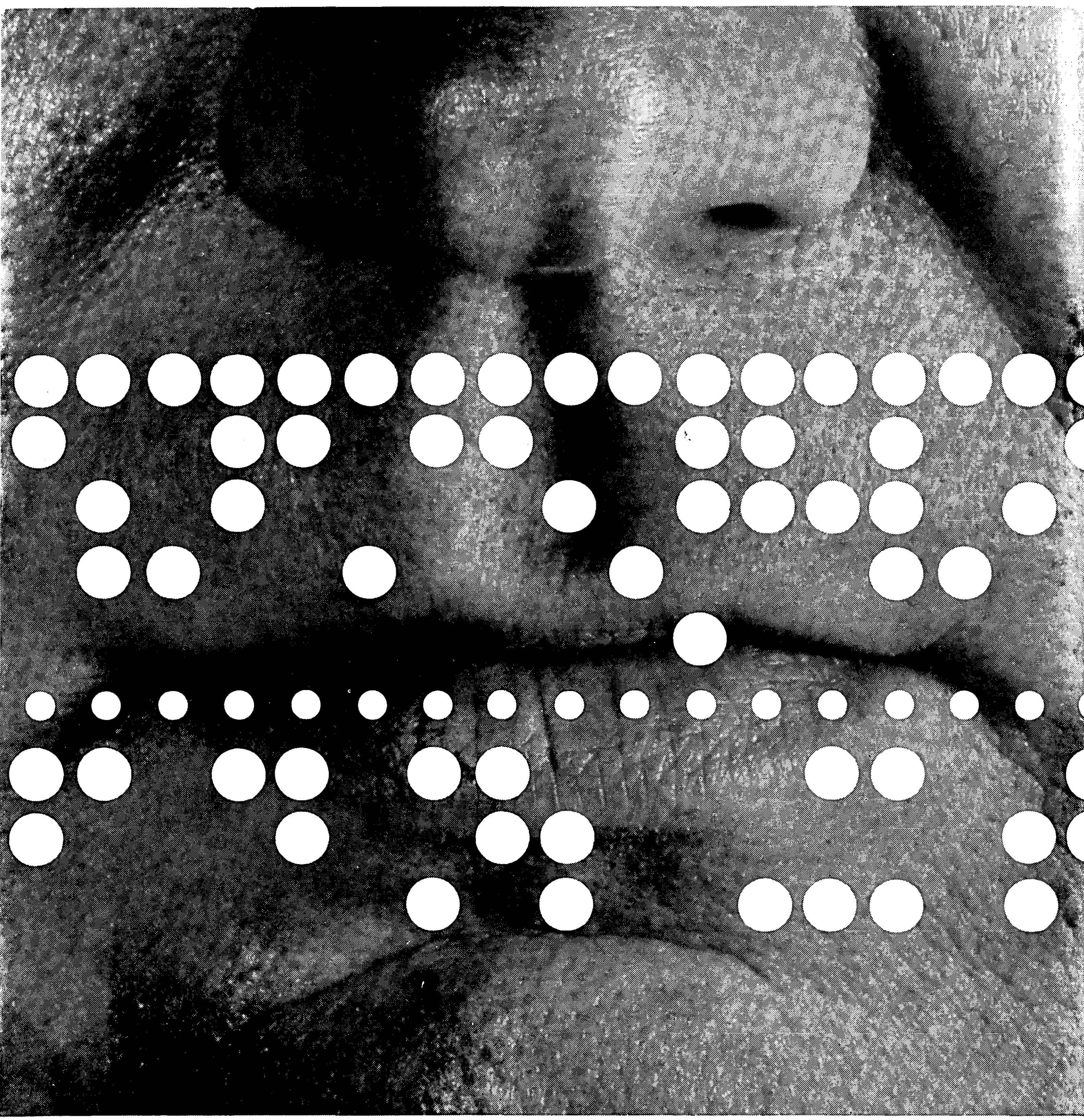
April, 1963

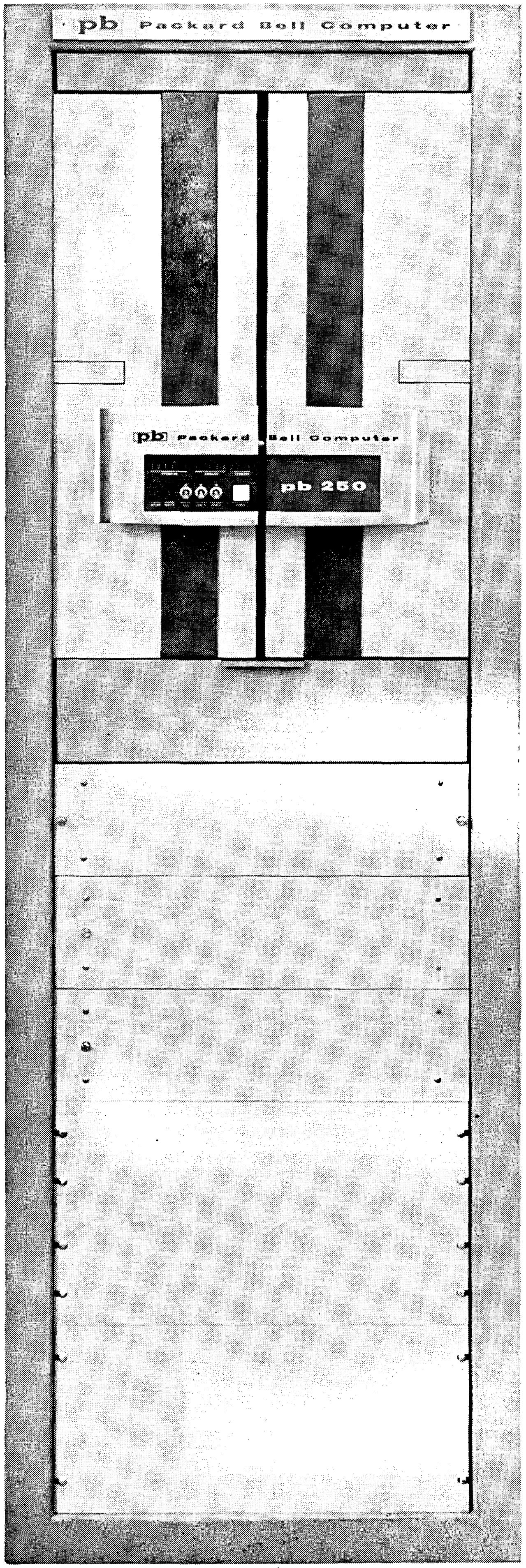
# computers and automation

To -



Military Command: *A Challenge for Information Processing*



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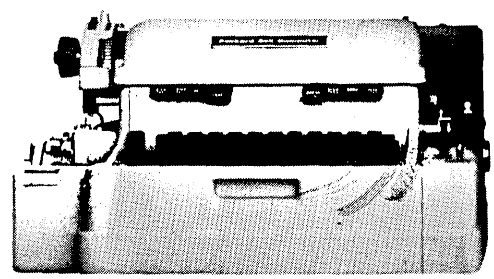

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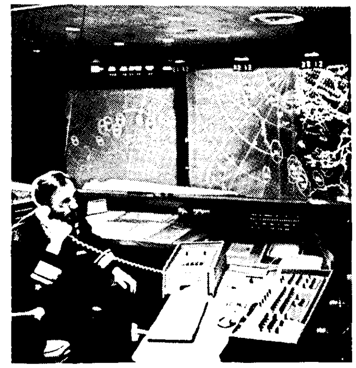
*The "go" or "no go" decision time of a military commander has shortened, from days and hours, to minutes and seconds during the last decade. To permit military leaders to make this decision on facts and not guesses is perhaps the greatest challenge in defense activities. Computer-assisted information processing systems have been proposed as a solution to this key problem. Walter Bauer provides a thoughtful analysis of the principle and techniques of information processing for military command on page 8.*



# computers and automation

APRIL, 1963 Vol. XII, No. 4



*computers and data processors: the design, applications, and implications of information processing systems.*

## *In This Issue*



## *In Every Issue*

### *across the editor's desk*



### *readers' and editor's forum*



### *reference information*



### *index of notices*



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# c & a
## READERS' & EDITOR'S FORUM

### ENCORES FOR DECEMBER

To the Editor:

We found your December issue of "Computers and Automation" to be most interesting and informative.

Please forward and bill us for two more copies.

J. PAUL GRIFFIN
*Reservations Control Operations Manager*
United Airlines, Denver, Colorado

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### "RENTAL VALUE" IN THE COMPUTER CENSUS

**I.**

To the Editor:

I have recently worked with your monthly computer census and found it very helpful.

However, I would very much appreciate receiving a definition of what is generally included under the term "rental value."

LENNOX N. LEE
Sprague Electric Company
North Adams, Mass.

**II.**

From the Editor:

As you no doubt realize, the actual monthly rental for a computer system varies widely depending on the array of input/output equipment included. For example, the IBM 650 and the IBM 7070 computing systems can treble in rental costs depending on their tape and disk configurations.

The "average monthly rental" figure we use in our computer census seeks to approximate the mathematical average of the monthly rental values for a class of actual computer installations. This provides a factor which can be multiplied by the actual number of installations to yield the cumulative monthly rental value of the computing systems installed. We believe this is the most useful way of presenting this information.

Comments and suggestions from other readers are invited.

---

### IBM MARKETING MEN OUTLINE FOUR GATEWAYS TO EDP FOR THE SMALL USER

I.

To: Mr. C. G. Francis, Director of Information
IBM Corp., Data Processing Div.
White Plains, N. Y.

A few months ago we received a news release stating that 6 banks in New York State are planning a multimillion dollar joint program to establish three computer centers to automate their paper work.

The release stated these banks would use exclusively IBM equipment.

This joint venture is apparently a significant step, recently legalized by Congress, to the joint ownership of computing equipment for financial data processing. It seems possible that many banks previously inhibited in placing their paper work on a computerized basis because of its costs, can now feasibly do so on a partnership basis.

We would like to publish in **Computers and Automation** an analysis from IBM of the marketing significance of this trend, and the extent to which it may be employed by other industries; for example, through the use of data communications. Is it possible we could receive such a statement?

NEIL MACDONALD
Assistant Editor
**Computers and Automation**

II.

To: Mr. Neil Macdonald

We've discussed with a number of our marketing experts your recent letter in which you asked for our comments on the significance of the cooperative venture in data processing recently undertaken by six banks in New York State.

They feel, obviously, that this is one way in which small banks can get together to take advantage of the economies implicit in electronic data processing. No doubt, as more smaller banks become aware of these advantages, similar ventures will be launched.

But the fact is that there is no one magic method applicable to all situations. They suggest at least four ways that smaller institutions can use data processing advantageously, all of which have merit:

1. *Computer service centers:* Customers can bring their data processing problems to the center for solution. Payment may be on an hourly or material basis. The service bureaus approach a customer problem in its totality, striving to reduce customer operating costs, devise tighter controls, and provide more useful accounting reports.

2. *Data processing centers:* These centers enable customers to rent electronic data processing equipment. They differ from the service bureaus in that the customer does his own programming and uses his own personnel to operate the equipment.

3. *Individual ownership:* A smaller firm may elect to rent or buy data processing equipment and, in addition to his own uses, offer this as a service on a fee basis.

Data processing manufacturers today are making low cost computer systems—such as the IBM 1440—that are well within the budget of many smaller in-

*(Please turn to Page 44)*


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# MILITARY COMMAND: A CHALLENGE FOR INFORMATION PROCESSING

Walter F. Bauer, President
*Informatics, Inc.*
*Culver City, Calif.*

Of the many technical areas in military electronics, information processing in military command is providing one of the greatest challenges among defense activities. But of cardinal interest is the challenge to information-processing technology itself, for the requirements are more severe and new techniques more urgent than in any other area of computer application.

There have been a number of writings on the subject and some of these are listed in the Bibliography. This discussion has a different orientation from most of these: it is directed at an explanation of information processing in military command to the computer professional so that he may appreciate the techniques and developments. These are important to him since they are among the most advanced in computer technology today and point the way to future uses of information processing in scientific and business applications. In particular the advances in on-line and man/machine operations are noteworthy. Hopefully, the techniques are also of interest to the military professional, in giving him the viewpoint of the computer professional. Command systems involve many very important technologies in information processing such as communications and sensor development. However, attention is limited here to the processing of information after it is received at the centralized command post.

Assuming the author's prerogative of defining the subject, it is perhaps best to start with a definition of what "Information Processing in Military Command" does *not* deal with. The subject does not involve the use of computers for operations such as inventory control, personnel records, war planning, and personnel training, although these operations are important to the military. Also, the subject is not that of the direct control of weapons or sensor systems (radar, radio receivers, etc.). Rather it is the processing of information in direct support of the command processes. It, therefore, includes topics on personnel, weapons, logistics and sensor systems as needed in the command process while not being principally concerned with them. The subject involves the data processing needed to supply information to the commander and his staff; therefore, one of the most salient characteristics of such systems is that they have a man/machine aspect.

By the above definition the SAGE system is not a command and control system since its main function is the direct control of aircraft through data links. Similarly, BMEWS (Ballistic Missile Early Warning System) is not a command and control system; it is best classified as a sensor system which supports command.

## Concepts and Characterizations

The motives from the military point of view for automating the command and control systems have been thoroughly discussed and are well understood (see Bibliography). Time periods measured in days and hours for the commander's decision in World War II have been reduced to minutes and seconds. The power of the weapons has increased by orders of magnitude. The power of the weapons when combined with the reaction time implies an important challenge. (As an example, the assessment of damage by "indirect" means or by mathematical models rather than by direct observation is necessary in view of the power-time factors.) The implications of the commander's decision have likewise increased. He must make decisions in a short time which could level countries and have far-reaching effects on a world-wide basis. Finally, the complexity of warfare has increased. The number of parameters describing the status of friendly and enemy forces, the manipulation of data to present those parameters, and the many courses of action available to the commander present problems which electronic data processing can help solve. It is probably not exaggerating to say that the application of electronic data processing is mandatory for modern military command.

The above argument suggests defining a quantity which might be appropriately called "command information index." Communicators have for some time defined quantity of information as the product of bandwidth and time. The "command information index" may be defined as the amount of information that the commander must have in

*(Based on a paper invited for the meeting of the Association for Computing Machinery at Syracuse, N. Y., September, 1962.)*

a digested, comprehensive and comprehensible form, divided by the time period reflecting elapsed time between the collection of the information and the time of his decision. This index would show an exponential increase from the time of the history of military operations. The index shows little sign of leveling off.

A review of the important characteristics of the command and control system shows that the emphasis is on the command function. The status of friendly and enemy forces and resources is of direct importance in the process of the deployment or commitment of forces. There is no direct weapon control in these systems. Rather, decisions are made which will bring other automated systems into operation to control weapons. These systems are directed to a principal operation on a "post-attack" basis. That is, after a war begins, the systems begin to operate in the principal way for which they were intended. Pre-attack operations are important, of course, to determine and monitor the status of forces and resources, and many regard post-attack operations to be simply an extension of pre-attack ones.

A most important characteristic of command systems is the close relationship of man to the machine. It is this relationship which opens up a new field of technology in information processing. The machine system must be organized to give and receive data from the human on the human's terms. However, it is important to realize that the military commander's prerogatives are not in any sense usurped by the data processing system. The electronic system extends his intellect and amplifies his ability to handle the many facts affecting decisions.

In order to define other needed terms and further introduce the subject, it is well to consider at least superficially the functions of the military commander. The commander must continually review the status of his forces on a pre-attack basis to commit them most effectively during post-attack. On a pre-attack basis he evaluates the threat and continues this evaluation during post-attack. He directs the battle by monitoring the effects and progress of his operation plan. He selects options from the plan based on the information he has. Behind all of this is the control of resources in support of the forces.

### Existing and Planned Command Systems

A discussion to any depth of existing or planned command systems borders on classified information and therefore will not be included here. It will be sufficient to outline the present status.

Command systems as they are being considered today are very new. First concepts developed and contracts let were probably those of System 465L, SAC Control System, in many respects an outgrowth of the SAGE system which, in fact, uses a SAGE-like computer. Shortly thereafter activity rapidly increased in nearly all major command areas: Atlantic and Pacific operational control centers for the Navy as well as their central Navy Information Center (NAVIC); the Air Force Command Post (System 473L), North American Air Defense (NORAD, System 425L), and its related SPADATS System for space vehicle monitoring for the Air Force; and the extensive Fieldata systems for battlefield data processing for the Army. A number of important intelligence or support areas came into existence which in themselves are similar to command systems from a data processing point of view, such as: Defense Communication Agency (DCA), Department of Defense Damage Assessment Center (DODDAC), and Air Force System 438L at SAC and at Air Force Central Intelligence.

More recently, increasing activity has occurred at the next higher levels of command. A new National Military Command System has been established but not yet implemented; this will be a command system for the Joint Chiefs of Staff. Of great interest are alternate command posts for the JCS in succession of command at hardened or mobile locations. Also, it is probable that the President himself will have an automated system or have direct access to such a system in the not-too-distant future.

### Data System Functions

Data processing systems in support of command and control can be thought of as consisting of three central parts: input, data processing, and output. Data processing is a well-established operation for the state of the art evolves from more than ten years of use of the electronic digital computer in the processing of data. Input and output areas, however, present quite a different story. Business data processing and scientific and engineering applications of computers at this state of the art have only a pedestrian need for an input system and an output system as compared with the military command and control system. It is in these two areas where the biggest challenges lie; it is in these areas where there is little or no automated operation.

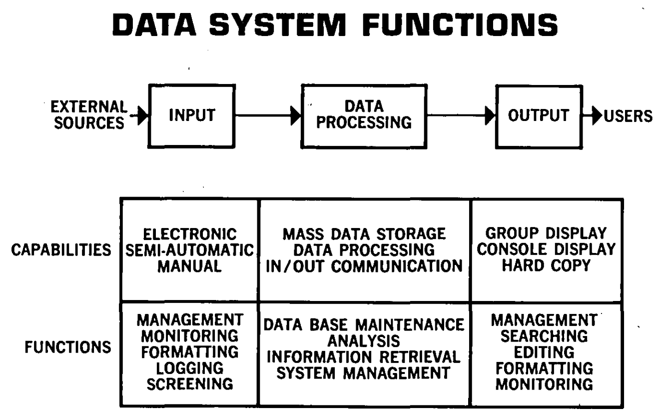


Figure 1

Figure 1 summarizes some of the capabilities and functions of the three areas. The input area deals with the receiving of data from external sources. It must also include the ability to handle data from semiautomatic devices like cards and punched paper tape and from manual sources such as keyboards. The main function to be performed by the input subsystem is the entire management of input data. This involves the handling of a priority problem; input data must be monitored so that high priority data can be switched to the appropriate part of the automatic control system, and lower priority items stored for later handling. Messages must be logged and they must be screened. Also, the messages must be brought to a specific format so that they can be entered into the data processing subsystem.

A special remark about input is warranted here. The biggest challenge in command systems is the injection of imperfect or unstructured data into the system. Teletype systems, for example, have a high error rate. Redundancy codes for error checking must be employed or the message must be corrected through human intervention. Even if the message is completely accurate alphanumerically, the information may still require structuring before it can be entered into the data processing subsystem. An example of the structuring is the receipt of an intelligence report which is simply a paragraph or more, of visual observations. This implies that the input subsystem itself must have a close relationship to the humans which operate it; displays and interrogation equipments are called for.

In general the output subsystem must provide communication to humans through group display, console or individual display, and hard copy print outs. The functions are entirely similar to those of input. In addition to the functions of formatting, logging and editing, there is the additional function of information retrieval or file searching. The output subsystem may have an input capability all its own. It may have, for example, a man/machine console to make information requests and to generally direct the information to be put on the group displays.

The data processing capabilities are as shown: data storage, data processing and communications with input and output. The functions are to maintain the data base, to analyze data, and to retrieve information. The last item, that of total systems management, is important for there must reside somewhere in the system the over-all electronic management of the automated system.

It seems important to regard the over-all data system as consisting of three major subsystems: input, data processing, and output as indicated in Figure 1. In fact, a multi-computer system with one or more computers for each of the subsystems is an important design trend. Each subsystem has functions that can be carried on relatively independent of the other subsystems requiring communications between them only of a small bandwidth. This allows an organization of the systems analysis, systems design and programming tasks which simplifies the over-all implementation tasks.

# MAN/MACHINE COORDINATION

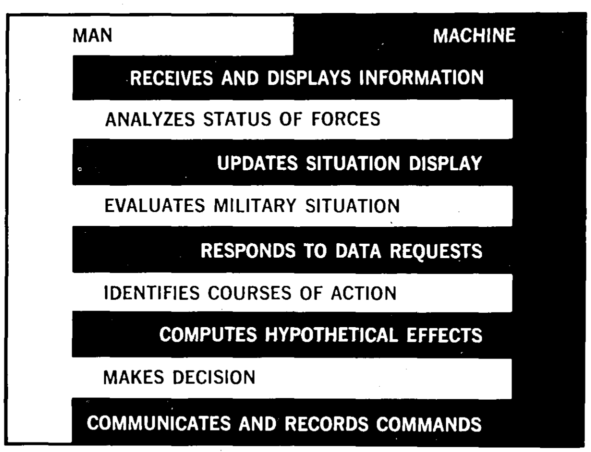


Figure 2

## Man/Machine Coordination

Figure 2 shows a schematic portraying the close interrelationship between man and machine in a command and control environment. During times of pre-attack as well as post-attack, the machine receives information from communication devices and displays it. The man analyzes the incoming information as to the status of his forces and those of the enemy. The machine receives additional information and updates the situation display. The man evaluates the military situation based on the information the machine has displayed. In so doing, he makes requests of the machine to which the machine responds, since it is impossible for the system to cover, under normal output procedure, data reflecting all contingencies in which the commander might be interested. The man identifies certain courses of action and the machine computes hypothetical effects based on the various possible choices. The man makes the decision and the machine communicates the commands and records them.

The function "computes hypothetical effects" is probably futuristic. At the present time there is no real-time or operational war gaming capability in command systems to help the commander make his decision during the actual post-attack period.

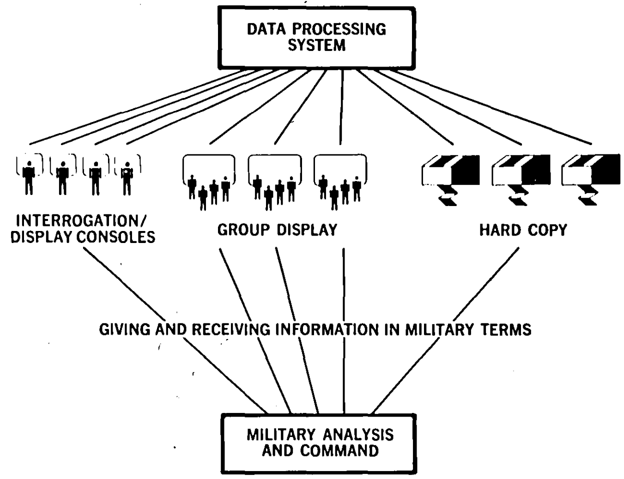


Figure 3

## The Command Viewpoint

Figure 3 shows schematically the data processing system from the point of view of the commander. He receives information from the machine, from console displays and group displays, and from hardcopy print outs. The likely ratio of the amount of data coming from each of these output areas is 20, 50 and 30% respectively, although this is a controversial point. Console displays reflect the working display to help prepare and format group displays and to react to particular requests of the commander. Group displays represent the major standard output to the commander reflecting tactical situations and situations which change rapidly. For example, consider the status of bomb aircraft missions, or the delivery patterns of weapons. Hardcopy output represents the back-up data which is frequently used for reference. The data processing system itself is simply a "black box" from the commander's viewpoint.

The most important aspect from the standpoint of the commander is that he must communicate with the machine in his own language—the military language (see the example below). This implies that the hardware and the procedures providing the input/output to him must be so designed to allow this. Communication with the machine in a programmer's language totally foreign to the military man is unacceptable. There must be an intermediate translation from the military language to the language of the console displays, group displays, or hardcopy print out.

## Man/Machine Techniques

It is not only the language that must be compatible with the commander's requirements. The procedures and resulting response of the system must be consistent with his needs.

In military command it is frequently required to ask complex questions with many quantifiers of a large data base. The computer must be an active participant in the process or the operation becomes unwieldy. Consider the functions as shown in the center panel of Figure 4. The military staff man must perform the selection, but there must be functions performed relating to the logic or syntax of the request and there must be consultation of a dictionary or format specifications. These in turn require a look-up operation to files which provide the required data. In manual operation, as shown, the computer performs only the process of retrieval and presentation. The burden of obtaining the procedure to be followed by consulting a thick operator's manual is left as a burdensome manual operation.

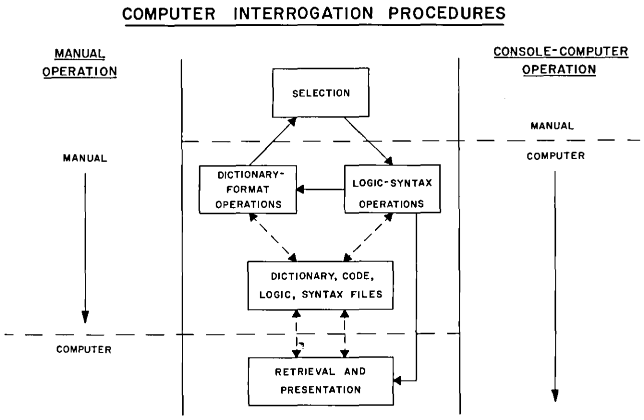


Figure 4

In the console-computer automated operation the *only* function left to the operator is that which must be left to him, the selection. The computer leads him by the hand down the complex, tortuous, procedural path.

As a simple example of the principle espoused, imagine that the commander wishes to have information about POL (petroleum, oil, and lubrication) resources and airfields in a certain section of the country. Also, for example, suppose he wishes to have a list of airfields in five western states which have a POL residual of 80% after an enemy attack. It is totally unacceptable for him to make the request to a technician who would then transfer the information to an obscure code or punch it on a card. Rather, he makes the request to a staff officer who *directly* asks the machine the question. The staff officer, for example, may specify to the machine that he is interested in "installations" and chooses, from a list of installations which the machine gives him, the category "airfields." He then tells the machine he is interested in resources and the machine provides him with a list of resources from which to choose. A similar procedure takes place with respect to the geographic location. When he tells the machine that he is interested in a residual of 80%, the machine presents him, electronically, a form to fill out in which he provides the number 80. The format of the request is natural. It is neither highly stylized, nor codified. The staff officer making the request and pushing the buttons is himself a military man who understands the commander's request and the reasons for it rather than the technical details of how to make the machine accept or respond to the request in its complex electronic way.

## Relationship with Scientific and Business Information Processing

It is useful to digress momentarily to discuss the implications of the military developments on non-military areas. It is the consensus among most computer professionals that most scientific and business systems, especially large-scale ones, will become on-line and will have important man/machine aspects.

Therefore these military systems represent pioneering technical efforts in information-processing systems; they are the vanguard of a new and important generation of information processing systems.

Future scientific systems, for example, will look functionally more like our Figure 1. They will receive data from automatic sources and will be called upon to perform many tasks simultaneously. Functions of input and output will grow in relative importance and complexity to central processing; multi-computers will be called upon to implement the tasks. Consider the multi-operations of a future scientific system in a typical aerospace company: test data is continuously arriving from stations and is being formatted; a trajectory problem is being run, man/machine requests are being made of the results of yesterday's tests, and files are being updated on reliability and inventory records. The similarity with military command systems from the point of view of data processing techniques is obvious.

Just as the military commander today gets information by automatic techniques for his decision making, so will the operations executive of the large firm tomorrow require such systems. There is a good analogy between the marketing executive and the military commander, for example; the executive must receive information from many sources such as advertising agencies, sales outlets, and supply or inventory areas; and he makes decisions involving prices, shipments, and further advertising. Response times required by businessmen will shorten as the techniques described here are better known, more widely used, and the techniques begun to be used by business. The economic factors will then come into balance with the benefits to be derived.

## Status of Hardware

At the present time the computer available for the mechanization of command and control systems is the most favorable aspect of the entire hardware picture. Computers are of sufficiently high speed and they are of sufficiently general purpose to do the job expected.

Some improvement is desirable, however, in the area of making the computer more adaptable to the ordinary military environment in which it might be found. This includes protection against shock and in general the fulfillment of more rigid military specifications. Also, reliability could be improved in the systems since reliability for military systems must be of the very highest. Systems must be designed to reorient themselves to appropriately carry out the job despite the fact that a fraction of the system's components may be inoperative. Multi-computer systems, better designed and implemented, will provide an appropriate answer.

The storage of data is reasonably adequate for command and control systems. Magnetic tapes and magnetic drums are available with reliabilities which approach acceptable operation. Disc files need to be improved both from the standpoint of the amount of information recorded and the response time or access time to obtain various pieces of information, but will provide important storage capability in their present forms. Again, however, all of these data storage devices need improvement in the direction of their meeting military specifications.

In the group display area, flexible, fast response full color displays are now lacking. A number of companies have systems in advanced states of development and the future will soon see, for example, the automatic, high response, full color slide-making display system delivered and proven operationally successful. There will be a continuing need, however, for other types of continuous response group displays which provide a continually changing picture of forces and resources.

Man/machine consoles for interrogation of the computer system and for the readout of specific amounts of information are now becoming available. A number of companies have consoles which are in many respects adequate. There is, however, no general agreement among users as to what the qualifications or specifications of these machines ought to be. In this respect, the man/machine console area is lagging far behind the computer areas as to general agreement on what is necessary.

In the input/output area, high-speed printers, punched card and paper tape readers are available and are, in general, reasonably adequate. An area which needs considerable attention is the communications multiplexing equipment, that is, equipment for tying into computer systems a multiplicity of teletype and digital data-link communi-

cation lines. Development is presently under way for attacking the problem but very few off-the-shelf items and certainly no standard techniques have been widely adopted. Developments such as Project Mercury and the Naval Tactical Data System and some of the new equipments offered for switching by communications companies represent important first steps.

Another lag in the I/O area is the unavailability of equipment for "natural" input. Optical readers will be important for command and control systems. Intelligence reports frequently, for example, arrive in written or printed form, making desirable the input directly into the computer of that kind of data.

### System Development and Implementation

Shown in Figure 5 is the over-all development cycle for command and control systems. The entire cycle from concept and environment through system test and implementation takes 2 to 5 years depending on the degree of ambition of the system conceivers. The system proceeds from the analysis of the concept and environment to the over-all design of the system, thence to system specification and system implementation and finally system test. As shown, these areas of activity and phases interact continuously with the policies and management activities. It is not intended to suggest that the development cycle proceeds in a linear way. There are many cycles, re-appraisals, and feedbacks in the process.

## COMMAND AND CONTROL SYSTEM DEVELOPMENT

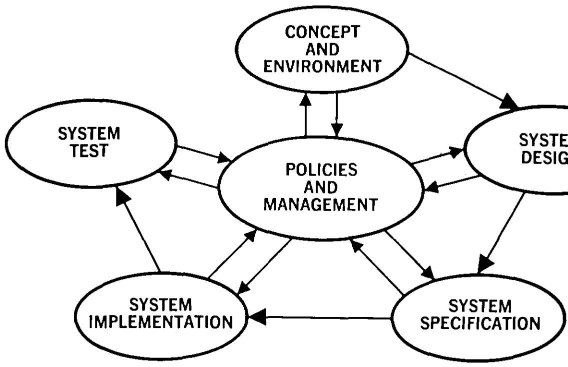


Figure 5

Also, mention should be made of the newly established idea of a test bed or developmental center for command and control systems to test out hardware and procedures prior to imbedding them in an operational system. This is a most desirable plan and will allow an orderly transition from developmental to operational system. It will result in much less frustration to military planners and civilian contractors alike, and will make considerably better use of the taxpayers' dollars.

In Figure 6 there is a breakdown of the various major phases of the development cycle. The differences of the phases from classical military electronic systems should be noted. The concept and environment phase, for example, breaks down into an understanding of the operating concept, that is, a general statement as to how the system fits certain similar systems and what its over-all responsibilities are. Military functions are then defined as an outgrowth of the concept. Following this, the data processing functions are defined. For example, if it is determined that forces and resources of a certain type are to be kept on file and referred to frequently, this will require the storage of data in random-access memories. Thus the system requirements are generated.

## CONCEPT AND ENVIRONMENT

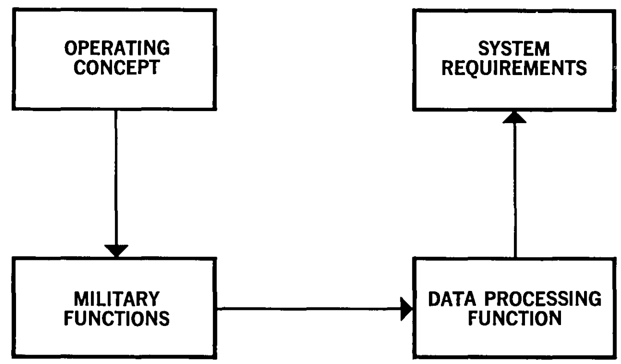


Figure 6

System design is the next step in the more detailed definition of the system. First of all, the input data must be defined. That is, it must be determined how much data is coming in, where it is coming from, the nature of it, and what must be done with it. The data base is then formulated; decisions are made as to how the data is to be organized in view of what is to be done with it. Similarly the data processing task must be defined. The major system programs are spelled out and their interaction with the input and the data base analyzed. All of these tasks are done, of course, to define the output of the system which is the principal product. The kinds of output are determined, various formats are defined, and the procedures for the output are spelled out.

Next comes the systems analysis and specification. It is in this area where there is the greatest deviation from the classical military electronic system development. This breaks down into three areas, the personnel system area, the task modeling, and the analysis of the equipment. Although maintenance and operational personnel at lower, non-command levels is not as serious a problem in these systems because of the high degree of automation, it is nevertheless important to determine the kind of personnel required to handle the various tasks and to spell out the procedures. Task modeling, however, is of extreme importance. Having determined the major data processing activities and programs which the system is to do, a detailed mathematical and logical model must be developed. Equations, relationships between quantities, and logical flow must all be integrated to provide the specifications for the programming to follow. Programming specifications are thus a detailed description of what the programs are to do and how they function; in the same way drawings and circuit designs specify the functioning of hardware. Also, equipment must be analyzed to determine the kinds of equipment needed and how the data processing functions will be mechanized. Hypothetical equipment configurations are evaluated. This leads to the specification of equipment and procurement.

All of these things interact with systems analysis activities as shown. Total system specifications are then generated.

Implementation and test phases complete the development cycle. Operator and maintenance training is accomplished as well as the installation and testing of the equipment. The installation and test of the equipment itself is not nearly as long, tortuous, and expensive a proposition as the performance of the programming and checkout of the programs themselves. Standard procedures are available for the computers since there are likely many copies of the same computer in existence. However, the computer programs are ad hoc and highly customized.

Completing the cycle is the analysis of the various subsystems and their test, the exercise of the system with their personnel, simulation of the system under various conditions, and finally, war gaming activities which may use all or parts of the system.

## IMPLEMENTATION COST DISTRIBUTION

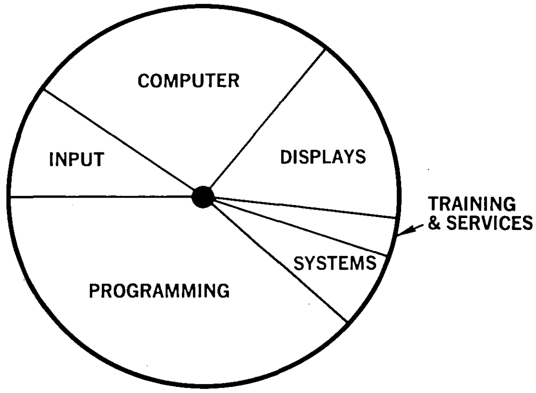


Figure 7

Figure 7 is a pie chart giving the distribution of the implementation costs of a system. It is immediately noted that hardware costs are approximately one-half of the total systems cost, making these systems unusual as compared with other military electronic systems. The input and displays area contributes a big fraction of the cost. In fact, the computer itself is in support of the input and display area so that hardware costs for input, data processing, and output would probably be divided equally.

Programming is the overwhelmingly big cost factor in a command system. Figures of $10 per computer instruction are frequently used. The cost is high because of the many steps which must be accomplished in terms of the design determination of the logic system, checkout, etc. for every computer program. In view of the fact that computer programs of 100,000 to 200,000 instructions in length are not unusual, it is easy to see why programming costs are high. More work needs to be done in the systems and programming area to reduce costs; otherwise it may soon happen that the non-hardware areas of these systems requires ⅔ or even ¾ of the cost.

### Equipment Needs and Major Problems

The needs for hardware development split into two areas; the computers—which are quite adequate functionally, and speedwise, but cannot cope properly with the military environment; and the group displays—which are not sufficiently fast and flexible at this time. Computers need to be made which fit better into the extra-environment of the military installation. The area of peripheral equipment meeting military specifications is almost an untouched area at the present time. Next, of course, miniaturized computers are needed so that they will take up less room in their cramped environment in ships, submarines, etc. As noted, there are needs for fast response, flexible group displays, and for multiplexing equipment to connect the communications device to the computer.

In general, computer-automated command systems are very new, and major problems exist from both the military and the contractor's viewpoints. In the first place, there is very little experience in the design of such systems and very little experience in the use of these systems. There are no standard design procedures and all design work is done on a "top of the head" basis. More principles and techniques need to be evolved to analyze data processing systems of this kind and to judge their merits.

The area of functional compatibility between the various command systems is badly needed if there is to be orderly growth.

In the area of hardware, command and control systems are totally dependent upon the development of communication systems. Without the ability to receive timely and accurate information, the command and control system need not exist, of course. The development of communication systems is probably behind the development of the data processing centralized installations which could use the information. In the above paragraphs we have already referred to the needs in the handling of input data and the necessary display hardware development and the development of automatic programming techniques to reduce the costs of programming.

It is probably also true that one of the major problems of command and control systems has been the eagerness of many civilian contractors to foist highly impressive systems on various military agencies and the lack of understanding of the long and tortuous development cycle, in terms of programs which need to be written and logic which has to be developed. On the other hand, the military has probably not in all cases been fully aware of the capabilities of the data processing equipment and the problems in system implementation. This is being corrected slowly but surely, by the development of more military personnel who are acquainted with data processing technology.

### The Future

It is platitudinous to say that our country depends very greatly on the development of automated command systems. Meanwhile, however, one reads of totally irresponsible statements of "computers deciding whether we should go to war." This is certainly not the case and never will be the case. The very essence of these command systems is that they provide the means of far more certain control by military personnel instead of haphazard control. This does not imply, however, that increasingly more functions of a routine nature cannot be taken over by the machines. It is probably accurate, however, to say that modern command techniques now being developed make the computer indispensable to the command process.

Command and control systems development undoubtedly will increase in importance to the country and will take its place alongside missile and space development and the atomic weapon in completing our arsenal for defense.

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# THE IMPACT OF AUTOMATION ON SKILLS AND EMPLOYMENT

Walter Buckingham, Director
*School of Industrial Management*
*Georgia Institute of Technology*
*Atlanta, Ga.*

More scientific and technical knowledge has been gained in the last fifty years than in all previous history. About 96 per cent of all the scientists who have ever lived are living today. The practical application of this science in the form of technology has solved many problems; but it has created others. Aristotle said, "When looms weave by themselves, man's slavery will end." Automation does indeed promise to end poverty but not without some cost.

### Advantages of Automation to Workers

The advantages of automation for workers are greater and more obvious than the disadvantages. Automation improves working conditions in several ways. In nearly every case there is greater safety. This is due to mechanized materials handling, elimination of the most hazardous jobs, and the reduction of the number of people in direct production areas due to remote controls such as monitoring dangerous operations with electric eye or television equipment. Hernia, eye troubles, and foot accidents have virtually disappeared in the Ford Motor Company's automated Cleveland engine plant.

In the pottery industry, silica dust has long been a hazard. Closed silos and automatic conveyors now handle all dust-producing materials. In the chemical and petroleum refining industries potential toxic exposures were always a great risk. Automation has reduced this risk. In our major automotive stamping plant scrap steel formerly was collected at individual scrap collection areas where it was baled and moved on open conveyors to the central collection area. Workmen were exposed to physical dangers and there were frequent injuries. Automatic equipment now leads the scrap into balers, and closed conveyors move it to the collection area where it is automatically loaded. The whole process is monitored by television.

Automation improves working conditions in general by permitting plants to be cleaner, neater, and more pleasant to work in. There are automated grain mills that have eliminated all dust. There are foundry workers who never touch the molding sand except from curiosity and oil refinery workers who could wear dinner jackets and white gloves on the job and never get them soiled. Automation is not without its esthetic advantages.

### Possible Disadvantages

The decline of physical risks could be effected partially by greater emo-

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

tional hazards. The highest incidence of gastric ulcers in the hourly paid group is now among skilled machinists who exert less physical effort than most workers. Ulcers, although physical in result, are caused primarily by mental or emotional stress. A recent medical study of heart diseases revealed that unskilled laborers are among the least likely to have heart attacks of all occupational groups. Among those most susceptible are people working with computing machines.

In some cases automation increases workers' feelings of security because the continuous nature of automatic processes permits greater regularity of employment and hence more job security. In other cases this advantage is partially effected because regularity of employment means regularity of night work, increased boredom, or a more rigorous industrial discipline from machines. In some instances automation reduces the interaction among workers both by reducing their numbers and by increasing the distances between their work places. A study of workers' attitudes toward automation by Professor W. A. Faunce of Michigan State University showed that the main complaints of 125 workers were increased noise, need for closer attention to work, and most important, loneliness from being isolated from other workers. At least one British union has already asked for "lonesome pay."

Related to lonesomeness is boredom. This is not peculiar to automation, of course. It is perhaps more typical of old-style conventional mechanization, but some operative jobs under automation may still be highly routine and boring. These jobs are usually the most likely to be mechanized, however, since they are based on simple, repetitive tasks. In Coca-Cola bottling plants the old method of inspection was to put four bottles of finished product in front of a strong light and have an inspector watch for any foreign matter in the drink. Then someone initiated a conveyor system in which the bottles ran continuously. This was a much faster process, but the job was so boring that every now and then a Seven-Up had to be run through to see if the inspector was alert.

People may become hostile if their personalities are ignored. A good way to make an enemy is to ignore someone. Professor Faunce quotes a typical worker as commenting, "They (the supervisors) never say hello—they treat you like a machine. They used to be friendly. Now they seem under a strain." But although automation reduced the interaction among workers in a particular area by reducing the number of workers under a foreman's jurisdiction it *increases* the opportunity for interaction between workers and supervisors. Likewise the greater integration of operations increases the foreman's contacts with other foremen and with his superiors.

Man-machine relationships are also changed. A worker quoted by Faunce reflected this in saying, "On my old job I controlled the machine. On my present job, the machine controls me." Still another worker expressed increased nervous tensions saying, "I pushed the wrong button and stuff flew all over. I was lucky [not getting hurt] but it cost the company $13,000 to fix the machine."

Automation may stimulate the mental activity of workers with desirable or undesirable effects depending on the presence of constructive outlets and opportunities to utilize it. Professor Charles Walker, director of the Yale Technology Project, quotes a worker as saying, "On my job my muscles got tired. I went home and rested a bit and my muscles were no longer tired. On this new automatic mill your muscles don't get tired but you keep on thinking even when you go home." Professor Faunce also found workers' nervous tensions to be higher after automation but, significantly, 72 per cent preferred their new jobs in automated departments over their previous factory work.

### Effects on Skill Requirements

Automation has generally improved working conditions but the case that it has upgraded workers is still unproved. According to testimony at the Congressional Hearings on Automation, 23 new activities have been created by automation in one industry but only four require special training. A survey made by *American Machinist* magazine of a cross section of automated metal-working firms revealed that 43 per cent believed the new machinery required less skill than the old equipment, 30 per cent reported no change in skill requirements, and only 27 per cent felt that higher skills were required.

Professors Floyd Mann and Lawrence Williams of the University of Michigan studied a plant that, prior to automation, had 450 employees performing 140 different tasks in its central accounting area. They estimated that 50 per cent of the tasks were eliminated by automation and 30 per cent more substantially changed. Ninety per cent of the workers were directly affected. But with all this dislocation there was no significant upgrading in skills required. Even some of the highest grade and supervisory tasks were programmed for the computer.

The U. S. Bureau of Labor Statistics has made several case studies of automation's effect on jobs and employment. They included an oil refinery, a major airline, a large mechanized bakery, a television manufacturing firm, and an insurance company. In most cases the effect on skill requirements was a transfer from one job to another of similar grade. In some cases there was definite downgrading. For example, in the insurance company study only five out of twenty employees transferred to computer operations were upgraded. None of the fifty-six who were retained in other jobs were upgraded although several new employees with higher skills were hired from the outside. In most cases, the new jobs created by automation were filled by existing personnel after some on-the-job training. For example, in the oil refinery nearly half of the factory workers affected ended up in maintenance work. These studies also showed that about 90 per cent of workers in automated plants had to develop new skills.

The general manager of a large, automated bakery in France said, "The only difficulty we experienced in the automatization of our cookie factory was when we had to transform our 'pastry cooks' into 'chemists' assistants'; when we had to indicate to them that a cooking temperature is not taken by opening the oven door and putting one's head inside but by reading the indications shown on the dial of an oven thermometer; and when we had to teach them to carry out precise and constant measurements."

Another French manager is quoted as saying, "The very rapid evolution during the past thirty years of the glass and mirror industry, the present very technical aspect of manufacture and means of scientific control, have transformed the trade of the glassmaker, who has nothing in common with his former self. The men at Chantereine today are controllers, estimators, electronics experts, mechanics, oven supervisors, operators of tractors or traveling cranes . . . yet the glassmaker's trade has preserved its particular spirit, built upon devotion to the trade and to the sense of teamwork, and has kept its traditions."

### "Job Enlargement"

Since automation requires nearly all workers to develop new skills—not necessarily higher skills, just different skills—it has thus led to a partial reversal of the trend toward labor specialization that began with the industrial revolution of the 18th century. Automation has forced "job enlargement" at all levels making economically profitable what was already socially desirable. Fortunately people can learn many new skills at a relatively constant cost whereas the cost of electronic machines that can do more than one task increases almost as the square of the number of additional tasks it must perform. This gives people a great economic advantage over machines if they are willing to take it.

Furthermore automation brings a shift toward a higher ratio of fixed costs. Direct labor costs, which can be varied with output, are declining. It may seem paradoxical that labor, which is usually a variable cost like raw materials, should benefit as the percentage of variable costs falls. But there is some importance in being unimportant. When there are few workers, as in automated plants, each is more strategic and necessary. Furthermore, when labor cost is a small share of total cost, wage increases are not felt so keenly and may even be almost unnoticed. For example, if wages are half of all costs a 10 per cent raise causes total costs to rise 5 per cent. But if wages are a tenth of all costs, a 10 per cent raise increases total costs only 1 per cent.

This effect of automation is in sharp contrast to old-style mechanization. In medieval times the relative proportion of fixed to variable costs tended to be high as it is today but for a different reason. Most production was from agriculture and land costs were high relative to cheap labor of slaves and serfs. The industrial revolution of mechanization brought a shift from fixed to variable costs in the new production systems. With the first mechanized factories, a larger share of total cost (such as wages and raw materials) could be varied with the amount of production. Automation is reversing this trend toward variable costs. But this time labor seems more likely to benefit than it did in the Middle Ages when labor costs were likewise low. For today status is based more on the kind of work people do and how much money they make than on the class into which they are born. And automation permits higher pay if not a more impressive sounding job title.

Labor can also expect to benefit because it may even become one of the fixed costs itself as the proportionate share of managers, supervisors, technicians, and maintenance people increases and that of direct, hourly-paid production workers declines. In automated industries the percentage of salaried workers rises substantially and the share of those paid weekly on an hourly rate falls. In an economy of predominantly high-fixed-cost industries, the accepted assumptions and conclusions based on an economy of high-variable-cost industries no longer hold.

The mechanization of the 18th and 19th centuries caused many jobs to be routine and uninteresting and this was a source of workers' dissatisfaction. But with automation, trivialization of work and its resulting specialization of labor may have reached its economic limits. At first mechanization reduced the physical exertion of labor by transferring the heavy, backbreaking jobs to machines but it left workers with an endless number of routine, repetitive, monotonous trifles. Automation permits many of the most petty tasks to be assumed by machines. Electronic control equipment can perform the more undistinguished jobs of counting, sorting, filing, deciding between two clearly defined alternatives, moving something from one fixed location to another at precisely the right time and so on.

On the other hand automation demands more flexibility, mobility, education, alertness, and progressiveness of workers. Maintaining full employment and expanding job opportunities through steady economic growth have also become of increasing importance. If these can be achieved, the worker may emerge after all as the master, not the slave, of industrial activity. If he can be relieved from trivial work, he will be able to disassociate himself from the erroneous but tenacious idea that the value of the worker is trivial also. His status will increase along with his ability. Human labor, of course, will still be important—more important than ever—since the worker will have to assume more controllership functions. Ideally, job skills, physical dexterity, and endurance would be abandoned as criteria of a worker's value and output incentive plans would disappear. This would be no loss since their only usefulness as a measuring device tends to reduce humans to a machine level. Workers should not be forced to compete with machines but should be given the opportunity to rise as high above the moron mentality of machinery as their talents, energies and ambitions permit. Labor's increased control activity under automation provides purpose which cannot be measured in units of production or time or encompassed in a theory. It gives dignity to both the work and the worker.

## Planning for Automation

A sign on a backwoods Georgia road reads, "Choose your rut carefully. You'll be in it for a long time." Many people seem to get great satisfaction from burying themselves in routine activities. They resist strongly any threat of change because it strikes at their basic emotional security. Industrial workers are no exception. Often they believe they are dependent for their livelihood on a unique combination of machines, plant organization, and their own highly specialized skills. Sometimes they are right; but, right or wrong, where this belief exists, workers can be expected to resist automation in a thousand subtle ways. In some cases they are able to sabotage automation effectively even despite official acceptance by their union leadership. Serious obstacles to automation loom where management fails to foresee this attitude and forestall its consequences. Many employee attitudes will have to change or be changed through better planning, communication, consultation, and education.

Preparation for automation has been handled in a variety of ways. In the baking and oil refining industries notification of employees concerning impending changes took part automatically as a part of union-management planning. In an insurance company the personnel manager met regularly for a year in advance with a representative of the section in which the computer was to be installed. He told the employees that some would be displaced but no one would lose his job or suffer a pay cut. The company's newspaper described impending transition to automation with no attempt to gloss over the expected effects. The result was a smooth, painless transition to automatic data processing. This advanced consultation requires a mature labor-management relationship and a mutual respect among the parties.

In some cases labor unions have initiated the necessary preparation for automation. The Amalgamated Lithographers of America appointed a director of technology to work with management to promote automation and has proposed a two million dollar union-management fund to help carry out this objective. In the case of the bakery studied by the Bureau of Labor Statistics, labor and management were found to have worked together successfully to solve employment problems raised by automation. Workers were fully consulted, not just told what was to happen. Frequent conferences were held. The result was the displaced workers were reclassified so as to retain the same pay scale even if moved to lower skilled jobs. Unions call this horizontal downgrading. After the transition to automation was completed, it was found that no worker had been cut in pay, some workers had been upgraded and only 5 per cent had been laid off in contrast with 25 per cent that had been predicted. In

this case, however, the entire transition to automation took five years.

Some unions have secured transfer rights for displaced workers to other plants of the corporation without loss of seniority. Others have urged increases in the age maximum for entrance to retraining programs. Some have secured more liberal severance pay, unemployment compensation and moving expenses. All of these would permit the necessary labor displacement from automation to be more comfortably absorbed without excessive downgrading and unemployment.

In the long run it seems probable shifts in the composition of the work force will upgrade labor. While workers may not be upgraded in the short run, jobs probably will be in the long run. Downgrading may be the lot of those who cannot or will not adjust to change. This was also true of the earlier mechanization of the industrial revolution. In general it was not the experienced craftsmen who were chosen to control the new machines. It was the younger men with mechanical aptitude. The village blacksmith rarely became an automobile mechanic. It was more often his son. In other cases mechanization so changed the materials used in production (as from wood to iron or iron to aluminum) that manufacturers turned to other suppliers so that whole new industries arose while others declined. Automation is likely to have the same effect. It will be the newer, younger workers entering the work force later who can expect higher skilled jobs in programming, machine design, and engineering.

### Impact on Total Employment

By its very nature automation abolishes many jobs. This fact is behind the terror that automation strikes in the hearts of many workers. But technology takes a variety of forms. There may be simple applications of scientific inventions, expanded mechanization, reorganization of production methods, automation, new product development, and so on. These do not all have the same employment effects. Some do not save labor but require more of it. Some are really labor saving but have many effects, displacement of labor being only one of them. Obviously, for example, it is wrong to regard the electric light as solely replacing gaslights and candles. It replaced these older methods certainly but it also replaced unlighted streets and going to bed early. Likewise, the automobile did far more than replace the buggy. It mainly replaced staying at home and is now in the process of replacing cities and towns altogether.

Advancing technology creates new jobs, of course, although not exactly the same number as it destroys. The production and employment statistics in many industries uphold this point. Six out of every ten people working in the United States today are at jobs that did not even exist forty years ago.

Case after case can be cited to show that total employment in single firms and in entire industries has increased following the introduction of mechanization or automation. The telephone industry offers a typical, though perhaps spectacular, example. Automatic dial equipment began to be introduced about 1920. Today over 98 per cent of telephone callers in the United States get their connections automatically without the help of an operator, yet since 1920, employment in the Bell Telephone system has increased from about 200,000 to over 650,000. The oil industry also began to use continuous flow refining methods about 1920 and in this industry employment has since doubled. However, these particular industries have had a great over-all economic expansion so the increase in employment cannot be attributed entirely to automation.

Minor recessions, like common colds, are easier to live with than to try to treat. Major depressions, such as that of the 1930's, are also of little concern. Like smallpox, we now know the cure and will take the medicine when necessary. But in between there is a new disease due, in part, to rapid automation. This is the persistence of excessive unemployment despite continuing labor shortages in certain skills.

On the average every electronic computer puts 35 people out of work and changes the kind of work for 105 additional workers. Since the United States alone is producing over 10,000 computers per year this multiplies out to 350,000 jobs disappearing every year and another 1,050,000 that will require retraining.

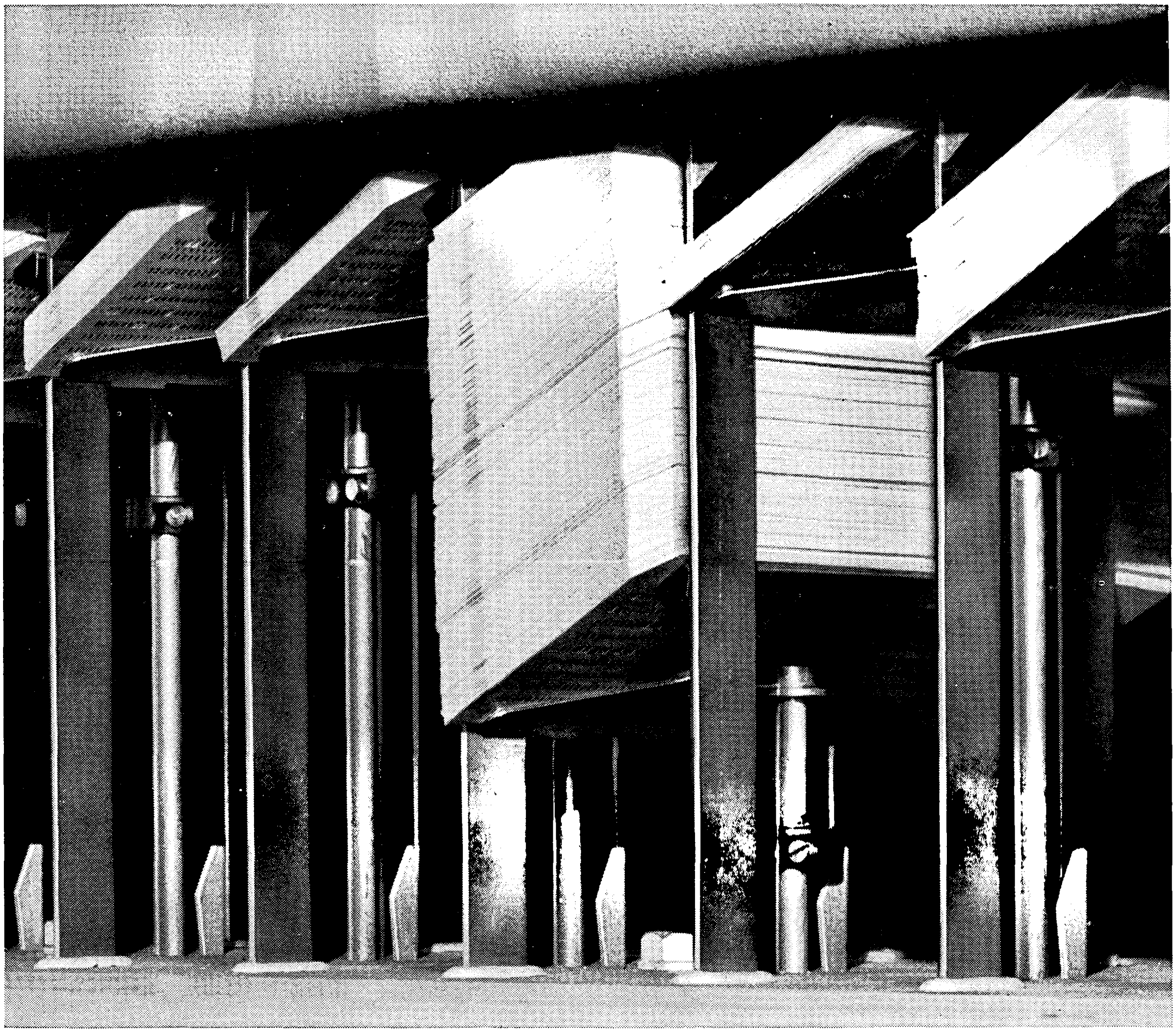
So far there have been no large-scale layoffs because economic growth has largely absorbed the unemployed into other industries. For example, the manufacturer of TV sets studied by the BLS showed no employees laid off as a result of automation. In fact, new job classifications and new machine-tending jobs were created. But he took advantage of a high turnover of women workers and simply cut back his hiring when automation began.

Therefore the problem becomes not the worker who is fired but the worker who is not hired. The unions call this silent firing. The major problem is a transfer one, displacement not general unemployment.

In the past, undue unemployment has been prevented by general economic expansion, except for relatively short recessions. Those workers no longer needed in manufacturing have been absorbed into new industries or the service areas. But full employment and expanding markets both at home and abroad, are vital prerequisites to a rate of absorption of displaced workers.

Rationality, self-interest, mobility, and flexibility, while highly desirable means of making industry more efficient and resource allocation more rational, are not ends in themselves. Too much of these makes pirates out of businessmen, gypsies out of workers and, in general, irresponsible citizens who do not own real property, vote, or assume civic responsibilities. On the other hand, too little of these qualities makes for narrow provincialism, ignorance, waste, and a great loss of potential accomplishments.

If automation is to benefit workers it will have to be largely through its effect on the national economy and not through its impact on the plant. Physical working conditions are undoubtedly improved but there is no other definitely established benefit to workers. Job opportunities have been substantially reduced. For the most part, over-all economic growth will probably have to provide the economic environment in which new entrants to the work force and the victims of silent firing, such as those subjected to forced job transfers, will be able to find opportunities for employment. The national economy must grow fast enough to maintain plenty of new job opportunities for workers displaced by automation. More important, the obvious and highly publicized advantages of automation for management should not be allowed to overshadow the plight of the little man searching for a place in a growing economy.



# THE APPLICATION OF PROGRAMMED INSTRUCTION IN THE COMPUTER FIELD

James Rogers and Donald Bullock
*Basic Systems, Inc.*
*New York 25, N. Y.*

Take a moment to read the following textbook statement carefully:

A COBOL word may be made up of any number of letters or numerals from one to thirty, or any combination of letters, numerals, and hyphens totalling not more than thirty characters, except that no COBOL word may have a hyphen as the first character or the last character of the word. Spaces may not occur as part of a COBOL word, nor may any punctuation mark or symbol except the hyphen (subject to the restrictions referred to above).

Now, keeping your eyes off the statement, try to define what a COBOL word is.

Were you able to do so easily and completely? Or did you feel the need to recheck or even re-read the statement? In all probability you found it difficult to cover every point mentioned in the paragraph without referring to it again.

This is no criticism of your ability to read or remember or think. As you read through the statement initially. nothing indicated what aspects of it you should focus on or retain in memory. The statement was structured merely to present information, not to *teach*. Without knowing what you would be called upon to do with the information, you could not reasonably be expected to formulate or retain its content in any particular way. Faced with such a situation, most people would scan the reading material until asked for some specific response —and then go back to focus attention on the relevant parts of the material.

Now, by way of contrast, look at Charts 1 and 2 and work through the ten steps of an instructional program designed to teach the definition of a COBOL word (answer each question before consulting the answer given).

## Effectiveness in Instruction

At this point you have no doubt noticed that the programmed version of the original paragraph is much longer, and yet it teaches more rapidly and effectively. This sequence of questions or "frames" is characteristic of self-teaching programs now being used to teach computer language in industry. The results of such programs and others in related fields have been impressive, not only in improving the quality of training but also in achieving major reductions in training time and cost.

By working through the sequence you also encountered those principles in operation which are responsible for programmed instruction's effectiveness. The new educational method is based on modern developments in behavorial psychology, particularly those initiated within the past decade through the work of Prof. B. F. Skinner of Harvard. Beginning with a behavorial analysis of the specific learning situation, a self-teaching program or sequence is prepared and carefully tested and revised in order to shape the trainee's learning process most effectively.

## Principles

The principles governing program preparation, briefly summarized, are as follows. Material to be learned is organized in the most efficient *logical learning sequence.* It is then divided into a large number of *small steps,* with only a slight increase in difficulty between each one. An *active response* is required of the trainee, so that he must construct or formulate rather than merely recognize a satisfactory answer to each question or directive.

The trainee's response is then confirmed (or denied) by *immediate feedback* of the correct answer; this at once gives a positive reinforcement to correct behavior, while correcting a wrong response before new knowledge can accumulate on a basis of error. The

| | |
|---|---|
| 1. Letters, Numerals, Hyphens<br>A COBOL word can be formed from the characters designated above. Thus, we can state that the permissible characters for a COBOL word are the ________ of the alphabet, the ________ (0, 1, 2, 3, 4, 5, 6, 7, 8, 9), and the ________. | 1. letters numerals hyphen |
| 2. Name the three types of characters which can be used in composing a COBOL word. ________ | 2. letters, numerals, hyphen |
| 3. I-O-CONTROL<br>The above is a permissible COBOL word. Thus you can state that the number of hyphens in a COBOL word (☐ is ☐ is not) restricted to one. | 3. is not |
| 4. You are permitted to write a COBOL word containing 30 characters. You are not permitted to write one containing 31 characters. Thus, the maximum number of characters allowed in a single COBOL word is ____. | 4. 30 |
| 5. A COBOL word may consist of ________, ________ and ________, and must be not more than ____ characters long. | 5. letters, numerals, hyphens (any order) 30 |

Chart 1

*low error-rate* incorporated into good programs assures efficient learning by keeping frustration at a minimum. And finally, programs are *self-pacing*—neither penalizing the slow learner nor retarding the fast one, while freeing instructors from routine teaching tasks or permitting the trainee to learn on his own without an instructor or the need for classroom study.

## Results of COBOL Programs

Self-teaching programs in COBOL—of which the foregoing frames provide a typical if tiny sample—have recently been instituted at Shell Oil Company and Burroughs Corporation. Basic Systems' 4,000-frame Required COBOL program, developed at Auerbach Corporation, was taken by an evaluation group of Shell employees. The final comprehensive performance examination required the trainees to write a COBOL computer program. They achieved an average grade of *94.5 per cent* on this test. Moreover, they were then able to prepare effective computer programs for actual operation on the first or second effort, rather than after the eight or ten attempts normally required by employees trained by conventional methods.

Shell has now adopted the self-instructional program to train employees at all installations. And already senior programmers who initially could not pass the final examination despite conventional study of all appropriate manuals are producing excellent COBOL programs, thanks to this self-instructional course.

This Basic Systems program was also successfully tested at U. S. Steel and the U. S. Army Signal Corps. All experimental data suggest that the Required COBOL program effectively meets such criteria as teaching the full set of required COBOL features, concepts and details in operational detail.

Burroughs Corporation is now publishing a 4,100-frame program to teach COBOL for the B 5,000 computer. Developed by the American Institute of Research, this program was tested last year on two separate groups of sales representatives. One group of 84 employees took one-third of the program; later a second group of 25 representatives were given the entire self-teaching course. Results of performance tests after training were sufficiently encouraging for Burroughs to plan on using the program for customer training as well as employee training.

## Programs in Computer Operation: Digital and Analog

A programmed course in teaching the operation of the IBM 7070 computer was prepared in 1960 under the direction of Dr. John Hughes of IBM. This course reduced the time required to train computer operators by *27 per cent.* Yet while achieving this reduction in time and its related saving in training costs, the program also produced a *10 per cent* improvement in training quality as compared with the conventional course.[1]

A self-instructional course in the operation of analog computers has demonstrated remarkable effectiveness at Du Pont. This 12-hour programmed course replaced a conventional 40-hour classroom course. The over-all reduction in training time was a huge *70 per cent,* amounting to a total of more than 2,000 man-hours saved in the initial group of students and instructors.

Improved performance from use of this program is measured by the fact that those employees who took it—55 out of a total of more than 300 trainees—greatly increased their proportionate share of engineering output. In fact, in the six months following training, the group taught by the programmed

6. A permissible COBOL word may consist entirely of letters, or entirely of numerals; or it may contain both. It may also contain hyphens, but no other marks or symbols are permitted.
Which of the following are permissible COBOL words?

- ☐ ABC51372W6-415TYYXL3M
- ☐ AS12345-ABCDEF-BUENX-8888883JTW3S5CG4Y
- ☐ 0123456789-10111213
- ☐ GO-TO-REGISTER-G*
- ☐ AAAAAAAAAAAAAAAAAAA
- ☐ 5,280-3.14159

6. ABC513...

012345...

AAAA...

7. There is a restriction concerning the use of hyphens in COBOL words: the hyphen cannot appear as the first or last character. Thus -1961COBOL (☐ is ☐ is not) a permissible word, whereas COBOL-1961 (☐ is ☐ is not).

7. is not
is

8. A COBOL word is "bounded" by spaces: that is, spaces are used to separate one COBOL word from another. Thus, you obviously cannot include a(n) ____________ within a COBOL word; for if you did, the result would be _____ (how many?) COBOL words.

8. space
two

9. COBOL 1961
COBOL-1961
COBOL-1961-

Concerning the above,

____________ is a single COBOL word
____________ is not a permissible COBOL word
____________ is two COBOL words

9. COBOL-1961
COBOL-1961-
COBOL 1961

10. What are the restrictions on a COBOL word with reference to:

kinds of characters permitted? ____________

size of word? ____________

use of hyphens, spaces? ____________

10. Only letters, numerals or hyphens may be used.

Not more than thirty characters in length.

Hyphens not permitted as first or last character; spaces not permitted within words.
(or equivalent answers)

## Chart 2

course instituted proportionately more analog studies than did *all* the conventionally-trained group in a like period.[2]

## Programmed Instruction in PERT

A related and equally effective application of programmed learning is to teach such network scheduling procedures as PERT (Program Evaluation and Review Technique). Basic Systems has redesigned and modified for industrial and business use a programmed course for PERT developed originally by Raytheon Company and the U. S. Air Force. The redesigned course has been used to accelerate the implementation of PERT on military projects.

This programmed course was evaluated on managers directing complex defense electronic systems. It enabled trainees to master PERT fundamentals in 5 hours of self-instruction—requiring no classrooms, trainee transportation, or formally organized procedures. An average comprehensive performance score of 92 per cent was attained by trainees on the final examination, despite wide differences in prior training, experience, and aptitude.

This programmed course in PERT prepares trainees for the use of both manual and computer procedures. Teaching by actual practice, the program enables trainees to design and understand PERT networks, to replan and modify networks, and to interpret management reports.

A few typical frames from the PERT program, illustrating some of the applications of this time-saving management tool, appear in Chart 3.

## Significance of Programmed Instruction for Training

The industrial uses of programmed instruction discussed above suggest many potential values for programmed learning technology in computer training and related fields. Its general advantages in industrial training are both qualitative and quantitative. Marked improvements in the quality of training have been achieved by well-designed programmed courses in various industrial uses—improvements ranging from 10 per cent to over 50 per cent. In behavioral training such advances are direct measures of better job performance by sales, system, and service staffs, or of increased expertness on the part of customers who need training. Quantitative savings in training time have ranged from 25 to more than 70 per cent; the cost reductions mentioned here do not include added savings in travel, living, and classroom expense arising from self-teaching programs that dispense with classroom instruction and thoroughly decentralize the teaching of many courses.

Specifically in the computer industry, the potentials of programmed instruction seem limited only by the growth of the industry itself. The continuous development of new computer languages, operating techniques, industrial applications, and managerial methods offers an expanding field for this demonstrably superior approach to the complex problems of computer training.

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[1] See J. L. Hughes, "The Effectiveness of Programmed Instruction: Experimental Findings," in *Applied Programmed Instruction* (ed. Margulies & Eigen), New York: 1962.

[2] A. J. Sindler, "Self-Instruction Analog Computer Training," *Journal of the American Society of Training Directors,* Nov. 1961.

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(4) —7.0→ (5)

You can now calculate the expected time for any activity in a PERT network. Given an expected time value of 7.0 ($t_e$ = 7.0) for an activity 4–5, how long after event 4 occurs is event 5 expected to occur? ____

Answer: 7.0 weeks

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(4) —7.0→ (5) —4.2→ (6)

If additionally, activity 5–6 has a $t_e$ equal to 4.2, it becomes evident that event 6 will be expected to occur ____ weeks after event 4.

Answer: 11.2 (weeks)

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(4) —7.0→ (5) —4.0→ (6) —9.0→ (7)

Each event in a PERT network has an accumulated expected time. This value is calculated by adding up the expected activity times ($t_e$'s) of all the activities which must be completed before the event can occur. The accumulated expected time for event 5 is 7.0 weeks, and that for event 6 is 11.0 weeks. Thus, the accumulated expected time for event 7 is ____ weeks.

Answer: 20.0 (weeks)

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(33) —8.0→ (34) —9.0→ (35) —6.0→ (36)

The symbol for the technical term accumulated expected time is $T_E$. Determine the $T_E$ for each event in the chain above.

$T_E$ of event 33 = ____
$T_E$ of event 34 = ____
$T_E$ of event 35 = ____
$T_E$ of event 36 = ____

Answer:
$T_E$ of event 33 = 0.0
$T_E$ of event 34 = 8.0
$T_E$ of event 35 = 17.0
$T_E$ of event 36 = 23.0

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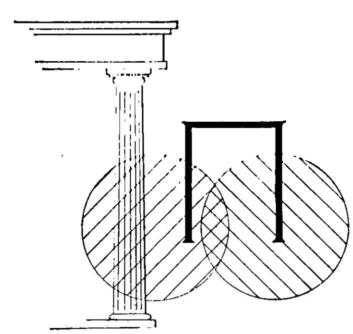
(41) —5.0→ (42) —7.0→ (43)

The value 12.0 weeks is the ________ (technical term, three words) for event ______ (number).

Answer: accumulated expected time (for event) 43

**Chart 3**



# THE COMPUTER: A TOOL FOR CLERICAL AUTOMATION OR

Harold A. Strickland, Jr.
*Vice-President*
*Industrial Electronics Division*
*General Electric Company*
*New York, N. Y.*

This year, it is estimated that 6,275 digital computers will be delivered in the United States for data-processing applications. Two hundred of these will go to Federal Government agencies, and more than 6,000 to institutions, industry, banking and commerce. Their total value, including standard peripheral equipment, will approximate $2.6 billion; their use will involve a total expenditure of some $4 billion.

This is by any measurement a large business and, as we all know, it is also a very young one.

The first business computer applications were purely clerical. In fact, we generally programmed them to do essentially what our systems and procedures people had previously had clerks or electric accounting machines doing. General Electric did this at Louisville on the first Univac and in dozens of other plants.

In doing it, we first ran into the rugged refusal of computer logic to accept any but completely consistent instructions—something that people incidentally have never been able to do. As a result of our review of the systems logic we gained a benefit not originally contemplated—not only did we obtain economies of direct processing, but we also gained through streamlining our procedures and making them more logical.

## Integrated Information Systems

As we progressed in learning to use computers, the more visionary saw the opportunity to reduce to orderly relationships the mainline functions of the business and to provide integrated information systems to handle many of the activities which involved not only clerical work, but also lower-level management decisions.

I do not mean to suggest that the computer itself made the decision—it didn't. But it did offer a sufficient economic bonus to a manager to entice him to think through the operation of his business and to make decisions in advance that would allow him to treat as routine the many decisions involved in quoting, ordering, making, inventorying and shipping (and sometimes even designing) his product.

Today, most advanced users of data processing are planning or implementing such systems. Their payoff is substantial. I know of one business having $40 million a year in sales that is now saving $1.1 million per year and will save $1.6 million a year through its integrated information systems when the present program is fully implemented. Another business, about the same size, is saving $650 thousand per year on a partial system.

## Payoff

The payoff is relatively quick. A typical integrated system will take about 3 years to get into the black on a cash flow basis. In the General Electric Division for which I am responsible, I recently asked for some figures to show what our net investment was in integrated systems. When the data were presented, I found that the saving had already exceeded the total investment.

By integrating the system across geographical distances, an even broader opportunity for saving exists. Checking inventory and credit ratings nationally, reducing the number of warehouses and distribution points, responding to a telephone inquiry with factual information while the caller is still on the line, are all realities today.

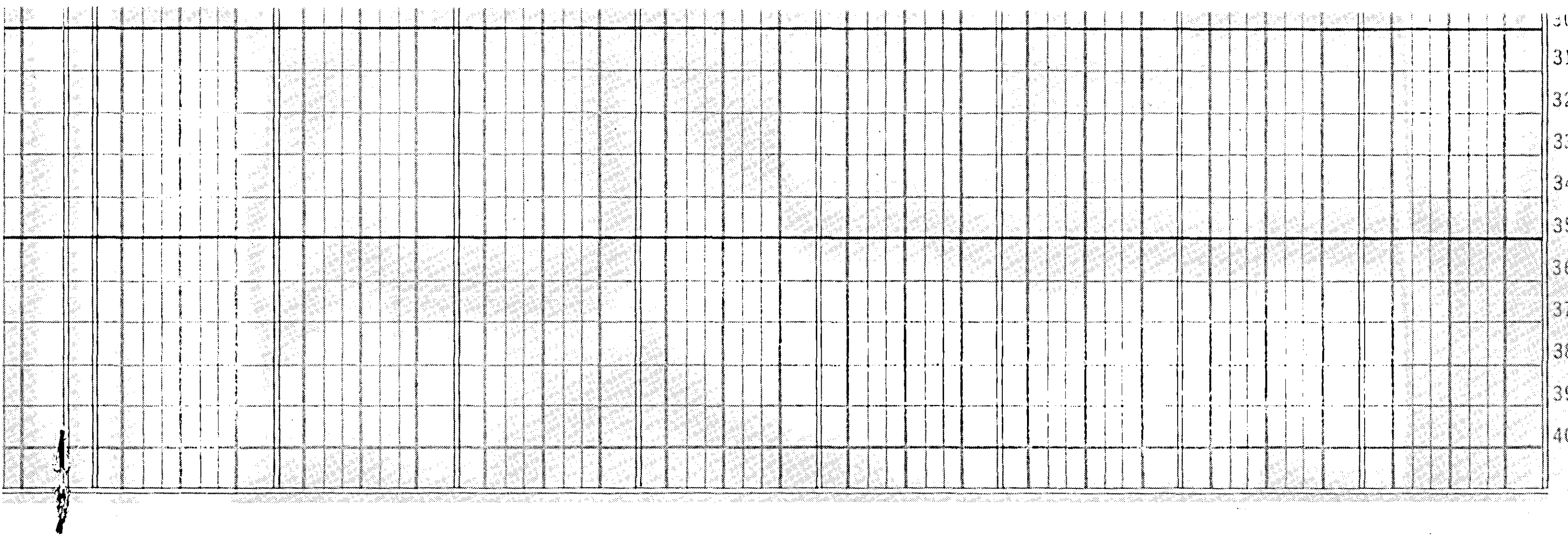
## Advantages

Thus, through integrated systems, we are:

1. Reducing our lower-level management decision load;
2. Reducing the number of clerical people to provide a given level of service;
3. Up-grading the kind of service (especially in promptness) that we can offer the customer;
4. Managing much of the business on a factual item-by-item basis instead of on a general intuitive basis.

## Limitations

The main limitation in our progress here is generally our difficulty in understanding our business practices and reducing them to logic. In GE, we have set up a special




## ON OR INTEGRATED MANAGEMENT SYSTEMS?

team effort, which we call our Internal Automation Operation, to help our businesses accomplish this transition.

We find that we can, through a group of highly capable people, bring in an outside point of view which, together with systems and hardware knowledge and experience, can be used to good advantage on this problem.

However you organize to do it, I expect you will find this reduction to logic a substantial obstacle to easy benefits from integrated systems; but in the search for this logic significant gains do accrue.

### Complex Relationships

Another area where we can use computers to help managers is in computing relationships which would be too complex, too time-consuming, and too expensive to do in any other way. We can balance the load on work stations on an assembly line for optimum use of people and equipment. We can determine the billing for bulk power in complicated exchanges between utilities in new and larger power grids. Through a critical path analysis and associated programming technique, we can choose the quickest and least expensive path to executing the largest projects.

In other words, we can quickly and accurately determine optimum conditions among a complex set of known factors: we can make better management decisions.

Many management decisions, however, involve factors between relationships which are not known or which can only be evaluated approximately. Even so, we can use the computer, together with appropriate mathematics, to explore the "what would happen if" sort of problem. This we call simulation. Simulation makes a computer into a model of one of our plants or one of our markets. It can even be a model of the economy as a whole or of our business as a whole.

The use of computers to predict election returns is an example of one such kind of model.

### Impact on Decisions

Of course, we are limited today by computer size and especially by our understanding of what we are modeling. But these limitations are moving outward and the technique will most certainly be more and more powerful.

Its impact on decision making will be tremendous. The uproar over the Department of Defense's use of computer techniques in evaluating advanced weapons systems is foreshadowing this.

### The Right Information at the Right Time

The biggest problem a manager may face, however, may be none of those which I have discussed so far. I suspect instead that it may be the problem of having the right information at the right time to make a decision.

Today, every manager is smothered with paper. Not only is much information generated by our EDP systems, but the growth of the copying machine business (doubling every 4 years) is an indication of our human motivation to hold onto information once we are exposed to it.

Perhaps this is an indication of our sense of inadequacy in making decisions with the information readily available. At any rate, our inability to obtain existing information is more than frustrating. Someone has estimated that it is cheaper to redo a technical project than to learn if someone else has already solved the problem, provided the project cost is less than $100 thousand.

Peter Drucker states, in a recent Harvard Business Review article, that in some space programs engineering documentation takes 75 cents out of each dollar for research and development. This I take to mean that the cost of record keeping is 3 times the productive work.

And yet, decision makers feel a need for even more information.

There is an opportunity here which we have as yet hardly tapped—in information storage and retrieval. Think how much better your decisions could be if you could only put your hands on information that exists somewhere in someone's file right now. Many of us look forward to vast electronic storage bins of information, so indexed and so

*(Please turn to Page 44)*

# "ACROSS THE EDITOR'S DESK"

## Computing and Data Processing Newsletter

TABLE OF CONTENTS



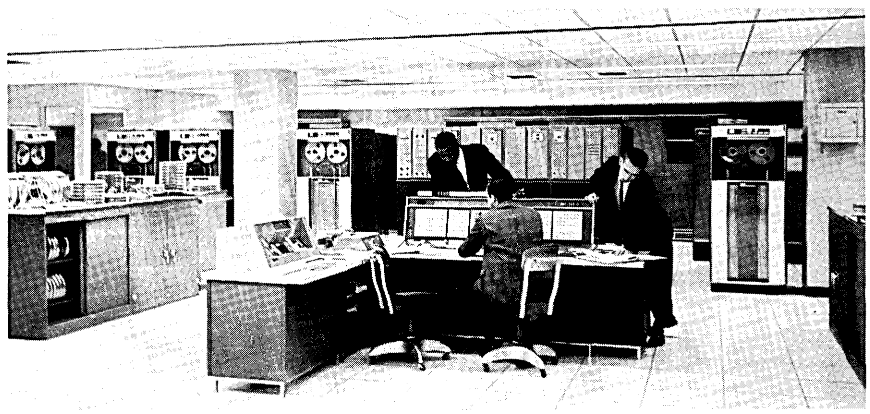
## NEW APPLICATIONS

### GOVERNMENT'S ELECTRONIC SUPPLY CATALOG

Every day more than 20,000 questions, from supply control points in the field, come to the Defense Logistics Services Center (DLSC), Battle Creek, Mich. The DLSC keeps up-to-the-minute records of the Federal Government's 4.2 million supply items using a new IBM 7080 to maintain an electronic catalog of Defense inventory. In its job as the Government's main single clearing house for cataloging and logistics data, the computer and its peripheral equipment sharply reduce the time needed to update, maintain, and cross-reference the vast files of active Federal stock numbers and corresponding manufacturers' identification numbers.

One of the newest services being provided for the Department of Defense, is a system whereby the computers check lists of parts and components required for a new weapon to be procured against DLSC files to detect duplications, locate potential system sources and prevent needless entry of new items into the supply system.

The DLSC, in its short history of seventeen months, has helped save taxpayers millions of dollars by preventing needless procurement; and, in addition, has returned millions of dollars to the Treasury. It is able to contribute to these defense cost reductions by managing under its roof, three interrelated world-wide logistics programs which are concerned with items of supply from the time they enter the supply system until they have outlived their usefulness to the government.



The Federal Catalog System managed by the Cataloging Division of the DLSC gives each item in the Federal Government inventory a single name, identification, classification and stock number. There are 4.2 million stock numbers covering items obtained from 30,000 sources of supply. This compilation of item identifications and related data is maintained on cards, magnetic tape, and on microfilm.

The microfilm information retrieval and filing system, now being sold commercially as the RAIR system, permits microfilming of Federal item identification cards, and subsequent filing, in elevator files occupying approximately 150 sq. ft. of space. Locating and producing a printed paper copy of the microfilm image requires only 30 seconds.

Through any key point in the network, a user, from vendor to supply sergeant, can refer requests for data to this single, correlated source, and immediately receive up-to-date information as to whether items are already identified in the Federal catalog. If a purchasing agency plans to buy an item already cataloged, the Center's system supplies a complete list of present users, the location, and amount of available excess inventories. Duplicate purchases are prevented, and the Federal stockpile of excess material can be tapped at a speed never before possible. Three million individual supply management actions a day can be handled by this new equipment, considerably more than the amount handled by the previous computer.

The computer can extract detailed information on supply items and feed it to the 35 distant communications points linked to the Center by specially designed dial telephone rapid-data transmission equipment. A total of 158 activities are served by the system, including Defense Supply Centers, DASA, GSA, AEC, NSA, NASA, and Civil Defense, in addition to other military and civil departments and allied nations' purchasing facilities.

DLSC's Utilization and Marketing Division serves all of the taxpayers by selling to them, at a fair price, that portion of material allocated for their defense which is no longer useful for that purpose. In the course of a year, the Division sells property originally worth about $1 billion, through its nationwide network of sales outlets. Prior to selling to individuals and private industry, the Division donates appropriate items to eligible schools and institutions through referral to donation program managers. The surplus sales program uses all modern, practical merchandising methods in order to return to taxpayers a maximum return for the products in inventory. Last year, after paying the expenses of the Division, over $60,000,000 was returned to the U.S. Treasury.

## COMPUTER-TYPESET NEWSPAPER MARKS PUBLISHING MILESTONE

The March 5 issue of the Oklahoma City Times marked the publication of a daily newspaper in which all news copy was produced by computer. Every line of news copy was typeset under control of the computer system, which was developed by The Oklahoma Publishing Company and IBM Corp. The milestone was the culmination of nearly two years of trial and error experiment.

The system consists of an IBM 1620 computer, equipped with high-speed tape-input read and tape-output punch devices. A second identical 1620 computer setup is used as a backup system. Each of the computer systems is capable of punching out 85 fully justified and hyphenated single column lines a minute. The Times and the Daily Oklahoman (both published by the Oklahoma Publishing Company) use a column width of 11 picas and a 9-point body type.

Under the systems present setup, hard copy from the keyboards of reporters, rewrite desks, or a wire service, moves to the copy desk for editing and then to the TTS room where a simple editing tape is prepared. With the computer system, the operator merely punches out edited tape, unjustified. The computer takes the edited, but unjustified tape, reads it, adds spacing to fill out the lines evenly, hyphenates where necessary, and produces a finished, fully justified tape to operate a line-casting machine.

Instructions allow editors to specify the appearance of the type line, as to width, type size or font. For example, lines within the same take can be set by the computer in varying width to run around an illustration cut.

The computer program has been written to deliberately assemble one word too many for each line, in an effort to conserve space and pack more news into the narrow 11 pica column. The system first tries to justify the extra word into the line by word spacing; second choice is by letter spacing; and if the entire word cannot be justified into the line, the third choice is to divide the word by hyphenation. The additional word is moved down to the following line only after it is found that none of the three possibilities are workable.

Word division is accomplished through an editing routine and a table of hyphenation probabilities, which was built into the machine's memory after analysis of nearly three million words from the language. The system first scans the hang-over word to determine the number of syllables and establish the vowel groupings. It then scans the hyphenation table which plots the probabilities of a hyphen occurring between any two given letters, and selects the highest probability as the dividing point. These calculations are made at speeds measured in milliseconds.

The computer system will from now on be used to produce daily the Oklahoma City Times and the Daily Oklahoman. The computer will also be applied to other areas such as: development of an editing program; paper makeup; production scheduling; and classified ads. Work is already under way on a newspaper makeup-ad placement computer program.

## ERRORS ON TAX RETURNS IN SOUTH CAROLINA TO BE FOUND BY COMPUTER

A new electronic system installed by The National Cash Register Company will check the arithmetic on all returns, made by the residents of South Carolina, to make sure that the tax computed by the taxpayer is what it should be. The electronic system, an NCR 315, will keep a magnetic file on every taxpayer; and can pick out any individual at random for special processing.

The system computes the tax due for every individual. It then compares that amount with the tax figure on each return. If both figures are the same, the computer prints out the refund due or the balance left to pay. If the figures are not the same, the computer prints out a special report.

The computer has three Card Random Access Memory (CRAM) units for storage. Data on more than half a million individuals is stored on 20 CRAM magazines. The arithmetic on the face of an individual return can be verified in 47/10,000 of a second. The machine is also used to send out next year's tax forms, automatically printing taxpayer number, social security number, and address on a separate label for each person.

This year, the computer is expected to process 1,663,000 returns of all types. In addition, the NCR 315 will write some 375,000 income tax refund checks and will prepare the biweekly payroll for about 550 employees.

## CHEMICAL PRODUCTION IMPROVED BY COMPUTER

A joint study conducted by IBM Corp., and the DuPont Co. has shown that a computer can improve the productivity of a complex chemical process. Efficiency of acrylonitrile production in a small-scale plant at DuPont's Repauno Works, Gibbstown, N.J., has been increased six per cent with a specially designed IBM control system built around an IBM 1620 computer. (Acrylonitrile is an intermediate chemical used in the manufacture of acrylic fibers and plastics.)

Acrylonitrile synthesis takes place very rapidly and at high temperature. In the study, DuPont's Explosives and Engineering departments, working for 18 months with a team of IBM specialists, used the computer to interpret more information from the process more quickly than was possible with previous methods. Techniques were developed for the computer to analyze the data and immediately adjust the process conditions to obtain best results, achieving "closed-loop control"

Blending modern techniques of chemistry, mathematics, and machine computation produced the improved performance. Economic advantages were achieved through greater output rather than from any decrease in personnel. Findings of the study are expected to apply to other chemical processes.

### COMPUTER SIMULATES EFFECT OF A SENSE ORGAN ON THE HUMAN HEART

Electronics Associates, Inc., Long Branch, N.J., through the use of analog computer techniques, has simulated the effect of the sense organ called the Carotid Sinus on the human heart. A demonstration showed that it is possible, using mathematical equations, to represent the central functions of both the heart and Carotid Sinus, through the use of the analog computer TR-10.

The Carotid Sinus is a sense organ that lies in the upper part of the neck near the bifurcation of the common carotid artery. The primary function of the Carotid Sinus is to sense changes in blood pressure. As blood pressure builds up the Carotid Sinus senses the change and through nerve endings signals the heart to slow down.

The TR-10 (using an X-Y Plotter readout) simulates the heart, the Carotid Sinus, nerve legs between the Sinus and the heart, and one of the major blood vessels which pumps blood to and from the heart. The computer is programmed to "exercise itself" so as to show changes in heart rate versus time, changes in frequency of nerve impulses coming from the Carotid Sinus caused by pressure changes, and changes in contraction and expansion of blood vessels. All these changes occur in real time.

### COMPUTER IS RECORD-KEEPER FOR 450 MILLION BONDS

The ownership and redemption records of the 450 million Series E bonds sold by the Treasury Department since October 1, 1957, are being maintained by a Honeywell 800 computer at the Bureau of Public Debt record center of the U.S. Treasury in Parkersburg, W. Va.

Documents are received at Parkersburg in batches. Each is microfilmed for permanent storage in a master microfilm file. After each is microfilmed, it is keypunched with alphabetic and numeric data to establish ownership records. There are two master files -- an alphabetic file containing the names of tens of millions of Series E bondholders, and a numeric file containing every bond by number. These files are updated daily by the H-800.

A control card containing summarized data is also prepared for each batch. Control card and individual bond data is then read through three card readers into magnetic tape for processing by the computer. The computer processes about 750,000 new documents a day, received daily from 20 Federal Reserve Banks and branches in the U.S.

Three types of Series E bond transactions are processed -- punched card bonds, paper bonds and issue stubs. The computer processes each category separately. Each batch in a category is audited and automatically balanced by the computer. It is then run through a series of class sorts, splits and edits before being merged into a stockpile tape used to update the master numeric and alphabetic files.

Daily reports include: a control listing that is a final, audited and balanced receipt for bonds and stubs; a detailed listing of out-of-balance batches noting dollar discrepancies; a daily stub and bond classification used by the Treasury in Washington to maintain records of Series E bond sales and redemptions; and a daily batch proof listing that summarizes transactions by bond denomination, number, agent and dollar value. Inquiries and discrepancies in the master file are also processed daily and noted on a separate report.

The Parkersburg system consists of a central processor with 4096 words of memory, eight high-speed magnetic tape drives, and three card readers, a card punch, and a high-speed printer, each with separate tape drives for off-line operation.

### U.S. CHEMICAL PATENTS MAY NOW BE SEARCHED BY COMPUTER

Information for Industry, Inc., Washington, D.C., has produced a new magnetic tape edition of the Uniterm Index to U.S. Chemical and Chemically-related Patents. This tape contains 10,080 key words or terms which have been used in patents issued since 1950. The numbers of every patent in which a term appears are referenced under that term. There are over 3,500,000 such references to the 102,343 chemical patents which were issued from 1950 through 1961.

One hundred sixty man-years of work were expended in reading, abstracting, and indexing all these patents. A high-speed computer can search this new magnetic tape in eight minutes and swiftly print out a list of every single patent number that contains any desired key word, or any particular combination of key words. Using this magnetic tape, ninety-nine three-term inquiries may simultaneously be searched -- and the third term may be put in the negative, if desired, e.g., a list of every patent issued since 1950 which treats of titanium combined with vanadium, but not in association with iron. A further use for the new magnetic tape is to print out all the key words contained in any particular patent, thus providing a skeletal abstract.

The tape is designed for use on an IBM 1401 computer, but may be prepared for any other type of electronic data processing equipment with similar capability.

## NEW CONTRACTS

### NASA AWARDS $15 MILLION CONTRACT TO RAYTHEON FOR SPACE COMPUTER WORK

The Space and Information Systems Division, Raytheon Co., Sudbury, Mass., has received a contract for $15,029,420 for work on the Apollo lunar mission from NASA's Manned Spacecraft Center, Houston, Texas. The contract calls for Raytheon to provide industrial support to MIT's Instrumentation Laboratory for the design and development of the on-board digital computer for the Apollo Command module. Raytheon will also be responsible for the production of the computer and its associated ground support equipment.

The Apollo on-board digital computer will process data for the automatic operation of certain flight functions and present essential information to the crew for navigation and control of the Command module during the lunar mission.

### TRW AWARDED ARMY CONTRACT FOR AUTOMATIC MAP-MAKING SYSTEMS

Thompson Ramo Wooldridge, Inc., Canoga Park, Calif., has been awarded a $1.75 million contract to produce two Universal Automatic Map Compilation Equipment (UAMCE) systems for operational use by the U.S. Army. The UAMCE systems will be used to obtain all necessary data from aerial photography to produce topographic maps. The 25-month effort will be under the direction of the Geodesy, Intelligence, and Mapping Research and Development Agency of the U.S. Army Engineer Corps.

### OVER $1 MILLION CONTRACT AWARDED DIVISION OF RCA

A contract in excess of $1 million has been awarded to the Data Systems Division of the Radio Corporation of America, Van Nuys, Calif., by the Autonetics Division, of North American Aviation, Anaheim, Calif.

Under the terms of the contract, the RCA division will manufacture some 300 computer chassis for use in Autonetics' Minuteman missile program. The units are the basic frame upon which the Minuteman's D-17 airborne digital computer is assembled. Work will be performed in Van Nuys.

### MILITARY CONTRACTS OVER $800,000 RECEIVED BY UNIVAC

Military contracts totaling over $800,000 have been received by the UNIVAC Division of Sperry Rand Corporation for the production of 23 UNIVAC Digital Trainers. The contracts call for installation and checkout of each of the desk-size computers, and "on-site" training of military instructors by UNIVAC personnel. All of the machines will be used by the Army, Navy, and Air Force as classroom training devices.

The Digital Trainer is a development of UNIVAC Division, St. Paul, Minn. It is a portable, binary, training computer which, under some circumstances, may also solve scientific problems. It occupies 8 cubic feet of space, operates from 60 cycle, 110V AC power, and dissipates 750 watts of electric power.

### TSI RECEIVES NASA CONTRACT FOR COMPUTER SERVICES

Telecomputing Services, Inc., (TSI), Los Angeles, Calif., has been awarded a contract of more than $478,000 by the Marshall Flight Center of NASA for the operation of a Central Computer Facility at Slidell, La. Performance under this contract will continue for one year with a contract renewal option for two additional years.

The facility houses one of the largest computer complexes in the world, and will provide direct support to NASA's space vehicle production and testing operations at Michoud.

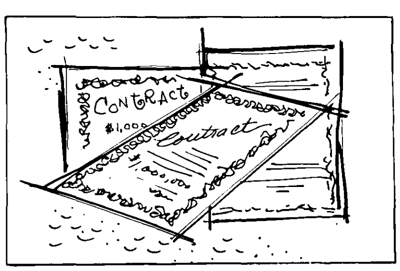
### NCR RECEIVES CONTRACT FOR EXPERIMENTAL DATA DISPLAY

The Electronics Division of The National Cash Register Company, Hawthorne, Calif., has been awarded a $98,000 contract for an experimental data display. The contract from the U.S. Army Electronics Materiel Agency in Fort Monmouth, N.J., covers a 12-month program of research and experimental investigation to study design criteria, techniques, and applications for automatic conversion of digital data into display form.

### ARMY CONTRACT TO GENERAL PRECISION

A contract, amounting to $95,000, has been awarded by the U.S. Army Ordnance District, Los Angeles, Calif., to the Information Systems Group, Librascope Division, General Precision, Inc., Glendale, Calif., to produce an auxiliary magnetic-tape memory system for the Army's Field Artillery Digital Automatic Computer (FADAC). The system is scheduled for delivery in August to the Frankford Arsenal in Pennsylvania for test and evaluation.

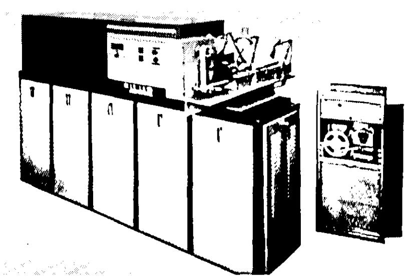
The memory system will be designed to supplement the main memory unit of the FADAC computer. FADAC is an operational field computer that solves ballistic problems for pinpoint firing of artillery weapons.



## NEW INSTALLATIONS

### RABINOW READING MACHINE SHIPPED TO EUROPE

The Rabinow Engineering Co., Rockville, Md., has shipped by air its fastest electronic reading machine to the AB Almex Company of Stockholm, Sweden. This machine reads alpha-numeric print on tally-roll tapes generated by Almex ticket issuing machines used on European buses -- and reads them at the rate of 6600 characters per second.



The high speed of this machine is made possible by the fact that it is a "full retina" machine: the images of the unknown characters are projected on a large bank of photomultipliers. The information is not digitalized but is handled in analog form by correlation circuits. Therefore, no "black-white" decision is made for each element, but all the gray-scale information is retained.

The machine employs "best match" recognition circuitry and handles information in analog form. This enables it to read poor characters, disregarding the presence of smudges and other interfering marks.

### "LANGUAGE LINK" IN POLARIS TESTING PROGRAM

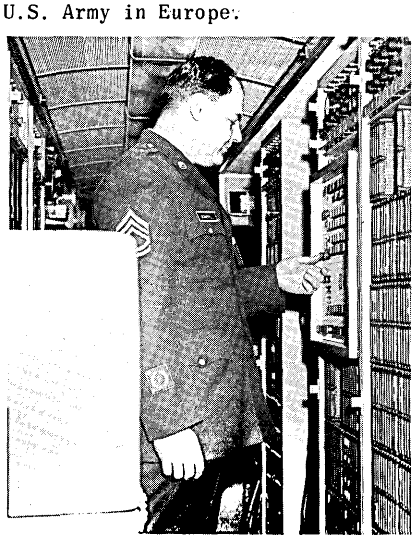
A complex data-processing system that serves as a "language link" between test instruments and computers in the Polaris weapon system testing program has been delivered to Cape Canaveral from Systems Engineering Laboratories, Inc., Fort Lauderdale, Fla. The system, costing in excess of $300,000, will be used by the Applied Physics Laboratory of The Johns Hopkins University (which is responsible for final checkout of instrumentation test data in the Polaris program) to speed up reduction of data obtained by new Polaris submarines as they arrive from test runs. It is installed near the submarine dock site at Cape Canaveral.

The SEL system is five times faster than existing equipment used in the Polaris testing program. Data processing rate for this new system is 40,000 digits or letters per second. The system will be used to process two basic types of data: telemetry data from Polaris missile and data from the submarine's digital computers which collect information on the vessel's operations and positions.

Although the system is intended for a specialized purpose, it has been designed to allow the unit to accept other types of data that may develop as the test program progresses.

### SYLVANIA DELIVERS MOBIDIC TO U.S. ARMY IN FRANCE

Sylvania Electric Products Inc. (a subsidiary of General Telephone & Electronics Corp.), Needham, Mass., has delivered a MOBIDIC (MOBIle DIgital Computer) system to the Ordnance Supply Control Agency, near Orleans, France. It will provide data processing control of Ordnance Supplies within the Communication Zone of the U.S. Army in Europe.



-- MOBIDIC system for U.S. Army in Europe contains an off-line control unit (above).

The MOBIDIC series presently consists of five models. In addition to the one in France, one is in operation at the Seventh U.S. Army's Stock Control Center in Zweibrucken, West Germany; a third serves as the data-processing heart of a prototype electronics command post under development at Newport Beach, Calif.; a fourth is at the Army's Electronic Research and Development Activity, Fort Huachuca, Ariz.; and a fifth is an evaluation model at Fort Monmouth, N.J.

### CREDIT UNION TO INSTALL COMPUTER

The first installation of a large-scale electronic computer in a credit union is scheduled to be made this spring at the Aircraft Federal Credit Union, East Hartford, Conn. The organization serves 36,000 employees of United Aircraft Corporation in the Hartford area.

Contract negotiations for a B250 computer system have been completed with Burroughs Corporation. The B250 computer will speed processing of members' share and loan accounts; it will also provide useful and timely operating information.

### FIRST H-400 IN ENGLAND

The first Honeywell 400 computer installation in the United Kingdom is now in operation in government offices of the borough of Bournemouth. The H-400 system consists of a central processor, four magnetic tape units, a high-speed printer and a card reader. It is being used for payroll, catering costs, financial control, statistics, and other purposes.

### AIR FORCE RESEARCH ANTENNA TO BE GUIDED BY UNIVAC 490 REAL-TIME SYSTEM

A Univac 490 Real-Time Computing system is being installed at the U.S. Air Force's Electronic Systems Division, Haystack Hill, Tyngsboro, Mass., where the Air Force is establishing a radio research facility. The facility is using a 120-foot, saucer-shaped antenna with a surface contour of unusual accuracy for global communications and space studies. The Univac 490 will be used in generating antenna-pointing instructions to guide the 185-ton rotating portion of the antenna. It will also be used for preliminary data processing of raw data and to generate information for a real-time display.

The configuration being installed at Haystack includes a central processor with a 16,000 word core memory, four Uniservo IIIC compatible tape units, a paper-tape subsystem, and a control console.

### UNIV. OF MARYLAND INSTALLS CONTROL DATA 160

Control Data Corp., Minneapolis, Minn., has delivered a Control Data 160 computer to the University of Maryland in College Park, Md. The computer will be installed in the Center of Atmospheric and Space Physics (CASP) within the Department of Physics and Astronomy.

The Control Data 160 will be used as part of the theoretical and experimental programs within the center. These include studies of radiation-belt phenomena, questions of planetary atmospheres with particular emphasis on the earth, and problems of basic physics such as objects in motion within a plasma. In addition, the computer will be used by other science departments.

### GROUND TELEMETRY SYSTEM FOR DEEP SPACE PROBES

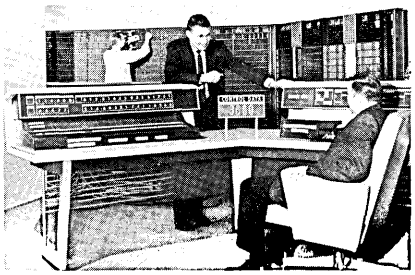
Scientific Data Systems, Inc., Santa Monica, Calif. has delivered a computer-controlled telemetry system to the Jet Propulsion Laboratory Instrumentation Facility at the tracking station at Goldstone, Calif. The system includes both SDS 910 and 920 high-speed computers, an analog-to-digital conversion system, and a magnetic system, all of which use only silicon semiconductors. The system will monitor telemetry from deep space probes.

### McDONNELL AUTOMATION CENTER INSTALLS IBM 7094

The McDonnell Automation Center, St. Louis, Mo., has in operation the first IBM 7094 computer in the Mid-West. This computer is in addition to the center's $13 million inventory of computing equipment. It replaces a 7090 computer, and will be associated with a 7080, nine 1401's, a 305 RAMAC, an assortment of electronic accounting machines and key punch machines, and will be integrated with the PACE, REAC and Beckman analog computer. One use of the 7094 will be to calculate engineering designs for the Mercury, Gemini, and ASSET spacecraft programs. Another use will be for the Phantom II aircraft program in performing thermodynamic, trajectory, aerodynamic and structural analyses.

## ARGONNE NATIONAL LABORATORY PURCHASES CONTROL DATA 3600

A Control Data Corporation 3600 computer is scheduled to be installed this summer at Argonne National Laboratory, Argonne, Ill. It will be the largest digital



computer for scientific research in the Middle West. The Control Data 3600 will interpret and execute instructions at an average rate of more than 400,000 per second. It will be the nucleus for a network of five electronic digital computers. Four desk-size Control Data 160-A computers will be tied to the 3600 for monitor control and input-output processing and for off-line data processing. Two of these will be at other locations on the 3700 acre Argonne site. The computer is expected to be in operation in August of this year.

## LEAR SIEGLER, INC. TO INSTALL NEWEST COMPUTER

Applied Dynamics, Inc., Ann Arbor, Mich., is now building a $240,000 analog computer which will soon join the battery of computers installed in the Aerospace Development Center of Lear Siegler Instrument Division at Grand Rapids, Mich. This new analog computer will operate 100 times faster than conventional analog computers, according to its designers. The computer, called Model AD-256 has a very large problem-solving capacity. The 24-foot-long computer is specially tailored to simulate large aerospace systems and to resolve system problems that cannot be handled by other analog computers.

## BANK INSTALLS UNIVAC III

The Harris Trust and Savings Bank, Chicago, Ill., has replaced its UNIVAC II (in use since 1958) with a UNIVAC III made by the Remington Rand Univac Division of Sperry Rand. The increase in speed of the UNIVAC III will be applied to time and demand deposit accounting and personal trust and stock transfer accounting.

## H-400 INSTALLED

The Lovable Company, Atlanta, Ga., one of the world's largest manufacturers of women's undergarments and foundations, has installed a Honeywell 400 data processing system at its manufacturing plant. The computer will be used initially for business data processing. Later, it will handle the company's inventory and production control operations.

# ORGANIZATION NEWS

## CONTROL DATA CORP. TO ACQUIRE BENDIX COMPUTER

The presidents of Bendix Corporation and Control Data Corporation have issued a joint statement to the effect that officers of the two companies have reached a preliminary understanding regarding the acquisition by CDC of the business and principal assets of the Computer Division of The Bendix Corp., Los Angeles, Calif., in return for an undisclosed amount of Control Data stock, cash and other considerations. The purchase price, which is to be paid partly in stock and partly in cash over a period of time, is under ten million dollars. The sale, subject to approval by both boards of directors, is under consideration as we go to press.

Control Data will continue the line of Bendix G-15 and G-20 computers. Both computers have a complete line of programming packages. Control Data, in adding the G-15 and G-20 computers to its product line, will take over the operations, service and support of all current Bendix Computer installations, as well as future installations.

## CONTROL DATA FORMS NEW SUBSIDIARY

A new, wholly-owned subsidiary, Meiscon Corporation, Chicago, Ill., has been formed by Control Data Corporation of Minneapolis, Minn. This subsidiary will engage in civil engineering and industrial engineering consulting, and intends to use computers in the automating of industrial and highway design procedures, with computing equipment to be furnished by Control Data Corp.

Meiscon has a core of professional engineers and mathematicians formerly associated with Meissner Engineers, Inc., a Chicago company, now in bankruptcy receivership. The initial work of the new corporation will be completing contracts formerly held by Meissner Engineers. Afterwards, the company will actively pursue consulting engineering contracts.

## FRENCH SALES SUBSIDIARY FORMED BY EAI

Electronics Associates, Inc., Long Branch, N.J., has formed in France a wholly-owned subsidiary, Electronic Associates, SARL, to handle sales and service of its instrument line in that country. The subsidiary will be headquartered in Paris and will act in support of the present Continental Sales Office in Brussels.

## UNIVERSAL DATA PROCESSING ACQUIRES INTEGRATED BUSINESS PROCEDURES

Universal Data Processing Corp., Los Angeles, Calif., has acquired the business and assets of Integrated Business Procedures, Inc., a subsidiary of Biochemical Procedures, Inc., North Hollywood, Calif., for an unannounced number of shares of Universal stock. Integrated Business Procedures will operate as a branch of Universal and will continue in its present offices with no change of personnel.

Universal Data Processing, a publicly-owned company, provides accounting, statistical and tabulating services for business application to more than 150 companies. It also operates a branch office in Downey, Calif.

## Newsletter

### EDUCATION NEWS

### AUTOMATIC CONTROL FILM AVAILABLE FROM ISA

A 16 mm sound and color film, "Automatic Process Control", running 33 minutes, describes the advantages of applying automatic control to a process in a small chemical plant. It is available from the Instrument Society of America, Penn-Sheraton Hotel, Pittsburgh 19, Pa. The film explains the four modes of control -- on/off, proportional, proportional with reset, and proportional with reset and rate action. The movie illustrates how a typical company's product quality and economic returns improve with the added refinement of each successive control mode. It also touches on how the relation of system analysis, centralized panels, and computer control can assist in bringing about optimum process conditions at maximum output with minimum costs.

The film is intended principally for career guidance and is aimed at the instrumentation newcomer. "Automatic Process Control" was planned and produced by a group of members of the ISA Rochester Section under the auspices of the Society's Education Division.

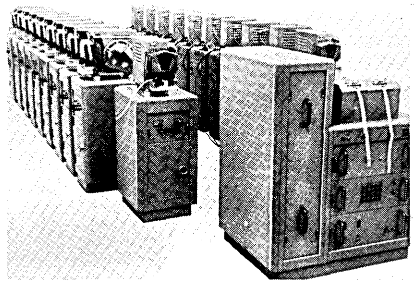
### NEW PRODUCTS

#### Data Transmitters and A/D Converters

### 850 WORD-PER-MINUTE COMMUNICATIONS SYSTEM

Elgin National Watch Company
Communications Division
Elgin, Ill.

A multiple-address processing system for high-speed communications via teletypewriter routing has been developed by this company. The system, called MAPS, sends messages simultaneously to 20 reperforators at the rate of 850 words per minute. In mass communications, MAPS enables one to communicate with hundreds, or thousands, simultaneously. The system segregates addresses automatically, recognizing and processing 96 different 8-character addresses. Unwanted addresses are automatically removed from the punch.



The first Elgin MAPS, called a high-speed TTY routing set, is in successful operation by the United States Navy. Other possible applications may include airlines, railroads, mass merchandisers, and civil defense.

### Digital

### NEW MODELS OF HONEYWELL 800 & 1800

Honeywell EDP
60 Walnut Street
Wellesley Hills 81, Mass.

Two new models of the large-scale Honeywell 800 and 1800 computers have been introduced by this company. Each has an unusual Input-Output Control Center that permits high-speed, simultaneous operation of a variety of peripheral devices. The new computers are called the Honeywell 800-II and the Honeywell 1800-II.

The Input-Output Control Center (IOCC) is located in the central processor of each computer. It is capable of controlling a card-reader-card-punch, a high-speed printer and up to four magnetic tape units in either on-line or off-line operation, or in a combination of on-line-off-line. A special buffering unit within the IOCC permits the simultaneous operation of any three peripheral devices. The IOCC operates under the direct control of the basic software of the system, eliminating the need for special programming requirements normally associated with peripheral unit control.

The new computers have the same operating characteristics as the standard Honeywell 800 and 1800 systems, except for the increased power and flexibility provided by the IOCC. The new systems will use the same programming aids already available with the standard 800 and 1800.

A minimum configuration for a Honeywell 800-II will be a central processor with 4096 words of memory (expandable to 32,000 words), four magnetic tape units (transfer rates of 48,000, 96,000, 133,000 or 186,000 decimal digits per second), card reading, card punching, printing devices, and an operator's console. The Honeywell 1800-II's minimum configuration will be the same, except that the minimum memory will be 8192 words.

### NEW COMPUTER BY IBM HAS 1100 LINE-PER-MINUTE PRINTER

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

A new computer, which has a printer with nearly twice the speed of present IBM printer models, has been announced by this company. The new computer is called the IBM 1460 data processing system. It functions like the 1401, yet processes information internally almost twice as fast.

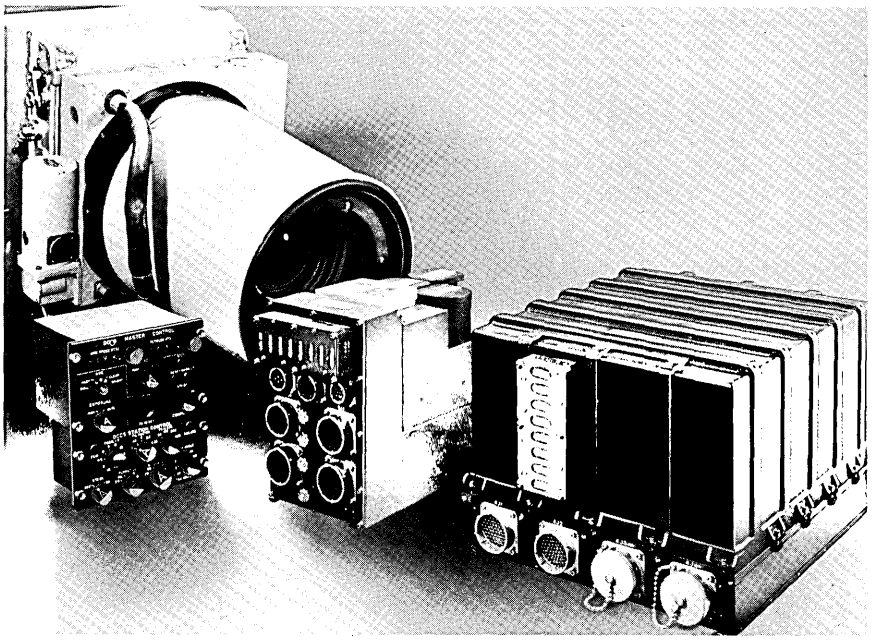
The 1460's new printer can print alphameric information at speeds of 1100 lines-per-minute. It is an advanced model of the 1403, Model II. The new printer, model III, uses a method of printing -- a rotating line of type -- similar to its model II counterpart. It has, however, two major advances. Instead of being attached to a steel band, the type slugs in the model III ride in a precision channel for maximum printing quality at higher speeds. Secondly, the type speed has been more than doubled on the model III. Linear type speed of the model II is 90 inches per second; linear type speed of the model III is 206 inches per second.

The new 1460 computer retains many of the features available with the 1401, but it offers significant increases in power and versatility. Its 6.0 microsecond memory cycle (memory cycle of the 1401 is 11.5 microseconds) allows the attachment of up to six high-density 729 VI magnetic tape units. This means that the 1460 can accept magnetic tape at speeds ranging from 7500 characters per second to 90,000 characters per second for a substantial saving in run time.

### AERIAL-RECONNAISSANCE CAMERA SYSTEM IS COMPUTER-CONTROLLED

General Precision, Inc.
Librascope Division
Glendale, Calif.

A computer-controlled aerial-reconnaissance camera system has been developed for the U.S. Air Force by this company. The system, called Digital Camera-Control System (DCCS), represents the first application of digital computing techniques to the control of aerial-reconnaissance cameras. The system is designed to control a group of aerial cameras mounted in reconnaissance aircraft. The system's digital computer also can provide automatic navigation capabilities for the aircraft.



-- Digital Camera-Control System showing (left to right, foreground) master and station control units, input-output unit, and 37-pound AN/ASN-24 (XY-1) digital computer. Aerial reconnaissance camera, equipped with 12-inch lens, is shown at rear.

The system's digital-control equipment consists of a 37-pound airborne computer, an input-output unit, and cockpit-mounted master and station-control units. The system's computer, designated AN/ASN-24(XY-1), is a general-purpose digital computer with a random-access memory and a high-speed integrator, called a Sigmator. The magnetic memory drum has a capacity of 2656 words -- word length is 25 bits.

The system's equipment is linked to USAF-supplied aerial camera equipment and aircraft sensing devices. The sensors include a terrain light detector and an image-velocity detector. The computer's operation is directed by a digital program, stored on the memory drum.

The system controls three basic camera functions: image-motion compensation, exposure, and cycling rate. To achieve pbotos with sharpness of detail, film must move across an aerial camera's focal plane at a speed matching that of the aircraft. If the film speed varies, the photo will be blurred -- as if the terrain below were in motion. The image-motion problem becomes more severe at faster speeds, lower altitudes and with longer camera-lens focal lengths. DCCS controls image-motion compensation with an accuracy of 99.968 percent (equivalent to an error of only 0.022 percent). This is compared to an accuracy of 88 percent (equivalent to a 12-percent error) in previous systems. This accuracy is achieved by an adaptive digital-calibration technique specifically developed for the Digital Camera-Control System. Adaptive calibration is used to control a digital velocity servo that moves the film across the focal plane at the velocity of the image being photographed. Thus, the image is "locked" on the film for the duration of exposure. Heart of the adaptive calibration is a mathematical model, the portion of the computer program that predicts the system's response.

Photographic exposure is regulated by computing and controlling the camera's shutter speed and diaphragm opening. The system controls the shutter speed and diaphragm opening to 1/4 f-stop compared to 1/2 f-stop in previous systems.

The system's third major function is control of the rate at which photos are taken. This function, called cycling-rate control, provides any required overlap for photos taken in a series. Height of ground objects can be determined from photos with an overlap of more than 50 percent. Cycling rate is controlled to an accuracy of 1 percent, compared to 15 percent in previous systems.

The system can be operated automatically or semiautomatically, and can be adapted to control the most advanced aerial cameras in existence or on the drawing boards. DCCS will be flight-tested at Wright-Patterson AFB, Ohio, following preflight evaluation in the Air Force's new space-simulation laboratory at the Aeronautical Systems Division (ASD), Dayton, Ohio. It is expected to enable jet reconnaissance aircraft to obtain extremely accurate photos at supersonic speeds during low-level flights as well as on high-altitude missions.

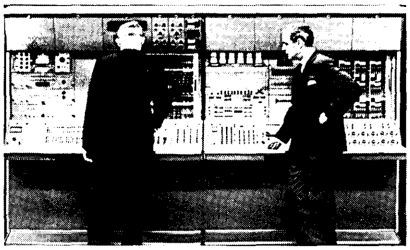
## Digital-Analog

### HYDAC 2000 COMPUTER OFFERS MAJOR IMPROVEMENTS

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

A major improvement in this company's hybrid digital analog computer (HYDAC 2000) is the incorporation of the new 231R-V Analog Computer System. This system adds new flexibility to HYDAC by including solid-state mode switching, multiple-speed repetitive operation, multiple time-scale selection, and a separate-mode logic pre-patch panel which permits the programming necessary for high-speed iterative calculations and hybrid simulation.

The digital portion of the HYDAC 2000 has a collection of general purpose digital building blocks which perform such functions as high-speed logic, digital storage, and digital arithmetic calculations. Communication between the elements of the analog and digital systems is via parallel data and logic conversion channels. The HYDAC 2000 system permits a programmer to select either analog or digital computing techniques for the solution of a particular problem.



HYDAC 2000

Flexibility in engineering and scientific computation has been achieved by combining the traditional advantages of both analog and digital computers into one centralized system. As an instrument for scientific research, HYDAC has wide applications in simulation laboratories for solving complex engineering and design problems. It is capable, for example, of simulating not only the flight of a space vehicle, but also the logical decisions that an airborne computer has to make in controlling flight.

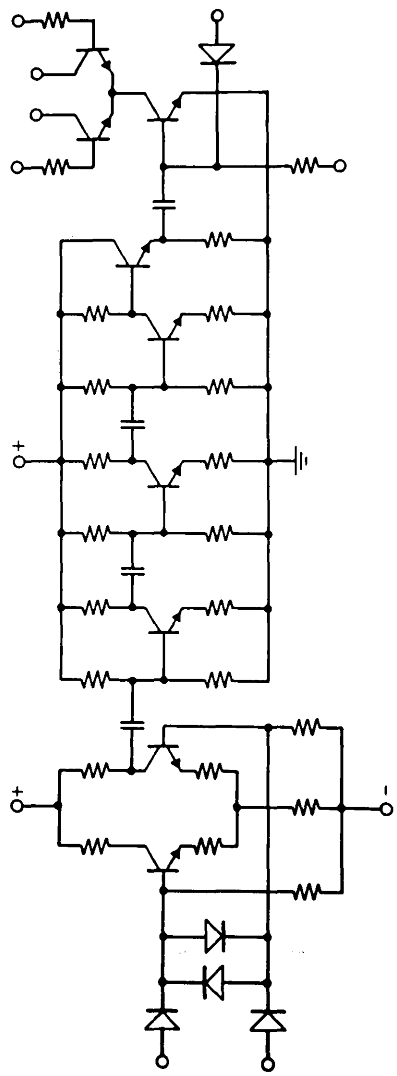
## Components

### MICROELECTRONIC INTEGRATED MEMORY SENSE AMPLIFIER FOR UNIVAC AEROSPACE COMPUTER

In developing the Univac microelectronic aerospace computers, Univac engineers, took full advantage of the integrated circuits technology of some electronics industry firms. One of these firms, Signetics Corp., Sunnyvale, Calif., produced the first memory sense amplifier in integrated form from a Univac circuit design, in less than eight weeks.

The sense amplifier consists of three related integrated circuits, each one-quarter inch square in a glass-kovar "package" It has a voltage gain of 13,000 for the five-stage linear amplifier. The output rise and fall times are less than 50 nanoseconds. The sense amplifier uses AC or capacitive coupling between stages to develop the high voltage gain. The device has the equivalent of 42 discrete components in the three units including 9 transistors, 24 resistors, 5 diodes and 4 capacitors. (See the accompanying schematic, at right.) Each package was designed to operate as an independent unit.

The integrated sense amplifier is used with a magnetic film memory. The Univac microelectronic aerospace computer which weighs 17 pounds uses 16 integrated sense amplifiers -- one for each bit for parallel 16-bit word readout. ("Computers and Automation" in February, 1963 reported in a cover story on the new Univac aerospace computer.)



## Memories

### NEW "TAG" MEMORY SYSTEM

A computer memory system that can search and compare up to 32,000 ten-digit numbers simultaneously has been developed by Goodyear Aircraft Corp., Akron 16, Ohio. This associative or "tag" memory system is up to 100 times faster than conventional computer searching methods. The new memory device can be used in association with existing computers. It may also provide a basis for a new generation of advanced computer systems.

Present-day digital computers are basically word-oriented. Memory contents are compared with input data on a serial word-by-word basis during search. In the GAC-developed associative memory, the input data is (by a parallel search) instantaneously compared to the contents of the entire memory. If a comparison exists, the word itself is made available as an output. Word lengths up to 200 bits are available.

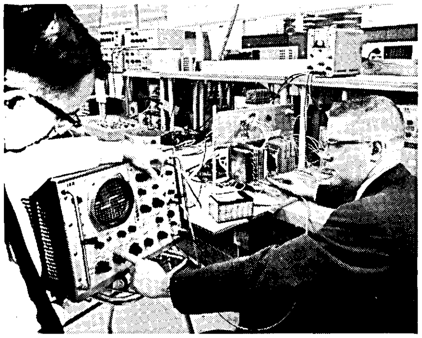
The heart of the associative memory is a multiaperture ferrite device developed under a GAC research and development program. This non-cryogenic system combines the logical operation A'B v AB' and non-destructive read-out storage. The multiaperture ferrite core, when applied in memory arrays, compares (in one operation) an input word to all information stored in the array. New sensing techniques provide for multiple responses in addition to providing signals indicating the location of the congruency between storage and input. Readout is then accomplished by conventional methods.

The system is expected to have wide application in intelligence data handling, cryptographic analysis, etc. Applications also include use in digital correlation systems, digital communications, data processing systems, real-time missile-countermeasure computers and space navigational computers.

### ELECTRICAL DELAY LINE MEMORY USING TUNNEL DIODES

The use of tunnel diodes in an electrical delay line memory has been developed by IBM Corp., Components Div., Poughkeepsie, N.Y. The new techniques give rise to extremely fast bit-rate frequencies and use circuits that are relatively simple compared to others that have been reported.

The basic memory cell consists of a conventional printed circuit pattern composed of the delay line and a capacitor; a tunnel diode, which amplifies and reshapes pulses; a conventional diode to give access to the individual cells; and a load resistor. Each cell operates serially in time (bit 1 followed by bit 2 followed by bit 3, etc.), but a complete system can use circuits for conversion to parallel from serial operation to achieve parallel input and output.



A fully operative model has been built but not fully complete (shown in above photo). It has a full read/write cycle time of 240 nanoseconds and a bit-rate frequency of 114 mc.

Besides the high pulse rates, the simpler circuitry allows even further simplification of the peripheral circuits. Only one sense amplifier is necessary for an entire memory. Also, each cell can have information erased and written with monopolar control drives and accessed through a simple connecting diode -- using two coordinates of selection.

## Software News

### IMPACT

Inventory Management Program and Control Techniques (IMPACT), is a new computer approach to scientific inventory management. It has been specifically designed for distribution industries by IBM Corporation.

Trial use of these new programs has resulted in important inventory reductions. (1) Inventory has been reduced by 20 per cent at S.S. Kresge Co., Detroit, Mich., with a corresponding 23 per cent increase in sales; at Bergen Drug Company, Inc., Hackensack, N.J., inventory has been reduced by 40 per cent; (2) Review time (time required for inventory review and writing of purchase order) has been reduced from two weeks to less than three days at Kresge -- and from 30 days to two days at Bergen Drug; and (3) Service level (representing the number of situations in which all customer orders can be filled) was unaffected at Kresge, where it had been pre-set by management at 98 per cent -- and improved from 97.5 per cent to 99.5 per cent at Bergen Drug.

The IMPACT system is made up of three basic functions stored within the computer: ordering, forecasting, and reviewing. The ordering function determines how much to order, balancing all the cost factors to arrive at the minimum-cost strategy for each item. The forecasting function has to do with when to order. These forecasts are used to set order points, taking into account such things as service levels desired, economical order quantities, the cost of maintaining inventory and seasonal trends. The reviewing function is similar to the action of a buyer in analyzing either ledger cards or a stock status report. The order point set by the forecasting function is compared with the available stock to determine whether stock is sufficiently low to order now. If so, the reviewing function looks up the order quantity computed by the ordering function. This quantity is then sent to the buyer for his approval The status of each inventory item usually is checked by the computer after an order is filled.

### FORTRAN II AVAILABLE

Scientific Data Systems, Santa Monica, Calif., has a FORTRAN II programming system now available, which may be run on both the SDS 910 and 920. The SDS FORTRAN II, which operates exactly like FORTRAN compilers that have been written for large machines, is believed to be the first available for a high-speed small computer.

SDS FORTRAN II is compatible with IBM 7090 FORTRAN, allowing a low-cost SDS computer to be used as a check-out device for the larger machine.

Complete processing and solution of FORTRAN II programs require only the basic SDS 920 or 910 computer with 4096 words of core memory plus paper tape and typewriter input/output.

### ADDITIONS TO UNIVAC SYMPAC LIBRARY

The UNIVAC Division of Sperry Rand Corporation has announced the addition of new post-processors to the SYMPAC (SYMbolic Program for Automatic Controls) Library. "Second generation" numerical control systems can now be computed and encoded automatically by UNIVAC Solid-State 80 and 90 computers. These computers are now able to generate final machine tool control information for Bendix Dynapath, General Electric Mark Century, Thompson Ramo Wooldridge, and Cincinnati Acramatic-1000 Series.

With these programs, UNIVAC Solid-State Systems can compute machining time, cut spans, and non-cutting movements in linear, circular, or parabolic modes. Machine tool feed rates and point coordinate data are used by the post-processors to precisely define all motion necessary for guiding the cutter. Acceleration or deceleration spans (consistent with the dynamic characteristics of the machine tool itself) are also computed to accommodate changes in tool path direction or feed rate. Output for circular interpolation is provided whenever desired. When restrictions inherent in the part geometry or the machine tool prevent using the programmed speed, the SYMPAC post-processor will automatically compute and define an optimum feed rate.

## Input-Output

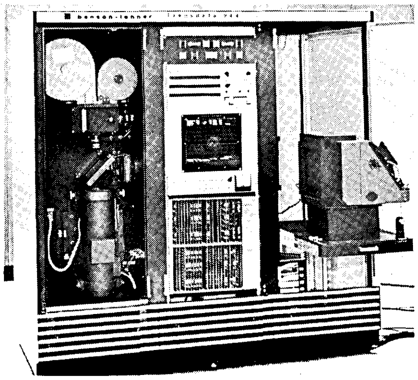
### PRINTER READOUT SYSTEM SPEEDS PAPER WORK 3000%

Benson-Lehner Corp.
Santa Monica, Calif.

A low-cost printer readout system, capable of printing 62,500 characters per second, has been introduced by this company. The new system, the Benson-Lehner/Transdata 944, was developed to Benson-Lehner specifications by Transdata, Inc., San Diego, Calif., and will be marketed exclusively under an agreement with this company.

The Transdata 944 is a solid-state system which reads digital data directly from computers or magnetic tape, translates it at computer speeds into curves, lines, or characters on a cathode ray tube, and records the picture instantly on microfilm or photographic paper. Computer printout speed is increased from 1000 lines per minute, the maximum capability now available, to 30,000 lines per minute.

## Newsletter



-- Exposed interior of the Transdata 944 shows placement of 35 mm microfilm camera used to record information from cathode ray tube.

The system consists of a basic printer/plotter, including 35 mm microfilm camera. Optional accessories include a line generator capable of drawing continuous axes of any length up to full scale from a single command; a forms projector which superimposes business forms, maps, or other "pre-printed" information on computer-generated data; and a camera capable of producing developed 9-inch-wide hard copy within four seconds after completion of exposure.

In business office applications the BLT 944 simplifies and speeds up the process of recording, storing, and retrieving information. In engineering and scientific laboratories the 944 may be used for such purposes as plotting missile trajectories, recording telemetry data from space vehicles, and recording pressure patterns.

### FAST OPTICAL CHARACTER READER

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

This company has announced an optical character reader that for the first time combines the scanning ability of the television vidicon tube with the data-handling capacity of the RCA 301 computer, to process hourly up to 90,000 printed documents -- a six-mile jetstream of paperwork. The new device, called Videoscan, examines the data on the fast moving documents by multiple scans of each of the printed characters, using television techniques especially adapted to EDP. An optional mark reader provides for direct entry into the computer of variable data indicated by an ordinary pencil stroke.

The Videoscan reads computer-printed lines of data at the rate of 1500 characters per second and can process up to 90,000 documents an hour. A line of data being scanned can include as many as 79 characters.

Documents are treated carefully despite the speed. The feed and transport mechanism can process the same documents repeatedly without causing mutilation, excessive wear or discoloration of the scanning surface. Videoscan accepts documents which have been folded, creased or even perforated along all four edges. Stub-size or full width documents are accepted. Documents four inches wide or less have a reading rate of 1500 per minute.

The scanning station, housing the Vidicon tube, is next to the document transport mechanism. As documents pass by, each character under scrutiny is illuminated by a concentrated light source. Reflected light from the document is directed through a lens to the target surface of the Vidicon tube, which makes a series of high-speed vertical scans of the character. The resulting video signals are converted and relayed in digital form to a character-recognition device where they are stored until a full pattern has been established. The completed-character signal is converted to RCA 301 code and the information fed into the computer.

Mounted beside the character read station, the mark reader examines vertical marks made by pen or pencil on a positional grid. It is used to enter variable data. The sensed vertical marks are translated into digital input code for the data system. Use of the mark recogntion sensing station in conjunction with printed data sensing adds to the flexibility of the system in billing, inventory taking, parts recording, meter reading or production recording applications.

Videoscan can be operated either as an on-line device working directly with the RCA 301 computer or performing off-line to segregate documents requiring special attention.

### RUGGED TAPE-HANDLING SYSTEM

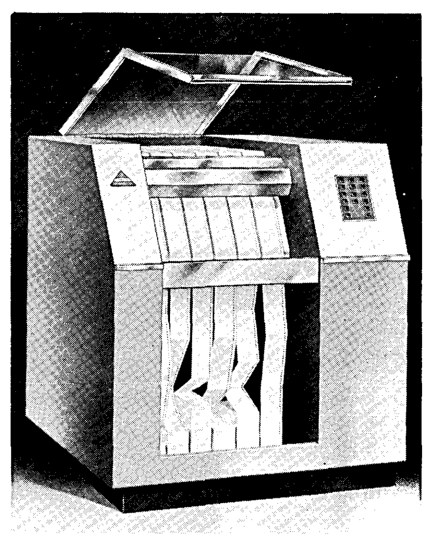
Sylvania Electric Products, Inc.
Needham, Mass.

The development of a tape-handling system for use in extreme environments has been announced by this company. It is a fully-automatic system which can withstand violent shock and vibration and perform its data-processing functions despite punishing temperature extremes. The equipment is reliable at temperatures ranging from minus 25-degrees to plus 125-degrees Fahrenheit and even after exposure to shock levels several hundred times the force of gravity. The system is compactly packaged, 19 inches x 23 inches x 24 inches.

### MULTIPLE-TAPE LISTER

Anelex Corporation
150 Causeway St.
Boston 14, Mass.

A new high speed "Multiple Tape Lister System", for proving and clearing operations in demand deposit accounting in banks, has been developed by this company. Use of the system makes it possible to print a master list, four transit lists and one miscellaneous items list in a single pass through the Sorter-Reader. The high speed Lister is compatible with almost all types of MICR Sorter-Readers. It prints at rates up to 2000 lines per minute on one, two or three parts sets. A single



soundproofed cabinet houses the entire system which includes six 24-column listers, control electronics and buffers. Solid-state electronics are used throughout this system. It will operate in any environment where other data processing equipment is normally located.

### NEW HIGH-SPEED DIGITAL PLOTTING

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

This company has designed a versatile digital plotter for scientific, industrial and military use. The new plotter, designated Series 3500 DATAPLOTTER, has been designed to provide fully automatic digital plotting. Preset origins and scale factors are automatically selectable upon computer command. Printing, line plot or point plot modes are also automatically selected as is line drawing speed.

The plotter operates on-line as well as from card or paper tape readers. It is able to plot points, symbols, or lines at speeds as high as 200 points or 120 lines a minute.

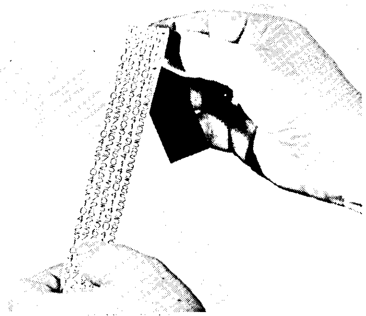
Accuracy for point plotting is ±0.05 per cent of full board width; repeatability is within ±0.01 per cent. Accuracy for line plotting is within 0.015 in. of straight line interpolation with 0.05 per cent of full board width for the end points. The system accepts information in the form of four decimal digits plus sign in both x and y. Input can be from serial or parallel punched-card readers, mechanical or photoelectric punched-tape readers, or, as manual input, from the self-contained adding-machine type keyboard.

### ON-LINE ELECTROSTATIC PRINTER

Omnitronics, Inc.
511 N. Broad St.
Philadelphia 23, Pa.

A new OMNI-DATA Instrumentation Printer, Model ITR-7, provides an on-line real-time window into telemetry, data-reduction, and data-acquisition systems by presenting an instant permanent visual record of data in readable numeric form for simple analysis of trends, influences, and normal fluctuations in data.

This company's Instrumentation Printer uses the OMNI-DATA electrostatic recording technique to deposit and fix up to five numeric characters per line across 1-inch paper tape at a longitudinal spacing of five lines per inch of tape. In synchronous operation, the ITR-7 produces 300 lines per second. Asynchronous (start-and-stop) operation may be accomplished at speeds up to 6 inches (30 lines) per second.



## PEOPLE OF NOTE

### "IBM FELLOWS" APPOINTED

IBM Corp. has established a new rank of "IBM Fellow" to give special recognition to members of its technical staff who have outstanding records of continued innovation and achievement. The IBM Fellow will have freedom in choosing and carrying out research projects within their field of specialty, and will act as consultants to other IBM scientists and executives.

Among the first scientists and engineers named IBM Fellows are:

John W. Backus, scientist at IBM's Yorktown, N.Y., research center. He has been a key figure in the development of special computer programming languages, including FORTRAN.

Genung L. Clapper, engineer at IBM's Endicott, N.Y., laboratory. Mr. Clapper has filed numerous patents covering a variety of features of electronic computers, including the IBM 650. He has also produced significant patents in the area of computer logic.

Charles R. Doty, Sr., engineer at the Poughkeepsie, N.Y., laboratory, a pioneer in the development of equipment used in long distance transmission of punched-card data by wire.

Frank E. Hamilton, also an engineer at Endicott, had an important role in the development of IBM's first large-scale computer, the Harvard Mark I, and also in the development of later systems including the IBM 650.

Ralph L. Palmer, IBM director of engineering, conceived and developed IBM's first commercially successful electronic calculator, the 604. He later directed development of the company's first large-scale production computers.

Llewellyn H. Thomas, a scientist at the Watson Laboratory, New York City, is known for his work in many abstract fields of mathematics and theoretical physics, including relativity, quantum theory, hydrodynamics and celestial mechanics.

### J. D. TUPAC NAMED CHAIRMAN 63 FJCC

James D. Tupac, head of computing services, The RAND Corp., will be chairman of the 1963 Fall Joint Computer Conference to be held November 12-14, 1963, in Las Vegas, Nevada. Mr. Tupac is chairman of the San Fernando Valley chapter of ACM.

### SHEINGOLD NAMED FELLOW BY IEEE

Dr. Leonard S. Sheingold of Sylvania Electric Products Inc. (a subsidiary of General Telephone & Electronics Corp.) has been declared a Fellow in the Institute of Electrical and Electronics Engineers (IEEE) for "contributions to microwaves and leadership in military electronics".

Following a one-year term as Chief Scientist of the U.S. Air Force, Dr. Sheingold rejoined Sylvania in June, 1962, as "Vice President - Advanced Technology" of the Sylvania Electronic Systems Division.

# Newsletter

## UNIVAC APPOINTMENTS

F. Gordon Smith has been appointed Vice President, European Marketing. Mr. Smith will direct the marketing of UNIVAC data processing systems through subsidiaries, dealer distributorships and direct sales efforts in Europe, the Middle East and Africa. Mr. Smith will be based in Lausanne, Switz.

Maurice W. Horrell has been appointed as Vice President, Engineering and Manufacturing for the UNIVAC division, Sperry Rand Corporation. Mr. Horrell is responsible for all divisional engineering and manufacturing programs.

## LEE AND HILLIARD PROMOTED AT GENERAL PRECISION, INC.

R. W. Lee has become Executive Vice President and General Manager of General Precision, Inc.'s Information Systems Group, Glendale, Calif. Mr. Lee was previously president of the GPL Aerospace Group, Little Falls, N.J.

William P. Hilliard, who has been Vice President and General Manager of GPL Division, Pleasantville, N.Y., has become President of that division.

## JOHN S. KANE NAMED VP

John S. Kane has been named vice president of Reeves Soundcraft Corp. (AMEX), New York. Mr. Kane will be general manager of Soundcraft's magnetic tape division located in Danbury, Connecticut.

## APPOINTMENTS AT SDC

Theodor H. Braun and William W. Parsons have been appointed Senior Vice Presidents of System Development Corporation, Santa Monica, Calif.

Wesley S. Melahn, Air Defense Division manager of SDC, has been appointed a Vice President of the firm.

## VICE PRESIDENT NAMED AT EAI

David P. Wilkinson has been elected as Vice President - Corporate Planning of Electronic Associates, Inc. Formerly, Director - Corporate Planning Mr. Wilkinson has responsibility for company-wide forward planning, including coordination of product programs.

## BUSINESS NEWS

## GE NOTES RECORD SALES, EARNINGS DROP

Results issued by General Electric Company on its operations for 1962 showed sales billed of $4,792,732,530, up 8% from 1961 sales billed of $4,456,815,169, and net earnings of $265,843,769, up 10% from earnings for 1961.

Sales of consumer goods and industrial equipment showed healthy gains over the prior year, while volume for defense sales and heavy capital goods increased moderately over 1961 sales volume. Sales of heavy capital goods, such as computers, were aided by particularly strong export volume, Chairman of the Board Ralph Cordiner reported. Earnings did not follow sales to a record in 1962 mainly as the result of the continuing squeeze between increasing costs and depressed prices, he said. "General Electric products on the average are now selling at price levels that prevailed in the 1953-1955 period, in spite of greatly improved product features and performance."

## NCR'S 1962 SALES RISE 9%; SET RECORD FOR EIGHTH STRAIGHT YEAR

Sales of the National Cash Register Company in 1962 set a new record for the eighth consecutive year, Robert S. Oelman, chairman and president, has announced.

According to preliminary figures, revenues from the company's sales, services, and equipment rentals totaled $564,021,000 for the year, compared with the previous high of $518,884,000 recorded for 1961, or an increase of 9%.

Reported net income for 1962 was $20,645,000, the second highest in company history, but 5% below the record $21,708,000 earned in 1961.

Mr. Oelman attributed the decline in reported earnings to two factors. The first was a reduction in remitted foreign earnings which reflected the lower earnings of the company's operations abroad during 1962, and the second was the impact of NCR's rapidly growing equipment rental business.

The NCR chairman said that 1961 was an exceptionally profitable year for the company abroad. Foreign earnings in that year were some 30% greater than in any previous year. In contrast, he said, 1962 earnings abroad were not only reduced by currency devaluation, but also were adversely affected by economic conditions in certain parts of the world. Also, the company made sizable expenditures overseas in 1962 for the expansion of its electronic data processing business.

The second factor which influenced 1962 earnings was a substantial increase during the year in the proportion of NCR equipment being rented. Equipment rentals tend to reduce current earnings because the company must bear initially the marketing, installing, and depreciation costs of such installations, yet receives its rental income only over a period of years.

During 1962 NCR sold and installed more computer systems -- most of which are rented -- than in any previous year, Mr. Oelman said. As a result, the investment which the company made in rental equipment during 1962 doubled over that made during 1961 -- rising from $13,293,000 in 1961 to $26,502,000 last year.

NCR's domestic sales in 1962 were at an all-time high of $316,-321,000, which was a 13% increase over the previous year. Overseas sales also set a new record, rising 5% to $243,748,000.

The NCR chairman said the company made substantial progress during 1962 in the electronic data processing field. By the end of the year, NCR had installed or had on order 700 computer systems of various types, approximately twice as many as a year earlier.

## HONEYWELL REPORTS RECORD 1962 SALES

Minneapolis-Honeywell Regulator Company, parent firm for Honeywell EDP, had record sales of $596,266,929 in 1962, as compared with $470,182,073 a year ago, according to a recent unaudited report.

Indicated earnings for the year ended December 31, were $26,-883,908, compared with 1961 earnings of $24,945,845.

Paul B. Wishart, board chairman, said most of the company's divisions earned more than in 1961. The most significant factors in the year's results, he added, were higher sales of military and space equipment and "encouraging progress" in the firm's EDP business.

Wishart said sales of Honeywell's EDP systems were the highest for any year since the company entered this fast-growing field. "We are most encouraged by the progress made in our electronic data processing business," he added. "Improved performance, both in terms of deliveries and financial results, was especially pronounced in the last half of the year. We fully expect this trend to continue in 1963."

Honeywell EDP now employs more than 3,000 persons at seven research, manufacturing and administrative facilities in the Greater Boston area.

## AMPEX REPORTS SALES GAINS

William E. Roberts, president and chief executive officer of Ampex Corp., has announced that record net earnings, sales and incoming orders were achieved in the first nine months of fiscal 1963. Roberts noted that earnings for the current nine months nearly equaled those for the full previous year.

Net earnings after taxes for the nine months ended January 31 were 141 per cent ahead of last year's first nine months at $3,-163,000. Pre-tax earnings for the nine month period totaled $5,588,-000, up 162 per cent from $2,132,-000 of last year.

Nine-month sales increased 13% to $66,789,000 from $58,808,000 reported for the first three quarters last year. Incoming orders totaled $74,809,000, 31 per cent ahead of last year's $57,132,000.

Estimating for the full year, Roberts said, "we will top $100,-000,000 in incoming orders for the first time in our history, and will exceed our earlier estimate of a 10 per cent sales increase and substantially improved earnings."

## REEVES SOUNDCRAFT SALES UP 28%; PLANS NAME CHANGE

Reeves Soundcraft Corp., New York, increased sales 28% in 1962, to $8.3 million against $6.5 million the previous year, and showed a net profit from operations of $90,227 compared to a loss in 1961, Hazard E. Reeves, president, announced.

All four company divisions contributed to improved sales volume during 1962, said Mr. Reeves. For 1963, the company's overall sales volume should exceed $10 million and produce a greater percentage of profit, Mr. Reeves said. According to Mr. Reeves, a motion to change the name of the company will be introduced at the annual stockholders meeting in April. "The change is being sought so the company's name will better reflect the diversified nature of our business and the many industries in which Reeves products are used," Reeves said.

Reeves Soundcraft Corp. divisions manufacture magnetic tape recording products, specialized motion picture and sound equipment.

## COLLINS REPORTS 20% SALES INCREASE

Sales of $111,211,000 and net income of $1,717,000 are announced by Collins Radio Company for the first six months ended Feb. 1, 1963.

The comparable results for the six months ended Jan. 31, 1962, were earnings of $1,041,000, with sales of $93,805,000.

The backlog of orders on Feb. 1, 1963, totaled $251,000,000 compared with $191,000,000 at Jan. 31, 1962 and $230,000,000 at July 31, 1962. New orders booked during the six month period amounted to $132,-000,000, exceeding deliveries during the period by $21,000,000.

## BURROUGHS AND IBM ACHIEVE PATENT PACT

Burroughs Corp. and IBM Corp. have announced a licensing agreement under which each will make available to the other for five years its patent rights covering information handling systems.

The agreement has the purpose of enabling each company to continue to develop and manufacture its own information handling systems free from concern about possible infringement of the other's patents. The license is non-exclusive and contains reciprocal rights as to the use of the respective patent rights owned by each company.

## DOC INC. DOUBLES EARNINGS

Documentation Inc., Bethesda, Md., a firm specializing in information retrieval systems, has reported record sales and earnings for the nine month period ending Dec. 31, 1962. Sales were $1,882,-700, up 126 percent from $831,383 for the same period a year earlier. Earnings were $40,000 in 1962 compared to $19,161 for the corresponding period in 1961.

# MONTHLY COMPUTER CENSUS

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

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

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

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

AS OF MARCH 20, 1963

| NAME OF MANUFACTURER | NAME OF COMPUTER | SOLID STATE? | AVERAGE MONTHLY RENTAL | DATE OF FIRST INSTALLATION | NUMBER OF INSTALLATIONS | NUMBER OF UNFILLED ORDERS |
|---|---|---|---|---|---|---|
| Addressograph-Multigraph Corporation | EDP 900 system | Y | $7500 | 2/61 | 11 | 11 |
| Advanced Scientific Instruments | ASI 210 | Y | $2850 | 4/62 | 6 | 3 |
| | ASI 420 | Y | $12,500 | 2/63 | 1 | 0 |
| Autonetics | RECOMP II | Y | $2495 | 11/58 | 130 | 7 |
| | RECOMP III | Y | $1495 | 6/61 | 30 | 17 |
| Bendix | G-15 | N | $1000 | 7/55 | 352 | 2 |
| | G-20 | Y | $15,500 | 4/61 | 20 | 6 |
| Burroughs | 205 | N | $4600 | 1/54 | 78 | X |
| | 220 | N | $14,000 | 10/58 | 58 | X |
| | E101-103 | N | $875 | 1/56 | 170 | X |
| | B250 | Y | $4200 | 11/61 | 50 | 42 |
| | B260 | Y | $3750 | 11/62 | 30 | 48 |
| | B270 | Y | $7000 | 7/62 | 14 | 27 |
| | B280 | Y | $6500 | 7/62 | 15 | 21 |
| | B5000 | Y | $16,200 | 4/63 | 1 | 20 |
| Clary | DE-60/DE-60M | Y | $675 | 2/60 | 92 | 4 |
| Computer Control Co. | DDP-19 | Y | $3500 | 6/61 | 1 | 2 |
| | DDP-24 | Y | $3000 | - | 0 | 1 |
| | SPEC | Y | $800 | 5/60 | 10 | 2 |
| Control Data Corporation | 160/160A | Y | $2000/$3500 | 5/60 & 7/61 | 272 | 56 |
| | 924/924A | Y | $11,000 | 4/62 | 6 | 11 |
| | 1604/1604A | Y | $35,000 | 1/60 | 44 | 9 |
| | 3600 | Y | $52,000 | 4/63 | 0 | 5 |
| | 6600 | Y | $120,000 | 2/64 | 0 | 1 |
| Digital Equipment Corp. | PDP-1 | Y | Sold only about $175,000 | 12/59 | 41 | 9 |
| | PDP-4 | Y | Sold only about $75,000 | 8/62 | 11 | 10 |
| El-tronics, Inc. | ALWAC IIIE | N | $2500 | 2/54 | 32 | X |
| General Electric | 210 | Y | $16,000 | 7/59 | 72 | 10 |
| | 215 | Y | $5500 | -/63 | 0 | 12 |
| | 225 | Y | $7000 | 1/61 | 115 | 88 |
| General Precision | LGP-21 | Y | $725 | 12/62 | 6 | 31 |
| | LGP-30 | semi | $1300 | 9/56 | 405 | 14 |
| | L-3000 | Y | $4500 | -/63 | 0 | 2 |
| | RPC-4000 | Y | $1875 | 1/61 | 68 | 17 |
| Honeywell Electronic Data Processing | H-290 | Y | $3000 | 6/60 | 12 | 3 |
| | H-400 | Y | $5000 | 12/60 | 40 | 66 |
| | H-800 | Y | $22,000 | 12/60 | 52 | 8 |
| | H-1400 | Y | $14,000 | -/63 | 0 | 2 |
| | H-1800 | Y | $30,000 up | -/63 | 0 | 2 |
| | DATAmatic 1000 | N | - | 12/57 | 5 | X |
| H-W Electronics, Inc. | HW-15K | Y | $500 | 3/63 | 0 | 2 |

| NAME OF MANUFACTURER | NAME OF COMPUTER | SOLID STATE? | AVERAGE MONTHLY RENTAL | DATE OF FIRST INSTALLATION | NUMBER OF INSTALLATIONS | NUMBER OF UNFILLED ORDERS |
|---|---|---|---|---|---|---|
| IBM | 305 | N | $3600 | 12/57 | 850 | X |
| | 650-card | N | $4000 | 11/54 | 700 | X |
| | 650-RAMAC | N | $9000 | 11/54 | 210 | X |
| | 1401 | Y | $2500 | 9/60 | 5100 | 3600 |
| | 1410 | Y | $10,000 | 11/61 | 162 | 385 |
| | 1440 | Y | $1800 | 4/64 | 0 | 700 |
| | 1460 | Y | $9800 | 10/63 | 0 | 15 |
| | 1620 | Y | $2000 | 9/60 | 1320 | 280 |
| | 701 | N | $5000 | 4/53 | 4 | X |
| | 7010 | Y | $19,175 | 2/64 | 0 | 30 |
| | 702 | N | $6900 | 2/55 | 4 | X |
| | 7030 | Y | $300,000 | 5/61 | 4 | 1 |
| | 704 | N | $32,000 | 12/55 | 77 | X |
| | 7040 | Y | $14,000 | 6/63 | 0 | 42 |
| | 7044 | Y | $26,000 | 6/63 | 0 | 11 |
| | 705 | N | $30,000 | 11/55 | 151 | X |
| | 7070, 2, 4 | Y | $24,000 | 3/60 | 330 | 235 |
| | 7080 | Y | $55,000 | 8/61 | 45 | 28 |
| | 709 | N | $40,000 | 8/58 | 39 | X |
| | 7090 | Y | $64,000 | 11/59 | 240 | 120 |
| | 7094 | Y | $70,000 | 12/62 | 6 | 10 |
| Information Systems, Inc. | ISI-609 | Y | $4000 | 2/58 | 20 | 1 |
| ITT | 7300 ADX | Y | $35,000 | 7/62 | 6 | 4 |
| Monroe Calculating Machine Co. | Monrobot IX | N | Sold only-$5800 | 3/58 | 163 | 3 |
| | Monrobot XI | Y | $700 | 12/60 | 245 | 180 |
| National Cash Register Co. | NCR - 102 | N | - | - | 30 | X |
| | - 304 | Y | $14,000 | 1/60 | 30 | 0 |
| | - 310 | Y | $2000 | 5/61 | 35 | 48 |
| | - 315 | Y | $8500 | 5/62 | 50 | 138 |
| | - 390 | Y | $1850 | 5/61 | 325 | 226 |
| Packard Bell | PB 250 | Y | $1200 | 12/60 | 133 | 24 |
| | PB 440 | Y | $3500 | 9/63 | 0 | 10 |
| Philco | 1000 | Y | $7010 | -/63 | 0 | 27 |
| | 2000-212 | Y | $68,000 | 1/63 | 1 | 14 |
| | -210, 211 | Y | $40,000 | 10/58 | 23 | 10 |
| | 4000 | Y | $6000 | -/63 | 0 | 10 |
| Radio Corp. of America | Bizmac | N | - | -/56 | 4 | X |
| | RCA 301 | Y | $6000 | 2/61 | 214 | 290 |
| | RCA 501 | Y | $15,000 | 6/59 | 90 | 15 |
| | RCA 601 | Y | $35,000 | 11/62 | 2 | 8 |
| Scientific Data Systems Inc. | SDS-910 | Y | $2190 | 8/62 | 12 | 39 |
| | SDS-920 | Y | $2690 | 9/62 | 6 | 9 |
| TRW Computer Co. | TRW-230 | Y | $1800 | 9/63 | 0 | 8 |
| | RW-300 | Y | $6000 | 3/59 | 32 | 2 |
| | TRW-330 | Y | $8000 | 12/60 | 8 | 18 |
| | TRW-340 | Y | $10,000 | -/63 | 0 | 4 |
| | TRW-530 | Y | $2500 | 8/61 | 17 | 6 |
| UNIVAC | Solid-state 80, 90, & Step | Y | $8000 | 8/58 | 538 | 150 |
| | Solid-state II | Y | $8500 | 9/62 | 5 | 30 |
| | 490 | Y | $26,000 | 12/61 | 5 | 12 |
| | 1107 | Y | $45,000 | 10/62 | 2 | 16 |
| | III | Y | $20,000 | 8/62 | 4 | 65 |
| | LARC | Y | $135,000 | 5/60 | 2 | X |
| | 1100 Series (except 1107) | N | $35,000 | 12/50 | 30 | X |
| | I & II | N | $25,000 | 3/51 & 11/57 | 58 | X |
| | File Computers | N | $15,000 | 8/56 | 72 | 1 |
| | 60 & 120 | N | $1200 | -/53 | 890 | 17 |
| | 1004 | Y | $1500 | 2/63 | 5 | 1300 |
| | | | | TOTALS | 14,549 | 8713 |

X — no longer in production

## THE COMPUTER: A TOOL FOR CLERICAL AUTOMATION OR INTEGRATED MANAGEMENT SYSTEMS?

*(Continued from Page 27)*

up-dated that we can, as easily as dialing a telephone number, have access to any pertinent information stored.

Since we shall be able to get information so quickly, we shall be content to store it centrally and not inventory it at each desk or office. Because we can store it centrally, or at least have it accessible at each desk or office through communication links, it will be easy to edit it, compare it, test it, and have automatic alarms if critical items go out of limits.

### Existing Examples

We are already doing this with process control computers to some extent; but the scale, which involves perhaps 1,500 wired inputs and 100,000 words of stored memory, is much smaller than the scale of management systems of the future.

We are doing pieces of this now in library retrieval systems. Western Reserve University, using a GE 225, is searching abstracts for the American Society of Metals.

Our jet engine laboratory at Evendale has a 30,000-document library on three reels of tape. A complete search takes less than three minutes, and the system prints out desired abstracts.

### Management Information System

Currently, some of our people are exploring the possibility of a management information system for the entire Company. Whether such an approach will be productive is too early to tell.

One thing is certain, however, and that is, we as managers are going to depend on *more*, rather than *less* computer-processed information in the future. Much of what we now do as managers will be assumed in one way or another by the information system. Unfortunately, or fortunately, depending on how you look at it, we will probably not reduce the level of contribution from our managers. We'll simply move them on to added tasks which are generated by the added capability of our other competitors whether they be nationally corporate or internationally political.

In a sense, managers will move on to higher levels of jobs just as clerical and other talents have expanded in total in spite of our progress to date in automation. But a specific manager may move "on" to a lower level unless he gives some serious thought now to the contributions computers and integrated systems can make to the management of his business.

*(Based on a paper given to the American Management Association Seminar, New York, N. Y., February 25, 1963.)*



## READERS' AND EDITOR'S FORUM

*(Continued from Page 7)*

stitutions. This is a relatively new development and there is every reason to believe that, as a trend, it will grow in significance.

4. *Cooperative projects:* Several smaller firms may join together to form a non-profit organization to handle data processing. The six New York State banks illustrate this approach.

The extensive growth of the data processing field makes it impossible to accurately predict the importance any one of these approaches will assume in the future.

C. G. FRANCIS
Director of Information

## CALL FOR PAPERS—1963 FALL JCC

Mr. Paul M. Davies, chairman of the program committee, has issued a call for technical papers for the program of the Fall Joint Computer Conference to be held November 12-14, 1963 at the Las Vegas Convention Center.

Papers are encouraged in the areas of system organization, computer hardware, applications, and programming with special emphasis on new developments which promise to have greatest impact on the computer field. Some subjects of particular interest are novel computer organizations, information retrieval, computer memories, computer devices, modern trends in programming, analog computers and hybrid systems.

In line with the growing awareness of the computer scientist's responsibility towards the social implications of his technology, one or more sessions are planned on this aspect of developments. Examples of suitable subjects are computer simulation of the economy, automation, and machine intelligence.

Only papers which have not been presented or published at national conferences are eligible. A complete manuscript is requested, in addition to a 300 word abstract, in order to permit evaluation of the technical content; however, special formats or artistic drawings are unnecessary. Three copies should be sent to Mr. Davies at Abacus, Inc., 1718 21st Street, Santa Monica, California. The deadline for submittal is June 3. Selection will be made by July 10 and final papers are to be submitted by September 2 to allow time for publication of the conference proceedings.

The Joint Computer Conferences are sponsored by the American Federation of Information Processing Societies (AFIPS).

# BOOKS AND OTHER PUBLICATIONS

**Moses M. Berlin**
**Allston, Mass.**

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

**Germain, Clarence B. / Programming the IBM 1620 / Prentice-Hall, Inc., Englewood Cliffs, N. J. / 1962, printed, 187 pp, $5.00**

This book is intended as a text for a first course in digital computer programming based upon the IBM 1620 computer and can be used either in the classroom or for individual study. Apart from some of the problems, no knowledge of college mathematics is required. The text may be used with either a card or a tape 1620. Apart from the text, the student should also supply himself with a diagramming template and the appropriate SPS and FORTRAN coding forms. The book contains 11 chapters which include: "Computing Fundamentals," "Operation of the 1620," "Address Arithmetic," and "Program Planning and Debugging." Bibliography, p. 150; Answers to Selected Problems, p. 151-155. Nine appendices include: "Significance of P and Q Addresses," "System Timings," "Character Coding," "Error Restart Procedures," and "Summary of Two-Pass SPS." Index included.

**Elonka, Stephen, and Alonzo R. Parsons / Standard Instrumentation Questions and Answers: For Production-Processes Control; Vol. I: Measuring Systems; Vol. II: Control Systems / McGraw-Hill Book Co., Inc., 330 West 42 St., New York 36, N. Y. / 1962, printed, 482 pp, $15.95 a set, $8.50 per volume**

These two volumes present a basic coverage of the field of instrumentation and control for the practical man in the form of questions and answers. Emphasis is placed on fundamental concepts and applications in production-process control and data processing. Ample, easy-to-understand line drawings illustrate the texts. The sixteen chapters in the two volumes cover, among others, the following subjects: basic characteristics and behavior fundamentals of instruments and processes, temperature measuring systems, flow measuring systems, pressure and vacuum measurements, level measurements, pneumatic control systems, process computers, and educational opportunities in instrumentation. The final chapter presents a comprehensive listing of educational and training opportunities in the instrumentation and control fields. Suggested reading lists are to be found at the end of each chapter.

**Gentile, Sylvester P. / Basic Theory and Application of Tunnel Diodes / D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J. / 1962, printed, 295 pp, $9.00**

The aim of this book is to provide a coherent, sequential presentation of the theory and application of tunnel diodes consistent with the present state of the art. The book is intended for the technician and the practicing engineer familiar with electron-tube theory and application. A knowledge of transistors is not required for an understanding of tunnel diodes as presented here. It contains 9 chapters of which the second and third are perhaps the most important. Chapter 2 provides the reader with a basic explanation of the internal conduction mechanism in heavily doped semiconductor diodes that results in the phenomenon of electron tunneling. Chapter 3 presents what the author believes to be a novel, but technically correct, explanation that eliminates the "mystery of negative resistance" and its use for amplification and oscillation. Three appendices entitled "References," "Derivation and Analysis of Formulas," and "Review of Transistor Fundamentals." A glossary and an index are included.

**Evans, Luther H., and George E. Arnstein, editors, and 22 authors / Automation and the Challenge to Education / Natl. Education Assn., 1201 Sixteenth St. N.W., Washington 6, D. C. / 1962, printed, 190 pp, $4.00**

This volume contains the revised papers presented at the proceedings of a symposium held in Washington, D. C., Jan. 17-19, 1962, sponsored by the Project on the Educational Implications of Automation. The goal of the project was to make recommendations on how education can answer the challenge of automation. The editors first present the background of the symposium discussing "Automation and Its Consequences" and "The Hypothesis: Statement and Discussion." Twelve papers follow which include: "Adult Learning: Limits and Potentialities," "A Curriculum Specialist," "A Social Psychologist," and "Educational Programs in Industry," Three appendices include: "The Impending Educational Revolution," "Biographical Backgrounds of Symposium Participants," and "Suggested Reading."

**de Pian, Louis / Linear Active Network Theory / Prentice-Hall, Inc., Englewood Cliffs, N. J. / 1962, printed, 535 pp, $16.00**

This text is written for students of electrical engineering. The author presents a generalized matrix treatment of linear networks providing a unified theory in dealing with all linear networks of vacuum tubes, transistors, or any linear device. In Chapter 1 the idea of circuit elements, other than the linear resistance, inductance and capacitance, is introduced. Chapter 2 deals with two-terminal networks. Three-terminal networks are introduced in Chapter 3. Chapter 4 deals with reciprocity and the gyrator (a special non-reciprocal three-terminal network) is used to account for the non-reciprocity of a network. Stability and instability are the subjects of Chapter 5. Chapter 6 focuses on passivity and activity through the use of positive real functions. There are nine chapters in all, as well as six appendices covering the following topics: quadratic and Hermitian forms, residues, Routh's and Nyquist's stability criteria, and positive real functions. Index included.

**Knowlton, Kenneth C. / Sentence Parsing With a Self-Organizing Heuristic Program / Mechanical Translation Group, Research Lab. of Electronics, Mass. Inst. of Technology, Cambridge, Mass. / 1962, planographed, approx. 250 pp, limited distribution (thesis was submitted to the M.I.T. Dept. of Electrical Engineering in partial fulfillment of requirements for degree of Doctor of Philosophy)**

Self-organizing, heuristic, search procedures for automatic sentence parsing were studied, and are here reported. Other areas that can be described in the same terms that were used in this study for parsing sentences, include: the playing of games; the writing of music; the design of machines; the planning of cities. In many such problem areas, one should expect to be able to use techniques like those developed in this experimental work in the parsing of sentences.

Experiments demonstrate that: (1) a statistically-guided computer program can produce correct parsings even using a grammar involving extreme overgeneralization; and (2) that strategies applied by a computer program can be developed automatically from a "computer-learning" sequence of sentences and their correct parsings.

Five chapters include: "Automatic Parsing of Sentences," "A Statistical Approach,"

## MANUSCRIPTS

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

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

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

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

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

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

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

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

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

and "An Experiment in Parsing." Six appendices include: "General Description of the Program," "Program Flowcharts and Descriptions of Routines," and "Listing of Symbolic Coding." References included.

**Juran, J. M., editor / Quality Control Handbook / McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. / 1962, printed, 1178 pp plus 42 page index, $22.00**

Written primarily for executives, supervisors and engineers, the Second Edition of this book is a widely expanded, comprehensive treatment of the basic principles, practices, methods and techniques for organizing and managing the quality function in industry. Managerial, engineering, statistical, personnel, product and process information is here presented. The handbook is problem oriented, starting with the reader's problem and taking him to a solution. The new edition discusses recent advances such as reliability organization, programming, methods and practices. Among the new sections included in this edition are: (with respect to managerial techniques) —"Quality Policy and Objectives," and "Planning for Quality"; (with respect to engineering—"The Quality Control Manual," and "Design of the Inspection and Quality Control Work Place"; (with respect to product and process control)—"Quality Control of Assembly Operations," and "Quality Control of Administrative Processes." Thirty-six chapters. Two appendices: "Glossary of Symbols," and "Tables and Charts." Index.

**Prudhomme, R. / La Construction des Machines Automatiques / Gauthier-Villars & Cie., 55, Quai des Grands-Augustins, Paris (VI), France / 1962, printed in France, 340 pp, $9.50**

This French-language text contains a basic information for the builder of automatic machines as recommended by the Colloque International, Paris, 1961. The author is a professor at the Conservatoire National des Arts et Metiers, and assumes a professional engineer's knowledge of mathematics. Part 1 contains an introduction and a classification of automation machines. Part 2 is entitled "Les Methodes," part 3 "Les Techniques," and part 4 "Exemples de Machines Automatiques." A brief bibliography and an index is included.

**Iverson, Kenneth E. / A Programming Language / John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N. Y. / 1962, printed, 286 pp, $8.95**

The central thesis of this book is that the descriptive and analytic power of an adequate language for algorithms or programming amply repays the considerable effort required for its mastery. This thesis is developed by first presenting the entire language and then applying it in later chapters to several major topics. The areas of application are chosen for their intrinsic interest and lack of previous treatment, but are also designed to illustrate the universality of the language. Chapter 2, "Microprogramming," illustrates the divisibility of the language, i.e., the ability to treat a restricted area using only a small portion of the complete language. Chapter 6, "Sorting," shows its capacity to express a relatively complex and detailed topic in a short space. Chapter 7, "The Logical Calculus," emphasizes the formal manipulability of the language and its utility in theoretical work. References and exercises at the end of each chapter. "Summary of Notation," list of "Illustrations," and an index included.

**Sarhan, Ahmed E., and Bernard G. Greenberg, eds., and 16 authors / Contributions to Order Statistics / John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N. Y. / 1962, printed, 482 pp, $11.25**

This technical and advanced book is divided into two parts: Chapters 2 to 9 give the mathematical and theoretical foundations of order statistics, while Chapters 10 to 12 give specific applications of this theory. The contributors have presented many formulas and numerical tables of the distribution (and moment constants) of order statistics for a great variety of life distributions. The criteria required in the techniques of multiple decisions and multiple comparisons are also discussed. There is also a comprehensive study of "short-cut statistics." Included among the chapters are: "Distribution and Moments of Order Statistics," "Generalized Least-Squares Theorem," "Approximation to the Best Linear Estimates," and "Tests of Significance Using Sample Quantiles." List of tables and an extensive list of references included. Index.

**Eary, Donald F., and Gerald E. Johnson / Process Engineering for Manufacturing / Prentice-Hall, Inc., Englewood Cliffs, N. J. / 1962, printed, 760 pp, $12.00**

The development and coordination of plans for manufacturing products is the subject of this book. The book is based on the authors' years of experience as process engineers with large industrial organizations plus years of teaching this subject at General Motors Institute. The contents of this book provide the essential background for college level teaching as well as for processing in actual plant operation. The principles presented will aid the process engineer at a time when close tolerances, new materials, high production, and economic competition are prevalent. Seventeen chapters include: "The Process Engineering Function," "Preliminary Part Print Analysis," "Dimensional Analysis," "Determining the Manufacturing Sequence," and "Classification of Tooling." Numerous illustrations and data have been contributed by various manufacturers. Index.

**Westcott, J. H., editor, and 9 contributors / An Exposition of Adaptive Control / Pergamon Press, The Macmillan Co., 60 Fifth Ave., New York 11, N. Y. / 1962, printed, 134 pp, $6.50**

Contains papers read at the Symposium on Adaptive Control held at the Imperial College of Science and Technology, London, 1961. Ten papers including: "An Introduction to Adaptive Control," "Self-organizing Systems," "Extremum-seeking Regulators," "Perturbation Measurement and Control" and "Quantization." References given with each report. Brief subject index.

**Meacham, Alan D., and Van B. Thompson, editors, and 27 authors / Total Systems / American Data Processing, Inc., 2200 Book Tower, Detroit 26, Michigan / 1962, printed, 200 pp, $15.00**

This is the first work to be published in the newly created Data Processing Library Series. The book contains 20 papers dealing with the concepts, planning effort, and implementation problems of the total information system for business and government organizations. Part 1, "The Concept of Total Systems," contains 10 papers which include: "The Scope of Management Systems: Past, Present, and Future," "The Systems Approach to Effective Management." Part 2, "Planning Total Systems," contains six papers which include: "Planning Considerations"; "Systems Analysis—

A City Planning Tool." Part 3, "Implementing Total Systems" contains four papers. Part 4, "Case Histories," contains case histories of five companies engaged in the search for a total system, each using an entirely different approach. Among the companies are: Allis Chalmers Mfg. Co., Monsanto Chemical Co., and Martin-Marietta Corp. Includes an annotated bibliography of over 200 references, reprinted with permission from the Systems and Procedures Association's "An Annotated Bibliography for the Systems Professional," edited by Maurice F. Ronayne.

**35 authors, no editor / 1962 IRE International Convention Record, Part 4: Electronic Computers; Information Theory / The Institute of Radio Engineers, Inc., One East 79 St., New York 21, N. Y. / 1962, photo offset, 199 pp, $5.00 to nonmembers**

This book contains approximately 22 papers presented at the IRE International Convention, New York, N. Y., March 26-29, 1962. These were the papers presented at: (1) Session 4: "Digital Computers: Components, Circuits, and Techniques" (including "Generalized Pulse Recording," "High-Density Magnetic Head Design for Noncontact Recording, etc."); (2) Session 12: "Computers in Control and Simulation" (including "Computer-Controlled ASW Training Facility," "Digital Simulation of Pulse Doppler Track-While-Scan Radar, etc."); (3) Session 20: "Artificial Intelligence: Recent Developments in Concepts and Hardware"; and (4) Session 34: "Panel: Status Session on Information Theory"; Session 49: "Information Theory—II."

**Proceedings Fifth Natl. Power Instrumentation Symposium / Instrument Society of America, Penn-Sheraton Hotel, 530 Wm. Penn Place, Pittsburgh 19, Penna. / 1962, 140 pp, photo offset, $?**

Accomplishments and problems in the field of measurement of control are discussed in the papers presented at this symposium, which took place at Fort Worth, Texas, May 7-9, 1962. The subjects are generally divided into three major topics: Advanced Digital Systems in Use, Advanced Analog Systems in Use, and Advanced Primary Measuring Elements in Use. Sixteen papers include:: "Instruments, Control, and Imagination," "Status of Computer Control at Little Gypsy," "Huntington Beach Control System to Date," and "The Processing of Analog Signals and the Control of Noise in Digital Systems." A Registration Roster is included.

**Gort, Michael / Diversification and Integration in American Industry / Princeton Univ. Press, Princeton, N. J. / 1962, printed, 238 pp, $5.00**

This book by the Natl. Bureau of Economic Research presents a comprehensive study of the interindustry structure of the large, diversified enterprise. The author bases his statistical study on 111 of the largest companies in the country, and shows that these companies have diversified mainly into industries experiencing rapid technological change. Eight chapters, include: "Concepts and Methods," "Patterns and Trends in Diversification," "Integration," and "The Direction of Diversification." Five appendices include: "Composition of Sample of 111 Large Enterprises" and "Product Record for 111 Large Enterprises." There is also a comprehensive list of "Tables" and "Appendix Tables." A list of "Charts" is also included. Index.

# NEW PATENTS

**Raymond R. Skolnick**
**Reg. Patent Agent**
**Ford Inst. Co.**
**Div. of Sperry Rand Corp.**
**Long Island City 1, New York**

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

**December 25, 1962**

3,070,305 / Franklin C. Chiang, Palo Alto, Calif. / I.B.M. Corp., New York, N. Y., a corp. of New York / Serial Delay Line Adder.

3,070,706 / Erich Bloch, Poughkeepsie, N. Y., and Robert C. Paulsen, Boonton, N. J. / I.B.M. Corp., New York, N. Y., a corp. of New York / Magnetic Logical Circuits.

3,070,707 / Iván Paul Venn Carter, Zurich, Switzerland / I.B.M. Corp., New York, N. Y., a corp. of New York / Magnetic Driver Device

3,070,708 / Frederick H. Dill, Pleasant Valley, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of New York / Logical Circuits.

3,070,711 / Sanford M. Marcus, West Collingswood, and John Wallmark, Princeton, N. J. / Radio Corp. of America, a corp. of Delaware / Shift Register.

**January 1, 1963**

3,071,754 / Jan A. Rajchman, Princeton, N. J. / Radio Corp. of America, a corp. of Delaware / Magnetic Memory Systems Using Transfluxors.

3,071,756 / Emerson W. Pugh, Ossining, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of N. Y. / Magnetic Memory.

3,071,757 / Martin L. Levene, Philadelphia, Pa. / Radio Corp. of America, a corp. of Delaware / Data Storage Apparatus.

**January 8, 1963**

3,072,328 / Lawrence L. Bewley, Covina, and Jerry F. Foster, Arcadia, Calif. / Burroughs Corp., Detroit, Mich., a corp. of Mich. / Data Conversion System.

3,072,333 / Edward Rogal, Scituate, Mass. / Universal Controls, Inc., New York, N. Y., a corp. of Maryland / Remote Controlled Adder / Subtractor Using Coded Frequency Inputs.

3,072,747 / Frank Allen Stallworthy, Bexleyheath, and Bernard Drake, Blackheath, London, England / Associated Electrical Industries (Woolwich) Limited, a British Company / Pulse Signalling Systems.

3,072,834 / Andre H. Mottu and Robert Viret, Geneva, Switzerland / Societe Genevoise d'Instruments de Physique, Geneva, Switzerland, a corp. of Switzerland / Automatic Programming System.

3,072,891 / Jean Auricoste, Paris, France / Societe d'Electronique et d'Automatisme, Courbevoi, Seine, France / Magnetic Core Binary Counters.

3,072,892 / Wallace A. Kluck, Dallas, Tex. / Texas Instruments Inc., Dallas, Texas, a corp. of Delaware / Magnetic Core Matrices.

3,072,893 / Harrison W. Fuller, Needham Heights, Mass. / Laboratory For Electronics, Inc., Boston, Mass., a corp. of Delaware / Data Handling Techniques.

**January 15, 1963**

3,074,052 / John Percival Bunt, London, England / Elliott Brothers (London) Limited, London, England, a British company / Magnetic Core Delay Circuit For Use In Digital Computers.

3,074,056 / Eugene S. Hawkins, Orange, Calif. / International Telephone and Telegraph Corp. / System for Large-Area Display of Pictorial and Alpha-Numeric Information.

3,074,059 / David B. Flavan, Jr., 10259 St. Charles Rock Road, St. Anns, Mo. / Multi-Sequence Pulse Code Transmitter.

**January 22, 1963**

3,074,636 / George T. Baker, Charles L. Kettler, and George Philip Sarrafian, all of Dallas, Tex. / Texas Instruments Inc., Dallas, Texas, a corp. of Delaware / Digital Computer with Simultaneous Internal Data Transfer.

3,074,637 / Hermann P. Wolff, Millbrook, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of New York / Gyrator Apparatus and Method For Handling Information.

3,074,638 / Robert E. Bible, Burbank, Robert L. McIntyre, Glendale, and Donald A. Peterson, Santa Clara, Calif. / Librascope, Inc., Glendale, Calif., a corp. of Calif. / Computer.

3,074,639 / Leonard Peter Morgan, South Godstone, John Anthony Weaver, Snow Hill, Crawley Down, and Denis Brian Jarvis, Reigate, Surrey, England / North American Philips Co., Inc., New York, N. Y., a corp. of Delaware / Fast-Operating Adder Circuits.

3,074,640 / Gerals A. Maley, Poughkeepsie, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of N. Y. / Full Adder and Subtractor Using Nor Logic.

3,075,091 / Merle E. Homan, Poughkeepsie, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of New York / Data Latching Systems.

3,075,093 / William W. Boyle, La Grangeville, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of New York / Exclusive Or Circuit Using Nor Logic.

3,075,149 / Thomas G. Marshall, Jr., Skillman, N. J. / Radio Corp. of America, a corp. of Delaware / Voltage and Frequency Memory System.

3,075,175 / Norman M. Louri, Newton Centre, Mass. / Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., a corp. of Delaware / Check Number Generating Circuitry For Information Handling Apparatus.

3,075,180 / Harry T. Mortimer, 702 Gilbuck Drive, Anaheim, Calif. / Non-destructive Sensing of Magnetic Storage Elements.

3,075,181 / Takashi Ishidate, Tokyo, Japan / Nippon Electric Company Limited, Tokyo, Japan, a corp. of Japan / Address Selection System for Magnetic-Core Matrix Memory Apparatus.

3,075,183 / Bloomfield James Warman, Charlton, and William Bernard Deller, Mottingham, London, England / Associated Electrical Industries (Woolwich) Limited, a company of Great Britain / Binary Magnetic Storage Devices of the Matrix Type.

3,075,184 / Bloomfield James Warman, Charlton, and William Bernard Deller, Mottingham, London, England / Associated Electrical Industries (Woolwich) Limited, a British company / Ferrite Core Matrix Type Store Arrangements.

3,075,185 / Wijnand Johannes Schoenmakers, Eindhoven, Netherlands / North American Philips Co., Inc., New York, N. Y., a corp. of Delaware / Matrix Memory Device.

**January 29, 1963**

3,075,701 / Carl R. Wilhelmsen, Huntington Station, N. Y. / Hazeltine Research, Inc., a corp. of Illinois / Binary Adding Circuit.

3,076,179 / Ernest H. Gatzert, Rochester, N. Y. / General Dynamics Corp., Rochester, N. Y., a corp. of Delaware / Data Transmission System.

3,076,182 / Donald E. Block, Pacific Palisades, Calif. / United States of America as represented by the Secretary of the Air Force / Binary Storage Element.

**February 5, 1963**

3,076,957 / Elmer J. Hankes and John D. Firehammer, Minneapolis, and Robert F. Lambert, St. Paul, Minn. / — / Data Processing System.

3,076,958 / Arthur V. Pohm, Ames, Iowa / Sperry Rand Corporation, New York, N. Y., a corp. of Delaware / Memory Search Apparatus.

**February 12, 1963**

3,077,304 / William B. Templeton, Northville, and Martin Siegel, Livonia, Mich. / Burroughs Corp., Detroit, Mich., a corp. of Michigan / Electrical Apparatus for Multiple Factor Storage.

3,077,579 / Jack E. Greene, Vestal, Joseph M. Terlato, Bronx, and Bruce M. Updike, Endwell, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of N. Y. / Operation Checking System for Data Storage and Processing Machines.

3,077,580 / Francis O. Underwood, Vestal, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of N. Y. / Data Processing System.

3,077,581 / Robert J. Grady, Los Angeles, Calif. / The Magnavox Co., Los Angeles, Calif., a corp. of Delaware / Dynamic Information Storage Unit.

3,077,582 / Edwin W. Bauer, Poughkeepsie, N. Y. / I.B.M. Corp., New York, N. Y., a corp. of N. Y. / Magnetic Core Logical Device.

# CALENDAR OF COMING EVENTS

Apr. 16-18, 1963: Optical Masers Symposium, United Eng. Center, New York, N. Y.; contact Jerome Fox, PIB Microwave/Res. Inst., 55 Johnson St., Brooklyn 1, N. Y.

Apr. 17-19, 1963: International Conference on Non-linear Magnetics (INTERMAG), Shoreham Hotel, Washington, D. C.; contact J. J. Suozzi, BTL Labs., Allentown, Pa.

Apr. 17-19, 1963: Philco 2000 Computer Users Group (TUG) Meeting, Antlers Hotel, Colorado Springs, Colo.; contact E. D. Reilly, Jr., General Electric Co., Knolls Atomic Power Lab., Box 1072, Schenectady, N. Y.

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

Apr. 22-23, 1963: Joint Meeting of Eastern and Canadian Regions of IBM 1620 Users Group, Queen Elizabeth Hotel, Montreal, Canada; contact David Cotton, Dewey and Almy Chemical Div., W. R. Grace and Co., 62 Whittemore Ave., Cambridge, Mass.

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

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

May 2, 1963: 2nd Annual Spring Systems Seminar, Washington Chapter, International Systems and Procedures Association, International Inn, Washington, D. C.; contact J. Robert Shaw, C & P Tel. Co., 910 G St., N.W., Washington 1, D. C.

May 7-9, 1963: 1963 Electronic Components Conference, International Inn, 14th & M Sts., N.W., Washington 5, D. C.; contact J. E. Hickey, Chilton Co., Chestnut & 56th Sts., Philadelphia 39, Pa.

May 13-15, 1963: National Aerospace Electronics Conference (NAECON), Biltmore Hotel, Dayton, Ohio; contact IEEE Dayton Office, 1414 E. 3rd St., Dayton, Ohio.

May 16, 1963: Western Systems Conference, Statler-Hilton Hotel, Los Angeles, Calif.

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

May 20-22, 1963: National Symposium on Microwave Theory and Techniques, Miramar Hotel, Santa Monica, Calif.; contact Irving Kaufman, Space Tech. Labs., Inc., 1 Space Park, Redondo Beach, Calif.

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

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

June 6-7, 1963: Symposium on Banking Automation, Palmer Motor Inn, U. S. Highway No. 1, Princeton, N. J.; contact Mrs. P. V. Burghart, National Computer Analysts, Inc., Route 206 Center, Princeton, N. J.

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

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

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

June 25-28, 1963: Data Processing Management Association's 12th International Data Processing Conference and Business Exposition, Cobo Hall, Detroit, Mich.; contact DPMA Headquarters, 524 Busse Highway, Park Ridge, Ill.

June 26-27, 1963: 10th Annual Symposium on Computers and Data Processing, Elkhorn Lodge, Estes Park, Colo.; contact W. H. Eichelberger, Denver Research Institute, Univ. of Denver, Denver 10, Colo.

July 15-17, 1963: 3rd Annual Rochester Conference on Data Acquisition and Processing in Medicine and Biology, Whipple Auditorium, Univ. of Rochester Medical Center, Rochester, N. Y.; contact Kurt Enslein, 42 East Ave., Rochester 4, N. Y.

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

Aug. 4-9, 1963: International Conference and Exhibit on Aerospace Support, Sheraton-Park Hotel, Washington, D. C.; contact F. K. Nichols, Air Defense Div. Directorate of Operations, DSC/O Hdqs., USAF, Washington 25, D. C.

# ADVERTISING INDEX

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

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

Audio Devices, Inc., 444 Madison Ave., New York 17, N.Y. / Page 6 / Charles W. Hoyt Co., Inc.

Bendix Computer Div., 5630 Arbor Vitae St., Los Angeles 45, Calif. / Page 51 / John B. Shaw Co., Inc.

Harvard University Press, Cambridge, Mass. / Page 45 / Franklin Spier, Inc.

Hughes Aircraft Co., Culver City, Calif. / Page 47 / Foote, Cone & Belding

International Business Machines Corp., 590 Madison Ave., New York 22, N.Y. / Page 21 / Benton & Bowles, Inc.

Litton Industries, Inc., 5500 Canoga Ave., Woodland Hills, Calif. / Page 13 / Ellington & Co., Inc.

National Cash Register Co., Dayton 9, Ohio. / Page 19 / McCann-Erickson, Inc.

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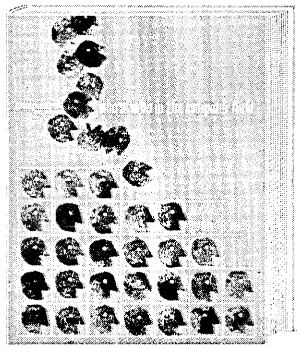

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