COMPUTERS and AUTOMATION

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



Herman Hollerith, The First "Statistical Engineer" Analytical Testing in Air Traffic Control Systems Electronic Data Processing and Its Potential for Retailing Simulating Computers With People Robots in Fiction and Fact

AUGUST 1961 • Vol. 10 - NO. 8



Washington, D.C.

by the Staff of OMEGA

We have to tell you about a few more positions available in the Company, this time in OMEGA (this is an acronym for Operations Model Evaluation Group, Air Force), the Washington, D.C. facility operated for the U.S. Air Force by Technical Operations.

This is easier than tech/ops' earlier effort, washington already—what it's like to live in this area, and the standard tourist inforin this after, and the standard to the sub-mation. We plan to come back to the sub-ject farther along, and add a few choice tidbits you may *not* have at the tip of your tongue. First, we'd like to tell you a little about what OMEGA is and what it does. Very subtly, we'll sneak in a few words about some of the people we need as we go along.

WHAT IS OMEGA? Spell out that acro-nym again, and you'll have a fairly good idea of what OMEGA is: a project engaged in very large scale air-battle digital computer simulations for the United States Air Force. These computer air battles are stochastic models which provide an unusual technique for studying problems of military strategy and weapons evaluations. Associated activity involves the design of advanced programming systems and computer languages which are expected to be independent of the first computer used-the computer itself augmenting and improving the language for use on other computers. Something like what Chaucer, that old astronomer and poet, did to the English language, paving the way for Shakespeare.

WHAT PEOPLE DO WE NEED? The best way to sum this up would be to say we're looking for 24-karat people of sterling character and agile brains. But who isn't? Let's boil it down a bit:



• Problem-solvers, junior and senior: The kind of analysts who can abstract the real physical world down into a model, who can find patterns in sometimes chaotic and unpatternlike situations. We have a goodly number of people in our programming staff to implement models.

- Programming systems designers with direct experience in the design and construction of programming system components.
- Operations analysts who can come to grips with day-to-day problems in military operations research, problems handled by using either large digital simulation models or any of the appropriate operations research techniques now available.
- Scientists for basic research in model development, and the development of analytic techniques-how to abstract and how to aggregate - better ways to use models.
- Experienced war gamers, to deal with problems of gaming "conventional" war.
- Basic researchers who can work toward the automation of plans and data inputs for war gaming.
- Men who like to take a long view, for basic research at OMEGA supports all its areas, and develops ideas for use years hence.

One note of warning: all OMEGA's research is intended to have a foreseeable impact. It is not pure, blue-sky research. If this is what you're looking for, you won't be happy at OMEGA. It isn't that kind of academic atmosphere in that limited sense.

THE ATMOSPHERE. Who can describe Washington as the old Washington hand knows it? Charles Laughton once said it reminded him of Paris — even smelled like Paris.



Not surprising; it grew up at the same time Paris did, and was planned by a Parisian named Major Pierre l'Enfant, who laid out those tourist-maddening circles as artillery emplacements in case of civil rebellion. The Old Georgetown section, where OMEGA is, comes older; full of ancient Georgian town houses, Federal fanlights, etc., if you like this kind of thing. Magnificent restaurants, too. Shops like none you've ever seen; record shops, book shops, antique shops, anything you care to name. Most tourists miss Old Georgetown; they're too busy climbing the Monument and listening to Congress in session. We don't mind.

One of our fellows positively hates Washington, and Georgetown. Dead, dull place, he says, without night life, theater, hot spots, culture.

We've tried in vain to tell him about the magnificent art galleries (National, Freer, Corcoran, Phillips, Dumbarton Oaks); the pre-Broadway theater, Arena Stage; the free chamber music concerts at the Library of Congress (the Budapest Quartet is the resident group, plus many others); the National Symphony Orchestra; the National Gallery Orchestra; the great Dixieland at the Bayou and Charlie Byrd at the Showboat; the professional Opera Society of Washington, with its annual season which connoisseurs swear beats the Met (Newsweek said so); professional baseball and football, if you like them. There's a large boom in embassies, thanks to the world-wide wave of nationalism, and many are open during spring tours. And many another focus of culture. Maybe you already know about these things. Washington is Washington, that's all there is to it, really.



THE EDUCATIONAL MILIEU. A whole clutch of good universities and colleges offering advanced study: American University, George Washington University, Georgetown University. University of Mary-land is practically a suburb of Washington. OMEGA has its own Educational Assistance Program, too.

For the children, the schools are among the nation's best, either inside the District or in Maryland or Virginia—public schools, a dozen famous private schools, a plenitude of parochial.

THE HOUSING. You name it. Pleasant apartment living, new developments in the suburbs, astonishing housing within the District limits-anything you can imagine.

THE CLIMATE. You may have read *Time's* favorite phrase about Washington's "jungle heat". This is written by young men in *Time's* air-conditioned ivory tower who don't know that New York is hotter. Actually, it does get hot here in summer; where doesn't it? Winters are normally quite mild (let's not mention the winter just past, in any context). But there's a more important kind of climate here; a feeling of being in the world's capital, a sense of great events shaping up, the coming and going of inter-esting people, and the special climate gen-erated by the interplay of governmental minds (it's not generally realized that many Washingtonians have no contact with the government at all, and still lead fairly full and rich lives).

THE COMPANY. Oh yes, the usual Com-pany benefits: extended vacation (you can save up vacation time from year to year), Company-paid insurance, reimbursement of moving expenses, etc., etc. And one benefit that'll make your eyes light up; an almost unique Investment Retirement Plan. Last year its growth was 95%!



If any of this sounds good to you, we'd be happy to discuss it further. Best way to start is to drop your résumé in the mail to this address:

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COMPUTERS and AUTOMATION

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Readers' and Editor's Forum

FRONT COVER: BALLISTIC MISSILE EARLY WARNING STATION AT CLEAR, ALASKA

The front cover shows an airplane view of the U. S. Air Force's Ballistic Missile Early Warning Station at Clear, Alaska, which will be operational in the later part of the summer of 1961.

Giant reflectors for the radar subsystem measure 165 feet high by 400 feet wide. Note the comparison with the helicopter (flying above the center reflector) which is used for radar pattern measurement tests.

If a ballistic missile attack should be launched against the United States and Canada from the western flank of the northern polar regions, it will be detected far out in space by a huge radar fan scanning some 3,000 miles across the top of the world.

This giant fan of radio frequency energy will be generated by the radar shown here, one of the largest existing long range missile detection radars.

This surveillance radar system and the one at Thule, Greenland, were developed, produced and installed by the General Electric Company's Heavy Military Electronics Department in Syracuse, N. Y., under a subcontract from the Radio Corporation of America.

Slightly more than a year ago this site at Clear, Alaska, was a barren wilderness of scrubby cedar trees and frozen tundra. In March 1960, the first shipments of more than 8,000 tons of equipment began to arrive. Erection of the three radar antennas, each larger than a football field, was started last June and completed in three months. Late in July, the task of installing 220 cabinets of electronic equipment and the monitor and control consoles began. This BMEWS station, when it becomes operational later this summer, will provide approximately 15 minutes advance warning if an ICBM attack should occur over the western part of the northern polar regions.

As the radar's antenna system probes the sky over the northern polar regions, it will radiate narrow fans of RF energy at two different degrees of elevation above the earth's surface. These fans will be scanned simultaneously across the face of the huge antenna reflector by means of high-speed scanning switches and a massive array of feedhorns, forming two horizontal detection fans one above the other.

When a missile passes through the lower fan, radar pulses are returned and detected by super-sensitive receivers. From these radar echoes, the position and velocity coordinates of the missile will be determined. Seconds later, as the missile passes through the upper fan, radar echoes again will be picked up and position and velocity coordinates will again be measured. The missile's trajectory then can be calculated from these coordinates since the ballistic missile will be in "free flight" (unpowered phase of its trajectory) as it passes through the radar fans. Calculation of the missile's trajectory will permit prediction of the impact area, impact time and area of launch. Data processing equipment installed at the radar stations will rapidly compute this data and flash a warning to the North American Air Defense Command Headquarters in Colorado Springs.

Heart of the surveillance radar subsystem is a combination transmitter-receiver unit. This unusual equipment sends out an extremely short burst of radio frequency energy at a power level measured in multi-million watts (megawatts). After each pulse, the transmitter automatically shuts down and extremely sensitive receivers listen for any tiny echo reflected from a target, which might be a nosecone smaller than a barrel and 3,000 miles out in space.

The power level of the return echo is measured in milli-micro-microwatts (thousandth of a millionth of a millionth of a watt). The difference in power levels between the transmitted signal and the return echo is approximately the same as the difference between the size of the earth and a basketball.

More than 2 miles of aluminum waveguide, which resembles conventional air ducts, have been installed to direct the radio frequency energy generated by the transmitters through a 1,500-foot long, enclosed, subway-like tunnel to the scanner buildings, located directly in front of each of the three antenna reflectors. An additional 12 miles of waveguide have been installed in the scanner buildings to "pipe" the energy from the high speed, mechanically rotated scanning switches to the hundreds of radar feedhorns. Arranged in upper and lower banks, these feedhorns bounce the RF energy off the 17-story high reflectors at precisely the right angles for the required spatial coverage. Twelve active de-icing heater units (4 per scanner building), capable of providing a total of 2.5 million BTU/HR, or enough to heat 32 average-size homes, keep the feedhorn windows free of ice during the sub-zero Alaskan winter.

Each of the three mammoth, torus-shaped steel reflectors, measuring 165 feet high and 400 feet wide, weighs 900 tons. The massive steel structures are designed to withstand severe cold, earthquake conditions, and winds up to 110 mph, as well as a half inch coating of ice. Twenty giant trusses and twenty 70foot long steel latticework backstays support each of the antennas.

The General Electric Company's Heavy Military Electronics Department in Syracuse, New York, is responsible for designing, developing, producing, testing and placing in operation the BMEWS surveillance radar subsystems under a subcontract with the Radio Corporation of America, overall systems manager for the U. S. Air Force.

In turn, a total of 450 subcontractors, both large and small, have supplied equipment and components for the surveillance radars in accordance with General Electric design and quality specifications. An estimated 42% of these suppliers have been small business firms with less than 500 employees. Likewise, 44% of the dollars subcontracted by General Electric have gone to small business.

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READERS' AND EDITOR'S FORUM

(Continued from page 6)

COMMENTS ON "ARMAMENTS AND COMPUTER PEOPLE"

William Viavant **Computer Laboratory** University of Oklahoma Norman, Okla.

To the Editor:

I have read your forum article "Armaments and Computer People" in the May issue of Computers and Automation. This brief note is to give you my sincerest compliments for speaking so clearly on the subject.

More than three quarters of all big computers and, as far as scientific applications go, of all computer people are controlled by various aspects of the military (including the AEC). Those professional people need to have their consciences continually prodded to keep them aware of their role as members of human society. Otherwise, they lose themselves in the challenges of their particular job. Only by our facing the enormous immorality of the armaments race and its inevitable result can we break the apathy which is obstructing any serious consideration of disarmament in this country.

Our situation is one of the world's most vicious examples of destructive suboptimization. We pose ourselves the question "How can we destroy the enemy (human life) most efficiently?" and we solve this problem with wonderful ingenuity. But we pay scarcely any attention at all to the real problem which when solved eliminates the other one (not solves it-eliminates it). This problem is, of course, how can human societies live in peace.

Here is a paraphrase of the doggerel about John O'Day:

"Here are the ashes of the U.S.A.

She fought for freedom and died in the fray,

She was right, dead right, as she armed so strong, But she's just as dead as if she were wrong."

The above is a first attempt at a parody. I am sure it can be improved.

THE DEHUMANIZING EFFECTS OF THE COMPUTER

Albert Baylis Framingham, Mass.

1. Resentment of the Computer

In recent weeks my associates and I have had a number of conversations about the philospohical and theoretical aspects of the computer field. Since I have some responsibilities for publications, teaching materials, and press releases in connection with computers, I have sensed at various levels among computer and noncomputer people a basic resentment-sometimes amounting to a sort of hostilitytowards the computer as an institution. This is, of course, composed of many factors, but most of these seem to focus on the reluctance of perceptive and intelligent persons to be dehumanized by delegating so much of their intellectual and administrative functions to a machine.

2. Growing Fear of Automatic Weapons Control

Compounding this, I think, is the growing fear (which I believe to be justified) of the increasingly automatic structure of our weapons systems. The constantly reiterated deadly potential of the weaponsin particular the missiles which apparently rely most heavily on computer programming-after a while bores into the consciousness, and rebellion sets in. This resentment, I think, breaks out of bounds and distorts the true potential of the computer for good and useful purposes.

All of this is made worse by the fairly common view of the computer among nonprofessionals as a "giant electronic brain," before which man must abjectly bow down. I realize fully that at the highest levels of computer science much of this is regarded as hogwash. It has been fostered, however, by many pronouncements from press and platform, and augmented by the idolatrous absorption with the computer which is evident variously in the broader echelons of "computer people."

3. Moral Responsibility of **Possessors of Disciplines**

I seem to recall a summary of replies to a questionnaire sent out from Computers and Automation to various trade and scientific journals in an effort to discover their point of view on their moral responsibility for their "disciplines." In this connection I assume that you do know about an organization, called something like "Society for the Social Responsibility of Scientists," which has its prime reason for being the promotion of this sense among scientists.

With the dehumanizing effects of the computer, I am concerned more and more, with what I think I see in the relation of the computer to weapons research and development. There are many other facets of life, of course, which are significant and important, but I am daily more convinced that man's precarious predicament vis-a-vis weapons should be the overriding concern of every living person.

4. The Computer as a Narcotic

I have the feeling that the computer has enabled men to work on and evaluate these deadly things without being aware of their meaning and frame of reference. It would seem that the computer transmutes them into "challenges," "games," etc.; that it acts something like a narcotic and enables men to do what their sensibilities otherwise could not endure.

I think this is dishonest and that we in the United States have a peculiar responsibility, for various historical reasons, not to continue to promote this type of activity without realizing what we are doing. It would seem that our development of atomic and hydrogen weapons *plus* our enormous preoccupation with electronic computers (which saturate and support the "defense" establishments) create an acute moral situation for us as we confront the world.

I realize that my attitude in these matters is strongly colored by the conviction I have-and this after really long and serious study-that these weapons cannot be used without destroying not only civilization but man himself and maybe even the earth. I believe we are only participating in a lethal illusion when we con-(Please turn to page 25)

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Herman Hollerith, The First "Statistical Engineer"

Frederick J. Rex, Jr. Project Manager, Research Division United Shoe Machinery Corporation Beverly, Mass.

In spite of all that is being written about data processing, a minimum of attention has been directed at its history and the inventive pioneers who made the giant step from laboratory to practical application. There are some who proclaim the genius of Türing, Babbage, or Pascal, but this writer would like to argue that Herman Hollerith was the key figure in making a practical tool out of a curiosity.

The best parallel directly at hand is to compare the automotive industry with data processing. Henry Ford, although not the inventor of the automobile, was the first to produce a car which combined the attributes necessary to revolutionize the world of transportation. In like manner, Herman Hollerith was the first to build data processing machinery which made machine accounting feasible.

For the past thirty years, Hollerith has been largely unnoticed, while Babbage and Türing have been enjoying a rebirth of popularity. Since it has been said that International Business Machines Corp. was founded on the Hollerith achievements, it seems timely that we re-examine this man's contributions. The Census of 1890, which employed the untested Hollerith machines, was the first example of largescale machine accounting.

Early Years

Hollerith gave an inkling as to his unusual qualities by being born on an unusual day, February 29, 1860! Therefore, at his death in 1929, he had celebrated only seventeen birthdays. Although he has been reported by some as being of German birth, he was, in reality, born in Buffalo, New York, the son of a German immigrant couple. He had a normal childhood which was highlighted by an inordinate dislike of spelling. Young Herman once leaped out of a second-story schoolroom window and sped home, rather than face the ordeal of a spelling class. Letters written as late as 1919 still impart a feeling of lack of confidence in this area; in a letter to his wife in 1895 he said, "Today I was asked to sit for my silouhette (I think this is the way they spell it).' (However, silhouette is correct.)

Following the spelling incident, he was taken out of formal school and tutored by a Lutheran minister. This action probably accelerated the education of a gifted scientific mind, as Hollerith received his Bachelor's Degree from Columbia in 1879 at the age of nineteen. Educators today stress that a gifted student should not be held to class level, as boredom and lack of interest often accompany a lack of challenge. Young Herman's unusual action in spelling class can be assumed to have played a major part in developing his talents earlier than if he had remained in school.

First Job

By chance, Prof. W. P. Trowbridge of Columbia was both Hollerith's teacher and Chief Special Agent for the Census of 1880. The professor asked him to assist in an important investigation with regard to the census; this, to all intents and purposes, was the point when Hollerith embarked on his road to later success. One can only conjecture as to the effect a negative decision could have had on his life. Certain persons seem to have that inner drive and creativity which make them prominent in any undertaking, and it can be assumed that Hollerith was one of these. However, his answer was affirmative, and the foundation was laid for the career as yet unplanned.

The man always retained something of the nonconformist little boy who leaped out of schoolroom windows. In later life, when asked how he had first thought of his census machine, he would always reply, "Chicken salad," which is an unusual answer and which, of course, was delivered with a smile and a hint of devilment in a twinkling eye. He had a good sense of humor and a warm, human quality which made the scientist less austere.

"Chicken salad" was prompted by the fact that a young lady, noticing the relish with which he was consuming some at a buffet, invited him to supper at her home to try some of her mother's. This young lady was named Billings, and her father was Dr. John Billings, who held a rather high position in the Census Bureau. At the supper, Dr. Billings, who knew Hollerith through work, embarked on a discussion of shop talk. He suggested that there should be a machine or a device to lighten the repetitive and dull clerical work of a census, and thus the idea was planted in Hollerith's mind.

If this were Hollywood, rather than history, we could twist into a romantic fantasy of young love bursting forth between our young engineer and his hostess, Miss Billings. However, any romanticist who might read this will have to be disappointed . . . Hollerith did not marry this young lady, and there is no record of anything more than a casual acquaint-anceship.

The Man Develops

In 1882, General Francis Walker, who was another census contact and also President of the Massachusetts Institute of Technology, invited Hollerith to become an instructor in the Department of Mechanthey J. orde D whie S7 nou agai SI a pi Wai RAI nun Woo mitt tem futu Ir AM sent Crei inst incl Bull B a go that is h effec

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n site Sales ical Engineering. After one year, the twenty-threeyear-old teacher became horrified at the thought of repeating the same material for another class. The non-conformist streak showed itself again; after resigning from M.I.T., he became an assistant examiner in the Patent Office. This was followed shortly by the establishment of his own office as an expert Patent Advisor. At this time, he was only twenty-four.

This can be seen as another major event which affected Hollerith's later life. His early and complete knowledge of patents stood him in good stead when he was to apply for his own, and the foundations he had learned enabled him to make his own patents that much stronger. A knowledge of patent law is an asset to any inventor, and there are many unhappy individuals who have suffered from a lack in this area. Hollerith was able to obtain the maximum patent advantage.

He was married in 1890 and fathered six children, three boys and three girls. Ever the family man, his letters to his wife from his frequent trips to Europe contain constant reference to his desire to be at home.

Early Experiments

Hollerith conducted his first experiments on his Census Machine (as it was first called) at M.I.T., while he was instructing there in 1882. His first thought was to use punched holes in a continuous strip of paper, but the length of paper needed for large-scale records made this impractical. It is significant to note that our multi-billion dollar data processing industry of today can be traced back, in part, to M.I.T. as a place of early work, as can so many other technological innovations.

Hollerith was always one to give credit to others where they had helped him in any manner. When his strip of paper proved impractical, he dredged up out of his mind an item he had tucked away earlier. On a train, he had seen a conductor hand-punching tickets which recorded a rough description of the passengers. His conclusion was that it should be possible to punch a card for each individual in the United States which would record the proper census statistics. Hollerith gives full credit to Dr. Billings for planting the idea and to the conductor for unconsciously providing the solution. He seems to be too modest in shying away from acknowledging the fact that he was the first man who possessed the creativity to associate these two items.

Machine Development

His method of financing is not known, but he did put all of his own available capital into his work, plus some from at least one brother-in-law. Hollerith filed for his patent on September 23, 1884, and was issued his first data processing patent, No. 395,781, on January 8, 1889. He later accumulated a total of thirty-one data processing patents, plus several others in unrelated fields.

The frustrations and heartbreaks of day-to-day development efforts have not been recorded. It can be said only that he worked for over two years, at great personal sacrifice, in order to file his first claim.

First System

The City of Baltimore used Hollerith Machines in 1887 to tabulate mortality statistics. This was the first use of punched-card accounting. Later, the State of New Jersey and the New York City Health Department used machines for the same purpose. These were small efforts as compared to the Census of 1890, but they were invaluable as field trials for a prototype system.

A conductor's punch, used to make the holes, was replaced by a much better, desk-top punch in time for the big job; a sorting box was added to the tabulating frame. Hollerith had already mastered the three basic steps of machine accounting, punching, sorting, and tabulating. Now let us look at this system. The punch had a matrix laid out to resemble the card, so that when a guide pin entered the proper matrix hole, the punch entered an inserted card in the right place. Once all the punches were completed, the card was removed manually and a new one placed in position. With an expected population of 65,000,000, there was a long job of punching to be done. However, as in any system, as the operators became more proficient, production rates rose until an average of 700 cards per operator per day was being produced. Estimates had been 500, yet some operators reached a daily output of almost 2,000 cards.

The reading mechanism was in the form of a press. A card was manually placed in a device which had a probe for every possible hole in a card. Where a hole was sensed, the probe passed through to make contact with a pool of mercury. Where no hole existed, the probe telescoped, as do the sensing pins of many machines today. The completed electrical circuits were used to energize relays, which in turn controlled tabulating.

The tabulator was a series of clock-like dials, which were in reality visual output counters. Printing was a refinement as yet not used. The tabulator relays were sensed as a matrix whose outputs were tied to the counters, so that when a card was inserted and the handle of the reader depressed, the proper counters all advanced one unit and a bell rang signifying completion. There was a crude verification system for detecting mispunched cards, such as widows under five years old or naturalized citizens here less than five years. If a valid combination of holes was not read, the counters did not advance and the bell did not ring. If this happened, the card was put aside for a manual checking.

The sorter was a series of covered compartments, and the covers were individually controlled by electromagnetic latching. When a card was read, the magnet associated with the correct compartment was energized and the cover popped open. The operator then placed the card from the reader in the open slot and relatched the cover with his hand. It was a crude, but effective, form of sorting.

This was the system Hollerith proposed to use for the Census of 1890.

Competition

However, in order to have his system approved, he had to enter a competition with two other systems. It

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had been generally agreed that the hand posting and tabulating systems of 1880 would be inadequate in 1890. It was felt that all of the statistics collected in 1890 would not be processed in time for the 1900 census. There was still much of the 1880 tabulation left undone, which served to emphasize the inadequacy of the existing method.

Because of this, Hollerith was not the only inventor to develop a census system. One method was presented by Mr. William C. Hunt, who had been in charge of the Massachusetts Census. Hunt had taken the 1880 method and refined it to the ultimate degree in order to make this essentially manual system faster. A second method was presented by Mr. Charles F. Pidgin and involved the use of small slips of paper which were called "chips." The chips were of different colors and different colored inks were used for recording. Then the tabulation resulted from sorting and counting chips by hand.

Four districts from the city of St. Louis were chosen, using the data which had been collected in 1880. The results were as follows:

Method	Transcribing	Tabulating
Hollerith (mech.		
punch. & elec. re	ead.) 72 h. 27 m.	5 h. 28 m.
Hunt (slips)	144 h. 25 m.	55 h. 22 m.
Pidgin (chips)	110 h. 56 m.	44 h. 41 m.

Projecting these figures for the total census gave the Hollerith System an advantage of almost one-quarter million man days, or \$600,000 if figured in money. So, even though the machines were unproven, the obvious advantages outweighed the uncertainties. Hollerith himself has said, "Think what would have happened had we failed!"

Further Developments

This task of doing the census started a great snowball rolling. Hollerith received honors such as the Franklin Institute's Elliott Cresson Medal, the Paris Exposition's Medaille d'Or, an honorary Ph.D. from Columbia, and the Bronze Medal from the World's Fair of 1893.

His machines became known internationally and he made many trips abroad between 1890 and 1900, visiting all prominent European countries. He lectured before many scientific organizations, but seemed most pleased when in Berne, Switzerland, in 1895 he was introduced as a "Statistical Engineer." In a letter to his wife he said, "I would not be at all surprised if the definition should stick. . . . Should it be so, I will have in future years the satisfaction of being the first "Statistical Engineer." From this came the writer's title for this article, because it was one which pleased Dr. Hollerith.

Hollerith followed a program of continual modification, and improved models of his machines were used for the Census of 1900. However, in 1910, even though he had developed a system of hopper-fed machines, he was unable to reach an agreement with the Census Bureau for their use. Expansion into other applications continued in an accelerated manner, and the company became too large for individual control. Hollerith sold the firm he had formed, Tabulating Machines Co., shortly after this and saw it merged into the combine which later became International Business Machines.

Under a consulting agreement, he was associated with the new company until 1921, and his last patent was awarded in 1919. He died on November 17, 1929, still envisioning better systems. In 1923, he wrote of his plans to develop a tabulator, the description of which is remarkably like those in use now. However, ill health interfered with his plans and he was unable to complete this.

An Evaluation

Hollerith made many vital decisions with respect to data processing and developed many policies still used.

- 1. He leased machines, because the intricate mechanisms required repair by a specialist, not a mechanic. He supplied service with his rental fees.
- 2. In the 1890 Census, the paper used by the government was of a very poor quality and affected machine performance. Because of this, Hollerith started manufacturing his own cards.
- 3. He established the original principle of complete patent protection.
- 4. He used corner cuts on cards as an identification measure, and this is still done.
- 5. Mercury contacts are used in high-priced components today and Hollerith used mercury contact seventy years ago.
- 6. Punched cards are still the same size that he chose in 1890. This is the same size that a dollar bill was at the time, but whether by coincidence or choice is not known.
- 7. Punched cards are a prime source of input and output on many modern computers.

All of these facts, combined with a history of his work, point up Hollerith as the father of data processing. Punched cards had been used by Jacquard on his loom and by Babbage in his difference engine, but they did not produce lasting policies or practical machines. The paperwork revolution came from Herman Hollerith and the Census of 1890.

His system, when introduced, caused a storm of reaction and gained a journalistic notoriety, but this was mainly because this growing nation of ours expected to count over 65,000,000 people. The count was announced at 62,000,000 and a storm broke, with people claiming that these new machines had counted wrong. Prominent scientists rushed to Hollerith's defense and proclaimed that, if anything, the 1890 count was the most accurate yet recorded.

Hollerith is much better known in Europe than in the United States. Machines made until the early 1930's were brand named and marked with the inventor's surname. Several of these early units are on display at the British Museum of Science in London. Ford is well known, partially because we see his name on automobiles every day, but in America, Hollerith never used his name on his machines, and somehow has become relatively obscure. He wanted it this way, and He sl salesr

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as he was of a retiring nature and was dedicated to technical excellence rather than personal fame.

The success of IBM is legendary and is due largely to the efforts of Thomas J. Watson, Sr., who became president in 1914 and started an extensive program of commercialization. However, it must be remembered that Hollerith supplied the foundation. Using athletes' terminology, it could be said that Mr. Watson was the All-American halfback who carried the ball and made the headlines, but we remember that his first football was provided by Herman Hollerith.

Acknowledgments

Because of a lack of recent material, it has been necessary to use many documents from fifty to eighty years old, and the author is indebted to all who helped him locate this information. Particular appreciation is due Miss Virginia Hollerith, the inventor's daughter, who provided the information and stories about his early life in addition to many other pertinent facts. Miss Anne B. Hoerner of IBM was very helpful in making available the relevant information possessed by her employers in their files, and the writer is grateful to IBM for granting permission to do this. The M.I.T. Library and the Boston Public Library were prime sources of data. Also, persons contacted by letter were most helpful, particularly Mr. Charles Hollerith, Jr., a grandson of the subject; Mr. R. Hunt Brown of Automation Consultants; and Rear Admiral D. S. Fahrney of the Franklin Institute. Finally, Miss Margaret Firth, Librarian for United Shoe Machinery Corporation, helped in obtaining copies of articles and pamphlets. Without the support of this entire group, there would have been little to record.

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Analytical Testing in Air Traffic Control Systems

Karl E. Korn Trenton, N. J.

The capability of a large scale scientific computer for solving complex problems may not always be fully appreciated. An IBM 709, for example, has a capacity to do arithmetic at approximately the same rate as about 100,000 men each supplied with a desk calculator, operating at 100% efficiency and without errors. Mathematical schemes have been developed whereby this "ability-to-do-arithmetic" can be readily utilized in solving large functional problems. Instructing the machine on what to do has recently been greatly developed, so as to convert what formerly was a great effort into a relatively small effort ("automatic programming").

The rate of progress in application of digital computers to the solution of technical problems is rapid. Much is now being done which would not even have been attempted a few years ago. The magnitude and complexity of the problems which can be solved is quite surprising, and the rate of effort required to achieve good results is reasonable, provided the problem analysis, work schedule, mathematical approach, computer selection, programming method and personnel are adequately coordinated.

Complete systems can be functionally represented by so-called "mathematical models." Whatever happens in the physical system is triggered to occur (from the "same" cause) in the model. The model is then operated under various external situations created by the programmer. Internal changes in the model can be readily made also, enabling various new systems to be "analytically tested."

When is a Digital Computer Solution Preferable?

Of itself, the ability to do arithmetic at a staggering speed seems, at first, to be of a rather remote value in problem solving. Various mathematical schemes have been developed which assist greatly in directing this ability so that it can be utilized to solve many of the problems of large systems. It is obvious that "numerical methods" will become involved. For this reason we compare, on the diagram below, the relationship between a numerical computer solution and a functional solution.

In a functional solution, the "solution" consists of equations. Inspection of the solution results in a general understanding, but only if the solution is relatively simple. A specific numerical input condition results in specific numerical answers or groups of answers. A series of input conditions produces a series of answers, which are then studied as graphs of results.

In a computer solution, the "solution" consists of a computer plus a program. Inspection of the solution produces little or no understanding, especially if the solution is complex. A specific numerical input condition results in a specific numerical answer or group of answers, and a series of input conditions a series of answers, which are then studied as graphs of results.

It can be seen that the two methods of arriving at a graph of the results are identical in many respects. The functional method has a great advantage in being understandable by inspection if the functions are relatively simple. It has the disadvantage of becoming almost valueless when a large number of non-linear relationships are involved (even if these relationships are not differential equations) because the functional method cannot achieve a solution. The concept of functional solutions is, however, so deeply imbedded in the minds of engineers unfamiliar with computed numerical solutions, that many problems which presently exist, remain unrecognized as single problems, and only small sections of these are examined at one time.

One such problem, namely, an air traffic control system problem, will be delineated on subsequent pages. It is in this area that the computer method becomes outstandingly valuable, since with the proper mathematics, a thousand or more non-linear simultaneous equations can be solved with iterative approximations to any desired degree of accuracy. The mathematical method used is known as the "finite difference calculus."

In this method, all differentials are treated as variables, and functional integration is replaced by numercial summation of successive values of these variables. A derivative is merely a quotient of two such variables. For partial derivatives, special care is required in functional description of the differentials to be divided. In problems involving transients containing a large number of physically simultaneous relationships, time can be considered as the "driving variable." Numerical values of all variables are then calculated for each small "finite change" (ΔT) of the driving variable (T). All relationships are therefore explicit, since values for every required variable are known at all times, i.e., values at either "T" or "T + Δ T" have already been calculated and tabulated.

It should be noted that a coordinated means must be utilized for insuring stability of the solution. The usual manner in which this is done for physical problems is to accompany the equations with the basic physical laws governing the (stable) system behavior.

Evaluation of an Air Traffic Control System

In an air traffic control system, many types of aircraft are involved, each having different capabilities of altitude, rate of ascent and descent, airspeed, acA numl mach Show maril to ra labor for i perin tive possi one mova

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celeration characteristics, and fuel usage. Wide differences are encountered in their flight profiles. Differences also exist in control philosophy, i.e., should control be "tight"—should the profile be "stipulated" to the pilot, or should control be "loose"—should the pilot make his incoming flight without being required to adhere to controller direction of such items as airspeed? The problem is so broad that often the information available to one individual, which has been accumulated over many years, differs from that available to another individual, with a resulting difference in viewpoint.

Various systems of control have been proposed, and many are well thought out. What computer models can do is to evaluate these different schemes in the light of equipment available or potentially available to determine where and under what conditions a particular system or certain equipment is more effective, and to what degree. A very great advantage of the mathematical model of the system is that it can analyze the system before the expenses of designing, building and testing are incurred. (This is not a small expense in a large system development program.)

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Such an analysis or evaluation must be comprehensive. It must be able to answer a question such as "What type of control will minimize the amount of fuel used by aircraft in landing at a terminal under crowded conditions?" The method by which a question of this sort is resolved is described in the following:

How to Construct a Computer Model— The "Finite Difference" Approach

A computer model is needed which can accurately represent an aircraft (or many aircraft) flying through, say, a transition/terminal area and landing at the airport. Since we wish to determine conflicts, we must require the model to maintain a complete record of the location of all aircraft at all times. This suggests a "motion picture" type of model of the real system in which the condition of the transition/terminal area is completely known at any one time. The instantaneous condition of the system corresponds to the particular "frame" of the motion picture. Data such as the velocity, altitude, wind at various altitude layers, etc., must also be known. The model is set up to print out the information which we wish to save from each "frame." All of the data relating to any "frame" is soon discarded, but only after it has been used to develop the complete system condition for the next "frame" occurring a small increment of time later. The time increment might be, say, five or ten seconds. It is obvious that large blocks of data must be generated for each time increment, and after printout of the significant values, these data must be superseded or "updated" for the next time increment. In order to operate, the model therefore requires:

- 1. A complete initial condition at some value of time.
- 2. Generalized equations, and the necessary "bookkeeping," to allow it to develop the condition of the system at a time $T + \Delta T$, when the condition is known at time T.

- 3. Instructions for printing out the desired data at each time, T, in order that they will not be lost.
- 4. A means whereby aircraft may be "flown in." (Note: This may be done by stacking the "enroute aircraft" on an input file, and allowing their flight plans and actual arrival times at the first transition fix to be keyed to the terminal's "clock time." This "clock time" proceeds as each subsequent "frame" of the solution is calculated.) Each aircraft is made to appear at the designated point at the proper time and proceed depending upon its characteristics and traffic.

Specifically then, the x, y, z, coordinates of each aircraft at time T are stored. Also stored is aircraft type, velocity, acceleration, rate of descent, distance-to-go and route to be flown for each aircraft. These data and profile data based on aircraft type are utilized to develop the x', y', z', coordinates of each aircraft at time $T + \Delta T$ (as well as the other necessary parameters). After the print-out the x, y, z, set of data is discarded and replaced by the x', y', z', set, and the process repeated. Note that the computer program is "looped," that is, the same program instructions operate again, but upon the newly developed set of numbers rather than the initial set of numbers. The program can therefore "run" as long as desired.

When a sufficiently small time increment is selected, the entire situation can be frequently examined for controller decision, i.e., potential conflicts can be determined, etc., before calculating the next condition of the system. As an estimate of order of magnitude, possibly 50,000 numerical calculations would be required per time increment in a system containing 50 aircraft. Including print out of data, the "terminalclock" within the program might advance at about $\frac{1}{3}$ the speed of real time, if a computer having the speed of an IBM 709 is used.

Since the functions are quite simple and are explicit in terms of time, an exact solution can be programmed for such parameters as x coordinate, new velocity, etc., at the next time increment. If ordinary or partial differential equations are involved as functional relationships, the solution is an "approximation" whose accuracy increases with decreased ΔT .

Programming Decisions

To obtain information by using a model, the model is "run" with a standard group of aircraft (a mixture of all aircraft types) coming in from enroute. If for example the length of time required to land this group of aircraft is desired as a function of wind speed, a run is made for, say, a wind speed of five knots. When this has been completed, the entire problem is re-run with the numerical value of wind speed at ten knots, then 15 knots, etc. It is important to note that to obtain proper results, only one variable is changed at a time. The similarity to engineering testing procedure is apparent. This type of problemsolving technique has been referred to as "Analytical Testing."

It turns out that any decisions which can be quantitatively described are capable of being programmed. Past experience has shown that rationally-arrived-at

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decisions can usually be reduced to quantitative descriptions, provided that the causes of the decisions are probed by the programmer to a sufficient degree before writing the program.

Model T Versions

The best way to build models of this type is to first make a simplified version, a "Model \hat{T} " version. Where difficulties are encountered in the "Model T" as to best approach, etc., an approximation is introduced to bridge the gap temporarily, and programming of the model continues toward completion without being delayed by simultaneous exploratory investigations. A more accurate model is made by inserting the results of special studies on the more difficult phases into the program in place of the approximations. Using this approach, results can be obtained on phases which do not depend upon the elimination of the approximations, by using runs of "Model T," "Model A" etc. Naturally, a model of any control scheme ("loose" or "tight") can be made. If this is done, comparisons of output of various methods of control can be made for various input conditions, and the methods of control can be evaluated.

Outputs

After a rather complete model has been developed, the following types of outputs can be expected from the production runs:

- 1. Analysis of total fuel usage of all aircraft during inbound flight.—This parameter is easily obtained as a summation of the fuel used in each time increment $\triangle T$. For each aircraft type, the fuel rate is a function of airspeeds, atmospheric conditions (altitude), acceleration and rate of descent. In a system where control of a large group of aircraft is by path stretch and hold, the policy on descent speed will influence the fuel usage. The model may therefore be used to determine how rapidly the fuel usage varies with average aircraft descent speed. If a variation of the model is made in which profiles are controlled by velocity adjustment, then the difference resulting from the two different methods can be found.
- 2. Analysis of terminal landing capability and runway utilization. Using a representative group of aircraft containing a mixture of aircraft types applicable to the particular airport, the landing capability or runway utilization (number of aircraft handled per hour) may be found as a function of the sequencing slot width in order to determine optimum magnitude of time slot. Since this may be a function of wind speed and wind direction, the relationship may be explored at several values of wind. (It should be noted here that such "analytical testing" cannot be done physically, as wind is, of course, not subject to control.)
- 3. Analysis of number of "missed landing slot" aircraft caused by time-error buildup.—If an aircraft group is flown through the transition/terminal region and some of these aircraft have IAS

instrument errors, then the resulting values of time-error buildup can be evaluated as a function of the average magnitude of instrument error. If the allowable tolerances at the runway are exceeded, then the aircraft must be classified as a "missed landing slot." A similar investigation may be performed based on wind data error.

4. Analysis of Route Configurations.—Once a complete model has been developed, it is a relatively simple matter to construct an additional model incorporating an alternate route configuration. Through the use of such models the same groups of flights can be "run" through each model, and the results of such parameters as average delay time and number of "missed landing slot" aircraft can be compared for the different route configurations.

Unique Value of Analytical Testing

The above four analyses are examples of what can be done by developing and operating the proper mathematical models. System analysis and evaluation studies by means of computer models should be made before the design of hardware and physical testing. In large systems, the theory is very difficult and frequently a mathematical model of the system, analytically tested, is the only way to fully understand the system's operating characteristics. If physical testing is done before the theory is well established, the results are difficult to interpret. The cost of obtaining system information through test of mathematical models is far less than for physical testing.



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Computers

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"ACROSS THE **EDITOR'S** DESK"

MICHIGAN HOSPITAL SERVICE BUYS COMPUTER TO SAVE \$750,000 A YEAR

Minneapolis-Honeywell Regulator Co. Electronic Data Processing Division Wellesley, Mass.

Michigan Hospital Service at the end of June announced purchase of a large-scale electronic computer that it estimates will save \$750,000 a year in Blue Cross-Blue Shield operating costs, after having rented it for 3 years.

The computer, a DATAmatic 1000, made by Minneapolis-Honeywell, has been in operation on a rental basis at the Blue Cross offices in Detroit since April 1958.

The decision to purchase the giant machine from the manufacturer was based on the computer's performance during the three-year period and its potential to effect major savings in the processing of the clerical records of 1,250,000 subscribers, said Robert J. Koch, director of the office management division for Blue Cross-Blue Shield.

800,000 subscriber records, about 60 per cent of the total, already are being handled by the computer; the remaining records will be converted to "electronics" by the end of the year. The 1,250,000 subscriber records cover some 3,500,000 Blue Cross-Blue Shield members.

Michigan Hospital Service, the second largest Blue Cross plan in the country, was the first Blue Cross organization to install a large scale electronic computer.

"The computer will have paid for itself, including all installation, programming, purchase and rental costs, by July 1962," Koch said. "From that point on, it will save Blue Cross-Blue Shield an estimated \$62,500 a month in operating costs.

"It normally takes a large computer about five years to pay for itself; this means we

have done considerably better than average in converting our record-keeping operations to electronics."

He said the Honeywell computer will save Blue Cross-Blue Shield major operating expenses because the machine's speed and flexibility make it possible to process a wide variety of records and reports more rapidly than previously, to take on larger amounts of work of a more complex nature without increasing the payroll and because the electronicallykept records are more uniform, accurate, and current than was possible with non-electronic bookkeeping equipment.

He emphasized that Blue Cross has a longstanding policy that none of its employees be laid off because of conversion of record-keeping to electronics.

Koch said the computer also is enabling Blue Cross-Blue Shield to provide improved service to its subscribers, as well as to hospitals and doctors. Subscriber payments. for example, now are being applied to records several days earlier than previously, he said.

The Blue Cross computer installation is an integrated data processing system that handles 90 per cent of the organization's bookkeeping from a single set of records on magnetic tape, Koch explained.

He said record-keeping now being handled automatically by the computer covers such items as subscriber payments, billings, member enrollment status, name and address changes, hospital admissions, doctor service reports, inquiries from members, membership changes and monthly accounting and statistical reports.

ARMS CONTROL IS FEATURE OF NIGHT SESSION AUGUST 23 IN WESCON TECHNICAL PROGRAM

1961 Western Electronic Show and Convention August 22-25, 1961 The Cow Palace San Francisco, Calif.

Technical, military, politico-economic, and psychological aspects of arms control, subject of much international debate in Geneva and major capitals of the world, will be discussed Wednesday, August 23, at the 1961 Western Electronic Show and Convention in San Francisco.

Session 41 -- announced in the Wescon preliminary program in an 85,000 mailing last month -- has created wide interest. The panel presentation is scheduled for between 8 and 10 PM at the California Masonic Memorial Temple on Nob Hill.

The main floor of the auditorium, seating 1700, is expected to attract a capacity audience from among the more than 35,000 persons anticipated in San Francisco for Wescon Week.

The session has been organized and will be led by Dr. L. C. Van Atta, recently special assistant for arms control in the Office of the Director of Defense, Research and Engineering. Dr. Van Atta returned to California early this month to rejoin Hughes Research Laboratories, Malibu, from where he was on leave for his assignment at the Pentagon.

This week Dr. Van Atta announced the composition of the panel.

Speaking on nuclear aspects will be Dr. W. H. K. Panofsky, professor of Physics at Stanford University and deputy director of Project M -- the two-mile linear accelerator due to be constructed on the Stanford campus. Dr. Panofsky is a member of the President's Science Advisory Committee.

Contributing remarks on military aspects will be Rear Admiral P. L. Dudley, special assistant to the Joint Chiefs of Staff for disarmament affairs.

Also representing the Defense Department will be Harry Rowen, deputy assistant secretary in the Office of the Assistant Secretary of Defense (International Security Affairs), who will speak on politico-economic aspects.

Other technical areas will be covered by Dr. Donald G. Brennan of M.I.T.'s Lincoln Laboratories, Lexington, Mass.

Dr. Charles E. Osgood, director of the Institute of Communications Research, University of Illinois, Urbana, will review pertinent psychological problems.

In conjunction with the announcement of the panel, Dr. John V. N. Granger, convention director for the 1961 Wescon, made this comment:

"For many scientists and engineers and for other thoughtful citizens as well, the single problem of greatest concern of recent years is the arms race. Or to put it in more 'scientific' terms -- the apparent instability in the 'balance of nuclear terror'. An increasing number of our nation's best minds have been devoted to intensive study of the complex problems involved, in an effort to find a means for reconciling the need for disarmament with the impossibility of disarming.

"In the belief that Wescon represents a unique opportunity to carry the problems and the issues involved in the technical area of arms control to an audience particularly qualified by experience and training and bearing a particular responsibility for intelligent and informed public leadership, the Board of Directors asked Dr. Van Atta to organize this special evening session. He is one of our most distinguished professional men and has given dynamic leadership to IRE affairs in the West. We look forward to his part of our convention program with great anticipation."

NATIONWIDE SERVICE FOR COMPUTERS BY CONTRACT

Clary Corporation		
408 Junipero St.		
San Gabriel. Calif.		

This company has contracted with Federal Electric Corporation to provide nationwide service for its computers.

In a joint announcement, Clary president W. G. Zaenglein noted "this departure from our traditional servicing methods was necessitated by growing demand for our DE-60 computer.

"Numerous benefits for both Clary and its customers are anticipated.

"Federal Electric, service associate of International Telephone and Telegraph Corporation, with headquarters in Paramus, N.J., employs nearly 4000 trained personnel and has widespread facilities to assure reliable service for our customers," Zaenglein commented.

"And Clary will be able to sell in areas heretofore beyond the scope of our servicing capabilities." rat the equ ele dev exa

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Federal Electric's J. W. Guilfoyle, President, said that in addition to supplying the full range of services normally received from a factory service arm, "FEC will also bring a system-oriented viewpoint to the maintenance of Clary installations."

"Federal Electric serves the world-wide ITT System, other companies and government agencies."

"Its own technicians and facilities can be supplemented with the specialized talents and technical resources of ITT throughout the world.

"One of its best known projects is the Distant Early Warning (DEW) Line which it operates and maintains for the Air Force. This 4500 mile radar chain extends from Alaska across Canada and Greenland to Iceland.

> "Another of its major projects is operation and maintenance of ground support equipment at the Navy's Pacific Range at Point Arguello, Calif."

ANALOG COMPUTERS SOLVING WATER SHORTAGE PROBLEMS BY LOCATING STRATEGIC POINTS TO INJECT WATER INTO NATURAL UNDERGROUND BASINS

EAI Computation Center Subsidiary of Electronic Associates Inc. Los Angeles, Calif.

Analog computers have helped Southern California solve serious water shortage problems, and have thrown light on replenishing the vast natural water storage basin which underlies the sprawling Los Angeles County area with fresh water transported from Northern California.

The computer study program told the California Department of Water Resources where to inject the water on the surface of the basin. It was performed by this computation center.

Events which led up to the computer studies go back several years when geologists first noticed the rapidly declining water level in the underground basin. This posed not only a serious threat to the continued growth of the metropolitan area, but the little fresh water that remained in the basin was being contaminated by seepage of sea water.

To alleviate this alarming situation, the recharge of fresh water imported from distant sources into the basin was proposed. But this raised several questions: where should the water be injected for even distribution so it wouldn't flood one area and leave another dry, and where along the coast should it be injected to retard seepage of salt water?

To provide answers to these questions, the nature and behavior of the ground-water basin underlying the Los Angeles Coastal Plain had to be determined. This is where analog computers entered the water resources and development project.

The Southern California Office of the California Department of Water Resources turned over years of accumulated studies of the basin to this center. The computers were able to simulate a mathematical model of the basin, which allowed geologists and hydrologists to investigate the characteristics of the underground reservoir in detail.

From this analog simulation, engineers were able to study the flow of water into and throughout the basin by actually portraying the effect of layers of water-bearing sands and water-inhibiting barriers of clay. The working model also accurately simulated various water-bearing characteristics of the aquifers so that the amount and direction of flow from one area to another could be determined.

These studies on the computers saved thousands of man-hours of tedious manual calculations, and showed not only in which areas water should be injected into the basin for best results, but also expected changes caused by injecting water at various areas for as many as 100 years into the future.

The successful use of analog computers in this field of engineering opens up whole new areas for applying computer techniques. Similar techniques, based on analog simulation, can be used to study oil fields, fresh water sources and other problems involving the flow of fluids.

The full technical paper by Donald A. Darms that describes this study is available upon request from: Clyde D. Carder, Gaynor & Ducas, Inc., 850 Third Avenue, New York 22, N.Y.



MEMORY SYSTEM FOR THE POST OFFICE FOR CODING AND SORTING MAIL

Bryant Computer Products Div. Ex-Cello-O Corp. 852 Ladd Road Walled Lake, Mich.

This company has delivered a complete information storage system to Rabinow Engineering Company, Washington, D.C. and the unit has been installed in a postal directory magnetic drum system, designed by Rabinow Engineering for the U.S. Post Office Department. The system is to be used for experimental coding and sorting of mail.

The system consists of three sections: a central logic section; complex input and output devices; and the Bryant drum storage and memory access section.

In the mail sorting process, each letter is coded. The code is then compared with information stored in the memory system, to assure the letter reaching its proper destination. Information stored in the memory system can be altered quickly to conform with code or address changes.

The system has a capacity of 1,250,000 bits of information, and an access time less than 17 milliseconds, and it is built around a standard Bryant memory drum. The drum is equipped with 512 magnetic heads, divided into eight groups for eight-bit parallel operation.

Associated electronics include a standard power supply, read circuits, write circuits, selection circuits, decoding matrix, and logic level translation circuits, to provide compatible operation with the computer.



HIGH-SPEED ELECTRONIC DATA PROCESSING EQUIPMENT FOR RADAR EYES OF BALLISTIC MISSILE EARLY WARNING SYSTEM AT CLEAR, ALASKA

Sylvania Electric Products, Inc. Waltham, Mass.

The second site of the Air Force's Ballistic Missile Early Warning System (BMEWS) at Clear, Alaska, (see the front cover picture) became operational on July 1; it is linked with the BMEWS Site I in Thule, Greenland, covering the northern polar wastelands; and provides the United States with a 15-minute notice of an impending ICBM attack.

The high-speed electronic data processing equipment that provides the vital "nervous system" for the huge BMEWS radar eyes was developed and produced by Sylvania Electric Products Inc., a subsidiary of General Telephone & Electronics Corporation.

Sylvania is a major subcontractor to Radio Corporation of America on BMEWS, a 3,000-mile radar system in the far north for detection of enemy intercontinental ballistic missiles. The company is responsible for design, manufacture and installation of the multi-million-dollar data processing phase of BMEWS.

The "nervous system" continually monitors the radar's operating status to assure reliability, as well as calculates radar target information for transmission to the North American Air Defense Command in Colorado Springs, Colo.

Returns from BMEWS radar are automatically processed through the system and displayed on three-dimensional wall-sized battle maps. Total time for BMEWS signals to strike their targets, reflect to receivers, be analyzed by computers, transmitted back to the United States, and displayed, is eight to ten seconds.

The BMEWS electronic "radar observor", called Detection Radar Data Take-Off subsystem (DRDTO), is the first three-dimensional device of its kind -- estimating target azimuth range and radial velocity. Similarly, the computer sub-system which receives this DRDTO information operates at the highest speeds available today, performing 200,000 mathematical operations per second.

The data processing system's generalpurpose computer apparatus is called Missile Impact Predictor Set (MIPS). MIPS is made up of two standard International Business Machines Corp. solid-state computer systems, and specialized "real-time" equipment designed jointly by Sylvania and I.B.M. and manufactured by I.B.M. on a sub-contract basis. gan of 1

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The MIPS computer relies upon a Sylvaniadeveloped program of thousands of stored instructions operating on thousands of computer words of stored data to:

- Recognize, among radar sightings reported by the DRDTO, those sightings which appear to resemble space trajectories or orbits.
- 2 Discriminate, from among the tracks discerned, the ones which represent potentially hostile missile trajectories.
- 3 Project the potentially hostile trajectories to predicted points and times of impact.
- 4 Keep traffic totals to expedite decision on whether its reported observations represent a concerted enemy attack.
- 5 Formulate clearly and within a few thousandths of a second the traffic totals and predicted points and times of impact both for operating personnel at the site and for transmission to display facilities at Colorado Springs.

A variety of reliability safeguards are built into the computer program. These include the continuous checking of its own internal performance, the processing of simulated, test raids introduced by over-all system-checkout equipment, and continuous liaison with the program of a standby computer to verify results and to provide for prompt switchover of computers in case of an internal malfunction.

GIANT COMPUTER TO DO ATOMIC RESEARCH IN EUROPE

IBM World Trade Corp. 821 United Nations Plaza New York 17, N.Y.

One of the most powerful computers existing, the IBM 7090, will soon be helping European atomic scientists reach new heights of achievement. The more-than-17 tons of highspeed data processing equipment, specially designed for scientific and engineering problems, left New York International Airport on July 8 on its way to the Ispra Atomic Research Center on the shores of Italy's Lake Maggiore. It will be the focus of a great deal of the nuclear work being done by EURATOM, the European Atomic Energy Community whose members are the same six nations forming the European Common Market.

One of the computer's most important functions will be to perform as an "electronic library". Scientists feel a great need for this, as every year well over a million technical journals are published throughout the world in a multitude of languages. Because of this it has been virtually impossible for a scientist to keep abreast of all the developments in his field. Work on the computer at Ispra will be concentrated not only on cataloguing this mountain of technical information, but also on actually translating various publications to give them a much wider audience.

In basic research, the data processing system will be used in such studies as the solution of "Boltzmann equations" which deal with the flow of neutrons, and "group diffusion" for the solution of special types of equations.

Use of the computer facility at Ispra will be shared by the other three EURATOM research centers in Germany, Belgium and Holland.

ONE MICROSECOND MODULAR MEMORY

Daystrom, Incorporated Military Electronics Division Archbald, Pa.

One-microsecond modular memories can now be obtained from this company. Supply of a standard high-speed modular memory is expected to increase application flexibility in a number of important computer areas.

Last year, this company designed and installed one of the largest and fastest computer memories for the NORC (Naval Ordnance Research Calculator). The NORC computer tracked the recent globe-circling satellite launched by the Soviet, and recorded the fact that Russian cosmonaut Major Yuri Gagarin was in orbit.

The new standard one microsecond modular memory employs concepts which have proved extremely reliable in preceding systems. Subminiature magnetic ferrite cores are used in the memory, augmented by sophisticated solidstate logic and drive circuits. The solidstate magnetic core array system has a full read-write cycle time of 1 microsecond, with access time of 0.4 microseconds.

Solid-state design facilitates incorporation of the memory in a wide variety of datahandling sytems. The standard modular memory has a capacity of up to 1024 words, each 50 bits in length. However, capacity is expandable in modules of 1024 addresses and word lengths up to 200 bits.

Components are stacked, rather than carded, giving improved packaging density through volumetric assembly. The design makes for speed and compactness of assembly, facilitates module testing and replacement, and allows for unusual flexibility for expansion.

COMPUTERS and AUTOMATION for August, 1961

American Systems Incorporated 1625 East 126th Street Hawthorne, Calif.

An operating prototype magnetic thinfilm shift register offering extremely small size, large memory capacity, and high operating frequency was demonstrated in July by this company.

to maintain	high	signal-to-noise	ratio	from
the miniatur	e uni	its.		

In the thin-film shift register, digital information is translated from place to place



-- The thin-film shift register is mounted in a closed-circuit TV demonstrator, which makes visible the pattern of magnetic domains on the actual operating thin film. Shown adjusting position of the register is K. D. Broadbent, Director of the Solid State Physics Laboratory, and inventor of the original thin-film shift register. In the demonstration setup, a beam of polarized light is directed at register surface. Reflections from magnetic domains on shift-register film are picked up by TV camera on right, and displayed on TV screen in background. --

Approximately 1" x 3" in size, the shift registers have memory capacities ranging from 128 to 256 bits, and operate up to 1 megacycle per second in frequency. These characteristics are achieved by an unusual register design, and by vacuum deposition processes in which several thin-film alloys are deposited with extreme precision on the small substrate.

The design and the fabrication processes are based on the register invented by K. D. Broadbent who described his early shift register in September, 1960, in an IRE professional group paper. The new register design greatly improves bit definition, increases immunity to noise, and raises top operating speeds.

Planned as a microminiature, integrated operational package, the register units will include the necessary driving and readout electronics. A novel readout method, based on the magneto-resistive effect, will be used through the magnetic surface without the necessity of moving the surface physically, as is done with magnetic drums and tapes. It is also unnecessary to convert magnetic information into electrical signals, as in the magnetic toroid shift register.

Fundamentally, this permits higher efficiency in terms of storage density, required power, and over-all weight and volume. And because the thin-film registers do not involve inertial elements, they can be synchronized instantly with data processing units having widely varying information rates.

A variety of applications are visualized for the thin-film shift register. In a typical application such as buffering, the production version of the register will be completely interchangeable with units performing this function in existing systems. The cost per bit of information is expected to be appreciably lower for most uses. lar(7074

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RUSSIAN LANGUAGE TRANSLATED AT 60,000 WORDS PER HOUR

Machine Translation, Ltd. 821 15th St., N.W. Washington 5, D.C.

The development of a test production system to translate one language into another by means of an electronic computer at the rate of 60,000 words per hour was demonstrated by this company at the end of June.

At a press demonstration of the system -called the Unified Transfer System (UTS) -- an article from the Russian newspaper Pravda was translated into English at the rate of 60,000 words per hour or 17 words per second. Part of this article was also translated into German.

"This important scientific advance should establish American leadership in the field," stated Mrs. Ariadne Lukjanow, president of this firm, and inventor and developer of the system. "The Soviet Union has had more than one thousand persons engaged in research on machine translation for several years," she noted.

The UTS system has been designed for use on general purpose computers and is suitable for translation of any language into another as long as one language is an Indo-European tongue.

Mrs. Lukjanow announced that a full production system will be ready within 12 months. At that time, the translation speed will be increased to over 150,000 words per hour using the IBM 7090 computer. She predicted the system may be able to translate one million words per hour when used on IBM's new STRETCH computer.

Mrs. Lukjanow pointed out that the present test model incorporates only 50 per cent of the linguistic rules, yet still produces a highly acceptable translation. The remaining linguistic rules have been prepared and will be phased into the final production system.

She noted the significance of the UTS development by relating these facts:

- Less than 10% of the scientific and technical data from Russia is available to U.S. scientists.
- 2. It is estimated by the House Space and Aeronautics Committee that there are only 1,000 professional Russian translators in this country and 80% of them are 60 years of age or over. A skilled person translates only 400 words per hour.

- 3. In the intelligence field, the need for translation is acute. A report of a Congressional Committee indicates that U.S. intelligence organizations translate only .09 of one per cent of Soviet publications and literature. If translation was limited to critical information only, it would necessitate the translation of 250 million words every month. This would require a 50-fold expansion of present government and private translation services.
- 4. Notice of the launching of the first Soviet satellite, including the frequencies of transmission, was published in a leading Soviet aviation publication several months before the Sputnik was actually launched. This important event was not brought to the attention of U.S. scientific and intelligence officials, because the article was translated only several months after the launching.
- 5. The two-way machine translation system UTS will make possible the translation and distribution of American textbooks and publications in underdeveloped countries, where Soviet-translated publications at present have little competition.

Mrs. Lukjanow -- who has been working on the problem for six years -- said Machine Translation Inc. now has a computerized Russian-English dictionary of over 5,000 Russian words and their 32,000 English meanings. By July 1, 1962, the dictionary will have been expanded to 50,000 Russian words and over 300,000 English meanings.

The Unified Transfer System combines the transfer of word function, word form, word meaning, and word distribution into a single transfer process. In order to achieve this transfer, a classification system has been devised for each of the transfers expressed in the form of a code, which is incorporated into unified code patterns.

Mrs. Lukjanow stated that Machine Translation Inc. hopes to translate, print and distribute Pravda and other Russian newspapers in the country on the same day they are published in Russia. The distribution of these publications could be limited to government agencies, universities and the press, she said.

"I see in the not-too-distant future one or two central translation centers in this country," said Mrs. Lukjanow. "These centers will be able to translate all needed foreign books and newspapers into English and our material into other languages," she concluded.

TINY EXPERIMENTAL THIN-FILM TRANSISTOR MAY SHRINK COMPUTER CIRCUITS TO BOOK-PAGE SIZE

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

An ultraminiature experimental transistor, so small that as many as 20,000 can fit on a postage stamp, has been developed by this company. The transistor is made by depositing thin films by evaporation on an insulating base. It is capable of shrinking the basic circuitry of a computer to the size of a book page. The basic circuitry of present-day computers ranges in size from the equivalent of a large hat box to a walk-in clothes closet.

The new device has been tested successfully at RCA Laboratories, and may open the way to new ultraminiature mass-production transistor circuits for many applications, expecially in electronic computers and perhaps ultimately in other equipment such as thinscreen wall-type television receivers.

Dr. Paul K. Weimer of the RCA Laboratories technical staff, was responsible for its development.

This is believed to be the first time that transistors having useful performances have been produced entirely by the thin-film technique of evaporating all materials upon an insulating base -- in this case, a glass plate.

Electronics research has long sought a way to make transistors cheaply in large arrays. This development at RCA Laboratories promises to provide a practical solution. The technique that has been used to produce operating units in the laboratory fits in with present methods of making thin-film devices of other types. Thus it points a way to low-cost mass production of entire transistor circuits containing hundreds or thousands of active elements, all connected and ready for operation.

A complete three-stage amplifier including thin-film transistors and their connections could be produced by this means on a surface only twice as wide as a human hair.

The active material used in the transistor is cadmium sulfide, a compound with considerably greater insulating properties than the germanium, silicon, and other semiconductor materials used in standard transistors.

In making the thin-film transistors, an evaporation process is used to deposit successive thin layers of cadmium sulfide and metal on a glass plate, creating a device that is only a few ten-thousandths of an inch thick. In the evaporation process, the cadmium sulfide crystals and the metal are heated in successive steps in a vacuum, and they turn to vapor which is collected by condensation on the glass plate, in the same manner as steam condenses in a film on a cooler surface held over boiling water.

By using a special mask to cover portions of the plate during the process, the metal layers are deposited in a pattern that forms the electrical contacts needed to operate the transistor. The masking process also can be used to produce various patterns of connections among many transistors to complete a desired circuit at the same time that the transistors themselves are being made.

The completed transistor is not only very tiny, but it also incorporates an important operating feature not now used in commercial transistors. In conventional transistors having comparable functions, electrons flow more or less freely through the semiconductor material between two of the contacts, and the third element provides control by reducing the flow in varying degrees. The operating principle of the experimental thin-film transistor is exactly opposite. The insulating properties of the cadmium sulfide hamper the flow of electrons between two electrodes, and the third element provides control by increasing the flow in varying degrees.

According to Dr. Weimer, this innovation, with further development, will permit extreme simplicity in the arrangement of circuits to link the tiny devices in large arrays, making the new device especially useful for computer applications.

SUMMER HIGH SCHOOL CLASS IN CONCENTRATED COMPUTER STUDY

> Royal McBee Corp. Port Chester, N.Y.

A significant project in the educational use of electronic computing equipment began at Staples High School, Westport, Conn., on July 10.

A group of 16 Staples students started learning the techniques of programming and operating an electronic computer. They are scheduled for 4 weeks of concentrated study, working with the computer 3-1/2 hours a day, 5 days a week.

The project is being conducted jointly by Staples High School and this company, which has installed a Royal Precision LGP-30 electronic computer in the classroom and is providing instructional assistance. offi Powd Chai

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COMPUTERS and AUTOMATION for August, 1961

SCORING THE ALL WOMAN TRANSCONTINENTAL AIR RACE

> Francis X. Splane Convention Hall Atlantic City, N.J.

The Royal Precision LGP-30 was appointed official "scorekeeper" for the 15th annual Powder Puff Derby by Mrs. Betty H. Gillies, Chairman of the Board of AWTAR, Inc.

The All Woman Transcontinental Air Race began in San Diego, Calif. at Noon, (EDT), July 8, and ended in Atlantic City, N.J., at Noon (EDT), July 12.

Computing final scores for the nearly 100 contesting planes meant handling a large volume of data quickly and accurately. This problem has required up to 24 hours of work by 3 operators of desk calculators in past years. The job was handled in minutes by the desk-size LGP-30 computer marketed by Royal McBee Corporation.

Each plane was eligible for several prizes. First, the grand prize of "winner" goes to the plane with the highest score for the entire 2709 miles. Prizes are also awarded to winners of various "legs" -- distances between intermediate airports -- and prizes are given to certain types of aircraft for the best performance within a class.

The LGP-30, operating from stored instructions, analysed each flight record. The average ground speed, the score, and the prizes for which the plane is eligible will then be "memorized".

A score is computed by subtracting a "par" assigned to each plane from the average ground speed attained. The "par" is established to allow planes of varying horsepowers to compete in the same race. It is similar to a golf or bowling "handicap".

When all planes have crossed the finish line, the electronic "brain" will sort the planes into sequence by final score within eligible categories and print the results on a typewriter.

The LGP-30's reliability, simplified programming, and mobility -- it operates from a conventional wall outlet and requires no special installation or air conditioning -- made it ideal for the large volume, "one time" job of computing the results of this annual coastto-coast classic, in full view of thousands of spectators in the Convention Hall, Atlantic City.

AUTOMATIC SPEECH RECOGNITION SYSTEM FOR VOICE-OPERATED TYPEWRITERS, ETC.

Sylvania Electric Products Inc. Applied Research Laboratory Waltham, Mass.

This laboratory is using a computer to analyze speech into a set of numbers and then convert the set of numbers back into speech.

The project is directed toward testing the effectiveness of a method of speech sound analysis being developed by the laboratory for the Rome Air Development Center, Rome, N.Y.

The object of the "speech analyzer-synthesizer" project is to determine the feasibility of a more efficient way of mapping speech for use in automatic speech recognition systems.

Speech sound analysis is the first step in the development of any automatic speech recognition.

Contemplated applications of such systems include voice-operated typewriters, voice programming of computers, voice dialing of telephones, and voice-routing of mail in post offices.

Automatic speech recognition is essentially translation of human speech into a mechanistic language that can be operated upon by a computer or used to control a machine. For this reason, it is anticipated that this process can be successfully reversed, permitting translation of the machine language back into human speech.

The speech sound analysis method consists of introducing a tape recording of a human voice into a digital computer. There the sounds are first mathematically analyzed, and then re-synthesized from the resulting numbers on a sound recording.

The fidelity of the synthesized recording to the original will be a measure of the project's success.

The method analyzes the wave forms that comprise speech in terms of a fixed set of orthonormal (uncorrelated) functions, chosen to resemble sound wave forms that occur naturally in speech.

All sounds are represented as the sum of the same 30-odd orthonormal functions, with only the coefficients of the functions changing for different sounds. The set of 30 functions should result in sufficient fidelity for most purposes.

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MAGNETIC INK CHECK PROCESSING IN SAN FRANCISCO

Federal Reserve Bank of San Francisco San Francisco, Calif.

Check processing at electronic speeds is becoming a reality for the Federal Reserve Bank of San Francisco it was announced. Installation at the bank's Head Office in San Francisco of a high-speed processing system, developed by National Data Processing Corporation of Dallas, is one of five pilot installations across the nation specially designed to handle the public's increasing use of checks. The Federal Reserve Banks of New York, Boston, Chicago, and Philadelphia are testing equipment developed by other manufacturers to determine_which_of the 5 installations will hest_ serve the needs of the 12 Federal Reserve banks and their 24 branches.

The NDP Document Processing System has a Dictionary Look-up Unit for storage of up to one-quarter million bits of information. The Processor reads the entire eight digit bank number on each check instantaneously, compares it to this stored information, and processes the check according to stored instructions. This Dictionary Look-up unit is capable of controlling three document processors simultaneously...all three machines operating independently at full speed. Checks are picked up, magnetized, read, endorsed, numbered, sorted and totals are accumulated...all at a rate of 72,000 per hour.

A vacuum feeding device, used exclusively by NDP, enables the processor to maintain this constant rate by placing checks in the transport at the rate of 20 per second. This unique feeding system keeps the speed constant no matter what length the checks may be. The San Francisco installation, at the present time, is the only pilot office using two processors. Three runs through these processors will sort checks into individual stacks for as many as 4,096 different banks. At the same time the checks are being sorted by the document processor, an Audit Lister, which prints 1,200 lines per minute, prints a control record of the checks, giving batch totals, totals for individual banks, and a master total of all the checks processed. This visible audit trail will give the bank complete control of documents, and print out-cash letters automatically.

Banks need to turn to automation to process the growing volume of checks, since the current national check volume of 13 billion a year is staggering, and this figure is expected to rise to 22 billion by 1970. This growing flood of checks simply cannot be processed by present methods.

Magnetic Ink Character Recognition "common language" adopted as standard by the American Bankers Association is utilized by all five pilot installations. The ink is not really magnetic; rather it contains iron oxide particles which are magnetized by machines handling the documents. These magnetized fields are then detected and interpreted by magnetic reading heads. The MICR system is based on three groups of characters encoded across the bottom of the check. The characters, which resemble the digits they represent and can be read by people as well as machines. show the Federal Reserve routing symbol, the ABA bank transit number, the customer account number, and the dollar amount of the checks. The commercial banks in the 12th Federal Reserve District are making excellent progress in having their checks preprinted with the new characters. Approximately 50% of the checks now handled by the Head Office of the Federal Reserve Bank of San Francisco are preprinted with the routing-symbol transitnumber. Those not preprinted will be encoded with NDP equipment when received by the bank.

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"It is anticipated that conversion to electronic processing will not result in layoffs" stated H. E. Hemmings, First Vice President of the bank. "Many of the employees presently in our check collection operation are being trained to operate the new equipment. Because it will require several years to complete the conversion to electronic processing of checks and because of the continuing increase in volume of checks handled, it should be possible to accomplish any reduction in staff through normal voluntary resignations and retirements. Document Processing systems are embraced, not to eliminate people, but to cope with the rising mountains of paper-work and to provide increased service to the banking community.'

DISK FILE MEMORY WITH ONE READ/WRITE ARM
FOR EACH DISK
International Business Machines Corp. Data Processing Division 112 East Post Road White Plains, N.Y.
Comb-like arms flying on layers of air an read as many as 280 million characters of

can read as many as 280 million characters of data in the new 1301 information storage system developed by this company.

The new disk storage unit can be linked to any one or two of IBM's intermediate or

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large solid-state computers (IBM 1410, 7070, 7074, 7080, and 7090).

Each 1301 unit holds from 50 to 56 million characters of information depending on the computer employed. A total of five units can be used with any of the five computers.

Computers will be able to process records in any order without being slowed while files are searched. As a result, the unit significantly extends the range of on-line randomaccess equipment, and makes possible many new data processing concepts.

Cylinder Concept

Each file contains one or two of 20 rapidly revolving disks for data storage. The unit has a read/write head for each disk surface. These heads, at the end of comb-like access arms, are aligned in parallel. Thus, at any given moment, they are positioned opposite corresponding tracks or grooves on all the 40 disk surfaces in a stack, constituting a vertical cylinder of tracks.

This arrangement makes possible the reading and writing of data in tracks of the same cylinder with no access movement. Related information needed for frequent reference can easily be placed in parallel tracks forming concentric cylinders of data for very fast reference. The only motion required within the file is horizontal from data cylinder to data cylinder. There is no need for vertical motion by the access arms, as in previous disk files, because there is a read/write head for every disk surface.

While reading in the same data cylinder, 102,000 characters in a stack, or 204,000 characters in one disk storage unit, or 1,020,000 characters in a maximum system of five units, may be reached with no access motion. (These figures vary slightly with the computer used.)

The access mechanism requires a minimum of 50 milliseconds to move horizontally from one cylinder to the next cylinder within small groupings of tracks on a disk surface. Within larger groupings of 50 tracks, maximum access time is 120 milliseconds. The maximum access time to any data in the 1301 is 180 milliseconds. Record organization techniques can cut maximum access time substantially.

The rate at which the 1301 reads characters in sequence into core storage is between 75,000 and 90,000 characters a second, depending on the type of system to which it is linked. This is faster than many tape systems. It is an important factor in sequential jobs such as recalling tables or programs stored on the disks into core memory; or transferring of the file to magnetic tape for a more permanent record of the data.

Flexible Record Length

A flexible record length feature adds to the efficiency of the 1301. Records (units of information) of different lengths may be stored on the cylinders. The capacity of the file, therefore, is much greater than that of fixed length files in which records are placed in identical storage spaces regardless of size.

The read/write heads are part of a gliding shoe designed to fly along the disk surface. These shoes actually glide on a layer of air created by rotation of the disk at 1,800 r.p.m. There is an equilibrium of forces which keeps the head balanced less than a hair's breadth above the disk surface.



PROBLEM-ORIENTED PROGRAMMING LANGUAGE INDEPENDENT OF SPECIFIC COMPUTER

Computer Sciences Corp. New York Division 400 Park Ave. New York, N.Y.

This company has developed a new programming system for business data processing. The system, called ADAPT, is problem-oriented, and permits the programmer to deal almost entirely with the basic functions common to all data processing operations, ignoring specific machine characteristics.

The first ADAPT compiler, now in test status and promised for delivery on or before September 1, 1961, is, however, designed for use with the IBM 1401 Data Processing System. CSC is offering, as part of its service to users of data processing equipment, a package consisting of the ADAPT language, the 1401 compiler, and programming training in both the use of the language and the logic of the compiler.

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16TH NATIONAL CONFERENCE OF THE ASSOCIATION FOR COMPUTING MACHINERY SEPT. 5-8, 1961

Local Arrangements Committee Association for Computing Machinery Statler Hilton Hotel Los Angeles, Calif.

A large number of the nation's computer technologists will hear more than 90 technical papers in 24 formal sessions at the 16th national conference of the Association for Computing Machinery, September 5 to 8, 1961, in Los Angeles.

The conference is expected to attract about 2500 scientists and engineers to the four-day session at the Statler-Hilton Hotel; it will include eight forum-like "Halls of Discussion".

Exhibits by computer manufacturers are scheduled for the hotel's Garden and Wilshire Rooms. Thirty-three companies will occupy 61 exhibit booths for the showing of the latest in computing components, products, and systems.

A broad range of advanced computer techniques -- computer languages, information retrieval, numerical analysis, automated teaching, and new approaches to business data processing -- will be covered by technical papers. Topics for the "Halls of Discussion", include: Dividing the Information Retrieval Chores Between Human and Non-Human Automata, Mathematical Programming, Basic Problems of Computer Installation Management, Applied Digital Simulation, Programmer Training, Business Data Processing, Digital Computing in Medicine, and Analog and Combined Simulation.

Field trips will include tours to Bendix's G-20 assembly areas in southwest Los Angeles, and a trip through National Cash Register's NCR 315 assembly line and test facilities.

The local ACM arrangements committee has reserved a large block of rooms in the Statler-Hilton, and has also arranged for dormitory accommodations in Myra Hershey Hall on the UCLA campus. Shuttlebus service will be available from the Westwood campus to the downtown hotel each morning and evening.

Following is the program for the opening session:

Opening Remarks, -- B. F. Handy, Jr., Litton Systems, Inc., Chairman, 1961 Conference Committee

Presidential Address, H. D. Huskey, Univer- sity of California, President, Association for Computing Machinery		dev str wor
The Gatlinburg Matrix Conference, A. S. Householder, Oak Ridge National Labora- tory, Oak Ridge, Tenn.		1
The Joint User Group Activites, Harry Can- trell, General Electric Company, Schenec- tady, N.Y.	ı	2
The Special Interest Group on Numerical Analysis, Peter Henrici, University of California, Los Angeles, Calif.	7	3
High School Students Study Programming A Large Scale Experiment, George Heller, IBM Federal Systems Division, Bethesda, Md.		4
Some New Developments in Automatic Language Translation, Franz Alt, National Bureau of Standards, Washington, D.C.		5
Character Reading Machines An Engineer's Report, Arthur W. Holt, Rabinow Engi- neering Company, Washington, D.C.		
Use of Digital Computers in Automated		
Instruction, John E. Coulson, System		L
Development Corporation, Santa Monica,		clu clu
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2,000,000th PRINTED CIRCUIT BOARD		wit
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Military Electronic Computer Division Detroit, Mich.		mal
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This is the Gold Plated 2,000,000th electronic printed circuit board produced by this company. These printed circuit boards are required to meet rigid reliability standards for ballistic missile guidance systems, early warning radar, and ultra-high-speed electronic commerical data-processing equipment.

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NATIONAL DRIVER REGISTER SERVICE USING COMPUTER

U.S. Department of Commerce Washington 25, D.C.

The National Driver Register Service began on June 30 at 3 p.m. in the computer room of the Bureau of Public Roads.

This Register, set up and maintained by the Bureau of Public Roads of the U.S. Department of Commerce, is a file on motor-vehicle operators whose driving privileges have been withdrawn for driving while intoxicated or for conviction of a violation involving a traffic fatality.

The States that make use of the Register will be able to prevent, or at least reduce the possibility, of the inadvertent granting of driver privileges to individuals whose licenses have been withdrawn in another State and whose operation of a motor vehicle would be likely to create a disproportionate hazard to other highway users.

Secretary of Commerce Luther H. Hodges emphasized that the Federal Government is not entering either the driver-licensing or the traffic-law-enforcement fields. The program is a purely voluntary, cooperative State-Federal enterprise. Names and identifying data on drivers whose driving privileges have been withdrawn for the specified causes will be furnished to the Bureau of Public Roads by the participating States. The States will request a check on new license applicants against the Register files.

As the Register Service prepared to go into official operation, 45 States and territories had already agreed to participate. It is probable that a number of the remaining States and Territories will join the operation in the future. It is known that some of them are revising their own licensing systems and are therefore unable to make commitments at the present time.

Although operation of the Driver Register does not begin officially until July 1, with the start of the new fiscal year, the States have already sent in information on nearly 11,000 drivers. Once the operation gets into full stride it is expected that records will be received on about 1,000 names daily, and requests for searches could well average 20,000 a day. High-speed electronic data processing equipment (an IBM 1401) is being used to handle the records and inquiries.

Establishment of the Driver Register Service was authorized by legislation approved July 14, 1960, and was one of the specific recommendations in the Bureau of Public Roads report, "The Federal Role in Highway Safety," submitted to the Congress February 27, 1959. Since that time the Bureau of Public Roads has been developing and trying out the details of the program now going into operation.

CENTRAL COMPUTING ELEMENT IN SERVICE AT NORAD

Hdqrs., North American Air Defense Command Office of Information Colorado Springs, Colo.

In July, the "heart element" of a space system for military warning was placed in the Combat Operations Center of the North American Air Defense Command. In time, it will provide round-the-clock electronic cataloging of all man-made objects in space.

The full title of the system is Space Detection and Tracking System, but it is called SPADATS for short. It is furnished to NORAD's Commander-in-Chief by the USAF as a part of its aerospace defense contribution.

The actual "heart element" which has gone formally into service is the Philco 2000 Electronic Data Processing System.

The Space Detection and Tracking System detects, tracks, and identifies man-made objects in space, and consolidates and displays information regarding such objects.

The system presently consists of U.S. Navy and U.S. Air Force operated sensors linked by a communications network to SPADATS located in the NORAD Combat Operations Center.

An integral part of SPADATS is the data processing element which utilizes an electronic computer to analyze the inputs from the various sensors, perform orbital calculations and comparisons, and catalog the data.

These data along with important information from a variety of other sources displayed in the NORAD Combat Operations Center form the basis of judgment and aerospace defense actions by the Commander-in-Chief, NORAD.

The Philco 2000 is an asynchronous computer, and is able to be connected with faster and faster units as they are finished without major redesign and rewiring. For example, a change from a 10 microsecond memory to a 2 microsecond memory will soon be made, by unplugging the one and installing the other.

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COMPUTER CONTROL SYSTEM FOR NEW ACETYL PLANT

Minneapolis-Honeywell Regulator Co. Special Systems Division Pottstown, Pa.

A computer-directed control system has been ordered by Celanese Corporation of America from Minneapolis-Honeywell Regulator Company for its new multi-million-dollar acetyl manufacturing plant being built at Bay City, Texas.

The integrated system will perform online monitoring and control of a new process for producing acetaldehyde, a petrochemical widely used in making paints, plastics, synthetic rubber, fibers, dyes, drugs, fuels and many other products. Celanese is one of the largest producers of acetaldehyde.

Development of the system is being undertaken by this division of Honeywell. In addition to the H290, a powerful, high-speed digital computer produced by the company's Electronic Data Processing division, the system will include compatible electronic instrumentation, a computer programming console, a centralized instrument board, an alarm printer and other equipment made by various Honeywell divisions.

In the initial phases of production, only a limited amount of the process will be controlled by the computer, according to Celanese. As more operating information becomes available, additional control loops are expected to be placed under computer direction.

Also to be under computer control, Celanese reported, will be the production from acetaldehyde of 2-ethyl hexanol, a chemical used in making vinyl resins, detergents, lacquers, penetrating oils and hydraulic fluids.

The computer system will monitor input signals of flows, temperatures, pressures, liquid levels, specific gravities, and other process variables at a maximum scanning rate of 200 points per second.

Key variables will be logged by electric typewriters along with calculated values of production rates, yields, efficiencies, material balances, and other engineering information.

The new acetaldehyde process uses ethylene gas and oxygen as raw materials instead of a mixture of other petroleum gases. The process has been licensed to Celanese by Aldehyd G.m.b.H., a German company owned jointly by Farbewerke Hoechst and Wacker-Chemie. The Bay City plant is scheduled to go on stream in 1962. It will enable Celanese to produce more than 500,000,000 pounds of acetyl chemicals annually by three different processes, each using different raw materials as feed stocks.

REMOTE	PRODUCTION	CONTROL	IN	THE	OTL	INDUSTRY	

Radio Corporation of America
Industrial Computer Systems Dept.
Natick. Mass.

An electronic system can keep a constant vigil over widely separated petroleum wells or cross-country pipelines, report breakdowns, relay instructions from a central control point, and log important production data. Such a system has been developed by this company.

It is known as the Automatic Logging Electronic Reporting and Telemetering system (ALERT) and is "virtually foolproof".

The system employs the RCA 130 Industrial Data Transmission Link to relay performance information and control instructions to and from individual wellheads, which may include pumping stations 50 miles or more off-shore.

In the case of a well network, the system enables the operator to keep in constant touch with all the wellheads under control, and make production changes instantaneously or according to a desired program to maintain the daily output required. In the case of a pipeline, the system provides the operator with up-to-the-second reports on pressures, pumping station failures, or power breakdowns. The system supervisor is as close to his most distant charge as the control panel beside him.

A wide variety of transmission media can be used with the RCA 130 equipment -- very high frequency radio, telephone or telegraph lines, submarine cable or microwave.

Because petroleum operators are limited to specific production levels by government regulation, the logging of production data is an important service of the ALERT system. The information is recorded by a logging typewriter automatically, or in the form of punched cards or perforated paper tape for use with an electronic computer. ide

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MEASUREMENT OF TIME TO 10^{-8} SECONDS

Computer Measurements Co. Division Pacific Industries, Inc. 142 Sansome St. San Francisco 4, Calif.

An electronic counting and timing device of such precision that it can split a second into more than 100,000,000 slices and make frequency and timing measurements of events occurring at speeds approaching that of a beam of light was demonstrated in May at this company.

The device is being put into immediate production for use in a variety of fields: radar; the design and testing of new missile and satellite systems; measurement of the rate at which explosions develop; counting the rate of atomic reactions developed in equipment converting nuclear energy into electric power; etc.

If used as part of an airport radar, the device would enable the operator to tell the exact position of an approaching airplane with a margin of error of less than 4 feet at a distance of 10 miles.

The newly developed high-speed counter is in a rectangular box about the size of an overnight bag and weighs only 24 pounds.

As one demonstration of the capabilities of the device, John K. Rondou, President of Computer Measurements Co., strung a 65-foot length of electric wire around a room, and then shot a burst of current through the wire. Observers saw flashing numbers on the control panel stop at .00000021 to indicate it had taken that fraction of a second for the current to flow the 65 feet.

Rerunning the experiment with a 130-foot length of wire, the numbers stopped at .00000042 -- or exactly twice as long to cover exactly twice the distance.

The device can be set to display the numbers steadily on its face as long as the operator needs them for visual observation; or it can furnish the information directly to a computer in a continuous series of readings of as many as 1000 per second, or put it on punch cards or tape for later use; or it can furnish a signal to other instruments.

TRANSLATORS MAKE HONEYWELL AND IBM SYSTEMS OF ELECTRONIC DATA PROCESSING COMPATIBLE

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

This division has developed magnetic tape translators that provide continuous "on-line" compatibility between Honeywell computers and IBM systems.

The translators enable Honeywell 800 and 400 EDP systems to work from tapes written by IBM machines, and to write tapes acceptable to such machines.

The translator for the Honeywell 800 will rent for \$1950 a month and the Honeywell 400 unit rents for \$975 a month.

The new translator supplements somewhat different units developed earlier for "one shot" conversion of data from both IBM and Univac tapes into Honeywell language. These converters are being operated by Honeywell on a Service Bureau basis as part of the company's program to establish compatibility between its own and other EDP systems.

The new translators are designed to provide continuous interchangeability of data between Honeywell and IBM computers operating in the same organization, also in cases where there may be an interchange of data on magnetic tapes between two or more organizations using different EDP systems. They will also be useful to organizations operating computers of varying types and capacities at decentralized locations.

The translators (Tape Control Unit 836 for the Honeywell 800 and Tape Control Unit 436 for the Honeywell 400) are linked directly between the non-Honeywell tape transports and the central processors of the Honeywell computers. They read data from the IBM tapes, convert it into Honeywell language and pass it on to the Honeywell computers for processing.

Finke said the translators also accept data from Honeywell systems, convert it from Honeywell to IBM language and write IBM tapes for processing.

The Honeywell 800 translator is completely automatic, whereas the Honeywell 400 unit operates on the basis of "programmed transposition of data", Finke said. Both translators operate "on-line".

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SIMULATING BOTH DIGITAL AND ANALOG IN STUDIES OF THE POLARIS' MISSILE GUIDANCE

Lockheed Missiles and Space Division Sunnyvale, Calif.

A Lockheed scientist on June 15 described the digital and analog hardware simulation program which has been instrumental in the development of the Polaris submarine's missile, and has resulted in considerable savings.

In a technical paper presented before the joint meeting of the Institute of Aerospace Sciences and the American Rocket Society, C. H. Kaufmann of this company discussed the system, and added that the techniques involved do have application to more general space simulation studies.

The Polaris simulation program comprises both digital trajectory routines which permit the guidance accuracy to be evaluated, and analog hardware simulation in which properties of the actual flight control guidance components are adequately simulated.

In this way missile design studies have been verified by simulation with actual hardware. Interface and design deficiencies have been discovered prior to costly flight testing. Malfunctions occurring during flight have been diagnosed and corrected for subsequent shots, all of which save both time and money.

The basic objectives of the Polaris simulation program include accurate simulation of the variations in environment which range through five "atmospheres" -- the environment of the submarine launch tube, the passage through the underwater environment, flight through the earth's atmosphere, flight through outer space, and the re-entry into the earth's atmosphere. High accuracy computation of impact is simulated to permit evaluation of the guidance system performance. Also, the program permits accurate simulation of the effects of the environment and missile component characteristics on controllability and stability.

Accurate simulation of the submarine motion and underwater launch dynamics of the trajectory is one of the most important phases of the trajectory. This is because the missile response during underwater flight and subsequent launch recovery impose severe conditions on the missile system and because the guidance accuracy also is affected by the underwater launch. All conditions are simulated even to the sea state when the missile broaches including wave heights, wave amplitude, and wave direction. In regard to analog simulation, the basic philosophy is to use actual hardware as much as possible. Non-linear and other properties of guidance and flight control hardware are difficult to simulate, and are best treated by using actual hardware. While the analog computers are used for a wide variety of simulation, their principal use is for the computation of missile dynamics in real time.

DATA PROCESSING SYSTEM TO KEEP TRACK OF MILLIONS OF ELECTRON TUBES

> Radio Corp. of America Electron Tube Division Harrison, N.J.

This division has put into operation in April an RCA 501 electronic data processing system to analyze facts, approve shipments and prepare reports on several hundred types of receiving tubes under production.

The new system makes possible a unique quality assurance program that was not considered practical by other computing methods.

It is making decisions on the quality assurance of approximately 300 different types of receiving tubes manufactured in Harrison.

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To handle this job by punched-card equipment would have been impractical, since it would have involved over two million cards. Now, with the RCA 501, volumes of test data from the tube rating laboratory covering a one-year period can be condensed on only one roll of magnetic tape.

Fifteen minutes of computer time a day results in a brief management report, which lists all production lots that have been approved for shipment. The computer gives the actual reasons for rejection on the few that failed final testing. Detailed reports are also produced at the same time for review by engineering, production management, and government inspectors.

In addition to quality assurance, the RCA 501 system will be used for production and inventory control, order handling, billing, and receivables accounting, as well as sales and cost analysis and market forecasting. es of funcnt ernway sified stigadata

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Make over 200 Small Computing and Reasoning Machines with . . . BRAINIAC ELECTRIC BRAIN CONSTRUCTION KIT

WHAT COMES WITH YOUR BRAINIAC® KIT? All 33 experiments from our original kit (1955), with exact wiring templates for each one. All 13 experiments from the former Tyniac kit. 156 entirely new experiments with their solutions. Over 600 parts, as follows: 6 Multiple Switch Discs; Mounting Panel; 10 Flashlight Bulbs; 2 Multiple Socket Parts, each holding 5 bulbs; 116 Wipers, for making good electrical contact (novel design, patented, no. 2848568); 70 Jumpers, for transfer contacts; 50 feet of Insulated Wire; Flashlight Battery; Battery Box; nuts, bolts, sponge rubber washers, hard washers, screwdriver, spintite blade, etc. ALSO: 256 page book, "Brainiacs" by Edmund C. Berkeley, including chapters on: an introduction to Boolean Algebra for designing circuits; "How to go from Brainiacs and Geniacs® to Automatic Computers"; complete descriptions of 201 experiments and machines; over 160 circuit diagrams; list of references to computer literature.

This kit is an up-to-the-minute introduction to the design of arithmetical, logical, reasoning, computing, puzzle-solving, and game-playing circuits—for boys, students, schools, colleges, designers. It is simple enough for intelligent boys to assemble, and yet it is instructive even to engineers because it shows how many kinds of computing and reasoning circuits can be made from simple components. This kit is the outcome of 11 years of design and development work with small electric brains and small robots by Berkeley Enterprises, Inc. With this kit and manual you can easily make over 200 small electric brain machines that display intelligent behavior and teach understanding first-hand. Each one runs on one flashlight battery; all connections with nuts and bolts; no soldering required. (Returnable for full refund if not satisfactory.) ... Price \$18.95.

WHAT CAN YOU MAKE WITH A BRAINIAC KIT?

LOGIC MACHINES Syllogism Prover James McCarty's Logic Machine AND, OR, NOT, OR ELSE, IF . . . THEN, IF AND ONLY IF, NEITHER . . . NOR Machines A Simple Kalin-Burkhart Logical Truth Calculator The Magazine Editor's Argument The Rule About Semicolons and Commas The Farnsworth Car Pool

GAME-PLAYING MACHINES Tit-Tat-Toe Black Match Nim

Sundorra 21 Frank McChesney's Wheeled Bandit

- COMPUTERS to add, subtract, multiply, divide, . . . , using decimal or binary numbers. — to convert from decimal to other scales of notation and vice versa, etc.
 - Operating with Infinity
- Adding Indefinite Quantities Factoring Any Number from 45 to 60 Prime Number Indicator for Numbers 1 to 100 Thirty Days Hath September Three Day Weekend for Christmas Calendar Good for Forty Years 1950 to 1989 Money Changing Machine Four by Four Magic Square Character of Roots of a Quadratic Ten Basic Formulas of Integration
- PUZZLE-SOLVING MACHINES The Missionaries and the Cannibals The Daisy Petal Machine Calvin's Eenie Meenie Minie Moe Machine The Cider Pouring Problem The Mysterious Multiples of 76923, of 369, etc. Bruce Campbell's Will The Fox, Hen, Corn, and Hired Man The Uranium Shipment and the Space Pirates General Alarm at the Fortress of Dreadeerie The Two Suspicious Husbands at Great North Bay

The Submarine Rescue Chamber Squalux The Three Monkeys who Spurned Evil Signals on the Mango Blossom Special The Automatic Elevator in Hoboken Timothy's Mink Traps Josephine's Man Trap Douglas Macdonald's Will Word Puzzle with TRICK

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... AND MANY MORE

MAIL THIS REQUEST or a copy of it Berkeley Enterprises, Inc. 815 Washington Street, R102, Newtonville 60, Mass. Please send me BRAINIAC KIT K18, including manual, instructions, over 600 parts, templates, circuit diagrams, etc. I enclose \$18.95 for the kit plus...... for handling and shipping (30c, east of Mississippi; 80c, west of Mississippi; \$1.80, outside U.S.). I understand the kit is returnable in seven days for full refund if not satisfactory (if in good condition). My name and address are attached.

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COMPUTERS and AUTOMATION for August, 1961

Robots in Fiction and Fact

Dr. John W. Clark

Manager, Hughes Nuclear Electronics Laboratory Culver City, Calif.

(Reprinted with permission from Vectors, vol. 3, no. 2, 1961, 2nd quarter, published by Hughes Aircraft Co., Culver City, Calif.)

Almost as far back as literature and folklore reach, there is evidence that men have mused on having mechanical slaves to perform difficult, unpleasant or dangerous tasks. Today it is technically feasible to create such automatons, and their use is certain to increase as our advancing technology reaches out to inhospitable environments. To the man in the street, these mechanisms have a single, popular name: Robots.

One of the earliest mentions of artificial servants occurs in the *Iliad*. Homer describes an episode in which Hephaestus, the Greek god of natural fire and metalworking, constructed 20 three-wheeled vessels which rolled of their own accord into meetings of the gods to bring back messages or instructions. Each had "pure gold-wrought wheels" and was fitted with "handles of curious cunning. . . ." Other robots of legend and mythology were depicted as destructive. The ancient Hebrew "golem" was made in the image of man, but without soul, and according to tale often wreaked havoc.

The Sorcerer's Apprentice

Still another tale, dramatized in Walt Disney's "Fantasia," is "The Sorcerer's Apprentice." Dating from remote antiquity and retold by the German poet Goethe, it was the inspiration for the familiar scherzo by Paul Dukas. Fritzl, the slow-witted apprentice to the sorcerer Willibald, put to work a semiautomatic water-carrying mechanism in the form of an animated broom. But since Fritzl had no instructions for turning the broom off, a near-disastrous flood resulted.

Robot

The word "robot" was coined by the Czechoslovakian playwright, Karel Capek, from the Czech robota, meaning "compulsory service" or work. Robots made their first public appearance in the play "R.U.R.," produced in January 1921. The play takes its title from a fictitious company called "Rossum's Universal Robots," in which the subjects were humanappearing creatures manufactured from synthetic protoplasm in large vats. Like many of their predecessors in fancy, they had dismaying effects on civilization. The piece ends with the robots taking over control of the world from humans and with the robots' despair on learning that the secret of their manufacture had been lost. Frankenstein's monster in the well-known story by Mary Wollstonecraft Shelley is not a robot as the term is usually understood; but since the word "Frankenstein" has popularly come to mean the monster itself —and because the story has served as the basis for many "horror" motion pictures—it deserves mention. The creature was assembled by Dr. Frankenstein from parts obtained from cadavers. It had a "soul" of sorts but usually was destructive when loose. Because it was not truly manufactured and its so-called intelligence not limited or controlled by human designs, it does not fully qualify as a robot.

The robot in science-fiction is a subject by itself. One example is the humanoid type not unlike those of "R.U.R." This variation is described by Isaac Asimov in a series of tales in which R. Daneel Olivaw ("R" standing for robot) is of enormous help to his human partner, Elijah Baley, in the solution of a number of interplanetary detective mysteries.

A True "Robot"

Nowadays, the term robot is most commonly used in referring to automatic or semiautomatic mechanisms. A "true" robot is understood to be a machine which has both mobility and knowledge of its own and is able to perform operations or assignments within its built-in limitations. This concept runs all the way from the golden-wheeled tripods of Homer to the humanoid robots of Asimov. *True* robots (capable of understanding and acting through their *own* thoughtful powers) are hopefully far beyond the capability of any day's technology. But at the rate of current advances in microminiaturization, patternrecognition machines, speech simulation, adaptive servomechanisms, etc., astoundingly auto-obedient robots may some day be conceived.

Meanwhile, a very useful kind of mechanical slave —an extension of its human master—is completely feasible in terms of today's technology. Such remotely controlled machines having no "brains" of their own but which are operator-controlled through cable or radio link have been given the name of MOBOT® devices. Using the machine, the manipulator can remain safely outside a hazardous area and send in an "alter ego" to project his muscles and senses. Thus, at least partly, we can realize a long-standing hope of eliminating or reducing the perils presented by many tasks. celera feren feren contr to the pilot to ac airspe forma accur able in vie

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A few specific applications selected from a large number are now in actual use or under study. The machines are primarily hazardous-area devices. Shown in the article are examples designed primarily to obviate the need for exposing personnel to radiation or radioactive contamination in hotlaboratory or reactor work. In a nuclear laboratory, for instance, the device can perform a chemical experiment, remove protective covers or replace a defective part in equipment under conditions in which possible contamination makes it impossible for anyone to be present. Sometimes the job is simply removal of sources of radioactive contamination.

Problems such as these call for a "rescue" vehicle "robot." Controlled by radio, it can enter an area exposed to radiation, or in which a major nuclear accident has occurred, find and secure any fissionable material involved, then bury the radioactive debris to make the locality again safe. All of these operations can be performed by the device . . . indeed, almost any such task which in the absence of a dangerous environment would be done by a man with his own hands.

To this limited degree, the mechanism can be considered as an electronically controlled extension of a man's hands, eyes and feet so that his intelligence can be fully utilized without exposing him to physical perils. The technology required already has been developed for the most part in connection with missiles, radar, computers and other modern electronic devices. The engineering to do actual tasks is a new and promising application for these well-proved technologies.

The Ocean

Then there is a completely different hazardous environment—the ocean. MOBOT devices can be made to operate at any desired depth under water and so can undertake salvage and recovery of valuable objects, gathering of minerals on or beneath the ocean floor, or development of permanent, complex installations below the surface. All of these things can be done without human divers. Refinement of MOBOT-centered technologies can make possible development and utilization of vast marine wealth.

Another exotic environment is space. While man will continue to explore space for psychological or political reasons, the performance of much useful work might better be done by MOBOT machines than by space-suited astronauts. Tasks ahead include assembly, maintenance and repair of large orbiting vehicles, and exploration of the moon.

The Moon

Before man himself undertakes to invade the moon, an unmanned device weighing about 750 pounds will land on the lunar surface to perform many semiautomated tasks by command of radio signals directed from earth. During the period 1963-1965, plans call for launching and soft-landing on the moon of seven sURVEYOR spacecraft designed, developed and manufactured by Hughes, on contract to the National Aeronautics and Space Administration. The tripodsupported SURVEYOR will be equipped with four television cameras, means for conducting lunar surface/subsurface experiments, instrumentation to measure radiation, meteorite impacts and other environmental factors.

Boredom

Also, there is the hazard of sheer boredom. MOBOT device command systems are readily adaptable to programming. This means that a given series of operations can be recorded. The recording can be played back as many times and in as many places as desired, greatly reducing manually performed repetitive production-line or maintenance operations.

One of the principal research interests in the realm of robots is psychological and has to do on the one hand with studies of the ability of the human mind to learn new ways of seeing, hearing, feeling and moving. On the other hand, work with robot-type machines promises to shed completely new light on the mechanism of the human mind. For now we can clearly separate the limitations inherent in our bodies from the capabilities intrinsic to the mind.

The Basic Technology

A basic technology is common to all the diverse applications mentioned, as well as to many others being investigated. The utilizations differ with the environments to which the equipment is subject. But they are alike in that in all cases a command system ("nerves"), a sensory system ("eyes," "ears," etc.), a handling system ("hands" and "arms"), and a locomotion system ("feet") must be provided. These several systems are essentially the same in all environments. So we can reasonably expect that a new field of engineering will evolve as practical experience accumulates.

The Flexible Human Mind Using Remote Control

As skills increase in producing remote-handling devices, their resemblance to human shapes decreases. Effective manipulation mechanisms are engineered to do specific tasks. Consequently, there is no real reason for an anthropomorphic geometry. Operators quickly become proficient in the use of devices having little or no likeness to the human hand and arm. Completely at ease with "substitute" senses such as the orthogonal two-channel TV viewing scheme used on some machines—quite different from the stereoscopic binocular vision of most vertebrates—the operators have demonstrated the extraordinary flexibility and capability of the human mind.

In many respects, a MOBOT device is comparable to a musical instrument, a typewriter or an airplane in the learning-time required and in the proficiency, speed and deftness obtainable after adequate practice. In engineering MOBOT machine systems—particularly in determining the detailed configuration of the control console and layout of the panel—much attention is given to operator convenience and orientation, comfort and minimization of fatigue. Skilled operators often admit that they "think like the machine." In other words, an experienced person learns to identify himself with the device and acts almost instinctively —a guiding principle in the design of successful remote-handling systems.

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Self-Identification

Self-identification with the MOBOT-type mechanism creates a new and interesting possibility in the manmachine relationship: even when remotely situated, the operator has the sense of *being at the location of the machine*. This enables him to "travel" without bodily doing so. When handling an underwater MO-BOT device one has much the same sensations of actually being in the ocean depths, of observing and studying the surroundings, and of performing useful work in an inhospitable environment. In the future, this may create entirely novel dimensions of our notions of enjoying regions of earth and space we cannot physically enter.

We have seen that intelligent applications of the principles of remote-handling technology virtually eliminate the necessity for personnel exposure to physical harm—or even boredom—in much of the world's critical work. To realize this idealistic state on a large scale would be one of the great achievements of a society committed to increasing jeopardy.

Electronic Data Processing and Its Potential for Retailing

Ethel Langtry

Director, Retail Research Institute, National Retail Merchants Association New York, N. Y.

(Based on a talk at the Metropolitan Controllers Association Meeting, Savoy-Plaza Hotel, New York City, March 22, 1961)

Over the years, many attempts have been made to automate retail store operations; they were well publicized but throughout them all there was one common denominator—the need for converting our data into machine language—economically, effectively and accurately.

These attempts were generally made on a decentralized basis via point-of-sale equipment producing punched paper tape. This technique, however, had two disadvantages:

- (1) This approach required a considerable capital investment with an indefinite payoff, and it
- (2) Imposed an additional burden on the salesclerks.

Many retailers have felt that the proper place to handle conversion into machine language was in the "back office" area, away from the selling floor, thus preventing any interference with customer service. I, for one, have concurred in this belief but have also felt that key punching, as a means of conversion into machine language, was too costly to make the operation a practical one.

Optical Scanning

However, today Optical Character Recognition represents a dramatic breakthrough, in that it allows the conversion or translation "automatically" of human readable language into machine language.

We hope to use Optical Scanning to convert information from unit media documents such as saleschecks, bill stubs, receiving reports, and order forms, into machine language. We also hope to use Optical Scanning to read cash register tapes and other similar tapes for the conversion of classification, sales audit, and payroll data, into machine language. Somewhere in the foresceable future, transports will be built to handle merchandise tickets of the size with which we are familiar and to convert the information contained on them into machine language. In each of these cases, we can eliminate key punching through the use of Optical Scanning, for we could capture all this data today *if* we key punched this information. Incidentally, perhaps this is the way to start, for the systems must be developed, reports designed, flow charts laid out, before Optical Scanning and/or EDP equipment can be successfully utilized.

Role of the Controller

This is where the role of the controller becomes particularly significant. The introduction of EDP to the retail industry and the necessity for defining our procedures in an organized manner has in most cases become the job of the controller. The controller is responsible for the communication between the electronics engineers representing the manufacturers on the one hand, and the retail management on the other hand. As a result, controllers must assume responsibility for evaluating the technical features of equipment before applying them to their businesses. This is not unusual, since traditionally the controllers and accountants have been the technicians of the business and probably will continue to be in the future.

However, the technical knowledge required has now been expanded to the engineering field. This does not mean that each controller must take time out of his busy schedule to study electrical engineering in order to do his job competently in the future, but it does mean that he must learn to communicate the problems and requirements of his business to the engineer responsible for the technical details of producing and running EDP equipment. To do this job properly, he must at least have an understanding of the functions of the various pieces of equipment, the advantages as he techr Th

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and disadvantages of various competitive products. He should not, and cannot rely on a manufacturer's salesman to make the decision for his company.

Little Room for Error

You have heard this statement on many occasions, but it bears repeating, particularly in this area of EDP: Fundamentally, the retailer buys and sells merchandise to produce a profit. However, the nature of our businesses and the tremendous competition ever present, result in profit margins which leave little room for error. Therefore, most retail establishments just cannot afford electronics on an experimental basis. The equipment must either pay off or break even, within a reasonable amount of time, as was true of our bookkeeping machines, mail inserters, and other mechanical equipment in the past. Most retail organizations have chosen to introduce data processing equipment in what I will term the "office function" of our organizations. These include sales audit, accounts receivable, accounts payable, and payroll. All of these areas lie within the jurisdiction of the retail controller. However, the original data that he must use is not gathered by people reporting to him. As we know, our salesclerks are responsible for originating the data required for sales audit, accounts receivable, and ultimately in compiling our statistics. In many cases "bookkeeping function" is considered a necessary evil-a nonproductive function by the sales force.

In view of this, a workable system must contain the following elements:

- 1. It must be a system which can either pay for itself in a reduction of personnel or operating cost, or produce increased operating efficiency in the merchandise area which can be concretely and directly attributed to the system.
- 2. The capital investment must be a sound one, particularly in view of the speed at which this equipment has become obsolete.
- 3. The system must be simple enough to operate on the selling floor so that the workload of a salesclerk is not increased, but preferably decreased.
- 4. The system itself must be as foolproof as possible, for with so many people originating data to be entered directly into an automatic system, errors could easily be increased over our present manual or semi-mechanized operations.

Some Operating Result Statistics

Thus far, I have emphasized the use of automatic data processing equipment in the office areas. But I would like to stop for a moment and point out a few statistics.

The recent Harvard Report, covering Operating Results of Department and Specialty Stores in 1959, discloses in their chart covering Expense Center Trends 1957-59, that the entire control and accounting expense center represents .95 per cent of sales for a department store of \$5 million or more. This figure incidentally, has been constant since 1957. Of this, Sales Audit represents only .18 per cent of sales, which is a decline rather than an increase since 1957. Accounts Receivable and Credit represents 2.30 per cent. However, the bulk of this represented Credit. Accounts Receivable, for the 3 years, consistently represented only .60 per cent of sales. Hence, the total for control and accounting functions, including Accounts Receivable, represented 1.55 per cent of sales. This is all we have to work with, to justify our computers and peripheral equipment, in the "accounting" area of our stores, provided of course that we could replace everything in our accounting area which of course is not possible.

In all probability, certain customer contact functions will increase in cost rather than decrease through the introduction of EDP equipment. The majority of stores who have automated their accounts receivable have found that at least in the initial stages, cost of bill adjustments have skyrocketed. Perhaps, at this point it is appropriate to say that EDP is no answer for an inefficient operation. We must first get our house in order and then we will be in a position to make a sound comparison of the costs and potential savings. I would also like to point out that we pay for accuracy in our EDP systems just as we do in our manual systems. The stakes in EDP can even be more costly for we are not dealing with a \$50 a week clerk and a comptometer, but in many cases a computer, at a rental of \$4,000 plus per month.

Techniques of the New Equipment

It is necessary for controllers to learn the techniques of this equipment so that they can use it to the best advantage. They must be willing to break with tradition and accept what may seem like new and radical approaches to the processing of data, otherwise this function will be turned over by management to technicians who are familiar with this equipment and a separate pyramid formed in the retail organization. It might be interesting for you to know, that such a step has already been taken in the manufacturing industry, where in certain concerns they have completely eliminated the title of CONTROLLER and have established a FINANCE function which deals with the interpretation of data supplied by another pyramid headed by a *Director of Information*, who through an EDP system is responsible for the preparation of all data in the organization, accounting as well as sales and marketing.

Merchandise Management Information

At this point I would like to turn from the automation of the office areas to the virtually unexplored area of sales information which I prefer to term "Merchandise Management Information." We currently spend approximately four-tenths of one per cent of sales to obtain vital statistics for our buyers and merchandise people. Obviously, we have merely scratched the surface.

What can be done to prepare reports on an exception basis of sales and stock on hand for our merchants?

Certainly, there are an increasing number of stores utilizing punch tickets, particularly in the ready-towear areas, but what sort of reports do we produce from these tickets? In most every instance, we grind

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out long cumbersome reports of every item sold or returned each day by color, size, style, manufacturer, and in some cases, we do not even differentiate sales by store where branches are concerned. These reports literally containing thousands of individual items are then turned over to buyers who must review all of this data before making a single decision. However, conversely, Controllers, if given a complete list of every single entry contained in a financial statement without an appropriate summarization, or explanation, of the items that are out of line would scream to high heaven that all this data doesn't mean a thing. Gentlemen: Let's examine the manner in which you look at a Profit and Loss statement, or an Operating Report, or Payroll Report. You glance through, looking for variables, items over or under the plan or showing an indication that they are out of line with previous months or last year, and it is these items that you then take action on, or at least investigate, to determine the cause for the fluctuation. There is no great mystery. This is the same technique our buyers follow. They must go through these voluminous reports to find items that are selling exceptionally well, or poorly-then investigate to find out why and then take appropriate action: Presently, however, as I have said, all we give the buyers and merchants is the raw data which they must literally spend hours reviewing to find those items which require action. Then we wonder why many of the merchants do not use these reports. It is fairly obvious that a well trained buyer can determine what is selling or not selling, by a quick look at her stock, rather than poring over long tabulated lists of numbers. Our buyers will use our reports when we reach the stage when we develop reports that indicate to them the items on which they must take action. This whole area of exception or action reporting is of vital importance to retailing if department and specialty stores are to survive and retain their share of the market with the ever-increasing competition from other forms of retailing. Needless to point out, even if retailing starts a comprehensive program of preparing this marketing information today, we will still be lagging far behind other industries who are increasingly applying EDP techniques to their marketing problems successfully.

For example: The Pepsi Cola Co. prepares reports for their distributors on a computer which outlines not alone their sales, but their potential sales, based on statistics for the area which includes such things as the number of restaurants, schools, cocktail lounges, and so forth. "Fortune" felt that this potential was so interesting that they recently completed a film outlining, in story form, the use of computers to solve marketing problems as illustrated in three or four case studies. Incidentally, one of the case studies outlined in this film relates to the work of one of our subcommittees. This subcommittee has been working with representatives of the Shoe Manufacturing industry in an attempt to develop statistics which the shoe manufacturers can create at the time they produce the shoes, which can be used by the retailers for control purposes through the use of turn-around documents, then can again be used by the manufacturer to analyze their sales and the market potential of their products.

Electronics Committee

At this point, I would like to say a few words about our Electronics Committee, a number of members of which made a presentation to you about a year ago, and which I am sure you are aware, is composed of representatives of the majority of major retail organizations in the country. Incidentally, these individuals and the organizations which they represent agree almost unanimously that regardless of the area in which you initially install EDP, the ultimate payoff will be in the area of improved (and by this I mean faster, more accurate and more selective) statistics in the merchandising area. I think that this means that controllers must learn not alone to "speak" to buyers, but to understand them and appreciate their problems, including what they really need in the area of statistical information.

It might be appropriate to report briefly the status of EDP among our Committee members:

News of EDP

CITY STORES: One of their units, Maison Blanche, is currently using an IBM 650 computer for Sales Audit & Accounts Receivable. They have on order a 1401 system which will replace a 650 in the near future. Several other of their units including Lit Bros. are studying computer operations to automate their receivables. In addition in Lit Bros., they are currently using punch tickets in conjunction with point of sale devices in their shoe departments and are thus producing reports of sales through size for their buyers. Incidentally, analysis by size was a statistic considered most important to reduce mark downs by the shoe buyers at a meeting of the Electronics Committee held a year ago. Franklin Simon, another unit of City Stores, is also processing on an IBM 650 computer (through a service bureau) Unit Control and Merchandise group reports.

ALLIED STORES CORP., has a 305 Ramac computer in their Dey Bros. unit on which they are experimenting with the type of exception reporting for their merchants which I have previously discussed. In addition, they use point of sales devices in their shoe department in Gertz, Jamaica, to obtain detailed analysis of shoe sales. They also have a number of punch ticket installations in their stores.

W. T. GRANT & CO., is utilizing approximately 150 Monroe Point of Sale devices in conjunction with the Monroe Distribu-Tape Processor. In addition, they are using a Ramac 305 in one of their warehouses. They are also testing Optical Scanning devices in their Dayton store.

WOODWARD & LOTHROP, has just completed conversion of their Accounts Receivable to a tab system using punch card saleschecks. In addition, they have a card 1401 on order which will be delivered in June, to be followed by a tape 1401 system later in the year. They are also using a RAMAC for payroll and merchandising statistics which they are producing on an exception basis.

F. & R. LAZARUS has an NCR 304 computer on site which they are currently programming for their Sales ical year repo non sign iner by 1 Pate

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other achuh to chanAudit & Accounts Receivable function. In the interim, they are using it for merchandise sales statistics.

J. C. PENNEY, has a number of card 1401 systems on order for Accounts Receivable.

DAYTON CO., is expecting delivery of NCR 304 which they will use for Accounts Receivable.

STRAWBRIDGE & CLOTHIER have recently announced an order for a RCA computer system and again intend to start in the Accounts Receivable area.

SEARS, ROEBUCK is using their Louisville store as a pilot to study applications of EDP. Montgomery Ward, another member of our committee has had a RAMAC installed in their Allen Park warehouse for a number of years for merchandise control purposes. Woolworths, Kresge's and other members of our committee are either conducting feasibility studies or contemplating placing orders for equipment in the near future.

In addition to these stores, many others both in the AMC group and the ATKINS group, who are represented on our committee through Oram and Joe Creighton, have either installed or are contemplating installing computer or punch card salescheck systems, including: Miller & Rhoads; Stix, Baer & Fuller; Bullock's; Halle's and D. H. Holmes.

Based on this, I am sure you will agree with me, that a good number of stores have arrived at the conclusion that automation is no longer a thing of the future, but is here now for those ready and able to apply it effectively.

Expense Reduction

In closing, I would like to again quote from the 1959 Harvard report: "With the best annual sales increase (1959) of any year since 1947, department stores might well have expected to achieve a modest reduction in the total expense percentage in 1959, but the disappointing result was a typical figure of 34.8 per cent of net sales against a comparative figure of 34.7 per cent in 1958. Evidently, management's job of establishing effective control over expenses is far from being accomplished. Perhaps this 1959 experience should be thought of as lending plausibility to the view that the social forces of our time tend to introduce a dangerous rigidity into distribution cost. A rigidity that in the aggregate can be effectively combatted only by bold innovation, not merely orthodox good management of established enterprises."

This statement applies specifically to the Controller. He must take the leadership in devising bold innovations including the introduction of data processing, operations research techniques, and long range merchandise information planning programs. I am firmly convinced that if the controller does not exercise this leadership, the opportunity will be taken away from him and given to those who are ready and willing to assume it. Retailing has an opportunity to set the pace in this country through creative thinking and planning in this consumer-oriented economy. Let's take advantage of it.

Simulating Computers With People

Bernard E. Howard

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Introduction

Computers are used with success to simulate all manner of processes, and even to simulate human behavior. Conversely, a group of people can simulate the operation of a computer. This is a useful educational device which demonstrates the rote nature of automatic computation.

On April 12, 1961, my class of 20 students in Introductory Numerical Analysis (Math 332) at the University of Miami successfully simulated the iterative part of a square root routine as programmed for an IBM 650, to the edification of all concerned. The purpose of this note is to describe the exercise.

Description of Problem

The basic idea was to have each student act as a single functional component, and to follow his instructions exactly, being careful not to think. (This last exhortation seemed to have general appeal.) Unfortunately, the complete square root routine involved many more individual elements than there were students in the class, so the initializing and testing parts of the routine had to be omitted. However, this did not seem to detract from the instructional value of the central part of the process.

The problem to be solved was: given a number y, find a number x such that $x^2 = y$. The iterative formula used was:

$$x_{i+1} = (x_i + y/x_i)/2$$

Below is the specific set of instructions used:

Location of		Insti	uction	
Instruction	OP	Data	Instruction	
0005	65	0103	0006	
0006	64	0104	0007	
0007	15	0104	0008	
0008	64	0101	0009	
0009	20	0104	0005	

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The following data was stored:

Address	Data
0101	2
0103	у
0104	\mathbf{x} (= y initially)

Thus a total of 13 parts (students) were needed to simulate the computer: 8 memory locations (5 to hold instructions, 3 to hold data), 4 operations, and a Lower Accumulator. (Since the class had been using Marchant desk calculators, an analogy was established between distributor and keyboard, lower accumulator and lower dial, and upper accumulator and upper dial.) The decimal point shift, and such side conditions as specialization of read and punch areas, were omitted in the interests of simplicity.

Computer Design

The design of the computer was simulated by identifying each functional part with a student, and specifying his operation.

The identification was achieved by pointing to one student and saying "You are Operation 15;" by pointing to another student and saying "You are the Lower Accumulator;" by pointing to another and saying "You are Memory Location 0005;" and so forth for all the parts required for the particular problem at hand.

The operation of each part was specified by giving the student an explicit set of instructions to follow to the letter. To simulate the iterative part of the square root routine, the sets of instructions detailed in the appendix sufficed.

Computer Operation

The class when so constituted as a computer functioned to find the square root of a number by the following procedure.

First (corresponding to reading instructions into the memory), one piece of paper containing the appropriate one of the set of 10-digit instructions was handed to each instructional memory location.

Second (corresponding to reading in data), one piece of paper containing the appropriate one of the set of three items of data was handed to each data memory location.

Finally (corresponding to starting the computer), the baton was handed to Memory Location 0005, the location of the first instruction in the program.

The class then proceeded to operate in a manner simulating that of an automatic stored program computer, and a successively closer approximation to the square root of the number in Memory Location 0103 appeared in Memory Location 0104.

The sequence of entries appearing in Location 0104 was recorded on the blackboard, to illustrate the convergence of the iterative process. At one point the divider made a mistake; rather than correct this division, we proceeded by rote, and the self-correcting nature of this iterative process was convincingly demonstrated.

The class bell served to terminate the procedure.

Conclusions

The procedure described above clearly can be made more realistic in a number of ways. However, it is doubtful if realism is as important as instructional clarity.

The solution of more than one problem with the same set of components would be instructive in demonstrating the role of the stored program and the general nature of automatic computation. For example, with the addition of a multiplier to the parts needed for the square root problem, the cube root of a number could be found by the formula:

$$+ 1 = (2x_i + y/x_i^2)/3$$

Xi

The game of "playing computer" described above is recommended as a first introduction to the idea of automatic digital computation. That this exercise was educational was demonstrated by the fact that the procedure rapidly speeded up from a slow start, and toward the end of the process an extra instruction mysteriously appeared in the chain which said "Go directly to jail. If you pass Go, do not collect \$200."

APPENDIX

Details of Instructions

Operation 15 (Add to Lower Accumulator)

- (A) When you hear "Operation 15" called out, say "Here."
- (B) When you are handed the baton and a piece of paper with 2 sets of 4 decimal digits written on it (your "instructions") act as follows (otherwise do nothing):
 - (1) Go to the memory location specified by the first set of 4 decimal digits (the person who says "Here" when you call out this number).
 - (2) Obtain from him a piece of paper with a number written on it.
 - (3) Hand this piece of paper to the lower accumulator (the person who says "Here" when you call out "8002").
 - (4) Pass the baton to the memory location specified by the second set of 4 digits in your instructions (the person who says "Here" when you call out this number).
 - (5) Throw away the piece of paper with the 2 sets of 4 digits on it.

Operation 20 (Store Lower Accumulator)

- (A) When you hear "Operation 20" called out, say "Here."
- (B) When you receive a piece of paper with 2 sets of 4 digit numbers written on it (your "instructions") act as follows (otherwise do nothing):
 - (1) Pick up the piece of paper being held by the Lower Accumulator (the person who says "Here" when you call out "8002").
 - (2) Deliver this piece of paper to the memory location specified by the first set of 4 digits in your instructions (the person who says "Here" when you call this number).
 - (3) Pass the baton to the memory location specified by the second set of 4 digits in your instructions, (the person who says "Here" when you call this number).
 - (4) Throw away the piece of paper with the 2 sets of 4 digits on it.

Operation 64 (Divide)

(A) When you hear "Operation 64" called out, say "Here."

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 - - Memory Location (Instructions)
 - (A) When someone calls out your number, (the

(B) When you are handed the baton and a piece of paper containing 2 sets of 4 digits (your "instructions") act as follows: (otherwise, do nothing):

- (1) Go to the memory location specified by the first set of 4 digits (the person who says "Here" when you call out this number).
- (2) Obtain from him a piece of paper with a number written on it.
- (3) Go to the Lower Accumulator (the person who says "Here" when you call out "8002").
- (4) Pick up the piece of paper with a number on it which this person is holding.
- (5) Divide the second number by the first, and write the quotient on a blank piece of paper.
- (6) Deliver this piece of paper to the lower accumulator.
- (7) Hand the baton to the memory location specified by the second set of 4 digits in your instructions (the person who says "Here" when you call out this number.)
- (8) Throw away the three pieces of paper you have left.

Operation 65 (Reset Add Lower)

- (A) When you hear "Operation 65" called out, say "Here."
- (B) When you are handed the baton and a piece of paper on which are written 2 sets of 4 decimal digits (your "instructions") you are to act as follows (otherwise, do nothing):
 - (1) Go to the Lower Accumulator (the person who says "Here" when you call out "8002"), pick up the piece of paper being held there (if any), and throw it away.
 - (2) Go to the memory location specified by the first set of 4 digits (the person who says "Here" when you call out this number).
 - (3) Obtain from him a piece of paper with a number written on it.
 - (4) Deliver this piece of paper to the Lower Accumulator.
 - (5) Pass the baton to the memory location specified by the second set of 4 digits (the person who says "Here" when you call out this number).
 - (6) Throw away the piece of paper with the 2 sets of 4 digits on it.

Lower Accumulator

- (A) When you hear "8002" called out, say "Here."
- (B) When you receive a piece of paper with a num
 - ber on it, act as follows (otherwise do nothing):
 - (1) If you don't already have a piece of paper with a number on it, just hold the paper which is given to you.
 - (2) If you do already have a piece of paper with a number on it, and are given another piece of paper with a number on it, add the two numbers, write the sum on a third piece of paper which you keep, and throw away the other two pieces.
 - (3) When someone asks you for the piece of paper you are holding, give it to him.

COMPUTERS and AUTOMATION for August, 1961

number assigned you at the beginning of the exercise) say "Here."

- (B) When someone gives you a piece of paper with ten digits on it (grouped 2-4-4), keep it. If you already have such a piece of paper, throw it away and keep the new piece.
- (C) When someone passes you the baton, act as follows:
 - (1) Read the 2 digit number, and call out "Operation-" where the blank is to be filled in with the 2 digit number.
 - (2) Deliver to the person who says "Here" the following:
 - (a) the baton.
 - (b) a piece of paper on which you have copied the 2 sets of 4 digit numbers which you are holding. Keep the original piece of paper.

Memory Location (Data)

- (A) When someone calls out your number, say "Here."
- (B) When someone hands you a piece of paper with a number of up to 8 digits written on it, keep it. If you already have such a piece of paper, then throw it away and keep the new piece.
- (C) When someone holds out his hand to you, copy the number from the piece of paper you are holding, and give him the copy. Keep the original.

READERS' AND EDITOR'S FORUM

(Continued from page 8)

sider ourselves to be engaged in "defense" and "security" operations as we continue to stockpile bombs and missiles. The so-called "dynamic deterrent" will, with almost mathematical certainty, backfire in our faces.

5. Contract for Computing the Potential **Spread of Fire**

It is no secret that there are government contracts to compute the potential spread of fire from an initial nuclear attack. I am interested in having some of the young people who are working on these projects realize what they are dealing with. I think it is morally indefensible to use mathematical equations to normalize this new dimension of terror. I would like to show these programmers a copy of "Community of Fear," a study of the arms race made by Harrison Brown and James Real for the Fund for the Republic's Center for the Study of Democratic Institutions, Box 4068, Santa Barbara, California. It is one of the most dismaying and alarming documents which ever came my way, and all stated with deadly calm. I wish every one in the world could read it. I think one copy is free; the succeeding ones sell for twenty-five cents, as I recall.

I really believe that for our world the chips are down and time is running out, and I can "do no other" than speak out in the hope that men's minds and motives may be radically changed before it is too late.

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6. The Computer as an Insulation from Realizing What One is Doing

As I have tried to say, in recent weeks I have come to feel very strongly about the way the computer is insulating so very many of our finest young scientists, engineers, and military men from the meaning of what they are doing.

Of course, I realize that not all people are able to bear the "emotional knowledge"—if there is such a quality—of what they are doing. Last summer I spoke to a conference attendee from an atomic military installation in the West. He stood by my desk and said "You can't *think about* what you are doing; if you did, you would just go crazy."

7. Dr. Louis V. Ridenour's Protests

And, when I tend to judge other people who don't have the same intense absorption with the subject as I do, I keep in mind the tragic case of Dr. Louis V. Ridenour, Jr., former vice-president of Lockheed's Missile Systems Division. He was one of our top radar experts during the War, formerly taught at M. I. T., was editor of McGraw-Hill's radiation series, etc. In January, 1946, FORTUNE Magazine published a brilliant "playlet" of his entitled "Pilot Lights of the Apocalypse," about the destruction of the world-by mistake-from an underground control station which operated satellites carrying A-bombs. This was, of course, long before these possibilities were much in the public's mind. About two years ago there was an account in the newspapers of his having "exploded" at a computer meeting in California over the terrible amount of money and human energy being spent on weapons, while so many in the world were homeless and starving. Shortly after this, as I later learned, he died with a cerebral hemorrhageat the age of 48 or thereabouts.

So—I don't want to urge you to promote a rash of vascular accidents, but hope you may find some moderate way to call this situation to the attention of the computer world.

CALENDAR OF COMING EVENTS

- Aug. 22-25, 1961: WESCON, Cow Palace, San Francisco, Calif.; contact E. W. Herold, c/o WESCON, No. Calif. Office, 701 Welch Rd., Palo Alto, Calif.
- Sept. 4-9, 1961: Third International Conference on Analog Computation, organized by the International Association for Analog Computation and the Yugoslav National Committee for Electronics, Telecommunications, Automation and Nuclear Engineering, Belgrade, Yugoslavia.
- Sept. 5-8, 1961: The First International Conference on Machine Translation of Languages and Applied Language Analysis, National Physical Laboratory, Teddington, Middlesex, England; contact Mr. John McDaniel, National Physical Lab., Teddington, Middlesex, England, TEDdington Lock 3222, Ext. 138.
- Sept. 5-8, 1961: 16th National Conference of the Association for Computing Machinery and 1st International Data Processing Exhibit, Statler-Hilton Hotel, Los Angeles, Calif.; contact Benjamin F. Handy, Jr., Gen. Chairman, Litton Systems, 5500 Canoga Ave., Woodland Hills, Calif.; E. Floyd Sherman, Exhibits Chair-

man, Control Data Corp., 8421 Wilshire Blvd., Beverly Hills, Calif.

- Sept. 6-8, 1961: National Symposium on Space Elec. & Telemetry, Albuquerque, N. M.; contact Dr. B. L. Basore, 2405 Parsifal, N.E., Albuquerque, N. M.
- Sept. 6-8, 1961: 1961 Annual Meeting of the Association for Computing Machinery, Statler Hotel, Los Angeles, Calif., contact Benjamin Handy, Chairman, Local Arrangements Committee, Litton Industries, Inc., 11728 W. Olympic Blvd., W. Los Angeles, Calif.
- Notice of Cancellation: International Symposium on the Transmission and Processing of Information, Mass. Inst. of Techn., scheduled for Sept. 6-8, 1961, has been CANCELLED because of inadequate response to call for papers.
- Sept. 11-15, 1961: The Third International Congress on Cybernetics, Namur, Belgium; contact Secretariat of The International Association for Cybernetics, 13, rue Basse Marcelle, Namur, Belgium.
- Sept. 11-15, 1961: ISA Fall Instrument-Automation Conference & Exhibit and ISA's 16th Annual Meeting, The Biltmore Hotel and Memorial Sports Arena, Los Angeles, Calif.; contact William H. Kushnick, Exec. Dir., ISA, 313 6th Ave., Pittsburgh 22, Pa.
- Sept. 24-26, 1961: International Congress of Automation, Turin Polytechnic, Turin, Italy; contact Secretary, International Congress of Automation, 1, Piazza Belgioioso, Milan, Italy.
- Oct. 10-13, 1961: USE Meeting, Warwick Hotel, Philadelphia, Pa.; contact J. W. Nickitas, Sec'y, USE, Remington Rand Univac, 315 Park Ave. So., New York 10, N. Y.
- Oct. 11-13, 1961: Conference on Application of Digital Computers to Automated Instruction (sponsored by System Development Corp. and the Office of Naval Research), Dept. of Interior Auditorium, C St., between 18th and 19th Sts. N.W., Washington, D. C.; contact Washington Liaison Office, System Development Corp., 1725 Eye St. N.W., Washington 6, D. C.
- Oct. 12-13, 1961: The Univac Users Association Fall Conference, Warwick Hotel, Philadelphia, Pa.; contact Walter Edmiston, Sec'y, Univac Users Association, Philadelphia Naval Shipyard, Philadelphia 12, Pa.
- Oct. 25-26, 1961: 1961 Computer Applications Symposium, Morrison Hotel, Chicago, Ill.; contact Benjamin Mittman, conf. program chmn., Armour Research Foundation, 10 W. 35 St., Chicago 16, Ill.
- Oct. 30-Nov. 3, 1961: 8th Institute on Electronics in Management, The American Univ., 1901 F St., N.W., Washington 6, D. C.; contact Dr. Lowell H. Hattery, Dir., 8th Institute on Electronics in Management, The American Univ., 1901 F St. N.W., Washington 6, D. C.
- 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.
- Mar. 26-29, 1962: IRE International Convention, Coliscum & 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.
- Aug. 29-Sept. 1, 1962: 2nd International Conference on Information Processing, Munich, Germany; contact I. L. Auerbach, Auerbach Elec. Corp., 1634 Arch St., Philadelphia, Pa.

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BOOKS AND OTHER PUBLICATIONS

Moses M. Berlin Allston, Mass.

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

Wiener, Norbert / Cybernetics or Control and Communication in the Animal and the Machine, Second Edition / The Technology Press, Massachusetts Institute of Technology, Cambridge, Mass. / 1961, printed, 212 pp, \$6.50.

The first part of this book includes all of the first edition: an introduction and eight chapters including "Newtonian and Bergsonian Time," "Feedback and Oscillation," "Computing Machines and the Nervous System," and "Information, Language, and Society." Part two consists of the supplementary chapters: "On Learning and Self-Reproducing Machines," and "Brain Waves and Self-Organizing Systems." Index.

Scott, Norman R. / Analog and Digital Computer Technology / McGraw-Hill Book Co., Inc., 330 West 42 St., New York 36, N. Y. / 1960, printed, 522 pp, \$12.75.

The principles of both electronic differential analyzers and electronic digital computers are presented at the level of the college senior electrical engineer. The fundamental theory and design of both systems, including non-linear function generators and specific analog problem solvers, the application of mathematical logic to the design of switching networks, logical circuits, and storage, are thoroughly covered in eleven chapters. The author is Professor of Electrical Engineering, University of Michigan. References and problems are included with each chapter. An appendix explains congruences.

National Physical Laboratory, Mathematics Division / Modern Computing Methods / Philosophical Library, Inc., 15 East 40 St., New York 16, N. Y. / 1961, printed, 170 pp, \$6.00.

This second edition, which has been largely rewritten and expanded to include current techniques and information, includes fifteen chapters on numerical methods which can be used to solve complex mathematical problems on digital computers. Prepared by members of the staff of the Mathematics Division, National Physical Lab., Teddington, England, the text discusses "Linear Equations and Matrices," "Finite-Difference Methods," "Ordinary Differential Equations," "Evaluation of Integrals," etc. Bibliography and index. National Science Foundation, Office of Science Information Service / Current Research and Development in Scientific Documentation, No. 8 / Supt. of Documents, U. S. Govt. Printing Office, Washington 25, D. C. / May, 1961, printed, 193 pp, 65¢.

This serial report (appearing May and November) of the National Science Foundation covers scientific documentation efforts in the U. S., England, Russia, Japan, France, Israel, and other European countries. The five major areas being reported are: Information Needs and Uses, Information Storage and Retrieval, Mechanical Translation, Equipment, and Potentially Related Research. Three indexes are given: Index of Individuals and Organizations, Index of Sponsors, and a Subject Index.

Blake, Richard F., Editor, and 22 authors / Static Relays for Electronic Circuits / Engineering Publishers, P. O. Box 2, Elizabeth, N. J. / 1961, photo offset, 198 pp, \$7.00.

The design, characteristics, and applications of static relays—electronic relays using no moving parts, with high resistance to shock and fast response times—are discussed. Seventeen papers given at a Static Relays Symposium include: Review of Semiconductor Regenerative Switching Devices, Technical Specification for Static Relays, Solid-State Analog Switching Circuits, Tunnel Diodes as Amplifiers and Switches, etc. The first paper discusses the "Static Relay Concept." No index.

Kent, Allen, Editor / Information Retrieval and Machine Translation, Advances in Documentation and Library Science, vol. III, part 2 / Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. / 1961, photo offset, 1376 pp, \$25.00.

The papers presented at the International Conference for Standards on a Common Language for Machine Searching and Translation, September, 1959, are here published as volume III of this series. Part 2 contains the final thirty-eight papers, which emphasize the problems of machine translation and the search for a common machine language. The papers discuss classification and retrieval of data, machine translation, language structure, simulation of behavioral systems, etc. Author and subject indexes.

Van Orman Quine, Willard / Word and Object / John Wiley & Sons, Inc., 440 Park Ave South, New York 16, N. Y. / 1960, printed, 294 pp, \$5.50.

The notion of "meaning" and the linguistic mechanisms of objective reference are examined by the author, Edgar Pierce Professor of Philosophy at Harvard University. In the first of seven chapters, "Language and Truth," the evolution of communication is discussed and various word-learning processes are described. In the succeeding chapters the difficulties involved in translation and the "anomalies and conflicts implicit in our language's referential apparatus" are discussed. The chapter titles are: "Translation and Meaning," "The Ontogenesis of Reference," "Vagaries of Reference," "Regimentation," "Flight from Intension," and "Ontic Decision." Bibliography and index.

Greniewski, Henryk / Cybernetics Without Mathematics / Pergamon Press Inc., 122 East 55 St., New York 22, N. Y. / 1961, printed, 201 pp, \$6.00.

The foundations, theories and applications of cybernetics are popularized in this book. The author, Head of the Polish Academy of Sciences, Department of Cybernetics, discusses, in simple phraseology, the basic concepts of cybernetics, including

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815 Washington St., Newtonville 60, Mass. If not satisfactory, returnable in seven days for full refund. stimulus and reaction, duality, serial coupling, feedback, matrices of couplings, etc. The eight chapters include: Biological Models; Signals and Expressions; Codes and Languages; Logical Models; and Economic Models. A set of references is given.

Thom, A., and C. J. Apelt / Field Computations in Engineering and Physics /
D. Van Nostrand Co., Inc., 24 West 40
St., New York 18, N. Y. / 1961, printed, 165 pp, \$5.75.

The use of Thom's squaring method to obtain numerical solutions to partial differential equations in two dimensions is described and applied. In fourteen chapters the authors discuss: Finite Difference Formulae, Laplace's Equation, Poisson's Equation, Navier-Stokes Equations, Solution to Problems with Axial Symmetry, etc. An appendix treats some mathematical data considered essential to the text. Bibliography and index.

Widder, David V. / Advanced Calculus, Second Edition / Prentice-Hall, Inc., Englewood Cliffs, N. J. / 1961, printed, 520 pp, \$12.00.

For the person familiar with elementary calculus, this book will serve as an excellent and comprehensive bridge to the theoretical aspects of the subject. Fourteen chapters include: Partial Differentiation, Vectors, Differential Geometry, Stieltjes Integral, Multiple, Line and Surface Integrals, Limits and Indeterminate Forms, Infinite Series, Convergence of Improper Integrals, Fourier Series, the Laplace Transform and its applications. Each chapter includes and introduction and problems. Answers to the problems, an index of symbols, and a general index are included.

Tillman, J. R., and F. F. Roberts / An Introduction to the Theory and Practice of Transistors / John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N. Y. / 1961, printed, 340 pp, \$8.00.

This book is written for the newcomer to the field of electronics who wishes to supplement college courses, and includes fundamental information about the theory and applications of many types of transistors. The first part includes three chapters on the physics of semiconductors and transistors. Part two covers transistor technology and applications. Index.

Del Vecchio, Alfred / Dictionary of Mechanical Engineering / Philosophical Library, Inc., 15 East 40 St., New York 16, N. Y. / 1961, photo offset, 346 pp, \$6.00.

Terms from the fields of architecture, automatic controls, engineering mechanics, fuels and combustion, and power plant control, are defined. In addition, some technical terms and phraseology from related fields, including heat transfer, basic electricity and basic mathematics, are defined. The author is Associate Professor and Director of Mechanical Engineering at Manhattan College.

Dresher, Melvin / Games of Strategy: Theory and Applications / Prentice-Hall, Inc., Englewood Cliffs, N. J. / 1961, printed, 186 pp, \$9.00.

The mathematical theory of strategy games and the applications of the theory to military, economic and political problems are presented in an elementary and formal manner, for a text in colleges and universities. In eleven chapters, the author, a research mathematician for the RAND Corp., studies "The Fundamental Theorem," "Properties of Optimal Strategies," "Methods of Solving Games," "Solution of Infinite Games," "Games of Timing -Duels," etc. A bibliography, an index and a list of published RAND research are included.

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PAYMENTS: In many cases, we make small token payments for articles, if the author wishes to be paid. The rate is ordinarily $\frac{1}{2}\phi$ a word, the maximum is \$15, and both depend on length in words, whether printed before, etc.

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

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, dis-
tinctions, etc.)
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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.

February 21, 1961 (cont'd)

- 2,972,736 / Phyllis Hersh, Teaneck, N. J. / Curtiss-Wright Corp., Carlstadt, N. J. / A bi-directional magnetic tape recording.
- 2,972,737 / Thomas P. Rona, Belmont, Mass. / Baird-Atomic Inc., Cambridge, Mass. / An information transfer and storage device.

February 28, 1961

2,973,141 / Evelyn Berezin, New York, N. Y. / Curtiss-Wright Corp., Carlstadt, N. J. / A control means with record sensing for an electronic calculator.

- 2,973,142 / Robert K. Jenner, Jr., Hamilton, Mass. / A. Kimball Co., New York, N. Y. / An apparatus for analyzing records having data encoded therein in a multi-position code.
- 2,973,146 / Herman Schmid, Binghamton, N. Y. / General Precision, Inc., a corp. of Del. / An electronic computer multiplier.

March 7, 1961

- 2,973,901 / E. J. Petherick, Rowledge, near Farnham, and G. C. Rowley, Sutton, Eng. / I.B.M. Corp., New York, N. Y. / A decimal digital computing engine.
- 2,973,902 / S. N. Einhorn, Philadelphia, Pa., and R. Van Andel, Dearborn, Mich. / Burroughs Corp., Detroit, Mich. / A decimal accumulating shift register.
- 2,974,286 / M. A. Meyer, Natick, Mass. / Laboratory for Electronics, Inc., Boston, Mass. / An electronic channel selector unit.
- 2,974,308 / F. Van Tongerloo, Eindhoven, Netherlands / North America Philips Co., Inc., New York, N. Y. / A magnetic memory device and magnetic circuit therefor.

COMPUTERS and AUTOMATION for August, 1961

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- 2,974,311 / J. A. Kauffmann, Hyde Park, N. Y. / I.B.M. Corp., New York, N. Y. / A magnetic shifting register.

March 14, 1961

- 2,974,866 / J. A. Haddad, Binghamton, R. K. Richards, Poughkeepsie, N. Rochester, Wappinger Falls, and H. D. Ross, Jr., Poughkeepsie, N. Y. / I.B.M. Corp., New York, N. Y. / An electronic data processing machine.
- 2,974,867 / F. G. Steele, La Jolla, Calif. / Digital Control Systems, Inc., La Jolla, Calif. / An electronic digital computer.

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- 2,975,369 / P. R. Vance, Concord, Mass. / Goodyear Aircraft Corp., Akron, Ohio / An electronic function generator.
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- 2,975,410 / J. C. Groce, Nutley, N. J., and W. T. Rusch, Kingsville, Md. / International Telephone and Telegraph Corp., Nutley, N. J. / A data translating system.
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- 2,977,178 / Albert S. Hook, Palos Verdes Estates, and Hazen K. Goodman and George L. Hutter, Redondo Beach, Calif. / Alwac International, Inc., a corp. of Panama / A computer memory section improvement.
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- 2,977,485 / Kenneth H. Olsen, Bedford, Mass. / Digital Equip. Corp., Maynard, Mass. / A diode-transformer gating circuit.
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- 2,977,487 / Kenneth P. Congelon, Cincinnati, Ohio / Avco Corp., Cincinnati, Ohio / An incremental sensor.
- 2,977,542 / Samuel G. Lutz, Los Angeles, Calif. / Hughes Aircraft Co., Culver City, Calif. / A push-pull excited recognition circuit.
- 2,977,544 / Norman W. Schubring, Hazel Park, and Merle E. Fitch, Dearborn, Mich. / General Motors Corp., Detroit, Mich. / A differentiating circuit.

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