tasks. The modular con-



-- The AD-2-24PB computer is small enough to fit on a desk top (20½ in. deep x 24 in. high x 30 in. wide). The complete computer weighs 125 pounds.

struction allows expansion to 24-amplifier capacity and the addition of interchangeable multipliers and diode function generators, one at a time. High-speed repetitive operation can be introduced by a switch which allows selection of compute periods ranging from 1.000 to 0.025 second. Slaving and trunking to all Applied Dynamics' and most other makes of analog computers is possible.

The new, 64-amplifier electronic analog computer comes in two models -- AD-2-64PB, a tabletop unit with removable, color-coded patchboard; the other, AD-2-64PBC, a console model with complete pushbutton control and monitoring. The tabletop model is particularly aimed at university, engineering, and medical applications where cost and space are likely to be most important.



-- AD-2-64PB electronic analog computer with removable, color-coded patchboard.

The new computer, in its typical, fully-expanded form, would include 64 amplifiers, 80 potentiometers, 16 multipliers, eight generators, 80 external trunks, 6 electronic comparators, 2 DPDT electronic switches, 8 electronic track and hold units, and 10 diode networks. Real time, fast time, repetitive, and iterative operation are available. Precision wideband components of the new computer have an accuracy of 0.02 per cent. All non-linear components are solid-state. The AD-2-64PB is compatible to other computers with a ±100 volt reference.

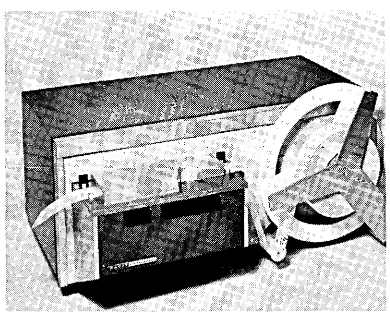
# Input - Output

## NEW PAPER TAPE READER OPERATES AT 1000 CHARACTERS/SECOND

Facit Electronics AB
Fack, Solna 1
Sweden

The company has developed a high-speed paper tape reader with dielectric reading and fully transistorized circuitry. The Facit PE 1000 is compatible with every data processing machine.

The exclusive, new principle, dielectric reading, created by the designers of the Facit PE 1000, is said to eliminate the usual reading-error risks. Advantages offered by the use of dielectric reading are: no lamps or photocells to age; reading unaffected by dust, dirt and light; paper tapes of any color as well as transparent and plastic tapes are fully acceptable.

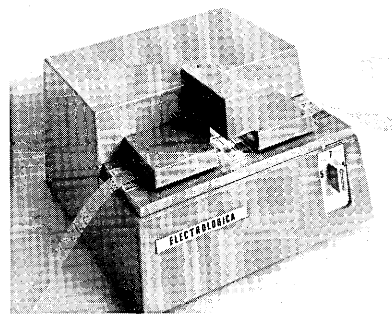


There are very few moving parts in the Facit PE 1000. Tape can be inserted and secured in a couple of seconds. If an incorrectly punched character stops the reader, the character is immediately visible. The error can be flagged because the reader can be stopped after every character. The Facit PE 1000 is convertible for 4, 6, 7 or 8-track punched tape. A simple hand motion performs the changeover.

## NEW PUNCHED TAPE READER

N. V. Electrologica
214, Stadhoudersplantsoen
The Hague, The Netherlands

This company has developed a fast punched tape reader, the EL-1000, with a speed of 1000 symbols per second. This tape reader is very easy to operate. By simply turning a switch it is set to read 5-, 7- or 8-channel tape in any code. The tape is read symbol by symbol so that it is brought to a stop before the following symbol has reached the reading station, if the absence of a new read instruction makes it necessary. The short start and stop times, necessary at high speed, are achieved by means of a special electronic amplifier. With this system a stop instruction from the central unit will bring the tape to a definite stop within one thousandth of a second.




-- The EL-1000, punched tape reader with a speed of 1000 symbols per second.

A check reading station can either be built in or added later to the EL-1000. Connection to any computer is easily made.

## CLARY ANNOUNCES NEW PRINTRON

Clary Corporation
San Gabriel, Calif.

The Printron, a high speed line printer, has been marketed by this company. The printer, with hypocycloidal action, has been adapted from a military counterpart used in the Atlas, Polaris, and Minuteman missile programs.

The Printron can be mounted in a panel or desk area 7" x 19". It prints up to 21 characters per line at a rate of 600 lines per minute. The Printron uses a squeezing printing action rather than on-the-fly printing. This is said to minimize wear, withstand shock and reduce noise. A new inking technique permits up to a quarter of a million impressions.

Applications include the instrumentation field, check-out systems, computer output, industrial production data logging, control data logging, field check-out of components and communication data recording.

### DATA TRANSMISSION CONTROLLER

General Electric
Computer Department
Phoenix, Ariz.

This company has developed a 15-channel data transmission controller, known as Datanet-15. The device permits the GE-225 general-purpose computer to automatically receive and transmit information over available telephone facilities, either in-plant or over nationwide communication networks.

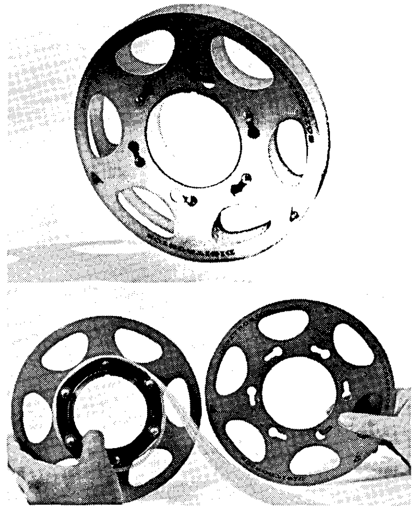
The controller accepts information transmitted over two-wire telephone and telegraph lines at speeds up to 3000 words per minute and feeds it directly to the GE-225 for processing. Conversely, it accepts information directly from the computer and prepares it for transmission to a remote station. The unit, operating with the GE-225, electronically scans all 15 channels 3000 times per second. If a station on any one of the channels wishes to send a message for processing by the computer, the controller informs the GE-225. The computer may accept or reject the message, depending upon the processing operation underway. If a message cannot be accepted, Datanet-15 "remembers" the transmission point. The computer automatically notifies that station when the message is acceptable. Messages are automatically checked for error or insufficient information as they are received.

The Datanet-15, while designed to handle from two to fifteen channels, has a building block arrangement permitting capability to be increased in increments of 15 to a maximum of 120 channels.

### NEW SPLIT REEL TO EASE HANDLING OF TAPE

Digitronics Corp.
Albertson, N.Y.

A split reel, for new ease of tape handling, has been developed by this company. The reel lets the operator remove tape from the take-up reel without removing the reel itself from the equipment. This new 8-inch split reel will

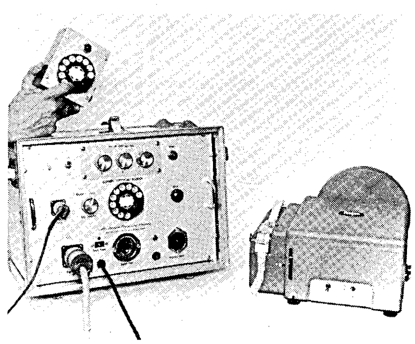


hold up to 400 feet of tape. The reel comes in standard widths of 1/16", 7/8" or 1". It can accommodate 5, 6, 7 or 8-level tape. The operator can assemble or disassemble the reel with the press of a button.

### EQUIPMENT PERFORMANCE RECORDER PRODUCES PUNCHED TAPE

All American Engineering Co.
Wilmington, Del.

An equipment performance recorder that records equipment downtime automatically on a computer oriented punched tape, has been developed by this company. This new recorder automatically produces a punched tape record showing the duration of equipment or system down-time. The punched tape produced by the recorder can be fed directly to a digital computer or



can be converted to cards for machine sorting and/or computer operation. The company recommends the Friden #1294-021 tape punch unit. The recorder can be modified to use other tape punch units.

The recorder is useful for analyzing performance of processing or manufacturing units, small research and development projects, semi-works or pilot plant operation, and for study of manufacturing systems.

## Components

### NEW DATA STORAGE MEDIUM FOR ELECTRONIC COMPUTERS

Monroe Calculating Machine Co.
Business Machines Group of
Litton Industries
Orange, N.J.

The Monro-Card magnetic record -- a new data storage medium for electronic computers -- has been introduced by this company. The Monro-Card is the size and shape of an ordinary tabulating card, but with a magnetic oxide coating. It is available with capacities of either 1400 or 800 digits of information, offering 10 to 15 times the capacity of an 80-column punched card.

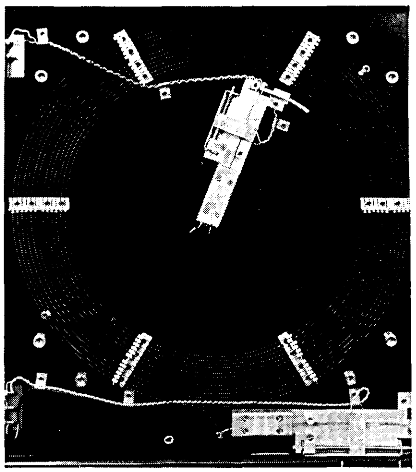
The Monro-Card magnetic record lets stored information be up-dated, changed or erased without destroying the original data document. It is estimated that the Monro-Card system will increase processing speed and reduce computer running time by 25%.

With the introduction of the Monro-Card, the company also announced: 1) the Monro-Card Processor, an additional input-output device for Monroe's Monrobot XI electronic computer; 2) a high speed photo-electric punched tape reader; 3) a 2048-word magnetic memory drum for the Monrobot XI.

MAGNETOSTRICTIVE DELAY LINE

Sonic Memory Corp.
494 Oak Street
Copiague, N.Y.

A magnetostrictive delay line, TD-4, has been developed by this company, which can store as many as 6000 bits at a digit rate of 2 Mc in a non-return-to-zero mode at a cost-per-bit of two cents for the line itself. Maximum storage capacity is provided at minimum cost. The delay line may also be operated at a digit rate of 1 Mc in a return-to-zero mode as well as 2 Mc in a NRZ mode.



PROGRAMMABLE DIGITAL CLOCK INTERVAL TIMER

Delco Radio Division
General Motors Corp.
Kokomo, Ind.

This company has developed a programmable digital clock and interval timer for use with the IBM 7090.

This real time clock provides a means of accurate time accounting of programs run on the 7090 computer. The device uses five machine cycles access time. This means that if an average 24-hour load of 600 accesses are required, all 600 accesses can be accomplished in less than 10 milliseconds. The interval timer structure lets the programmer limit the computer time used for a problem. Timing is accurate to one millisecond.

It is simple to program since it is addressable as a data channel. It does not require setting daily, since it operates independently of the 7090 power and is automatically set at midnight each night.

Use of the clock will result in a saving of accounting time, and more efficient usage of the computer, according to company spokesmen.

## Converters

BI-DIRECTIONAL DATA CONVERTER

General Dynamics/Electronics
Rochester, N.Y.

An electronic translator is being built by this company, for the Rocketdyne Division of North American Aviation, Inc., to permit communication between a pair of data processing devices -- using different input media. The device will receive data recorded on magnetic tape and convert them to punched paper tape form, or vice versa.

At Rocketdyne, the translator will convert data generated by the company's 7090 computer into punched paper tape that will then control the operation of complex machine tools. Data received from paper tape will be converted into magnetic tape form for computer input or tool control. The "translator" will operate at a speed of 250 characters per second when converting data from magnetic to paper tape. In the reverse process, a speed of 500 characters per second is possible.

The data converter, known as Model SC-332-A, will also operate with a GD 4020 electronic printer (produced by General Dynamics/ Electronics in San Diego) which can convert computer-produced data directly into engineering drawings, circuit schematics, or other graphic representations.

SOLID STATE VOLTAGE TO FREQUENCY CONVERTER

Vidar Corporation
Mountain View, Calif.

A solid state voltage-to-frequency converter has been developed by this company.

The Vidar 211 Converters have linearity of better than 0.025% and long term drift of less than 0.1% per week. The converters have three frequency outputs -- 0-1 Kc, 0-10 Kc and 0-100 Kc. A single 3½ in. housing accepts up to 10 converters and their associated power supply. Total power drain for the housing with the full 10 converters and common power supply is approximately 30 watts.

Chief applications of Vidar 211 Converters are analog-to-digital conversion, precise integration, and telemetry.

## NEW FIRMS, DIVISIONS, AND MERGERS

LIBRASCOPE FORMS NEW BRANCHES

General Precision's Librascope Division, Glendale, Calif., has completed another step in a long-range decentralization program. The new step involves the formation of the Data Processing Systems Branch and the Components and Special Devices Branch, both located in Burbank, Calif. They were organized from Librascope's former single branch operation in Burbank.

The Data Processing Systems Branch will specialize in the design and manufacture of large-scale data processing systems for commercial, military, and scientific applications. It will also produce small- and medium-scale computers.

The Components and Special Devices Branch will specialize in the production of Librascope's electronic, electromechanical, and mechanical components for computing and control applications. The product line includes integrators, differentials, and over 200 types of encoders. The branch will also produce computer sub-systems, custom components, and electronic test equipment.

CONTROL DATA ESTABLISHES COMPANY IN EUROPE

Control Data Corporation, Minneapolis, Minn., has established a subsidiary, Control Data AG at Lucerne, Switzerland. The company has also established sales offices at Schweizergasse 8, Zurich, Switzerland, and at Heuschelsheimer Landstrasse 21, Bad Homburg, Germany. Control Data plans to establish additional subsidiaries in Scandinavia, Benelux and France within this year.

Control Data's European companies will initially market and service Control Data computers made in the United States. Operations will include training facilities for its customers and employees. Training courses will be provided on computer system applications, programming systems and techniques, and customer engineering and maintenance. Control Data plans to establish computer equipment manufacturing facilities in the Common Market area.

### ITT BUYS LEADING SUPPLIER OF DIODES

International Telephone and Telegraph Corporation has acquired National Computer Products, Inc., of Lawrence, Mass. National Computer Products, Inc., with its division, National Transistor, is one of the nation's fastest growing firms in the field of electronic components. The purchase price was not disclosed, but involved an exchange of ITT stock for the assets of National.

It is planned to maintain operations under the same management, and to continue production in Lawrence. National Transistor will retain its name and will operate as a subsidiary of ITT.

The company is engaged in new product development in the field of microminiature semiconductors. It is now a prime supplier of germanium and silicon diodes to major computer manufacturers in the United States.

### NUMERICAL CONTROL DEPARTMENT ESTABLISHED BY WESTINGHOUSE

The Westinghouse Electric Corp. has established a numerical control department at the Systems Control division, Buffalo, N.Y. The new department is under the direction of James R. Jowett. It is responsible for the development, manufacture, sales, installation and service of numerical control systems and devices.

Westinghouse plans to work with the machine tool builders and design the optimum numerical control system for each specific application and installation. In 1960 Westinghouse introduced the Prodac line of numerical control systems and has more than 50 systems presently installed.

### AUERBACH CORPORATION FORMS NEW GROUP

The Auerbach Corporation, Philadelphia, Pa., has formed the Business Information Systems (BIS) group. The group is staffed to provide a complete range of technical and management services for the application of EDP to both accounting and manufacturing operations. The BIS group will provide services in three basic application areas: new systems development; current systems evaluation and conversion; advanced-systems development. Headquarters for the new group will be in Philadelphia, at 1634 Arch Street. An additional office will be maintained in Arlington, Va.

### CHANGES NAME

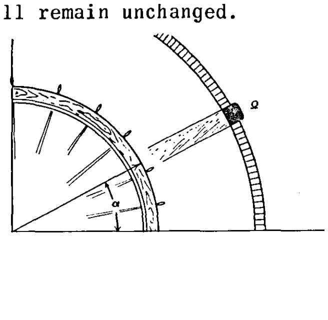
Pacific States Engineering, Santa Ana, Calif., has changed its name to Pacific Data Systems, Inc. and has moved into new facilities at 1058 East First Street.

Paul J. Linebarger, General Manager of Pacific Data Systems, stated that the reason for the name change was to more clearly reflect the nature of the company's business in the development of special purpose data handling equipment. Current projects include the design of a digital control center for automatic checkout systems, a device for the storage and retrieval of microfilmed information, and a large information display.

### C-E-I-R ANNOUNCES ORGANIZATIONAL CHANGES

C-E-I-R, Inc., New York, N.Y., has completed a program of reorganization. The international computer services and electronic data processing corporation has regrouped its national network of seven independent service centers under three regional managements: West, with centers in Los Angeles and San Francisco (headquarters in Los Angeles); Central, with centers in Washington, Philadelphia and Houston (headquarters in Washington, D.C.); and Northeast, with centers in New York and Boston (headquarters in New York).

Vice Presidents of C-E-I-R named to head the new regional centers are: Northeast, George Wulfing; Central, Dr. Jack Moshman; West, Dr. J. Paul Walsh. The operating personnel and equipment will remain unchanged.



## NEW INSTALLATIONS

### UNIVAC 1107 THIN-FILM MEMORY

Computer Sciences Corporation, Los Angeles, Calif., has received the first commercially available electronic data processing system with a magnetic thin-film memory, shipped from the UNIVAC division of Sperry Rand Corp., St. Paul, Minn.

The UNIVAC 1107 thin-film memory computer system has one of the largest memory capacities ever delivered to a commercial user -- a 128 word magnetic thin-film control memory, 65,536 words of magnetic core memory, and 6,291,456 words of magnetic drum memory. The thin-film control memory of the UNIVAC 1107 consists of a series of metal dots, a few millionths of an inch thick, made by depositing vapors of iron, nickel, and cobalt, on a thin glass substrate. Thin-film memory can be switched in nanoseconds, or, billionths of a second.

Programming aids for the system will include: an assembly system; an executive monitoring system; COBOL, an English language compiler; and the FORTRAN 4 compiler, the latest scientific programming aid. Computer Sciences Corporation will use the UNIVAC 1107 for solution of complex scientific problems and other major data processing projects.

### NETHERLANDS BANK WILL INSTALL FIRST NCR 315 COMPUTER IN SOUTH AFRICA

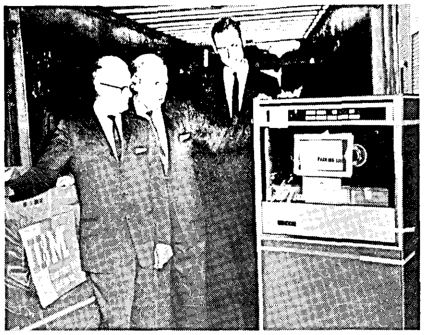
The Netherlands Bank of South Africa, Ltd., will be the first organization in that country to install a National Cash Register 315 computer system. The NCR 315 system will be used to automate the processing of accounts at the bank's main office in Johannesburg and eight branches. The computer will also be used to control the collection of bills of exchange and to maintain records for inter-branch accounts.

The NCR 315 computer system will have two Card Random Access Memories (CRAM). CRAM enables the 315 computer to locate, read, update, and refile a customer's record in less than a second.

The Netherlands Bank has 90 branches throughout South Africa as well as offices in many other countries.

## "SECOND-GENERATION" COMPUTER FOR INSURANCE COMPANY

A new 12-unit electronic data processing system, the IBM 1401-1410 system, will replace an IBM 650 system for the Harleysville (Pa.) Insurance Companies. The IBM 1401-1410 system will be capable of almost instantaneous rate checking and calculating 25,000 insurance policies per hour, with a printing speed of up to 600 lines per minute. The transistorized



magnetic-tape-type computer will be the principal component of the electronic data processing center in Harleysville's new $1.1 million home office building addition. Arthur A. Alderfer (left), president of the Harleysville Insurance Companies, and George R. Boyer (center), the companies' director of data processing, are shown accepting delivery of the first unit of the new system from Francis A. Marks, Jr. an IBM account executive.

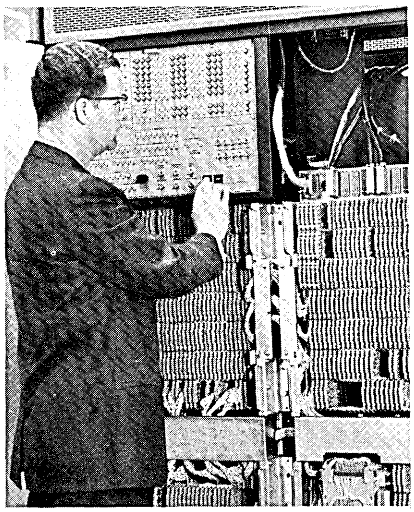
## AIR FRANCE TO INSTALL TELEREGISTER SYSTEM

Air France headquarters in Paris will have Europe's first electronic real-time inventory system of airline seat availability early next year. The system, built by The Teleregister Corp., Stamford, Conn., and known as a Magnetronic Reservisor, will answer passenger requests for reservations within seconds.

In the initial installation the system will include, two real-time computers and 150 directly-connected agents' handsets. A handset query to the computer will return space availability information, for any flight, in a matter of seconds. Each seat sale or cancellation made through a handset is automatically added to or subtracted from each flight inventory. When sales reach a prescribed level, the Magnetronic Reservisor will print out a seat status report to advise the possible need for an extra section. The system is capable of answering seat availability requests at the rate of 6000 an hour.

## UNIVAC SHIPS FIRST OF NEW COMPUTERS

A UNIVAC 580 has been shipped by UNIVAC St. Paul to the Westinghouse Computer Systems Division in Pittsburgh, Pa. This is the first of a new line of general purpose process control computers developed by UNIVAC for use in industrial control systems, to be offered under a joint program with Westinghouse. The new Westinghouse control computer system, designated the Prodac 500 Series (see COMPUTERS & AUTOMATION, Across the Editor's Desk, September) uses these UNIVAC computers as major components.



-- UNIVAC engineer presses button on console of new UNIVAC 580 computer to activate a test program.

These systems represent the first in a series developed for wide industrial applications, including steel, paper, chemical and many other process industries, and in the electric utility industry. Westinghouse has complete system and marketing responsibility for the new system under the joint program.

This first UNIVAC 580 computer will be a permanent installation at the Westinghouse computer systems laboratory.

## DIGITAL COMPUTER SYSTEM FOR NIAGARA POWER PROJECT

Leeds & Northrup Company, Philadelphia, Pa., has supplied the Power Authority of the State of New York with a new digital computer system. This system, LN 3000, was designed to handle more efficiently the production of electricity in the Authority's Robert Moses Power Plant at Niagara Falls, N.Y.

The system will have two functions: to compute the most efficient operation of the project's generating units, and to continuously produce various operating data. Among important elements of this information are water level and flow of the project reservoir and waterways, and energy production and power-flow in kilowatt hours of the generating units and interconnecting tie lines extending from the project. The data is printed on hourly, daily, and monthly bases.

The Niagara Power Project will have a rated capacity of 2,190,000 kilowatts making it the largest hydro-electric project outside of the Soviet Union.

# COMPUTING CENTERS

## UCLA TO HAVE MEDICAL COMPUTER CENTER

A large scale health sciences computer center is being established at the UCLA Medical School, Los Angeles, Calif. The $3,300,000 computer center was made possible by grants from the U.S. Public Health Service.

The computer, an IBM 7094, is expected to be in operation before the end of the year. The new center will be largely devoted to processing medical research data. Laboratory data such as brain wave recordings, electrocardiograms, and blood flow data, may be fed by direct wire from the laboratory to the computer, and thus processed immediately. Patient data, such as clinical laboratory and radiological procedures, may also be stored in the computer's memory units for future statistical studies. The center will also be used for training programs to acquaint students with the medical uses of computers and for the graduate training program for specialists in biostatistics in the School of Public Health.

A smaller computer facility has already been established in the Brain Research Institute for use in the investigative program there. An IBM 7090, installed at UCLA last year, provides general computing for UCLA's scientific and other researchers, and the Western Data Processing Center, which emphasizes research in business and also serves 74 other educational institutions in the West.

### NEW COMPUTERMAT ESTABLISHED AT LOS ANGELES REFINERY

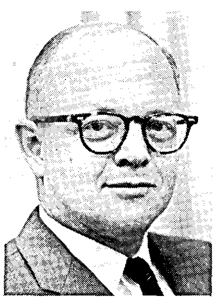
ComputerMat, Inc., Los Angeles, Calif., has established a new computing center at the Union Oil Company's Los Angeles Refinery in Wilmington, Calif. The Union Oil Company is one of the first companies to meet a major data processing requirement by engaging an outside contractor to establish a computer facility on its premises. ComputerMat will handle all of the computing needs of the refinery and will service other accounts in the area.

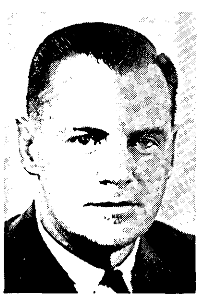
An IBM 1620 Data Processing System has been installed. A full line of tab equipment also will be available. Clients may purchase time on the 1620 system and run their own programs, or they may contract with ComputerMat to prepare programs and operate the system for them.

## PEOPLE OF NOTE

### EXECUTIVES NAMED IN IBM's DATA PROCESSING DIVISION

Frank T. Cary has been named vice president, field operations, of IBM's Data Processing Division, White Plains, N.Y. Mr. Cary will be responsible for the divisions field operations, including marketing, service and administration. Los Angeles, Chicago and New York regional managers will report to Mr. Cary.





In Los Angeles, F. G. Rodgers was named vice-president and regional manager for IBM's Data Processing Division. Mr. Rodgers will direct IBM's domestic marketing and services in the 14 western states from the region's headquarters in Los Angeles. He formerly served as marketing manager for the division's eastern region.

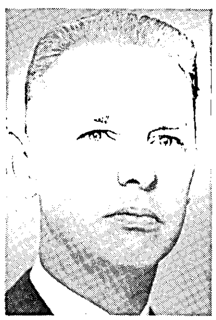
### HONEYWELL EDP NAMES ASSISTANT VICE PRESIDENT

Richard M. Bloch has been named assistant vice president of Honeywell Electronic Data Processing. He was formerly director of product planning.

Mr. Bloch, who will report directly to the president of Honeywell EDP, will be responsible for planning and development of advanced computer systems and networks. He will counsel both the Marketing and Product Planning Divisions on the development of large and complex systems opportunities and aid in the planning of market expansion for the complete Honeywell EDP product line.

### COMPUTER CONTROL NAMES SENIOR VICE PRESIDENT

Franklin R. Dean has been named Senior Vice President for Operations at Computer Control Company, Inc. He formerly served as Vice President for the Company's Product Division.



Mr. Dean was one of the founding engineers of the Company. He was active in the design and development of the electronic circuits and techniques employed in 3C's digital logic module lines.

In his new post, Mr. Dean will be responsible for the Company's operations, including the Product Division, Western Division, Eastern Systems, Manufacturing and Technical Services.

### TELEREGISTER NAMES EXECUTIVES

Milton Sanders has been elected Vice President, Engineering, of The Teleregister Corporation, Stamford, Conn. Mr. Sanders steps up from the post of Assistant Vice President, Engineering.

Dr. Herbert F. Mitchell, Jr. has been appointed Vice President, Advanced Systems Development. Dr. Mitchell was formerly with Collins Radio Co. as a member of the technical staff.

Samuel Levine has been elected Assistant Vice President-Advanced Systems Development. He has been Manager of Systems and Design Engineering.

### NEWLY NAMED EDITOR OF THE IBM JOURNAL OF RESEARCH AND DEVELOPMENT

Dr. Arthur L. Samuel has been named editor of the IBM JOURNAL OF RESEARCH AND DEVELOPMENT, a quarterly scientific journal published since 1957. He succeeds Bruce MacKenzie, who recently joined the Peace Corps. Dr. Samuel will continue as Director of research Communications with responsibility for coordinating IBM's internal scientific communications.

### ELECTRADA VICE PRESIDENT

Paul S. Collins has been appointed Vice President, Corporate Planning and Product Development, for The Electrada Corporation, Los Angeles, Calif. He will be responsible for the development of new programs and product areas for both military and commercial applications. Mr. Collins was formerly an executive with Hughes Air-Craft Co. for twelve years.

## NEW CONTRACTS

### NASA SELECTS IBM COMPUTER SYSTEM FOR MANNED FLIGHTS

The National Aeronautics and Space Administration selected International Business Machines Corp. to provide the ground-based computer system needed for the agency's future manned space flights. The contract will require an initial expenditure of about $1 million during a planning phase.

An interim computer facility near NASA's manned spacecraft center at Houston will be established to determine what permanent computer equipment will be needed, and install, checkout, maintain and program these computers. They will be used for Project Gemini two-man flights about the earth and Project Apollo three-man flights to the moon.

### NATIONAL SCIENCE FOUNDATION AWARDS CONTRACT TO C-E-I-R

C-E-I-R, Inc. of Washington, D.C., has been awarded a contract by the National Science Foundation to assist in developing a scientific referral center. The study is in support of the National Science and Technology Referral Center, which is being established in the Library of Congress as a clearinghouse to which anyone may turn for guidance in seeking the answer to any scientific question. The files of the Referral Center will include such sources and services as special libraries, scientific journals, information and data centers, abstract journals, etc. The C-E-I-R study will take into account the utilization of this variety of materials to answer inquiries and publish guides and directories, and to classify and analyze the information sources.

### GT&E RECEIVES $16 MILLION

General Telephone & Electronics, New York, N.Y., has received $16 million in additional funding for the development of an improved ground electronics system to provide command and control functions for the Air Force's Minuteman inter-continental ballistic missile weapon system. The award was made to Sylvania Electric Products Inc., a GT&E subsidiary, by the Air Force Ballistic Systems Division, San Bernardino, Calif.

The contract calls for the design and integration of a "blast resistant" system which will provide continuous control of the unmanned missile sites and will monitor the operational readiness of the missiles and their related equipment.

### CONTRACTS FOR THREE ANALOG COMPUTER SYSTEMS

Beckman Instruments, Inc., Richmond, Calif., has received contracts totaling $1.5 million from the Boeing Company for three analog computer systems to be used in the design of the X-20 Dyna-Soar manned space glider.

The computers will "test fly" the manned glider while it is still in the design stage. They are designed to simulate actual performance of a complex process by creating an electronic model from the mathematical equations of the process.

The X-20 Vehicle is a one man delta-winged glider which will be launched into space by a Titan III rocket booster.

## BUSINESS NEWS

### EDP FIRMS REPORT SALES, EARNINGS

GE reports an increase of 9% in sales and an increase of 3% in earnings for the third quarter over the same period last year. Sales for the third quarter of this year were $1,164,317,000 and earnings were $59,518,000.

IBM had the second highest showing for any quarter with gross revenues from sales, rentals and services for the third quarter ended Sept. 30, of $467,655,906 for a net income of $59,213,831. The record was set in this year's second quarter when the company showed earnings of $60,044,018 on a volume of $478,478,773. For the third quarter last year IBM reported a net income of $52,028,538 on a volume of $433,437,890.

NCR reports that this year's sales should increase about 8% and earnings "will be close" to the 1961 pace of $21.7 million. Sales are expected to climb to $560 million from $519 million last year.

RCA is nearing the realization of the best year in its 43-yr. history, according to its officials. It reported that net profit for the third quarter rose 66% over the same period last year. The company had earnings of $10,300,000 on $411,600,000 in sales. This compares with $6,200,000 in earnings on $368,300,000 sales for the third quarter last year.

Raytheon reports that its earnings for the first nine months of this year had already exceeded total earnings for the entire year of 1961. Sales goal of $600 million for 1962 was predicted by the company. It reported third quarter earnings of $2,483,000 on $128,125,000 total sales for this year. This compares with $1,838,000 on $126,962,000 on sales for the same period last year.

### CALCOMP REPORTS EARNINGS MORE THAN TREBLED SALES MORE THAN DOUBLED

Earnings 3.8 times those of the previous year, sales up 2.4 times, and a year-end backlog 6.7 times that of the previous year are disclosed in the annual report of California Computer Products, Inc., for its fiscal year ending June 30, 1962. The results were attained with a reported increase of 52 per cent in the number of employees.

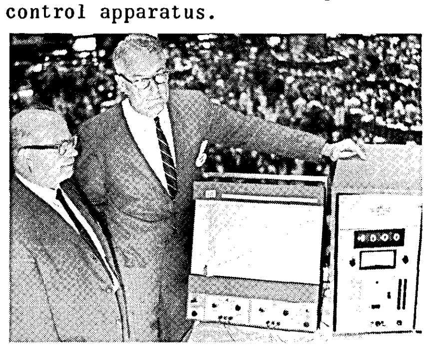
CalComp sales increased from $738,566 in the previous year to $1,768,965 for 1961-1962. After-tax earnings rose from $22,583 to $86,787. Backlog is $1,843,173 as compared with last year's $273,000.

CalComp manufactures computer peripheral equipment, including digital plotters and plotting systems.

### NYSE GETS EAI

Electronic Associates was listed for the first time on the "Big Board" of the N.Y. Stock Exchange, Sept. 19 under ticker symbol EA. Listed were 969,879 shares of the company's capital stock, previously traded over-the-counter.

Electronic Associates, also known as EAI, is one of the world's primary manufacturers of general purpose analog computers. It also produces electronic plotting equipment, instruments and process control apparatus.



-- Lloyd F. Christianson (left), president of EAI, and G. Keith Funston, president of the New York Stock Exchange with EAI equipment.

The company was founded in 1945 by Mr. Christianson with ten ex-Army associates. In 1952, sales first exceeded the million-dollar mark, and in 1961 totaled $18.6 million. Net income during the same decade rose from $96,758 to $1.1 million. Electronic Associates this year reported record first half profits of $645,942 on sales of $8.2 million.

# 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 below a monthly report on the number of American-made computers installed or on order as of the preceding month. We revise this computer census monthly, so that it will serve as a "box-score" to 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 OCTOBER 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 | 3 | 2 |
| Advanced Scientific Instruments | ASI 210 | Y | $2850 | 4/62 | 4 | 2 |
| | ASI 420 | Y | $12,500 | -/62 | 0 | 1 |
| Autonetics | RECOMP II | Y | $2495 | 11/58 | 125 | 0 |
| | RECOMP III | Y | $1495 | 6/61 | 24 | 0 |
| Bendix | G-15 | N | $2150 | 7/55 | 354 | 12 |
| | G-20 | Y | $15,500 | 4/61 | 20 | 6 |
| Burroughs | 205 | N | $4600 | 1/54 | 92 | X |
| | 220 | N | $14,000 | 10/58 | 58 | X |
| | E101-103 | N | $1000 | 1/56 | 157 | X |
| | B250 | Y | $5000 | 11/61 | 22 | 34 |
| | B260 | Y | $3750 | - | 0 | 42 |
| | B270 | Y | $7000 | 6/62 | 4 | 30 |
| | B280 | Y | $6500 | - | 0 | 16 |
| | B5000 | Y | $16,200 | - | 0 | 10 |
| Clary | DE-60/DE-60M | Y | $675 | 2/60 | 70 | 10 |
| Computer Control Co. | DDP-19 | Y | $2800 | 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 | 200 | 56 |
| | 1604 | Y | $35,000 | 1/60 | 38 | 15 |
| | 3600 | Y | $52,000 | - | 0 | 2 |
| Digital Equipment Corp. | PDP-1 | Y | Sold only about $500,000 | 12/59 | 18 | 13 |
| | PDP-4 | Y | Sold only about $100,000 | 8/62 | 1 | 2 |
| El-tronics, Inc. | ALWAC IIIE | N | $2500 | 2/54 | 32 | X |
| General Electric | 210 | Y | $16,000 | 7/59 | 53 | 20 |
| | 225 | Y | $7000 | 1/61 | 59 | 90 |
| General Precision | LGP-30 | semi | $1300 | 9/56 | 400 | 20 |
| | RPC-4000 | Y | $1875 | 1/61 | 60 | 20 |
| Honeywell Electronic Data Processing | H-290 | Y | $3000 up | 6/60 | 9 | 4 |
| | H-400 | Y | $8000 | 12/60 | 24 | 44 |

| 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 | 43 | 5 |
| | H-1800 | Y | $30,000 up | -/63 | - | 2 |
| | DATAmatic 1000 | N | - | 12/57 | 6 | X |
| HRB-Singer, Inc. | SEMA 2000 | Y | $700 | 1/62 | 15 | 17 |
| 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 | 3230 | 4670 |
| | 1410 | Y | $10,000 | 11/61 | 48 | 450 |
| | 1620 | Y | $2000 | 9/60 | 1300 | 460 |
| | 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 | - | 0 | 30 |
| | 7044 | Y | $38,600 | - | 0 | 5 |
| | 705 | N | $30,000 | 11/55 | 160 | X |
| | 7070, 2, 4 | Y | $24,000 | 3/60 | 230 | 260 |
| | 7080 | Y | $46,000 | 8/61 | 33 | 25 |
| | 709 | N | $40,000 | 8/58 | 45 | X |
| | 7090 | Y | $64,000 | 11/59 | 200 | 150 |
| | 7094 | Y | $70,000 | 12/62 | 4 | 3 |
| Information Systems, Inc. | ISI-609 | Y | $4000 | 2/58 | 18 | 5 |
| ITT | 7300 ADX | Y | $35,000 | 7/62 | 3 | 1 |
| Monroe Calculating Machine Co. | Monrobot IX | N | $340 | 3/58 | 150 | 7 |
| | Monrobot XI | Y | $700 | 6/60 | 195 | 150 |
| National Cash Register Co. | NCR - 102 | N | - | - | 30 | X |
| | - 304 | Y | $14,000 | 1/60 | 30 | 0 |
| | - 310 | Y | $2000 | 5/61 | 25 | 40 |
| | - 315 | Y | $7250 | 5/62 | 21 | 135 |
| | - 390 | Y | $1850 | 5/61 | 250 | 220 |
| Packard Bell | PB 250 | Y | $1200 | 12/60 | 118 | 35 |
| Philco | 2000-212 | Y | $68,000 | -/63 | 0 | 6 |
| | -210, 211 | Y | $40,000 | 10/58 | 18 | 25 |
| Radio Corp. of America | Bizmac | N | - | -/56 | 4 | X |
| | RCA 301 | Y | $6000 | 2/61 | 125 | 320 |
| | RCA 501 | Y | $15,000 | 6/59 | 80 | 10 |
| | RCA 601 | Y | $35,000 | -/62 | 0 | 6 |
| Scientific Data Systems Inc. | SDS-910 | Y | $1700 | 8/62 | 2 | 10 |
| | SDS-920 | Y | $2500 | 9/62 | 1 | 4 |
| TRW Computer Co. | RW530 | Y | $2500 | 8/61 | 14 | 7 |
| UNIVAC | Solid-state 80, 90, & Step | Y | $8000 | 8/58 | 525 | 155 |
| | Solid-state II | Y | $8500 | 9/62 | 1 | 32 |
| | 490 | Y | $26,000 | 12/61 | 4 | 12 |
| | 1107 | Y | $45,000 | 10/62 | 1 | 16 |
| | III | Y | $20,000 | 8/62 | 1 | 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 | 65 | X |
| | File Computers | N | $15,000 | 8/56 | 77 | 1 |
| | 60 & 120 | N | $1200 | -/53 | 910 | 32 |
| | | | | TOTALS | 11,875 | 7,827 |

X -- no longer in production

# THE CASE FOR BUYING A USED COMPUTER

**I. M. Anonymous**
Manager, Data Systems
A Major American Corporation

***A frank and revealing discussion of why the author's company purchased a used computer, how they did it, and what the advantages and disadvantages have been. Actual names are withheld at the request of the company.***

Recently Henry Thomas of the Great Lands Company (both these names and other names in this article are pseudonyms, but this anecdote is true) telephoned me, offering to sell me a computer. Mr. Thomas and I know each other well. He knows my company already owns one computer. When I pointed this out to him and plainly expressed my lack of interest, Henry said that he had a "dazzling" offer which I could not possibly refuse. I set a date to meet with him after he justly pointed out that our computing capacity is almost fully utilized.

Henry brought an associate with him, Mr. John Simpson. Mr. Simpson explained that they had recently rented an IBM 7090 and wished to sell their present computer—which had cost, new, $2,200,000. It was only four years old, and they would sell it to me for $405,000.

Mr. Simpson, Mr. Thomas, and I had a half hour's conversation. I told Henry that I knew him too well to doubt that his offer was sincere. However, his offer was not only no bargain, but it was about twice as much as his computer was worth. He and Mr. Simpson left me shortly before lunch. They called me back that same afternoon to offer me their computer for $200,000.

### The Argument

The purpose of this anecdote is to illustrate the argument which resulted in such a drastic price change in so short a period of time. There are both advantages and disadvantages of purchasing a used computer. If a purchase is to be advantageous, it must be at the right price. And in determining "right price" there are at least two considerations of importance:

1. The only value of a purchased computer is the elimination of rental payments for modern hardware which would serve the same purpose. The original cost of the computer is now meaningless (sic) in calculating the value of its capacity. A comparison must be made of the "capacity" of the purchased equipment versus the capacity of computers available for rental.
2. The rental cost of computers is declining. Some life must be assigned to the purchased computer, and the cost of depreciating that purchase will be a large part of the comparison to rental cost. If this life extends to more than about three years, the rental cost, to which the depreciation is to be compared, must be reduced.

**TABLE I**

**Purchased IBM 705 vs. Rented IBM 1410**
**(Operating 10 Shifts/Week)— Comparison**

| | First Two Years $ | Second Two Years $ |
|---|---|---|
| Rental of 1410 or successor (monthly) | 13,000 | 10,500 |
| Maintenance of 705 (monthly) | 3,500 | 3,500 |
| Depreciation of 705 (monthly for 4 years) | 4,000 | 4,000 |
| Gross savings before tax (monthly) | 5,500 | 3,000 |
| Income tax (monthly) | 2,750 | 1,500 |
| Gross savings after tax (monthly) | 2,750 | 1,500 |
| Total savings generated (in two years) | 66,000 | 36,000 |

* A purchase price of $217,000 and salvage value of $25,000 is assumed for a 705 which has 8 tape units with no auxiliary equipment. So does the 1410. No characteristics of the 1410's successor are known. It is assumed to provide "equivalent capacity" at 75% of the cost of the 1410 and to be available in 1965.

### An Example

Those are complicated considerations. Let's try to express the same thing another way. Table I illustrates the point with an example. Suppose the computer we were considering buying was an IBM 705 (continuing the disguise, in my case it wasn't). The modern equivalent of the 705 is the 1410. With a particular configuration of auxiliary equipment, tape units, etc., a 705 rented originally for about $40,000. An approximately equivalent (really better) 1410 rents for about $22,000. Thus in the years from 1956 to 1960 the rental cost of a computer is down 50%—or more. I write "more" because the memory of a 40,000 position 1410 can be used more effectively than 40,000 positions of a 705, because the 1410 has fewer breakdowns, because the printers are faster and more reliable, and for many other reasons.

This reduction in price is not true only of the 705—1410 pair, but characteristic of the field. There will probably be a replacement of the 1410 in two or three years and a proper estimate would assume that the replacement will be cheaper. Table I illustrates one way to calculate the effect of this on the value of a purchased computer. In order to simplify the example and to bring it up-to-date, all auxiliary equipment are excluded. This is not the complete 705, mentioned above, renting for $40,000. (There are no such 705's anymore since the peripheral equipment has been replaced by modern cheaper equipment.)

### Comments on Table I

Table I does not report the economics of the purchase of a 705. Instead, it shows the *initial* calculations in determining the value of one. Note immediately that several considerations can change the picture:

1. If there are three shifts of work per day (five days/week) the rental of the 1410 increases by $2,500 and maintenance of the 705 by, say, $500. Over the four year life this generates an additional $45,000. Further savings are generated if the equipment operates 7 days rather than 5.
2. The 1410 calculations are based on considering 7330 (tape drives) as equivalent to the 727 drives of the 705. If 729 tape drives are felt to be a closer equivalent, the 1410 rental increases (for 10 shifts/week) by $2,500/mo. This generates an increase of $55,000 over the four-year life. There are always such equivalences to choose among.
3. In a new installation the cost of construction for a 705 is significantly more than for a 1410 due to the large difference in heat generated. This cost will vary widely but $25,000-$60,000 is a range that might cover most cases.
4. It is worth repeating that the 1410 has more capacity than the 705 and some discount must be taken (but is not in the example) from the savings to account for this.

What have we tried to establish so far?

1. The only way to calculate the value of a computer purchase is in terms of rental cost of equivalent equipment over its life. We should anticipate reductions in rental cost (which is an increasing rate of obsolescence of the purchased equipment).
2. The "value" of the purchase is altered considerably by the difficult judgement of what the equivalent new computer configuration is. I would recommend normal accounting conservativism here, tending to resolve doubts in favor of increased capacity for rented or decreased capacity for purchased equipment.
3. There are sizeable differences in installation cost unless one is buying a computer installed on his own premises and previously rented.
4. Finally the judgement about the life of the purchased equipment varies the results of the calculation widely because depreciation is so large a fraction of costs. It seems rash to think of much more than about four years. In the example in Table I three year life would cut the savings generated over the life from $102,000 to $61,000.

Note that the effect of reducing the life to three years is to reduce the price we are willing to pay for the computer, thus decreasing the depreciation, increasing the savings, and restoring some of the amount we are willing to pay. A little algebra easily resolves this circle.

Noting a last time that Table I is not a calculation of the economics of purchasing, let's turn to the advantages and disadvantages of purchasing. My company uses a purchased 704. The return on investment originally calculated was satisfactory to management. Because of considerably higher use than first predicted the return is significantly greater than anticipated. Incremental use of purchased computers is extremely cheap.

### The Disadvantages

Briefly the disadvantages of purchasing a computer are related to falling behind in computer technology and the advantages (other than the rental savings discussed already) are related to saving programming costs. Table II lists some of the disadvantages of purchasing a used computer.

**TABLE II**

**Disadvantages of Purchasing a Used Computer**

1. Reduction of contact with the computer profession.
2. Loss of technical prestige.
3. Loss of ability to do a few "frontier" problems.

In my opinion, not many problems encountered by most companies really require the most modern hardware. Ten years ago some users of the last wired-board calculators pushed those machines to the ultimate of their capabilities. Few users of computers now tax the hardware the way those calculators were taxed. The number of problems which cannot be efficiently solved on the computers of the "mid-50's" is small. This is not to deny that there are some. Furthermore it is not necessarily economic to do the hard programming work to maximize the utilization of hardware. It is often less expensive to use better hardware, and program inefficiently, but quickly.

In general, though, the major disadvantages I see to second-line computers are in the morale and prestige areas rather than in the loss of ability to do problems. The best people in the computer field are attracted to the new machinery. Meetings of user groups devote little attention to equipment not actively in production. Also for engineering computers—not commercial ones—there may be some tendency for customers, especially the Federal Government, to assay engineering competence at a higher level if the engineers are using the most modern hardware.

### Conversion Costs

It is because the disadvantages of purchasing are of this type that I have emphasized so strongly that the calculations in Table I are not economics. In an economic decision about purchasing, some "value" figures must be assigned to these nebulous disadvantages.

A decision to purchase a used computer is a decision to fall behind in the race for glamor in the computer field. To appreciate the advantages of such a decision anyone familiar with the costs of programming need only review the costs of keeping up with computer technology. In a large company, not my own, with which I am familiar, the cost of converting from four 705's to two 7080's was estimated at about three quarters of a million dollars. There are few easier conversions to be made than that one. Conversions are expensive in big numbers and it is much more usual to underestimate than to overestimate their cost. Skipping a computer model doesn't usually add any expense to the cost of acquiring the next computer model. A purchased machine might be expected to skip one generation of computers and completely eliminate the cost of one conversion.

Aside from the problem of conversion *per se*—by which I mean changing a set of programs which work on Machine X to a set which work on Machine Y—there is the cost of converting the programming staff. This can be a small cost; if the staff is of top quality, they will shift to new machines nearly effortlessly. However, it will cost something to convert most programming staffs. If one recognizes how limited in validity such estimates are, a man-month plus per programmer might be proffered as an average cost of converting a staff.

### Results

As a concluding note it may be useful to describe the operability of the 704 my company purchased. My operating experience is with two different installations of 705's, both rented, and with this 704. All equipment has been maintained by IBM. The 704 was purchased from IBM and when it arrived that company extensively overhauled it at what must have been considerable expense to themselves. For example, they added five new motors and new read-write heads to each of ten tape units.

Performance in the first eight to ten weeks was poor in comparison to a similar period for either 705. My opinion is that the customer engineers had not been adequately pretrained on the 704. Performance since can only be described as excellent. Unscheduled maintenance has averaged a ½ hr./day. My recollection is that we did not do better than this on the new 705's.

While it is important to recognize that our experience with the purchased 704 may not be entirely typical, it can be said that there has been no perceptible physical deterioration of the computer now 5½ years old.

## FRONT COVER: COMPUTER COMMUNICATION VIA TELSTAR

Walter W. Finke, president of Honeywell EDP, is shown viewing a one-third size model of Telstar by the console of a Honeywell 800 computer. The pair joined together last month to demonstrate the use of outer space to provide data transmission between computer installations.

The 800 computer, located at the Honeywell Research Center, sent a series of messages through telephone voice circuits to the AT&T ground station at Andover, Me., where the data was transmitted by microwave to the orbiting satellite. Within milliseconds, the messages were received back at the computer and printed out without error by a Honeywell 800 high speed printer.

Telstar travelled 4,000 miles during the twenty minute test. When transmission began at 11:50 a.m., Telstar was located over the North Atlantic Ocean near its apogee at an altitude of 3,250 miles. The satellite orbits at a speed of about 16,000 miles an hour.

In another computer land-space communications test on the same day, a Burroughs D825 modular data processing system at the Burroughs Laboratories in Paoli, Pa., was linked via Telstar to a S203 high speed electrostatic printer at the Burroughs headquarters in Detroit. Electronic signals were sent by telephone lines to the Long Lines Dept. at AT&T, in New York City, relayed to Andover, and transmitted to Telstar. The message was amplified 10 billion times, then sent back to Andover, and transmitted by land-lines to New York, and then to Detroit.

Mr. Finke predicted that "this test illustrates the type of the high-speed intercontinental computer network that in years to come will handle the data processing need of the bulk of the world commerce."

U. S. industry is expanding its international operations at the rate of nearly $5 billion a year, Mr. Finke noted. At the same time, the European Common Market and other international trade blocs have shown every sign of continued healthy growth. These developments, he said, "will create a tremendous demand for fast data communications that can only be met by sophisticated data processing and communications networks."

# THE USED COMPUTER MARKET

**Neil Macdonald**
**Assistant Editor**

## *Used bits for new uses*

The sale of a used computer, such as reported in the previous article, is an event occurring with increasing frequency in the computer field. The rapid advances in computer technology during the past several years have encouraged many users to exchange "first generation" computers for more modern solid-state units. The result has been the appearance of a brisk market for used computers.

*Computers and Automation* made a survey of computer vendors who have had machines available for more than three years to determine the present structure of this used computer market. Table I presents a summary of the information which was collected.

The prices quoted in the Table should be treated as rough approximations. There are many factors which can alter the selling price of a used computer substantially. Much depends on whether there is an outright purchase or a lease arrangement, on whether there is a new sale rather than another system going to the same customer, and on whether there are strong prospects for future sales of new equipment to the same customer.

The used computer marketplace is shaping up as a hotly competitive arena. The Burroughs Corp. reports that it "is sustaining a strong secondhand computer market." They report that sufficient 205's are available so that they can be delivered immediately. The E's are being factory reconditioned at the rate of one a week. Burroughs states it currently has a backlog for reconditioned Es. They anticipate that there will be some larger 220 systems available in 1963.

Remington Rand Univac declares that it is "aggressively promoting the used computer market." Univac cites as an example a large life insurance company which was one of the first users of a UNIVAC I, installed over ten years ago. When after five years the workload became greater than the computer could handle, the company decided to purchase another UNIVAC I, then a used machine,

### TABLE I

### Prices for Typical Used Computer Systems

| System | Price New | Price Used, 1962 | Number Available | Percentage of Original Prices |
|---|---|---|---|---|
| **Alwac Corp.** | | | | |
| Alwac III E | $50,000-80,000 | $26,764-43,875 | 6 | 50-60% |
| **Burroughs** | | | | |
| E101-103 | $40,000 | $22,000 | ? | 30% |
| 205 Card | $190,000 | $61,000 | | |
| 205 Paper Tape | $155,000 | $48,000 | | |
| 205 Magnetic Tape | $400,000 | $130,000 | | |
| **Clary Corp.** | | | | |
| DE-60 | $20,000 | $12,000 | ? | 40% |
| **General Precision** | | | | |
| LGP-30 | $49,500 | $18,000 to schools only | 40 | 35% |
| **IBM** | | | | |
| 650 Card | $190,000 | $76,000 | ? | 40-60% |
| 650 Magnetic Tape | $525,000 | $244,000 | | |
| **Remington Rand UNIVAC** | | | | |
| Univac I | $1,250,000 | Individually Negotiated | "enough to satisfy many customers" | 25-50% |
| File Computer 0 | $325,000 | | | |
| File Computer 1 | $665,000 | | | |

to handle the additional workload. Presently the company is in the process of negotiating for the purchase of a third UNIVAC I to provide still additional computer capacity in the coming year.

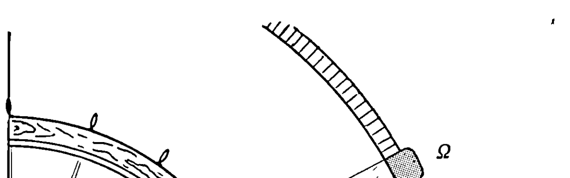
The IBM Corp. does not consider itself an active factor in the used computer marketplace. In a carefully worded policy statement, designed no doubt with the Justice Department's Anti-Trust Division in mind, IBM disavows any interest in promoting the direct sale of traded-in computers to new users. Its policy statement reads: "IBM sells new equipment outright and has been doing so for several years. In addition, IBM leases equipment.

"If a customer renting one of IBM's machines decides he wants to buy it, IBM will sell it to him. The price will vary depending on the age of the machine in question. This is one case in which it might be said that IBM sells 'used' computers, but the limitation should be noted. IBM in this case is only selling a used machine to the customer who has been renting that particular machine.

"Suppose a customer buys an IBM machine, new or 'used,' and he decides for one reason or another that he wants to replace it with a newer machine. If IBM has a need for the older type machine involved, IBM will accept the older machine as a trade-in. It first offers the machine for sale, as is, to used equipment dealers. If they are not purchased, however, the machine normally is scrapped.

"It can be seen then that IBM is not involved in what might generally be described as a 'used computer market.' IBM does sell used machines to customers who are already using the machine, and IBM does sell machines that are traded in, not directly to customers, but to used machine dealers."

Conservative estimates suggest that there will be over 60 used computers purchased in 1963 by users who had not previously leased or rented the equipment. The figure will probably expand to 500 by 1965 as many of the smaller solid-state systems are exchanged for larger computers. These facts suggest a time in the 1970's when the unit sales of used computers will outstrip that of new computer systems. The used computer market should soon become a major factor in the development of the computer industry.




## Color-Coded Tape Filing


*". . . and these red ones are for our internal auditing."*

## STATEMENT OF OWNERSHIP AND MANAGEMENT OF COMPUTERS AND AUTOMATION

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1. The names and addresses of the publisher, editor, managing editor, and business manager are:

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   Max S. Weinstein, 25 Highland Drive, Albany 3, N. Y.

3. The known bondholders, mortgagees, and other security holders owning or holding one per cent or more of the total amount of bonds, mortgages, or other securities are: None.

4. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was 3552.

Patrick J. McGovern, Business Manager

SWORN TO and subscribed before me, a notary public in the Commonwealth of Massachusetts, on September 18, 1962.

Kevin A. Burns, Notary Public

My commission expires May 14, 1966.

# CALENDAR OF COMING EVENTS

Nov. 4-7, 1962: 15th Annual Conf. on Elec. Tech. in Medicine and Biology, Conrad Hilton Hotel, Chicago, Ill.; contact Dr. J. E. Jacobs, 624 Lincoln Ave., Evanston, Ill.

Nov. 5-7, 1962: NEREM (Northeast Res. & Engineering Meeting), Commonwealth Armory, Somerset Hotel, Boston, Mass.; contact NEREM-IRE Boston Office, 313 Washington St., Newton, Mass.

Nov. 7-9, 1962: Data Processing Management Association South Central Div. Conference, Washington Youree Hotel, Shreveport, La.; contact J. D. Parker, Jr., Conference Chairman, P. O. Box 1724, Shreveport, La.

Nov. 12-14, 1962: 1962 Radio Fall Meeting, King Edward Hotel, Toronto, Canada; contact EIA Engineering Dept., Room 2260, 11 W. 42nd St., New York 36, N. Y.

Nov. 29-30, 1962: ACM Sort Symposium, Nassau Inn, Princeton, N. J.; contact Mrs. L. R. Becker, c/o Applied Data Research, Inc., 759 State Rd., Princeton, N. J.

Dec. 3-7, 1962: Course in Mathematics of Information Storage and Retrieval, Georgia Institute of Technology, Atlanta 13, Ga.; contact Director, Department of Short Courses and Conferences, Georgia Institute of Technology, Atlanta 13, Ga.

Dec. 4-6, 1962: FJCC (Fall Joint Computer Conference), Sheraton Hotel, Philadelphia, Pa.; contact E. Gary Clark, Burroughs Research Center, Box 843, Paoli, Pa.

Dec. 6-7, 1962: PGVC (PG on Vehicular Communications) Conference, Disneyland Motel, Los Angeles, Calif.; contact W. J. Weisz, Motorola, Inc., Comm. Div., 4545 West Augusta Blvd., Chicago 51, Ill.

Dec. 12-14, 1962: American Documentation Institute Annual Meeting and Exhibit, Diplomat Hotel, Hollywood, Fla.; contact John L. Whitlock Associates, 253 Waples Mill Rd., Oakton, Va.

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. 28-Feb. 1, 1963: 1963 Winter General Meeting of the American Institute of Electrical Engineers, 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. 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. 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.

April 17-19, 1963: International Conference on Nonlinear Magnetics, Shoreham Hotel, Washington, D. C.; contact J. J. Suozzi, Technical Program Chairman, Bell Telephone Labs., Allentown, Pa.

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

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.

May 26-28, 1964: Spring Joint Computer Conference, Washington Hilton Hotel, Washington, D. C.; contact Mr. J. D. Madden, System Development Corp., Santa Monica, Calif.

June 21-26, 1964: ASTM 67th Annual Meeting and 16th Materials Testing Exhibit, Conrad Hilton Hotel, Chicago, Ill.

## INTEGRATED AUTOMATIC CONTROL SYSTEMS

*(Continued from Page 10)*

high-performance aircraft and missiles operating over wide variations of speed, altitude, acceleration, and temperature; and in the presence of extreme aerodynamic cross-coupling and complicated aeroelastic phenomena.

The advances in control technology represented by such automatic pilots have, as in the case of the automatic gunner, required the concurrent development of delicate sensors; high performance power systems; and multi-variable, non-linear computation. The sensors involve radio receivers, radar and pressure altimeters, air-speed and Mach-number indicators, angle-of-attack and angle-of-sideslip detectors, shaft-position and speed-measuring devices, gyroscopes, accelerometers, thermometers, and strain gages. The power elements include primary power sources such as electrical batteries and internal combustion engines; electrical generators and motors; hydraulic pumps, valves, accumulators and actuators; and all of the auxiliary power transmission and control equipment which so often in the past has been considered too unsophisticated to be interesting to the servo-mechanism designer, but which, nevertheless, has represented major items of cost, weight, and reliability in the reduction of control system theories to practice.

The computation elements of such an automatic pilot include signal amplifiers, lead and lag networks, resolvers, integrators, differentiators and algebraic function generators. Recently, the major computational load has been successfully assumed in some automatic pilot designs by high-speed, real-time digital computers. Here, as in all other automatic control applications, the ability to apply real-time digital computers has added a new dimension to system flexibility and the practical mechanization of adaptive control techniques.

3.3. *Automatic Navigator.* A third member of the automatic crew is the "automatic navigator"—sometimes, in the case of an unmanned vehicle, called a "guidance system." These devices are used to determine components of vehicle position, velocity, and acceleration. The vehicle-position data and its appropriate time derivatives are then displayed to a human pilot, together with other pertinent information such as distance, time, and heading to destination. These outputs are also used to generate steering inputs to an automatic pilot.

Once again, the control problem of the automatic navigator involves several variables, sensors, and computers. Generally speaking, since the primary output of an automatic navigator is information, the mechanical power elements of the system are secondary to the sensors and computation. A common characteristic of many types of automatic navigators is a requirement for extreme precision in the sensors and computer. Elementary dynamical computations show, for example, that the cut-off velocity of a ballistic missile must be established to an accuracy of about 0.005 percent to achieve an accuracy of one mile on a 5,000 mile flight, even if all other errors are zero.

Precision automatic navigators are generally classified into two types: "Externally Controlled" and "self contained." There are, of course, combinations of these two. Externally controlled automatic navigators involve the whole class of radio navigation aids, including the very new applications of transit satellites. Self contained automatic navigators involve air-speed and magnetic-compass dead reckoning systems; doppler-inertial systems; stellar-inertial systems; all-inertial systems; and the use of checkpoints obtained by visual or radar observation of known locations on the surface of the earth.

Generally speaking, the dynamic-response problems of the navigation automatic-control systems have been far less severe than those of the automatic gunner or automatic pilot. Improvements in accuracy and reliability, and reductions in size and cost of precision sensors for navigation automatic-control systems have been every bit as dramatic as the solution of high-performance, multipli-coupled dynamical problems in the automatic-pilot and automatic-gunner applications.

The requirement for accuracy in computation characterizes the automatic-navigation-system application in contrast to the requirement for speed-of-computation in the previous two examples. This has made it feasible and desirable to introduce digital computers as basic elements of automatic navigators at an earlier date than has been practicable in the case of automatic flight control. The digital computers used in automatic navigation equipment today represent major improvements in size, capacity, and reliability over those which were used for airborne applications in the first postwar decade.

A further very important advance, made possible by the use of digital computers, has been the inclusion of capabilities for pre-operational readiness checks, fault isolation and operation countdown, as well as the programming on non-navigational vehicle activities. The exploitation of these capabilities of digital computers is only beginning as we enter the era of microminiaturization.

3.4. *The Automatic Crew Chief.* The automatic crew chief is the fourth member of the automatic crew. Although I am not aware of any equipment specifically designated "automatic crew chief," the name is appropriate for a most important class of automatic-control systems associated with malfunction detection and isolation; pre-operational calibration and checkout; and automatic countdown as applied to complex aircraft, missile, and space systems.

The complexity of operational equipment results in a corresponding complexity in the various levels of malfunction detection and isolation, and in the pre-operational functions of calibration checkout and countdown. As complicated missile systems moved into the field, it became obvious that the ordinary manual or semi-automatic methods which had sufficed for the vehicles of World War II, would result in intolerable delays and costs. There was also the very real danger of wearing out the operational equipment during its period of test, calibration and checkout. As a result, a whole new class of automatic control equipment has been developed. This equipment has at its center a device of broad applicability, often called a "programmer-comparator."

The programmer-comparator contains logical circuits closely akin to those of general-purpose digital computers. In fact, the trend in programmer-comparator design has been toward the use of high-capacity digital computers for increasing the number of functions which can be performed; for increasing the accuracy with which obscure malfunctions can be implicitly determined; and for instituting tests, the results of which are compared with predetermined values. Depending upon the results of the comparison, a built-in logical decision is automatically called for, which may continue the first-level testing if the comparison is within a certain tolerance band; initiate second-level or subroutine testing if the comparison is within a larger tolerance band; or stop the whole test procedure when a malfunction is indicated which is either beyond the capabilities of the system to isolate or which represents a clearly established condition of inoperability for the major system being tested. Of course the programmer-comparator may alternately be programmed to continue the tests to search for other malfunctions even when the nature of a malfunction or the need for repair has been established and reported.

In addition, the programmer-comparator normally contains certain basic standards, usually of an electrical nature, such as voltage levels, current levels, standard frequencies, and phase detectors. It also has within itself the means for providing standard inputs in the form of single or combination sine waves, doublets, impulses, step functions, ramp functions, and various kinds of noise which may be necessary to calibrate or otherwise determine the operability of the system being checked.

The programmer-comparator can be operated by punched cards, punched paper tape or magnetic tape, or other types of memory. It normally contains provisions for printing out the results of its tests, for visually indicating the status of the checkout, for showing the presence of malfunctions, and for otherwise interfacing with the human operator. Since the programmer-comparator is a general-purpose equipment, it is not normally capable of communicating directly with the equipments being tested, so the automatic crew chief also includes special adaptors which operate between the programmer-comparator and the operational system. These adaptors are special-purpose elements of the automatic control system, whose function is to make the language of the programmer-comparator understandable to the system being checked out, and vice versa. The problem of adaptor design and connection to the equipment being tested is simplified if the operational system contains a digital computer through which the operational system can be controlled.

## Other Applications of Automatic Control Stimulated by Defense and Space Efforts

The previous discussion has concerned itself with a particular classification of automatic control technology associated with the missions of military vehicles. Although the fall-out from these vehicle-control system problems covers a very large part of today's industry, it by no means represents the totality of the influence of defense programs on the science of automatic control.

*Command, Communication and Control.* A very significant technology has been built up around the complex problems of command, communication and decision-making. These are the problems of collecting, transmitting, analyzing, and evaluating large numbers of different inputs from which are developed the bases for command decisions. Such systems are characterized by extreme complexity, and they require very large computing capacities and logical designs which determine the optimum compromise among rigorous solutions of many problems. All this information must then be compressed into presentations which can be comprehended and acted upon by human beings in a specified short time.

*Management Aids.* Another class of application of automatic control consists of the man-machine combinations designed to improve various management characteristics of complex organizations and programs. Generally speaking, these systems involve human beings as data sources or inputs; elements of the feedback loops; error analyzers; and action initiators. Machines, usually in the form of computers, are the system's controllers. The dynamics of such systems are extremely complex, involving as they do finite time delays, human perception and human inertia. Some systems are designed to improve program forecasting and control; others to ensure configuration control or rapid feedback of reliability data, and still others are aimed at improving the speed and detail with which cost information is accumulated and disseminated.

Far-sighted and enlightened governmental agencies have begun to encourage and demand the development of man-machine systems for management assistance in government and industry alike. In response, a considerable number of relatively preliminary manifestations of this new facet of automatic control science are already in successful operation. It can be expected that future progress in these areas will be rapid, and that the science of automatic management-assistance systems will take its place as a major branch of automatic control system technology.

*Proposal Preparation.* Additionally, application of the broader concepts of integrated man-machine systems has developed in connection with the actual preparation of proposals for the complex programs of modern missile and space projects. All of the different manifestations of the proposal effort are beginning to be programmed into high-speed digital computers to permit automatic performance of all of the calculations and data accumulation tasks; followed by actual printing of the proposal itself on the computer's automatic printer.

*(To Be Continued in the December Issue)*

# 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.**

**Miller, David W. and Martin K. Starr / Executive Decisions and Operations Research / Prentice-Hall, Inc., Englewood Cliffs, New Jersey / 1962, printed, 446 pp, $10.60**

The application of operations research to problems of business administration is here discussed. The book's first part, "The Executive and Decisions," traces the history of business management and describes the modern view of the manager and his objectives. Part 2, "Operations Research and Decisions," discusses "Applied Decision Theory," "Qualitative Models" and "Quantitative Models." Methods for using operations research to discover strategies and to determine outcomes are given. Parts 3 and 4, "Decision-Problem Paradigms" and "The Executive and Operations Research," present problems in marketing, production and administration, and demonstrate the applicability of operations research techniques to their solutions. Fourteen chapters, a bibliography and an index are included.

**Wilcox, Richard H. and William C. Mann, Editors / Redundancy Techniques for Computing Systems / Spartan Books, 6411 Chillum Place, N.W., Washington 12, D. C. / 1962, offset, 403 pp, cost ?**

This book includes the proceedings of a symposium which was sponsored by the Office of Naval Research and the Westinghouse Electric Co., and held in February, 1962 to discuss new ideas, research and developments which may lead to the sound introduction of redundancy techniques into forthcoming computer systems. Much useful information on techniques for avoiding failure, diagnosing computer malfunctioning, and improving hardware design are discussed. Among the twenty-three papers: "Codes and Coding Circuitry for Automatic Error Correction within Digital Systems," "On the Nature of Reliability of Automata," "Analysis and Synthesis Methods for Redundant Logical Design," "Redundant Digital Systems," and "Two Approaches to Incorporating Redundancy into Logical Design." A bibliography on redundancy techniques is given.

**Todd, John, Editor / A Survey of Numerical Analysis / McGraw-Hill Book Co., Inc., 330 West 42 St., New York 36, N. Y. / 1962, printed, 589 pp, $12.50**

The classical and modern theory, applications, and ramifications of Operations Research are here discussed by fourteen experts in the field. The editor, a Professor of Mathematics at California Inst. of Technology, directed a training program supported by a grant made to the National Bureau of Standards by the National Science Foundation. This book developed from the program. In the first of seventeen chapters, Dr. Todd discusses "Motivation for Working in Numerical Analysis," demonstrating the applicability of various branches of mathematics to Operations Research. Other titles: "Automatic Computers," "Use and Limitation of Computers," "Numerical Methods in Ordinary Differential Equations," "Discrete Problems," and "Linear Estimation and Related Topics." Index.

**Proceedings of the 1962 Spring Joint Computer Conference: American Federation of Information Processing Societies / The National Press, 850 Hansen Way, Palo Alto, Calif. / 1962, offset, 392 pp, $6.00**

Thirty-three of the technical papers given at the conference held in San Francisco, May, 1962, are here published. The sessions included, "Study of Business Information Systems," "Theoretical Problems in Artificial Intelligence," "Man-Machine Cooperation," "Data Analysis and Model Construction in the Study of the Nervous System," "Programming and Coding," "Information and Retrieval," and "DDA and Hybrid Computation." Among the titles are: "A Simulation of a Business Firm," "Circuits for the FX-1 Computer," "Are the Man and the Machine Relations?", "Neural Analogs," "An Organization of an Associative Cryogenic Computer," "A General Test Data Generator for COBOL," "A Programming Language," and "Hybrid Techniques Applied to Optimization Problems."

**Dijkstra, E. W. / A Primer of ALGOL 60 Programming / Academic Press, Inc., 111 Fifth Ave., New York 3, N. Y. / 1962, printed, 114 pp, $6.00**

The ALGOL compiler, which is designed to translate ALGOL language into a form that a computer can understand, and the ALGOL language itself, are here discussed. Twenty-seven brief but informative sections discuss the various formats and statements of ALGOL 60 expressions. "Assignment Statements," "Conditional Statements," "Procedures," "Bound Variables," "Conditional Expressions," and "Special Input-Output Procedures," are among the topics covered. A forty-page appendix, "Report on the Algorithmic Language ALGOL 60," includes numerous examples of ALGOL syntax and demonstrates various ways in which the compiler works.

**Bellman, Richard E. and Stuart E. Dreyfus / Applied Dynamic Programming / Princeton University Press, Princeton, N. J. / 1962, printed, 366 pp, $8.50**

This book discusses in detail methods for applying the techniques of dynamic programming. The problems to which dynamic programming is applied include: numerical solution of optimization problems arising in connection with satellites and space travel, the determination of trajectories, feed-back control, inventory and scheduling processes, and many others. The results were obtained in a RAND Corp.study for the U. S. Air Force. Twelve chapters include: "One-Dimensional Allocation Processes," "Optimal Search Techniques," "Dynamic Programming and the Calculus of Variations," "Multistage Production Processes Utilizing Complexes of Industries," and "Numerical Analysis." Five appendices include discussions relating to the subject, and a brief description of the RAND JOHNNIAC computer. Name and subject indices.



**Kaplan, Wilfred / Operational Methods for Linear Systems / Addison-Wesley Pub. Co., Inc., Reading, Mass. / 1962, printed, 577 pp, $10.75**

This book is intended as a text for a course on the mathematical methods employed in the design and analysis of linear systems. The author emphasizes Fourier series and transforms, Laplace transforms, and their application to ordinary differential equations. The first of eight chapters discusses "Linear Differential Equations," in which a brief review of the subject is given. In addition, the theory is extended to integrodifferential equations and impulse functions. Among the other titles: "Basic Concepts of Systems Analysis," "Analytic Functions of a Complex Variable," "Fourier Series and Finite Fourier Transform," "The Laplace Transform," "Stability," and "Time-Variant Linear Systems." Three appendices discuss "The Operational Calculus of Mikusinski," "Recapitulation of Principal Tables," and a glossary of symbols. Index.

**Guilbaud, G. T., trans. by Valerie Mackay / What is Cybernetics? / Grove Press, Inc., 64 University Place, New York 3, N. Y. / 1960, printed, paperback, 126 pp, $1.45**

This interesting and informative book discusses the origin, evolution, and importance of cybernetics. In the introduction,

## WHO'S WHO IN THE COMPUTER FIELD — CUMULATIVE EDITION, 1962

**Computers and Automation** will publish this fall a cumulative edition of "Who's Who in the Computer Field."

If you are interested in computers, please fill in the following Who's Who entry form (which may be copied on any piece of paper) and send it to us for your free listing. If you have friends in the computer field, please call their attention to sending us their Who's Who entries. The cumulative edition will include only the entries of persons who send us their Who's Who information.

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Its Address? ....................

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Your Main Computer Interests?
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( ) Business
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( ) Design
( ) Electronics
( ) Logic
( ) Mathematics
( ) Programming
( ) Sales
( ) Other (specify):

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Year of birth? ....................

College or last school? ....................

Year entered the computer field? ....

Occupation? ....................

Anything else? (publications, distinctions, etc.) ....................

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the author traces the etymology of the term and reveals that currently "cybernetics" is mistakenly associated with "thinking machines" and electronics instruments. The first part of the book, "Control Systems," includes chapters on "Circuits and Networks" and "Feedback and Purposive Activity." Part two, "Signals and Messages," includes "The Measurement of Information," "Imitative Gibberish," and "Communication." The final part, "Towards Unification," includes the chapter "Pilots, Planners and Gamblers," in which the components which form a decision are discussed. A conclusion and a selected bibliography are included.

**Vichnevetsky, R., Editor / Analogue Computation Applied to the Study of Chemical Processes, International Seminar / Gordon and Breach Science Publishers, Inc., 150 Fifth Ave., New York 11, N. Y. / 1962, printed, 172 pp, $10.50**

Twenty-three papers given at a conference held in Brussels, Nov., 1960, are here published. The discussions following some of the papers are included, and often these discussions raise questions which lead to relevant and interesting information. The conference, attended by participants from nineteen countries, concentrated on current applications of analog computation to on-line chemical processes, chemical reactors, and heat exchange and transfer problems. Among the titles: "The Use of Computers in the Design and Operation of Chemical Plants," "Simulation of Chemical Processes on a Combined Analog-Digital Computer," "Process Control by Computer," "Application of the Analogue Computer in the Study of the Esterification of Terephthalic Acid," and "The Use of Standard Analogue Techniques in Solving Propagation Problems." Sixteen of the 23 papers are published in English.

**Finn, James D. and Donald G. Perrin / Teaching Machines and Programmed Learning, 1962: A Survey of the Industry, Occasional Paper No. 3 / Associate Investigator, Technological Development Project, National Education Association, 1201 Sixteenth St., N.W., Washington 6, D. C. / 1962, photo offset, 85 pp, $1.50**

This paper reports on trends and developments in new media of instruction and in the development of hardware and devices used with the new media. The information given is derived in part from surveys of recent activities in the field, and in its thoroughness reflects the research efforts of the U. S. National Education Assn. The seven sections include: "Machines and Programs: Some Definitions and a Conceptual Structure," "Directory of Machines," "Directory of Programs," and "Directory of Manufacturers and Publishers." In a prologue, Edward L. Thorndike's comments on "guidance in habit-formation and reasoning" are quoted. Bibliography.

**Amos, S. W. / Principles of Transistor Circuits, second edition / John F. Rider Publisher, Inc., 116 West 14 St., New York 11, N. Y. / 1962, printed, 210 pp, $4.25**

The fundamentals of transistorized circuitry are discussed in this book, which incorporates information on recent developments not covered in the earlier edition. The first of fourteen chapters, "Semiconductors and Junction Diodes," describes the physical processes which occur in transistors. Among the other titles: "Basic Principles of Junction Transistors," "Bias Stablization," "Large-Signal A. F. Amplifiers," "Multivibrators," "Further Applications of Junction Diodes and Transistors," and "Further Semiconductor Devices." Index.

**Bulletin of the Provisional International Computation Centre, nos. 15-16 / Prov. International Comp. Centre, Palazzo degli Uffici, Zona dell' E. U. R., Rome, Italy / 1962, printed, 70 pp**

This issue of the French and English publication includes articles, reports and reviews on topics relating to data processing. Included are: "A Progress Report on Machine Translation," by A. D. Booth, "Origin and Scope of the Libyan Pilot Project," by C. K. Dilwali, an "International Repertory of Computation Laboratories" (supplements to an earlier list), "Report on a Research Programme on Learning Machines," and reviews of symposia, new computers, and publications.

**The Rate and Direction of Inventive Activity: Economic and Social Factors / Princeton University Press, Princeton, N. J. / 1962, printed, 635 pp, $12.50**

Twenty-three papers presented at a conference held at the University of Minnesota in the Spring, 1960, are here published. The subject, generally, is inventive activity, and many aspects of the process of invention are discussed, questioned, and evaluated. In addition, some of the papers, and the comments which follow, analyze the allocation of inventive efforts, and study industry's methods for implementing inventions. Among the topics (which are in six sections): "Inventive Activity: Problems of Definition and Measurement," "The Economics of Research and Development," "The Changing Direction of Research and Development Employment Among Firms," "The Origins of the Basic Inventions Underlying Du Pont's Major Product and Process Innovations, 1920 to 1950," "The Link Between Science and Invention: The Case of the Transistor," and "Economic Welfare and the Allocation of Resources for Invention." The conference was sponsored jointly by the Universities-National Bureau Committee for Economic Research, and the Committee on Economic Growth of the Social Science Research Council.

**Beth, Evert W. / Formal Methods: An Introduction to Symbolic Logic and to the Study of Effective Operations in Arithmetic and Logic / Gordon and Breach Science Publishers, Inc., 150 Fifth Ave., New York 11, N. Y. / 1962, printed, 170 pp, $9.75**

In the preface to this book, the author asserts that many intelligent people cannot, or are unwilling to "argue *ex hypothesi*." The intention of the book is not to teach this skill, but rather to explain principles, foundations and methods of logic to people who possess the skill. The explanations are presented in simple and concise form, and although no exercises are given, the reader can easily create exercises to test his understanding. Seven chapters include: "Purely Implicational Logic," "Theory of Quantification, Equality, and Functionality," "Completeness of Elementary Logic," and "On Machines Which Prove Theorems." An appendix provides "Supplementary Explanations." A list of schemata and axioms, a bibliography, and an index are included.

**Ledley, Robert S. / Programming and Utilizing Digital Computers / McGraw-Hill Book Co., Inc., 330 West 42 St., New York 36, N. Y. / 1962, printed, 568 pp, $12.50**

This book, written as a college text in programming digital computers, introduces many of the programming methods currently in use. The first part of the book, "Machine Languages," includes an introductory chapter which discusses the historical development of the computer. Included are sections on: "Numerical Solution to Equations," "Process Control," "Block Diagram of a Computer," "Words and Pulses," and "Input, Output, and Memory Systems." Other chapters in part one are: "Principles of Programming," and "Programming for Special-Purpose Digital Computers." Part II, "Automatic-Programming Languages," includes: "Development of Automatic Programming," "Algebraically Oriented Languages: ALGOL," "COBOL," and "Programming to Achieve Intelligence." Part III, "Data-Processing Techniques," includes: "Fundamentals of Numerical Analysis," "Boolean Algebra" and "Searching, Sorting, Ordering, and Codifying." Each chapter includes exercises and references. An appendix cites examples of three- two- and one-address instruction systems. Name and subject index.

**Greenberger, Martin, Editor / Management and the Computer of the Future / John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N. Y. / 1962, printed, 340 pp, $6.00**

Eight lectures and discussions on the subject of management and the computer of the future which were given in a series sponsored by the M. I. T. School of Industrial Management in 1961, are published. The contributors include specialists in computer technology and programming, psychologists and psychophysiologists actively engaged in the simulation of human thought processes, physical scientists in fields closely related to computer technology, economists and social scientists. The lectures and authors are: "Scientists and Decision Making," C. P. Snow; "Managerial Decision Making," J. W. Forrester; "Simulation of Human Thinking," H. A. Simon and A. Newell; "A Library for 2000 A. D.," J. G. Kemeny; "The Computer in the University," A. J. Perlis; "Time-Sharing Computer Systems," J. McCarthy; "A New Concept in Programming," G. W. Brown; and "What Computers Should Be Doing," J. R. Pierce. Each lecture is discussed by two commentators and a number of other participants, all of whom are listed. Selected bibliography and index.

**Van Ness, Robert G. / Principles of Punched Card Data Processing / The Business Press, 288 Park Ave. West, Elmhurst, Ill. / 1962, printed, 263 pp, $9.75**

This book discusses the need for, the history of, and the methods for successfully applying punched card data processing. Fourteen chapters include: "Principles," "Case Study," "Coding Systems," "Data Processing Services," and "The Future—A Challenge." Each chapter includes "end-of-chapter" questions. Index.

**Coulson, John E., Editor / Programmed Learning and Computer-Based Instruction / John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N. Y. / 1962, printed, 291 pp, $6.75**

The Proceedings of the Conference on Application of Digital Computers to Automated Instruction, held Oct., 1961, and jointly sponsored by the Office of Naval Research and the System Development Corp., are here published. Twenty-one papers are included under the headings: "Theory and Experimentation in Programmed Learning," "Computer-Based Instructional Systems," and "Computer Technology in Automated Teaching." Among the titles: "The Challenge of Automation in Education," "New Directions in Teaching-Machine Research," "Adaptive Teaching Machines," "A Computer-Based Laboratory for Research and Development in Education," "Computer Techniques in Instruction," and "Interactions between Future Computer Developments and Automated Teaching Methods." Index.

**Halstead, Maurice H. / Machine-Independent Computer Programming / Spartan Books, 6411 Chillum Place, N. W., Washington 12, D. C. / 1962, printed, 270 pp, $6.50**

This book is based on the course, "Neliac, a dialect of Algol," given at the University of California. The groups of students included experienced computer programmers and others unfamiliar with programming. In the first chapter, "Introduction to Machine-Independent Programming," the author explains the methodology of organizing a computer program, and describes the Neliac language. Subsequent chapters explain how to read and write the language, and the "Basic Concepts of Self-Compilers." The second part of the book discusses the input-output aspects of the Neliac compiler, its noun processing, decompiling, generators and utility subroutines. Four appendices include examples of programs written in the Neliac language for the IBM 704 and the CDC 1604. Index.

**Williams, R. W. / Analogue Computation / Academic Press, Inc., 111 Fifth Ave., New York 3, N. Y. / 1962, printed, 271 pp, $9.50**

This book surveys the field of analog systems, concentrating on components and techniques rather than on the complete computer system, and "giving prominence to a.c. operational amplifier techniques." The reader need have little more than a cursory knowledge of light current engineering to understand the theory set forth by the author. Nine chapters include: "Introduction," in which the history of analog systems is described and future possibilities discussed; "Potentiometers," "A. C. Methods," "Function Generators," and "Transistor Applications." Subject and name indices.

**An Introduction to the PERT-Cost System for Integrated Project Management / Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. / 1962, printed, 32 pp, 35¢**

This booklet discusses PERT (Program Evaluation and Review Technique) which was developed for the Navy Special Projects Office by a management consultant firm. In addition, General Electric Co., and Lockheed Missile and Space Co., have experimented with PERT by applying it and evaluating its usefulness. The booklet describes the system, explains its procedures and includes examples of its application. A number of charts and diagrams supplement the text.

**Data Processing, Volume IV: Proceedings of the 1961 International Conference of the National Machine Accountants Association / N. M. A. A., International Administrative Headquarters, 524 Busse Highway, Park Ridge, Ill. / 1962, printed, 388 pp, $5.00**

More than fifty of the papers presented at the conference are published in this volume. Seven categories include: Management, Machines, Systems Development, and Applications. Among the titles: "Does a Computer Pay Off?" "New Concepts—New Devices," "Operations Research for the Layman," "Automatic Coding," and "Better Inventory Control." Computer applications to the banking, trucking, utilities, and railways industries, and to education are discussed in other papers. A section on the fundamentals of computers includes, "How They Work," "Developing a Computer System," and "Getting the Show on the Road."

## MANUSCRIPTS

WE ARE interested in articles, papers, reference information, and discussion relating to computers and automation. To be considered for any particular issue, the manuscript should be in our hands by the first of the preceding month.

ARTICLES: We desire to publish articles that are factual, useful, understandable, and interesting to many kinds of people engaged in one part or another of the field of computers and automation. In this audience are many people who have expert knowledge of some part of the field, but who are laymen in other parts of it.

Consequently, a writer should seek to explain his subject, and show its context and significance. He should define unfamiliar terms, or use them in a way that makes their meaning unmistakable. He should identify unfamiliar persons with a few words. He should use examples, details, comparisons, analogies, etc., whenever they may help readers to understand a difficult point. He should give data supporting his argument and evidence for his assertions.

We look particularly for articles that explore ideas in the field of computers and automation, and their applications and implications. An article may certainly be controversial if the subject is discussed reasonably. Ordinarily, the length should be 1000 to 3000 words. A suggestion for an article should be submitted to us before too much work is done.

TECHNICAL PAPERS: Many of the foregoing requirements for articles do not necessarily apply to technical papers. Undefined technical terms, unfamiliar assumptions, mathematics, circuit diagrams, etc., may be entirely appropriate. Topics interesting probably to only a few people are generally not acceptable.

REFERENCE INFORMATION: We desire to print or reprint reference information: lists, rosters, abstracts, bibliographies, etc., of use to computer people. We are interested in making arrangements for systematic publication from time to time of such information, with other people besides our own staff. Anyone who would like to take the responsibility for a type of reference information should write us.

NEWS AND DISCUSSION: We desire to print news, brief discussions, arguments, announcements, letters, etc., anything, in fact, if it is likely to be of substantial interest to computer people.

PAYMENTS: In many cases, we make small token payments for articles, if the author wishes to be paid. The rate is ordinarily ½¢ a word, the maximum is $15, and both depend on length in words, whether printed before, etc.

All suggestions, manuscripts, and inquiries about editorial material should be addressed to: *The Editor,* COMPUTERS *and* AUTOMATION, *815 Washington Street, Newtonville 60, Mass.*

**Newell, Allen, Editor / Information Processing Language-V Manual / Prentice-Hall, Inc., Englewood Cliffs, N. J. / 1961, offset, 244 pp, $6.00**

The uses of the computer language and the concepts and techniques it employs are here discussed. Although the work is intended as a reference manual for the language, it includes valuable information on general programming methods. The first section discusses *the Elements of IPL Programming,* including examples which are clearly explained. Section two, *Programmers Reference Manual,* includes general definitions, routines and subroutines, input-output conventions, monitor system and in-process loading. Index.

**Applications of Statistics and Computers to Fuel and Lubricant Research Problems / Southwest Research Institute, 8500 Culebra Road, San Antonio 6, Texas / 1962, offset, 218 pp, $10.00**

The Proceedings of a Symposium held March 13-15, 1962, at San Antonio, Texas, are here published. The first session, *Fundamentals,* includes "Statistics and the Computer as an Aid to Engineering Research and Development," "Introduction to Statistics," and "Statistical Control of Nuisance Variables in the Comparison of Fuels or Lubricants"; *Design of Experiments,* the second session, includes, Analysis of Variance and Analysis of Regression with More Than One Response," and "Cross-Over Experimental Designs." The third session, *Evaluation of Results,* includes, "The Interpretation and Use of Multiple Regression Results." No papers from the *Applications* session are included.

**Scarborough, J. B. / Numerical Mathematical Analysis, Fifth Edition / The Johns Hopkins Press, Homewood, Baltimore 18, Md. / 1962, printed, 594 pp, $7.00**

This edition, incorporating all of the information of the renowned previous editions, includes in addition: a chapter on interpolation with unequal intervals by means of Newton's general formula; the derivation of all central-difference interpolation formulas by means of divided differences; and methods of investigating errors in the solutions of single equations when the coefficients are subject to errors. The text covers numerical differentiation and integration, solution of algebraic and transcendental equations, theory of errors, precision of measurements, and empirical formulas. Nineteen chapters, an appendix which gives tables of values of the probability integral, and index and answers to the exercises found in each chapter, are included.

**Jacobowitz, Henry / Computer Arithmetic / John F. Rider Publisher, Inc., 116 West 14 St., New York 11, N. Y. / 1962, printed, 128 pp, $3.00**

This soft cover edition aimed at "trainees and other interested readers" discusses arithmetical operations of all positional number systems, with a concentration on the fundamentals of decimal, octal, binary, hexadecimal and ternary arithmetic. The fourth and last chapter describes and illustrates techniques for conversion from one number system to another. An appendix includes tables of the powers of two, eight, sixteen and three. Index.

**ICC Bulletin, Vol. 1, no. 1 / International Computation Centre, Palazzo degli Uffici, Zona dell'E. U. R., Rome, Italy / 1962, Printed, 79 pp, $3.00 per annum**

This edition of the Bulletin includes six articles on topics in data processing and computers. In English, a "Symposium on Symbolic Languages in Data Processing," an article on the "Libyan Pilot Project," and the following articles, "Automated Instruction and Computers in Education," "The New IBM Disk Storage Unit," and "Analog and Digital Computers Manufactured in Japan," are included. In French, the paper, "L'Analyse fonctionelle et le Calcul numérique" is given. New computers, reviews of books, notices of conferences and a supplement which lists computation centers in Germany, Canada, the U. S., Sweden, India, Italy, the United Kingdom, and Norway is included.

**Mickel, Joseph / Digital Computer Programs / J. Mickel, P. O. Box 9144, Austin 17, Texas / 1962, offset, 26 pp, $1.50**

A collection of computer programs written in the machine language, "GOTRAN," is here presented. The programs can be run on the IBM 1620, and with modifications, can be run on other systems, as FORTRAN routines. A brief but useful discussion of GOTRAN is included. The programming techniques used by the author are instructive and worthy of review.

**Ruiter, Jacob H., Jr. and R. Gordon Murphy / Basic Industrial Electronic Controls / Holt, Rinehart and Winston, Inc., 383 Madison Ave., New York 17, N. Y. / 1962, printed, 283 pp, $8.50**

The aim of this book is to "take the mystery out of the thousands of 'black boxes' which make up industrial electronics." Unfortunately, the authors have attempted to solve mysteries on too many levels; the result is a text which mixes fundamental principles in simple language with complex theories in technical language. Of the seven chapters, six have summaries and all have questions. Among the titles: "Industrial Electronics," "Transducers," "Indicators and Recorders," "Actuators," and "Applications." Glossary and index.

**Cerni, R. H. and L. E. Foster / Instrumentation for Engineering Measurement / John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N. Y. / 1962, printed, 456 pp, $12.50**

A survey of current techniques and equipment for testing a variety of instruments is here given. The applications include missile flight testing, nuclear reactor measurements, satellite tracking and telemetry and general industrial development testing. The material is written for the engineer familiar with the terminology and theory of engineering. Seven chapters include, "Measurements of Physical Systems," "Transducers and Primary Sensors," "Data Indication and Recording," "Data Handling and Processing," which includes sections on analog and digital systems, and "Data Instrumentation System." Index.

**Holmes, James F. / Communications Dictionary / John F. Rider Publisher, Inc., 116 West 14 St., New York 11, N. Y. / 1962, printed, 96 pp, $1.50**

More than 2,500 terms in the fields of electronic communications and data processing are here defined. The definitions have been checked against those approved by the American Standards Association, and conform with glossaries published by the U. S. Air Force, the Data Transmission Study Group of the major aircraft companies and with the "American Standard Definitions of Electrical Terms."

**Problematical Recreations 4, Fourth in a series / Litton Industries, 336 North Foothill Rd., Beverly Hills, Calif. / 1962, printed, 38 pp, free on request**

A fourth collection of 33 humorously illustrated mathematical puzzles is here presented, for the interest of the mathematically inclined. Solutions are given.

# 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.

**July 31, 1962 (Continued)**

3,047,733 / Richard F. Rutz, Fishkill, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of New York / Mulitple output semiconductor logical device.

3,047,739 / Heine Andries Rodrigues de Miranda, Mollenhutseweg Nijmegen, Netherlands / North American Philips Co., Inc., New York, N. Y., a corp. of Delaware / Shift register utilizing free charge carrier storage of cascaded delay network coupled transistors.

3,047,840 / Victor Harms, 4224 16th St. SW., and Jerry Howard Schwartz, 3032 Hampton Crescent, both of Calgary, Alberta, Canada / ——— / Translators for multi-channel codes employing matrices.

3,047,842 / William R. Johnston, Los Angeles, Calif. / Ampex Corp., Redwood City, Calif., a corp. of California / Magnetic core shift register.

3,047,868 / Henry W. Schrimpf, Waltham, Mass. / Minneapolis-Honeywell Regulator Co., a corp. of Delaware / Information storage apparatus.

**August 7, 1962**

3,048,327 / Frank I. Gewickey, Fishkill, Robert K. Golden, Peekskill, and Bernard M. Muenzer, Hyde Park, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of New York / Information Reproducing System.

3,048,333 / Joseph L. Brown, Jordan M. Taylor, and Philip N. Stroughton, Poughkeepsie, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of New York / Fast Multiplying Apparatus in an Electronic Digital Computer.

3,048,334 / Edward Arthur Newman, Oxshot, and John Bentley Stringer, Hanworth, England / National Research Development Corp., London, England, a British Corp. / Electrical Digital Computing Engines.

3,048,335 / Ralph W. Burhans, Chagrin Falls, Warren Jackson, Jr., Lyndhurst, and Philip J. Stevko, Euclid, Ohio / The Standard Oil Co., Cleveland, Ohio, a corp. of Ohio / Simultaneous Equation Optimal Solution Computer.

3,048,826 / Robert M. Averill, Jr., Murray Hill, N. Y. / Bell Telephone Laboratories, Inc., New York, N. Y., a corp. of N. Y. / Magnetic Memory Array.

3,048,827 / Esmond Philip Goodwin Wright, Desmond Sydney Ridler, and Robert Grimmond, London, Eng. / International Standard Electric Corp., New York, N. Y. / Intelligence Storage Equipment With Independent Recording and Reading Facilities.

3,048,828 / Ottavio C. Cataldo, Suffolk, N. Y. / American Bosch Arma Corp., a corp. of New York / Memory Device.

3,048,829 / Edward Michael Bradley, Stevenage, Eng. / International Computers and Tabulators Ltd. / Magnetic Data Storage Devices.

3,048,831 / John Joshua Sharp, Stevenage, Eng. / International Computers and Tabulators Ltd., London, England, a British company / Magnetic Reading and Recording.

**August 14, 1962**

3,049,295 / William H. Rhodes, Poughkeepsie, James G. Brenza, Lake Carmel, and Wayne D. Winger and Robert C. Jackson, Poughkeepsie, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of N. Y. / Multiplying Computer.

3,049,296 / Theodore M. Hertz, Whittier, Calif., and Frederick H. Young, Missoula, Mont. / North American Aviation, Inc. / Binary Square Root Mechanization.

3,049,297 / Ernest Edward Barber, South Harrow, and Kenneth Henry Simpkin, Aylesbury, Eng. / General Precision Systems Ltd., a corp. of Great Britain / Analog Computers.

3,049,298 / Ernest Edward Barber, South Harrow, and Kenneth Henry Simpkin, Aylesbury, Eng. / General Precision Systems Ltd., a corp. of Great Britain / Analog Computer for Angular Relationships of Three Axis Reference Systems.

3,049,299 / Cyrus Beck, 1855 Brentwood Road, Abington, Pa. / ——— / Great Circle Navigation Computer.

3,049,692 / Warren A. Hunt, Poughkeepsie, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of New York / Error Detection Circuit.

3,049,694 / Gerhard Dirks, 44 Morfelder Landstrasse, Frankfurt am Main, Germany / ——— / Storage Devices for Signals.

3,049,695 / Vernon L. Newhouse, Haddonfield and William L. McMillan, Little Rock, N. J. / Radio Corp. of America, a corp. of Delaware / Memory Systems.

3,049,696 / Hewitt D. Crane, Palo Alto, Calif. / Burroughs Corp., Detroit, Mich., a corp. of Michigan / Magnetic Core Circuits Providing Fractional Turns.

3,049,697 / Thomas G. Slattery, Wellesley Hills, and Bradford M. Torrey, Arlington, Mass. / Automation, Inc., Wellesley Hills, Mass., a corp. of Mass. / Magnetic Memory Device.

3,049,698 / Leonard H. Thompson and John W. Wenner, Poughkeepsie, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of New York / Readback Circuit for High-Density Magnetic Bit Storage.

3,049,706 / Harold Philip Freedman, Twickenham, Eng. / Avel Corp., Geneva, Switzerland / Data Exchange Systems.

**August 21, 1962**

3,050,243 / Rudolf Bothe, Manchester, N. H. / Bothe Computronics, Inc., Manchester, N. H., a corp. of New Hampshire / Data-Transmitting and Punching Mechanism.

3,050,251 / Floyd G. Steele, La Jolla, Calif. / Digital Control Systems, Inc., La Jolla, Calif. / Incremental Computing Apparatus.

3,050,633 / Egon E. Loebner, Princeton, N. J. / Radio Corp. of America, a corp. of Delaware / Logic Network.

3,050,641 / James L. Walsh, Hyde Park, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of New York / Logic Circuit Having Speed Enhancement Coupling.

3,050,714 / Carl M. Campbell, Jr., Broomall, Pa. / Burroughs Corp., Detroit, Mich., a corp. of Mich. / Shift Register.

3,050,715 / Edward P. Stabler, North Syracuse, N. Y. / General Elec. Co., a corp. of N. Y. / All Magnetic Shift Register.

3,050,716 / Ernest G. Andrews, Mountain Lakes, N. J. / Bell Telephone Labs., Inc., New York, N. Y., a corp. of N. Y. / Magnetic Storage Circuits.

3,050,717 / George G. Hoberg, Berwyn, John R. Van Andel, Bridgeport, and Edward W. Veitch, Rosemont, Pa. / Burroughs Corp., Detroit, Mich., a corp. of Mich. / Computer Shift Control Circuits.

**August 28, 1962**

3,051,387 / James H. Pomerene and John Cocke, Poughkeepsie, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of New York / A synchronous Adder-Subtractor System.

3,051,480 / Harry Carlin, Inwood, N. Y., and Ronald J. Cieplik, Elizabeth, N. J. / Vari-Typer Corp., Newark, N. J., a corp. of Del. / Business Machines.

3,051,787 / William J. Parks, Rochester, N. Y. / General Dynamics Corp., Rochester, N. Y., a corp. of Del. / Buffer Storage Between Magnetic Tape and Synchronous Output.

3,051,791 / F. Mansfield Young, Boston, Mass., and Evan T. Colton, Melrose, Mass. / Epsco, Inc., Boston, Mass., a corp. of Mass. / Multiplexing Means.

3,051,793 / Rolf Hiller, Starnberg, Upper Bavaria, Karl Rütkowski, Munich-Grosshesselohe, and Werner Krageloh, Dieter Voegtlen, and Siegfried Zahlhass, Munich, Germany / Siemens & Halske

Aktiengesellschaft, Berlin and Munich, a corp. of Germany / Electronic Selection Circuits.

3,051,836 / John H. Howard, Media, Pa. / Burroughs Corp., Detroit, Mich., a corp. of Mich. / Coded Document Reader.

3,051,843 / Eiichi Goto, Meguro-ku, Tokyo-to, Japan / Kokusai Denshin Denwa Kabushiki Kaisha, Toyko-to, Japan / Coupling Circuits for Digital Computing Devices.

3,051,845 / Robert K. York, New Brunswick, N. J. / Bell Laboratories Inc., New York, N. Y., a corp. of New York / Gate Circuit.

3,051,848 / Edward Gary Clark, Oreland, Pa. / Burroughs Corp., Detroit, Mich., a corp. of Mich. / Shift Register Using Bidirectional Push-Pull Gates Whose Output is Determined by State of Associated Flip-Flop.

3,051,929 / Larrabee M. Smith, Morris Plains, N. J. / Bell Laboratories, Inc., New York, N. Y., a corp. of New York / Digital Data Converter.

3,051,931 / Peter William Lennox, London, Eng. / International Standard Electric Corp., New York, N. Y., a corp. of Delaware / Intelligence Equipment.

**September 4, 1962**

3,052,406 / George J. Saxenmeyer, Vestal, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of New York / Data Classifying Device.

3,052,407 / Donald W. Haney, Vestal, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of New York / Data Storage Device.

3,052,411 / Peter Bose and Elmar Götz, Berlin Frohnau, Germany / Licentia Patent-Verwaltungs-G.m.b.H., Frankfurt am Main, Germany / Computer.

3,052,412 / Herbert B. Baskin, Peekskill, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of New York / Multiplier Circuit.

3,052,872 / Lorenz Hanewinkel, Neukirchen, Germany / Zuse KG, Neukirchen, Germany / Information Storage Device.

3,052,873 / Andrew H. Bobeck, Chatham, N. J. / Bell Telephone Labs., Inc., New York, N. Y., a corp. of New York / Magnetic Memory Circuits.

**September 11, 1962**

3,053,449 / George G. Hoberg, Berwyn, Lucille E. Mott, Ardmore, John R. Van Andel, Bridgeport, Edward W. Veitch, St. Davids, and Richard C. Weise, Philadelphia, Pa. / Burroughs Corp., Detroit, Mich., a corp. of Mich. / Electronic Computer System.

3,053,450 / Frank A. Litz, San Jose, Calif. / I.B.M. Corp., New York, N. Y., a corp. of New York / Photoelectric Digtal Adder Circuit.

3,053,452 / Tom Kilburn, Davyhulme, Manchester, and David Beverley George Edwards, Chorlton-cum, Hardy, Manchester, England / National Research Development Corp., London, England, a British corp. / Adding / Subtracting Circuits for Digital Electronic Computers.

3,052,486 / Samuel H. Auld, Jr., Canoga Park, Calif. / Lear, Inc. / Circuit for Integrating, Differentiating and the Like.

3,054,090 / Elmer N. Lenk, Westchester, John G. Weeks, Downers Grove, and Quentin W. Wiest, Western Springs, Ill. / Western Electric Co., Inc., New York, N. Y., a corp. of New York / Coincidence Circuit.

3,054,091 / Andrew E. Brennemann, Poughkeepsie, Herbert K. Wild, Wappingers Falls, and William Wolensky, Poughkeepsie, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of N. Y. / Data Transferring Systems.

# 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.


## "Why we chose the NCR Computer." — T. J. BETTES COMPANY

"The major consideration in our choice of equipment was NCR's provision of a total system, completely integrating original entries from NCR machines at our branches, to computer processed management reports.

"We needed a data processing system capable of providing immediate service to our 21 branch offices. After thorough investigation, we chose the NCR CRAM (Card Random Access Memory) System, with its unique method of storing data, as best suited to our particular needs.

"With our new NCR Computer System, our major branches, though located hundreds of miles from Houston, will be able to communicate directly—on line—with our computer files. We will have a data processing network wherein each major branch will have the use of the computer at all times. Smaller branches, linked by teletype with their home branch, will also have fast access to the computer files.

"This means that we will now be able to better serve our more than 180,000 mortgage accounts; be able to better evaluate and assist our branch managers in their operations; better serve our more than 400 Institutional Investors; and grow and expand without the corresponding cost increases normally associated with growth."

Thomas E. McDonald

*Vice President*
*T. J. Bettes Company, Houston, Texas*

NCR PROVIDES TOTAL SYSTEMS—FROM ORIGINAL ENTRY TO FINAL REPORT—
THROUGH ACCOUNTING MACHINES, CASH REGISTERS OR ADDING MACHINES, AND DATA PROCESSING
The National Cash Register Co. • 1,133 offices in 120 countries • 78 years of helping business save money

NCR


How reliable are
you, Computape?
Come clean now.
Come clean? Penelope, I come clean-est.
So clean, I guarantee 556 or 800 bits per inch
with no dropouts for the most severe computer
applications. How's that for reel-liability?