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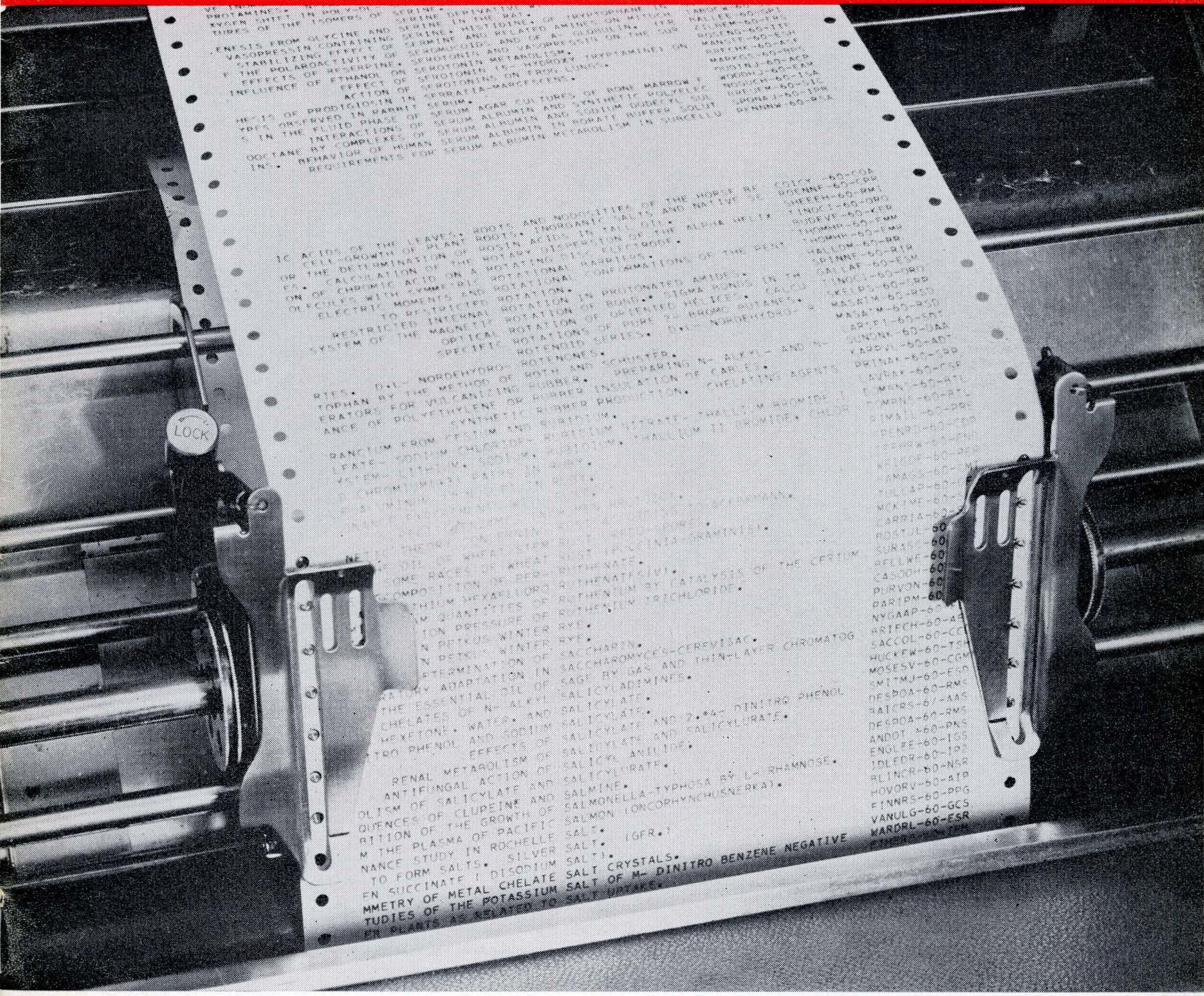

Computer Programming for Command Control Systems

Using Computer Services in Small Business

News of Computers and Data Processors:
ACROSS THE EDITOR'S DESK

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COMPUTER PROGRAMMING FOR COMMAND CONTROL SYSTEMS

M. O. Kappler

President, System Development Corp.
Santa Monica, Calif., and Lodi, N.J.

(Based on a talk given to members of the U. S. Air Staff, Washington, D.C., October, 1959)

What is the role of computer programming in command control systems?

Let me first explain briefly what I mean by "command control systems." There are military organizations which have a job to do. This may be a job of logistics, of combat, or both. As long as the operation takes place within the sight and sound of the commander or leader of such an operation, he can see what's going on, and he can call over to the person he wants to direct. But this is not the kind of situation that we're confronted with in modern warfare; we're confronted with a situation where everything is out of sight, a situation where a much larger and much less visible operation takes place. The complexity of the operation demands that information be reduced to symbols. These symbols have to be "communicated in" to the commander or command group; records have to be made; displays have to be made; decisions have to be made; and commands have to flow out. You notice I haven't said anything yet about computers. In the concept I am setting forth, a command control system exists whether you have computation, or data processing, or not. Let me say at this point that computers or data processors are not necessarily ends in themselves; they are tools which aid us in performing operations. When I refer to a computer, I am referring to any kind of calculating machine, with its associated display equipment and in-out equipment, which utilizes a computer program.

Data Processing Assistance

Now, why do we even consider adding data processing assistance to a manual command control system? There are several reasons. There is an overwhelming volume of data that modern command control organizations must deal with. The speed with which the data must be reduced — made meaningful — is so great in some instances that man cannot do the job manually. Also, there is too much material to remember, even with the aid of manual displays and recordings. In addition, the decisions that have to be made, which are based on this enormous amount of data, are too complex for the unaided individual to make. Advances in technology give us no alternative but to add data processing assistance or computer assistance to a manual command control system. It is impossible for us to live in the modern warfare environment without this kind of help.

Powers of Data Processing Equipment

The various kinds of data processing assistance presently available can greatly supplement the activities of a control organization. Let's look for a moment at what data processing equipment can do, just in general terms. It can "communicate in," that is, it can receive messages from components of the system, and it can translate these into various forms for more useful application, either for "communication out" or for storage inside. It can delay them for further use until something else is ready to utilize the information, and it can route them around internally. This is the communication function that it can perform "in." It can also serve as a memory. It can keep things stored internally in an invisible form, or it can keep status boards that are visible to the people who need the information. It can automatically update these status boards or the invisible parts of the memory, and it can sort according to various criteria — all that are longer than something, shorter than something, faster than something, or of higher priority than something. And it can correlate the various things that are in the memory. It can also compute (I define computing here as the solution of mathematical equations). Furthermore, in some sense it can even make decisions. It can make an optimization or a sub-optimization, and it can make the kind of analytical decisions which are difficult for people to make. A moment ago I said that the kind of decisions that have to be made in modern warfare are too complex for the individual to make quickly and easily. The machine can assist with this kind of decision. Also, the machine can make various kinds of displays. These displays can be made from the memory, either directly or from aggregates of information accumulated inside the memory, or it can produce them from an analysis or computation that it has made. I should mention also that the machine can make displays either continuously or on demand. Lastly, the machine can communicaate instructions based on the computations it has made.

Powers of Analog Computers and Digital Computers

The earliest data processing machines used by the military, I believe, were analog machines. Analog machines are quite sophisticated from the standpoint of mathematics. They can do calculus, for example. Analog machines in general, have the mathematics built in, but digital machines, at least the ones we commonly use, do not. We feel that the general purpose digital machine is more advantageous than the analog machine because we can make it a special purpose machine by writing a computer program for it. Furthermore, we can write more than one computer program. When we write a program to solve a particular equation, the machine has that special purpose. Next week, when we do another, the machine has a new purpose. In the case of

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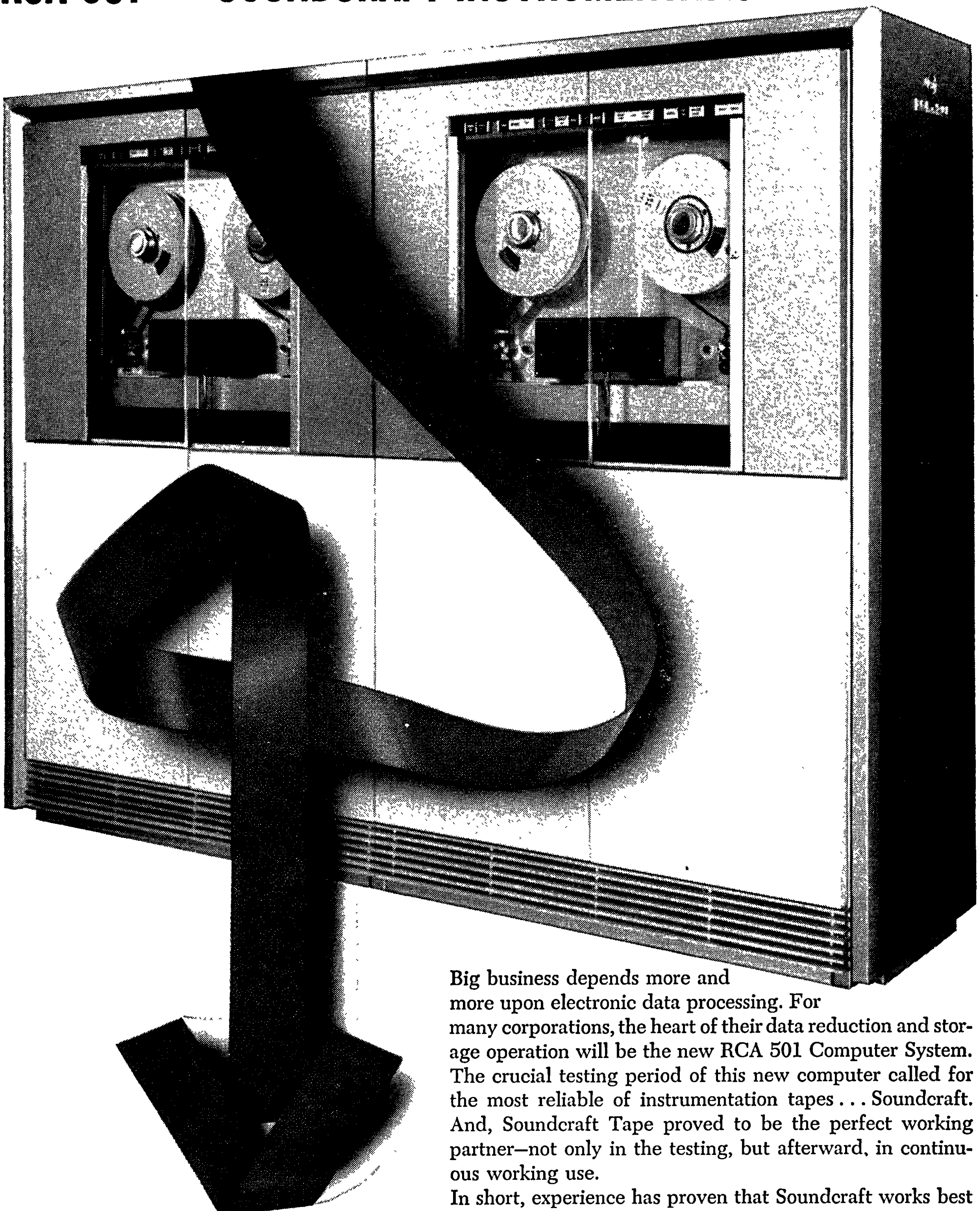

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the command control system the practice has been to write a set — perhaps 25 or 30 computer programs for a machine. Here the general purpose digital machine becomes 25 or 30 different special purpose machines solving different problems or carrying out different data processing functions. Sometimes the machine runs through a whole sequence of these in a few seconds. However, there is no necessity for it to go through this sequence in a fixed order. The order can vary according to the needs of the system. Also, in some systems it won't be necessary for it to go through the cycles as quickly. Depending on the demands of the system, it may be permissible for operations to take minutes rather than seconds.

Another aspect of the utilization of computers in command control systems, as distinguished from purely scientific computation, is the fact that the computer action is generally completed before the militaary action and can influence the progress of the military action.

Some Command Control Systems

Let us turn from these generalizations to look for a moment at some specific military functions that are assisted by data processing. One of the command control systems currently under development is the Strategic Air Command Control System (465L). Earlier I mentioned the phrase "communicate in." One of the "communicate in" functions in the SAC Control System is to receive data about logistics status in an emergency war operation. This includes such things as aircraft availability, weapons availability, base capability, and weather. These are all items which are received by the machine and dealt with in some appropriate way. The SAGE System (Semi-Automatic Ground Environment System of Air Defense) differs slightly in that radar information flows automatically into the machine. This, by the way, provides an example of my earlier reference to delay. Radar information has its own time pattern, which corresponds to the rotation of the antenna. When this timing is not in phase with the timing of one's need for information, the flow of information can be delayed momentarily until various activities can re-combine.

I said earlier that the machine can also translate. In the SAGE System translation is a part of the data processing function. Radar information is taken from the range-azimuth coordinates of the radar and is automatically converted to the rectangular coordinates of the sector by the machine. When the radar information is ready to be used, it can be added to the track data, which has been previously recorded by the machine, and associated with an already-established track. These are typical examples of the kinds of data processing assists that can be done in the "communication in" area.

The memory function now becomes obvious. In the case of SACCS, for example, the force status is in the machine's memory unit at all times. It is even displayed continuously on the display surfaces for ready reference by the commander, who can request supplementary information as he needs it. There is a vast amount of information ready in the memory. There is also invisible information available in the memory unit for the machine to call on for its own processing operations.

Intercepting

Thus far, I have been discussing computation as a data processing function. Let me make this more concrete by citing an example from the SAGE System, that of intercept computation. You will recall that one reason for adding data processing assistance to a manual system is that some operations may be difficult or impossible for a person to do manually. In intercept computation the action progresses too rapidly for manual operation. Also, the extremely complicated mathematical computation involved in bringing the moving interceptor to meet another moving body can be done much better by a machine.

Assigning Weapons

Another type of analysis that you can ask a machine to make, to cite another example from SAGE, is in weapon assignment. Consider the situation where the approach of a number of bogey aircraft has been detected. There are several bases available; there are several types of interceptors on each base; and each interceptor class has several types of weapons available. Making a reasonable distribution of weapons and interceptors is clearly a problem that a man needs some help with. Even with paper, a pencil, and plenty of time, he can't do a very good job. The machine can measure the distances, calculate the times of intercept, look at the volume in which bogey aircraft are present and make a weapon assignment that is much more sophisticated than men can make.

Writing "Demosthenes"

Now a few words about the difficulty of programming. Suppose I want to make a display on a panel and I call on a man to make the display. I tell him to write "Demosthenes" on the panel and he does it. However, if I want the computer to make the display, my instructions have to be considerably more detailed. In the first place, I have to tell the computer that I want the first letter 10 inches from the left hand side and 14 inches from the top. Then I have to say what the first letter is. Next I have to say that I want the second letter 14 inches from the top and 11 inches from the left hand side. And I have to say what that letter is — a very laborious process. This is one of the difficulties with data processing assistance in the present state of the art. Methods of communicating with the machine are not optimum from our viewpoint. I can't just tell it to put "Demosthenes" on the panel. I have to write out a very, very detailed description — called a computer program — of what I want done.

Unable to Write a Program for Some Cases

Unfortunately our knowledge of all military operations is not as complete as my knowledge of how to write "Demosthenes" on the blackboard. Military operations are infinitely more complicated, and a great deal of effort is required to deal with the data processing problems they present. We have to formalize what we want to say and then say it with great precision, especially when we want to get down into the computer language. This is so true in many cases that we are unable to ever get the program written in a fashion that will enable the machine to assist us. When this happens, our usual procedure is to let the machine operate up to a certain point. Then a man reads the machine's display material, takes some sophisticated action, reports this to the machine, and the machine carries on. We use the man as a mechanism because we don't know how to design a machine that's clever enough to do this particular job. I should add here that this man is not the commander.

There may be another way to approach this problem, however, and that is to learn to communicate with the machine, to get into the machine in some fashion different from the detailed computer program coding fashion we now use. We don't know how to do this, but I believe it is the most fruitful avenue to pursue to improve our methods of utilizing data processing iin military systems.

Communicating Out

I want to comment briefly on "communications out," which I referred to earlier. "Communications out" do not necessarily have the same form. It isn't necessary that SAGE outbound communication all have the same language or that they all be in the same form. For example, SAGE forward-tell from the direction centers to the control centers uses one message form; SAGE cross-tell to the adjacent sectors is in two forms: track cross-tell and fighter hand-over. SAGE also "communicates out" time-division data-link information direct to airborne interceptors in still another form. We should not fall into the trap of deciding that all the outbound communications of any particular system should have the same form. Nor is it necessary that we have a common computer language. These are limitations that we can do without.

Let me return to computer programming for a minute. I want to emphasize the fact that neither the computer program nor the machine carry out a military operation. In our context what really happens is that the succession of computer programs in the machine serves the command control organization as data processing assistance. By the way, there is no black magic about writing a computer program. The specificity that I referred to requires great, great volume, and the fact that we interleave sequencing programs together makes it complex and perhaps conceptually difficult, but it is an orderly process. In my example of the display, I think that if all of us knew the details of the mechanism of getting the letter down 14 and over 10, we could sit down and write the computer program for that particular display. However, there is a difficult problem associated with specifying precisely the military activity for which you want data processing assistance. This is especially true where intuition and judgment are important.

Changing Programs at Later Dates

I don't think we should worry too much about flexibility in the program of data processing assistance in military operations. In the concept that I have advanced, if you decide before you have completed the design and implemented the system that the items that you've selected for data processing assistance were wrong or had the wrong priority assigned them, there is nothing that prohibits modification or substitution. Furthermore, even after the system is operational, the operational functions supported by data processing can be revised by changing the computer program.

Scientific Observation of Operations

In order to design a command control system which includes data processing assistance, scientific observation of the operation is critical. Much less is known about how to do this than is known about how to design a machine. However, integrating data processing assistance is an orderly process. The procedure for designing a command control system should start with the preparation of the system operation description (a description of existing facilities, the integration of data processing assistance, and the data processing components). The first step here is to observe both the current operation and the current organization. Since the system probably won't be implemented for approximately two years, the new hardware and the new operational concepts which will be in use by the time the system is turned on should be considered.

In the case of SACCS, for example, the impact of changes in missile technology must be anticipated. Because of changes in weapon technology and defense configurations, recommendations will have to be made that will change both operational procedures and the organization itself. The manual organization should also be reviewed and revised so as to take maximum advantage of data processing support. In the case of SACCS, it took about eight or nine months to get the first version of the system operation description on paper. Even then, the people who worked on it were hesitant about publication, feeling that there were still too many unanswered questions.

Iterations of Operating Descriptions

However, the best way to develop a better version of the system operating description is to write it down, circulate it among the people who are working on it, and let them interact with each other about it. Next, the hardware people should review it and give their reaction as to whether it is feasible from the hardware standpoint. Then it should be sent to the command using the system to see whether it meets their needs. There is not time for enough of these iterations in SACCS before the date for an initial operating capability, but a minimum of three or four iterations is required to do even a reasonable job. However, iterations can continue after the system is in operation. Certain things will be fairly fixed because of the nature of existing hardware, but the general purpose computer, made special purpose by its program, enables us to revise the data processing support being given the command control organization. The iterative approach to this problem is not nearly as precise as desired. Iterations like this only converge; they don't go directly to the solution. Much more research and development on the technology for implementing control systems is needed. There is one important tool, though, that is presently available: simulation. We anticipate the characteristics of the operating situation for the command control organization and simulate them, not elaborately, but with simple devices. This enables us to actually bring people in and let them perform the operation. We can tell from their reactions whether or not there is a reasonable system operation description and whether the data processing assistance serves their needs. We get a much better reaction from them than we could by any discussion, because in simulation we reconstruct a real situation. Our experience with simulation in air dedense shows that even with fairly crude simulation the "crew members" get so completely absorbed that they feel they are in the real situation. This method provides excellent design review.

Time and Cost

I don't want to minimize the amount of effort required to do iteration, simulation, etc. This is an activity that involves several hundred people for approximately two years. While these techniques do not produce a really complete job, they produce something that is adequate. I think this is a very good investment. In the case of SACCS, the total amount that the Air Force expects to spend for the system may be from 200 million to 300 million dollars. The effort to do the system operation description will be approximately 10 million dollars, a small piece and certainly well worth the effort. The computer program preparation will probably cost about 10 million dollars.

Hardware

After the system operation description has been prepared, the earliest priority goes to the hardware designers who prepare the specifications for the equipment. Since the hardware designers are needed for this purpose even before the first version is available, they must interact with the engineers on a day-to-day basis in the early phase of development. This interaction, which is maintained through successive iterations, gives rise to the methods and procedures that each individual crew member will use, whether he is one of the mechanisms in the system or whether he is in the command organization itself. It also yields the organizational design referred to earlier. It gives rise to plans and specifications for both system training, that is, training the total crews in conducting their activities, and individual training. Lastly, it supplies the specifications for the computer program that makes the general purpose machine into the special purpose machine required.

Making Computer Programs

A useful analogy to computer programming is that of a military aircraft and the operations orders that send it out on a mission. In this analogy, the aircraft is the machine and the computer program is the operations order. If the commander is on the mission and he discovers that the operations order isn't satisfactory, he can modify it. Similarly, if the data processing assistance isn't appropriate, it can be changed — both before and after the operational date. There was a case of this kind in SAGE. At the very last minute the need arose for automatic target-to-battery evaluation for the NIKE battery. The data processing function was compressed a little and ATABE became operational in the field in a matter of six or eight months.

The computer programmer can't prepare the program from written specifications. He has to become much more knowledgeable and the correct practice, we believe, is for the computer programmers to take their place in the team writing the operation description system during the early phases of development and proceed from there after the first version.

People for Making System Operation Descriptions

The kind of people required to prepare the system operation description are an unusual breed. They aren't just engineers, but people who are oriented towards and who are accustomed to looking at military operations. Many human factors specialists (psychologists), for example, in their examination of operations for the purpose of designing training programs, have gained good insight into operations leading to a systems operation description. We have found that mixed teams of engineers, physicists, human factors specialists and operations research people, who combine the knowledge of the empirical and the less tangible, work out very well. The training in statistical observation of human factors specialists and operations researchers makes them especially valuable.

Exchange of Information Between Systems

I want to give some attention now to interface problems — the exchange of information between systems. As we have seen in connection with SAGE "communication out," the technical problem of inter-communicating between various systems is difficult but not insurmountable. We've made mistakes in this area in the past. For example, when the FST-2 data converter at the long-range radar sites and the SAGE Direction Center input was first connected, the FST-2 was reversed for entry into the SAGE computer. Incidentally, these were not programmed machines but logically wired machines which had to be rewired. However, this is a much less difficult problem than the question of operational requirements for communicating between systems. Let us look for a moment at three systems: 438L, 425L and 465L. One system, 438L, has intelligence information which it might just tell to 425L and 465L — and in exactly the same form. The machine's conclusion to use the same form would be wrong because SACCS has quite a different need for intelligence information for targeting purposes than NORAD does for defense purposes. The most difficult problem here is to examine the operation, parcel out the operational functions to one system or the other, and then write a very precise description that will enable each operator to understand what comes in and what goes out. This is quite different from the technical problem of common language. We should not be overly preoccupied with problems like "message form." These are very small details compared with the operational problem of where the information is. If we make a mistake in this area, however, our flexibility and our successive iterations will provide relief. The iteration method applies not only to the development of the single systems but applies equally well to the way the systems will work together. If we find that we've made an unsatisfactory division of functions, we can adjust this to some extent after joint operations begin.

The selection process of a contractor for one of these systems ought to place primary emphasis on the capability of doing the operational job, not on a hardware proposal. It is a great temptation to view favorably a proposal in which there are tangible things. But it is a mistake to select on the basis of hardware, since the bidders who prepare proposals for us have spent only two or three weeks, usually under pressure, and the job of writing a system operation description is 100 times bigger than writing a proposal.

Research Needed in Data Processing

On the question of the research needed on better ways of communicating with the machines, SDC is doing some of this work as a part of both its SACCS and SAGE work and our other numbered L-systems work. However, not nearly enough attention is being given to this kind of activity. The problem of getting from a word description into the machine needs much, much more investigation. I hope that SDC and the Air Force will jointly support more research here. The computer manufacturers and the communications manufacturers are, in some ways, outdistancing us. They can turn out, in production, bigger and faster machines than we can use. For our part, we don't have people to do system operation description and write the consequent computer programs in anywhere near the numbers necessary to write an adequate system operation description for all the systems of current interest, let alone for all the machines the manufacturers are capable of turning out.

There is some current research on computer programming, particularly in the language area, but we should not be overly encouraged by this. There is a long process of operations observation and step-by-step organization of observations before we actually get to computer programming. The research being done on computer language is only a tenth or so of the total data processing assistance research. It is good work and it is helping tremendously to get computer programs written, but it deals with only a part of the problem. In spite of the modest research effort in computer programming, our know-how has advanced a great deal. The number of people involved in writing the SACCS computer program is only a tenth of that used in writing the original SAGE program. Our learning curve in this area is good, but we have a long way to go. We've made almost no inroads into the problems involved in writing the system operation description. In addition to the need for research in this area, there's room for quite a bit more research in simulation techniques.

We can continue to devise good systems for the Air Force to use, but the efficient implementation of these systems depends on the successful prosecution of research in data processing which supports military operations.

Using Computer Services In Small Business

I. J. Seligsohn

Computer Services Division
C-E-I-R, Inc.
Arlington, Va.

(Based on a report of the Small Business Administration, Washington 25, D.C.)

Only very large corporations can afford to purchase a computer installation costing $2 million or more. And even these corporations must keep such expensive equipment continually busy, usually 16 hours a day at least, in order to pay off the initial heavy investment within a reasonable time.

But what about the small businessman — the one with say less than 250 employees? He needs a computer's help scarcely once a week, perhaps only once a month. Can he take any advantage of the time-saving, labor-saving, giant electronic computers to strengthen his competitive position? For these machines have the lowest cost per unit operation performed, once a certain minimum number of operations is exceeded.

The answer is definitely YES — if the small businessman will make use of available computer services organizations.

Some computer service firms have complete staffs of mathematicians, economists, and other scientists, in addition to their computer specialists. One (or a team) of these people can come right to a small plant, analyze a problem, and gather the data needed to solve it. This does not mean, however, that a small manufacturer with daily engineering problems can do without engineers of his own. Computer services experts should be used as consultants on difficult problems, not as operating personnel. The small business owner who fails to recognize this distinction is not being fair to himself nor to any computer service with whom he may deal.

A further point is worth noting, too: You can't just walk into a computer services organization and get answers to all your problems right off the shelf. Many significant applications are already in use. There is no doubt of that. But many others are more in the realm of future possibilities; their greatest impact is still to be felt. Nevertheless, the small manufacturer who fails to look into computer services may be likened to the woodsman who felt he was too busy to sharpen his axe.

Computer Services

Typically, a computer services firm has one or more large electronic general purpose digital computers on its premises.

The general-purpose nature of the digital computers implies that many different businesses can solve many different kinds of problems on these machines. This is exactly the case. Computer services organizations have a variety of clients, many of them small, in nearly every field of business and industry.

If you, as a small businessman, consult a computer services firm, you will be offered two major types of services to help solve your problem: programming services, and computing machine services.

Programming Services

First, a computer analyst carefully studies your problem, and tells you whether a computer solution is feasible and economical; in your situation, he helps in determining whether the problem that brought you to the computer services organization is complex or difficult enough to warrant a computer solution. When the analyst has finished his work, he turns the problem over to computer "programmers."

You pay for only the programming services for that particular problem. You have no overhead costs of maintaining a programming staff just to solve an occasional problem.

Computing Machine Services

When the problem is ready to be run on the computer, both program and data are fed into the machine. The computer then solves the problem at electronic speeds. Answers can be put down on paper by a high-speed printer.

You are charged only for the time it takes the computer to process your set of data. This charge usually is based on an hourly rental of the computer. If you are to be a large user of computer time, rates are often figured on some other preiodic basis. Most small businesses, of course, rent time on a computer by the hour. They want the benefits of fast, accurate computer solutions, without the large overhead of buying or renting their own computer full-time.

The computer services firm does, of course, have a large overhead. But it is divided among many jobs and clients. Often, computer services organizations plan to keep their machines running two shifts a day, sometimes around the clock. Thus, with fixed overhead spread thinly over many clients, individual job costs can be lowered.

What Types of Problems?

Large-scale, general purpose digital computers can solve a wide range of business problems. The following are representative:

Engineering Problems

Complex engineering problems often must be solved before a given product can be manufactured. Typical engineering problems that can best be solved by computers include stress analysis, heat and pressure calculations, vibration analysis, engine and lens design. Most important of all, small manufacturers can now enter new fields that were closed to them before the advent of computers.

For example, one small manufacturer makes arresting gears for jet planes. Recently he used a computer for the first time to engineer his product. Then he announced enthusiastically, "From now on, in research and product development — all the way from deep freezers to atomic engines — the small company can hope for the first time to make a definite contribution."

Lengthy Data-Processing Problems

The high speeds of electronic digital computers today make possible the rapid processing of great amounts of clerical data. Computers can drastically cut the time and costs spent on functions such as payroll processing, billing, shop-order writing, and sales analysis. Certainly, large corporations can and do effect greater savings by applying computers to these problems. Why not small business?

Indeed, some of them are now finding it increasingly profitable to turn to computer services firms for data-processing help. They find that fewer clerks can handle much more work in less time and at a lower ultimate cost with the aid of computer services. This is especially true in the case of a small firm expanding its business but not yet able to afford more clerical personnel or a move to larger quarters.

Computer services can also provide small firms quickly with up-to-date control information for use in inventory control, cost accounting, and the like. The freshness of this information is often vital to the success of a business.

Here's an example: One small manufacturer now receives a complete sales and inventory analysis once a week — sometimes once a day when volume is high. This enables him to balance his operations, preventing over-production or under-production, while keeping inventories low but still without the risk of running short. For highly seasonal products, computers can predict within reasonably safe limits the requirements for preseason and working inventories of finished items and sub-assemblies. This helps to level out production curves, lower costs, and obtain more efficient operation. Before computers were available, this manufacturer had to make production decisions using information that was months old. His plans were based on estimates and samples rather than on accurate facts.

Other types of business, of course, need up-to-the-minute information; for instance, wholesalers, manufacturers agents, construction firms, small banks, and brokerage houses. One computer services firm specializes in rapid data-processing for banks that do not have their own computers. At 6 P.M. each day, the computing firm receives from various banks the posting documents, new account data, figures on installment payments received, and so on. At 8 A.M. the next day, the banks receive the day's complete transaction journal, and every 5 days they receive new borrowers' payment books, delinquent accounts lists, and the like — all prepared by the computer. The result? The banks are able to give excellent service to their customers, with fewer personnel and lower costs, and with less delinquency. Customer accounts of manufacturers (merchants, agents, and brokers, too) can be handled with equal facility by computers.

Production Problems

Small manufacturers have been making increasing use of computer services to solve complex production problems, such as:

(1) Machine shop scheduling — finding the number of each item to be produced by each station in a machine shop, to minimize delays and overtime, and to shorten delivery time;

(2) Production scheduling — designing schedules to meet expected sales, and varying these schedules in accordance with sales fluctuations;

(3) Blending or mixing problems — finding the best combinations of ingredients or raw materials; and

(4) Reduction of trim losses — forming, shearing, slitting, or punching rolls and sheets of material to produce various sizes, while at the same time minimizing waste.

The typical small manufacturer seldom has the knowledge or staff to calculate mathematically the most precise solution to such problems. Until recently, the best he could do was make an educated guess among many alternatives. And the odds were always against his making the most economical choice. But now, through the use of computer services, the best solution can be found swiftly and accurately. A high-speed computer can examine all the factors, explore all the possible choices, and come up with the answer that will yield the most profit.

Transportation and Distribution Problems

Illustrative of these problems is a business which operates a fleet of trucks. The manager wanted to find out the most economical routes for them to follow. The factors that had to be considered included among others mileages, traffic congestion, toll roads, and load capacities. In just a few hours, a computer analyzed 10 million possible route combinations and found the best ones. Without a computer, it was estimated that it would have taken 20 years to solve that problem. Obviously during that time the trucker would not have been able to save several thousands of dollars per year as he is now doing.

Similarly, computer services can help manufacturers find out how to ship their products at lowest cost and yet meet marketing requirements.

Management Analysis Problems

Computer services have also helped small businessmen in the field of management analysis and prediction. They have solved such problems as:

(1) Deciding where to locate a new plant or branch, taking into consideration the expected customer demand, transportation, distribution and the many other factors that affect costs and profits;

(2) Deciding whether to make or buy components — which items or parts to manufacture, which to buy, and when;

(3) Evaluating bids — deciding which offering is most desirable when prices, terms and conditions vary among the bidders; and

(4) Forecasting sales and demand — performing market research by determining sales probabilities in different geographical areas for different products.

Many of the techniques used to solve thsee problems have been developed by the relatively new field of operations research which applies the methods of science to the operating problems of business. Some computer services organizations have operations research experts on their staffs. This combination often has a great appeal for a business which must solve complex problems without hiring a permanent staff of technical specialists.

What Does It Cost?

What will it cost you to take advantage of computer services — to have your problem programmed and solved on a computer? At one end of the scale many large computer manufacturers have formed computer service subsidiaries. They sell computer time at around $650 to $700 per hour. Programming time costs an average of $15 per hour.

At the other end of the scale, small independent computer services firms sell computer time (on the same types of equipment as the big companies use) at around $350 an hour. Programming costs average $15 an hour, but can go down to around $8 an hour for simpler problems. Of course, for recurring problems, where existing programs can be applied to new data, there are no programming costs. A charge is made only for computer running time.

Certain background facts are worth considering in relation to these broad cost ranges. For one thing, large computers are so expensive to buy and become obsolete so quickly that over 90 percent of all computers are rented from the manufacturers, rather than purchased. The rental cost alone can be $500,000 to $800,000 or more a year. One computer services firm with two machines pays $1,350,000 a year in rent. For another thing, the installation and start-up costs for a single machine run around $800,000. Finally, the operating cost for a single machine averages an additional $235,000 a year.

The important question for small firm operators is: "What do computer services cost **in terms of what we get out of them?**" Many companies have found that the answers they got led to profits which more than offset the expense. In such conditions every delay in getting the needed data amounts to a charge against profits.

Some small business owners even consider the typical rates to be a bargain. As one man put it: "For a few thousand dollars in computer service costs, I'm saving many man-months of work, and I've boosted my profits by $10,000 per year.

For Further Information

Businessmen interested in learning more about computers and their applications to business problems may wish to consult the following publications. In keeping with the policy of the series, this list is brief and selective. However, no slight is intended towards authors whose works are not included.

Electronic Data Processing for Business and Industry, by R. G. Canning, John Wiley & Sons, Inc., New York, N. Y. 1956. $7.

An Introduction To Automatic Computers: A Systems Approach for Business, by Ned Chapin, D. Van Nostrand Company, Inc., Princeton, New Jersey, 1957. $8.75.

Special Report — Computers: A Delayed Revolution, Business Week Magazine, June 21, 1958. Reprints available from Reprint Dept., Business Week, 330 West 42nd Street, New York 36, N.Y. 50c each.

To make contact with specific computer services organizations, a good starting point is the classified telephone directory of one of the larger cities; consult such headings as "Computing" or "Data Handling Systems."

NEWS of Computers and Data Processors

"ACROSS THE EDITOR'S DESK"

COMPUTERS AND AUTOMATION

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Number 5 B

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SCORE: 15 OUT OF 25 SOLID-STATE EDP SYSTEMS NOW IN USE, AND TWO NEW TYPES

RCA Electronic Data Processing Div., Radio Corporation of America, Camden, N.J.

Of a total of twenty-five solid-state computer systems now in use, RCA has supplied fifteen of them -- all the RCA 501, or medium-sized electronic data processing system. The company has orders for close to 50 more on hand.

Two new systems were announced on April 13: the 301, smaller than the 501; and the 601, which is larger. They are already in demand. There were 35 orders on hand for the 301, even before its formal announcement on April 13. Considerable interest also has been shown in the 601; the first two of them already have been ordered by the New Jersey Bell Telephone Company and Southern Bell Telephone Company.

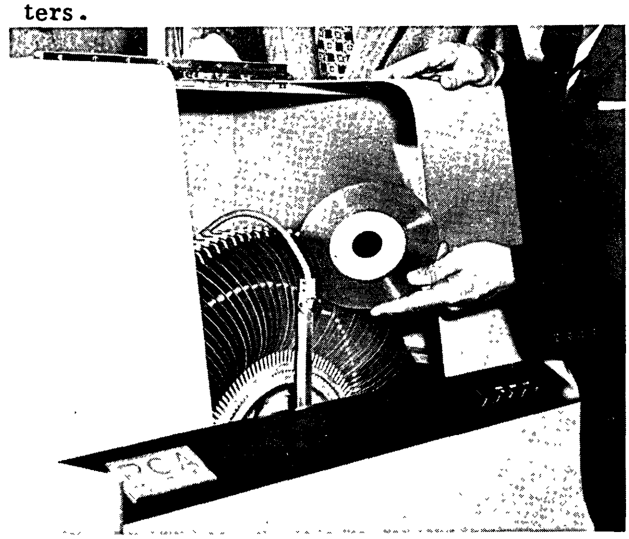
Data on the RCA 301

The RCA 301 is a completely-transistorized, general-purpose electronic data processing system for the medium size or smaller business or government organization. It is designed on the building block concept. Virtually any combination of punched card, paper tape or magnetic tape input-output and disc file or magnetic tape storage is possible to meet varying user requirements.

In the RCA 301, flexibility is made possible through multiple, fast input-output media, rapid access core memory, a highly flexible and powerful instruction vocabulary, and high speed arithmetic capabilities on such problems as linear programming and matrix operations in connection with scientific computation.

A disc file or "juke box" memory unit holds 128 discs with magnetic recordings on both sides for a capacity of 4-1/2 million data characters. Up to five such disc files may be incorporated in an RCA 301 system. The discs may be rapidly interchanged or erased for re-recording.

Up to 12 magnetic tape memory units can be included in an RCA 301 system, each capable of storing nearly 4 million data characters.



-- Here are magnetic memory discs of the new RCA 301 Electronic Data Processing System, designed to provide full-scale data processing for small firms. This is the first data processing system to use magnetic discs -- similar to 45 rpm records -- for its "memory storehouse". It also can use magnetic tape on reels. The discs are said to provide new convenience in the handling and storage of information.

Data on the RCA 601

The RCA 601 is one of the world's fastest electronic data processing systems. Fully transistorized, it is suitable for both business and scientific applications and is capable of handling with ease the paperwork load of many of the largest corporations.

The high speed memory is expandable up to 262,000 numbers, letters or symbols. As many as 64 high speed tape stations can be linked to the computer for the system's main memory storage. Each unit is capable of holding 20 million data characters. The system has a memory cycle of 1.5 millionths of a second, with tape speeds up to 120,000 numbers, letters and other symbols per second. The computer can multiply eleven-digit numbers in 10 millionths of a second. The system can make 666,667 decisions per second.

A multi-programming technique has been designed to permit the automatic running of any number of independently written programs simultaneously, limited only by the system's total memory. In parallel processing or control operations, the RCA 601 not only will work on a job priority basis but can handle changeable priorities.

The RCA 601 uses a "universal computer language", making it completely compatible with other computers. Data can flow freely between the RCA 601, the RCA 301 and the RCA 501, and all three can be readily integrated into communications systems connecting widely-separated company activities.

NEW MOTOR OIL DESIGNED BY COMPUTER

Esso Standard Division, Humble Oil and Refining Co., New York 19, N.Y.

A new motor oil built with the aid of an electronic computer and atomic radiation was announced April 1 by the company.

The formula for the oil, called New Uniflo, is complex, and an IBM 704 was needed to help prepare the formula. Radioactive tracers were used to keep track of the molecules as they were built into the formula.

Comparative research with the new oil and other very good lubricants showed that it keeps car engines cleaner than any of the others, Esso said. The research studies consumed two-and-a-half years of effort and three million miles of testing in cars, including road testing by a fleet of 150 taxicabs in New York City. Stop-and-go travel like taxi driving is extremely severe for engines because incompletely burned particles of gasoline collect to form sludge.

The new formula oil attacks the problem of car engine lubrication and cleanliness in a different way. It concentrates on breaking engine-formed sludge into minute particles, far smaller than particles normally found in an oil. These particles, less than a millionth of an inch wide, Esso said, are kept floating in suspension, away from engine parts they would otherwise damage. When the oil is changed, the sludge is drained off with the oil, leaving the engine clean and assuring longer life for engines.

At the heart of the new formula is a complex polymer--or super molecule--on which most of the computer and tracer activity was centered. Three ingredients have to react with each other in a certain sequence to form the polymer. The polymer is so intricate that the computer was used to select the most effective combination of the three ingredients.

To find out whether the computer was right the ingredients were tagged with Carbon 14--a radioisotope--so they could be traced through the reaction. This research confirmed the 704's predictions.

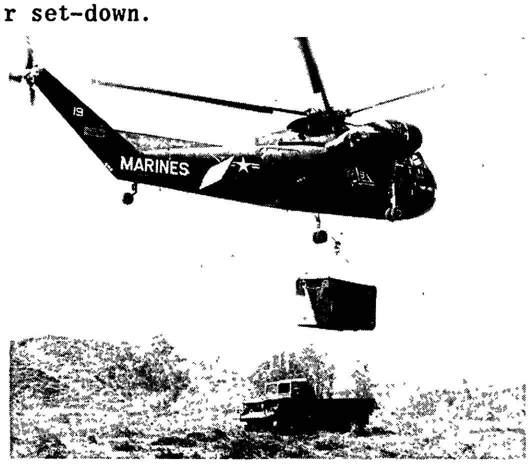
The three million miles of testing demonstrated the new oil's anti-sludge characteristics.

This development is believed to be the most prominent role ever played by a computer in developing any new lubricant.

HELICOPTER AIR-BORNE ELECTRONIC AIR DEFENSE SYSTEM

Hughes Aircraft Co., Culver City, Calif.

Here is a versatile, electronic air defense system installed in five 3,500-pound aluminum shelters transportable by helicopters. The United States Marines has purchased it from Hughes Aircraft Company, Fullerton, Cal., who developed the "Airtrac" system, which gives air defense capability to ground troops. Below, one "helihut", transported as far as it can go aboard truck is lifted skyward by a HR-2-S1 helicopter for movement to an isolated forward area. The air defense system is operational wherever these helihuts can be landed -- from the bottom of a deep canyon to a mountain top. They could go into action within minutes of their set-down.



TEACHING DEVICE FOR REDUCING TRAINING TIME

General Atronics Corp., Bala Cynwyd, Pa.

A new automatic teaching device designed to increase the effectiveness of the instructor in a wide variety of learning and training situations was announced by this company at the end of March.

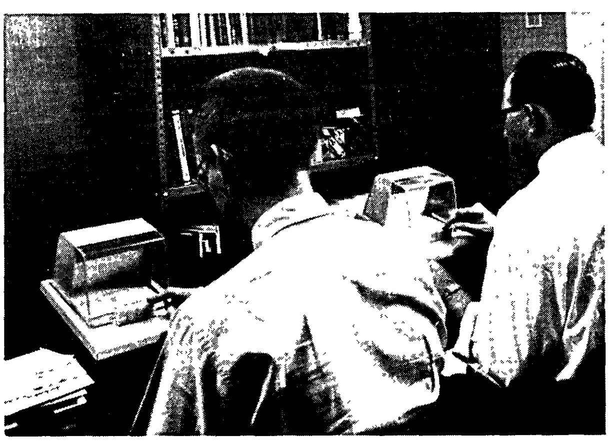
Called the Atronic Tutor, the new machine is a simple, reliable, entirely mechanical unit about the size of a small adding machine. It presents step-by-step text material to the trainee at a rate corresponding to his ability to absorb it. The Tutor also tests the student on the subject matter, and measures his progress.

This new technique, appears able to reduce the time required for industrial training courses by as much as 50 per cent... or teach the student up to twice as much in the same period as is taught by normal teaching methods.

The Atronic Learning System consists of two parts:

(1) The Tutor-Text, containing the subject matter organized in a series of finely graded steps or increments, with a question or problem and a set of alternative answers on each page. The text is written to build up a gradual mastery of the subject as the student moves from step to step.

(2) The Tutor, an inexpensive mechanical device which turns the pages of the Tutor-Text when the appropriate key at its base is pressed. After the student has read the information on each page, he selects the answer from the set of alternatives and presses the corresponding key. If he is correct, the page turns; if he is wrong, the Tutor waits until he chooses the right answer. It takes less than half a second for the page to turn.



SALE OF A DIVISION OF CLARY TO REMINGTON RAND

Sale by the Clary Corporation of its Adding Machine and Cash Register Division assets to the Sperry Rand Corporation, Remington Rand Division, was announced in early April by the two companies. The sale, which is subject to final approval of the definitive contract by Clary stockholders and the Sperry Rand Corporation Board of Directors, will be for a cash amount of approximately $8,050,000 and will become effective on July 1.

The transaction will add a line of full keyboard adding machines, and a line of manual and electric cash registers, to Remington Rand lines. Included in the sale will be all physical assets of Clary's manufacturing plant in Searcy, Arkansas.

Clary personnel engaged in manufacturing, sales, and service of adding machines and cash registers, will be retained by Remington Rand. Clary adding machines and registers will continue to be sold under the Clary name by the present Clary dealers and other Clary sales outlets.

Clary Corporation, at its headquarters plant at San Gabriel, Calif., will continue to design and manufacture electronic computers, electric print punches, and other data-handling equipment, and mechanisms for guidance and propulsion systems used in missile programs.

EDUCATING THE IBM 7070 COMPUTER

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

A group of fifty logicians, members of IBM's Applied Programming Department, took delivery in New York in late March of the first IBM 7070 data processing system produced. Their assignment was to teach problem-solving short-cuts to the computer.

Operating around-the-clock continuously for the next two months, the computer will carry out more than ninety billion instructions, in order to determine and test programs for the new data processing system.

The high-speed computer and associated equipment as installed at 11 Broadway is the most powerful configuration of the 7070 data processing system possible. This capacity is necessary because of the initial applied programming application. The system the IBM programmers now command would sell for $1,948,850. As comparison, a typical 7070 system sells for $900,500 and rents for $20,350 a month.

RPC-4000 ELECTRONIC COMPUTING SYSTEM

Royal McBee Data Processing Division, Port Chester, N.Y.

A new, fully transistorized, general-purpose, digital electronic computing system was announced in March by Royal Precision Corporation, called the RPC-4000. It will be available at a monthly rental of $1,750, or a total sales price of $87,500. This includes the computer and the Tape Typewriter system. First deliveries are scheduled for July.

The computing system is capable of operating on 9-digit numbers at rates up to 4,000 operations per second. The speed results from: high operating rates; versatile command list (42 in all) including commands which facilitate double-precision and floating-point operations; an index register that allows high-speed instruction modification; repeat execution feature; high-speed input-output equipment; and an 8-word accumulator for block operation (eight sums may be accumlated simultaneously).

The magnetic drum memory section incorprates many new design features. The entire unit is encased in a metal covering to protect it from dust particles or accidental damage. The drum is tapered and floats on a cushion of air. When the machine is idle, the drum rests away from the heads. Air pressure automatically raises the drum to correct operating position when power is turned on. The memory has a storage capacity of 8,008 words (word length is 32 usable bits, accommodating a 9-decimal digit number). A variety of programs can be stored permanently for instant access when needed. Average access time to the main storage is 8.5 milliseconds. Memory may be searched for full or partial words (through special masking feature) at a sustained rate of nearly 200,000 words per minute.

Basic tape reader speed is 60 characters per second, basic punch speed is 30 characters per second. A reversible photo-electric reader, which reads punched paper tape at 500 characters per second, and a high-speed punch (300 characters per second) are available as optional accessories.

The computing system draws less than 10 amps., from a standard 110 volt line.

FAST NEW MINIATURE PRINTER

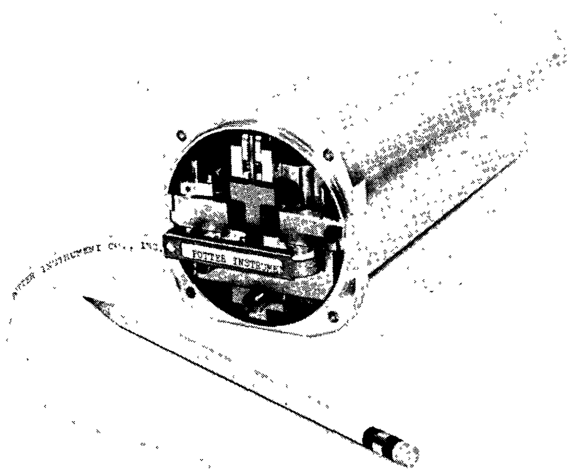
Potter Instrument Co., Plainview, L.I., N.Y.

Printing speeds of more than 30 characters per second on 5/16" tape are attained by a small printer newly developed by this company. Only 9 1/4" long, with a self-contained paper supply, the printer fits a standard 3" instrument case.

The high speed and small size of this instrument make it useful as a printer for computer output and for weapons system checkout devices. It is also being used in burst communication to conserve the bandwidth of a radio transmission link. It relieves an aircraft pilot of the need to remember instructions and permits higher speed in control tower operation, thus reducing chances of pilot error. It can provide a written record at both ends -- in the plane and on the ground. The new printer is now being tested by the Federal Aviation Administration in connection with the Air Traffic Control Program.

Other applications for the miniature printer include: dispatching control for police cars and fire trucks, trains, busses, taxi cabs and many other forms of transportation; communication systems for private planes; office use to reduce the size of present office teletype equipment, and by troops in the field, using battery power and connected with a miniature keyboard.

Developed by Potter for Stromberg-Carlson, this small high speed printer is designed to sell for less than $500.00.



COMPUTERS FOR MEDICAL DIAGNOSIS

Packard Bell Electronics Corp., Los Angeles, Calif.

Robert S. Bell, president of Packard Bell Electronics Corp., told a luncheon meeting of the Electric League of Los Angeles on March 21 that the day is coming when diseases will be diagnosed electronically by advanced computers. They will determine the disease and recommend appropriate drugs and treatments according to the patient's age, height, weight, and other data and symptoms.

ANNOUNCE JOINT EFFORT IN COMPUTER CONTROL OVER POWER PLANTS

Republic Flow Meters Co., Chicago, and The Thompson-Ramo-Wooldridge Products Company, Beverly Hills, Calif.

These two companies have agreed to cooperate in designing and furnishing complete computer-operated systems for electric power industry. They will cooperate in engineering, installing, and servicing complete valve, combustion-control, data-logging, alarm-scanning, and computer-control systems to fulfill the requirements of the power industry.

Republic has been a leader in pneumatic combustion control systems for over a quarter of a century; during the last 10 years Republic has designed and installed more than 125 electronic combustion control systems for steam generating plants. Thompson-Ramo-Wooldridge Products has been a pioneer and leader in the development of industrial computer control systems for more than five years, and has installed more than a dozen of its RW-300 computer control systems for on-line applications.

THE HONEYWELL 400 COMPUTER

Samuel D. Harper, Datamatic Division, Minneapolis-Honeywell, Wellesley, Mass.

The Honeywell 400, announced in early April, although not as powerful as the Honeywell 800, is, nevertheless, a complete and powerful system. First of all, it is a moderately priced all-transistorized data processing system, renting for under $10-thousand a month; it is one of the most powerful data processing systems available in its price class. Because of its relatively modest price it will bring new-generation data processing to thousands of companies that could not afford the larger systems.

In standard form, it will look like this:

The Central Processor contains a memory of 1,024 words, and operates with 48-bit words. For comparative purposes this may be thought of as providing storage for 10,000 characters.

Like the Honeywell 800, the 400 is programmed with 3-address instructions. This is important not only on its own merits, but, being a specification of both the Honeywell 800 and 400, it facilitates the employment of common programs.

The internal speed of the Honeywell 400 is approximately 6,000 of these 3-address instructions per second. Compare this for a moment with the speed of the Honeywell 800, which is 30,000 3-address instructions per second. The 800, however, is built to exploit the economic advantages of automatic parallel-processing, while the 400 is built for situations where the volume of work is insufficient to load an 800. However, it is recognized that rapid sorting of data is always important and for this reason the Honeywell 400 provides the facility of simultaneously reading from one magnetic tape and writing on another magnetic tape.

In addition to the memory, the arithmetic unit and the control unit, the central processor contains the control circuits for a printer, a card reader, a card punch and up to six magnetic tape units.

Central Processor:

Speed	4500 to 6000 3-address operations per second
Memory	1024 words of core memory (approx. 10,000 characters)
Checking	Internal parity checking
Features	Simultaneous read-write, special automatic editing provisions, high-speed sorting ability
Options	Multiply-Divide, print-storage for simultaneity with other operations, additional memory.

Magnetic Tapes:

Speed	96,000 decimal digits per second
Features	Identical to Honeywell 800 tape units; Orthotronic Control (automatic error correction)

Printer:

Speed	900 lines per minute
Horizontal Span	160 columnar positions (any 120 may be active)
Features	Clean carbons, ruggedness, fully checked

Card Reader:

Speed	650 cards per minute
Features	Fully checked

Other Input-Output Devices:

Card Punch	100 cards per minute or 250 cards per minute
Provision	for accommodating other types of input such as paper tape

MULTIPLE USE FOR A UNIVAC 1105 COMPUTER

Remington Rand, Division of Sperry-Rand Corp., New York, N.Y.

A Univac 1105 computer system has begun to work for education, industry, science, government, and culture as a giant $3.6 million Computation Center was "unveiled" at the end of March at the University of North Carolina, Chapel Hill, N.C.

Dr. Robert W. Burgess, director of the U.S. Bureau of the Census, said that the Univac 1105 system will save time and money in tabulating the 1960 census.

The census this year will be completed in considerably less time than has been required to complete censuses in the past, he said. "Our plans for the 1960 Censuses of population and Housing contemplate faster publication of results than has ever before been achieved.

"We expect to have 100 per cent of the data tabulated and published by early 1961... This will be 12 to 18 months earlier than similar results for previous censuses were made available.

Dr. Burgess said census officials "were extremely pleased when we were able to work out arrangements with Remington Rand, the National Science Foundation and the University of North Carolina, for installations of equipment exactly compatible with our two Univac 1105's. Under the arrangement we are guaranteed the part-time use of facilities of this Computation Center during the period when we most need help."

The Univac 1105 system, which is valued at $2,400,000, was built by Remington Rand and made available to the University of North Carolina at a 50 per cent reduction in cost. The other half of the cost was shared by the National Science Foundation and the Bureau of the Census, the latter agency purchasing time on the Univac for the 1960 census. The University of North Carolina constructed a $1,200,000 building to house the Univac and its accompanying Computation Center, which is currently operating 20 hours a day on 15 projects.

COURSES IN COMPUTER SCIENCE AND ENGINEERING

University of Michigan, Engineering Summer Conferences, Ann Arbor, Mich.

The following intensive courses for practicing scientists and engineers will be given June 13-24, at Ann Arbor:

- Introduction to Standard Methods of Numerical Analysis -- Bernard A. Galler in charge.
- Introduction to Digital Computer Engineering -- Harvey L. Garner and Norman R. Scott in charge.
- Theory of Computing Machine Design -- Harvey L. Garner and Norman R. Scott in charge.
- Advanced Numerical Analysis -- R. C. F. Bartels and T. B. Curtz in charge.
- Programming Concepts, Automata, and Adaptive Systems -- J. H. Holland in charge.

Applications for enrollment and requests for information should be directed to R. E. Carroll, Engineering Summer Conferences, 126 West Engineering Building, Ann Arbor, Mich.

WESTERN JOINT COMPUTER CONFERENCE AND EXHIBIT

The sponsoring societies of the Western Joint Computer Conference are: Institute of Radio Engineers; American Institute of Electrical Engineers; and the Association for Computing Machinery. The conference will be held May 3, 4, 5, at the Jack Tar Hotel, San Francisco, Calif.

"The Challenge of the Next Decade" will be the general theme at this year's conference and the topics of the sessions and papers are as follows:

Tuesday, May 3
Session I-A

COMPUTER ORGANIZATION TRENDS -- Panelists: Gene Amdahl, Aeronutronic Corp.; Morton M. Astrahan, IBM Corp.; J. Wesley Leas, RCA.

The Historical Development and Predicted State-of-the-Art of the General Purpose Digital Computer -- C. P. Bourne and D. Ford, Stanford Research Institute

The Harvest System -- P. S. Herwitz and J. H. Pomerene, IBM Corp.

Horizons in Computer Systems Design -- Walter F. Bauer, Ramo-Wooldridge Corp.

Organization of Computer Systems--The Fixed Plus Variable Structure Computer -- Gerald Estrin, University of California, Los Angeles

Session II-A

DATA RETRIEVAL -- Panelists: John Postley, RAND Corp.; Mrs. P. B. Bremer, FMA, Inc.; M. E. Maron, RAND Corp.

A Multi-Level File Structure for Information Processing -- Louis Miller, Jack Minker, W. G. Reed, and W. E. Shindle, RCA.

Symbolic Logic in Language Engineering -- H. M. Semarne, Douglas Aircraft Co., Inc.

The Fact Compiler--A System for the Extraction, Storage, and Retrieval of Information -- Charles Kellogg, Ramo-Wooldridge Corp.

Session II-B

COMPONENTS AND TECHNIQUES -- Panelists: D. A. Meier, National Cash Register; Norman L. Kreuder, Electrodata

A Word-Oriented Transistor-Driven Non-Destructive Read-Out Memory -- D. G. Fischer and T. C. Penn, Texas Instruments, Inc.

Unifluxor: A Permanent Memory Element -- A. M. Renard, Aeronutronic; W. J. Neumann, Remington Rand Univac

Characteristics of a Multiple Magnetic Plane Thin Film Memory Device -- K. D. Broadbent, S. Shohara, and G. Wolfe, Jr., Hughes Aircraft Co.

Session II-C

ANALOG EQUIPMENT -- Panelists: Vernon L. Larrowe, University of Michigan; Mark E. Connelly, Massachusetts Institute of Technology

Analog Time Delay System -- Charles D. Hofmann and Harold L. Pike, Convair Astronautics

DAFT: A Digital/Analog Function Table -- Robert M. Beck and Jack M. Mitchell, Packard Bell Computer Corp.

Mathematical Applications of the Dynamic Storage Analog Computer-- J. M. Andrews, Computer Systems, Inc.

Wednesday, May 4
Session III-A

LEARNING AND PROBLEM SOLVING MACHINES -- Panelists: Oliver Selfridge, Lincoln Laboratory, MIT; J. C. R. Licklider, Belt, Beranek, and Newman, Inc.; H. J. Bremermann, University of California, Berkeley

Recognition of Sloppy, Hand-Printed Characters -- Worthie Doyle, Lincoln Laboratory, MIT

Empirical Exploration of the Geometry Theorem Machine -- H. Gelernter, J. R. Hansen, and D. W. Loveland, IBM Corp.

A Suggested Model for Information Representation in a Computer that Perceives, Learns, and Reasons -- Peter H. Greene, The University of Chicago

Session III-C

ANALOG TECHNIQUES -- Panelists: G. A. Korn, University of Arizona; Walter Brunner, Electronic Associates, Inc.

Analog Computer Techniques for Plotting Bode and Nyquist Diagrams -- G. A. Bekey and L. W. Neustadt, Space Technology Laboratories, Inc.

On the Reduction of Error in Certain Analog Computer Calculations by the Use of Constant Equations -- R. M. Turner, Lockheed Aircraft Corp.

The Use of Parameter Influence Coefficients in Computer Analysis of Dynamic Systems -- Hans F. Meissinger, Hughes Aircraft Co.

Session IV-A

TRENDS IN COMPUTER APPLICATIONS -- Panelists: Clair E. Miller, Electronic Computing Center, San Francisco; A. R. Zipf, Bank of America; George W. Evans, Stanford Research Institute

Data Processing--What Next? -- John M. Salzer, Ramo-Wooldridge Corp.

The Outlook for Machine Translation -- Franz L. Alt, National Bureau of Standards

Computers for Artillery -- Lt. Colonel Louis R. van de Velde, U. S. Army Artillery and Missile School, Fort Sill

Session IV-B

LOGICAL DESIGN -- Panelists: A. Jennings, California Computer Products; D. Aufenkamp, General Electric Co.; B. Elspas, Stanford Research Institute

Communications Within a Polymorphic Intellectronic System -- George P. West and Ralph J. Koerner, Ramo-Wooldridge

Encoding of Incompletely Specified Boolean Matrices -- T. A. Dolotta and E. J. McCluskey, Jr., Princeton University

A Built-in Table Lookup Arithmetic Unit -- R. C. Jackson, W. H. Rhodes, Jr., W. D. Winger, and J. G. Brenza, IBM Corp.

Session IV-C

HOW WELL ARE WE PROCESSING OUR OWN INFORMATION? -- Panelists: Sandy Lanzarotta, Editor, "Datamation"; Jackson W. Granholm, Editor, "Computing News"; Fred Gruenberger, News Editor, "Communications of the ACM"

Thursday, May 5
Session V-A

DESIGN, PROGRAMMING, AND SOCIOLOGICAL IMPLICATIONS OF MICROELECTRONICS --

On Microelectronic Components, Interconnections, and System Fabrication -- Kenneth R. Shoulders, Stanford Research Institute

On Iterative Circuit Computers Constructed of Microelectronic Components and Systems -- John H. Holland, University of Michigan

On Programming a Highly Parallel Machine to be an Intelligent Technician -- Allen Newell, The RAND Corp.

On a Potential Customer for an Intelligent Technician -- C. West Churchman, University of California, Berkeley

Session V-C

ANALOG APPLICATIONS -- Panelists: John H. McLeod, Convair-Astronautics; Donald F. Zawada, Ford Motor Company

Real-Time Automobile Ride Simulation -- Robert H. Kohr, General Motors Corp.

Using an Analog Computer for Both Systems Analysis and Operator Training on the Enrico Fermi Nuclear Power Plant --

Samuel N. Irwin, and Robert Kley, Holley Carburetor Company

Anatran--First Step in Breeding the Diginalog -- Lee Ohlinger, Northrop Corp., Norair Division

Session VI-A

PROGRAMMING SYSTEMS -- Panelists: Robert L. Patrick, Manhattan Beach, Calif.; Ascher Opler, Computer Usage, Inc.; Richard Ridgway, IBM Corp.

Man-to-Machine Communication and Automatic Code Translation -- A. W. Holt, on leave from Remington Rand Univac to the Moore School of Electrical Engineering, and W. J. Turanski (deceased)

The Computer Operation Language -- G. F. Ryckman, General Motors Corp.

A New Approach to the Programming Problem -- William Orchard-Hays, Corp. for Economic and Industrial Research, Inc.

Session VI-B

INPUT-OUTPUT AND COMMUNICATIONS -- Panelists: J. Svigals, IBM Corp.; G. Warfel, Bank of America

A Line-Drawing Pattern Recognizer -- Leon D. Harmon, Bell Telephone Laboratories

Automatic Store and Forward Message Switching System -- T. L. Genetta, H. P. Guerber, and A. S. Rettig, RCA

The Videograph Label Printing System Developed for Time Inc. -- B. H. Klyce, Time Inc., and J. J. Stone, A. B. Dick Co.

EXHIBITS: Exhibits will be located adjacent to the technical sessions in the Jack Tar Hotel. These will be open to the public as follows:

May 3	12 noon to 6:00 p.m.
May 4	12 noon to 9:00 p.m.
May 5	9:00 a.m. to 6:00 p.m.

SYSTEMS SIMULATION USING DIGITAL COMPUTERS -- SEMINAR

Cornell University, Ithaca, N.Y.

An industrial engineering seminar on "Systems Simulation Using Digital Computers" will take place at Cornell, June 14-17. The program follows:

June 14

Introduction. The experimental investigation of complex systems. R. W. Conway, Cornell University.

The Modern Digital Computer. Equipment requirements for digital simulation. R. W. Conway.

Logical Representation of an Operating System. Translation to computer language. Sidney Saltzman, Cornell University.

June 15

A Simple Queue Simulator (I). Construction of a computer program to simulate a simple queuing system. Sidney Saltzman.

A Simple Queue Simulator (II). Simulation runs will be made at the Cornell Computing Center.

The Cornell Simulator. A program to simulate a production shop. W. L. Maxwell, Cornell University.

June 16

Problems in the Design of a Simulation Experiment. Elements of experimental design important in simulation. R. E. Bechhofer, Cornell University.

Operating Problems in a Simulation Experiment. Problems of multi-variable exploration, equilibrium, starting conditions and sampling. R. W. Conway.

Production Control Simulation (I). Experimental comparison of production control decision rules suggested by seminar participants using the Cornell Simulator. W. L. Maxwell.

Manufacturing Systems Simulation in the General Electric Company. W. E. Barnes, Production Control Service, General Electric Co.

June 17

Production Control Simulation (II). Analysis and evaluation of experimental results. W. L. Maxwell.

Survey and Summary of Applications of Simulation. General discussion and conclusions. R. W. Conway.

Informal Discussion. An optional period for individual consultation and informal group discussion.

AUTOMATIC DEGAUSSER OF MAGNETIC TAPE ON REELS

Consolidated Electrodynamics, Pasadena, Calif.

An automatic degausser for reeled tapes has been added to this company's line of magnetic tape equipment. A reel of instrumentation tape recorded to saturation is erased by the degausser to at least 50 db below normal record level.

The new Type 5-055A Automatic Tape Degausser can be used with tapes from one-quarter to two inches in width, reels from seven to 14 inches in diameter, and reel hubs of all dimensions.

Uniform degaussing is achieved with automatic time cycling of reels in the magnetic field. After a reel of tape is placed on the turntable spindle and the OPERATE button pressed, capacitor-type motors slowly move the reel into the erasing field, rotate it several times, and slowly withdraw it. When the reel returns to its original position the degausser shuts off. The degaussing cycle is completed in approximately 60 seconds. Heavy shielding prevents erasing field radiation from reaching nearby tape system components.

TWO RW-300 COMPUTERS WILL BE INSTALLED IN SECOND FRENCH NUCLEAR POWER PLANT

Thompson-Ramo-Wooldridge Products Company, Beverly Hills, Calif.

The second commercial nuclear power plant in France will utilize two RW-300 Digital Control Computers to detect and locate burst fuel slugs.

The plant is being constructed near Chinon by Electricite de France, electric power utility owned by the French Government. The nuclear reactor will be started up at the beginning of 1961 with the two RW-300 computers connected to the system for monitoring the radioactivity of the cooling gas.

Two RW-300 computers are now being installed in the first French commercial nuclear power plant, also at Chinon, France.

The second plant will have a rated output of 800 megawatts of heat and 250 megawatts of electricity. It will be among the largest nuclear power plants in the world. The reactor will require 250 tons of natural uranium as fuel and 2,000 tons of carbon (graphite) as moderator. Carbon dioxide at a pressure of 360 pounds per square inch will transfer heat from the reactor to a heat exchanger, where steam will be formed to drive turbine-generators.

Intertechnique, a prominent French electronics and instrumentation company, has the prime contract for the reactor monitoring system which will incorporate the two RW-300 computers. Intertechnique has primary responsibility for engineering the instrumentation and data-handling portion of the burst-slug detection system into the nuclear reactor plant.

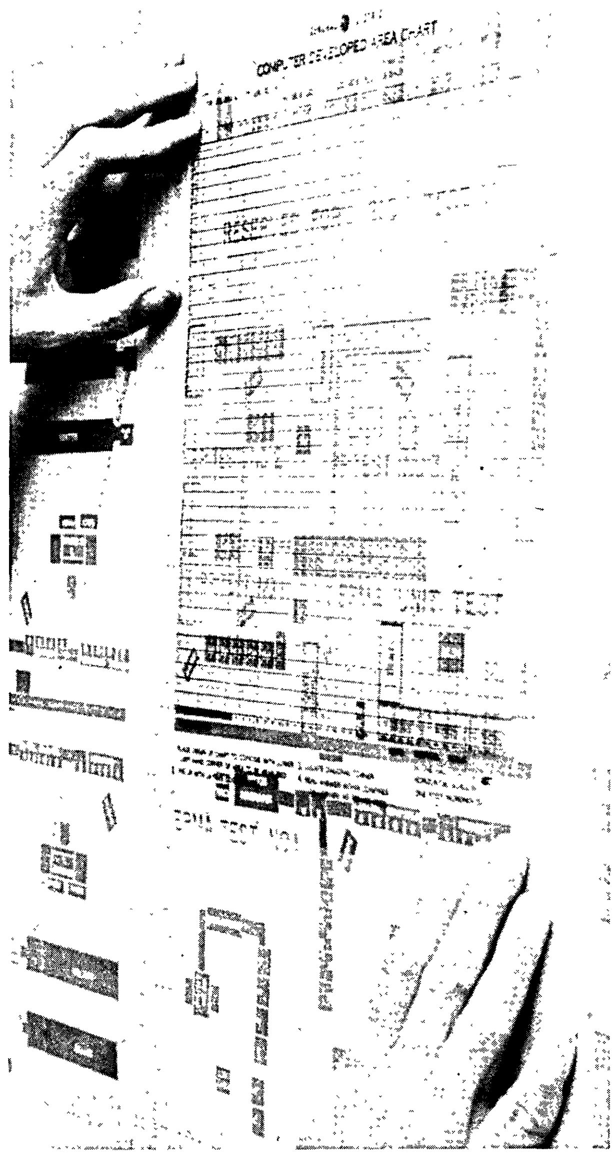
COMPUTER-DEVELOPED AREA CHART

General Electric Co., Phoenix, Arizona

By using a computer, two plant-layout engineers at the General Electric Company's Computer Department have developed a transparent, calibrated area-chart for determining at a glance the square footage of any rectangular mapped surface. Time studies show use of the new chart saves up to 40 per cent of the time formerly required to determine square footage. Possibility of error is reduced by as much as 75 per cent.

The chart, comprising 3,200 calculations, is placed on top of a scaled map of an area to be measured. Origin of the chart coincides with the lower left corner of the rectangular area to be measured. Exact square footage may then be read in the diagonally opposite corner.

Calculations for the chart were worked out on a computer in 13 minutes. Although the chart was designed specifically for determining square footage on a one-quarter-scale layout, it may of course be prepared in any unit of measurement, such as miles, yards, etc. Such charts may find wide use on scaled-maps used by architects, engineers, the military, and others.



THE FERREED: MICROSECOND MEMORY DRIVES METALLIC CONTACTS

Bell Telephone Laboratories, Whippany, N.J.

A team of engineers here has invented a very fast electromechanical switch called the "ferreed". It utilizes a new technique for actuation which is compatible in speed with electronic circuits.

The ferreed may find use as an interconnecting element in telephone switching networks, where it could be controlled a thousand times more rapidly than switches presently employed.

Inventors of the new switch, A. Feiner, C. A. Lovell, T. N. Lowry, and P. G. Ridinger, are members of the technical staff of Bell Telephone Laboratories. They anticipate applications for the ferreed in various types of systems where advantage may be taken of metallic contacts controllable by current pulses of a few microseconds duration.

Magnetic materials that can be quickly switched between two alternate states have been widely used as "memories" for storing information in digital computers. The useful output from these elements has generally been limited, however, to electrical signals of a transitory character.

In conventional electromagnetic relays, on the other hand, continuous electrical currents can be used to open and close metallic contacts for extended periods of time, but at speeds limited by the mechanical motion of the moving parts.

The ferreed combines the rapid switching of bistable magnetic material with metallic contacts for output indications that persist as long as desired without further application of power. In several models of the device, a cobalt ferrite has been used as the magnetic material and a glass-sealed magnetic reed switch for the output contacts -- hence the name, "ferreed".

In operation, the magnetic material is switched by a magnetomotive force applied, typically, as a five-ampere current pulse in a thirty-turn winding. Control pulses as short as five microseconds will switch the magnetic material, resulting in the passage of magnetic flux through the movable members of the reed switch. Actual closure of the contacts is delayed by inertia of the reeds for several hundred microseconds.

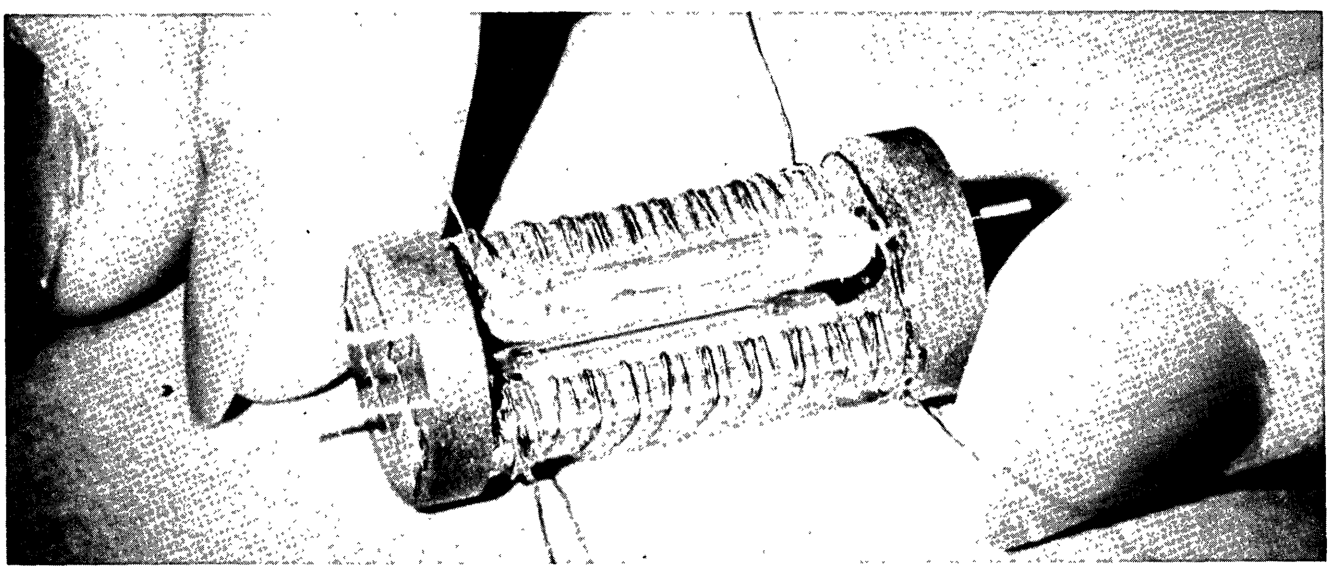
Release of the contacts is brought about by cancellation of the magnetic flux through the reeds, as the result of another five-microsecond switching operation. Opening of the contacts requires less time than the closing operation.

Several new magnetic materials have been synthesized for use in developmental models of the ferreed. Among these are ferrites exhibiting characteristics midway between permanent magnets and computer memory materials, and ferrite suspensions in plastic "tailor-made" for specific magnetic, electrical, and mechanical properties. The reed switch is similar to a type used in standard electromagnetic relays for the past decade.

In a telephone switching network, subscribers are interconnected by the closure, in specified patterns, of switches called "crosspoints". A typical central telephone office contains many thousands of these switches; of these, a few dozen are operated for each call. Those crosspoints required for a particular connection must be selected by the coincidence of pairs of control pulses. The ferreed's magnetic structure responds to a pair of pulses by closing the output contacts. They are opened by a subsequent single pulse.

Besides coincident pulse operation and rapid actuation, the magnetic structure permits the desired switching by current pulses of widely variable character.

The result, when ferreeds are used in switching networks, is reliable operation from simple control circuits.



The ferreed, developed at Bell Telephone Laboratories, is a very fast electromechanical switch with metallic contacts, requiring no holding power.

In the two-branch ferreed pictured, two ferrite bars, two glass-sealed magnetic reed switches, and two plastic end-pieces comprise the magnetic circuit.

Non-conducting electrically, the plastic end-pieces magnetically couple the ferrite bars to the magnetic reed switches, at the same time providing a good structural support for the assembly.

The passage of magnetic flux through the movable metallic members of the reed switch closes a circuit. Control pulses of five microseconds through the windings on the ferrite will switch the magnetic material.

RESEARCH ACTIVITY AT PHILCO -- SOME NOTES

Philco Research Division, Philco Corp., Philadelphia 34, Pa.

On January 1, 1960, Philco's Research group became a separate division, with its own administrative organization, preparatory to a move in early 1961 to a new Research Center under construction in Whitpain Township, near Norristown, Pa.

According to Philco President James M. Skinner, Jr., "We have spent twice as much on research in 1959 as was spent in 1949; we predict that research expenditures will double again in the next five-year period."

Areas of Research Activity

Basic Science and Technology:
- Semiconductor metallurgy:
  - Single crystals
  - Polycrystalline materials
- Magnetic and dielectric materials
- Physics and chemistry of transistors
- New physical and chemical sources of electric power
- Thermoelectric cooling
- Electron optics
- Information theory applied to communications and radar

Devices and Components:
- Transistors
- Microelectronics and micromodules
- Transistorized, computer components
- Infrared devices
- Single-crystal and film detectors, imaging systems, cooling devices
- Microwave components
- Combination of transistors and harmonic generators for higher frequency performance
- Parametric-diode amplifiers
- Semiconductor oscillators and amplifiers for X-band and above
- Thermoelectric power generators and fuel cells for conversion of heat energy to electricity
- Electrovisual devices -- data displays and techniques for the manipulation of visual data

Circuits and Equipments:
- Arithmetic and memory assemblies for computers
- Digital circuits and equipments
- Analog circuits and equipments
- Acoustic subsystems
- Digital computer circuits, continued work toward higher speed
- Conversion -- analog-to-digital, digital-to-digital, digital-to-analog
- Digital communication
- Microwave circuits -- enhancement of signal-detection; solid-state devices for oscillation and amplification.

Systems Research:
- Missiles and space systems
- Surveillance -- radar and infrared
- Communications -- ground and space
- Anti-submarine warfare

COMPUTER FOR BRITISH GOVERNMENT PENSION OPERATIONS

F. C. Livingstone, London, England

An enormous electronic computer is to be installed at Newcastle-on-Tyne, England, to handle, the British Government's new graduated pensions scheme. The Ministry of Pensions has placed an order for an Emidec 2400, one of the largest and most advanced computers in Europe.

This machine will check the records of every insured person in Britain - some 25 million - every day. The job will take about four hours.

Thirty million forms a year will be processed when the scheme is running full blast. The relevant information will be fed into the computer's memory, the main part of which will consist of 22 large magnetic tape recorders. A new type of printing machine, which can print 50 lines a second, will put the results of the machine's calculations down on paper.

This is the second Emidec 2400 to be sold. The first was bought by the Royal Army Ordnance Corps, mainly to keep track of spare parts used in Army vehicles.

An Emidec 3400 is being planned, a still larger and more powerful machine than the 2400. It will be on a similar scale to the Ferranti Atlas machine being developed in association with Manchester University and the IBM "Stretch".

The British Government's National Research Development Corporation has been supporting the development of the Emidec 2400 and 3400 and is also supporting the Atlas.

DEVELOPING AND TESTING BOOK-MARKING EQUIPMENT

Council on Library Resources, Inc., Washington, D.C.

Two grants, totaling $22,600, have been made by the Council on Library Resources, Inc., to the American Library Association, 50 East Huron St., Chicago.

The grants are for research and development to be undertaken by the organization's Library Technology Project.

A $20,000 grant will be used to develop a mechanical book-marking device to replace the present hand methods. A smaller grant of $2,600 covers several small testing programs which will be conducted by the Chicago Paper Testing Laboratory, Inc.

Battelle Memorial Institute of Columbus, Ohio, will conduct research and development on the book-marking machine. The millions of volumes added to library collections each year must be individually labeled on the spine with a number. Development of a book-marking device would mechanize a process which has used slow, unsatisfactory hand methods for many years. A conservative estimate indicates that with a satisfactory machine books could be marked twice as rapidly as by hand and with increased legibility and complete uniformity.

The project hopes to develop a device similar in size and ease of operation to a small adding machine. Battelle will conduct the project in two phases, the first to demonstrate the feasibility of the system, and the second to construct a complete prototype. The present grant covers the first phase only, which will take about six months.

If the first phase is successful, the construction of a prototype is expected to take about four months. The completed prototype will be library tested, and cost comparisons will be made between present methods of marking and the machine method.

The Council on Library Resources, Inc., is a non-profit agency established in 1956 with the aid of a grant from the Ford Foundation to assist in solving the problems of libraries.

MAGNETIC CORE MEMORY TO WITHSTAND SHOCKS OF 10 G AND VIBRATION OF 2000 CYCLES PER SECOND

Telemeter Magnetics, Los Angeles, Calif.

A new magnetic core memory stack for withstanding great vibration and shock has been developed by this company. Made up of an assembly of core arrays, the new memory stack is designed to withstand the rigors of military applications where vibration and shock would destroy ordinary units.

The new units, which are called MIL-STAK, are unaffected by acceleration to 10 g with vibration to 2000 cps.

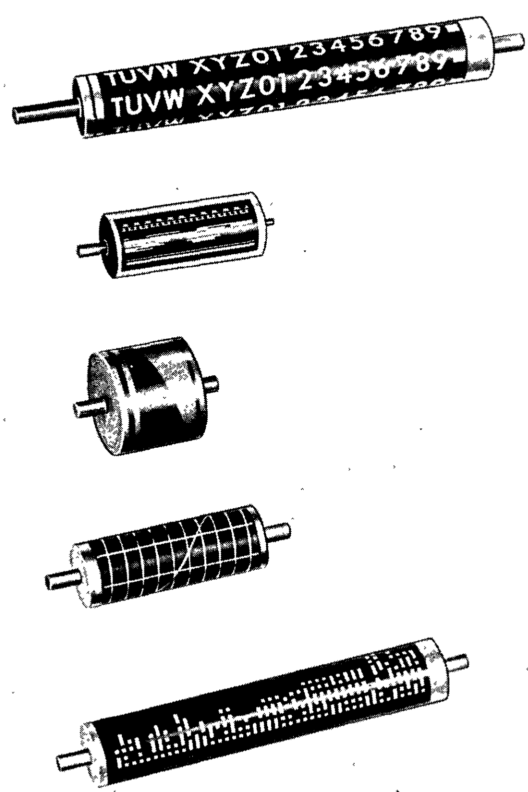
To achieve the rugged construction, a molded plastic frame has been designed on which the cores are wired to form an array. Then the wired arrays are interconnected by a locked link method and then the entire stack is encapsulated in polyurethane.

With the interest in automatic digital control of missiles and other space vehicles, a wide variety of applications is anticipated.

CODE AND SWITCHING DRUMS USING EMBEDDED CIRCUITS

Beck's, Inc., St. Paul, Minn.

The accompanying figure shows some of the drums carrying codes and switching circuits made by this company. The shaft can be metallic or nonmetallic, of any length. The conducting area can be copper, brass, silver, aluminum, etc.; and can be plated. The insulation can be epoxy or other resins with or without fillers, and is flush with the conducting areas. The inside of the drum can be hollow or filled. The diameter can be one quarter inch to four inches or larger. The code pattern can be any that is desired. The code drums are used in telemetering, automation, control devices, etc.



HIGH-SPEED COMPUTATION AND INSTRUMENTATION FOR PROCESS CONTROL

Instrument Society of America, 313 Sixth Ave., Pittsburgh 22, Pa.

Under the theme "High Speed Computing and Instrumentation for Process Control" a number of papers are scheduled for the technical sessions of the Instrument-Automation Conference & Exhibit of the Instrument Society of America, to be held in the Civic Auditorium, San Francisco, May 9 through 12, 1960.

Approximately 60 papers are scheduled for some 25 technical sessions of the Conference. The session dealing particularly with computing, is:

DATA HANDLING & COMPUTATION
(Wednesday, May 11 - 9:30 a.m. to Noon)

"Applications of the Quadratron to Computation and Data Reduction", Dr. Ladis A. Kovach and William Comley, Douglas Aircraft, Inc., El Segundo, Calif.

"The Generation of Information For Decisions Of Specified Risks", J. E. Witherspoon, Rocketdyne, Canoga Park, Calif.

"Real-Time Aspects of On-line Computer Control", Arthur J. Donovan, Librascope Div'n., General Precision, Burbank, Calif.

"Real-Time Digital Computer Control System For Industrial Applications", Geert H. Bouman, Minneapolis-Honeywell Regulator Co., Phildelphia, Pa., and Dr. Joseph J. Eachus, DATAmatic Division, Minneapolis-Honeywell Regulator Co., Newton Highlands, Mass.

PRODUCTION IMPROVEMENTS FOR THE NUVISTOR TUBE

Radio Corp. of America, Camden, N.J.

Several important new developments for the economical production of RCA's thimble-size nuvistor electron tube have taken place:

(1) a brazing operation for the nuvistor's assembly in which eleven wires are sealed vacuum-tight through a ceramic wafer while fourteen other joints are made;
(2) because of the open-ended cantilever construction within the nuvistor, complete mechanized assembly of the parts into jigs for accurate positioning of electrodes;
(3) means to control the processing of vitreous ceramic bodies so that finished parts can be made to very small tolerances without expensive machining operations;
(4) a simple, reliable method for metallizing the ceramic.

Readers' and Editor's Forum

FRONT COVER: RAPID INDEXING OF THOUSANDS OF CHEMICAL ARTICLES

The front cover shows the actual printing out of two pages of a new journal called "Chemical Titles," which is to be produced entirely by computer, once the initial titles and authors of articles have been punched on punch cards. The publisher of this journal is the American Chemical Society, 2 Park Ave., New York 16, N.Y.; the machine which prints the master pages for photo offset publication is an International Business Machines Corp. Type 407 Printer; the computer is an IBM 704; and the method of production is called the "Keyword-in-Context" method, and has been devised by H. P. Luhn, of the Advanced Systems Development Division of IBM, Yorktown Heights, N.Y.

This publication is another milestone in the effort to inform chemists of what is being published in the field of chemistry. The journal which does most of the work in this regard is "Chemical Abstracts" (published by the American Chemical Society), which in 1960 expects to publish some 150,000 abstracts of papers and patents, covering 9000 journals representing nearly 100 countries and appearing originally in more than 50 languages. "Chemical Titles" will seek to accomplish a more modest task but much faster: covering 550 of the most important chemical journals (including 100 Russian ones) and with a time delay very much less than the delay of "Chemical Abstracts." "Chemical Titles" is in two parts, the keyword-in-context index, and a bibliography. Each title will appear in the index as often as it contains a keyword; but 960 words are rejected as keywords — not only prepositions and conjunctions, but also words such as "use, theory synthesis, chemistry" which contribute little or nothing to the recognition of subject matter. Each key word is amplified by the surrounding portion of the title (see the examples in the front cover picture), and is accompanied by the "identification code" of the article which the computer determines and which enables the full title, author, and citation to be quickly found in the bibliography.

WORKING GROUP FOR BETTER EDUCATION

The first regional meeting of the Working Group for Better Education was held in a morning and afternoon session on Saturday, March 26, at Mass. Inst. of Technology, Cambridge, Mass. Nineteen people were present, 3 from Connecticut, 2 from New York, 2 from New Jersey, 1 from Mexico City (Dr. Sergio Beltran, Director of the Computing Center, National Univ. of Mexico), and the remainder from Massachusetts.

W. Eugene Ferguson, Chairman, Dept. of Mathematics, Newton High School, talked on new developments in secondary mathematics courses and distributed a guide to them. Norton Levy, Chairman, Dept. of Mathematics, Concord High School, talked on the use of community resources in Concord, consisting of some 80 professional people who have helped in the teaching of mathematics and in the pursuit of mathematical projects by students. Dr. Robert B. Davis, of Syracuse University, and the School Mathematics Study Group at Yale, talked briefly on their program. Dr. Sergio Beltran talked on the thirst for education in Mexico, the lack of means for fulfilling it, and the tremendous energy going into the task.

At the end of the morning session, certain resolutions were discussed and passed unanimously:

— 1. That membership in the WGBE should not be restricted to only members of the Association for Computing Machinery and readers of **Computers and Automation,** but that membership should be open to all seriously concerned, academically or technically trained persons, such as members of the IRE or AIEE or teachers of mathematics in secondary schools, etc.

— 2. That the WGBE therefore could not ask the Association for Computing Machinery to pay its costs, but that it should have membership and dues.

— 3. That dues should be $2 a year, for the present.

— 4. That there be two officers, an Acting Treasurer and an Acting Secretary. For Acting Treasurer, Frank Verzuh was elected; for Acting Secretary, Edmund C. Berkeley was elected.

— 5. That there should be some simple bylaws. For bylaws committee, the two officers were elected.

— 6. That the WGBE should be a "permissive and enabling" organization, permitting and helping good work to get done with a minimum of formality.

It was agreed that six working subgroups should be started; a list of them (with members as of March 26) follows:

1A. Teaching computers and data processors to high school and college students: R. V. Andree, Walter Taylor

1C. Automatic teaching machines: Frank Verzuh, Ed Berkeley, Loren Bullock, Robert B. Davis

2C. Logic and reasoning: Werner C. Rheinboldt, Sheldon Rifkin (both of Syracuse)

3A. Verifying the quality of education produced: Ed Berkeley

6B. Use of community resources in professional people: Norton Levy

7C. Better education in Mexico: Sergio Beltran, Ed Berkeley

For the afternoon session, seventeen people reassembled. News of the Los Angeles WGBE group, and of the Syracuse WGBE group, was reported. For the last hour and a half an open discussion took place based on agenda of 16 topics put together by those present.

THINKING BY MACHINES

I. From William C. Christian, Asst. Editor

Management and Business Automation
Chicago, Ill.

Management and Business Automation magazine . . . has tackled the important and exciting subject of the thinking ability of machines.

The daily press and various magazines are continually publishing conflicting articles on this subject. The term "electronic brain" is kicked around and some of the connotations are actually injurious to the positive progress and development of automation, especially among users of the equipment.

As an authority in your area of automation, would you help us clear the air for our readers? We are going to make a sincere effort to communicate the full implication of machine thinking between the scientist working with advanced automation theories and the businessman who is utilizing the tools of today. We request evidence of a machine's ability to "think" in terms the businessman can understand. We want to explain how far today's machines have progressed, and how far they could go if they were fully utilized. In your opinion:

1. Can or will machines be able to "think" entirely for themselves?
2. What do you predict the state and extent of automation will be in the next 10 years?

It may be a difficult task to sum up this information in a brief statement. You may express yourself at length, if you wish. We would appreciate any information that would help in the development of this article. In giving our readers your updated and important opinion, you will, in effect, be rendering a service, by communicating a vital but much misunderstood message. . . . Your cooperation will be greatly appreciated.

II. From the Editor

1. The Meaning of "Thinking"

The word "thinking" received most of its meaning years ago. Its applicability to various kinds of situations involving reasoning and judgment was established almost entirely in the years before automatic computing and data processing machines were invented.

As one result, when the word "thinking" is applied to machines, the connotation of the word "thinking" arouses emotional reactions in people.

As a second result, there is an uncertain and fuzzy area in the meaning of the word "thinking" when it is applied to novel situations. The operation of automatic machines that handle information reasonably and automatically is a novel situation.

Therefore, most of the argument about whether or not a machine can think is shallow and fruitless, because it reduces to an empty argument over whether or not some kind of specific activity (for example, like carrying on a sensible conversation) is or is not to be included under the term thinking. It does not seem to be worthwhile to be much interested in this part of the argument any longer, since the answer in any discussion depends upon which person in that discussion succeeds in capturing the right to define the word "thinking."

2. Education and Thinking

A more important part of the argument is based on considering how a human being manages to think. Clearly, he does not succeed in thinking adequately in the way human beings think unless he has been educated, and rather well educated at that. A completely uneducated human being would be one deprived, from birth on, of any contact with other human beings; such a person cannot think, cannot even communicate.

Let us contrast briefly the education of a human being and a computer, first as to schooling:

Human Being	Computer
Reading	Taking in information
Writing	Putting out information
Spelling	Control over format so that output is produced in satisfactory form
Arithmetic, mathematics	Arithmetical unit of the computer, and some programming
History, geography, literature, social studies	Storage of certain information in the memory units and magnetic tapes of the computer
Foreign languages	Machine translation
English composition	Capacity to compose sentences having meaning (shown to be possible in the report "Conversation with a Computer" by L. E. S. Green, published in the October, 1959, **Computers and Automation**)

Let us compare some other subjects which are not part of the curriculum of formal education in school:

Human Being	Machine
Capacity to look around, see, and recognize various features of the environment	Present to some extent in radar tracking scopes, character reading devices, etc.
Capacity to listen to spoken language and extract phonemes (unit speech sounds) from them	Not present in any existing machine but being worked on actively
Capacity to put phonemes together into words	Clearly reducible to a program for a computer
Capacity to take strings of words and get an idea out of them	Present in today's computers in mathematical and logical areas
Capacity to take ideas and put them into words	Present in today's computers
Capacity to combine ideas in new ways to solve problems	Present in today's machines (see for example "A Report on a General Problem Solving Program for a Computer" by A. Newell, J. C. Shaw, and H. A. Simon, published in the July, 1959, **Computers and Automation**)

With this list of thinking activities in front of us, we can ask "Are any human thinking abilities beyond the capacity of computers?" The answer is clearly "No."

We cannot see any insuperable obstacle, any theoretical barrier. The differences between human being and machine are differences of degree rather than quality.

3. Personality and Programs

After computers become able to do a really large number of the kinds of operations we call "thinking," then a computer will appear to have a personality — a way of behaving which is a reflection of the properties of the computer and the way it has been programmed. In the same way, a human being has a personality which is a reflection of his properties and his education.

But there remains a marked difference. A human being comes as a whole. It is not possible at will to cut off from him quantities of certain kinds of thinking behavior, in the way that certain kinds of programs can be taken out of a computer. Also, it is not possible to add into a human being, in a minute or two, quantities of certain other kinds of thinking behavior, in the way that certain other programs can be put into a computer. Probably no human being will ever change his personality entirely in one minute, in the way that a program taken out of a computer and another program put in changes its personality.

Shall we say then the programs do the thinking and not the computers? (and assert that "the programs are made by human beings"?)

Nowadays many programs are made by human beings. But they are mainly transmitting the education with which they themselves have been programmed by the processes of more than 5000 years of civilization. But also computers make programs and improve programs; and this will happen to a much greater extent in the future. For example, the forecast has been made that during the next ten or twenty years the world's champion chess player will be an automatic computer.

The tide is running strongly in the direction of more and more thinking abilities becoming parts of the powers of computers. An engineer is well guided when he says, "If human thinking can do it, then a computer ought to be able to do it."

COMPUTER BERGERAC

Milton Weiss

Newton, Mass.

In the air-conditioned room overlooking the New York skyline the lights of the large digital computer blinked in changing patterns as the machine analyzed the profits and losses, the sales and earnings of 251 large corporations simultaneously. A battery of teletypewriters connected directly to the computer clattered noisily at one side of the room, fed questions and financial data to the machine and automatically transmitted its answers throughout the nation and Canada. Representing the efficient effort of that Stock Exchange firm, Magill, McCord, Jones and Lindsay to give their branch offices the best financial and investment advice as quickly as possible, the entire room with its gleaming assemblies of panels and auxiliary operators was in sole and complete charge of young Dave Harland, who sat sprawled in a chair before the main panel of the computer.

A young man with red hair, lanky legs, big steady hands, and an MIT degree, Dave knew every transistor, gear and magnetic scanning head of his computer better than his own initials. Author of programming shortcuts undreamed of by the computer's maker, he had developed the system of communication with teletypewriters between the branch offices and the machine.

To Dave the computer was more a beloved friend than a complex maze of pulses, potentials and power, but as he now gazed moodily at it he didn't see the lights on the panels nor did he hear the continuous drumming of the typewriters. Instead his mind was filled with Betty Marshall. She was more than 200 miles away but her blue eyes and the smooth curves of her slender figure were more real to Dave than the shock from a high voltage power supply.

Suddenly Dave raised his hand and banged the side of the chair in frustration. For the last week thoughts and visions of Betty had filled his mind leaving him unable to concentrate on computers or anything else. Engrossed with studies and work Dave had never paid any attention to girls. Besides they always confused him and made him feel alone and shy. Even trying to talk with a girl froze Dave's vocal chords and clenched his hands into tight fists. But last week he had met Betty and more than anything else he wanted to know her better.

A week ago he had been in Boston to show the teletype operator how to word questions transmitted directly to the New York computer. Betty was seated at the Boston machine kept by itself for maximum privacy in a small room. When she smiled up at him while being introduced, Dave's heart skipped a beat and he gulped. Somehow he mumbled his pleasure but he could barely take his eyes from her petite face framed in curly blonde hair.

He couldn't remember a single word of his instructions to her, but he had no trouble recalling the sound of Betty's low voice or the occasional touch of her shoulder as they sat together before her typewriter. Desperately Dave sought for a conversational opening after the lesson — some way of getting to know her — but neither the thought nor the words would come. He returned to New York that same day, a confused and unhappy young man. And ever since Betty had haunted him.

And now as he sat in his New York office, Dave was distinctly unhappy. "This can't go on," Dave reflected grimly. Abruptly he uncoiled his legs, lifted himself from the chair, and in two long strides he was beside the group of teletypewriters. The Boston line wasn't in use. Good. Without giving himself a chance to think, he flicked a switch and typed, "Hello, Miss Marshall. How are you?" Then he typed his name, and waited.

For a long surprised moment the machine remained silent. Dave held his breath and prayed that Miss Marshall still worked for the company. Then the typewriter carriage danced jerkily as the reply spelled itself on the paper. "Fine, Mr. Harland, how are you?"

Dave heard a sigh. With hands that trembled slightly he responded that he too felt fine and that he hoped she was having no trouble with her machine. Miss Marshall replied that all was well and that his instructions of last week had proved very helpful.

"I'm very glad to hear it," said Dave, making only two typing errors. Then he stopped. His fingers remained ready on the keys but his brain sent them no message. Images of Betty, incoherent words, bits of programming code, all swarmed through his mind, but he could think of nothing to say — absolutely no way of continuing the conversation. Dave's scalp tingled and he clenched his teeth. After a long and awkward pause, he lamely managed, "Well, see you later."

In Boston, Betty Marshall, making no effort to continue the conversation, typed a quick goodbye. Then she tore the sheet from the typewriter, and slowly reread it. Very deliberately she folded the paper and put it in her handbag, a slight smile on her lips.

At the other end of the line, Dave's face was scarlet as he switched the teletypewriter back to the computer. He felt like a complete fool. Slowly he turned and walked to the programming console near the computer main chassis. There he gazed with obvious distaste at the programming schedules neatly laid out near the large rolls of magnetic tape.

Then he started to swear, softly and slowly, with deliberate emphasis on each syllable. After a few moments he stopped, his feelings apparently eased somewhat. He sat down, shook his head as though to clear it, and started to program a tape for a new investment analysis survey.

But now Dave couldn't concentrate on the work. Thoughts of Betty and his recent performance at the typewriter interfered with the programming routines. Several times he found himself punching the wrong coding keys. Finally he made a wry grimace and stopped, his fingers still on the keyboard. It was no use. Quickly he erased the tape, and pushed the programming schedule to the back of the desk.

And now that it was too late, thoughts of what he might have said to Betty flooded through him. Boston — New York — his visit — her typing. Each topic presented itself in clear and complete sentences. There was even a logic in their sequence, a logic which Dave sensed could almost be programmed on his computer.

Idly Dave pressed the coding keys on the programming board, slowly at first then faster. A smile touched his lips — no mental block this time. After making sure that the magnetic tape was in proper position, Dave worked briskly for about half an hour. Then he flipped the playback switch. Immediately, the programming typewriter, actuated by the magnetic tape, pecked out precise words that paid high tribute to Miss Marshall's typing ability. There were of course several grammatical errors, and the spelling was often phonetic. Dave scanned the words twice, his eyes grave and anxious. Then he chuckled quietly, turned to the programming board, and his fingers began to fly.

As though the computer were a trusted friend interceding for him, speaking for him to Betty, Dave's coded words flowed smoothly onto the tape. Completely at home with the familiar computer and programming techniques, Dave at first spoke about light and impersonal subjects — the weather — a play he'd seen — the crowded city streets. Each topic was to be triggered by an analysis of words sent by Betty. And Dave's tape would phrase questions so she would use key words in answering.

Then as the stream of his thoughts continued, Dave's talk gradually veered to himself. Cramped over the desk Dave spoke of his dreams and his hopes, talking to that magnetic tape as he could never talk to a girl. It was near midnight, long after everyone had left the building, when Dave stood up, his fingers weak and his legs stiff. For a long moment he gazed at the programming desk with tired eyes. Now he wanted only to sleep — but he was happier than he'd been for a long time. He placed the bulky roll of magnetic tape in the computer then left the office humming under his breath.

When Dave called Betty late the following afternoon, her reply came almost immediately. "Hi — how are things in New York"?

For a moment Dave tried to type his answer in person. His fingers tensed on the keys but again, knowing he was speaking directly to Betty Marshall, his mind seemed paralyzed, unable to form even a syllable. He gritted his teeth but still couldn't think of a word to say. Even the computer, which had also received Betty's greeting, seemed to mute its constant hum.

Suddenly Dave's strained expression eased. He swung away from the typewriter and pressed a new button on the computer console — a button he had connected early that morning. Immediately the computer took control and at a rate approximating Dave's typing speed told Miss Marshall that things in New York were going well but that memories of Boston were still vivid. The machine then asked Miss Marshall about Boston affairs, and there ensued a short but lively conversation between the two. As Dave gazed almost with awe at the typed sheet unreeling before him, he felt that his work of the previous night had really been worthwhile.

The computer ended its talk with Betty on a very cordial note; it even thanked her for her time and hinted that it was looking forward to speaking with her again. Dave's face broke into a wide grin and he patted the machine. Then he scanned the paragraphs again looking for words or phrases that were keys for new topics. Carefully he tucked the sheets into his pocket and that night, for the second time, he worked late at the programming console.

Dave was hovering over the computer at 4.07 p.m. several afternoons later when, just as he had arranged, it again opened the line to Boston and greeted Betty. He had programmed the computer so that starting at four o'clock each afternoon it would check the Boston line and automatically call Betty when the line was free. If someone other than Betty replied, the computer would very politely say the line was being tested and would then sign off. This arrangement eliminated any possibility that some one else than Betty, would be on the line or that Dave might freeze at the teletypewriter as he had before.

Warm thoughts of Betty entered Dave's mind as he watched the computer get well into its talk with her. Wondering idly about new topics to program for her, he turned and sauntered back to his desk leaving the computer to its simultaneous tasks of making love to a girl in Boston while it sent financial data to Texas and Toronto. Pulling some papers on current analysis toward him Dave sank into his chair. In a few minutes the image of Betty faded somewhat and the chatter of the automatic typewriters went unnoticed as he became engrossed in calculations.

With practiced ease Dave manipulated his slide rule stopping every so often to make quick computations on a large sheet of paper. Orderly rows of figures covered most of the sheet when abruptly the tempo of the typewriters changed. Dave glanced toward the machines and cocked his head. The continuous muffled drumming now seemed to include a rhythmic pounding as though several keys were being hit again and again in the same order.

In two strides Dave bounded to the row of typewriters and anxiously looked at each one. With some relief he saw that all the financial material was flowing smoothly out over the wires but he stopped short and gulped when he came to the machine connected to Betty's line. In marked cadence it was typing the words — "date with you" — "date with you" — "date with you" — over and over. The phrases, already spread over two lines of the roll of yellow typewriter paper, were rapidly filling a third. That line too was covered before Dave recovered from his shock and pressed hard on the button disconnecting the computer from the typewriter.

For a long moment Dave stared down at the typewriter as though it were a snake he had just killed with a club. Confused and shaken but certain that the computer couldn't be faulty, he closed his eyes and started a mental search for the coding errors he might have made in programming the tape.

The sudden banging of the typewriter carriage rudely shattered his reflection, and the keys started clattering a message from Betty. "What's going on? Are you all right, Dave?"

A flood of red climbed Dave's face and he gripped the typewriter table trying to think of a reply. His mind awhirl, there was no way of explaining the breakdown to Betty. Besides the thought of addressing her himself started to overwhelm him again. Biting his lips Dave forced stiff fingers onto the typewriter keys and pecked out "trouble on line — sorry — see you later." Without waiting for a reply he abruptly switched off the circuit and dashing back to the computer he viciously yanked out the offending magnetic tape.

It was almost three the next morning before Dave replaced the tape, corrected and with many additions, back in the computer.

Circles rimmed his eyes when Dave slowly walked into his office the next morning at nine o'clock. Mr. Robert Lindsay was seated at the computer console waiting for him.

"Good morning," Dave said surprised. It wasn't often that a partner of the firm visited him, and none had ever come in that early in the morning to the computer room. Cautiously he searched Lindsay's face. Did he know about Betty, he wondered.

"Morning, Dave," said Lindsay. His steady blue eyes smiled without even a hint of disapproval. "Don't take off your coat," he cautioned. "I've got plane tickets to Boston."

"What for?" asked Dave. He tried to keep his voice casual.

"The Boston office just called. Some English investment men want to hear about your computer before they leave for home today." Lindsay smoothed his iron-gray hair and reached for his hat. "It may mean more business."

"What about the computer?" protested Dave.

"It's automatic, isn't it?" said Lindsay. "I'll have some one look in here during the day." He started walking toward the door, beckoning. "Besides, Boston said their line wasn't quite right. Perhaps you ought to look at it." His tone was even and impersonal.

Dave swallowed and glanced sharply at Lindsay, then followed him out of the room.

Once in Boston Dave was keenly disappointed to find that the meeting was being held in a hotel rather than the office where Betty worked. The English visitors had seen the teletype responding to the computer, and now they wanted information on the computer itself before leaving for London. Surprisingly they were interested in the technical details of the machine as well as its cost and abilities. Completely at ease on matters concerning the computer he knew so well, Dave described it at length, and it was late afternoon before he had answered all the questions and received admiring thanks.

The meeting over, Dave excused himself, and leaving Mr. Robert Lindsay to see the visitors to their plane, he hurried to the Boston office. He was tired as he started the walk to Federal Street but the anticipation of seeing Betty soon put bounce in his step and made his temples throb with an increasing excitement.

Once at the office, he barely stopped to greet some of the men he knew, then hurried to Betty's tiny room. He stood quietly in the doorway for a moment, drinking her in with his eyes, his face calm, his heart pounding. Her back toward him, Betty sat erect in the chair, her slim shoulders moving slightly as her fingers travelled over the teletypewriter keys. The late sun coming through the window turned her hair golden.

Finally Betty stopped typing. Only then did Dave move. Quietly he stepped into the room and coughed. Hearing him Betty turned in her chair and looked at him. For a fleeting moment she stared without recognition and then her eyes widened in surprise.

"Dave," she exclaimed, "what are you doing here?" Behind her the keys started to clatter.

Dave managed a small grin but his cheeks started to warm. "Hi," he said softly, the shyness starting to close his throat.

Betty smiled and swivelled her chair to face him. Her sheath-like dress, deep blue in color, outlined the lithe curves of her young figure and contrasted sharply with her smooth white skin. She opened her mouth to speak but becoming aware of the typewriter tapping behind her a puzzled gleam replaced the welcome in her eyes. Slowly she turned her head to watch the words forming on the yellow roll. Then she looked back at Dave and very deliberately stood up.

"What sort of a joke is this?" she asked. Her voice was low but her eyes were blazing. "If you're Dave Harland, who is on the other end of that line?" Angrily she pointed to the machine steadily typing its message.

Dave's muscles tensed and abruptly he snapped his head toward the machine. In a single stride he was beside it reading the words. He grunted as though a fist had hit him in the belly. The computer was trying to persuade Betty to visit New York and see the sights with him. It was making conversation just as Dave had ordered it to.

"I forgot to take out the tape," he said weakly.

"That's me — I mean — the computer." He took a step toward Betty and tried to smile.

Betty retreated toward the doorway. "What are you talking about?" she asked. "Is this some game you and your pals are playing?"

Dave's face was crimson. "Oh, no!" he protested. You see — I couldn't —". And then he choked. The words to tell her that a computer had been programmed to speak for him simply would not form. Yet as he looked at Betty, standing stiff and angry near the doorway, he longed for her more than ever.

"Wait," he said hoarsely, "Wait, let me show you!"

Then he turned to the machine and typed a single line. "Do you like me?" Behind him he heard Betty approach. Without looking at her he said, "The computer thinks you sent that."

"You must be insane" Betty said, but she remained, staying a stiff foot distant from Dave.

Together they saw the letters form a reply, "I'm falling in love with you."

"It's a trick," Betty said blushing. "No machine can do that."

To Dave this criticism of his machine and his ability had to be answered. Forgetting his shyness he blurted, "Would anybody repeat the same phrase over and over like the computer did yesterday?"

"Maybe not," retorted Betty, "but why use the computer at all? Can't you speak up for yourself?"

Dave looked at Betty soberly, then he smiled. "It's much easier to talk to the computer than to you," he confessed. "Watch."

Turning back to the machine he typed out Betty's question. "Why do you use the computer? Why don't you speak for yourself?"

There was a slight pause and then the computer under the control of Dave's tape replied — "Some men talk well, others write, or paint, or sing. The genius of each is stimulated by love, and each best makes love in the language of his genius. Computers are my language."

Betty opened her lips to speak but Dave shook his head and pointed at the machine. The computer was telling of Dave's lonely shyness and how hard it had been to meet and talk to girls. It told how he had tried to talk to her the first time on the teletypewriter and failed, and how he had poured out his heart to the magnetic tape program, and finally some of the way he had programmed the system to talk with her.

After an outpouring of teletyped words, the machine stopped. Betty walked over to the window and looked out into the dimming light at the crowds of people going home. Dave stayed quiet but his eyes followed her. In the stillness he became conscious of the traffic noisily flowing past.

Finally Betty turned and walked over to him. "Why not have dinner at my house tonight, Dave," she said. He saw that her eyes were moist but that she was smiling. "Dad's an electronics engineer. He'd like to hear about your computer."

Dave started to put his arms around her but Betty gently pushed him away and touched her finger to his lips. "There are some words you must first learn to speak for yourself, Dave." Then she added, musingly, "Perhaps we can learn them together."

BOOKS
and
OTHER PUBLICATIONS

Moses M. Berlin
Cambridge, 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.**

Data Processing Seminar on Status of Digital Computer and Data Processing Developments in the Soviet Union / Office of Naval Research, Dept. of the Navy, Washington, D.C. / 1958, offset, 179 pp, cost ?

Four computer people, specialists in the field of digital data processing, offer reports on progress in the field in the Soviet Union, having visited a number of computer installations there, during the summer of 1958.

John W. Carr III of the University of Michigan covers tours, talks, physical structure, programming theory, mathematical techniques, logic, and, in two appendices, key excerpts from Soviet literature pertinent to the report. A bibliography on Soviet Computer literature is included. A. J. Perlis, Carnegie Institute of Technology, reports on the comparatvie merit of Russian coding systems. Excerpts from Computer publications are included; in the second of two appendices, the internal design of the Soviet computer is described.

The report by James E. Robertson, University of Illinois, elaborates on the design of the computer, and the report by Norman R. Scott, University of Michigan, covers the mathematical efficiency and reliability of Russian data processing systems.

A discussion session between the four authors and led by M. C. Yovits, ONR, follows the reports.

An Annotated Bibliography, Univac Educational Series No. 3 / Remington Rand Univac, 315 Fourth Ave., New York, N.Y. / 1959, printed, 54 pp, cost ?

This bibliography of 267 references has been prepared for those whose training in computers has been either limited or extensive. This second edition comprehensively covers: the history of digital computers; books on theory and operation; applications; and general background and sources. The last section includes lists of indexes, periodicals, bibliographies, and glossaries.

Report of the Commission on Mathematics, Appendices / College Entrance Examination Board, c/o Educational Testing Service, Box 592, Princeton, N.J. / 1959, printed, 231 pp, $1.00

The purpose of this edition of appendices is to provide teachers with information, instruction and enrichment, to help the teacher implement the recommendations for a more advanced high-school curriculum. Algebra, geometry and trigonometry, are covered, with an index following the text.

Goldman, Stanford, Dept. of Elec. Engrg, Syracuse Univ., Research Inst., Syracuse, N.Y. / Cybernetic Aspects of Homeostasis (PB 151733) / Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C. / 1958, offset, 67 pp, $2.00

"The maintenance of a prescribed internal environment in the body of an organism, in spite of wide fluctuations in its activity and in its external environment, is called homeostasis." This paper discusses the principles of feedback, servo, and information theory, and describes their relationship with homeostasis, and what light these subjects throw on homeostasis.

Murphey, Robert W. / How and Where to Look It Up / McGraw-Hill Book Co., Inc., 330 West 42 St., New York 36, N.Y. / 1959, printed, 721 pp, $15.00

This reference book provides a comprehensive guide to standard reference sources, containing more than 3,900 topics of interest for research. An introduction explains how to make efficient use of the book, followed by three sections discussing: reference works and their use, basic types of reference, and specific sources of information. Encyclopedias, dictionaries, periodicals, almanacs, handbooks, biographical works and foreign informational sources are included. An alphabetical subject heading list, and an index, are included.

The Systems Approach to Electronic Wiring and Connections / Methode Manufacturing Corp., 7447 W. Wilson Ave., Chicago 31, Ill. / 1959, printed, 28 pp, free on request

This pamphlet discusses many possible ideas for wiring device advancement. In three sections, "case histories" of printed circuit and wiring device applications are described, and check lists to assist in specification are given.

Automation, Annual Product Review / Penton Pub. Co., Penton Bldg., Cleveland 13, Ohio / 1959, printed, 35 pp, cost ?

Precisely what the title states, a catalogue of products, from actuators to worm gear jacks, with computers included. The contents consist of descriptions of automation equipment, products, components, and services advertised in Automation during the past twelve months.

Annales de l'Association Internationale pour le Calcul Analogique, for September, 1959, vol. 1 no. 6 / Presses Academiques Europeennes, 98, chaussee de Charleroi, Bruxelles 6, Belgium / 1959, printed, 64 pp, cost ?

This issue is published mainly in French, with certain articles in English, it includes abstracts of articles, a bibliography, items about the European computer scene. The articles in English are: "A Special Function Generator: the Frequency Programming System for the 25 GeV C. E. R. N. Proton Synchroton," and "Digital vs. Analog Computation."

LGP-30 ACT 1 Compiler / Royal McBee Corp., Data Processing Div., Port Chester, N.Y. / 1959, offset, 18 pp, free on request

A detailed description of an Algebraic Compiler and Translator, which has been designed to facilitate the coding of problems through the use of common mathematical terminology. The technique makes use of basic algebraic rules to eliminate the need for many involved sets of instructions. This edition includes definitions of terms, examples, and in four appendices, a scaling technique, brackets and precedence, subroutine and calling sequence, and assembly for ACT 1.

Dummer, G. W. A. / Modern Electronic Components / Philosophical Library, 15 E 40 St., New York 16, N.Y. / 1959, printed, 472 pp, $15.00

A reasonably comprehensive summary

of essential data on electronic components. Contains thirty-two chapters on: component specifications and characteristics, reliability, behaviour under arduous environmental conditions, and testing methods and techniques. Also includes a brief history of component development in Great Britain, and an index.

Proceedings of the Eastern Joint Computer Conference, Boston, Mass., Dec. 1-3, 1959 / Eastern Joint Computer Conference, Nat'l Joint Computer Committee, IRE, One East 79 St., New York 21, N.Y. / 1959, printed, 260 pp, $3.00.

This volume contains thirty-two papers which were delivered at the conference.

A number of the new data processing systems are described—some, in great detail. Included are STRETCH, Mobidic, SIMCOM, and Univac-Larc. Other papers discuss methods for solving mathematical problems on a computer, applications of Boolean algebra, etc.

Computer Language Translator—Application Information / Electronic Engineering Co. of Calif., 1601 East Chestnut Ave., Santa Ana, Calif. / June, 1959, printed, 20 pp, free.

The Computer Language Translator provides for rapid and efficient translation between different types of automatic data processing systems. This publication provides information on: translation capabilities; the basic translation system; five common translation modes; and physical characteristics of the translator. An appendix presents systems delivered or in production.

Caldwell, W. I., G. A. Coon and L. M. Zoss / Frequency Response for Process Control / McGraw-Hill Pub. Co., Inc., 330 West 42 St., New York 36, N.Y. / 1959, printed, 395 pp, $11.50.

The fundamental methods of frequency response and their application to the analysis, testing, and design of process control systems, compose the two parts of this book. In the "Basic Theory" section, certain methods of analysis are given, with a careful treatment of distance-velocity lag, linear lag, and stability considerations.

These methods—which reduce the amount of mathematical computation usually needed—are applied to problems. Included are techniques for calculating system time constants, and material on the dynamics of temperature measurement. A chapter of the book discusses a technique for converting from step to frequency response, using a desk calculator. Two appendices include a list of symbols, and construction of templates.

Value Engineering, 1959 / Engineering Publishers, Elizabeth, New Jersey / 1959, printed, 165 pp, $6.00.

This book contains the complete versions of the technical papers presented at the Electronic Industries Association Conference on Value Engineering, Oct. 5-6, at the Univ. of Penn. The nineteen papers discuss this new type of engineering, and its use by a large number of companies.

Kirchmayer, Leon K. / Economic Control of Interconnected Systems / John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y. / 1959, printed, 207 pp, $12.50.

This book presents for electrical engineers theories and applications for optimizing computer control in a continuous process industry including power systems (steam and hydro). In eight chapters, the author discusses: the use of mathematical methods to determine equations whose solution would result in optimum economic performance; the use of theoretical and differential analyzer methods of predicting the dynamic performance of interconnected systems; and the integration of computer and controller to obtain a computer-controlled system. An index is included.

Goodman, L. L. / Automation Today and Tomorrow / Essential Books, 1600 Pollit Drive, Fair Lawn, N.J. / 1959, photooffset, 158 pp, $7.20.

From a purely technical point of view, this is an up-to-date report on the progress of automation. The first part of the book discusses computer control and automation in such fourteen varied industries, including machine tools, sugar beets, chemicals, pulp and paper, ice cream, and concrete. The second part presents an extensive bibliography including informative books on most of the technical advances in automation. Subject and author indexes follow the bibliography.

Automation Systems—Proceedings of the Electronic Industries Association Conference on Automation Systems, 1958 / Engineering Publishers, GPO Box 1151, New York 1, N.Y. / 1958, printed, 180 pp, $5.00.

Seventeen papers delivered at the Conference are presented, including: "The Systems Concept as Applied to Automation"; "Reliability of Production Equipment Testing"; 'Progress Toward Nationwide Integrated Data Processing Systems"; and "The Interest of the Federal Government in Automation." Topics covered: Automation Within the Electronics Industry, (two sessions); Automation Outside the Electronics Industry, (two sessions); The Economic, Educational and Social Aspects of Automation; a Summation session.

Zemanek, Heinz / Elementare Informations theorie / R. Oldenbourg, Munchen, den Rosenheimer Strasse 145, W. Germany / 1959, 120 pp, cost?

A German-language introduction to information theory, with five chapters and two appendices which include tables and lists of functions used in the text.

Oppelt, W. / Anwending von Rechenmaschinen bei der Berechnung von Regelvorgangen / R. Oldenbourg, Munchen, den Rosenheimer Strasse 145, W. Germany / 1959, printed, 128 pp, cost?

A German-language discussion of analog-digital computing systems. Numerous diagram accompany the text, which describes the logical design and application of the machines.

Bowker, Albert H. and Gerald J. Lieberman / Engineering Statistics / Prentice-Hall, Inc., 70 Fifth Ave., New York 11, N.Y. / 1959, printed, 585 pp, $11.00.

This book is intended as a text for a first course in statistics, for students in engineering and the physical sciences. There are thirteen chapters with a great number of sections on probability, random variables, distribution theory, estimation, analysis of variance, significance tests, analysis of enumeration data, statistical quality control, and sampling inspection. A comprehensive treatment on how to fit straight lines is offered. An appendix contains various tables relevant to the study; and index is included.

Data Processing—1959 Proceedings / Nat'l. Machine Accountants Assn., Mt. Prospect, III. / 1959, printed, 394 pp, $10.00.

The general theme of the forty-six papers presented in this book, is the development and application of data processing in the past year. Among the topics are: "Why Automate?", "Planning New Applications," "Progress in the Data Processing Industry," "On Job Training," "Determining Equipment Needs," etc. The book, which lacks an index, contains papers which were given June, 1959, at the National Convention of the NMAA ;some have been published in the "Journal of Machine Accounting."

Proceedings of the Fourth National Conference of Bendix G-15 Users Exchange Organization / Bendix Aviation Co., Computer Div., Calif. / 1959, offset, no. of pp not stated, limited distribution.

A collection of the reports delivered at the conference, is presented. No table of contents; no consecutive paging.

Perry, J. W., and Allen Kent / Tools for Machine Literature Searching / Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N.Y. / 1958, printed, 972 pp, $27.50.

This volume provides, in four parts: Introduction to Machine Literature Searching; Engineering of Machine Literature Searching Systems; Procedures for Analyzing, Encoding and Searching of Recorded Information; and a Thesaurus of Scientific and Technical terms. The last part includes the Semantic Code dictionary, useful as a cross reference tool and as an authority for developing subject heading lists.

CALENDAR OF COMING EVENTS

May 3-5, 1960: Western Joint Computer Conference, Jack Tar Hotel, San Francisco, Calif.

May 9-11, 1960: Meeting, Burroughs 220 Computer User Group (CUE), San Francisco, Calif.; contact Merle D. Courson, First National Bank of San Jose, San Jose, Calif.

May 9-12, 1960: 2nd ISA Instrument-Automation Conference and Exhibit of 1960, Civic Auditorium and Brooks Hall, San Francisco, Calif.

May 17-18, 1960: Symposium on Superconductive Techniques for Computing Systems, sponsored by Information Systems Branch, Office of Naval Research, at Dept. of Interior Auditorium, Washington, D.C.

May 18-20, 1960: Operations Research Society of America Seventeenth National Meeting (Eighth Annual Meeting), Statler-Hilton Hotel, New York, N.Y.

May 19, 1960: Conference on Parallel Programming, sponsored by Cleveland-Akron Chapter of Association for Computing Machinery, Cleveland, Ohio / Contact: L. R. Turner, NASA, Lewis Research Ctr., 21000 Brookpark Rd., Cleveland 35, Ohio

May 23-25, 1960: 9th Annual Telemetering Conference (West Coast), sponsored by ISA with ARS, AIEE and ISA cooperating, Miramar Hotel, Santa Barbara, Calif.

May 24-27, 1960: Conference on Automatic Computing and Data Processing in Australia, Universities of Sydney and New South Wales, Sydney, Australia.

June 1-3, 1960: 6th Annual ISA Instrumental Methods of Analysis Symposium, Montreal, Canada

June 2-4, 1960: National Conference of University Computing Center Directors, Shoreland Hotel, Chicago, Ill.; contact Mrs. Robert Drew-Bear, American Mathematical Society, 190 Hope St., Providence 6, R.I.

June 6-7, 1960: Second Conference of The Computing and Data Processing Society of Canada, University of Toronto.

June 13-24, 1960: University of Michigan Engineering Summer Conferences, Courses in Computer Science and Engineering, University of Michigan, Ann Arbor, Mich.

June 14-17, 1960: Seminar on Systems Simulation Using Digital Computers, a Cornell University Industrial Engineering Seminar, Cornell University, Ithaca, N.Y.; contact J. W. Gavett, Seminars Coordinator, Dept. of Industrial and Engineering Admn., Upson Hall, Cornell Univ., Ithaca, N.Y.

June 15-29, 1960: 7th Rassegna International Electronics, Nuclear Energy, and Cinematography Scientific Congresses and Exhibition (included in the program: Electronic computers — collation and processing of data for research operation), Palazzo dei Congressi, Rome, Italy.

June 22-24, 1960: 1960 National Conference and Business Show, National Machine Accountants Association, Mark Hopkins and Fairmont Hotels, and Calif. Masonic Memorial Temple, San Francisco, Calif.

June 25 - July 5, 1960: 1st International Congress for Automatic Control, AACC sponsored, with ISA, ASME, IRE and AICE cooperating, Moscow, U.S.S.R.

July 19-22, 1960: USE Organization Meeting, Syracuse, N.Y.; contact James W. Nickitas, 315 Park Ave.. New York, N.Y.

Aug. 6-7, 1960: 3rd Annual Conference of the Northwest Computing Association, Portland, Ore.

Aug. 8-12, 1960: Pacific General Meeting of the American Institute of Electrical Engineers, San Diego, Calif.

Aug. 10-12, 1960: Annual Meeting G-15 Users' Exchange Organization, Pittsburgh Hilton Hotel, Pittsburgh, Pa.; contact Dr. Jerry C. L. Chang, Richardson, Gordon & Associates, 3 Gateway Center, Pittsburgh 22, Pa.

Aug. 23-26, 1960: WESCON, Ambassador Hotel and Pan Pacific Auditorium, Los Angeles, Calif.

August 23-25, 1960: Annual Meeting of the Association for Computing Machinery, Marquette Univ., Milwaukee, Wisc.

Sept. 19-21, 1960: 5th Annual Symposium on Space Electronics and Telemetry, sponsored by The Institute of Radio Engineers, Inc., Shoreham Hotel, Washington, D.C.

Sept. 20-24, 1960: Symposium on the Numerical Treatment of Ordinary Differential, Integral and Integro-Differential Equations, University of Rome, Rome, Italy; contact Prof. A. Ghizzetti, Provisional International Computation Ctr., Palazzo degli Uffici, Zona dell'EUR, Rome.

Sept. 22-23, 1960: Fall Meeting of The Univac Users Association, Washington, D.C.; contact W. C. Rockwell, Remington Rand, 315 Park Ave. So., New York 10, N.Y.

Sept. 26-30, 1960: 3rd ISA Instrument-Automation Conference and Exhibit of 1960, and ISA's 15th Annual Meeting, New York Coliseum, New York, N.Y.

Oct. 4-6, 1960: Meeting, Burroughs 220 Computer User Group (CUE), Philadelphia, Pa.; contact Merle D. Courson, First National Bank of San Jose, San Jose, Calif.

Oct. 9-14, 1960: 1960 Fall General Meeting of American Institute of Electrical Engineers, New York, N.Y.; contact Clarke S. Dilkes, Assoc. Dir., Burroughs Corp., Research Ctr., Paoli, Pa.

Oct. 10-12, 1960: National Electronics Conference, Hotel Sherman, Chicago, Ill.; contact Prof. Thomas F. Jones, Jr., NEC Program Chairman, School of Electrical Engrg., Purdue Univ., Lafayette, Ind.

Oct. 17-19, 1960: Symposium on Adaptive Control Systems, sponsored by Long Island Section, Institute of Radio Engineers, Garden City Hotel, Garden City, L.I., N.Y.; contact F. P. Caruthers, Symposium Chairman, c/o Specialties Inc., Skunks Misery Rd., Syosset, N.Y.

Nov. ?, 1960: 13th Annual Conference on Electronic Techniques in Medicine & Biology, sponsored by ISA, with IRE and AIEE cooperating, Washington, D.C.

Sept. 6-8, 1961: 1961 Annual Meeting of the Association for Computing Machinery, Statler Hotel, Los Angeles, Calif.; contact Benjamin Handy, Chairman local Arrangements Committee, Litton Industries, Inc., 11728 W. Olympic Blvd., W. Los Angeles, Calif.

Dec., 1960: Eastern Joint Computer Conference, New Yorker Hotel, New York City; contact Dr. Nathaniel Rochester, IBM, Yorktown Heights, N.Y.

SURVEY OF RECENT ARTICLES

Moses M. Berlin
Cambridge, Mass.

We publish here a survey of articles related to computers and data processors, and their applications and implications, occurring in certain magazines. We seek to cover at least the following magazines:

Automatic Control
Automation
Automation and Automatic Equipment News (British)
Business Week
Control Engineering
Datamation
Electronic Design
Electronics
Harvard Business Review
Industrial Research
Instruments and Control Systems
ISA Journal
Proceedings of the IRE
The Office
Scientific American

The purpose of this type of reference information is to help anybody interested in computers find articles of particular relation to this field in these magazines.

For each article, we shall publish: the title of the article / the name of the author(s) / the magazine and issue where it appears / the publisher's name and address / two or three sentences telling what the article is about.

Office Automation — A Challenge to Personnel Relations / Raymond Dreyfack / Punched Card Data Processing, vol. 1, no. 7, Nov.-Dec., 1959, p 15 / Gille Associates, Inc., 956 Maccabees Bldg., Detroit 2, Mich.

This article discusses the personnel problems created by a change to automation. Allaying the fears of employees is a problem which must be dealt with honestly, before and during the implementation of automatic data processing.

A Comparison of Integral [Transfer] and Incremental [Transfer] Digital Computers for Process Control Applications / Edward L. Braun / Control Engineering, vol. 7, no. 1, Jan., 1960, p 113 / McGraw-Hill Publg. Co., Inc., 330 West 42 St., New York 36, N. Y.

"Integral transfer computers" are digital computers which are general purpose computers and are not digital differential analyzers. "Incremental transfer computers" are digital differential analyzers. Each type of computer is discussed in regard to its suitability for process control applications, and the general conclusion in regard to which to use appears to be "it depends."

Computer Uses / Instruments & Control Systems, vol. 32, no. 12, Dec., 1959, p 1816 / Instruments Publg. Co., Inc., 845 Ridge Ave., Pittsburgh 12, Penna.

Thirteen computer applications are listed and briefly described. Among the systems which are computer controlled: electric power station polymerization process, electric power generation, and natural gas liquids cracking.

Performance of a Solid-State Process Computer / Joseph A. Reine, Jr. / Instruments and Control Systems, vol. 32, no. 12, Dec., 1959, p 1820 / Instruments Publg. Co., Inc., 845 Ridge Ave., Pittsburgh 12, Penna.

This article presents the performance record of an installation in a power and light company, which includes a solid-state logger computer. Equipment performance, maintenance and trouble shooting activities are described.

Computer Control Philosophy / Clifford E. Mathewson and Byron White / Instrument and Control Systems, vol. 32, no. 12, Dec., 1959, p 1830 / Instruments Pub. Co., Inc., 845 Ridge Ave., Pittsburgh 12, Penna.

The two authors discuss computer control in side-by-side articles, presenting information on computers designed for specific applications, analog and digital systems, mathematical model uses, and control by automatic experimentation with the process.

A Computer Pays Off in Plant Research / J. A. Curran / Automation Progress, vol. 4, no. 9, Sept., 1959, p 300 / Leonard Hill Technical Group, Leonard Hill House, Eden St., London, N. W. 1.

Appreciable savings are realized in a heat transfer process which is computer controlled. The research work is being performed in tests of heat transfer in a full-scale heat exchanger pilot plant; the computer's functions are described.

Some Case Histories of Business Computers in the U. S. A. / Journal of Institution of Electrical Engineers, June, 1959, p 347 / J. of I. of E. E., Savoy Place, London WC 2, England.

This article describes computer installations of four U. S. companies, including a bank, a major airline, and a radio company. Results from the data processing systems are given, with a number of suggestions for successful implementation of computer use.

Compact Memories Have Flexible Capacities / D. Haagens, Engineering Mgr., General Ceramics Corp., Keasby, N. J. / Electronics, vol. 32, no. 40, Oct. 2, 1959, p 50 / McGraw-Hill Pub. Co., Inc., 330 West 42 St., New York 36, N. Y.

A description of a technique — coincident-current — for constructing digital computer buffer memories. The system allows for the addition of plug-in packages to increase capacity, and provides random and/or sequential access.

Managing Men — Not Machines / L. J. Hale / Punched Card Data Processing, vol. 1, no. 7, Nov.-Dec., 1959, p 19 / Gille Associates, Inc., 956 Maccabees Bldg., Detroit 2, Mich.

Automation, says the author, will never replace the need for human beings to operate and control the automatic controls. This article urges understanding on the part of management, as they begin to use computers and data processing. Training of personnel and a knowledge of employees are essential to the success of any automated industry.

Use of Automatic Computers for Scientific and Technical Calculations and Direct Production Control / Z. Drab and A. Halek / Automatizace, vol. 11, no. 11, 1959, p 328 / Automatizace, Praha 2, Spalena ul. 51, Czechoslovakia.

This article, in Czechoslovakian, presents a brief review of the advantages afforded by the use of computers for scientific and technical calculations, and direct production control. Examples are given of possible applications for control in metallurgy, power generation, the chemical industry and transport.

Preparing for an Electronic Data Processing System / Charles J. Graham, First Nat'l. Bank of Boston / Journal of Machine Accounting, vol. 10, no. 10, Oct., 1959, p 9 / Nat'l. Machine Accountants Assn., 720 Kensington Rd., Arlington Hts., Ill.

This article offers some general solutions and specific illustrations of the problem of determining the necessity of, and preparing for, a computer system. Included are suggestions on recruitment, selection of equipment, and methods for efficient application.

European Technical Digests, vol. 4, no. 11, Nov., 1959 / European Technical Digests, Specialized Information Section, European Productivity Agency, 3 Rue André-Pascal, Paris 16, France.

This edition contains a representative sample of the work accomplished by the "Digests," including technical improvement papers on: chemicals; plastics, electronics; electrical engineering; food; agriculture; fuel; power; metallurgy; safety; water; textiles; etc. The publication aims to publicize industrial process developments on the international scene, and to crossfeed ideas from one national industry to another.

Survey of Progress, and Trend of Development and Use of Automatic Data Processing in Business and Management Control Systems of the Federal Government, as of Dec., 1957 / Controller General of the U. S. / Communications of the ACM, vol. 2, no. 5, May, 1959, pp 17-20 / Assn. for Computing Machinery, Mt. Royal & Guilford Aves., Baltimore 2, Md.

This is a report which was delivered to the Congress of the U. S. The title describes clearly the contents of the report, which proceeds from early state of development in the computer field, to the need for research and development, in spite of great advances over the past decade.

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 computers and associated equipment from the "Official Gazette of the United States 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.

November 17, 1959, (Con't):

2,913,178 / Edward J. Petherick, Rowledge, near Farnham, and Geoffrey C. Rowley, Sutton, Eng. / International Business Machines Corp., New York, N.Y. / A coded decimal multiplying arrangement for a digital computer.

2,913,179 / Bernard M. Gordon, Concord, Mass. / Laboratory for Electronics, Inc., Boston, Mass. / A synchronized rate multiplier apparatus.

2,913,181 / Jacob Leeder, Aberdeen, Md. / U.S.A. as represented by the Sec. of the Air Force / An electronic scaling apparatus in analog computers.

2,913,593 / Henry W. Kaufmann, Phoenixville, Pa. / Sperry Rand Corp., a corp. of Del. / A half-adder for computers.

2,913,594 / John P. Eckert, Jr., Philadelphia, Pa. / Sperry Rand Corp., a corp. of Del. / A quarter-adder for computers.

2,913,598 / Robert D. Torrey, Philadelphia, Pa. / Sperry Rand Corp., a corp. of Del. / A transistor core logical element.

2,913,600 / J. A. Cunningham, Wheaton, and Arthur W. Holt, Silver Spring, Md. / U.S.A. as represented by the Sec. of Commerce / A diode amplifier and computer circuit.

2,913,705 / Bonnar Cox and Jacob Goldberg, Palo Alto, Calif. / General Electric Co., New York, N.Y. / Apparatus for transferring digital data from a first tape to a second tape.

2,913,706 / Ragnar Thorensen and Biagio F. Ambrosio, Los Angeles, Calif. / U.S.A. as represented by the Sec. of Commerce / A transcriber selection circuit for magnetic drum memory.

2,913,708 / Stephen Paull, Falls Church, Va. / — / A magnetic core nondestructive readout circuit.

November 24, 1959: 2,914,248 / Harold D. Ross, Poughkeepsie, N.Y., Bernard L. Sarahan, Bellwood, Ill., and Morton M. Astrahan, Bennett .Housman, and Walker H. Thomas, Poughkeepsie, N.Y. / International Business Machines Corp., New York, N.Y. / A program control for a data processing machine.

2,914,250 / Etienne Honore and Emile Torcheux, Paris, Fr. / Compagnie Generale de Telegraphie Sans Fil, a corp. of Fr., and Societe Marocaine de Recherches d'Etudes et de Developpements "Somarede," a corp. of Morocco / A function generator for analog computer systems.

2,914,681 / Floyd G. Steele, La Jolla, Calif. / Digital Control Systems, Inc., La Jolla, Calif. / A logical gating network.

2,914,748 / John R. Anderson, Dayton, Ohio / Bell Telephone Lab., Inc., New York, N.Y. / A storage matrix access circuit.

2,914,751 / William F. Steagall, Merchantville, N.J. / Sperry Rand Corp., a corp. of Del. / A quarter adder for computer circuits.

2,914,754 / Karl Ganzhorn and Theodor Einsele, Sindelfingen, and Hans Bornhauser, Boblingen, Germany / International Business Machines Corp., New York, N.Y. / A magnetic core memory system.

December 1, 1959: 2,915,246 / Raymond G. Piety, Bartlesville, Okla. / Phillips Petroleum Co., a corp. of Del. / A polynomial roots computer.

2,915,740 / James B. Ricketts, Jr., Milwaukee, Wis., and Eric E. Bittmann, Downington, and Joseph Deutsch, Berwyn, Pa. / Burroughs Corp., Detroit, Mich. / A static magnetic memory system.

December 8, 1959: 2,915,966 / Marvin Jacoby, Norristown, Pa. / Sperry Rand Corp., a corp. of Del. / A high speed printer.

2,915,967 Arthur J. Gehring, Jr., Haddonfield, N.J. and Lawrence F. Harrison, Philadelphia, and Lloyd W. Stowe, Broomall, Pa. / Sperry Rand Corp., a corp. of Del. / An information reproducing system.

2,916,209 / Phil A. Adamson, San Gabriel, and Merritt L. MacKnight, Los Angeles, Calif. / Hughes Aircraft Co., a corp. of Del. / A digital-to-analog converter.

2,916,210 / Ernst S. Selmer, Oslo, Norway / Burroughs Corp., Detroit, Mich. / An apparatus for selectively modifying program information.

2,916,211 Joachim Schulze, Limbach-Oberfrohna, and Johannes Hofmann, Erlangen, Germany / VEB Buchungsmaschinenwerk, Karl-Marx-Stadt, Germany / An electronic calculating machine provided with an arrangement for rounding off electronic counters.

2,916,727 / Claude E. Jones, Jr., Belleville, N.J. / International Telephone and Telegraph Corp., Nutley, N.J. / A data processing system.

2,916,728 / Paul R. Gilson, West Covina, Calif. / Burroughs Corp., Detroit, Mich. / A magnetic recording and reading system.

2,916,729 / Stephen Paull, Falls Church, Va. / —— / A magnetic core binary circuit.

December 15, 1959: No applicable patents.

December 22, 1959: 2,918,218 / Eric L. Thomas, Hollywood, and Robert J. Paul, Belfast, Northern Ireland / Short Brothers and Harland Lim., Belfast, Northern Ireland. / An analogue computer.

2,918,574 / Donald J. Gimpel, Chicago, and William A. Davidson, Evanston, Ill. / U.S.A. as represented by the Sec. of the Navy / A digital converter.

2,918,656 / George V. Nolde, Santa Monica, Calif., and Joseph A. Brustman, Narberth, Pa. / R.C.A., a corp. of Del. / An information storage apparatus.

2,918,660 / Tung C. Chen, Havertown, and John H. Lane, Malvern, Pa. / Burroughs Corp., Detroit, Mich. / A non-destructive read-out of magnetic cores.

2,918,661 / Tung C. Chen, Havertown, and John H. Lane, Malvern, Pa. / Burroughs Corp., Detroit, Mich. / A non-destructive read-out of magnetic memory elements.

2,918,663 / Tung C. Chen, Havertown, Pa. / Burroughs Corp., Detroit, Mich. / A magnetic storage device.

2,918,664 / Edwin W. Bauer, Poughkeepsie, N.Y. / I.B.M. Corp., New York, N.Y. / A magnetic core register.

2,918,669 / Martin L. Klein, Woodland Hills, Calif. / North American Aviation, Inc. / An arbitrary function generator.

December 29, 1959: 2,919,063 / Donald R. Young, Poughkeepsie, N.Y. / I.B.M. Corp., New York, N.Y. / A ferroelectric condenser transfer circuit and accumulator.

2,919,066 / Warren D. White, East Norwich, N.Y. / U.S.A. as represented by the Sec. of the Army / A vector adding system.

2,919,354 / Louis A. Russell, Poughkeepsie, N.Y. / I.B.M. Corp., New York, N.Y. / A magnetic core logical circuit.

2,919,355 / Choang Huang, Ipswich, Mass. / Sylvania Electric Products, Inc., Wilmington, Del. / A bi-stable transistor circuit.

2,919,429 / Francis E. Hamilton, Binghamton, and Ernest S. Hughes, Jr., and Charles B. Smith, Vestal, and Archie L. Furr, Endicott, N.Y. / I.B.M. Corp., New York, N.Y. / A data transfer mechanism.

2,919,430 / Jan A. Rajchman, Princeton, N.J. / R.C.A., a corp. of Del. / A magnetic switching system.

2,919,431 / Stephen H. Blackford, Endicott, N.Y. / I.B.M. Corp., New York, N.Y. / An apparatus for the magnetic recording of data.

January 5, 1960: 2,919,857 / Charles R. Bonnell, Columbia Heights, Minn. / Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. / A torque integrating analog computer with inductive device.

2,920,193 / Jack Breckman, Haddonfield, N.J. / U.S.A. as represented by the Sec. of the Army / A precise analogue store and impedance transformer.

2,920,313 / David L. Nettleton, Haddonfield, N.J. and Lowell S. Bensky, Levittown, Pa. / R.C.A., a Corp. of Del. / An information handling device.

2,920,314 / William Miehle, Havertown, Pa. / Burroughs Corp., Detroit, Mich. / An input device for applying a synchronously timed data signals to a synchronous system.

2,920,315 / Seymour Markowitz, Los Angeles and Ben T. Goda, Gardena, Calif. / Telemeter Magnetics, Inc., Los Angeles, Calif. / A magnetic bidirectional system.

January 12, 1960: 2,920,824 / Walter C. Lanning, Plainview, N.Y. / Sperry Rand Corp., a Corp. of Del. / A digital computer circuit for adding first and second binary digital numbers respectively.

2,920,825 / Walter C. Lanning, Plainview, N.Y. / Sperry Rand Corp., a Corp. of Del. / A digital computer for subtracting from a first binary digital number a second binary digital number.

2,920,826 / Edward J. Panner, Allentown, Pa. / Bell Telephone Lab., Inc., New York, N.Y. / An electronic computing circuit utilizing stepping tubes.

2,920,828 / Billy E. Davis, China Lake, Calif. / U.S.A. as represented by the Sec. of the Navy / An analog computer which permits four quadrant multiplication.

2,921,190 / Franklin H. Fowler, Jr., Washington, D.C. / Sperry Rand Corp., a Corp. of Del. / A comparison circuit for detecting coincidence and anti-coincidence of nonoverlapping signals from two sources.

2,921,192 / Robert F. Casey, Pompton Plains, and John Gibbon, Morristown, N.J. / Monroe Calculating Machine Co., Orange, N.J. / A bistable circuit.

2,921,204 / Donald F. Hastings, Suffern, N.Y., and John B. Venezia, Leonia, and Philemon A. Wallace, Bloomfield, N.J. / Bendix Aviation Corp., Teterboro, N.J. / A data converter for converting analog information to digital form.

2,921,296 / Theodore G. Floros, Poughkeepsie, N.Y. / International Business Machines Corp., New York, N.Y. / A deskewing device.

2,921,297 / George E. Lund, Havertown, Pa. / Burroughs Corp., Detroit, Mich. / A shift code counter.

January 19, 1960: 2,921,737 / Mao Chao Chen, Palo Alto, Calif. / General Dynamics Corp., Rochester, N.Y. / A magnetic core full adder.

2,921,738 / John P. Greening, Bartlesville, Okla. / Phillips Petroleum Co., a Corp. of Del. / A polynomial multiplier.

2,921,740 / Willis E. Dobbins, Manhattan Beach, Charles R. Williams, Hawthorne, Hrant H. Sarkissian, Hermosa Beach, Donald E. Eckdahl and Floyd G. Steele, Manhattan Beach, and Albert E. Wolfe, Jr., Compton, Calif. / Northrop Corp., Hawthorne, Calif. / A binary incremental slope computer.

2,922,095 / Victor L. Hesse, Playa Del Ray, and William O. Felsman, Tarzana, Calif. / Litton Industries, Inc., Beverly Hills, Calif. / A digital-to-analogue converter.

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.

2,922,143 / Herman Epstein, Philadelphia, Pa. / Burroughs Corp., Detroit, Mich. / A binary storage system.

2,922,144 / Donald F. White, Oakland, and William H. Reinholtz, Berkeley, Calif. / Smith-Corona Marchant, Inc., a Corp. of New York / A read-record circuit.

2,922,145 / Andrew H. Bobeck, Chatham, N.J. / Bell Telephone Lab., Inc., New York, N.Y. / A magnetic core switching circuit.

January 26, 1960: 2,922,231 / Victor R. Witt, Poughkeepsie, and Rex C. Bradford, Wappinger Falls, N.Y. / I.B.M. Corp., New York, N.Y. / A recording and reading transducer for permitting simultaneous recording and reading in closely spaced storage areas of a traveling magnetizable record medium.

2,922,577 / Luciano Cignetti and Siegfried Reisch, Ivrea, Italy / Ing. C. Olivetti & C., S.p.A., Ivrea, Italy / A digital computing apparatus.

2,922,578 / Gareth M. Davidson, Bronx, N.Y. / American Bosch Arma Corp., a Corp. of N.Y. / A trigonometric con verter.

2,922,579 / David A. Goldman, Yorktown Heights, N.Y. / —— / An electromechanical vector solver and resolver computer.

2,922,900 / Carl K. Gieringer, Cincinnati, Ohio / The Cincinnati Time Recorder Co., Cincinnati, Ohio / A program timer.

2.922,983 / Arthur H. Dickinson, Greenwich, Conn. / I.B.M. Corp., New York, N.Y. / A data processing machine.

2,922,985 / David J. Crawford, Poughkeepsie, N.Y. / I.B.M. Corp., New York, N.Y. / A shifting register and storage device therefor.

2,922,986 / Alan G. Chynoweth, New Providence, N.J. / Bell Telephone Lab., Inc., New York, N.Y. / A ferroelectric memory device.

2,922,987 / George Haugk, Succasunna, N.J. / Bell Telephone Lab., Inc., New York, N.Y. / An information storage system.

2,922,988 / Charles W. Rosenthal, New York, N.Y. / Bell Telephone Lab., Inc., New York, N.Y. / A magnetic core memory circuit.

2,922,989 / Myron J. Mendelson and Marc Shiowitz, Los Angeles, Calif. / The National Cash Register Co., Dayton, Ohio / A computer input data control system.

2,922,990 / Ralph A. Anderson, Deerfield, Ill. / Information Systems, Inc., Skokie, Ill. / A data reduction system.

2,922,991 / Robert L. Frank, Great Neck, N.Y. / Sperry Rand Corp., a Corp. of Del. / A plural speed data receiver.

Feb. 2, 1960: 2,923,468 / Sigmund Rappaport, Port Washington, N. Y. / Sperry Rand Corp., a corp. of Del. / A component solving and integrating system.

2,923,469 / William W. Woodbury, San Jose, Calif. / I.B.M. Corp., New York, N.Y. / An electronic calculator.

BIG NEWS

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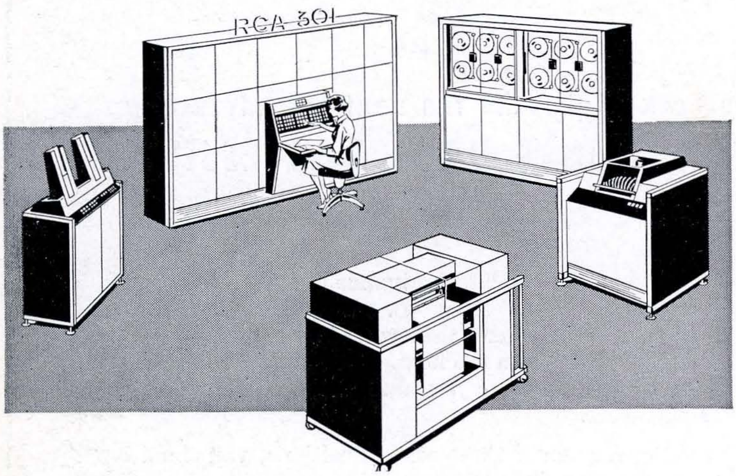

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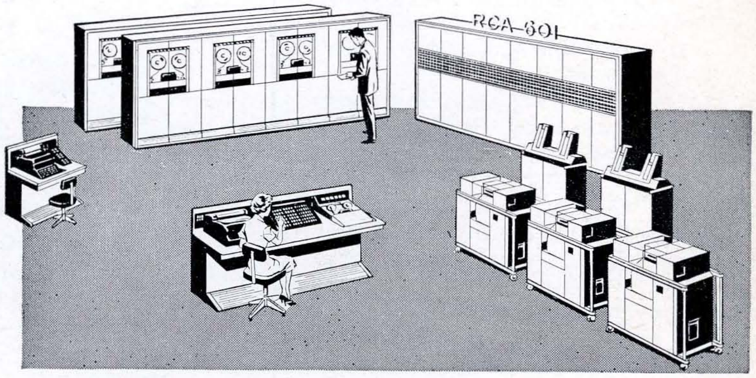

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