COMPUTERS *and* AUTOMATION

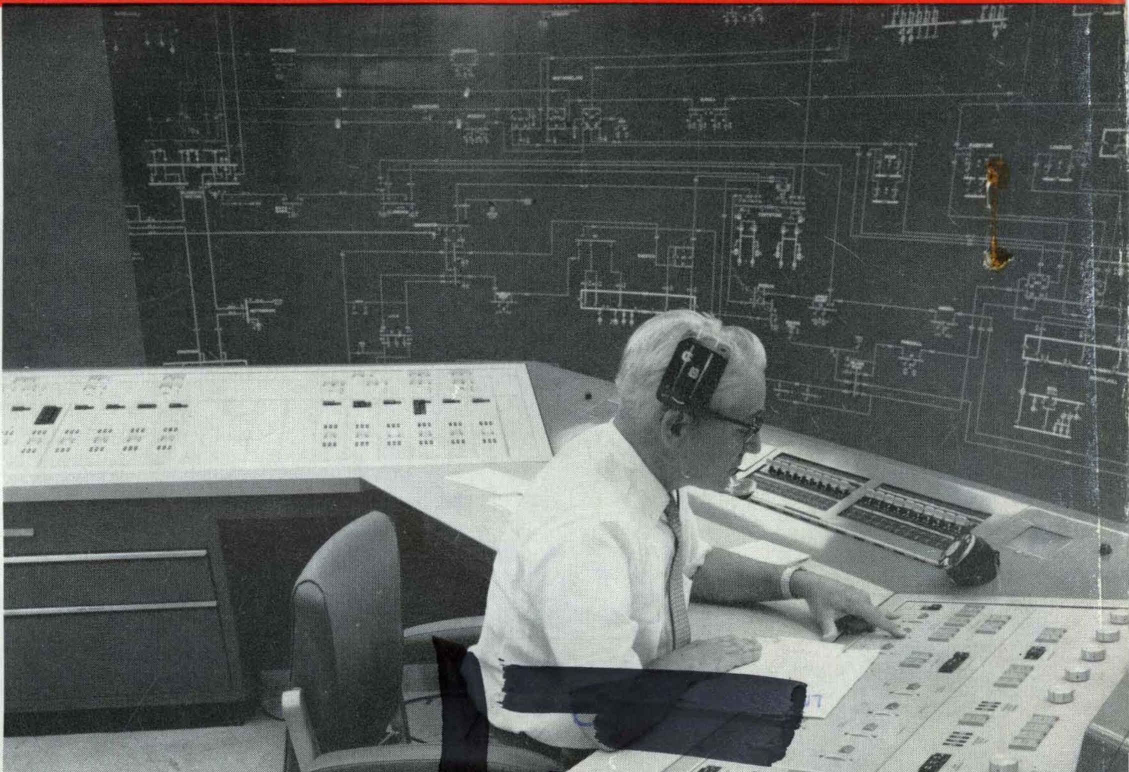
COMPUTERS AND DATA PROCESSORS, AND THEIR CONSTRUCTION, APPLICATIONS, AND IMPLICATIONS, INCLUDING AUTOMATION

SOME SIGNIFICANT NEW APPLICATIONS OF COMPUTERS

Mathematical Models of Air Traffic Control Systems

Management and Control By Exception

Automated Information-Processing Assistance For Military Systems
(Part 1)



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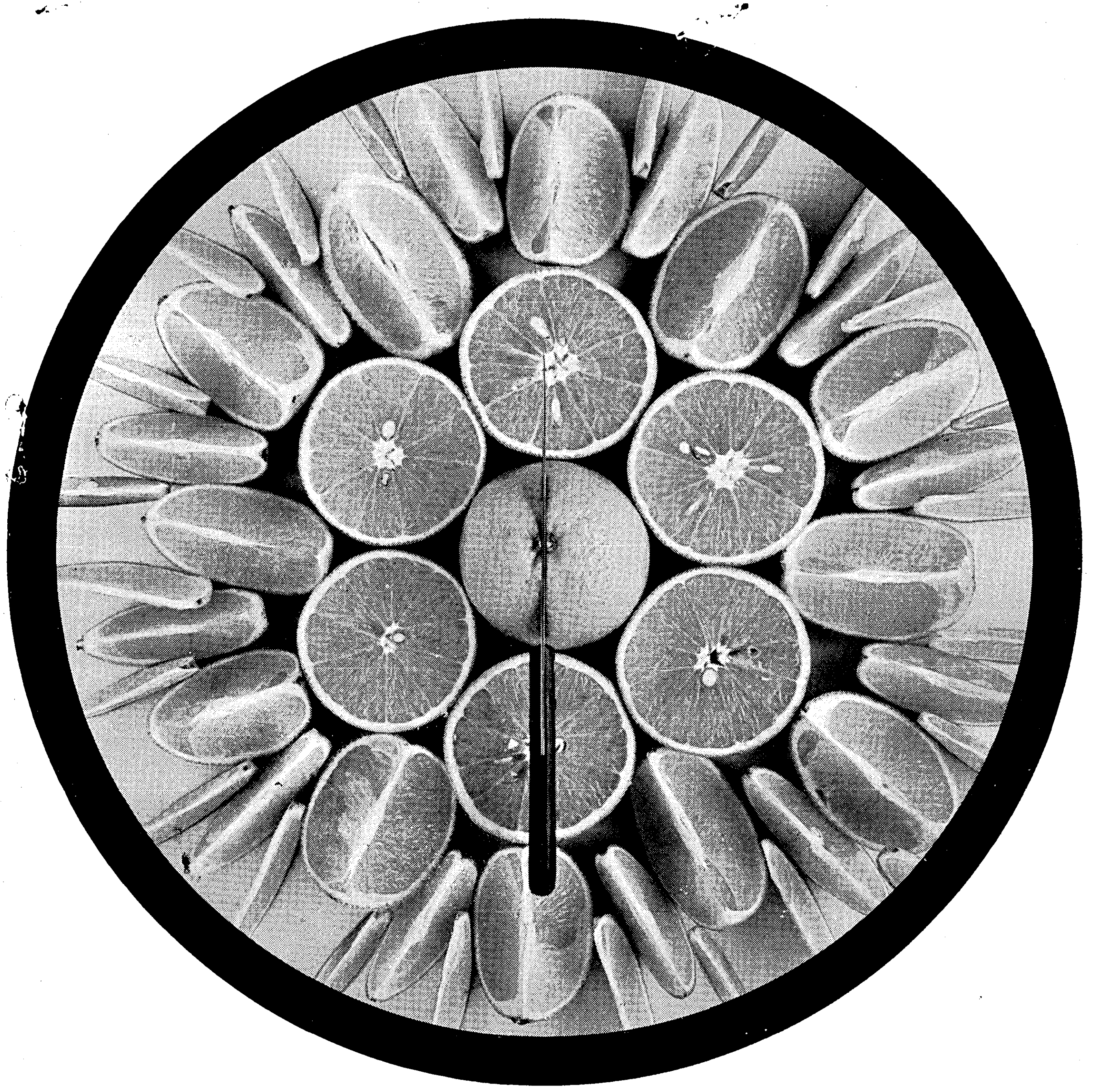

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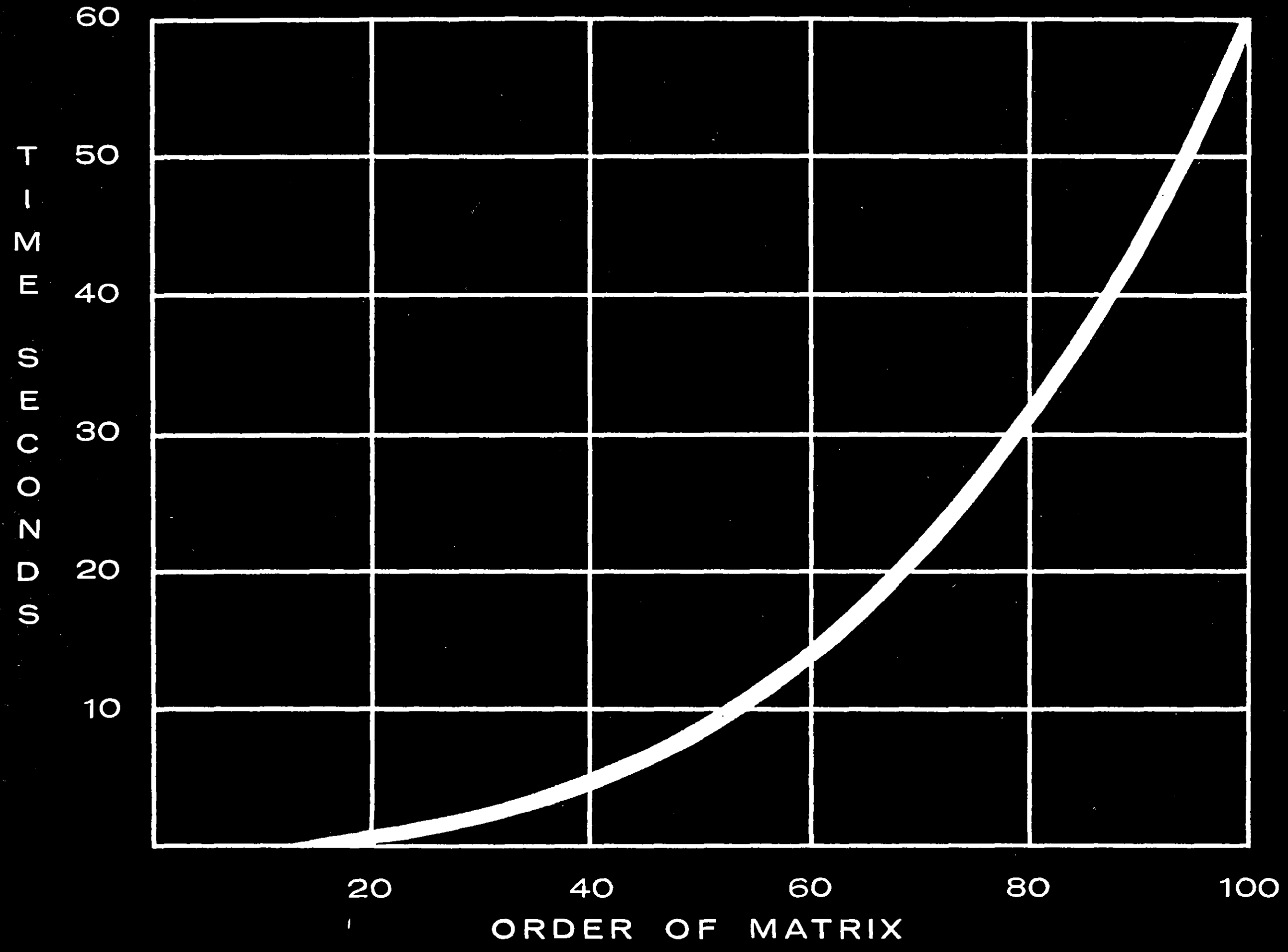

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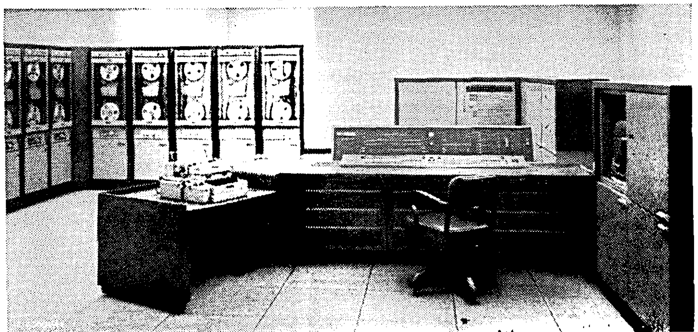

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COMPUTERS *and* AUTOMATION

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

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Number 11

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Readers' and Editor's Forum

FRONT COVER: COMPUTER CONTROL OF 34 GENERATING UNITS IN 9 PLANTS

The front cover shows a console in the Philadelphia Electric Company's dispatching office, where the firm's power director supervises operation of a computer control system. The "heart" of the system is a digital computer that tells 34 generating units in nine plants how much of the company's total electric requirements each is to produce for most economical operation. The computer-directed system is a joint development of Minneapolis-Honeywell and Philadelphia Electric. For more information, see the story on page 17.

PROFESSOR HOWARD AIKEN

In the summer of 1961, Professor Howard Aiken, Head of the Computation Laboratory, Harvard Univ., Cambridge, Mass., became professor emeritus. A surprise party in his honor was given in Boston on October 6, attended by over 120 of his students, alumni, disciples, and friends; and he was presented with a model in silver of the Harvard IBM Automatic Sequence Controlled Calculator (Mark I) which began operating in 1944, the first automatic digital computer. Your editor, while in the Navy, was fortunate in being stationed at the Harvard Computation Laboratory, August, 1945 to May, 1946, doing work on computers under Professor Aiken's direction.

Following are the substance of the remarks by Mr. Charles A. Coolidge, acting president of Harvard University:

I find it a pleasant duty to say a few words on this occasion. It is pleasant because I have both an official and personal interest in honoring Professor Aiken. My official interest is as Acting President of Harvard. My personal interest is because my son worked for Professor Aiken and, with his stimulation and help, got a Ph.D. in Applied Science and Electronics.

Looking at Professor Aiken's career since the time of the first computer, one cannot help being impressed with its breadth. It covers three major fields:

First, the technical side—the original thinking necessary to produce the concept underlying the modern automatic sequence-controlled computer. And the tough engineering feat of actually constructing computers and of so designing their components as to produce a high degree of reliability.

Second, Professor Aiken has not been "dog in the manger" with his ideas. He has not guarded them against industry, in order to enhance his own prestige or even the prestige of Harvard. On the contrary, he has encouraged pioneering efforts by industrial engineers, which have led to opening up entirely new areas in the field of non-numerical data processing.

Last, but not least, Professor Aiken has been an inspiring teacher. He has not only been an inspiration to regular Harvard engineering students but also to students and scholars from all over the world.

I am sure I do not have to tell this audience of the ever-increasing importance of computers in almost every facet of our complex civilization. But I detect, or think I detect, one development which is interesting and, to me, entertaining. I happen to be a Trustee of The MITRE Corporation, which was formed as a spin-off of MIT's Lincoln Laboratory, to back-stop the Air Force in developing the SAGE system.

Both in its original SAGE work and its present principal assignment of designing command and control systems, computers play a very important part in MITRE's operations. (I still do not understand how the modern computers work—incidentally, I have found that they don't always work—but I have noticed that those who work with computers a lot seem to regard them as having a personality—like a ship, only more so.)

As recently as three weeks ago I was out at Santa Monica looking over the activities of System Development Corporation, which, as you know, is extremely skillful at setting up computer programs. They have a Research Department, and one of their researchers gave us an account of their progress in teaching computers to think—to play such games as checkers (hopefully chess some day) and moving hoops from one stick to another in the minimum number of moves, and to discriminate between different pictures in comic strips. In a few cases the computer has already done better at games than its instructor.

This kind of achievement suggests to me that we can truthfully say that the brain child of Professor Aiken was indeed a child and is now growing up.

And now I come to the pleasant ending of my layman's remarks, which is the presentation to Professor Aiken of a model of Mark I.

I present this to you, Professor Aiken, on behalf of your friends and admirers, many of whom are here tonight. May you enjoy it as evidence of their friendship and admiration, and of their good wishes for your future!

CONTINUING DISCUSSION OF SOCIAL RESPONSIBILITIES OF COMPUTER PEOPLE: COUNTERBALANCING EFFORTS

I. From Milton H. Aronson

Pittsburgh 1, Pa.

To the Editor:

Mr. Hinman, in your September 1961 issue, joins your discussion of the social responsibility of scientists with a rather complete catalog of all the accepted reasons why the United States ought to devote its primary energies (especially technically traned men) to preparation for nuclear war.

Mr. Hinman should realize that his list of reasons, if the result of his own conclusions, happen to be the reasons drummed into every citizen by the minute,

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the hour, the day, by all media of mass communication. Mr. Hinman's reasons may be valid—but they are not very original.

Secondly, the clue to Mr. Hinman's entire position—the position of our media of mass communication today—is his statement, "Nothing short of their (the 'enemy's') destruction will prevent it (our destruction)." This is the inevitable result of believing that the "enemy" is an amoral bloodthirsty animal. History shows that this is the position taken by every propagandist who ever set out to arouse human beings to the state of hate necessary to kill other human beings.

Mr. Hinman says, "I don't need to be told, sir, what my social responsibilities ought to be." But I think he has been told, because few human beings would permit themselves to be used in preparing weapons of mass destruction without being "told."

What Mr. Hinman fails to realize is that nuclear weapons destroy completely *innocent* human beings (infants, children, aged, maimed, ill, derelict, etc.) in such vast numbers that the user of the weapon is hardly any longer a human being (or, if he is one, a human being without a conscience, like the Nazi death camp commanders). Can nations, as well as individuals, lose their conscience? Perhaps this happened at Hiroshima and Nagasaki—if so, all we see now is the inevitable result.

Social responsibility is an individual decision. Here is mine: I consider every action and effort made to produce nuclear and other weapons of mass destruction to be anti-social and inhumane. If such weapons are needed at all, for reasons of self-protection, they should be counterbalanced at all times by at least an equal effort to help the intended victims. For example, if we spend $40 billion in 1962 for weapons of mass destruction, then we should also spend at least $40 billion to help any possible victims—before their victimization. If this means doubling my income tax, I approve. In the case of an individual technical worker, if x hours per week are being spent on weapons manufacture, then the same number x of hours per week should be spent in helping the possible victims. Only in this way can the perpetrator of an eventual nuclear outrage retain his conscience and his social responsibility. A case can be argued that these "counterbalancing" efforts will save his life and heritage far more surely than his weapons.

Mr. Hinman says, "This is a war for men's minds." And so it is. But the United States today is alienating men's minds by marshalling its national efforts for uncivilized nuclear war. Our way of life is in my opinion by far the best produced by civilization to date. But all mankind would come to see this much more quickly if we devoted at least as much national effort to helping other nations as we now devote to preparing their destruction.

This concept of "counterbalancing effort"—doing as much good as harm to an enemy—has been stated much better in the nowadays strange-sounding words "Love Thine Enemy."

II. From the Editor

The grooves of ordinary everyday thinking often fail to make clear the great variety of different kinds of possible alternatives in working out solutions to questions.

In other words, there are more ways for getting to the other side of a mountain than digging a hole straight through.

How did the people of India get the British out of India? By the methods of nonviolence pioneered by Mahatma Gandhi.

How did the Dutch save the family of Ann Frank in a warehouse garret in Amsterdam for 2 and ½ years while Holland was occupied by the Nazis? By secret, careful, and astute resistance, defeated in the end only by an informer, a stoolpigeon.

How can the people of America help persuade the people of Laos not to adopt a Communist government? By pouring in money and corrupting everyone in sight? (See "A Nation of Sheep"* by William J. Lederer, author of "The Ugly American" and formerly a Captain in the U. S. Navy.)

One quote: ". . . Officials are direct reflections of you and me. If we are ignorant and apathetic, then our government also is ignorant and apathetic."

Imagine a computer scientist engaged 40 hours a week, say, in programming the evaluation of weapons systems. How can he contribute to arms control, and disarmament, the avoidance of nuclear death for hundreds of millions of human beings? He can't put in 40 hours a week of counterbalancing effort—for there are hardly enough hours in the week for that. But can't he put in 15 hours, or 10 hours, or 5 hours, or 3 hours a week—finding out what are the facts, writing letters to newspaper editors and congressmen, working with similar-minded computer people—to avoid the deadly result of what Lewis Mumford has called "The Morals of Extermination"?

* Published by W. W. Norton & Co., Inc., New York, 1961, 194 pp.

COMMENTS ON "THE DEHUMANIZING EFFECTS OF THE COMPUTER"

by Albert Baylis in the August Issue

I. From H. R. J. Grosch

New York 22, N. Y.

Dear Ed:

Please publish the following remarks in your next "Readers' and Editor's Forum"—and no censorship, old boy!

COMMENTS ON
"DR. LOUIS V. RIDENOUR'S PROTESTS"

To the Editor:

That really tears it, Ed! Here I bled all over fifty states and ships at sea, courtesy of the Associated Press, and that needlenoggin Baylis gives the credit to a Black Hat!

Albert boy, the guy that popped off about "the swansong of a dying civilization" at that Cal Tech meeting two and a half years ago was *me.* And I didn't have a hemorrhage afterwards, although my then employers sure did: what I got, if I may coin an expression, was vocational quadriplegia!

Seriously, what happened was this: Ridenour gave a cynical, even contemptuous, prepared speech about the missile race as a perfect exemplar of wasteful,

(Please Turn to Page 16)

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06050  J  06068 U          06141  ,  12043
06057  A  12050 12046      06147  ?  12012 12047
06068  ⌑  12040            06158  S  12022 12047
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Mathematical Models of Air Traffic Control Systems

Peter Kugel
Technical Operations
Burlington, Mass.

As systems get larger and more complex, the job of analyzing them gets increasingly difficult. A satisfactory analysis usually requires a mathematical model which is far beyond the means of the unaided human calculator. In such cases, only the use of high speed digital computers makes an analysis possible.

An example is the air traffic control system. In the August issue of COMPUTERS AND AUTOMATION, Karl E. Korn[1] commented, quite correctly, on the utility of computers in such applications. Unfortunately, he also proposed a particular type of model which, although it appears eminently sensible, realistic and natural, is highly defective. In this article I want to consider the defects of this type of model and to propose an alternative which appears preferable.

Time-Sequenced Models

The model that was proposed is of a kind which we shall call "time-sequenced." According to this scheme, the status, at some initial time, of the system being modelled is given to the computer to start with. The computer contains a series of instructions (a program) which allow it to calculate the status of the system at some time $T + \Delta$ from the status of time T (where T is any time). Thus, for example, if at a time T in the system, a certain 707 jet is over Topeka, travelling north at 400 miles an hour and the wind is blowing south at 100 miles an hour, the computer calculates its position at $T + 2$ minutes as ten miles north of Topeka $((400 - 100) \times 2/60)$. Using calculations of this sort (though probably of somewhat greater complexity), the computer can produce a series of "pictures" of the situation in the airspace every two minutes. (For our example we are letting $\Delta = 2$ minutes, but we could have picked any value.) Starting at the given initial time, it keeps adding 2 minute increments and computing "pictures" until the model reaches a predetermined stopping time. Such a series of "snapshots" is a "movie" of what would happen in the real world. From such "movies," produced by running the model for a period of time under the conditions being analyzed, we can predict the effect of the conditions on the system. We can answer such questions as: How many conflicts could adding a certain piece of equipment avoid? How much would increasing the separation between airplanes increase average flying time? What will the existing system be like in 1975 if we assume that the amount of traffic will have doubled by then? We do this by looking at the "movie" produced by the computer. How can such an eminently reasonable scheme be criticized? Is it not the most accurate way to "model" the real world?

Certainly the aim of this scheme is perfectly sound. The ability to analyze the system's safety and efficiency under varying conditions is important, and a computer model is, indeed, the best way to perform such analyses. However, time-sequenced models are far from being the best kind of computer model for the purpose.

Purpose of Models

To understand how this could be, one must keep in mind the purpose for which the model is intended. Contrary to what one might intuitively expect, realism is seldom, if ever, the main purpose of a mathematical model. In this case, the purpose of the model is to test system design concepts, and this is not best done by slavishly imitating reality. (To test the strength of an airplane wing one may load it down with sandbags. This may be a far more efficient test than actually trying to land an airplane, but nobody is going to claim that it is more realistic. Airplane wings are not intended for carrying sandbags.)

Imitation in Relevant Aspects

What is wanted, in general, is not an imitation of the system being modelled but an imitation of the system in relevant respects. But this does not mean in every respect. Indeed, the desire to model a system in *every* respect often conflicts with the ability to model it in some *relevant* respect. Thus, for example, early in the twentieth century people spent considerable effort trying to imitate birds when all they were interested in was imitating them in one relevant respect—flying. The most favored scheme at that time was to imitate them in as many respects as possible. People built huge wings which they then flapped, and some even went so far as to glue feathers to them. The Wright Brothers, on the other hand, used fixed wings (without feathers) and as a result ended up in a scheme that imitated birds in very few respects. But one of these was the one that counted; the Wright Brothers' craft could fly.

In the field of mathematical modelling there are also schemes which are like the fixed wing approach to flying or the sandbag approach to wing testing in that they imitate reality badly in most respects, but extraordinarily well in the respects which count. These schemes frequently upset the intuition of the layman who is interested in realistic tests, but they have one rather striking advantage over time-sequenced models: they do the job for which they are intended. Such models are called "event models" and it is the purpose of this paper to describe the general nature of such models and to cite their major advantages.

Inadequacy of Time-Sequenced Models

Before describing these models, however, let us briefly consider some of the reasons why time-sequenced models are unsuitable for most purposes. There are at least three defects in such models: they are unwieldy, they are inaccurate, and they are unusable. Let us consider these points individually.

(1) Time-Sequenced Models Are Unwieldy

We began by remarking on the incredibly high speed of the contemporary computer. It can perform a single operation in an amazingly short period of time, but no computer has yet been designed to do an operation in no time at all. If one gives a computer enough individual operations to perform for a single problem, these short periods add up. This occurs at an astounding rate with time-sequenced models. At each time step the computer must determine the position of each plane, the direction and velocity of wind at the location of each plane, and the like. Each plane requires hundreds of calculations, and there may be hundreds of planes. And, of course, there are other elements in the system.

It has been estimated that a time-sequenced model of an air traffic control system with 50 planes would run at ⅓ real time, and the model would have to be quite limited in scope to run even that fast. A model which runs at ⅓ real time would take three days to duplicate, or model, a day's traffic. This is not bad, but of course, a system which works successfully for one day is not necessarily adequate. A good deal more testing would be required before one could consider a system acceptable. (After all, an error here can cost human lives.) Such testing could take months of computer time. The cost and difficulty of such testing might well suggest that this was not the ideal method for analyzing air traffic control systems. However, one might argue that the results are worthwhile since saving lives is worthwhile, that any other method for testing such systems is more expensive, and that this model gives us such accurate results.

(2) . . . and Inaccurate

A time-sequenced model gives us an accurate "fix" on every plane at every moment, or so it would appear. Unfortunately, there are two flies in this ointment. One lies in the word "accurate" and the other in the phrase "every moment."

There is the problem, for example, of determining accurate input data for our model. We know the speeds of planes involved, but (although it might be nice if we did) we do not know the speeds of winds, and other weather information. (It is unfortunate that weather is generally not well known at any one time at any one place outside of weather reporting stations.) We could, of course, guess at the weather. We could make some pretty reasonable estimates and this would probably be all right—errors in one place would be counter-balanced by errors in another. But the lack of inputs with sufficient detail makes one wonder. The model gives us results which are terribly accurate—indeed more accurate than the inputs. We guessed at the speed of winds, but the positions of the airplanes which result from these winds is given exactly, and stored in the computer in all its gory detail. Is this not much like the work of a high-school physics student who (working on a simpler mathematical model), when given some data to two places, produces a result to fifteen places? (There is one difference: the physics student is only wasting his *own* time.)

A second difficulty is that we know the positions of planes only at fixed points in time. Time-sequenced models are particularly deficient when it comes to modelling events which occur at regular intervals or which require a fixed amount of time and are then repeated. If, for example, an airplane is holding in a large circular pattern which takes five minutes per complete circuit, and the model by chance, also happens to operate on a five minute time interval, then the plane will (to the model) appear to be standing still. This may strike the model as the ideal holding pattern since it occupies such a small amount of the airspace. If other holding patterns interfere with it, the model will continue in ignorance of the fact.

Even where events are not cyclical, or where the time interval of the model is regularly varied to overcome this difficulty, the possibility still arises that planes may interfere with each other (or even collide) between intervals. The computer model will not make us aware of this fact.

We have spent months of expensive computer time getting data which is inaccurate (in spite of the apparent realism of the model). Fortunately, however, there is one good point: the results of the model, inaccurate as they may be, probably will not lead us to any incorrect decisions. The reason for this is that:

(3) The Results Are Unusable

What are the results the model gives us? Whenever the model increments the time, it gives us a "snapshot." This is a very informative thing. It tells us where every plane is at that moment, what is going on at the air traffic control centers at that moment, and the like. There are thousands of these snapshots. What are we supposed to do with them?

We might be interested in seeing whether two planes ever got within, say, 50 miles of each other. To figure this out we would have to take the locations of each of the planes in a given snapshot and compare it to that of each of the others; this would involve more than 1200 comparisons (49 + 48 . . . . +1) per snapshot, and this suggests another computer program to process this cinerama of the airways. By the time we are through analyzing results the system being analyzed may well be obsolete.

Event Models

Fortunately, there is a more efficient, more useful, and more accurate way of modelling real world situations on a computer. This method, however, is strikingly unnatural; as unnatural, indeed, as the fixed wing plane itself. We call such models "event models." Event models do not keep track of what is going on at every moment. They keep track only of the important things that happen (which we call "events"). They leave out the things that don't count. They do not record when the pilot has a cup of coffee (neither does the time-sequenced model) nor do they record the position of a plane when it is in a place where it could not possibly interfere with another.

How can the computer tell what things are and are not events? That is, how can it tell what is and what is not important?

In an event model of an air traffic control system there are airlanes, control facilities, and airplanes. Let's call all of these the "equipment." An event occurs whenever a piece of equipment either enters or

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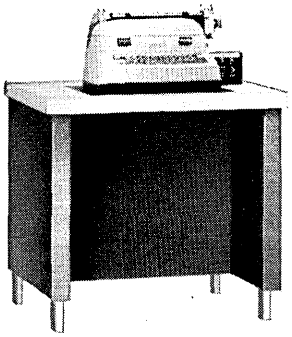

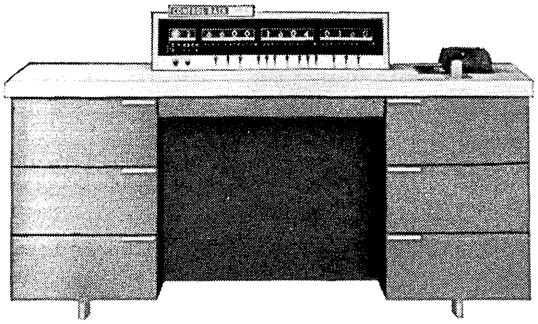

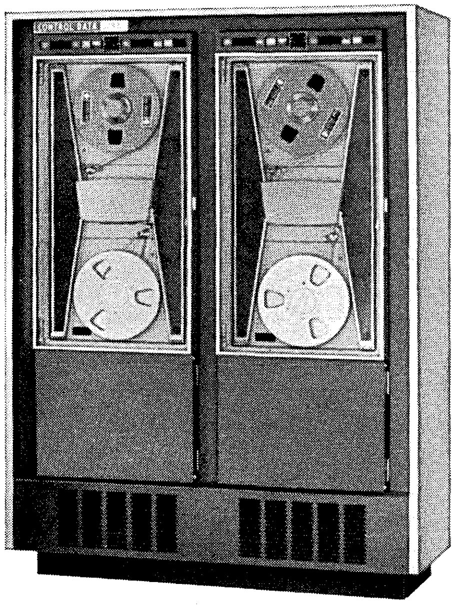

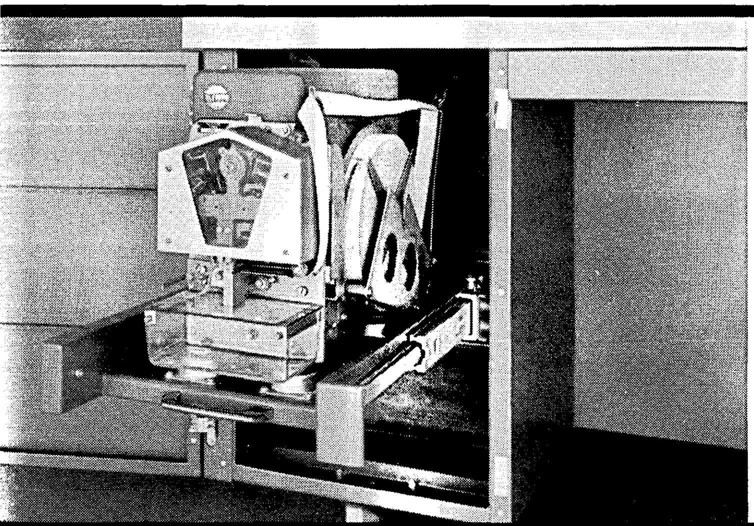

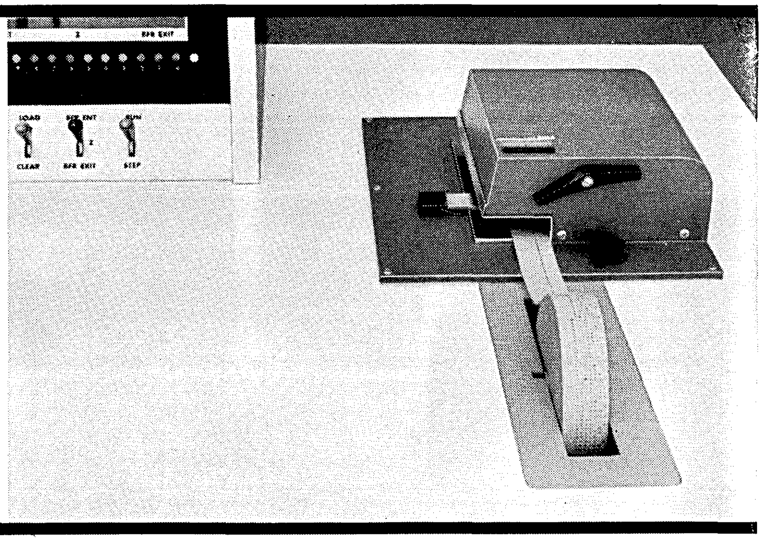

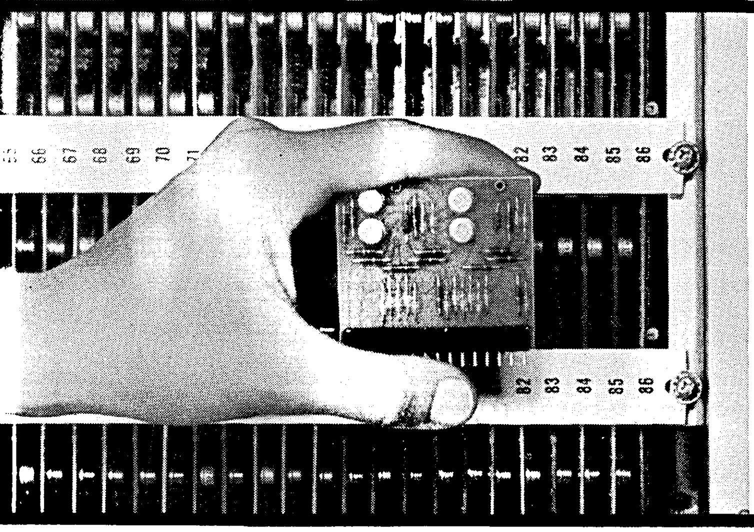

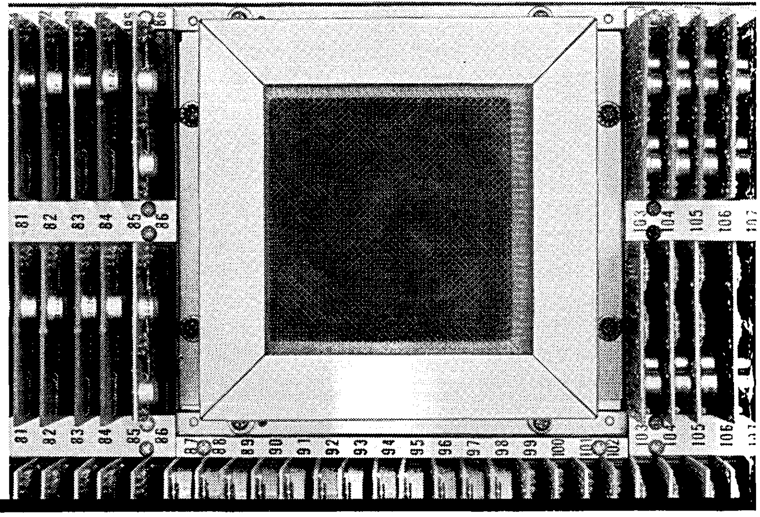

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160-A COMPUTER

SMALL-SCALE COMPUTER WITH LARGE COMPUTER CAPABILITIES

The 160-A is a parallel, single address data processor. Basic memory consists of two banks of magnetic core storage, each with a capacity of 4096 words and a **storage cycle time of 6.4 microseconds.** This basic memory can be expanded in modules of 8192 words up to a maximum of 32,768 words. Instructions with 12-bit operands are executed in one to four storage cycles, with execution time varying between 6.4 and 25.6 microseconds. Average program execution time is approximately 15 microseconds per instruction.

Other features of the 160-A Computer include:

- **Buffered** input/output
- Internal and external **interrupt**
- External **multiply and divide unit**
- Control Data 350 Paper Tape Reader
- 110-character/second paper tape punch

The 160-A weighs 810 pounds and is 61⅝″ long by 30″ wide by 29″ high . . . the size of an ordinary office desk. It requires 16 amps, 110 volt, 60 cycles.

A basic 160-A Computer System can be expanded to include the following external equipment:

- Up to 40 magnetic tape handlers
- Input/output typewriters
- Punched card readers and punches
- Low-speed line printers (150 lines/minute)
- High-speed line printers (1000 lines/minute)
- Plotting and digital display devices
- Analog-to-digital and digital-to-analog converters

TYPICAL APPLICATION AREAS FOR THE 160-A COMPUTER

The 160-A is a general purpose computer and can be used in an almost unlimited number of applications including:

REAL-TIME APPLICATIONS

The 160-A exchanges data with input-output devices at any rate up to 70,000 words per second. This transfer rate, an average instruction execution time of 15 microseconds, and the capability of buffering data while computing or while the operator manually enters data (whether the computer program is running or stopped) make the 160-A ideal for real-time applications.

OFF-LINE DATA CONVERSION

The 160-A is capable of controlling a variety of off-line peripheral equipment. Available service routines permit: 1) card-to-magnetic tape, 2) magnetic tape-to-card, 3) paper tape-to-magnetic tape, 4) magnetic tape-to-paper tape, 5) magnetic tape-to-printer, and 6) plotter output operations.

COMMERCIAL DATA PROCESSING

Along with the capability of buffering input-output devices, the 160-A Computer system includes accessories for reading 1300 cards per minute, printing 1000 lines per minute, or filing 30,000 characters per second.

DATA ACQUISITION AND REDUCTION

The input-output circuitry in the 160-A Computer permits direct communication with analog-to-digital conversion equipment. Following transmission, the data can be converted, reduced, or formated by a stored program and written on magnetic tape for later analysis if desired.

ENGINEERING-SCIENTIFIC PROBLEM SOLVING

The high-speed, buffering, and interrupt features of the 160-A make it exceptionally useful in engineering-scientific applications.

COMMUNICATIONS AND TELEMETERING SYSTEMS

The 160-A Computer, used as a high-speed, parallel processor with decision-making powers, can be the principle element in communication and control networks. Proven reliability of the 160-A is a prerequisite for such application.

CONTROL DATA SATELLITE COMPUTER SYSTEM

The desk-size 160-A Computer is an integral part of the Control Data Satellite Computer System. Working with the large-scale 1604 Computer and the 1607 Magnetic Tape Sub-System, the 160-A presents a new dimension of computer power added to its own speed and versatility.

The Control Data 160-A is a small-scale computer with the speed, capability, and flexibility of many large-scale computers. For more detailed information, write for the **160-A Programming Manual.**

CONTROL DATA
CORPORATION

COMPUTER DIVISION
501 PARK AVENUE, MINNEAPOLIS 15, MINNESOTA

leaves another piece of equipment. When a plane leaves a given airlane, this is an event. When it talks to a control center on its radio, it occupies both its own radio and that of the control center and this is an event which occupies two pieces of equipment for a period of time. When a plane from outside enters the control area, this is an event. Events generate other events, and these are the main things that our model looks at. It keeps two kinds of records of events; one based on when they are to occur (or have occurred) and the other in terms of the pieces of equipment being occupied by the events.

The Event Queue

We call the list of events waiting to occur (and arranged in order of increasing lateness of occurrence) the "event queue." Events are handled as they come along in the event queue. When an event's turn comes, there are several things which may happen. If the pieces of equipment required for that event are not available, the event is postponed until that equipment becomes available. (That is, the same event is re-entered into the event queue, but at a later time.) Since, unlike the people in the real world, the computer knows how long the events occupying the equipment, at any time, will take, it can easily compute the time at which to have the postponed event occur. On the other hand, if the equipment required is free, then the event occurs. It occupies the equipment called for a certain period of time, and two new events may be produced: the release of the equipment being used, and the release of the equipment doing the using. Finally, there is a third possibility which will occur if the event has a high priority (an airplane that has run out of fuel, for example, and must land immediately). In this case it is possible that the equipment required may be seized by the event, even if it is currently being used by another event.

Example of Two Jet Planes

Consider the following simplified situation. (Any resemblance between this situation and any situation living or dead, is purely coincidental. Only the principles illustrated are real.) Suppose we have a 707 jet entering an airlane from Casper, Wyoming, to Salt Lake City, Utah, at 3:00. When it began its trip, it filed a "flight plan" with the air traffic control system. This plan listed all the points where this plane planned to be and the times at which it planned to be there. According to the flight plan, arrival at Salt Lake City was predicted at 3:40.

Meanwhile another jet, an 880 this time, is coming in from Denver, Colo., and it expects to get to Salt Lake City at 3:45. Let us suppose that since they are five minutes apart, in the particular system we are testing they will be allowed to occupy the same airlane in continuing on from Salt Lake City.

The time-sequenced model, grinding away at two minute intervals, will compute 22 places where this plane will be (we are going to slow the 707 up so that it arrives five minutes late) in between. We are not so accurate. We know by looking at the record that this particular airlane usually takes forty minutes for a 707 to traverse. How long will it take this time? The time-sequenced model will guess at wind velocities, temperatures (icing on the wings may slow things down), visibility, and the like.

We, too, will guess at the time it takes for our 707 to get to Salt Lake City, but we will do so on the basis of information that is available so that our guess will be more realistic and we will do so a great deal faster. The information we will use will be a history of 707's in that airlane (or if it does not yet exist, statisticians know how to predict such histories). We will find that a certain number take forty minutes, a smaller number take 39, and 41, a still smaller number will take 38 and 42, and so forth. We now do the equivalent (on a computer) of placing one piece of paper into a hat for each plane in this history and picking one of these at random. Our odds are greater for picking a more common speed, but our selections will be distributed over the faster and slower speeds, too. This uses all the data that is actually available, it is quick, and it is as accurate as the available data allows. There is an additional advantage to this scheme in that if we want to test the system under really adverse conditions we might throw the more average speeds out of the hat, and have all planes arrive either too soon or too late. Let us say that both the time-sequenced model and our model pick a flying time of 45 minutes. Our plane which is due to arrive at 3:40 will now arrive at the same time as that anticipated for the one from Denver, due at 3:45, and it is the job of the control system to make sure that they don't enter the same airlane.

The time-sequenced model will compute 22 wind velocities, 22 temperatures, 22 visibilities, and compute 22 locations. Our model will generate a single event: the arrival of the 707 at Salt Lake City at 3:45, and place this on a list for consideration when the time on the model is 3:45.

Let us also assume that the 880 gets to Salt Lake City one minute ahead of schedule. It radios its position to the control center at Salt Lake City, which, observing that there is a plane which is supposed to go first in the desired airlane, tells the 880 to wait. (This is the control scheme we are testing: not first-in/first-out, but first-scheduled-to-arrive/first-out.) A minute later the 707 arrives, and is given the airlane. But a plane has been delayed and this is a black mark against the system. Another black mark might be the fact that both planes, over Salt Lake City were at the same altitude at the same place at the same time. Our system notes both these facts, but the time-sequenced modeller has some difficulties. At 3:45, when these planes were at the same spot at the same time, is not one of his time gaps. He got no "snapshot" of this. His "snapshots" show the 707 before Salt Lake City and after Salt Lake City, but not at Salt Lake City. He notes the delay, but not the possible collision.

In the event model we do not know where the plane was at 3:02, at 3:04 and so forth. Neither does the time-sequenced modeller, of course, but his model has made an educated guess. Where things count, however, it has fouled up.

Appraisal of the Event Model

Haven't we missed some important things, too? What, for example, if two planes are in the same airlane and one catches up to the other. This is between events, and it does not seem as if our model could catch it. But, of course, it would be noting that the order in which two planes left the airlane was the opposite of the order they entered it, or that they left it too close together.

We have missed a number of other things, but these are precisely the things that do not count (if they did, we would fit them in among the class of events). There are several other things to be noticed about this model:

1. It is no more accurate than the input data which is readily (or even conceivably) available. We did not devote a lot of effort at guessing things we could not reasonably guess, and which made no difference in the end.
2. As a result, our model is not only faster to run, but considerably easier to program for a computer.
3. Since our model is inexpensive to run, it allows considerable experimentation and repetition of experiments to prove that a single success is not just a matter of luck.
4. It also allows us to control experiments more easily by allowing us to make things harder (or easier) for the system.
5. Our model is not realistic, but realism is a means toward an end and not an end in itself. As with any satisfactory analytic tool, the emphasis in our model was not on realism but on the validity of the result.
6. Not only does the event model produce more valid results but it produces them in a form which is far closer to what we want than is the TV spectacular produced by the time-sequenced model. Those who like computer programs with mounds of output will find this a disadvantage. Those, on the other hand, who are interested in getting the job done (and done not only well but at reasonable cost) will find it fortunate.

Footnote

1. Korn, Karl E., "Analytic Testing In Air Traffic Control Systems," **Computers and Automation,** August, 1961.

CALENDAR OF COMING EVENTS

Nov. 6-8, 1961: American Documentation Institute Annual Convention, Hotel Somerset, Boston, Mass., and Kresge Auditorium, M.I.T., Cambridge, Mass.; contact P. D. Vachon, Literature Physicist, Melpar, Inc., Applied Science Div., 11 Galen St., Watertown 72, Mass.

Nov. 14-16, 1961: NEREM (Northeast Research and Engineering Meeting), Somerset Hotel & Commonwealth Armory, Boston, Mass.; contact F. K. Willenbrock, Pierce Hall, Harvard Univ., Cambridge 38, Mass.

Dec. 12-14, 1961: Eastern Joint Computer Conference, Sheraton Park Hotel, Washington, D. C.; contact Jack Moshman, C-E-I-R, Inc., 1200 Jefferson Davis Highway, Arlington 2, Va.

Dec. 14-16, 1961: Forum on Legal Questions Raised by Computer Use in Business, Industry, and Government, sponsored by Joint Committee on Continuing Legal Education of the American Law Institute and American Bar Association, Statler-Hilton Hotel, Los Angeles, Calif.; contact John E. Mulder, Esq., Director, The Joint Committee, 133 So. 36 St., Philadelphia 4, Pa.

Jan. 15-17, 1962: Symposium on Optical Character Recognition, Dept. of the Interior Auditorium, C St. between 18th and 19th St., N.W., Washington, D. C.; contact Miss Josephine Leno, Code 430A, Office of Naval Research, Washington 25, D. C.

Feb. 6-7, 1962: Symposium on Redundancy Techniques for Computing Systems, Dept. of the Interior Auditorium, C St. between 18th and 19th St., N.W., Washington, D. C.; contact Miss Josephine Leno, Code 430A, Office of Naval Research, Washington 25, D. C.

Feb. 7-9, 1962: 3rd Winter Convention on Military Electronics, Ambassador Hotel, Los Angeles, Calif.; contact IRE Los Angeles Office, 1435 So. La Cienega Blvd., Los Angeles, Calif.

Feb. 14-16, 1962: International Solid State Circuits Conference, Sheraton Hotel & Univ. of Pa., Philadelphia, Pa.; contact Richard B. Adler, Rm. C-237, MIT Lincoln Lab., Lexington, Mass.

Feb. 27, 28-Mar. 1, 1962: Symposium on the Application of Switching Theory in Space Technology, Lockheed Missiles and Space Co., 1123 No. Mathilda Ave., Sunnyvale, Calif.; contact Kenneth T. Larkin, Lockheed Missiles & Space Co., Sunnyvale, Calif.

Mar. 26-29, 1962: IRE International Convention, Coliseum & Waldorf-Astoria Hotel, New York, N. Y.; contact E. K. Gannett, IRE Headquarters, 1 E. 79 St., New York 21, N. Y.

April, 1962: SWIRECO (S. W. IRE Conference & Elec. Show), Rice Hotel, Houston, Tex.; contact R. J. Loofbourrow, Texaco Co., P.O. Box 425, Bellaire 101, Tex.

April 11-13, 1962: SWIRECO (S. W. IRE Conference and Electronics Show), Rice Hotel, Houston, Tex.; contact Prof. Martin Graham, Rice Univ. Computer Project, Houston 1, Tex.

May 1-3, 1962: Spring Joint Computer Conference, Fairmont Hotel, San Francisco, Calif.; contact Richard I. Tanaka, Lockheed Missile & Space Div., Dept. 58-51, Palo Alto, Calif.

June 27-29, 1962: Joint Automatic Control Conference, New York Univ., New York, N. Y.; contact Dr. H. J. Hornfeck, Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio.

Aug. 21-24, 1962: WESCON (Western Electronics Show and Conference), Los Angeles, Calif.; contact WESCON, 1435 La Cienega Blvd., Los Angeles, Calif.

Aug. 29-Sept. 1, 1962: 2nd International Conference on Information Processing, Munich, Germany; contact Mr. Charles W. Adams, Charles W. Adams, Associates, Inc., 142 the Great Road, Bedford, Mass.

Sept. 3-8, 1962: First International Congress on Chemical Machinery, Chemical Engineering and Automation, Brno, Czechoslovakia; contact Organizing Committee for the First International Congress on Chemical Machinery, Engineering and Automation, Vystaviste 1, Brno, Czechoslovakia.

READER'S AND EDITOR'S FORUM

(Continued from Page 8)

materialistic American society. I remarked, in the ensuing discussion—no explosion, by the way—that such views were a "swansong"; Harold Urey made an optimistic rejoinder; I countered. That was the last talk on the program, so we went home. Next day the AP had us shouting from the floor, the meeting breaking up in confusion, everything but fistfights. Alas! it was much less exciting than that at the time, and much more exciting later, when I was being sawed off back East.

Thus do martyrs perish—not by the sword and the fire, but nibbled to death by termites like you, dear Albert. Grrr!

Herb Grosch

Some day I'm going to tell the whole story of that weird and wonderful swivet, Ed. Only problem would be how to identify the characters without further cutting myself off from old Dulce Et Decorum Est. . . .

Sincerely,
Herb

II. From the Editor

Dear Herb:

Thank you for your letter to Editor's Forum. I have no desire to censor it, but I am having trouble understanding it.

Will you please translate for me the following expressions which I don't understand:

1. What does "really tears it" mean?
2. What does "needlenoggin" mean?
3. What does "Black Hat" mean?
4. What is "quadriplegia"? As I remember, hemiplegia is paralysis on one side. Does vocational quadriplegia mean paralysis in four vocations? I don't understand.
5. What is the difference between exemplar and example?
6. What does "sawed off" mean?
7. Why is Albert Baylis (a pseudonym by the way) a termite?
8. What is a "swivet"?
9. What does "Dulce Et Decorum Est" mean in the place you used it? I know "Dulce et decorum est pro patria mori" means "it is sweet and proper to die for one's country," but how do you cut yourself off from that motto? This is what I do not understand.

I would be delighted to give you ample space in the pages of COMPUTERS AND AUTOMATION to make the story clear to the uninitiated person—the person who is not already completely in the know about Herb Grosch and his ways of looking at things.

With best wishes to you,

Ed

III. From H. R. J. Grosch

Dear Ed:

Here is an abridgement of the Grosch Glossary, for your own use or for publication:

1. Really tears it—the smooth fabric of everyday existence has been rent asunder.
2. Needlenoggin—pinhead; one of minute cranial capacity.
3. Black Hat—a villain; in TV westerns, the hero wears a white hat.
4. Quadriplegia—paralysis on all sides.
5. Exemplar—an ideal model. Example—a model.
6. Sawed off—made into a (vocational) quadriplegic.
7. Termite—a friend of Pogo who bores from within.
8. Swivet—a large variety of tizzy.
9. Dulce Et Decorum Est—It Is Sweet And Proper; hence, a certain large computer manufacturer.

I know of no simpler way to awaken "the uninitiated" to the harsh realities of the data processing racket than to expose them forthwith to

Your fellow-sufferer,
Herb

P.S. Did I *use* "swivet"? I've mislaid my carbon—H.

IV. From the Editor

Note: Re no. 7, he did not explain why (the question asked) but only the meaning (which was not asked).

STATEMENT OF OWNERSHIP AND MANAGEMENT OF COMPUTERS AND AUTOMATION

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1. The names and addresses of the publisher, editor, managing editor, and business manager are:
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   Max S. Weinstein, 25 Highland Drive, Albany 3, N. Y.
3. The known bondholders, mortgagees, and other security holders owning or holding one per cent or more of the total amount of bonds, mortgages, or other securities are: None.
4. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was 3630.

Edmund C. Berkeley, Editor

SWORN TO and subscribed before me, a notary public in the Commonwealth of Massachusetts, on October 2, 1961.

Esther W. McHugh, Notary Public

My commission expires October 31, 1964.

SOME SIGNIFICANT NEW APPLICATIONS OF COMPUTERS

DIGITAL COMPUTER APPLIED ON-LINE REAL-TIME TO ASSIGN ELECTRIC LOAD GENERATION AT MINIMUM INCREMENTAL COST

Wm. E. Ware
Minneapolis Honeywell Regulator Co.
Special Systems Division
Pottstown, Pa.

Philadelphia Electric Company has become the first utility to operate an economic dispatch control system directed by a digital computer.

The system was developed jointly by Minneapolis-Honeywell Regulator Company and Philadelphia Electric Company. It is in use in an extensive electric system at Philadelphia Electric. The system represents a major advance in the application of automatic control for the economic dispatch of electric power.

For the first time, high-speed analog control elements are joined with an industrial-process-control digital computer, the Honeywell 290, to perform the primary function of assigning generation at minimum incremental cost.

Of significance also is the solid-state design of the system. Conspicuously absent are motors, servos, slidewires and vacuum tubes.

How the System Works

Philadelphia Electric is one of eight members of the Pennsylvania-New Jersey-Maryland Interconnection (four other utilities have interconnecting ties) which operates under the principle of equal incremental generation costs and free flow of tie-line power interchange. When the generation level is determined, P. E.'s power director manually adjusts a dial on the control console for total assigned generation. In order that assignment changes can be held to a rate equal to system response, the assigned generation signal is first sent through a rate-limiting circuit. A frequency bias component is then added. The resulting signal represents the desired generation, including both manual and controlled steam generation and hydro generation.

Next, the power director sets the level at which loading of hydro generation is to begin -- when hydro cost is equal to the cost of the steam generation it replaces. At the same time, he selects the total amount of hydro generation.

Thus, the system allocates steam generation on an economic basis (considering transmission losses) up to the point where hydro loading begins, holds steam load constant while varying hydro generation in this range, and, when maximum hydro is reached, assigns all additional increases to steam generation at minimum incremental cost.

Desired steam generation, which is sampled every 10 seconds by the computer, is allocated by sending a portion of the total generation change to each unit without regard to economical distribution. As units follow the change, the H290 computer rapidly samples generation and makes new economic calculations which reset the assigned generation among units. While all generators initially start changing load to satisfy changing total generation, the total amount of each unit's generation is determined economically. A rate limiter protects each unit by restricting its rate of generation change.

Involved in the control system are 34 generators -- 27 units in eight steam stations and 7 units in one hydro station. Installed rated capacity of the Philadelphia Electric system as of June 30 was 3,459,850 kilowatts.

Computer Nerve Center

The H290 digital computer is the nerve center of the complex control system. Although primarily responsible for allocating steam generation on a minimum incremental cost basis, it computes, as a secondary function and on a time-sharing basis with dispatch calculations, data for interconnection billing.

In addition, the computer is available for systems studies and calculations, including maintenance scheduling on an off-line basis.

Accepted equations for incremental cost of power, which take into consideration transmission losses, are employed in programming the computer for economic dispatch. These equations are applied by the computer so that individual megawatt loadings can be determined for each unit on the line not operating at its maximum limit. In this manner, total system generation load is allocated at minimum incremental cost.

LIFE INSURANCE AGENCY ACCOUNTING SWITCHING TO EDP

The Mutual Life Insurance Company of New York
Broadway at 55th
New York 19, N.Y.

Seven years of experience began to bear fruit in October when this company's long-planned electronic data processing system took over all the routine daily operations relating to life insurance policyholders in two of its agencies.

For the last several months, the company has been conducting a dual manual-and-electronic operation to check out its new equipment, an IBM 7070-1401. The results were favorable.

The company now has begun switching its 167 sales agencies in the United States and Canada to exclusive electronic operations.

The first two agencies on the conversion schedule, in Manchester, N.H., and Indianapolis, Ind., were switched over October 2.

Others will be converted, one and two at a time, during the next two years or longer.

When all agencies have been switched to electronic operation, the solid-state, tape-oriented system will review all of the company's 1,500,000 life insurance policies in four hours each day. It will extract from the master tape record all those policies -- 25,000 on an average day -- requiring action.

It will then handle many of these actions itself; others it will hand over to the company personnel concerned, with instructions.

It will, for example, calculate all the information to be shown on premium notices and then print those notices at the rate of 10,000 in less than two hours.

The 7070-1401 is doing all of these things now for the two agencies already converted.

The company began studying electronic data processing in 1954 and ordered the 7070-1401 in 1958.

PREFLIGHT CHECKOUT OF MOON ROCKET

R. G. Gillen
Radio Corp. of America
Data Systems Division
Van Nuys, Calif.

Pre-flight checkout of the Saturn rocket, which will be capable of sending payloads of several tons to the moon, will be handled by an advanced new ground checkout computer system which was researched and developed by this division. The computer was produced by RCA's industrial computer systems department, Natick, Mass., under contract with the Data Systems Division.

Recently the system was installed at the George C. Marshall Space Flight Center at Huntsville, Alabama.

The system is powerful and highly versatile and will decrease substantially the time required for the pre-flight checkout of the Saturn and other large multi-engine vehicles. The Saturn with 1,500,000 pounds of thrust -- equivalent to approximately 32,000,000 horsepower -- can be used to send payloads of several tons into earth orbit and into deep space as well as to the moon.

The guidance and control division at the George C. Marshall Space Flight Center is using the system in developing automation techniques that will insure higher reliability in pre-flight checkout.

Basically, the checkout computer system analyzes swiftly many functions occurring inside the Saturn rocket during the pre-flight count-down before launching.

The digital computer system provides exact duplications of the checkout procedures; it gives high-speed automatic checkout which eliminates many possibilities of human error; and it furnishes high-speed analysis of the results during pre-flight operations.

It enables NASA scientists and technicians to monitor and control the Saturn under tests in real time.

The computer uses both magnetic core and drum memories. The core memory is used to store the main program and any data being processed at any time as well as emergency programs which must be available to the computer system immediately on receipt of unpredictable external signals. The magnetic drum unit provides bulk memory storage for additional programs required in vehicle pre-flight operations.

NEW DATA PROCESSING SERVICE FOR SAVINGS BANKS

W. L. Melville
The National Cash Register Company
Dayton 9, Ohio

A new electronic data processing service for savings banks was placed in operation for the first time in September when The Manhattan Savings Bank's Westchester County office in Mt. Kisco began feeding depositor data recorded on punched tape directly into a National Cash Register Company computer center 40 miles away in midtown New York.

When a savings transaction at the suburban office takes place, the teller enters the transaction on an NCR Class 42 window posting machine, equipped with a punched tape recorder. At the end of the day, the information on the tape is transmitted automatically by telephone line to the NCR Data Processing Center in Manhattan. The new procedure eliminates the conversion of tape to punched cards.

To transmit the data, a bank employee simply picks up a conventional telephone and dials the NCR phone number. Data are flashed daily into the center, where an NCR 304 computer handles the bank's entire record-keeping job automatically.

Before the bank opens its doors in the morning, the center supplies it with a detailed report on the previous day's transactions.

The service utilizes eight-channel teletypewriter equipment installed by the New York Telephone Company.

Initially, the bank will use the NCR service only for its Westchester office, but eventually it plans to turn over to the Data Processing Center the paperwork job for all of its five offices.

The system will provide greater convenience for depositors as well as cut the time and cost of handling the bank's record-keeping job. He said the service also would insure greater accuracy in handling accounts. The system contains an electronic mechanism that automatically prevents a savings transaction from being entered to the wrong account.

The system is capable of balancing the books on 1,000 savings accounts in one minute -- several hundred times faster than conventional methods. It also will speed the handling of savings transactions at the teller's window, since it eliminates the need for a teller to search through a large file of depositor ledger cards each time a customer makes a deposit or withdrawal.

The new system eliminates the tedious task of calculating interest on deposits. The equipment at the center automatically performs this operation as a by-product of recording a deposit or withdrawal.

OIL DISTILLATION UNIT RUN BY COMPUTER

TRW Computers Co.
Division of Thompson Ramo Wooldridge, Inc.
Los Angeles, Calif.

This company has installed an RW-300 computer control system at the Tulsa refinery of DX Sunray Oil Company to perform on-line, closed-loop control of a new 85,000 barrel-per-day crude oil distillation unit.

The new distillation unit replaces five older crude units that had combined capacity of 75,000 barrels per day. This installation is the first major refinery unit to incorporate a computer control system in its original design. It went on stream in mid-September.

The computer provides continuous and automatic control of the huge process by continually scanning 191 process instruments and adjusting 30 controller setpoints to maintain optimum efficiency. Such variables as temperatures, pressures, flow rates, and stream compositions are checked every 10 minutes and their readings are compared with predetermined limits stored in the computer's memory. Using this instrument data and a mathematical model of the process, the computer exercises direct control over the distillation unit by automatically adjusting the appropriate controller setpoints.

In addition to the central computing unit, the control system includes an operator's console, analog input equipment, and three automatic logging typewriters which provide a printed log of all process variables bi-hourly, daily, and on demand. From the operator's console, the operator can push a button to request a demand log or to check instrument readings. The console also provides the means for the operator to take over manual control of the unit if he feels such action is necessary.

The new crude unit, a three-stage distillation process, produces straight run gasoline, naphtha, kerosene, heating oils, fuel oil, asphalts, cracking stocks, and stocks used in the production of lubricating oils and waxes.

The RW-300 is expected to provide operational efficiency much greater than could be realized using conventional control methods; the saving in operational costs and maintenance should be substantial.

The TRW computer systems are marketed, installed, and serviced by TRW Computers Company. More than 300,000 operational hours have been logged on these systems in a variety of industries with an average reliability exceeding 99 percent.

A COMPUTER FOR A BLOOD CELL SCANNER

William Pepper, Jr.
Navigation Computer Corporation
Valley Forge Industrial Park
Norristown, Penn.

In the Proceedings of the Western Joint Computer Conference, 1961, is a paper on "The CELLSCAN System -- a Leucocyte Pattern Analyzer". This paper was given by Kendall Preston, Jr. of the Perkin-Elmer Corporation. Navigation Computer Corp. built the special-purpose computer for this unusual system.

Up to this time, no good method has been found for measuring low levels of radiation damage in human beings. There is some evidence that the number of a certain type of white blood cell called a binucleate lymphocyte increases with the dosage of radiation. The only difficulty in testing this theory is that in a normal man there is only one of these special cells in every 10,000 white blood cells. This means that several tens of thousands of white blood cells must be counted and cataloged by a technician in order to determine the incidence of the special cells. This, of course, takes hours for each sample.

The Perkin-Elmer company is developing a machine which will do this job automatically and rapidly. As a first step, they have devised a machine to make a catalog of the parts of a white blood cell according to size. The binucleate lymphocytes can be identified by the absence of small parts and the presence of two large parts.

The Scanner

A Dage Data-Vision scanner is coupled to a microscope. In order to provide data at a rate compatible with a low-cost tape deck, the scan is 60 lines per second. The video signal is digitized so that white areas are represented by "zeros" and dark areas by "ones". A special technique is used to emphasize the separation between the dark parts of the image. This reduces the amount of data which has to be handled in order to distinguish between parts that are close to each other. All of this is done before the data is entered into the special-purpose computer.

The Shrink Operation

Dr. Marcel Golay, a consultant for Perkin-Elmer, is the inventor of a multislit infrared spectrometer and the Golay Column used in gas chromatography. He suggested the "shrink operation" as a means of finding the size and number of the cell parts. (Perkin-Elmer has made a patent application on the idea.)

The shrink operation consists of removing all "ones" which are on the periphery of a dark area in the image. It takes a single bit in the dark area and examines its eight neighbors.

1	2	3
8	X	4
7	6	5

Figure 1 - The eight neighbors of bit X.

The shrink operation asks three questions about the eight neighbors:

(1) Are there three adjacent "zeros"? If so, the bit is on the periphery of a dark area, and will be eliminated unless the answer to either question (2) or question (3) is "yes".

(2) Are there three or more unlike pairs? If so, the bit connects two parts of a single dark area, and eliminating it would make two dark areas.

(3) Are all the neighbors "zeros"? If so, the bit is an isolated "one". If this question is left out of the shrink operation, isolated "ones" will be eliminated from the image.

The Computer

The computer uses a modified tape transport as its memory. The transport has a loop of tape between the "write" and "read" heads which will hold a complete scan of the image. This is about 20,000 bits. A closed-loop transport is not used because there would be too much tape wear with such a short loop.

The first operation is to remove white holes in the dark areas, which may be due either to noise in the system, or to inclusions in the cell nuclei. These would prevent the shrink operation from reducing the image to an isolated "one". The white holes are removed by complementing the image and applying the shrink operation with question (3) omitted.

The next operation is to produce the catalog of cell parts. The operator sets a pass counter to perform the shrink operation a certain number of times. The computer shrinks the image, re-records the processed data, and repeats the process, until the desired number of passes is completed. Then it holds the result, reading and rewriting it continuously. The operator then commands the computer to count the isolated "ones". This count is the number of parts in the cell up to the size which can be reduced to an isolated "one" in that many passes. This process is repeated until all the data is counted out as isolated "ones".

The computer is very flexible, as the operator has control over the number of passes in each series of shrink operations, and can keep or eliminate the isolated "ones" at any time. In this way, the best sequence of operations for efficient detection of binucleate lymphocytes can be found, and the ground work laid for a more ambitious machine.

COMPUTER SYSTEM FOR WORLD-WIDE MANPOWER ASSIGNMENTS

W. L. Melville
The National Cash Register Company
Dayton 9, Ohio

In June the Strategic Air Command displayed a new automation system which will give an exact picture every 24 hours of its manpower needs throughout the world.

The equipment automatically will report the number and type of men needed by each SAC unit. It also will locate the most eligible and qualified men for assignments and give a daily projection of SAC's manpower needs six months in advance.

The detailed daily report will enable SAC to anticipate its future personnel needs with a maximum of efficiency, the defense organization stated.

When a man is needed for an assignment, the computer, which was developed by this company, will search the files on more than 200,000 members of SAC. In less than two minutes it will consider more than 50 different facts about every individual and select the most eligible man for the job. The computer will consider such factors as the individual's training, choice of duty, family status, length of service, and eligibility for promotion.

SAC said it expects to save hundreds of thousands of dollars annually through the speed and accuracy of the new installation. The saving, it was explained, will result from more efficient utilization of personnel. In making assignments the computer will be able to consider many more factors about an individual than was previously possible.

SAC's force rests in the hands of more than 270,000 personnel trained in hundreds of skills. The many careers include crews to fly bombers, tankers and other types of aircraft, technicians to operate inter-continental ballistic missiles, communication teams, maintenance crews, security guards, and a host of other vital jobs. For example, every few minutes around the clock a plane is refueled by a flying tanker which depends on the combined teamwork of hundreds of highly skilled persons assigned to various world-wide bases.

Under the new system, SAC Headquarters will receive during the night all changes in personnel status throughout the United States over a microwave and cable network. The network also enables information from as far away as a SAC base in Madrid, Spain, to be transmitted directly to Omaha, where the data is automatically punched into cards in less than 72 hours.

The NCR 304 computer then reads the punched cards through a 2,000-card-a-minute reader. It instantly makes the necessary changes among the more than 200,000 personnel records which are contained on five reels of magnetic tape. Annually, over a million changes must be made to the personnel file.

The computer system will include a remote inquiry unit which will enable SAC's personnel officers to communicate directly with the computer from their office. They will be able to query the computer to locate a man for an assignment or to determine the manpower needs at any base. The system will then assist in the equitable distribution of assignments according to skills, eligibility, and choice of duty. Even when the computer is performing other operations, answers to simple inquiries can be obtained in less than two minutes.

The defense organization stated that the new system will "personalize" SAC assignments, since it will enable more personal factors to be impartially weighed than was previously possible. Transfers will still be effected by SAC planners in the best interest of defense requirements, they pointed out, but the computer information will simplify recordkeeping and at the same time improve manpower efficiency.

AUTOMATED TEACHING STUDY AND EXPERIMENTATION

A. J. Dwyer
Philco Corp.
Computer Division
Willow Grove, Pa.

Systems Development Corporation of Santa Monica, Calif., has organized a laboratory for the study of automation in school systems. This Computer-based Laboratory for Automated School Systems, or CLASS as it has been designated, is concerned with educational research and the improvement of educational technology. It will use a Philco 2000 Electronic Data Processing System as a central control unit and data processor.

The purpose of the computer is threefold: to control the different modes of instruction; to permit monitoring of the learning behavior of one student or a group of students, by teachers and experimenters; and for use in counseling and administration.

A cumulative record of the student's performance is kept inside the computer. If a student's performance falls below a certain level for a particular topic, the computer detours the student to a special set of remedial items on that topic. If a student makes a good record on any given topic, the computer will let him proceed rapidly, skipping some material as he proceeds.

While instruction is going on, teachers and experimenters are able to check the learning behavior of students by means of four different devices: a teacher's display console; a sound-proofed electric typewriter with tape punch (Flexowriter); a response device similar to the student's unit; and a film viewer for checking the instructional program. The display console indicates, through lighted buttons, the students who are experiencing difficulty. The computer then causes the typewriter to print out information on the performance of a student in difficulty. The CLASS teacher can continue to check this student by observing his responses on a response device and by observing on a film viewer the items which are causing the student difficulty.

For administrators and counselors, the computer in addition gives diagnostic data on call, student histories, and daily attendance. Registration scheduling, and accounting programs also can be accomplished automatically. A high-speed printer provides the administrators and counselors with immediate information.

Eventually SDC's CLASS may be a completely computer-based educational system. As this system develops, it is expected that students will be able to draw upon accumulated knowledge of past and present through a very large information retrieval system. Also, they will be individually machine-tutored as well as instructed in groups by the computer; the productivity of the teaching hour will be increased; and the data processing tasks of administrators and counselors will be handled much more efficiently.

SPACE WATCHING

A. J. Dwyer
Philco Corp.
Computer Division
Willow Grove, Pa.

The North American Air Defense Command, on July 1, 1961, established a constant space watching system for its combat operations center at Colorado Springs, Colorado. Its missions are the detection, identification, interception, and if necessary the destruction of any aerospace threat to North America.

This Space Detection And Tracking System is known as "SPADATS". The central unit of this system is an ultra high-speed computer, a Philco 2000 Electronic Data Processing System.

The computer collects a multitude of information from varied sources, such as: the Ballistic Missile Early Warning System; the Air Force Space Tracking unit at Hanscom Field, Massachusetts; the Navy's Space Surveillance Facility; the National Aeronautics and Space Administration and Flight center; the Smithsonian Astrophysical tracking system; the Discoverer Satellite network; and the National Security Agency.

The computer digests the information at very high speed, says where the object is now, where it will be in the future, and points out any significant changes in the objects orbit.

The present job of SPADATS consists of tracking less than 100 objects. The system can be expanded to keep track of 10,000 objects or more.

It will take questions from punched cards, reading 30 of them a second, figure the answers, and store them for further reference, or present them immediately on display panels or in typescript, printed at 15 lines per second.

WIRING LIST PRODUCED BY COMPUTER

H. A. Wattie
Ferranti-Packard Electric Ltd.
Toronto 15, Ontario, Canada

Most computing apparatus is designed by assembling logical packages. Each package may contain more than one logical element; packages are usually of the same physical size and are arranged in tiers in cabinets similar to books in a book case. A computer may consist of several such cabinets. A logical element normally has more than one input and an output. The machine is constructed by interconnecting inputs and outputs in a clever manner in order to produce the required sets of logical operations. We are concerned at this point with the element-to-element branch connections that form the basic design rather than the specific package terminal connections.

The number of each type of package, the arrangement of these packages into tiers, and the assigning of locator numbers to each logical element follows from the basic design. A locator number specifies the package by cabinet, row, and column number and an element by its element type.

The final diagrams showing actual point-to-point wiring require a great deal of meticulous effort. This last stage of work is now being turned over to the Pegasus Computer at the Ferranti-Packard Computing Center here.

A program has been written which will produce a terminal wiring list from basic design data. A matrix, forming an image of the package types and their location in the cabinets, is stored in Pegasus. A list of package types is also stored, with details about each element on a package, including input and output terminal numbers. From the basic design charts, element-to-element connection statements are keypunched into paper tape in the form of locator number to locator number. The output is a list of wires defined by statements of terminal-to-terminal connections. These can be grouped in classes of colour for convenience during actual wiring procedures. For example, all wires that do not leave a package but connect elements of the same package could be outputed together for each tier. Such a list can greatly decrease wiring time. Errors in element connections can be detected during the program run. A degree of optimized wiring is carried out.

Further development is under way to extend the program so that it will produce wiring of plugs and jacks between cabinets.

CONTROL OF LIVESTOCK BREEDING IN SWEDEN

T. I. Bradshaw
Radio Corp. of America
Camden, N.J.

Control of livestock breeding is another assignment for electronic data processing.

The Stockholm Svensk Husdjursskotsel (SHS), the national Swedish cattle breeders association, has ordered a computer for use in maintaining detailed breed-line records of dairy cattle throughout Sweden.

The computer system will record milk and meat production of each animal on the association's roster. Utilizing these records, the system can select the most productive animals for breeding purposes. This is one of the newest techniques in Sweden's cooperative breed improvement program.

The Swedish cattle breeders association for many years has conducted a widespread artificial insemination program; this has cut costs and improved livestock. Recently developed techniques however, now enable the association to preserve bull semen, by deep freezing, in active condition for fifteen to twenty years.

The freezing technique is coordinated with the data processing system to improve the breed, as follows: Heretofore, the useful breeding life of high-quality bulls was limited, because most bulls advanced well beyond their prime before the productive capacity of their female offspring could be evaluated. With the electronic computer making rapid statistical comparisons of milk and meat production of all stock, the semen of the most productive bulls, as indicated by the computer's comparisons, can be utilized on a selective breeding basis to assure improved milk-and-meat producing offspring.

AUTOMATION FOR SMALLER CORRESPONDENT BANKS

P. A. Union
Booz, Allen & Hamilton
Chicago 3, Ill.

In October, The First National Bank of Denver, Colo. (a $357 million bank) began processing on its computerized check-handling equipment the demand deposit accounting for the first one of half a dozen of its smaller correspondent banks. On its automated system, installed earlier this year, The First National Bank of Denver is running checks of the nearby $10 million First National Bank in Golden (Colorado).

The correspondent banks, individually, cannot support the costly and complex automated check handling equipment. Such equipment may typically cost $10,000 - $20,000 a month, in addition to a heavy installation cost. Computer sharing by correspondent banks is a major avenue open to the majority of the nation's 14,000 banks to automate and achieve the economies and new services possible through bank automation.

A recent study by this firm shows that over 100 of the nation's larger banks have installed or have on order the new computerized check processing systems. The 100 banks committed to automation represent over $90 billion in bank deposits, nearly one-third of the country's $267 billion bank deposits. While the giant banks can each support an elaborate computer system, the smaller banks must use some other method to achieve the savings and advantages of automation in order to stay competitive. Two methods lie ahead for such bank survival.

One route is to process checks of the smaller bank on the equipment of a larger correspondent bank, like The First National of Denver. The other approach is to utilize a data processing center, such as a bank cooperative, in which several smaller banks share the computerized equipment.

The widespread use of computers in banking is likely to bring full recognition of magnetic tape as the latest form of financial exchange in the United States. Since the Revolutionary War, the nation's money has consisted of gold, silver and copper coins; paper currency issued by private banks, state banks and the federal government; and most recently, money in the form of checks.

The nation's extensive check writing has led to automation and the use of magnetic tape, computers and magnetic ink. In 1952, some 8 billion checks were written, this year there will be about 14 billion, and by 1970, 22 billion. In addition, a Federal Reserve study shows that bank services have grown since World War II at these rates: savings accounts, up 33%; commercial loans, up 113%; checking account activity, up 163%; mortgages, up 290%; consumer installment credit, up 850%. Bank employment has risen 65% during this time, which means that, unless something is done, everyone in the country will be a bank employee by the year 2100.

A major breakthrough to corral this paper stampede has been the development of the Magnetic Ink Character Recognition technique (MICR). The MICR method enables banks to print in magnetic ink the identity of the bank, its check clearing route information, the depositor's account identification and the amount of the check. This data can be read visually, but more importantly, it can be read automatically by machines and translated onto magnetic tape for microsecond calculations on a computer.

The system at The First National Bank of Denver illustrates the future of our banking system and how important the needs of magnetic tape will become. For customers' checking accounts, magnetically encoded checks and deposit tickets are read by data conversion devices that serve as the "eyes" of the system, at a rate of up to 45,000 documents per hour. A document sorter-reader is the "hands" of the system that then arranges the checks in proper order for giving information to the file processing computer; it fine-sorts checks at up to 10,000 checks an hour.

The computer digests the information and serves as the "memory brain" of the system. The computer will calculate changes and post accounts at rates up to 100,000 per hour. To process checks, deposits, returned items, overdrafts, stop payments, and holds, the computer makes over 16,000 calculations a second. Finally, high-speed printers write for the system and each can turn out more than 1,000 complete customer statements or up to 10,000 abbreviated statements each hour.

The automated system at The First National Bank of Denver not only can turn out its own work, but also has the capacity to process data for more than a dozen smaller correspondent banks. For the Golden bank to use First National of Denver's computer capacity, the system will work like this. At the end of the bank day, the Golden bank's checks and deposits will be delivered to the First National. During the night shift, the First National will process all this paper work, update each account affected, and print out new records in sequence for the correspondent bank. The entire work is ready in the morning and is delivered to the bank in Golden by eight a.m.

Such an electronic data processing system will free bank personnel to do more skilled work and keep labor costs in line. Also, it will enable smaller banks to provide new services, just as the larger banks will be able to do. Among such new services possible are bookkeeping for individuals and small businesses, preparation of income tax returns, accounting services for mortgage companies, payroll preparation, and many others.

NEWS of Computers and Data Processors

"ACROSS THE EDITOR'S DESK"

UNIVAC SOLID STATE COMPUTER AND 4 FELLOWSHIPS -- GIFT

University of Pennsylvania
Philadelphia 4, Pa.

This university received contributions having a value of more than $1,000,000 from the Remington Rand division of Sperry Rand Corporation on October 12, as a mark of appreciation of the University's pioneering role in the development of the electronic computer industry.

The major contribution, a UNIVAC Solid-State 80 computing system, will supplement a UNIVAC I which was presented to the University by Remington Rand in 1957.

In addition to the new computer system, Remington Rand will provide four fellowship grants and will assign a group of advanced computer experts to the University for the advancement of the institution's computer research and education programs.

The announcement of the new gift computer and related contributions from Remington Rand was one of the features of a dinner commemorating the 15th anniversary of the completion of the ENIAC -- the first all-electronic digital computer. This computer was conceived, designed, and constructed in the University's Moore School of Electrical Engineering by Dr. John W. Manchly, Mr. J. Presper Eckert, and others.

The dinner, held in the University Museum, was attended by representatives of the computer industry, leading scientists and educators, government officials, and trustees of the University.

The University's new computer is one of the most up-to-date to be installed at any university. The new computer performs 11,760 additions and subtractions per second and it prints out the results of computation at the rate of 600 lines a minute.

The four unrestricted fellowship grants established by the corporation total $17,000 a year for a period of three years. The grants are to be used at the University's discretion for graduate and faculty study in the application of computers.

MISSILE FLIGHT PREDICTION HANDLED BY HIGH-SPEED ITERATIVE ANALOG COMPUTER

David M. Trotsky, Applications Mgr.
GPS Instrument Co., Inc.
180 Needham St.
Newton 64, Mass.

Before a missile can leave a launching site, many man-hours must be spent in testing control devices and predicting the orbit. A vital step here is the statistical evaluation of the effects of externally caused random disturbances on the missile's course.

Until recently the equipment to perform these calculations economically and quickly, with high confidence-level, had not been available.

This company has designed from the very start an analog computer with repetitive mode, wide bandwidth, and high dynamic accuracy.

One of the units will be delivered to the National Aeronautics and Space Administration to solve the problem of iterative-type missile flight prediction. Since the iterative steps are performed at high-speed, computing in compressed time-scale is used. By compressing the time scale, physical processes can be simulated electronically at rates several thousand times faster than they actually occur. For example, a heat-transfer phenomenon, actually requiring minutes to stabilize, can be simulated in one tenth of a second.

As the time scale is compressed, the operating bandwidth is increased to maintain high dynamic accuracy in the calculation. Operational bandwidth in excess of one megacycle is standard. The resulting dynamic accuracy of this computer is comparable to the static accuracy available in the market today.

Another unit will be delivered to Westinghouse to evaluate reliability in the control of nuclear reactors. Here the multi-conditional characteristics of the problem can best be analyzed by iterative techniques.

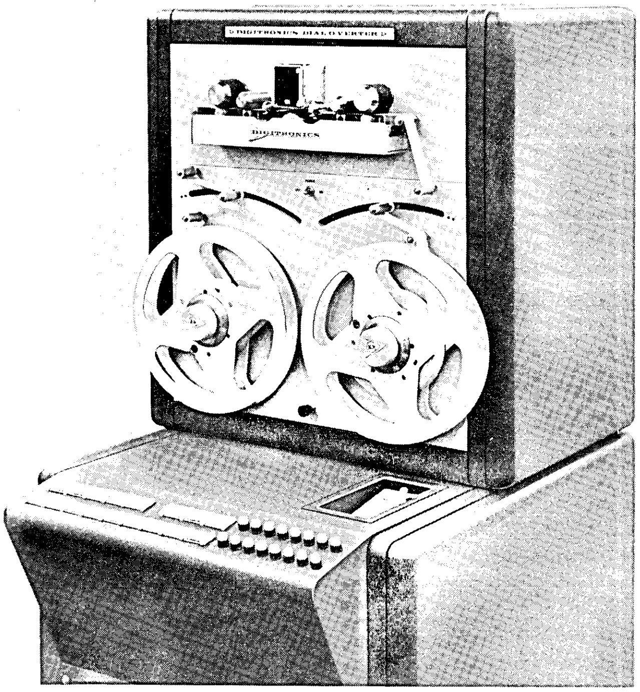
The ability of the computer to perform both iterative and statistical computation has greatly broadened the potential range of analog computation.

FIRM USES DIAL-O-VERTER SYSTEM TO TRANSMIT MILLION WORDS OVER TELEPHONE LINES WITHOUT SINGLE ERROR

Lester Krugman, Vice-President
Digitronics Corporation
Albertson, N.Y.

Mohasco Industries, Inc., one of the world's largest carpet manufacturers, has transmitted more than 1,000,000 words of business data over telephone lines without a single error.

Transmitting at a speed of 1,000 words per minute, the carpet company has reduced transmission time from nine hours per day to one hour and ten minutes, using Dial-o-verter paper-tape terminals made by Digitronics. The system is used to transmit interplant data for Mohasco's Mohawk Carpet Mills and Alexander Smith divisions.



This new communications system between Mohasco's central production control and order department headquarters in Amsterdam, N.Y., and its major manufacturing division in Greenville, Miss., 1,200 miles away, has been successful. The system will also be in operation between Amsterdam, N.Y., and Dillon, So. Carolina. Data transmitted covers production schedules and other interplant instructions where speed and accuracy are essential.

Transmission over the system, made and received via punched paper tape, is 10 to 15 times faster than conventional transmission equipment. Advantages of this system are speed, accuracy, economy and great flexibility for diversified use. It greatly expedites information on current and prospective sales orders with any error in transmission automatically detected and corrected electronically.

THE DIGITAL DATA PROCESSOR, DDP-19

Computer Control Co., Inc.
Western Division
2251 Barry Avenue
Los Angeles 64, Calif.

A high-speed, stored program digital computer, designed to perform quick look, plotting, and give analog or digital output on test data, has been developed. Called the DDP-19, it is compact, modular and a new entry into the medium-sized computer field.

The company's experience in building special purpose computers suggested a requirement for high-speed computers in the 19 to 25 bit range. Medium-sized computers with suitable input-output flexibility and real time computational speed have not heretofore been available except as custom-built equipment.

The DDP-19 is a 19 bit machine with a 5-microsecond core storage to 4,096 and 8,192 words. A second 25 bit machine, the DDP-25 is being designed.

The computer is single-address, parallel, and binary. Memory access time is 2.5 microseconds. A complete minor cycle is performed in 5 microseconds. A shift instruction can be read from memory and completed in one minor cycle. An add or subtract instruction can be read, the operand taken from memory, and the result made available in the arithmetic unit in two minor cycles. An average multiply operation is performed in 36 microseconds, and a divide operation in 57 microseconds.

Major applications of the DDP-19 lie in on-line real-time uses, as an auxiliary to larger computers, and in special situations requiring a variety of input-output equipment or very high operating speed.

LARGEST COMMERCIAL SALE OF ELECTRONIC DATA PROCESSING EQUIPMENT EVER MADE

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

The largest commercial sale of electronic data processing equipment ever made, and the signing of a patent licensing and technical information agreement, were announced on October 2 by the Radio Corporation of America and Compagnie des Machines Bull of Paris, France.

Under the multi-million dollar international agreement, Machines Bull has placed an initial order with RCA for the purchase of a minimum of 50 and a maximum of 100 RCA data processing systems. Shipments are scheduled to begin in quantity by July 1962 and be completed in 1964.

RCA entered the commercial data processing field in 1959, and is now a major factor in computer manufacturing. Machines Bull is one of the world leaders in data processing and has more than 1,000 electronic computers in operation around the globe.

RCA is making changes in the circuitry of the equipment to be delivered to Bull in order to make it compatible to Bull's code and European language character changes.

Machines Bull, the largest European-owned data processing firm, employs some 16,000 workers in 10 plants in France and one in Amsterdam.

Under the patent license agreement, RCA has granted the Bull Company non-exclusive patent licenses for the manufacture of data processing equipment.

At the same time, Bull has granted RCA non-exclusive patent licenses for the manufacture and sale of data processing equipment, with the exception of punched-card equipment.

STRETCH COMPUTER TO BE AT C-E-I-R CENTER IN CAMBRIDGE, MASS.

C-E-I-R, Inc.
270 Park Ave.
New York 17, N.Y.

At Technology Square in Cambridge, Mass., on October 9, groundbreaking ceremonies for a large and powerful electronic computing center took place.

Dr. Herbert W. Robinson, president of this company, which will install and operate the $15 million facility; Massachusetts Governor John A. Volpe; Dr. James R. Killian, Jr., chairman of the Massachusetts Institute of Technology Corporation; Cambridge Mayor Edward A. Crane; and Gerald W. Blakeley, Jr., president of Cabot, Cabot & Forbes participated in the ceremony.

The new Center will be equipped with a giant new IBM STRETCH computer and will serve the eastern half of the United States.

The company announced last year plans to provide service to the western half of the United States with a STRETCH system scheduled for installation at the Los Angeles C-E-I-R Center.

Capabilities of the STRETCH computer are typified by its ability to perform more than 30 billion multiplications during a 24-hour period; a 14-digit number for example, can be multiplied by itself in 2.7 millionth of a second. Its huge capacity allows it to work on as many as nine programs simultaneously, selecting itself those problems having the greatest priority and looking ahead to schedule its own workload.

The great capacity of the C-E-I-R STRETCH computer will allow the corporation's staff of mathematical, economic, statistical and programming people to attack "total" problems now beyond the scope of any computing machinery in existence. These include the world-wide logistical and management problems of such large organizations as the Department of Defense and large oil companies, global weather forecasting and national and economic problems.

SOFTWARE DEVELOPMENTS

W. D. Sutcliffe, Jr.
Computer Usage Co., Inc.
1825 Connecticut Ave., N.W.
Washington 9, D.C.

The Electronic Data Processing Division of Minneapolis-Honeywell has awarded two new projects to Computer Usage Co., Inc. (CUC) following successful development of the H-800 algebraic compiler and other program packages.

CUC is to assist Honeywell in designing COBOL compilers for the H-400 and H-800 and in preparing a programming system to facilitate the writing of compilers.

CUC already has completed the algebraic compiler for the H-800, as well as a simulator for the IBM 650 on the H-800, and Card ARGUS, a symbolic assembly program for card-only H-800s.

FAST MAGNETIC TAPES IN CURRENT COMMERCIAL OPERATION

Walter W. Finke, Pres.
Electronic Data Processing Div.
Minneapolis Honeywell Regulator Co.
Wellesley, Mass.

High-density magnetic-tape systems, for use with Honeywell electronic computers, will now read or write data at 133,000 decimal digits per second.

Some of the new systems are now in daily operation at Honeywell 800 installations transferring data to and from magnetic tapes at a rate of 133,000 decimal digits per second. Standard Honeywell tape systems read and write 96,000 decimal digits per second.

High-Density Packing of Data

The new equipment achieves greater speed and efficiency because of high-density packing of data on the tapes. About 33 per cent more data is written on the tape by the new systems than by standard Honeywell equipment. Information is recorded on the new tapes at a density of 1,112 decimal digits per inch, compared with 794 decimal digits per inch on standard tapes.

High-speed systems have been in full field operation for over six months, and have proved highly reliable.

JOINT USERS GROUP -- AFFILIATE OF ACM MEETING, DEC. 11, 1961

H. M. Semarne
Information Services, Joint Users Group
c/o Ramo-Wooldridge
8433 Fallbrook Avenue
Canoga Park, Calif.

On Monday 11 December 1961, the day preceding the Eastern Joint Computer Conference in Washington, D.C., the JOINT USERS GROUP will meet as an affiliate of the Association for Computing Machinery (ACM). At this meeting, ratification of the conditions of membership by the participating member groups is expected, and action on problems common to all user groups is to be taken.

The main purposes of the Joint Users Group are the promotion of an exchange of information in areas of mutual interest, the encouragement of inter-group activities, and the investigation of current work on questions important to its member user groups. Many fruitful activities along these lines have already started.

Harry Cantrell, of General Electric Schenectady, Vice-Chairman of the Joint Users Group, gave a comprehensive talk on the activities of this federation of user groups at the ACM National Meeting in Los Angeles in September. At the ACM Meeting the Joint Users Group also sponsored a lively discussion among computer users of the effects of monitor systems on programmer-machine communication and on operating procedures.

A meeting of the Joint Users Group, at which thirteen founding user groups and the ACM were represented, was held in Los Angeles on 8 May 1961. At a plenary session, the question of affiliation with the ACM was settled. Committee discussion sessions on Communications, Standards, and Computer Installation Problems, followed.

The Joint Users Group, now also a permanent member of the American Standards Association's X-3 Committee, was represented by Harry Cantrell at the New York X-3 Sectional Committee Meetings of 28 March and 21 June. The part that the Joint Users Group may plan in the work of the X-3 Committee is expected to consist of attempts to advance problem definition work through the education of users, and to help set guide-lines for the development of new information processing areas. The Joint Users Group will, of course, serve as a center for the distribution of materials to computer users.

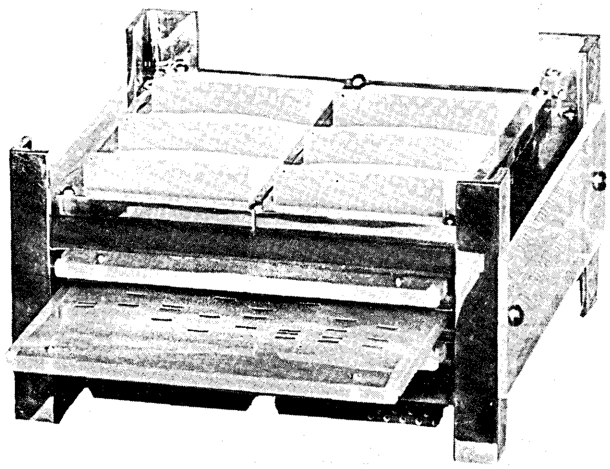
SEMI-PERMANENT TWISTOR MEMORY FOR TELECOMMUNICATIONS SYSTEMS

R. Wolin
Automatic Electric Co.
Northlake, Ill.

A new Twistor Memory Module has been developed by this company for future electronic telecommunications systems.

The memory stack employs a new method for using the twistor principle in a semi-permanent memory. Semi-permanent storage is accomplished by coding a "virtual solenoid" (made up of a printed-circuit conductor and a sheet of copper) which encloses the twistor elements. By pulsing through the printed-circuit conductor, an eddy current is induced in the copper sheet. The twistor elements then "see" a flux density of sufficient strength to disturb them. But if a hole has previously been punched in the copper sheet at a particular bit location, the flux density will be insufficient to disturb that twistor element. Thus, the semi-permanent storage, at any given "one" or "zero" bit location is governed by the presence of absence of a hole in the copper sheet.

Coding can be readily changed by sliding the plug-in "virtual solenoid" from its shelf and replacing it with another. "Virtual solenoids" are made up with any desired coding by simply punching holes in the proper locations of the copper sheet.



The twistor array developed at Automatic Electric is a 16 plane stack; each plane having eight words of 60 bits per word. Larger storage capacity can be had by increasing the number of planes in a stack or connecting a series of stacks. The minimum "one" output from an 80 mil bit length is 15 millivolts.

The twistor is composed of a copper wire, about the diameter of a human hair, helically wrapped with a flattened permalloy wire. Tiny segments of this permalloy wire act as permanent magnets. If a segment of the permalloy wire is magnetized in one direction, the bit read-out is a binary "one"; if the polarity is reversed at this bit location, it is a "zero".

The twistor wire provides both sense and access means for stored information. For noise reduction, each twistor is paired with a plain copper wire to form a transmission pair. A series of five-turn printed-wire solenoids are placed at right-angles to the twistor pairs. An intersection region of one twistor with one solenoid represents a storage location or bit. All of the bits along a single solenoid make up one word.

DRY, ONE-MATRIX PRINTER PRODUCING 50 WORDS PER SECOND

Motorola Inc.
Communications & Industrial Electronics Div.
4501 West Augusta Blvd.
Chicago 51, Ill.

This company has developed a high-speed page printer capable of producing 50 words per second.

The printer was developed for military teleprinter use, and is now ready for business and industry applications. Designed for operation over cable, radio or telephone channels, it can be used in connection with computer print-out, and in many communications applications, where rapid transfer of records or information is required.

The printer uses a completely dry process, eliminating any fixing step. At the same time, the sheets can be read while the printing is taking place.

The basic system consists of a message buffer, translator, and the printer. In a typical system, the information is stored in an external message buffer in its entirety prior to a print cycle. The print cycle may be simulataneous with the loading of another message in an alternate buffer.

Any data code can be utilized with the printer. Data code is converted to printed code by the translator. These signals are then fed to a moving printing head where the alphanumeric characters are formed.

All alphanumeric characters are composed from a 35-dot matrix. The printing head has seven "fingers" or styli which sweep across the page forming dots on white coated conductive paper. With the "moving matrix" print head, the fingers are brushed clean after each line of printing by passing them over brushes held in a miniature vacuum-cleaning hood which removes residue almost as quickly as it is formed.

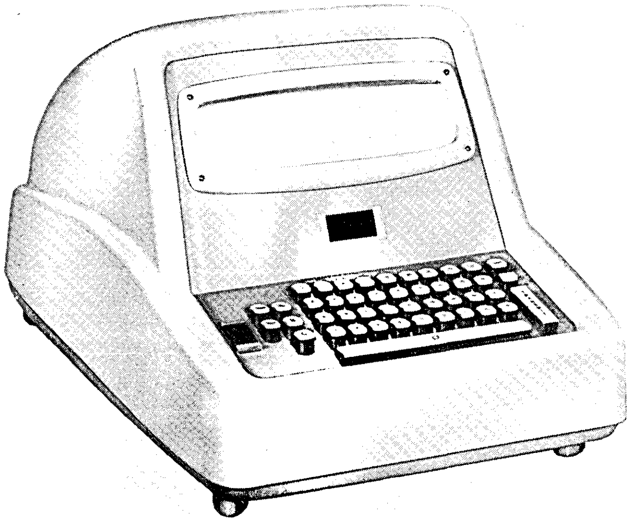
Use of the "moving matrix" print head eliminates the need to set up a separate print head for each character position. This reduces markedly the amount of electronic circuits and mechanical devices involved.

NEW NUMERIC INTERROGATOR PERMITS POINT-OF-USE AUTOMATIC DATA PROCESSING

Paul Blumenthal, Vice-President
Information Products Corp.
156 Sixth St.
Cambridge, Mass.

A numeric interrogator developed by this company permits general point-of-use automatic data processing.

The interrogator can be used to send information to and receive it from remote data-processing equipment in a matter of seconds. The interrogator looks like a compact adding machine with a built-in television screen. It can be operated by anyone after one or two hours instruction.



The numeric interrogator can be applied where responses are needed at a distance from central data processing equipment.

A bank teller, for example, will be able to receive up-to-the-minute information about a waiting patron's account simply by entering the account number on the Interrogator keyboard and depressing a Transmit key. The coded information request is sent over a direct wire or an ordinary telephone line to the central bank's remote data processing installation. Within a fraction of a second the requested information is sent back over the same line and visually displayed on the viewing screen of the teller's Interrogator.

Other applications of the new device are for reservation handling, order processing, credit checking, insurance investigation, inventory control and production control.

ENGLISH CHARACTER PHOTOCOMPOSITION FOR RUSSIAN-ENGLISH TRANSLATING COMPUTER

A. L. Koop
Mergenthaler Linotype Co.
Brooklyn 5, N.Y.

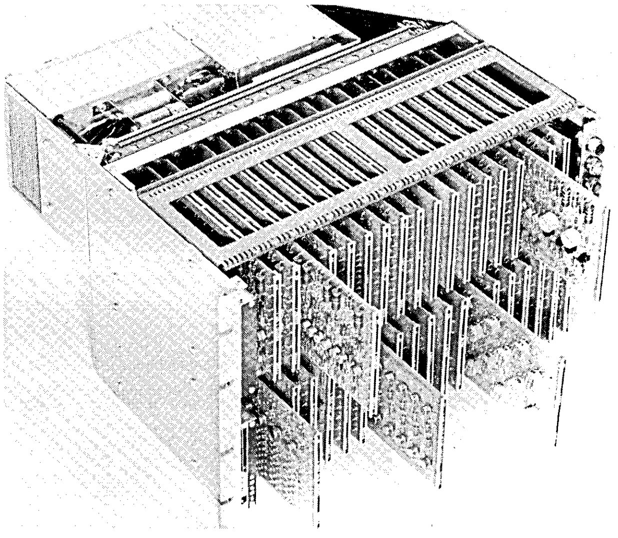
A photocomposition system, called Linofilm, developed by this company, is now being used to convert automatically the output of an experimental Russian-translating computer into English text of good typographic quality.

Until recently the material the translator produced was printed out on an electric typewriter. However, the printed material produced in this way was not of a typographic quality satisfactory for the wide circulation intended. Therefore, it was necessary to copy the material completely prior to photo-offset reproduction. Substituting a Linofilm Photo Unit for the electric typewriter results in a book quality printout on film or paper and is at once suitable for reproduction by offset or letterpress printing.

NEW MEMORY UNIT STORES 16,000 BITS OF INFORMATION

General Ceramics Div.
Indiana General Corp.
Keasbey, N.J.

The accompanying picture shows a new memory unit made by this company. Memory units such as this sequential interlaced buffer memory can store more than 16,000 bits of information for later use by electronic computers. This equipment is used in a variety of applications from monitoring space vehicles to process control systems. This year the company introduced .030" diameter ferrite memory cores, the smallest in use; also, modular-built complete computer memories.



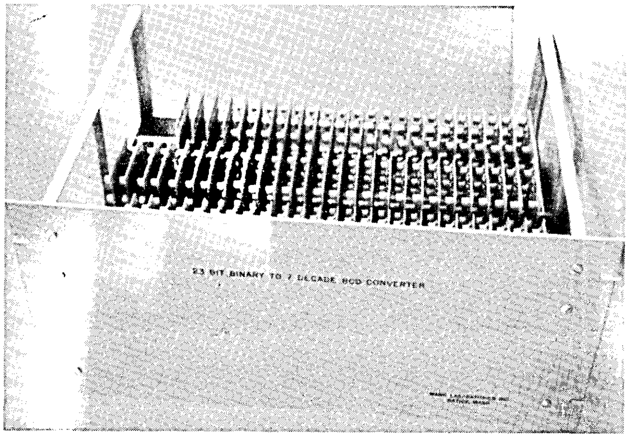
NEW CONVERTER FROM BINARY TO BINARY-CODED-DECIMAL PRODUCES SEVEN-DECIMAL OUTPUT IN 50 MICROSECONDS

Wang Laboratories, Inc.
12 Huron Drive
Natick, Mass.

A new direct converter from binary to binary-coded-decimal (BCD) is being produced by this company. The device will, for example, convert a 23 bit binary number into a 7 decade decimal number in 50 microseconds.

The design is based on parallel conversion directly from binary to BCD form without the necessity of using existing counting methods. The output is in 1 - 2 - 4 - 8 BCD code, but any other standard codes, such as 1 - 2 - 2 - 4, etc., can be furnished. Other converter units available can be for any number of bits. For fewer bits and for special applications, it is possible to design units to convert in only a few microseconds.

Applications are in data-processing equipment for use with computers and/or angular-position encoders, for operating readout and other peripheral devices.



"CUSP" PROGRAM FOR NUMERICAL INTEGRATION OF SATELLITE ORBITS

Liston Tatum, Vice-President
Computer Usage Company
41 East 18th Street
New York, N.Y.

The CUSP program is a new computer program developed by this company for numerically integrating the orbit of an artificial earth satellite. Its distinguishing features are its speed and its accuracy. Its speed is attributable to the fact that fixed point arithmetic is used throughout, and to the fact that a painstaking effort was made to minimize the number of machine cycles per time-step.

Its accuracy is obtained by carrying the coordinates as double precision numbers and effectively retaining 43 binary bits in the coordinates, as opposed to the 27 binary bits that floating point arithmetic employs.

The program uses Cowell's method and carries differences up through the ninth order. The potential for the earth is expressed in terms of zonal harmonics with all even and odd terms retained up through the sixth harmonic.

The only inputs required are the initial rectangular position and velocity coordinates, the earth's equatorial radius and gravitational constant and the coefficients of the 2nd, 3rd, 4th, 5th, and 6th harmonics.

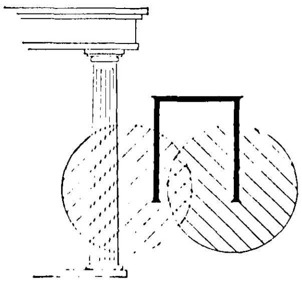
In addition to considering the effect of the earth's oblateness, the program permits the inclusion of the effect of the drag owing to the earth's atmosphere.

The density used in the drag function is computed by means of table look-up as a function of height and thus different models of the atmosphere may be introduced. Unequal tabular intervals in the height may be used.

The time step is variable and good results have been achieved with time-steps as high as eighty seconds.

The machine time per time-step is 42 milliseconds when no atmospheric drag term is necessary and 52 milliseconds when an atmospheric drag term is necessary. For an 80 second time-step, this is approximately 1900 times real-time without drag and 1500 times real-time with drag. The IBM 7090 version of the code is expected to require only 8 milliseconds per time-step and will therefore operate about 12,000 times real-time.

A test problem was run on an orbit whose eccentricity was .33 and reasonable accuracy was retained even after 1000 revolutions (120,000 time-steps).



OVER $10 MILLION OF COMPUTER EQUIPMENT INCLUDING IBM 7080 AT WORK

McDonnell Automation Center
Division of McDonnell Aircraft Corp.
St. Louis 66, Mo.

This center, which supplies data processing services to more than 30 industries in the East, Midwest and Southwest, has installed an IBM 7080 Computer, one of the world's fastest commercial data processing systems.

Inclusion of the huge solid-state computer brings to some $10 million the value of the analog and digital equipment in use by the Automation Center and its staff of more than 400. This center offers a complete range of planning and consulting services, systems design, programming, data processing and computing.

Among the applications the Automation Center handles are: student scheduling, grade reporting and record-keeping for secondary schools, magnetic ink check processing, refinery simulation for petroleum producers, actuarial work for an insurance firm, direct mail advertising for a financial institution, nuclear research for a consulting firm, inventory control, market and sales analyses, general accounting, accounts receivable, stockholders' records, sales audit, production control, etc. Industries served include: financial, retailing, electrical, chemical, automotive, steel, appliance, wholesaling, liquor, metalworking, medical research, communications and food.

ANALYSIS AND EVALUATION OF WEAPONS BY COMPUTER SIMULATION

Picatinny Arsenal
Dover, N.J.

Thousands of mock battles will be fought during the next few months at Picatinny Arsenal -- yet not a shot will be fired nor a soldier wounded.

The battleground will be a newly-installed computer system -- an IBM 709/1401. The 709 can handle up to 42,000 additions or subtractions a second.

The computer installation is an important link between the weapons under test today and the defense of the U.S. tomorrow.

This arsenal is the Army Ordnance Corps' principal research and engineering center for ammunition and special weapons, and is staffed by scientists who are studying future weapons requirements. The main purpose of the new computer system is to speed up and enlarge the scope of scientific research in basic weapons and weapon systems.

To analyze and evaluate a single ammunition item, as many as 1000 tactical situations are simulated on the computer by introducing data on troop placement, wind effects, atmospheric conditions, range, elevation angles, projectile size and weight, warhead lethal potential, and other variables.

Results obtained from these computer "battlefields" might under actual conditions have required up to 1000 field engagements.

Among the major jobs assigned to the computer will be terminal effectiveness studies, exterior and interior ballistics, design calculations, data reduction and management science techniques for control of research, and development programs.

These applications will be especially significant for the development of such weapons as the Nike-Zeus anti-missile missile and the Davy Crockett portable atomic weapon for infantry soldiers, which was perfected by Picatinny scientists.

The new installation actually consists of two computers -- the IBM 709, capable of performing complex scientific and technical calculations very rapidly, and the IBM 1401 medium-size computer which speeds up input of raw data to the 709 and the output of its results. The 1401 printing unit is capable of producing records at speeds up to 10 lines per second.

COMPACT, ACOUSTIC SERIAL MEMORY STORES 1600 BITS AT 16 MEGACYCLES

Computer Control Co., Inc.
983 Concord St.
Framingham, Mass.

A digital serial memory with pulse delays ranging from 20 microseconds to 100 microseconds at operating frequencies of 8 to 16 megacycles is now available from this company in a compact, self-contained plug-in package. Designated the SM-40, this memory provides storage at unprecedented data input rates, as high as 16 megabits per second, without the need for carrier modulation. The package contains all necessary input-output logic and is fully compatible with existing H-PAC digital modules of this company for the implementation of complete serial memory systems.

This memory makes use of a newly developed fused silica ("glass") acoustic delay line with a temperature coefficient that approaches zero

(± 2 ppm/°C max), thereby obviating the requirement for temperature control. This feature enables the memory to be handled in essentially the same way as any solid-state digital plug-in package.

TWO FORUMS ON ELECTRONIC COMPUTERS FOR LAWYERS

John E. Mulder, Director
Joint Committee on Continuing Legal Education
American Law Institute and the
American Bar Association
133 South 36th Street
Philadelphia 4, Pa.

Electronic computers are with us with dramatic suddenness. It is essential that lawyers, accountants, government officials, business men, computer specialists, and others learn about the full scope of their use and their impact at once. No one can afford to drag his heels.

Two important forums on "Legal and Practical Questions Raised by Computer Use" have been scheduled. They will be held at the Pick-Congress Hotel in Chicago on October 19, 20 and 21, 1961 and at the Statler-Hilton Hotel in Los Angeles on December 14, 15 and 16, 1961. The sponsor is the Joint Committee on Continuing Legal Education of the American Law Institute and the American Bar Association, the educational arm of the organized bar. The need for these educational sessions was demonstrated by the successful forum on the same subject, the first of its kind, conducted by the Joint Committee in Washington, D.C. in March, 1961.

The three-day sessions will be highly informative. They are intended to help minimize legal frictions and entanglements in the ever-widening adoption of computer technology throughout society. The forums will be divided into two parts. In the first, the computers themselves, their functions, their future and their shortcomings, all in relation to their legal implications, will be discussed by those with expert knowledge. In the second, and major portion leading lawyers in their respective fields will participate. They will explain specific factors of the new technology requiring legal attention, as well as methods of forestalling problems and resolving unusual situations. The presentations will be designed to equip lawyers as well as others concerned with designing and using computer systems, to spot legal and other pitfalls in advance.

More specifically, attention will be directed to the impact of computers in the following areas of law: The Rules of Evidence; Tort (Accident) Law; Banking, Insurance, Corporation, Labor, Antitrust, Patent and Copyright Law; and Tax Law and administration. Finally, suggestions will be made on how to utilize improved information processing technology in the practice of law.

Detailed descriptive brochures will be mailed in due course to lawyers, accountants, government officials and other interested individuals and organizations. In the meantime, information can be obtained from the writer. In charge of overall planning will be Roy N. Freed of the Philadelphia Bar, who was in large part responsible for the success of the first forum in Washington, D.C.

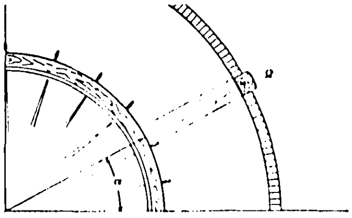
NEW OPERATING EFFICIENCY

Boston Edison Co.
Boston, Mass.
(Announcement to its customers)

Another advance in the interest of operating efficiency has been made at Boston Edison's Mystic Station, Everett. The installation of a Data Logging Computer to gather and analyze information pertinent to the operation of all six boiler-turbine-generator units is now completed and in operation.

The functions of the computer, which required the installation of some 58 miles of wiring, are as numerous as they are amazing. It provides information gathered instantaneously from hundreds of separate sources. Audio alarms and automatically typed recordings inform operators of any abnormal condition which might cause equipment failure if not quickly detected.

The computer calculates efficiency of generation of each of the six units. This information is channeled to a central information room. Important among the multifold advantages of the installation is the more efficient utilization of personnel.



AUTOMATIC PRINTING OF 130,000 ADDRESS LABELS PER HOUR FOR READER'S DIGEST

A. B. Dick, Co.
Chicago 48, Ill.

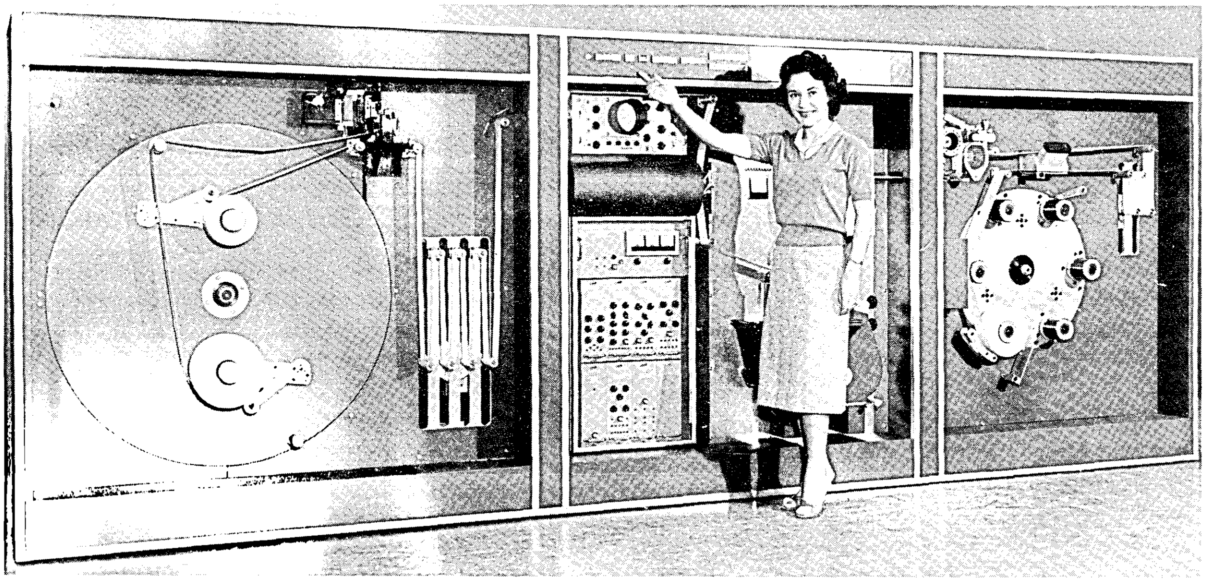
This company will install an address-label printing system for Reader's Digest, Pleasantville, N.Y., to reduce time and costs in handling the publication's mailing list of over 12,000,000 subscribers.

The system, called Videograph, is capable of printing 131,400 address labels per hour from magnetic tapes prepared on an electronic computer. It is expected that the March 1962 and later issues will be addressed in this way.

A printer control unit operates from fully-edited tapes prepared on small general-purpose computing equipment, and is compatible with virtually all modern electronic computers.

The printer will be linked to two large-scale Remington Rand Univacs by an IBM 1401 computer. It is a high-speed electrostatic printer for producing address labels from digital pulse-code input. It operates "off-line" from magnetic tape or punched paper tape, or, if desired, directly from an electronic computer. Automatic flying paper-slicing and roll-changing mechanisms permit completely continuous operation.

It has three main sections: paper supply, printing and take-up. A paper transport system carries the paper web from a supply roll past the various printing and punching stations and rewinds the printed labels on a take-up reel.



Paper Supply

A turret assembly supports an active and a stand-by supply roll positioned at 180 degrees to each other. The active paper web is guided through the splicer and into a paper elevator. The stand-by roll is threaded into the splicing mechanism.

As the active roll is depleted, the stand-by roll is automatically spliced to the active web and the turret rotates slowly to bring the stand-by roll into the feed position. During the splice the web is momentarily stopped but the reserve supply of paper in the elevator mechanism continues to feed the printing section without interruption. The operator loads and threads a new stand-by roll about every thirty minutes.

Printing

The printing function is a three-step process: Imaging, Developing, and Fusing. The "heart" of the Videograph printer is the electrostatic printing tube (EPT) and its associated character generator. The character generator converts digital input signals into readable "television-type" signals which operate the EPT.

Electrostatic charge-patterns in the shape of latent character images are formed on the moving paper web as it passes in front of the EPT. Printing is at the rate of over

6000 characters per second on the paper web moving 36.5 inches per second. The paper web then enters a developing unit in which rotating magnetic drums brush a thermo-plastic, resinous toner powder over the surface of the electrostatically charged paper. The black toner particles adhere to the electrostatic images on the paper making the image visible.

Next, the paper enters an infrared fusing unit where the image is permanently fused to the paper. The fuser generates sufficient heat upon the paper surface to melt the toner. The temperature of this unit is controlled by a variable transformer connected to a heat sensor which measures reflected heat from the moving web. In event of shutdown for any reason, the fuser elevator immediately descends, lowering the paper web from the fuser station to prevent burning the web.

Take-Up

At the output end of the printer, the paper web enters a drive mechanism which is coupled with a rotary sprocket punch. Control-hole punching of the web and synchronization of input signals, which feed the label information to the printer, are also accomplished at this station.

The web then enters a third paper elevator which maintains constant web tension during the take-up operation. A turret assembly supports six take-up reels positioned at 60 degree intervals on the turret.

Rewinding is accomplished on a take-up reel in the 7 o'clock position. The paper web is also in contact with an empty reel in the 9 o'clock position. The take-up reels are perforated plastic cores, and the spindles on which they ride are subject to a vacuum when in the 9 o'clock position.

The printer can produce a uniform number of labels per roll or may cut-off a roll at any point in response to "end-of-roll" signals from the in-put source. At an "end-of-roll" signal, a high-speed cutting knife opposite the 9 o'clock position cuts the web and forces the leading edge of the web against the vacuum-operated empty reel to bring a new roll. The turret assembly then performs a 60 degree counterclockwise rotation to position an empty reel for the next "end-of-roll" signal.

The operator removes the rolls of printed address labels and replaces plastic cores on the spindles.

PROJECT PLANNING PROGRAMS FOR USE BY SMALL BUSINESS FIRMS

Bendix Computer Division
Los Angeles, Calif.

Small business and industrial firms can now take advantage of planning programs originally designed by the military services for project planning of large-scale government contracts.

This company has devised a simple and practical approach to project planning similar to the Navy's Program Evaluation Review Technique (PERT) and the Air Force's Program Evaluation Procedure (PEP). Developed for the Bendix G-15 computer, it permits automatic planning, scheduling, estimating and control of engineering, construction and development projects. Computer assistance for the control and coordination of multifactor projects is becoming increasingly interesting to business and industry for commercial applications.

The program is being used particularly in chemical and petroleum fields.

The program provides a simple and direct way of setting down the problem manually, and its subsequent handling by the computer. It requires only one time estimate for each job in a project and only the critical path of events.

Input to the computer includes individual jobs and the estimated time required to complete each job. Output is in chart form, showing status of jobs and where to expect "trouble spots".

The method allows random numbering of jobs in a project, with no editing or sorting required of the computer. It also allows changes and additions to be made in the original diagram of the project after the program has been entered into the computer. Occasional input errors may be corrected without rerunning the entire program.

The PERT/PEP method requires that events be numbered in exact sequence. Other methods require no exact numbering for input to the computer; however, editing and sorting of information to provide exact sequence must be accomplished before computation can take place.

The Bendix system allows jobs to be numbered in any order, with the single requirement that the last event must be given the highest number. The computer does <u>no</u> editing.

INFORMATION RETRIEVAL BY CITATION INDEXES -- $300,000 GRANT

Institute for Scientific Information
Philadelphia, Pa.

A $300,000 grant extending over a three-year period has been awarded to this institute to study the practicability of "citation indexes" and to test ways to prepare them. The grant is from the National Institutes of Health and the National Science Foundation, and it is aimed at producing a unified citation index for science including the publication of a genetics index.

What is a "citation index"? If an article you were reading had a bibliography of references cited, the article would be called the "referant", and each item in the bibliography of the article would be called a "reference". A list of references, each of them being followed by its associated list of referants, is a citation index. By using a citation index, the researcher finds out what works have cited a particular reference following its publication.

By making use of citations rather than specific subjects, there is a possibility that a citation index will be a more useful way into scientific information than a subject index. A scientific researcher is generally aware of one or more particular papers already published in the area of his specialized interests; so he will tend to use the citation index as a starting point in research, rather than various specific topics found in the usual subject index catalog.

Authors will be able to see at a glance what literature has been published following their own works, that cite (refer back to) their own works.

Because of its different construction and purpose, a citation index complements an index like Chemical Abstracts or Biological Abstracts, and is not intended as a substitute.

Experimental studies on systems for extracting and processing citations will soon be completed. It is estimated that approximately 1,000,000 references will be processed during the next 6 months on a high-speed magmagnetic-tape computer. Approximately 3,000,000 citations from scientific literature published 1959 to 1963, will be processed during the life of the project.

COMPUTER FACILITY IN CHICAGO FOR INFORMATION PROCESSING

General Electric
Schenectady 5, N.Y.

An Information Processing Center to serve the computer needs of local and area businesses has been established in Chicago, Ill., by this company, and is scheduled to open in late fall of this year. The center will be equipped with complete GE 210 and 225 computer systems. It is the first of a projected nation-wide network of Information Processing Centers.

The center will render service to area businesses not now using a computer or those not large enough to use their own computer. In addition, the center will be available to firms requiring peak overload capacity and companies in need of analysis or programming service which is not available from their own staffs.

The center will also provide service to G-E computer customers whose equipment is not yet installed or who may require emergency service, and will be a training site for G-E and customer personnel.

WESTINGHOUSE AND SPERRY RAND TO DEVELOP AND MARKET PROCESS CONTROL COMPUTER SYSTEMS

Westinghouse Electric Corp.
New York 5, N.Y.

Westinghouse Electric Corporation and Remington Rand Division, Sperry Rand Corporation, announced on Sept. 5 they will begin immediately the joint development of new and improved automatic control systems using electronic computers.

The control systems would be applied to automatic control of customers' processes in industrial, marine, and other applications.

The two companies will,immediately begin cooperative development of an advanced line of process control equipment. Westinghouse will have system responsibility for supplying complete systems including installation and related services.

Management and Control By Exception

Owen Smith
First Vice President
Statistical Tabulating Corp.
Chicago, Ill.

(Based on a talk before the 1961 Annual Seminar of the National Association of Cost Accountants, St. Louis Chapter)

Can American industry harness computer-electronic technology and channel the massive information potential to useful purpose? or are executives about to be buried, literally buried, with computer-produced facts?

In large measure, the answer to this question is in the hands of specialists such as accountants and computer people.

We have a tiger by the tail in this problem and its answer: more effective *management by exception.*

An Old Idea

The *exception principle* in managing is an old idea with its roots in human nature itself. It simply states that a person in charge (a manager) pay *routine* attention *only* to important matters requiring *his* action. Such matters are *exceptions* relative to all other possible matters which, in turn, are *delegated* to subordinates or disregarded.

Now, this is universally prevalent—parents constantly filter out all the children's noises to get a signal, teachers know a routine and ignorable gripe from a real complaint, all of us *really listen* to only a minute fraction of what others say.

It *has* to be this way—the human transmitter puts out a massive volume and we'd literally go mad if we sought to respond to all of it.

In business managing, the idea is also ancient—one writer[1] traces it back to the advice of Jethro (an early consultant) to Moses on organizing the Israelites into thousands, hundreds, fifties, and tens. More recently, in 1903, it was set forth as fundamental by Frederick W. Taylor, of "scientific management" renown:[2] "It is not an uncommon sight . . . to see the manager of a large business fairly swamped at his desk with an ocean of letters and reports. . . . The exception principle is directly the reverse of this. Under it the manager should only receive the condensed, summarized, and invariably comparative reports . . . and have all of the exceptions to the past averages or to the standards pointed out . . . giving him in a few minutes, a full view of progress that is being made." Note that this was in 1903 and since then it has been re-iterated by many, many people and is generally accepted as a business "law."

However, in practice, this law is honored more often in the breach than in the observance; and when followed is usually "accidental." We have a common example of accidental management by exception when the "boss is busy" and "can't be bothered."

The situation of accidental exception has its roots in management's disinclination to follow rational exception procedures. The "busyness" of the manager is due to his inclination to want "all the information" that is available. He feels that by having this mass of detail pass over his desk he is keeping in close touch with the entire business.

Professors Lemke and Edwards of Michigan State University[3] suggest it is not just the manager who ignores the exception principle: "Frequently the controller 'solves' the problems by giving line managers everything there is to know, swamping them with details."

This tendency gets progressively more absurd and more dangerous. For we have now, in electronic computers, the literal ability, not to swamp, but to bury a manager. In one situation, that must remain unnamed for obvious reasons, *daily* sales reports from a 1957 model computer to *one* sales division manager's office, ostensibly for his personal perusal, measured four feet high.

Manufacturing companies among Statistical Tabulating Corp.'s clients use from 500 to 2500 different forms. It has been estimated that employees of one large automobile firm handle a million different pieces of paper a day.[4] "Computer technology is outdistancing computer sociology. The problem today is not getting more and more information," he said. "The problem today is the need of management to get this information in the form that it needs it and in time to take effective action."

Our job must be to bring home this lesson to management. We must tell them: "You managers cannot review every piece of data, oversee every event, and deal effectively with every item of information. This procedure is unnecessary, in many cases impossible, and most assuredly not desirable."

Professor John M. Allderige of Cornell University[5] put it none too strongly, when he wrote . . . "We are easily in danger of wallowing in ever-greater complexity in this management business . . . there is the general idea that refinement and insight are the same in management problems . . . that if more information is obtained faster, all problems can be solved . . .

overwhelmingly detailed data processing systems can be very real blocks to progress both in the money they can cost *and* the knowledge they can retard by all that clutter."

Planned Exception Control

The only answer is the planned, not accidental, use of the exception principle. The principle is being intelligently used today. But there is a possibility of even greater use. Its use is essential if we are to avoid my nightmare. Let us look for a moment at a few examples of how the exception principle is being used right now.

As reported recently in *Factory*[6] the American Machine and Foundry plant in Brooklyn is using a small Univac computer which prepares work-behind-schedule reports. Note the exception character of "work-behind-schedule": It is not a record of all work accomplished. Only those areas where management attention is needed because the work is *not* being done are noted.

Department stores are becoming big users of planned exception control. Macy's in New York City, Dey Brothers in Syracuse, N. Y., and McCurdy's in Rochester, N. Y., to mention but a few, have going or are experimenting with the reporting of just "fast" or "slow" moving items, rather than all items on the daily sales report.

The Cummins Engine Company in Columbus, Indiana, has recently installed an integrated process control system.[7] One aspect was the establishment of control limits with respect to customer demand. Weekly, estimated average monthly requirements for each part are compared with the corresponding upper and lower control limits by means of an IBM 650. If the requirements are above the upper control limit or below the lower control limit, the Production-Control Group is notified. This Group then reviews the relevant information pertaining to the part and acts accordingly.

This principle is important to you even if it is not utilized on a computer. For example, the Allerton Chemical Company in Rochester, N. Y., operates a visual inventory system without the customary stock ledger cards. Only the exceptions in the form of raw materials at or below the order point are reported or recorded.

Needless to say exception control can reap enormous benefits. Let me cite an excellent example. The Westinghouse meter plant in Newark, N. J. is reported to be saving a cool million dollars a year by computer inventory control.[6] Using sales figures, and taking into account the costs of labor turnover, machine set-up, and so forth, the computer decides when to stock an item formerly produced to order, when to adjust the inventory of an item losing popularity, etc.

Decision Rules

Note the key word is decision. The computer can make decisions and must be allowed to do so. But it can't think.

It can only decide on the basis of *decision rules* established by management. In department stores, fast and slow criteria were set forth *beforehand;* at Cummins, control limits were set *beforehand*. Exception control requires this.

Exceptions to standard performance are reported. Then management can decide according to the amount of variance whether the manager should investigate the situation further. If exception control is working there will be less data and fewer and shorter reports being passed around.

You'll be reading about the exceptions on which you must take action rather than reading yourself blind just to find out that everything is dandy . . . you'll be thinking about getting the routine decisions made for you, rather than getting reports upon which you must make the decisions.

As Mr. Robert W. Christian, Associate Editor of *Factory*[6] advised. . . . "Insist on getting decisions, not just reports . . . that's what computers are for. . . . Don't hang new machines on an old system. . . . A horse with dual carburetors is still a horse."

Designing Decision Rules

Machines can't think for us but they do force us to think and re-think our business problems.

One of the tragedies of computer use today is the automation of current confusion. It isn't sufficient to just state old rules. New rules must be designed to take advantage of the new technology available.

It should be noted that the decision rules can be rather complex, ranging all the way from the simpler rate-of-sales rules in the department store example to the apparently sophisticated rule of the Westinghouse plant. We have both the mathematical insight to concoct detailed rules as well as the computer capacity to handle the complex mathematics.

Indeed, this leads to another danger substituted for the aforementioned danger of excessive reporting—the danger of over-complicated exception criteria. This usually stalls for some time the installation of effective controls. The current brand of operations research people must be watched and prodded so they don't get carried away with the delights of analysis.

We must be aware of confusing figures with facts. I would define facts as pertinent figures in manageable form.

This shouldn't be construed as a negative, however, for there are some very fine efforts in research areas on complex rules for often complex situations. Your recent *NAA Bulletin* of January 1961 has an excellent paper by Robert Grant of Phillips Petroleum on a mathematical approach to decisions[8]. And in the March 1960 issue of *Fortune* Mr. George Boehm had an extensive coverage of this difficult subject. As Mr. Grant says, "Mathematical models of varying complexity are being used today to assist management in many operating areas. . . . These new tools will greatly aid industry to meet the economic challenges of the future."

And that aid will be more greatly realized if this design concept is brought more effectively to bear in setting up the exception criteria.

Tailor-made control systems are a must—whether we use arithmetic or mathematical programming, one sheet of paper or the most elaborate computer. Other-

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wise management and control by exception is just not a reality.

The Difficulties and the Challenge

The difficulties are enormous—we have a staggering capacity for information storage and emission. It is natural, moreover, for us to be pleased with this truly amazing accomplishment and push it even further. But it mustn't be done without awareness of the social impact on people.

Nuclear development has forced upon society new political problems and social solutions. Computer advances are forcing on management society, new channels, forms of conduct, and a re-programming of our thinking.

Of course, we can't afford to generate all the facts, information, and data that we are capable of producing. We have seen that it is necessary to channel all the noise we are capable of and make it intelligible.

This channeling presents a very real human problem in decision rule design. Unconsciously the manager very often resents mathematical models for decision making; the programming of the computer which enables it to make judgments. He can view it as an afront to his personal contribution of making decisions in complex and uncertain situations.

In fact we know that the construction of these mathematical models places a premium on top management's contribution.[9]

This fact which you and I are aware of, is our hope, our only hope, if we are to guide management into intelligible uses of data processing and computing equipment.

We can't jam computerized mathematical decision-making down management's throat and yet we can't afford *not* to have it. Somehow, someway this "new thought" must be conveyed. We must convince the manager that these apparent encroachments on managerial prerogative are really opportunities for far greater leadership.

Managers are hardly running out of problems as science moves in on schedules, budgets, inventory levels, production planning, and the like. True, the unimaginative may run out of vision. But all this science in business is really *releasing* executive talent for its basic job of broad leadership and creativity.

The challenge, then, is to harness our massive information potential to useful purposes. It has to be *used* of course, my own situation insists that at least, but used wisely.

Nor is this wisdom going to come strictly from technological research—they need *your* experiences as observers of the management scene, and as intelligent observers of management in action. Only in this way can we gain insight as to what good exception criteria are. Only in this way can we make management and control by exception—evermore fundamently and urgently needed—a thorough and effective reality.

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WHO'S WHO IN THE COMPUTER FIELD

From time to time we bring up to date our "Who's Who in the Computer Field." We are currently asking all computer people to fill in the following Who's Who Entry Form, and send it to us for their free listing in the Who's Who that we publish from time to time in **Computers and Automation.** We are often asked questions about computer people—and if we have up to date information in our file, we can answer those questions.

If you are interested in the computer field, please fill in and send us the following Who's Who Entry Form (to avoid tearing the magazine, the form may be copied on any piece of paper).

Name? (please print) ....

Your Address? ....

Your Organization? ....

Its Address? ....

Your Title? ....

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

....

Year of birth? ....

College or last school? ....

Year entered the computer field? ....

Occupation? ....

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

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When you have filled in this entry form please send it to: Who's Who Editor, **Computers and Automation,** 815 Washington Street, Newtonville 60, Mass.

Honeywell EDP Presents:

A FEW QUICK FACTS ON SOFTWARE

Software is a new and important addition to the jargon of computer users and builders. It refers to the automatic programming aids that simplify the task of telling the computer "hardware" how to do its job. The importance of software lies in the fact that programming a computer can be an arduous, time-consuming and costly operation and the quality of automatic programming aids has become virtually as important as equipment specifications in evaluating the total capability of a data processing system.

Generally, there are three basic categories of software: 1) Assembly Systems, 2) Compiler Systems, and 3) Operation Systems.

Assembly Systems

The basic element of any assembly system is a programming language that uses simple, easy-to-remember codes or terms to represent the various machine instructions. Code names are also used to represent entire fields of information stored in the computer memory. Under control of an assembly program, the computer translates these terms into the appropriate machine-language instructions.

Most good assembly systems include an extensive library of re-usable routines that can be combined into a group or inserted as part of a program by a computer. This way, routines for repetitive functions do not have to be re-written each time they are required. A sophisticated assembly program also includes routine generators that require only definitive parameter information to yield detailed sorting routines and input or output editing routines. Assembly systems also include routines for housekeeping functions such as controlling end-of-file conditions and the flow of data to and from the computer memory, tape-labeling to check and update the identifying information recorded on every magnetic tape, and other controls as opposed to data processing functions.

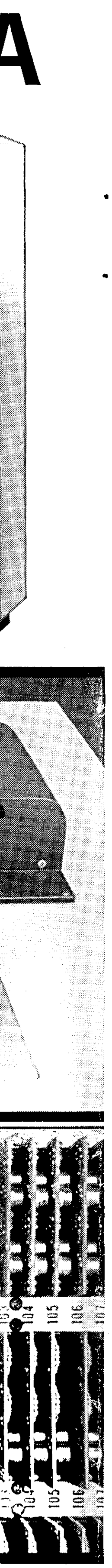
Compilers

Compiler systems differ from assembly systems in that they translate from a source-language into a machine-orientated language. The source-language of a compiler is based on the nature of the work to be done — business terms for business compilers, mathematical terms for scientific compilers — rather than on symbolic machine-language. When a problem stated in compiler (or source) language is fed into the computer, the compiler program translates the source-language program into detailed machine-language or asembly-language instructions that tell the computer how to carry out the desired work.

Compilers vary widely in sophistication and usefulness. The more advanced types produce programs with as little as 1-10th of the human effort required using an assembly system, or 1-100th of the effort that manual machine programming would require. Because so much of the detailed work is done by the computer, there are fewer opportunities for logical or human errors. Programs written in compiler language are easily read and evaluated by supervisors or others with an interest in the details of the computer application.

An added plus is the fact that the programs in this form provide readable documentation, including the latest changes, of the data processing procedures.

An advanced compiler can generate sorting routines, create files, generate printed reports, and edit and check data. If compilers do not have all these capabilities, the gaps have to be filled in using assembly-or machine-language. Obviously this dilutes much of the original value of the compiler.



Operation Systems

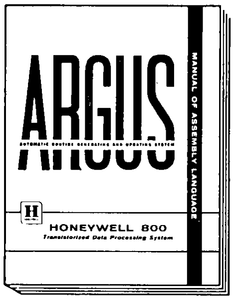
The terms assembly and compiler systems pertain principally to the language in which a program is written and the means of translating this language into machine-language programs. In addition to these systems are systems for monitoring the operation of the machine-language program and for operating these programs in varying modes. For example:

Program diagnostic systems may help make good use of computer time by permitting "batch" checkout without human intervention. Special outputs can be tailored to the programmers' needs to tell them what they want to know about their programs. This testing technique can speed program checkout by enormous factors.

Simulator Programs can be written to make one computer act like another. During conversion periods, for example, programs written originally for an outmoded computer can be run directly on the new computer with a simulator program. This permits immediate operation on the new system without reprogramming, and new programs, designed to utilize the capabilities of the new computer with maximum efficiency, can be written unhurriedly.

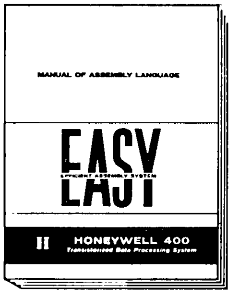
Monitor routines increase the efficient utilization of equipment by controlling the selection and sequencing, starting and stopping of programs, and thereby removing much of this detail from the duties of the computer operator.

With every electronic data processing system, Honeywell provides an unusually complete and powerful package of automatic programming aids. Here are some of the Honeywell innovations in in above three areas.



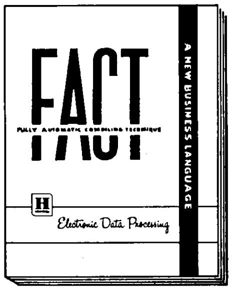
Honeywell ARGUS

An assembly program for the Honeywell 800, called ARGUS, includes an easy-to-use assembly language, a library of routines and generators, and all the operational programs that simplify program writing, reduce errors, and keep the need for human intervention to a minimum, thus utilizing the computer in the most efficient manner. There are versions of ARGUS for both punched-card and magnetic-tape systems.



Honeywell EASY

EASY is the name of the assembly system for the Honeywell 400. EASY includes all the elements of a powerful assembly system including powerful editing instructions for input and output operations and the ability to incorporate thoroughly tested routines into a program. Programs written in EASY language can be checked out and run on Honeywell 800 as well as Honeywell 400 systems.



Honeywell FACT

An advanced business compiler for the Honeywell 800, called FACT, is the acknowledged leader in its field. It is the first compiler to take into account all facets of data processing including editing input information, sorting, creating files, processing variable-length records and generating output reports. Due to the exceptional breadth and power of FACT, an unprecedented percentage of business operations can be programmed for a Honeywell 800 with this system — and in a fraction of the time previously required.

Honeywell Algebraic Compiler

This Honeywell compiler aids the creation of scientific and mathematical programs. The programming language is the same basic terminology used by several computer manufacturers and the sub-routine library consists of routines commonly used in solving scientific and engineering problems. Algebraic compilers are being offered for Honeywell 400 and Honeywell 800 data processing systems.

Honeywell COBOL

Considerable effort has been expended by the computer industry in an attempt to develop a universal problem-oriented programming language that can be implemented for all computers. One such business-language compiler is called COBOL (Common Business-Oriented Language). Facilities are being provided in both Honeywell 400 and 800 for accepting programs written in COBOL language.

Honeywell Executive System

Maximum use of the ability of Honeywell 800 to run programs in parallel is achieved through an automatic programming aid called Executive System. The executive system assists the human planner in preparing and executing a daily production schedule which optimizes utilization of the system's available equipment configuration and parallel processing ability. It controls program loading, turning on and off of programs, provides restart facilities in case of program failure or operator error and communicates with the operator, keeping him informed of progress of the run, and accepting his control instructions in case the schedule has to be modified at production time.

Honeywell Program Test System

Efficient machine utilization is the primary benefit of the Program Test System which permits programs to be batched and tested at high computer speeds without human intervention. Programmers receive whatever output information they require to evaluate their efforts and make necessary changes and improvements.

Honeywell Library Addition and Maintenance Program

The utility of a library of re-usable routines is directly dependent on the extent of provisions for adding, deleting or merely selecting routines for use. A special Honeywell program called LAMP handles these functions automatically.

Honeywell Scientific Routines

An important part of the library of routines furnished by Honeywell are the various scientific programs for computing trigonometric functions, exponentials, logarithms and other transcendental functions; performing matrix multiplication and matrix inversion, interpolation curve fitting, solving ordinary differential equations, linear programming problems and others.

Sort and Collate

A unique series of sort generators have been designed for use with Honeywell data processing systems. These generators require only basic parameters to develop sorting or collating routines utilizing special advanced sorting techniques developed by Honeywell specialists. These new techniques take advantage of the high-speeds and multiple-duty capabilities of Honeywell EDP systems and result in exceptionally high-speed sorting.

THOR

To minimize the amount of manual tape-handling procedures necessary in the operation of Honeywell 800 systems, a special routine called THOR has been devised. Under the direction of operator-devised parameters, THOR handles all tape positioning, copying, correcting, and editing of recorded information. THOR also helps locate information on tape, compares the contents of two tapes for discrepancies, and performs general tape maintenance.

Simulator Systems

Among the extensive Honeywell automatic programming aids available are simulator programs that facilitate changeover from outmoded systems to Honeywell systems. These simulators enable programs written for other computers to be run directly on a Honeywell 800 without modification, often at speeds as much as four times faster than on the original system.

Want More Information?

For more hard facts on Honeywell "Software" (and hardware, too), contact your nearest branch office or write Honeywell EDP, Wellesley Hills 81, Massachusetts. In Canada, Honeywell Controls Limited, Toronto 17, Ontario.

Honeywell

H Electronic Data Processing

Automated Information-Processing Assistance For Military Systems

PART 1

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President
System Development Corp.
Santa Monica, Calif.

INTRODUCTION

This paper discusses automated information-processing assistance—what it is, why it is needed and what it can do in large military systems, and how such a system is developed.

Before we proceed, however, let us define our terms. "Automated information-processing assistance," in this paper, refers to the use of high-speed digital computers together with their related equipment and computer programs as a tool in the performance of a job. The emphasis here is the help a computer can give and no attempt is made to describe the intricacies of computer operation.

A "military system" (in this paper) is an assemblage of men and equipment following defined procedures to carry out a mission. The management element of such a system (the Commander and his staff) is physically separated from some or all of the operating elements but must be supplied with accurate and timely information on the status of all of them if the system is to function effectively. The information communicated to the command group must be recorded, organized, and displayed. When decisions are made, the resulting commands must be transmitted to the operating elements.

Why should automated information processing be added to a military system? There are several reasons. First, there is the overwhelming volume of data with which military organizations must deal. The amount of data that has to be reduced and made meaningful is so great in many instances that men—any number of men—cannot do the job without assistance. In the second place, the decisions that have to be made are frequently too complex for the unaided individual and must often be made with the utmost speed. In fact, the permissible reaction time has in some instances become so short that it is beyond human capability to react appropriately.

WHAT AUTOMATED INFORMATION-PROCESSING ASSISTANCE CAN DO

General Functions

In addition to processing information, an automated system of the sort we are discussing also assists in receiving and transmitting information. This assistance is every day more necessary since the time is past when human beings in a large system can carry out such tasks unaided.

As we have seen, the amount of information which is required for a command decision has become so great and reaction time has become so short that some mechanical or electronic assistance is required. There is just too much data for a few men to process and evaluate; to increase the number of men in a command position may do no more than compound the problem. In a condition such as this, a computerized system is invaluable as a central receiving agency. The computer receives messages from such sources as radio, telephone, teletype, and automatic data lines. This information is converted into common terms, then stored for future use or presented to the human operators. This decision can be automatic since the computer program can be written so that routine messages are stored in the computer memory for future use; on the other hand, priority messages trigger an alarm. Thus all inputs come to one central source without delay and are instantaneously available to whoever needs them. Operations ranging from simple addition and subtraction to the solution of complicated equations in real time can be performed on data stored in the computer with a great savings of time. Once these computations are complete, the computer can communicate the results in many ways at great speed and to selected people. Communication may be by way of local displays and printed matter or by teletype and high-speed data lines. The recipients can be determined so that all messages of a certain type are always sent to a specific station. Information can also be made available by request.

Operational Examples

An automated information-processing system gives assistance to a military system in many ways. This assistance varies in complexity from a simple memory function to the solution of complicated equations. For example:

In SAGE, the computer receives the weather at each interceptor base and holds it until it is requested as a display.

In SACCS (the SAC Control System), the number of bombers on alert at any base is kept in the computer and added to, or subtracted from, as aircraft are put on alert or removed to standby.

A SAGE Direction Center receives thousands of radar returns every few seconds. The computer converts each radar return from a location expressed in range and azimuth into a location expressed in grid coordinates for the whole area under surveillance.

In both SAGE and SACCS, messages are received from many sources at once. The computers sort and summarize them and use them in calculations which give an instantaneous picture of continental and world-wide operations.

In SACCS, up-to-the-minute intelligence is provided on the locations of the enemy's attack facilities and on his major troop and plane movements.

SACCS gives a picture of global weather conditions. A knowledge of the location and intensity of storms is an important factor in determining bomber strike routes and points over which to conduct aerial refueling.

DEVELOPING A PLAN FOR AN INFORMATION-PROCESSING SYSTEM

Customer's Statement of the Problem

The development of an automated information-processing system is an orderly process. As a first step, the customer provides a statement of the problem that he hopes to solve with automated information-processing assistance. In the SAGE System, for example, the basic problem is to identify, track, and intercept manned bombers in large numbers. In SACCS, there are two basic problems. The first is the world-wide control of the SAC deterrent force; the second is information-processing assistance in the mammoth job of generating plans for emergency operations.

System Performance Requirements

The next step in development is to expand the customer's statement of the problem into a detailed set of performance requirements. (The major focus of these requirements is on the system's initial operating capabilities.) The preparation of system performance requirements involves an analysis of the environment within which the system will operate. This environment includes the forces to be controlled, the anticipated threat, interfaces with other systems, and the organization whose mission the system will support. Our observations at SDC indicate that the latter two aspects of the environment are often neglected. A brief examination readily shows the danger of such neglect.

System-Interface Analysis

Most large military systems interact in some way. Consider, for example, the NORAD COC (425L), SACCS (465L), and 438L, an intelligence-handling system. Suppose that 438L has intelligence which it might tell to the other two and to both in the same form. To use the same form would be wrong, however, because SACCS' need for targeting intelligence differs from NORAD's need for air-defense intelligence. Obviously, the designer of each of these systems could not restrict his investigations to the system being designed.

Another important interface consideration is the division of functions between systems. If several systems are generating much the same kind of information (intelligence data, for example) the duplication may be revealed and eliminated by an examination of system interfaces.

User-Organization Analysis

The systems we are discussing arise out of problems faced by an existing command; this same command will use the system when it is developed. Therefore, the command must be studied in detail to learn its organization, its problems, and its goals. Such a study leads to a better definition of the problems which the new system must handle. The study will also make it easier to phase in the new system. Finally, it may suggest improvements which can be made in the present operation before the new system is available. The study can be concurrent with the study of the environment in which the system must operate on its initial operational date.

We at SDC have found that the best way to carry out a study of this sort is to assign experienced system designers to work directly with military personnel. These designers are not liaison people; they are men who can talk with the military on the basis of common experience. In this way, we make an analysis which is an accurate reflection of the organization as it actually exists.

System Design

So far, we have discussed system performance requirements from the standpoint of the initial operational capabilities and the analysis of the user's organization. It is also important to look at the demands which are likely to be made on the system after its initial operational date. By considering such factors, we design a system which has the flexibility to handle new tasks as they arise.

Once these tasks are defined in the system performance requirements, system design can begin. The primary purpose of system design is to assign tasks to individual components. These components include such elements as equipment, computer programs, and standing operating procedures.

Until recently, the approach to system design was an outgrowth of component hardware design. That is, an engineer was told what a component was to do, then left to design it. For several reasons, this approach does not work well in the design of large military systems. A system is more than a conglomeration of black boxes. According to our definition, it is an assemblage of men and equipment following defined procedures to carry out a mission. Add automated information-processing assistance to a system and you add another sizable non-hardware element, the computer program. In designing an automated information-processing system, then, we must consider more than hardware; we must carefully consider the human element, the imbedding organization, and the programming requirement. Such an approach demands a team effort. The approach used by SDC, for example, integrates engineers, operations analysts, human-factors scientists, and programmers into the design team.

This interdisciplinary approach to system design must be anticipated during the generation of the system performance requirements to make sure that the necessary detail is supplied. Furthermore, we have found it desirable to have personnel continuity between the two operations; some of the people who wrote the system performance requirements should take part in the design of the system.

Simulation is one of the major tools in the development and validation of system design. At SDC, our first step in simulation is to put together a simple but functionally adequate replica of the system we are studying. Key positions are duplicated with relatively inexpensive (often makeshift) devices. Simulated input materials are formulated and introduced into this simulated system as they would be in real life. This enables us to bring in people and actually let them perform the operation. An analysis of performance in the simulated mode tells us whether or not we have a reasonable design concept. The analysis considers the match between inputs, equipment, people, and outputs; it also considers the reactions of the military people who will later man the system.

Simulation is used in several ways. As described above, it can be used for design verification. Its use for training will be discussed in a later section. Simulation is also a means of indoctrination to demonstrate the feasibility of a system. A new system is not always readily acceptable to the people who operate within it because they lack confidence in it. They cannot immediately see and understand the mathematical formulation that underlies the operation. Before the system is acceptable to them, they need to work with it and gain confidence by seeing it yield the proper results. As more sophisticated systems are developed, this problem of acceptance becomes more difficult to overcome.

When such systems go operational, neither the Commanders nor the people who man the system will be able to follow and confirm mentally the complex system calculation and logic which were formalized and rationalized in the design stage. For example, SAGE fighter-interceptor controllers give voice commands to the fighter pilots on the basis of computer-processed information displayed to the controllers on their consoles. The early SAGE controllers all had experience in directing fighter-interception from the radar control position of the pre-SAGE manual air-defense system. When such men first sat down at the SAGE consoles, we found them skeptical about the solutions provided by the computer. They tended to do as they had done before—that is, to estimate interception by eye and ignore the computer information. Simulated exercises gradually convinced them that the mathematics underlying the computer solutions (mathematics which were not at all obvious) really worked.

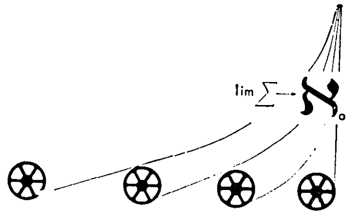
Operating-System Description

The product of the system-design effort is the operating-system description. The system description may take on a variety of forms during the design process. The important thing, regardless of form, is that the designers put their ideas on paper early in the design phase and as precisely as possible. The more precise the statement, the easier it can be validated by logical analysis or by simulation testing. Committing these design concepts to paper in an operating-system description also enables the user and the component producers to criticize and approve the design or portions of the design at various stages of the design process. This step-by-step approval allows component producers to begin work prior to the time the complete design has been agreed upon.

It is important to note that the requirements, the system design, and even the component design never become final since requirements levied upon the system constantly change. Therefore, the process leading to the system performance requirements must continue throughout the life of the system. This iteration allows new requirements to be incorporated in the system not only during the original design but even after the system has become operational. This is the primary manner in which system flexibility is achieved.

An important adjunct of iteration is the requirement for concurrence. Both the user and component producers must review and concur in the design at various stages. Concurrence is a task of some size, since a large amount of detailed and varied technical information must be reviewed by the representatives of several organizations. Differences must be resolved and agreements recorded. Newly identified problem areas sometimes require additional study. Through experience, we have developed procedures which facilitate this important process of concurrence.

(To Be Continued in the December Issue)



Who's Who in the Computer Field

(Supplement)

A full entry in the "Who's Who in the Computer Field" consists of: name / title, organization, address / interests (the capital letters of the abbreviations are the initial letters of Applications, Business, Construction, Design, Electronics, Logic, Mathematics, Programming, Sales) / year of birth, college or last school (background), year of entering the computer field, occupation / other information such as distinctions, publications, etc. An absence of information is indicated by — (dash). Other abbreviations are used which may be easily guessed like those in the telephone book.

Every now and then a group of completed Who's Who entry forms come in to us together from a single organization. This is a considerable help to a compiler, and we thank the people who are kind enough to arrange this. In such cases, the organization and the address are represented by . . . (three dots).

Following are several sets of such Who's Who entries.

Ordnance Supply Systems Field Agency, Rossford Ordnance Depot, Toledo, Ohio

Biniak, Vern S / Prgmr, . . . / ALP / '29, Univ of Toledo, '57, systems analyst

Carr, Victor J / Tabulation Proj Planner, . . . / ABMP / '25, BGSU, '59, tab proj planner

Cooper, James L / Supv Digital Comptr Prgmr, . . . / ABLPS / '27, Dexter High Schl, '45, systems analyst

Hogle, Charles R / Prgmr, . . . / ALP / '26, Woodward High School, '58, systems analyst

Kring, Harold L / Supvsry Dig Comptr Prgmr, . . . / ADLP / '18, Nappanee High Schl, '56, systems analyst

Nowicki, Richard R / Prgmr, . . . / ABLP / '31, Univ of Toledo, '57, prgmr

Oberto, Norman J / Prgmr, . . . / ABLPS / '28, Madison High, '47, systems analyst

Palmer, Gerald H / Prgmr, . . . / ALP / '31, Vallejo Jun Coll, '58, systems analyst

Robbins, Dennis L / Prgmr, . . . / ALP / '28, Coll of Pacific, '58, prgmr

Seitz, Ellsworth E / Chief, Data Procg Div, . . . / ABLP / '11, NYS Teachers Coll, '48, consultant

Shamdera, Robert L / Systems Analyst, . . . / AL / '11, North High, '58, systems analyst

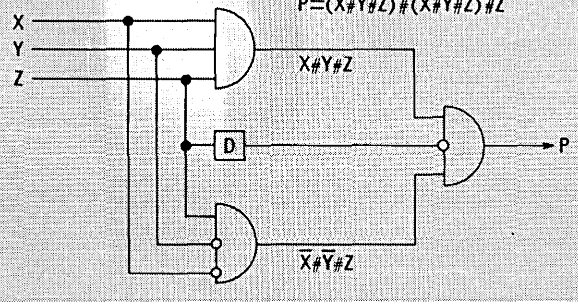
DERIVING MAJORITY LOGIC NETWORKS

FUND THM: $f(X,Y,Z) \equiv (X\#Y\#f_{x\bar{y}})\#(\bar{X}\#\bar{Y}\#f_{x\bar{y}})\#f_{xy}$

DEFINITIONS: $X\#Y\#Z \equiv \mathrm{Maj}(X,Y,Z)$; $f_{xy} \equiv f(X,X,Z)$; $f_{x\bar{y}} \equiv f(X,\bar{X},Z)$

DERIVATION: Let $f(X,Y,Z)$ be even-parity function P.
Then $f_{xy} \equiv \bar{Z}$ and $f_{x\bar{y}} \equiv Z$ so

$P = (X\#Y\#Z)\#(\bar{X}\#\bar{Y}\#Z)\#\bar{Z}$



The fundamental theorem of majority-decision logic, a typical product of Univac's Mathematics and Logic Research Department, has practical as well as theoretical interest. The even-parity checker derived above from the fundamental theorem can be treed to determine the parity of 3^n bits in n logic levels using only $\sum_0^n 3^i$ three-input majority gates.

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Blue Bell, Pa.

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New York 10, N. Y.

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Szady, Richard J / Dig Computer Prgmr, . . . / ALP, ord corps data prcg systs / '25, Univ of Toledo, '57, prgmr

Picatinny Army Arsenal, Dover, New Jersey

D'Alessandro, Phyllis / mathematician, . . . / ABLMP, ins, adv, telephone & clothing mfg / '27, St. Elizabeth Coll, '56, computress

Grobstein, David / Physicist, Res Engrg & Computing Sec, . . . / AMP / '33, Rutgers Univ, '56, prgmr, physicist / various classified reports dealing with systems feasibility studies and computer analysis of physical systems

Isakower, Robert I / Dig Computing Unit Chief (acting), . . . / AMP, management of computing installation / '32, NYU (MME), '58, mech engr / various publications

Nielsen, John N / Engrg Techcn, . . . / AMP / '33, Fairleigh Dickinson Univ, '59, prgmr

Pinamonti, William J / Physicist, . . . / MP / '31, Fairleigh Dickinson Univ, '59, physicist

Spector, Joseph / Chief, Res Engrg & Computing Sec, . . . / A, computing center management / '24, George Inst of Tech (BME), Univ of Va (MSME), '54, res engr / 10 classified reports dealing primarily with ballistics and computing

Yuill, Robert T / Mech Engr, . . . / P / '30, Tufts Univ, '56, prgmr, mech engr

Pratt & Whitney Aircraft, Florida Research & Development Center, United (West Palm Beach), Fla

Baker, Louis E / Numerical Analyst, Applied Prgmg, . . . / AM / '26, Manchester Coll, '59, —

Beultenmuller, Donald J / Numerical Analyst, Systems Prgmg, . . . / ABMP / '18, Univ of Fla, '56, systems prgmg

Curli, H E / Numerical Analyst, . . . / MP / '33, Florida State U, '59, prgmr

Guadano, Robert N / Dir, Data Processing, . . . / ABDELMP / '24, Columbia Univ, '50, mathtcn

Hamilton, Thomas Erwin / Analyst, . . . / MP / '33, Univ of Ala, '59, analyst

Hilovsky, Richard T / Analyst, . . . / AELMP / '33, Grove City Coll, '60, analyst trainee

Holcomb, Franklin J / Analyst, . . . / A / '28, Columbia Univ, '59, analyst

Huckaby, Eugene E / Numerical Analyst, . . . / ALM / '37, Univ of Alabama, '60, analyst

Jacobsen, Ronald A / Numerical Analyst, . . . / P / '36, Northern Ill Univ, '60, prgmr

James, William T Jr / Numerical Analyst, . . . / MP / '37, North Carolina State, '59, num analyst

Jette, O Q / Supvsr, Data Processing, . . . / ABDLP / '26, Hartford Inst of Acctg, '50, data processing

Keathley, S M / Numerical Analyst, . . . / LP / '34, Univ of Ala, '57, analyst

Konides, James A / Supvsr, Applcns & Systems Prgmg, . . . / AMP / '26, St, Anselms, '53, analyst, numerical

Losey, Herbert / Numerical Analyst, Applied Prog, . . . / AMP / '31, Univ of Okla, '59, num analyst

Loyd, Donald / Numerical Analyst, . . . / AM / '35, N. C. State Coll, '59, analyst

Lussier, Virginia C / Numerical Analyst, Applied Prgmg, . . . / ABLMP / '33, Univ of Conn, '55, num analyst

McKeever, Jack / Numerical Analyst, . . . / ALPS / '35, Indiana Univ, '58, system analyst

Metzner, Marlene / Numerical Analyst, . . . / AMP / '34, Xavier Univ, '56, prgmg asst

Oldehoeft, Arthur E / Analyst, . . . / AMP / '35, North Carolina Univ, '56, num analyst / Pubcns: "Titles of Papers Reviewed in Referativnyi Zhurnal", "Translation of Soviet Publications in the Area of Computers", "The Dept of Computer Mathematics at Moscow State Univ", Pi Mu Epsilon, Phi Kappa Phi

Ostlie, Jay D / Numerical Analyst, Applied Prgmg, . . . / AELMP / '37, Concordia Coll, '60, num analyst

Powell, Leon Max / Numerical Analyst, . . . / ALMP / '33, N C State Coll, '58, analyst

Russo, Edwin Price / Numerical Analyst, . . . / ELM / '38, Tulane Univ, '60, num analyst

Sandefur, Gene G / Numerical Analyst, . . . / ALMP / '32, Western Kentucky State, '60, analyst

Shapiro, Jerry / Numerical Analyst, . . . / MP / '38, Cornell Univ, '60, num analyst

Sink, Henry Rodney / Numerical Analyst, Applied Prgmg, . . . / AM / '37, North Carolina State Coll, '59, analyst

Sorrels, William P / Analyst, . . . / AM / '29, North Carolina State Coll, '58, num analyst

Taylor, George D / Numerical Analyst, Applied Prgmg, . . . / ALMP, analysis / '27, Troy State, '57, num analyst

Townsend, Clarence W / Numerical Analyst, Applied Prgmg, . . . / AP / '31, N C State Coll, '58, analyst

Vanderpol, Adriana J / Numerical Analyst, Applied Prgmg, . . . / AMP / '27, Univ of Mass, '55, num analyst

White, Nelson H Jr / Numerical Analyst, Systems Prgmg, . . . / AMP / '36, Trinity Coll, '57, system prgmg

Williams, Harry L / Group Leader, Numerical Analysts, . . . / ALM / '34, Mich State Univ, '56, Supvsr of Scientific Numerical Analysts

Zamberletti, Romeo C / Group Leader, Numerical Analyst, . . . / AP, systems / '28, St. Anselm Coll, '53, supvsr scientific analysis and prgmg

Radiation Inc, Box 6904, Orlando, Fla

Brigham, Robert C / Staff Mbr, . . . / ALMP / '34, MIT, '57, electrical engr / "A Translation Routine for the Deuce Computer", co-author

Burgess, Peter D / Staff Mathematician, . . . / AM / '33, N C State Coll, '59, scientific res

Lytle, E J / Staff Mbr, . . . / ABEMP / '13, Univ of Fla, '56, mathematician

May, Harry C / Staff Mbr, . . . / ABLMP / '32, Fla State, '59, prgmr

Morgan, John C / Staff Mbr, . . . / ADLMP / '25, Syracuse Univ, '50, electrical engr / numerous papers and programs for 700 series IBM computers

Young, John W / Head, Analysis & Computers, . . . / ALMP, planning / '12, Univ of Fla, '54, math and computing / Various publications

Sperry Gyroscope Co, 3 Aerial Way, Syosset, L I, N Y

Benedetto, J / Asst Publications Engr, . . . / AL / '38, Stevens Inst, '59, asst pub engr

Bonasera, John / Engr, . . . / DL, systems / '30, Lafayette, '55, engr

Brehemey, Richard F / Field Training Engr., . . . / teaching, design and systems analysis / '34, RCB Institutes, '57, field training engr

Bryant, Bernard L Jr / Res Engr, . . . / ALM / '30, VPI, '52, engr

Dacier, Joseph J / Engr, . . . / DEL / '29, Brooklyn Polytechnic, '57, computer des engr

Liguori, F / Eng Report Coordinator, . . . / computer publications / '30, Tufts

Univ, '57, publications engr / various publications

Rogich, Stephen / Engr, . . . / CDEL / '34, Columbia Univ, '56, engr.

Sylvania Electric Products Inc, Electronic Systems Div, 100 First Ave, Waltham 54, Mass

Breault, Dermott A / Sen Prgmr, . . . / MP / '35, Carnegie Inst of Tech, '57, prgmr

Chaves, Claire V / Prgmr, . . . / AMP / '37, Univ of Rhode Island, '58, prgmr

Halpern, Barbara M / Prgmr, . . . / AMP / '35, Brandeis Univ, '58, prgmr

Pembroke, Margaret G / Sen Prgmr, . . . / MP / '32, Kent State Univ, '56, prgmr

Sidlo, Clarence M / Supvsr, Computer Section, . . . / AMP, computer center administration / '28, Northwestern Univ, '54, prgmr-mathematician

Spahl, Ruth L / Prgmr., . . . / AMP / '36, Univ of Mass, '58, prgmr

---

Colwell, M C / Prgmg Analyst Sen, System Development Corp, K I Sawyer AFB, Gwinn, Mich / P / '35, Iowa Teachers, '58, prgmr

Elfes, Orlo B / Field Services Administrator, System Development Corp, Sage Bldg, Truax Field, Madison, Wisc / administration / '19, Univ of Minn, '57, administration

Lepine, Louis T / Senr Training Leader, System Development Corp, Sage Bldg, K I Sawyer AFB, Gwinn, Mich / battle simulation and system training / '27, Catholic Univ of America, '58, psychologist

Miller, Barbara / Prgmr, Minute Maid Corp, W Colonial Dr, Orlando, Fla / LMP / '22, Mount Holyoke Coll, '58, prgmr

Pena, Charles A / Genrl Sales Mgr, ALWAC Computer Div, 13040 Cerise Ave, Hawthorne, Calif / ADS / '27, Oregon State Coll, '51, sales mgr

Peterman, Allen F / Elec Systems Analyst, Philco Corp, C & Tioga Sts, Phila 34, Pa / P, teaching computers and/or prgmg / '27, Electronics Inst, '57, EDP systems analysis and prgmg

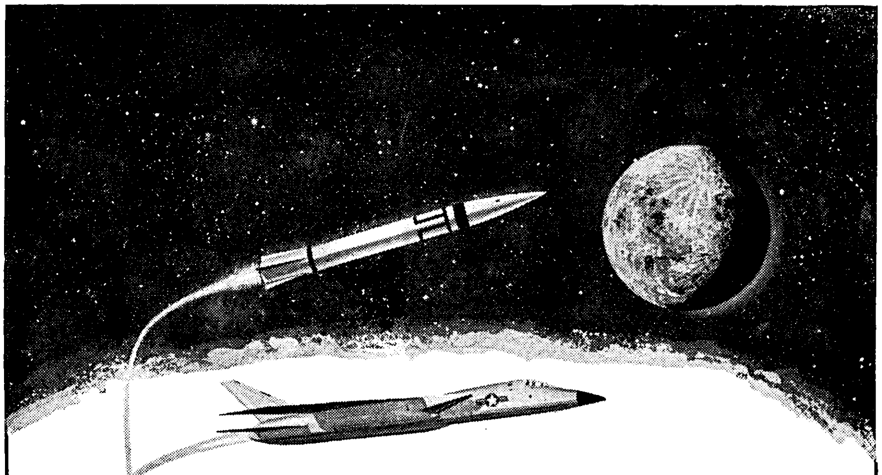
Peterson, Daniel E / Comptr Prgmr, Atlantic Flt Opconcenter, FAU Cinclant, Norfolk 11, Va / ABP / '31, Univac Scientific 1103A Systems Operations Training, '58, prgmg

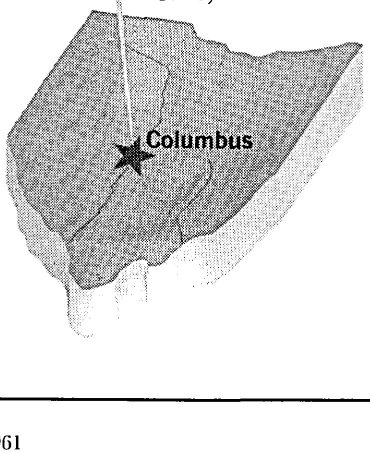
Petree, Barbara Rogers / Scientist, Technical Operations, Inc, 3600 M St, Washington, D C / P / '33, MIT, '55, prgmr

Pettit, John T / Dir, Industrial Dynamics, Hughes Aircraft, Culver City, Calif / AB, integrated systems / '23, S.M. (PhD), '47, —

Pierce, James A / Consultant, Computer Applcns, 103 N Terrace Dr, Wichita 8, Kan / AP / '25, Westminster Coll, Purdue Univ, '50, consultant / member ACM, Kansas Computing Assoc

Pina, Eduardo I / Unit Chief, Analysis Unit, Boeing Airplane Company, P O Box 707, Renton, Wash / AM, Operations res / '31, Univ of Mass, '54, mathematician / Pi Mu Epsilon Mathematics Hon Soc, Sigma Xi, "Operational Requirements for A Collision Warning System," "Comparison of Two Cooperative Collision Avoidance System Test Statistics," various papers





NEW PATENTS

RAYMOND R. SKOLNICK

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

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

May 23, 1961 (Cont'd)

2,985,868 / John A. Kauffmann, Hyde Park, and Robert M. Tomasulo, Poughkeepsie, N. Y. / I.B.M. Corp., New York, N. Y. / A magnetic neither-nor circuit.

May 30, 1961

2,986,650 / Eric Wolfendale, Smallfield, Horley, Eng. / North American Philips Co., Inc., New York, N. Y. / A trigger circuit comprising transistors.

2,986,651 / Raymond G. Schayes and Guillaume J. Fooy, Brussels, Belgium / North American Philips Co., Inc., New York, N. Y. / A trigger-circuit arrangement comprising two transistors.

2,986,652 / Joseph J. Eachus, Cambridge, Mass. / Minneapolis-Honeywell Regulator Co., a corp. of Delaware / An electrical signal gating apparatus.

2,986,653 / Richard F. Rutz, Fishkill, N. Y. / I.B.M. Corp., New York, N. Y. / A non-commutative logical circuit.

2,986,654 / William F. Gunning, Fullerton, Calif. / Beckman Instrument, Inc., a corp. of California / A single transistor series gate with grounded control voltage.

2,986,655 / Neil L. Wiseman and Clyde W. Baxter, Rochester, N. Y. / General Dynamics Corp., Rochester, N. Y. / A variable level gating circuit.

2,986,656 / Johannes M. Cluwen, Eindhoven, Netherlands / North American Philips Co., Inc., New York, N. Y. / A device for reading out the state of a trigger.

2,986,658 / Arthur W. Carlson, Harrison, Maine / U. S. A. as represented by the Sec. of the Air Force / A binary counter having gating means to prevent reversal of more than one stage during each input.

2,986,725 / Gerhard Dirks, 44 Mofelder Landstrasse, Frankfurt am Main, Germany / —— / A device for storing data signals on tapes.

2,986,726 / Edward M. Jones, Cincinnati, Ohio / The Baldwin Piano Co., Cincinnati, Ohio / An analog to digital encoder.

2,986,727 / F. S. Macklem, Freeport, N. Y. / Servo Corp. of America, New Hyde Park, N. Y. / A cyclic digital-to-analog converter.

June 6, 1961

2,987,252 / William F. Steagall, Merchantville, N. J. / Sperry Rand Corp., New York, N. Y. / A serial binary adder.

2,987,253 / Kenneth E. Schreiner, Harrington Park, and Byron L. Havens, Closter, N. J. / I.B.M. Corp., New York, N. Y. / An information-handling apparatus.

2,987,707 / Richard H. Fuller, Cambridge, and Dudley A. Buck, North Wilmington, Mass. / Giddings and Lewis Machine Tool Co., Fond du Lac, Wis. / A magnetic data conversion apparatus.

2,987,708 / Theodore H. Bonn, Philadelphia, Pa. / Sperry Rand Corp., New York, N. Y. / Magnetic gates and buffers.

2,987,709 / Theodore H. Bonn, Philadelphia, Pa. / Sperry Rand Corp., New York, N. Y. / A magnetic gate and head switching network employing the same.

June 13, 1961

2,988,216 / Robert M. Hayes, Los Angeles, and Jerome B. Wiener, Granada Hills, Calif. / The Magnavox Co., Los Angeles, Calif. / A card processing system.

2,988,217 / George W. Mayle, Canoga Park, Calif. / The Magnavox Co., Los Angeles, Calif. / A data processing system.

2,988,277 / Hiroshi Yamada, Ota-Ku, Tokyo-to, Japan / Kousai Denshin Denwa Kabushiki Kaisha, Chiyodaku, Tokyo-to, Japan / A borrowing circuit of a binary subtractive circuit and adder.

2,988,649 / Edward P. Stabler, North Syracuse, N. Y. / G.E. Co., a corp. of New York / A magnetic logic circuit employing magnetic relay components.

2,988,730 / Noah S. Prywes, Pennsauken, N. J. / R.C.A., a corp. of Del. / A magnetic memory with non-destructive readout.

2,988,731 / Kam Li, Gloucester, N. J. / R.C.A., a corp. of Del. / A memory system.

2,988,732 / Albert W. Vinal, Owego, N. Y. / I.B.M. Corp., New York, N. Y. / A binary memory system.

2,988,733 / Paul Mallery, Murray Hill, N. J. / Bell Telephone Lab., Inc., New York, N. Y. / A magnetic memory arrangement.

2,988,734 / Anatol G. Samusenko, Camden, N. Y. / R.C.A., a corp. of Del. / A magnetic memory system.

2,988,735 / Robert R. Everett, Reading, Mass., and Robert L. Walquist, Palos Verdes Estates, Calif. / Research Corp., New York, N. Y. / A magnetic data storage system.

June 20, 1961

2,989,235 / Arthur H. Dickinson, Greenwich, Conn. / I.B.M. Corp., New York, N. Y. / A binary-decimal conversion system.

2,989,236 / Willy H. P. Pouliart, Berchem-Antwerp, and Jean P. H. Vandevenne, Brussels, Belgium / International Standard Elect. Corp., New York, N. Y. / A bi-quinary multiplication device.

2,989,239 / Christopher E. Bailey, London, Eng. / The Solartron Electronic Group Lim., Thames Ditton, Surrey, Eng. / An analogue computer.

2,989,731 / Nicholas J. Albanes, Poughkeepsie, N. Y. / I.B.M. Corp., New York, N. Y. / A data storage unit.

2,989,734 / William Miehle, Havertown, Pa. / Burroughs Corp., Detroit, Mich. / A binary comparer.

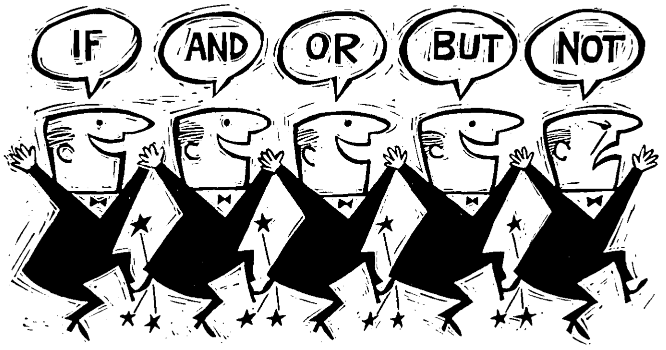
2,989,741 / Bernard M. Gordon, Concord, and Robert P. Talambivas, Cambridge, Mass. / Epsco, Inc., Boston, Mass. / An information translating apparatus and method.

June 27, 1961

No applicable patents.

July 4, 1961

2,991,009 / Walter G. Edwards, Manhattan Beach, Calif. / The National Cash Register Co., Dayton, Ohio / A coded digit adder.



2,991,452 / Herbert F. Welsh, Philadelphia, Pa. / Sperry Rand Corp., New York, N. Y. / A pulse group synchronizer.

2,991,454 / James P. Hammer, Endicott, N. Y. / I.B.M. Corp., New York, N. Y. / A matrix switching means.

2,991,455 / Edgar A. Brown, Owego, N. Y. / I.B.M. Corp., New York, N. Y. / A magnetic core logical device.

2,991,457 / George R. Hoffman, Sale, and Michael A. Maclean, Manchester, Eng. / I.B.M. Corp., New York, N. Y. / An electromagnetic storage and switching arrangement.

2,991,459 / Paul F. Darois, Stamford, Conn. / The Teleregister Corp., Stamford, Conn. / A digital storage oscillograph.

2,991,460 / John L. Hill, North St. Paul, Minn. / Sperry Rand Corp., New York, N. Y. / An apparatus for data handling and conversion.

2,991,461 / John R. Sturgeon, Farnborough, Eng. / National Research Development Corp., London, Eng. / An analogue-to-digital converter.

July 11, 1961

2,992,339 / Stanley T. Meyers, East Orange, N. J. / Bell Telephone Lab., Inc., New York, N. Y. / A binary adder circuit.

2,992,413 / Francis V. Adams, Endicott, and William L. Swanton, Glen Aubrey, N. Y. / I.B.M. Corp., New York, N. Y. / A data storage system.

2,992,415 / Edwin W. Bauer, Poughkeepsie, N. Y. / I.B.M. Corp., New York, N. Y. / A magnetic core pulse circuit.

2,992,416 / John C. Sims, Jr., Springhouse, Pa. / Sperry Rand Corp., New York, N. Y. / A pulse control system.

July 18, 1961

2,992,876 / Lynn W. Ellis, Jr., Madrid, Spain / International Telephone and Telegraph Corp., Nutley, N. J. / A data indicator system.

2,993,195 / John C. Groce, Nutley, N. J. / International Telephone and Telegraph Corp., Nutley, N. J. / A time recording in data storage systems.

2,993,196 / Robert W. Hughes, Mountain Lakes, and Daniel G. Fawcett, Upper Montclair, N. J. / International Telephone and Telegraph Corp., Nutley, N. J. / A magnetic memory system.

2,993,197 / Kent D. Broadbent, Los Angeles, Calif. / Hughes Aircraft Co., Culver City, Calif. / A magnetic core device.

July 25, 1961

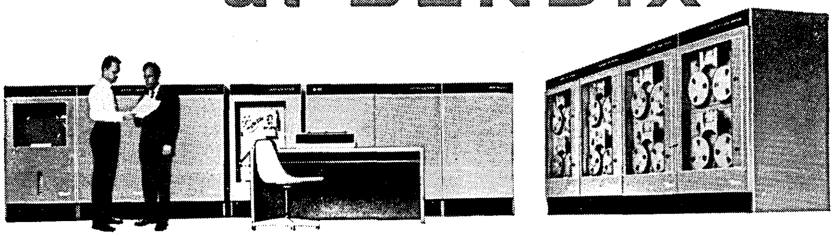
2,994,062 / Anton Chiapuzio, Jr., Downey, and Glenn H. Shaw, East Whittier, Calif. / North American Aviation, Inc., Calif. / A coincidence detector.

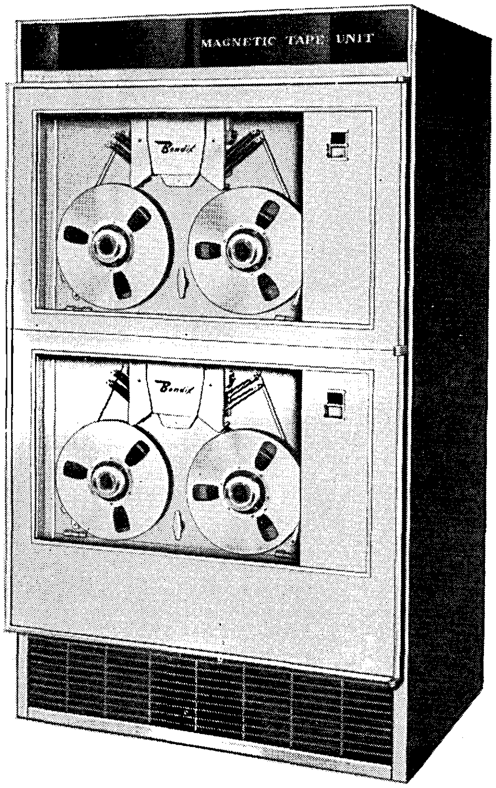
2,994,065 / Llewelyn H. Thomas, Leonia, N. J., and James W. Toner, Poughkeepsie, N. Y. / I.B.M. Corp., New York, N. Y. / A self-sorting storage device.

2,994,066 / Myron J. Mendelson, Los Angeles, Alfred Doig, Jr., Culver City, and Robert S. Douthitt, El Cerrito, Calif. / The National Cash Register Co., Dayton, Ohio / A computer sorting system.

2,994,069 / Jan A. Rajchman, Princeton, and Arthur W. Lo, Fords, N. J. / R.C.A., a corp. of Del. / A magnetic control system.

2,994,070 / Frank Goatcher, Ashford, Eng. / Electric and Musical Ind., Lim., Hayes, Middlesex, Eng. / A shifting register stage, such as may be employed in digital computing apparatus.





August 1, 1961

2,994,478 / Bernard L. Sarahan, Samuel L. Thompson, Poughkeepsie, N. Y., Richard C. Jeffrey, Boston, John F. Jacobs, Natick, and Rollin P. Mayer, Concord / Research Corp., New York, N. Y. / A digital computer with inherent shift.

2,994,788 / Edward G. Clark, Paoli, Pa. / Burroughs Corp., Detroit, Mich. / A transistorized core flip-flop.

2,994,790 / Frank J. Delaney, North Hollywood, Calif. / Collins Radio Co., Cedar Rapids, Iowa / A data phase-coding system using parallel pulse injection in binary divider chain.

2,994,851 / J. Fred Bucy, Jr., Hal J. Jones, John A. Morrison, Jr., and Luverne J. Spieker, Dallas, Tex. / Texas Inst., Inc., Dallas, Tex. / A data processing system.

2,994,852 / Martin S. Schmookler, Poughkeepsie, N. Y. / I.B.M. Corp., New York, N. Y. / A decoding circuit.

2,994,853 / Morton M. Astrahan, San Jose, Calif. / I.B.M. Corp., New York, N. Y. / An information record reading system.

2,994,854 / Francis Stern-Montagny, Poughkeepsie, N. Y. / I.B.M. Corp., New York, N. Y. / A transfer circuit.

August 8, 1961

2,995,231 / Ferdinand G. von Kummer, Bloomfield, and Paul F. Stanley, West Hartford, Conn. / Royal McBee Corp., Port Chester, N. Y. / A data processing system.

2,995,303 / Arthur F. Collins, Vestal, N. Y. / I.B.M. Corp., New York, N. Y. / A matrix adder.

2,995,304 / Styrk G. Reque, Schenectady, N. Y. / G.E. Co., a corp. of N. Y. / An electrical multiplying circuit.

2,995,305 / Hermann Schmid, Binghamton, N. Y. / General Precision, Inc., a corp. of Del. / An electronic computer multiplier circuit.

2,995,631 / Sidney M. Rubens, Falcon Heights, Minn. / Sperry Rand Corp., New York, N. Y. / A magnetic reading device.

2,995,663 / Hewitt D. Crane, Palo Alto, Calif. / Burroughs Corp., Detroit, Mich. / A magnetic core binary counter circuit.

2,995,664 / Don E. Deuitsch, Haddonfield, N. J. / R.C.A., a corp. of Del. / A transistor gate circuit.

2,995,666 / James W. Wood, Waltham, Mass. / Lab. for Electronics, Inc., Boston, Mass. / An exclusive or logical circuit.

2,995,668 / Harold M. Sharaf, Cochituate, Mass. / Lab. for Electronics, Inc., Boston, Mass. / A compensated transistor trigger circuit.

2,995,733 / Richard S. C. Cobbold, Ottawa, Ontario, Canada / Her Majesty the Queen in Right of Canada, as rep. by the Minister of National Defense / A magnetic core memory.

2,995,734 / Glenn L. Richards, Rochester, N. Y. / General Dynamics Corp., Rochester, N. Y. / A data storage system.

2,995,735 / Gerald F. Frank, Bloomington, Ill. / G.E. Co., a corp. of N. Y. / An electrical circuit shiftable between bistable conditions.

August 15, 1961

2,996,699 / Charles M. Kramskoy, Ealing, London, Eng. / Electric and Musical Ind. Lim., Middlesex, Eng. / A data-handling apparatus.

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.

Audio Devices, Inc., 444 Madison Ave., New York 22, N. Y. / Page 52 / Charles W. Hoyt Co., Inc.

Automatic Electric Co., Northlake, Ill. / Page 5 / Kudner Agency, Inc.

Columbus Division of North American Aviation, Inc., 4300 East Fifth Ave., Columbus 16, Ohio / Page 47 / Batten, Barton, Durstine & Osborn, Inc.

Control Data Corp., 501 Park Ave., Minneapolis 15, Minn. / Pages 12-13 / —

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Electric Boat Division / General Dynamics Corp., Groton, Conn. / Page 2 / D'Arcy Advertising Co.

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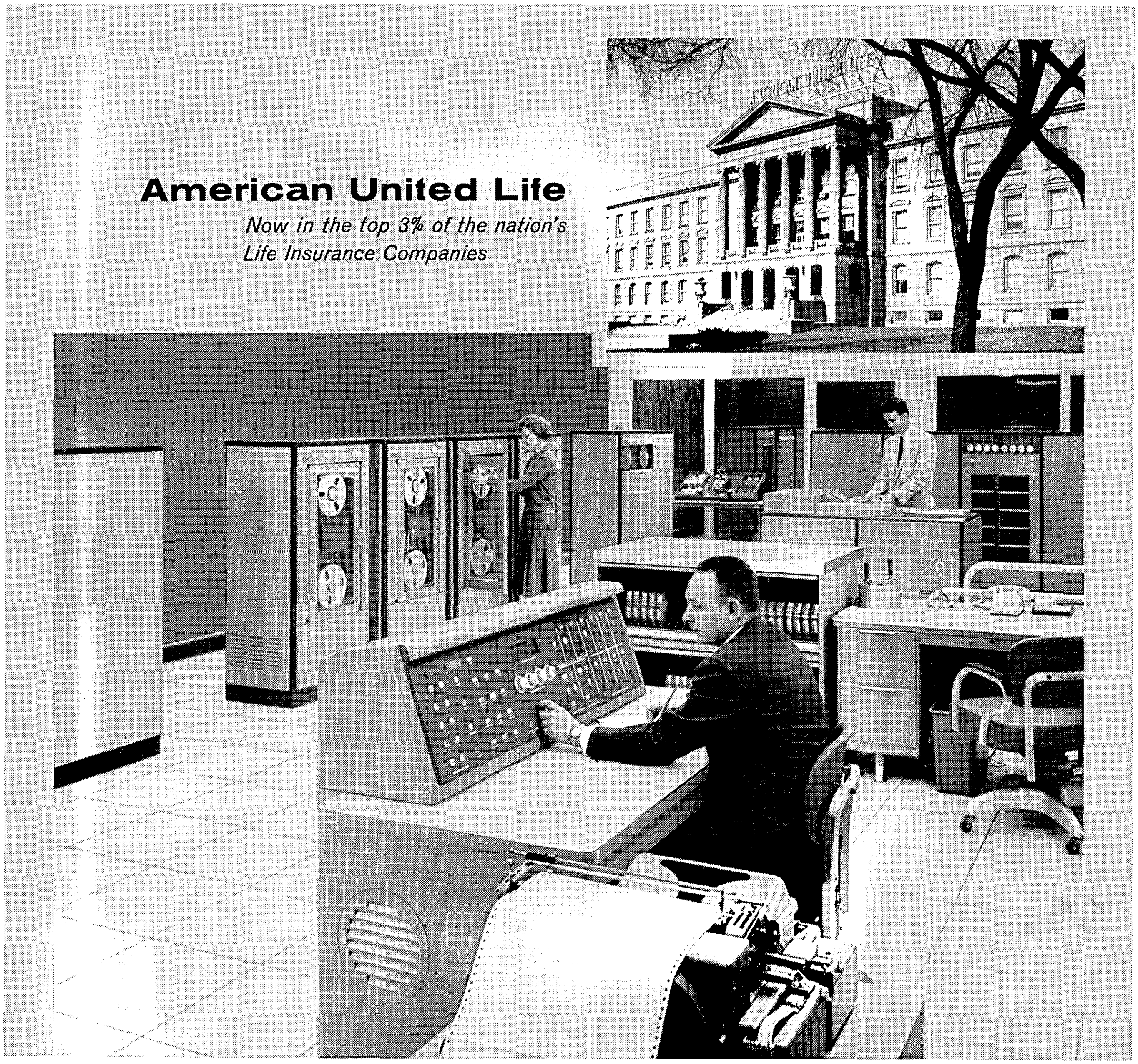

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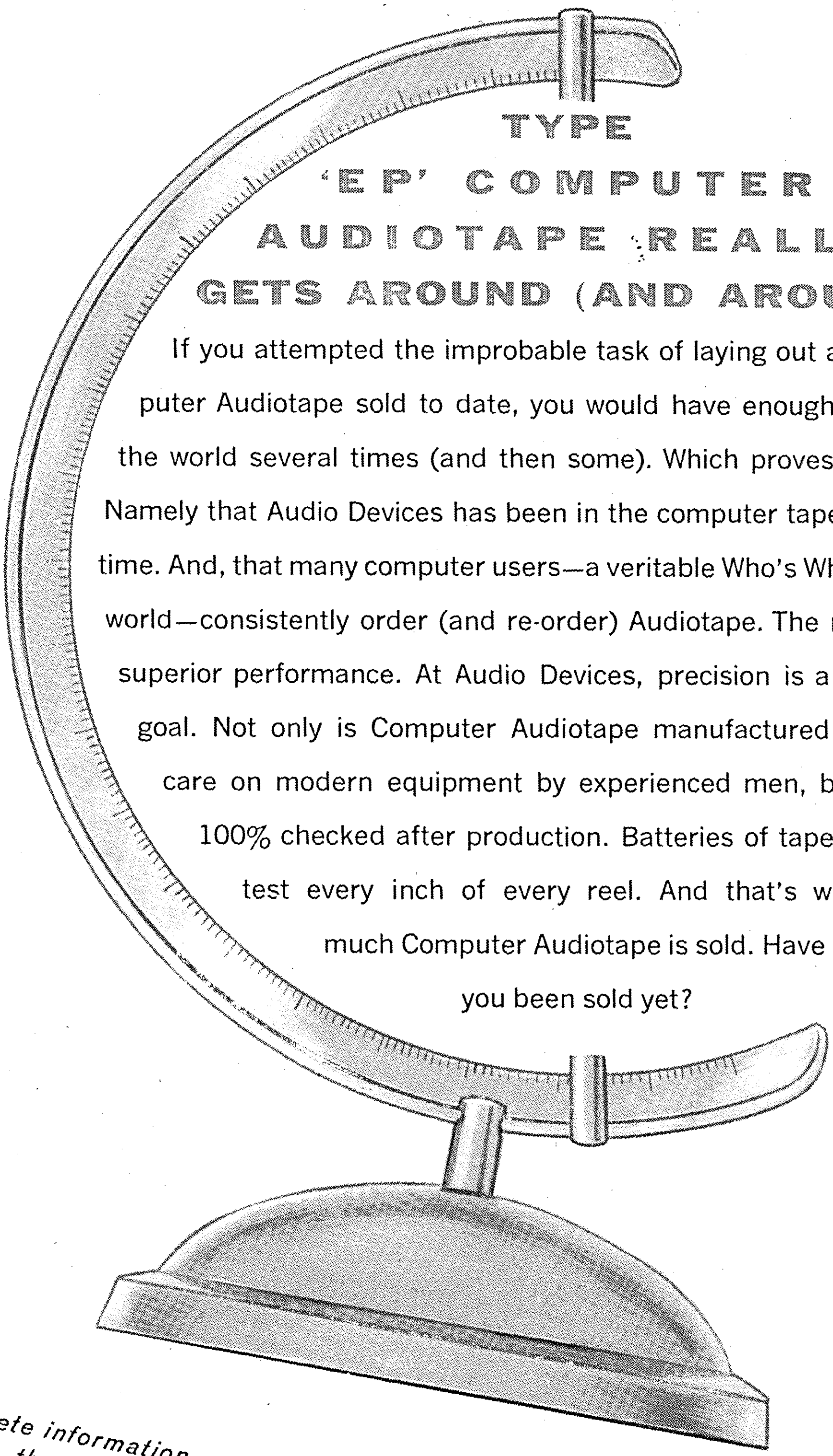

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