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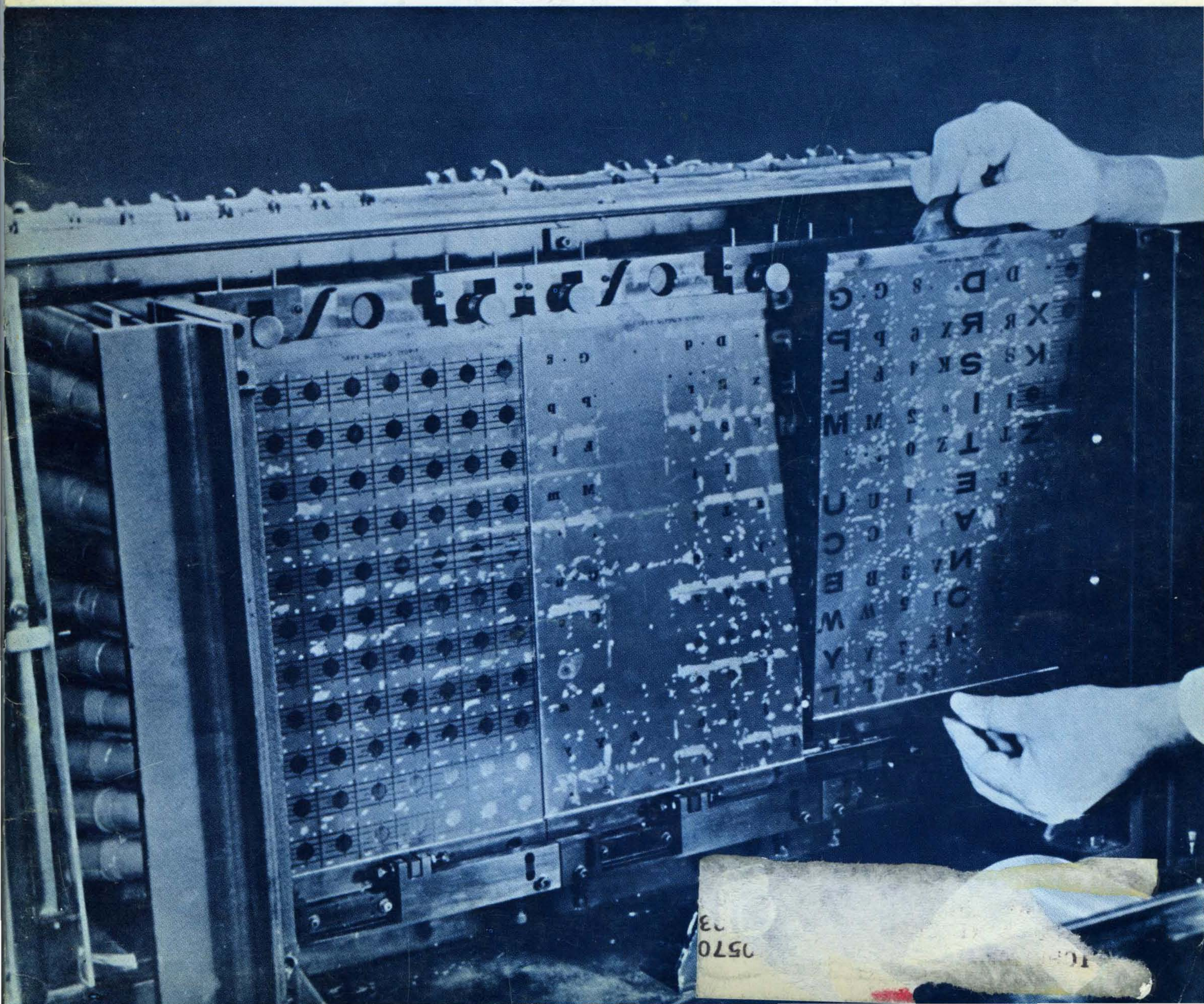
September, 1964

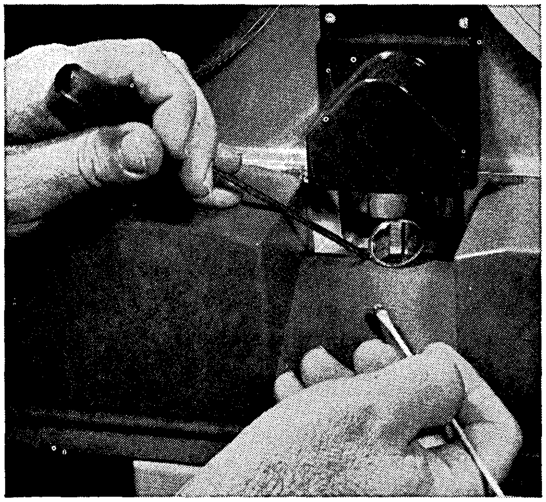
computers and automation

Computer Controlled Phototypesetter



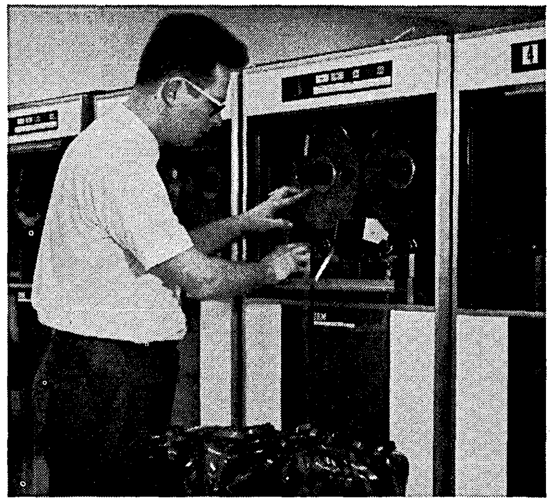
4 REASONS FOR BUYING ONLY PREMIUM TAPE

(Memorex, of course!)



Reduced maintenance down-time. Premium tape increases head life and reduces head replacement. Its better adhesion of oxide coating and tougher, smoother coating surface minimize operating interruptions resulting from oxide build-up on heads and guides.

Memorex magnetic tape is premium tape.



Longer life. Premium tape minimizes tape stripping. It assures error-free performance long after inferior tape breaks down and becomes loaded with dropouts. The more severe the use, the more the economies afforded by premium tape's tougher, smoother coating.

Memorex magnetic tape is premium tape.

Greater reliability. Premium tape remains error free — pass after pass, reel after reel — and provides greater security of data in demanding routines. Despite the somewhat higher price of premium tape, few users can afford to miss the economy inherent in its greater reliability.

Memorex magnetic tape is premium tape.

No rejects. Premium tape provides freedom from rejects because it is always read-pass perfect — reel after reel. Its price is higher, perhaps. But its effective cost is less because premium tape delivers machine-time savings by eliminating pre-testing and maximizing error-free operation.

Memorex magnetic tape is premium tape.

Memorex tape is premium tape. No need to pre-check it. You can place Memorex computer tape directly in service — reel after reel.

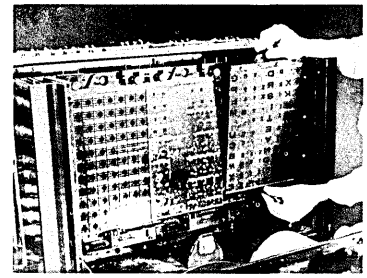
Memorex certification means what it says: Memorex computer tape is error-free. Extra care, extra steps and scrupulous attention to every detail make it that way. We know the importance to you of having a tape you can depend on.

Are you on our mailing list to receive the Memorex Monograph Series of informative technical literature? Write 1176 Shulman Road, Santa Clara, California

MEMOREX

PRECISION MAGNETIC TAPE

Our front cover shows part of a computer-controlled phototypesetter which produces 150 8-inch lines per minute. For more details, see the story on page 41.



computers and automation

SEPTEMBER, 1964 Vol. XIII, No. 9

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

In This Issue

In Every Issue

COMPUTERS AND AUTOMATION IS PUBLISHED MONTHLY AT 815 WASHINGTON ST., NEWTONVILLE 60, MASS., BY BERKELEY ENTERPRISES, INC. PRINTED IN U.S.A. SUBSCRIPTION RATES: UNITED STATES, $15.00 FOR 1 YEAR, $29.00 FOR 2 YEARS, INCLUDING THE JUNE DIRECTORY ISSUE; CANADA, ADD 50c A YEAR FOR POSTAGE; FOREIGN, ADD $1.50 A YEAR FOR POSTAGE. ADDRESS ALL EDITORIAL AND SUBSCRIPTION MAIL TO BERKELEY ENTERPRISES, INC., 815 WASHINGTON ST., NEWTONVILLE, MASS., 02160. SECOND CLASS POSTAGE PAID AT BOSTON, MASS.

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c & a
EDITORIAL

Access to Computers

> "The colleges will not have sufficient computing capacity until full access to a machine can be given to anyone with an interesting idea."

This intriguing and important proposition is part of an editorial "The Innocent Eye" in "Data and Control," British computer magazine, for June 1964.

We heartily agree. For many years after 1946, when your editor left the IBM Harvard Mark I computer under Professor Howard Aiken in the Harvard Computation Laboratory—which was able to be used "sometimes"—your editor and a great many other people were in outer darkness so far as access to a computer was concerned. Many investigations of interesting ideas both in colleges and outside of them, over recent years, have been significantly slowed up and obstructed for lack of inexpensive ready access to a computer and quick interaction with it. Persons need a computer for the exploration and verification of their mental experiments; and access to a computer is like water for the thirsty.

Much discussion has taken place in the computer field, towards increasing the access to computers. There are several directions of solution.

One is time sharing. A good example is the Compatible Time-Sharing System at Project MAC at Mass. Inst. of Technology. Recently there were about 30 consoles where persons with problems for the computer had remote access to an IBM 7094, which behaves most of the time as if the console operator had a whole computer to himself. But even so there are times on some days when there is a heavy load of people desiring access to the computer, and the pauses before access can be obtained amount not to half seconds but sometimes minutes.

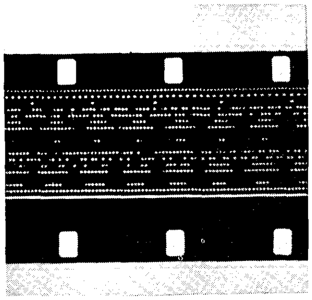
A second, and probably more significant direction of development in the long run, is, it seems, the steady decline in the cost of computers and the steady increase in their numbers and accessibility. The day is not too far distant when a whole digital computer with integrated circuits will cost less than $5000; and two or three interested persons will be able to buy one together for less than the cost of a new car, agreeing among themselves over how the 168 hours a week for its use shall be scheduled. An ordinary electric typewriter in an ordinary office, price $400 to $600, should be able to be equipped with a pluggable device which will read the operation of the keys and report to the computer, and which will take computer impulses and activate the keys. Probably also a photoelectric paper tape reader, and a tape punch should be available, so that information may be stored in machine-readable form and the reference memory of the computer may be considerably increased.

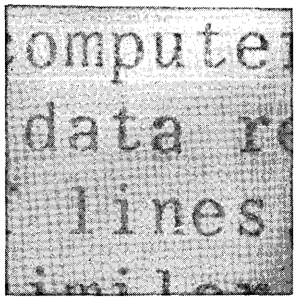
To conclude, we shall quote a bit more of the editorial in "Data and Control":

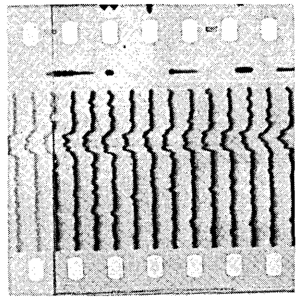
> "The least reward we can hope to gain from satisfying the needs of the universities is a technocracy versed in computer usage. No one can forecast the greatest gain that could be obtained."

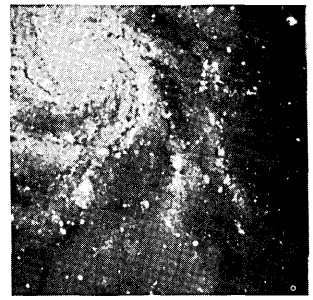
Edmund C. Berkeley
EDITOR

5000 POINTS PER SECOND









Information International, Inc., Cambridge, Mass., has developed a fully automatic Programmable Film Reader to read scientific or engineering data recorded on photographic film, paper, or similar media. Readout can be had on IBM-compatible magnetic tape, or in the form of numerical print-outs, graphs or plots, or visual CRT displays. This article describes the system and its applications.

THE FILM READING SYSTEM Using 16 or 35 mm. film as a medium for recording scientific data has many advantages. Because of the small input power and limited storage space that are required, it is particularly suitable for recording data produced by recording devices in space vehicles or aircraft; by wind and current measuring devices; and by other devices of similar nature.

However, reading or transcribing the data from film once it has been recorded has presented many problems in the past. It has generally been necessary for an analyst or researcher to read the data visually from the film and transcribe it by hand. This has been found to be a time-consuming, laborious and relatively expensive operation. In some cases, semi-automatic film reading devices are available. However, these can read only about 5000 points per day and require a human operator.

Information International, Inc., of Cambridge, Mass., has now developed a completely automatic computer film reading system which can read film at the rate of approximately 5000 points per second. Scientific data recorded on 16 or 35 mm film can be read completely automatically and printed out in the form of numerical listings or recorded on magnetic tape for further processing and analysis. The film reading system is based on three major elements: A general purpose digital computer, together with a visual display scope; a film reading device; and computer programs for using the computer and film reader.

THE FILM READING PROCESS The film reading process involves the scanning of film by a rapidly moving light point on the visual display scope. The output of this scanning operation is detected by a photo-sensitive device in the film reader and relayed to the digital computer for further processing and analysis. In addition to translating the data itself into a more desirable format, the film reading system can also furnish additional summaries and analyses of the data as may be required.

EXTREMELY FLEXIBLE SYSTEM The flexibility of the film reading system in two respects should be emphasized. First, almost any format of data on film can be read, with appropriate modifications to the basic computer program. This includes data represented in the form of lines, graphs (e.g., radar pulses), points, and other similar forms of data. Second, almost any type of desired output may be obtained once the basic data is obtained from the film. Forms of output which are available include the following:

(i) A print-out or listing of data on paper.

(ii) A record of the data on magnetic tape.

(iii) Visual representations of data. These may take the form of a continuous graph (using a digital x-y plotting device). Or they may take the form of photographs — still or motion — of scope displays.

In addition to data recorded on film, data recorded on paper can also be read by means of the film reading system.

SYSTEM APPLICATIONS

(i) Analysis of data produced by oscillographs or other types of graphic recorders

(ii) Tracking and analysis of objects for which motion pictures are available (e.g., missile tracking studies)

(iii) Reading of astronomical or astrophysical data recorded on film (e.g., analysis of stellar configurations)

(iv) Reading photographs of cloud chambers, bubble chambers, and spark chambers

(v) Counting of particles (such as blood cells or bacteria) in photographs

(vi) Character recognition

To the best of our knowledge, Information International is the only commercial firm supplying fully automatic computer film reading systems. We do essentially two things. We develop and manufacture film reading systems for clients to use at their own facilities (as, for example, in the case of radar film reading systems we have developed for Lincoln Laboratory and the U. S. Air Force). And we furnish services for reading films which are sent to us for processing (as in the case of oceanographic current meter film).

III is able to supply equipment to satisfy a variety of customer needs. Customer options include transmittive or reflective input media, binary density decision, multiple level density measurement, local contrast measurement, and various degrees of system resolution.

We can supply a completely set-up, ready-to-run "turnkey" film reading system (including a medium price, general purpose computer). Or we can provide the basic film reading device, appropriate computer programs, or technical consulting to those planning to develop their own film reading systems. The film reading device itself may be used with specialized film reading computer programs, such as those we have developed, which make use of highly sophisticated filtering techniques to minimize the effect of "noise" (dirt, scratches, general illegibility) on the film. As a result, the film reading system is capable of reading film in relatively poor condition. Or, where the quantity of data on film is not great enough to justify investment in a film reading system, I.I.I. can furnish services for reading film and transcribing data on a production basis. A brochure describing the film reader and film reading systems we have developed is available on request.

INFORMATION INTERNATIONAL INCORPORATED
200 SIXTH ST., CAMBRIDGE, MASS.

PICTURES FROM SPACE, AND THE POWERS OF COMPUTERS

From: The Editor

An extraordinary scientific triumph occurred on July 31, when the Ranger 7 Spacecraft approaching the Moon transmitted — across more than 200,000 miles of space — over 4000 excellent pictures before it crashed, as planned, into the Moon's surface. The first pictures were taken about 1200 miles above the lunar surface, and the last one about 1/3 of a mile above the surface. The 6 camera television systems, which functioned perfectly, were built by RCA Astro Electronics Division, Princeton, N. J. The computer instructions which directed the trajectory and determined the midcourse correction, and the underlying equations for space navigation, were developed by TRW Space Technology Laboratories, Redondo Beach, Calif. The whole mission was under the direction of California Inst. of Technology Jet Propulsion Laboratory, National Aeronautics and Space Administration, Pasadena, Calif. The later photographs attained a resolution 1000 times better than the best prior photographs from telescopes on the earth's surface, and showed details, including minuscule craters down to sizes of 3 feet across. As these photographs are studied by scientists, we can expect a sizeable increase in our knowledge about the Moon. We give our congratulations to all persons who helped make this scientific triumph.

The phenomenal capacity of direction of Ranger, attained by means of computers, is illustrated by these facts: The platform from which the spacecraft was launched (Earth at Cape Kennedy) rotates around its axis at 1000 miles an hour, and circles the Sun at 66,500 miles an hour; the projectile has to be launched 240,000 miles to the Moon, which is 2000 miles in diameter, and is orbiting the Earth at 2300 miles an hour. In directing the Atlas launching engine as it climbs towards maximum speed of 4-1/2 miles a second, one second's delay in a command can mean an error of hundreds of miles at the Moon.

And nowadays this sort of accomplishment is amazing for only a couple of days — so taken for granted are the powers of computers!

Edmund C. Berkeley
EDITOR

INVITED SHORT PAPERS ON SOCIAL IMPLICATIONS FOR THE FALL JOINT COMPUTER CONFERENCE

The Social Implications Committee of the American Federation of Information Processing Societies (AFIPS) will sponsor a Symposium on:

> "Plans, Procedures, and Constructive Suggestions on What to Do to Minimize the Dislocations to be Expected in the Transition from the Society of Today to the Computer-Automated Society of the Future"

at the Fall Joint Computer Conference, San Francisco, Calif., on the evening of Wednesday, October 28, 1964.

The Committee is interested in hearing from people who would like to participate in the Symposium. Participants will be allowed ten minutes to present short papers on the topic prior to general discussion.

To be considered for the Symposium, a prospective participant should submit a complete copy of the ten-minute paper he desires to present. This should be sent to: Paul Armer, 1700 Main Street, Santa Monica, California, 90406. The deadline for receipt is October 1, 1964.

FIRST COMPUTER COURSE FOR FRESHMEN IN A SCHOOL OF ENGINEERING IN ARGENTINA

From: Prof. Ing. Horacio C. Reggini
Head of the Dept. of Computation
School of Physical and Mathematical
Sciences and Engineering
Argentine Catholic University
Buenos Aires, Argentina

I should like to inform you of the first computer course for freshmen given at a school of engineering in Argentina. The course subject is "Computer Programming"; it is for all freshmen and takes two hours weekly. Its purpose is to give the undergraduate a clear notion of the present importance of computer science in a scientific or engineering career. Laboratory work includes a series of programs to be performed on an IBM 1620 in the Dept. of Computation.

DATA PROCESSING CENTER AT THE INDIANA REFORMATORY

From: Roscoe E. Walls
Supervisor, #42665
Data Processing Center
State of Indiana, Dept. of Correction
Indiana Reformatory
Pendleton, Ind.

The following is a brief resume of the highlights of activities of the Data Processing Center for the past fiscal year, 1 July 1963 to 30 June 1964.

1. This year marks the end of the third fiscal year of the Data Processing Center at the Indiana Reformatory. It is to be noted that again this year, as in the previous two years, the department has operated without any budget. During this period, a total of 203, 929 man-hours (with only one court report since the start of the Center) have been accumulated by its members, of which 88, 344 man-hours have been accumulated since July 1, 1963 without incident. The Center has been expanded to include several additional rooms.....

2. The Center received considerable favorable outside publicity in many national magazines and in Indiana press mediae. Statistics compiled by our department were used in various reports that were broadcast on radio and television.....

3. During the past fiscal year, members of the Center have toured several 'outside' EDP installations.....

4. We were very pleased to hold two graduation ceremonies for a total of 27 inmates who had successfully completed the three-phase training program. Of these 27 men, one was an inmate who had transferred to the Reformatory from the State Prison for the express purpose of taking our training course so a similar program could be initiated at the Prison. Also on hand, at the second graduation, were three women from the State Women's Prison. These three had completed the first phase of the course thru correspondence and were awarded certificates of accomplishment. The Central Indiana Chapter of the Data Processing Management Association (DPMA) was gracious enough to undersign all diplomas and certificates. The DPMA received a copy of our training curriculum and examinations and carefully studied each point included. After thorough consideration, they agreed to endorse the diplomas for those graduates completing all three phases.....

5. In September, 1963, a progressive step in building compatible inmate/official relations was taken as 13 Reformatory officials attended the first of 12 electronic data processing training classes. The classes were conducted for them by inmate instructors of the Data Processing Center. These officials volunteered for the classes, which were held during their spare time in the evenings.

6. Since the start of the fiscal year, the Center has expanded to include an installation at the State Prison and a correspondence course with the Indiana Women's Prison. Thus far, both places are doing exceptionally well.

7. In September, 1963, the Central Stores Inventory was placed into operation under the auspices of the Data Processing Center.....

10. The first Annual Probation Report, prepared entirely by members of the Center, was completed. The report, compiled from data sent monthly to the Center from 117 courts in the 92 counties of the state, shows the movement of probation in Indiana during the 1962-1963 fiscal year period.....

11. Letters were received from correctional department officials from four states this year requesting detailed copies of our training curriculum and statistical system. To date, there have been 13 such inquiries about our department. These interested parties were either planning or had already started a data processing or statistical system at their respective state institutions.....

12. Many parties interested in the data processing field were guided through the center on tours during the past year.....

14. A program was written for an IBM 1401 computer at Indiana Bell Telephone Co. in Indianapolis by a former advanced programming student of this department.....

17. Many donations were received by the Center from several outside sources. These included: two sorters, one Model 3 Tabulator with summary punch, one interpreter, many wiring panels and wires for IBM machines, wire cages for Rem-Rand machines..... The total estimated value of all donations received during the past fiscal year is $56, 014. 90. It is felt by all members of the Center that we could not have functioned efficiently without these donations. We sincerely express our appreciation to all who helped make the Indiana Reformatory's Data Processing Center the functioning reality that it has become.

WHAT TOP MANAGEMENT SHOULD EXPECT FROM AN INTEGRATED DATA PROCESSING SYSTEM

Harvey W. Protzel
President, H. W. Protzel & Co., Inc.
St. Louis, Missouri, 63105

Are your office expenses killing your profit picture?
Are you completely and accurately informed?
Are you constantly pressed for time?
Integrated data processing could be the answer.

Executives hear and read a considerable amount of contradictory information today concerning data processing concepts and many types of machines available to facilitate systems of data processing, record keeping and reporting. Many companies have purchased machines; changed systems to fit machine requirements; and are contemplating such actions for the future. On the surface this may appear to be progress. But the problem that we very often have in many companies is that this so-called progress is not properly planned and although certain changes may be helpful to the functions where improvements are needed, the lack of adequate planning results in new systems creating hardships in related areas.

Some companies find, after going to the expense of revising systems and bringing in machines and possibly technical personnel to do certain jobs, that many changes are required in the new systems when improvements are begun in related functions. Other companies find that improvements and savings anticipated are never realized for one reason or another. Still other companies wonder what prompted them to make a change after they compare their new system with the old one.

To point out what top management should expect from an integrated data processing system, I will cover the following three major areas:

1. The need for improvement and the executives' needs.
2. Scheduling of paperwork processing and record-keeping
3. Management by exception.

The Need for Improvements

The need for improvement in data processing, record-keeping and reporting in most companies is valid; but making changes is of course not progress unless improvements actually are realized.

I believe Abraham Lincoln described this very simply when he cautioned against "confusing motion with progress."

The desired improvements should be pre-determined and the goals should be set before any action is taken.

Recently, the University of Pittsburgh made a study of business collapses. The results of this study showed that slovenly record-keeping contributed to failure of 90% of the cases investigated.

Another recent report concerning business practices stated that 65 cents out of every dollar spent for paperwork operations is wasted and that paperwork is the largest single maintenance cost of a company regardless of its size.

Further, it was stated that the average company spends $1.25 in checking paperwork to save 87 cents and even then has trouble finding customer information when it is needed.

The report went on to say that the average company dictates, types, proofs, and files hundreds of letters that need not have been dictated, typed, proofed or filed in the first place. It buys labor-saving devices and dollar-saving forms without getting any savings. It allows office files to crowd personnel and equipment out of valuable space. In an era of labor-saving devices, it uses more clerical personnel than ever before, and at a time of huge pressures for cost cutting, most firms are staggering under a heavier burden of unnecessary paper-work costs than ever before.

This is a serious indictment. Yet every criticism has been confirmed by scientific research by the Records Management Institute in cooperation with Columbia University, Adelphi College, and the American Management Association.

The Trend

The problems in modern business become more complex every day. There was a time when executives could spend a few hours a day walking through the office and/or the factory and get a pretty good picture of what was going on. They could make most of the necessary decisions based upon these observations. Today this is impossible. Even relatively small businesses are so complex that an executive does not have the time to spend looking for areas that need his attention.

The executives' methods of directing a business today are comparable to the methods of the general and his staff during wartime. Many years ago a general directed an army from the field since armies were smaller and the equipment utilized was not too variable. Today, this is an arm-chair job. Decisions are made from the information received. Future plans and decisions are made from the results of the activity based upon past decisions and the goals predetermined for the future. Accuracy and timeliness of the information received is of the utmost importance, just as it is in the business of today. Poor decisions will naturally result from incorrect information. Good decisions may be too late to be of value if they are based upon information which is not promptly received.

This brings us to a logical conclusion. If company executives are required to direct the activity of the business from their offices, then the data processing, record-keeping, and reporting systems must be designed primarily to facilitate their needs.

Analyzing Executives' Needs

In order to determine what actions should be taken so that an executive will be equipped to make day-to-day decisions and plans for the future, it is necessary to look objectively at the over-all policies and methods presently in force and make long range plans for the future, in order to supply him with whatever information he needs, whenever he needs it.

Some of the major points are as follows:

1. Record-keeping requirements.
2. Reporting requirements based upon management by exception.
3. Data processing methods based upon integrated data processing.
4. Internal control requirements.
5. Functional organization requirements.
6. Scheduling requirements, as they pertain to paper-work processing, record-keeping and reporting.

Scheduling

Extensive efforts are put forth in most companies in the scheduling of factory production. It is believed, and rightly so, that production should be scheduled so that products are available when needed for shipment to customers. Production in the office is not usually given as much consideration. However, the records maintained and the reports issued can not be considered less important than factory production because decisions, based upon the information contained therein, affect the status of the entire company. Office production should be considered important enough to warrant timely scheduling also.

For example, I was in a company recently that had made a big investment in the installation of a punched card system which was designed to produce monthly sales analyses and financial reports. These reports were being produced at the end of the following month, which of course is much too late if operating decisions are to be forthcoming from the figures. The reports were no later than under the previous system, but the company had installed the machines with the thought that they were faster than a manual method and consequently they believed they would receive the finished products sooner.

We were asked to review the problem and assist with the implementation of our recommendations for the solution.

When we scheduled all paper-work processing so that the tabulating department received their source documents on a more timely basis, the desired reports were received thereafter no later than the fifth working day of the following month. One of the major changes required was a complete revision of their order-billing system which also resulted in orders being filled sooner, invoices being rendered sooner, and fewer clerks.

Also required was the setting of definite cut-off dates so that financial documents could be processed sooner and in an orderly fashion.

Many revisions were required in departments processing paper-work that resulted in general ledger entries. By integrating the processing of the various documents and the departments involved, a substantial saving in personnel was realized in addition to the speeding up of the work. Also some antiquated company policies were changed, for the advisability of change was brought to the attention of management.

In order for the finished products of the office to be produced at the time they are required, it is necessary to plan the scheduling of all related paper-work processing and to revise procedures when it is found to be advantageous. If planned and implemented properly, many other advantages can also be realized.

Record-Keeping

Most companies spend far too much money maintaining records that are unnecessary, either partially or completely.

For example, an analysis of most material inventories will result in the demonstration that approximately 80% of the investment is represented by only 20% of the items. Most companies spend as much money processing paper-work and maintaining perpetual inventory records for the inexpensive items as they do for the expensive items.

I was in a company recently and found they had acquired an electronic computer at a rental cost of approximately $50,000.00 per year for the purpose of maintaining perpetual inventory records on all material and purchased-part inventory items.

An analysis revealed that 87% of the items equaled 15% of the inventory investment. It was pointed out to the company that it was a waste of money to control all the hardware and other low-cost items as closely as the ones representing the substantial cost of the inventory.

With their permission, a study was made of related functions such as procurement methods, production control, subassembly inventory control, finished-goods inventory control, order processing, etc. An integrated plan was adopted to be installed in a period of two years which would reduce the inventory investment by approximately two million dollars. The number of people that would be saved was difficult to estimate at that time, but it appeared that it would be substantial. In addition, savings were to be derived by better control methods, which incorporated the concept of procuring the high-value items as directed by requirements while the low-cost items were to be controlled physically in the stock room.

The system installed incorporated the following basic features:

1. A forecast of finished-goods requirements was produced quarterly by the joint efforts of the sales and production departments.
2. Bills of materials containing the high-cost materials only were exploded via punched cards to produce a report which showed the material requirements by month required.
3. The difference between actual material usage and the forecasted requirements was used to adjust future procurement activity.
4. A formula, supplied by one of our engineers, was used to achieve a desirable turnover of the low-cost items. The formula supplied minimum quantities, reorder levels, reorder quantities, and maximum quantities for each item, so that the questions of when and how much to order became automatic and perpetual inventory records unnecessary.
5. Finished-goods inventories and production were controlled with another formula, which necessarily incorporated a seasonal factor. The goals were to achieve a desirable turnover with a minimum of investment and still be in a position to fill most of the customers' orders.

6. Sub-assembly inventories were controlled according to turnover requirements and production schedules.

Basically, the over-all integrated plan is easily understandable. However, when the many details and exceptions begin to enter the picture, it becomes more complex. Such things as economical purchases and production runs, controls and scheduling of all paper-work and reporting, personalities of some individuals, and many other factors had to be given appropriate importance in order to complete the task properly.

Of the many other types of record-keeping functions found to be excessive, two that are usually most prominent are the various ledgers maintained for accounts receivable and accounts payable. Usually the necessary records can be achieved in one process. If bookless bookkeeping is adopted all ledgers can be eliminated.

Punched card equipment, if properly utilized, can be used to great advantage for accounts receivable. We have installed numerous systems which produced monthly agings, automatic past due notices, and statements to customers within two days after the closing of the month, thereby reducing considerably the amounts outstanding as well as clerical expense.

Punched card equipment, when applied to the accounts payable function, offers as a by-product distribution of expenses and a mechanical reconciliation of checks if punched card checks are used.

As pointed out previously, record-keeping functions are expensive. The value of all information contained therein should be reviewed and challenged. Each record that is found to be absolutely necessary should be set up as a goal and all prior processing should be integrated so that the goal is reached with a minimum of expense and time.

Management by Exception

Most executives today are plagued with a steady delivery of stacks and stacks of detailed reports to their desks. Employees with new, rapid-process duplicating machines are putting forth all their efforts to "impress" management with how much information can be produced.

I have heard executives complain of not having enough time to absorb the information in the many reports given them. One executive told me recently that he was very disturbed since he couldn't look at all the reports he received, and he didn't know which ones he should look at and which ones he could ignore.

The reason for the present situation is understandable. Not too many years ago most executives recognized their need for more information. At that time the rapid-process office equipment business began to increase tremendously. Executives, who couldn't get sufficient information quickly enough, previously, were easily sold and before long they were in the same position as the boy who suddenly found what ice cream was like.

An executive's job primarily is to make important decisions. If you will select any report that you are currently receiving and look through it in detail, you will probably find very little that requires a decision to be made by you. Certainly, some of the information may require action on your part but what you probably have to do is go through all the unimportant data to select that which you must act upon.

When designing reports for management, one of our prime objectives is to design them and the related processing of data so that only the exceptions appear. All information reflecting normal activity is selected and removed prior to the preparation of the reports. It is evident that this concept of "management by exception" permits the executive to spend most of his valuable time with the problems and not trying to find the problems. It should also give him a maximum amount of time to devote to making plans for the company, which is of the utmost importance.

As an example, we recently assisted a company with the installation of a budget. It was a large company and the mechanically produced monthly report was very detailed. A certain executive would have had to devote many hours to this report in order to find the areas that appeared to need his attention. Instead of giving this report to him as it was, we designed an exception report especially for him which listed only the items that were outside of the allowable percentage of variance.

This particular executive had been working long hours at the office and was also taking work home with him a number of evenings a week. When all his reports were converted, using the management by exception concept, he was able to relax, yet concentrate better, and in this manner do a better job for the company.

Similarly, there was a new sales manager who wanted the many salesmen under his jurisdiction to do an outstanding job for the company. He set up an elaborate quota system that covered many product classifications. By the time he had received his weekly report and went through all the details involved, it was the end of the week and almost time for the next report.

We changed his report so that all he received was the sales quantities that were a predetermined percentage below quota. An electronic calculator computed the figures according to a formula which took into consideration other things, such as the year-to-date sales, the total sales of related product classes, etc.

Incidentally, the effectiveness of this sales manager increased to the point where his salesmen's activity report became almost a blank sheet of paper. The fact that most of the men were meeting their quotas stood out more prominently with this type of reporting is easy to visualize. An increase in quotas was indicated and immediate action was instituted.

Anyone who wants to spend most of his time being productive should give sincere consideration to the "Management by Exception" concept.

Integrated Data Processing

Management reports and I.D.P. are found to be closely related when the following definition is considered:

> "Integrated data processing is the effective production of a coordinated and uninterrupted flow of essential data needed by management in its decision-making, control, and planning functions, through the systematic organization of all related clerical functions."

The main objectives of an I.D.P. program should be to get reports to management as quickly and accurately as possible with a minimum of expense.

I.D.P. should be installed so that management decisions produce a chain reaction of related activities, each function being carried out in a predetermined manner as prescribed by procedure and resulting in reports which management can use to evaluate their previous decisions and make further decisions. In this manner management can control, in effect, the detailed operations of the company without having to personally observe each employee's daily activities.

Too many discussions of I.D.P. have stressed the hardware involved. Systems have been developed specifically to utilize certain types of equipment. This type of approach will usually limit the results and the flexibility required for future expansion.

A company does not decide what type of equipment they would like in their factory and then produce their finished products in the best manner in which the equipment will permit. They design the items they want to make exactly the way they want them and then they get the machines that will do the job.

Some time ago an executive called me to ask what machines usually comprised a basic punched card installation. A few months after that he called again, and told me he had placed an order for the machines I mentioned to him and that now he wanted me to come in and tell him what to use them for. We made a feasability study and found no punched card application. However, we were able to make a number of recommendations directed at better integration of his data processing requirements that saved him a substantial amount of money.

The office machines on the market today are all designed to facilitate data processing requirements. However, they must be selected after the requirements have been determined if they are to perform a profitable service.

For example, one company installed an elaborate order processing system based upon a particular type of machine that was known to work very satisfactorily in another company with which they were familiar. They were very disturbed about the results they obtained. Although by-product advantages were made available with the adopted type of equipment, it also required much more time to prepare the orders. Service to the customer was of the utmost importance to this company in order to compete while it was relatively insignificant in the other company.

In this case, a completely new data-processing system was developed which employed office equipment that would meet the requirements of the company. All orders received were on their way to the warehouse on an average of less than one half hour after they entered the order department.

Many types of equipment are capable of performing similar data processing functions. The important thing is to determine first the requirements and then select the proper equipment.

I.D.P. was originally presented as complete mechanization with the common language paper tapes linking one machine process with that of another. This type of thinking should be changed so that machines are used only when they can be justified. Nothing should be put on machines just for the sake of mechanization. There are many procedures or portions of a system that would better serve management if accomplished manually.

Actually, a small company could have much to gain from an I.D.P. program even if no machines were used. One small company headed in this direction by making their bills of lading a part of their order set. This somewhat minor improvement saved the clerical expense of one person, which was quite substantial to them. Other similar clerical changes added welcome dollars to their profit picture. The fact that they could not afford an elaborate machine processing system did not discourage them from applying the principles of I.D.P., to their business. Percentagewise their savings were as great to them as some of the companies in which we have installed electronic computers.

The thing to do then is not only try to determine which machines will do the best job but also determine if machines are absolutely necessary for all functions.

By way of summary, the things that management should expect from an integrated data processing program when applied to the entire company are these:

1. Scheduled processing of paperwork at a minimum of cost to the company, utilizing mechanical, electrical, or electronic equipment when proved justifiable.
2. A minimum of record keeping.
3. Adequate internal controls.
4. Accurate management reports, which are based upon management by exception and which are received soon enough for effective decision-making.

Table 1

PROGRAMMING LANGUAGES AND THE EXPERTS WHO PROGRAMMED IN THEM

Programming Language	Person
A-LANGUAGE (Auxiliary Language)	William Henneman (Information International, Inc.)
ALGOL (Algorithmic Language)	Robert T. Braden (Carnegie Inst. of Technology)
BELL MACRO-FAP (Bell Laboratories Macro ("large") FORTRAN Assembly Program)	M. Douglas McIlroy (Bell Telephone Laboratories)
COBOL (Common Business Oriented Language)	Charles G. Hurd (Prudential Ins. Co. of America)
COMIT (Compiler, Mass. Inst. of Technology)	Carol Bosche (Mass. Inst. of Technology)
FORTRAN (Formula Translator)	Roland Silver (Mitre Corp.)
GATE (?)	Alan T. Perlis (Carnegie Inst. of Technology)
IPL-V (Information Processing Language, edition V)	Alice Wolf (Bolt Beranek and Newman)
JOVIAL (Jules' Own Version International Algorithmic Language)	Henry Howell (System Development Corporation)
LISP (List Processing Language)	Timothy P. Hart (Mass. Inst. of Technology)
MAD (Michigan Algorithmic Decoder)	Robert A. Fabry (Mass. Inst. of Technology)
SLIP (Symmetric LISP Processor)	Joseph Weizenbaum (Project MAC, Mass. Inst. of Technology)

THE PROGRAMMING LANGUAGE LISP:

Every now and then, in the joint development of mathematics and computers in this century, a relatively new branch of mathematics becomes interesting, important, and widespread—more and more widely understood and used. This has happened several times since computers became prominent in the 1940's.

One of these branches of mathematics is Boolean algebra, the algebraic technique for manipulating AND, OR, NOT, and conditions. Another of these branches is binary arithmetic, in which 0 and 1 are the only digits, and the successive digits in a number count powers of two instead of powers of ten. A third interesting, important, and entirely new branch of mathematics in this same category is linear programming, a method dating from 1949 for systematically solving many types of huge multiple-answer problems to find optimum solutions.

Among the languages for instructing computers is an interesting new one called LISP, which is essentially a powerful new branch of mathematics. The name comes from the first three letters of LIST and the first letter of PROCESSING. It seems quite possible that LISP (and other list processing programming languages, like IPL-V and others) will join the group of Boolean algebra, binary arithmetic, and linear programming.

LISP, and the first compilers for enabling computers to be governed by it, were worked out by a group at Massachusetts Institute of Technology, Cambridge, Mass., including John McCarthy (who is regularly given the major credit), Stephen B. Russell, Daniel J. Edwards, Paul W. Abrahams, Timothy P. Hart, Michael I. Levin, Marvin L. Minsky, and others.

Not only is LISP a language for instructing computers but it is also a formal mathematical language, in the same way as elementary algebra when rigorously defined and used as a formal mathematical language.

LISP is primarily designed not for processing numbers but for processing data consisting of lists. For example, the difference between "the dog bites the man" and "the man bites the dog" is the difference in the order of elements in a list. And an appropriate instruction written in LISP if applied to one of these expressions would change it into the other.

Some Comparisons of LISP with Other Programming Languages

Before proceeding to explain LISP in some detail, it is worthwhile to report on an investigation made at Information International, Inc., Cambridge, Mass., in early 1964

AN INTRODUCTION AND APPRAISAL

Edmund C. Berkeley
Editor

Table 2

THE SEVEN ILLUSTRATIVE PROBLEMS AND THEIR ANSWERS

Problem 1a. Add 27 and 59. (Values implicit in the program.)
Answer: 86

Problem 1b. Add A and B. (Values to be read in.)

Problem 2a. Add 74, 3.259, 1027.22, 369.285, 3.2896, 896.25, .05638, .9598. Print out the count of the numbers, the total, and the average.
Answer: 8, 2374.31978, 296.78997

Problem 2b. Read in a list of numbers not 0; the last number in the list is a zero. Add them, using a loop. Print out the count of the numbers, the total, and the average.

Problem 3a. Given the sequence of symbols:

```
M   TANK  PLANE  GUN    ZOMRHITOSHKU    TANK
TT  GUN   BOMB   PLANE     PLANE     TT   BOMB
```

Print out a list of pairs, such that the first member of each pair is one of the symbol types, and the second member of the pair is the number of times that that symbol type occurs in the sequence.

```
Answer: M      1    ZOMRHITOSHKU  1
        TANK   2    TT            2
        PLANE  3    BOMB          2
        GUN    2
```

Problem 3b. Given a sequence of symbols where each symbol is between 1 and 12 letters long. Print out a list of pairs such that the first member of each pair is one of the symbol types, and the second member of the pair is the number of times that that symbol type occurs in the sequence.

Problem 4. In the programming language, write a program which defines and enables the programmer to use AND(A,B), OR(A,B), and NOT(A), where A and B are Boolean variables and have only the values TRUE or FALSE, and these three functions have their normal meaning in Boolean algebra. In the definition, use either more primitive functions or equivalent arithmetical functions, or actual machine code if necessary. Do not make use of already existing definitions in the programming language if the programming language already has them defined.

comparing a dozen programming languages, in accordance with a task under contract SD-162 with the Advanced Research Projects Agency, U. S. Department of Defense. The task was to show how these programming languages actually worked on a set of simple problems as illustrations.

Seven simple problems were selected, and arrangements were made to have the set of problems programmed in these programming languages by certain experts. The programming languages and the experts who programmed in them are shown in Table 1.

Nine of these 12 languages (all except Nos. 1, 3, and 12) were actually implemented on the IBM 7094 computer; the sample problems were actually run; and the card decks were preserved. If desired, the actual running of any of these problems in any of these languages could be demonstrated, assuming an IBM 7094 computer and the system tapes to set the computer to accept the programming language. In these nine cases, full records were received of the work done in coding, running, and obtaining the correct answers to the problems.

The problems which were selected for illustration were identified as 1A, 1B, 2A, 2B, 3A, 3B, and 4; and they are stated with their solutions in Table 2.

Various times are shown in Table 3. These include the estimated (or actual) times for the expert to program the problem, to debug the program, and to get it through the computer room, including all the operations that took place.

The actual running time on the computer to solve the problems when correctly coded and in the machine was in nearly all cases less than a minute, and in many cases less than a few seconds.

The extended time of *weeks* to obtain total solution, in some cases, was due to such reasons as follows: (1) the programming language was not originally adapted for the 7094 computer, but for another computer; (2) the installation where the computer was located was at a considerable distance from the programmer; (3) the installation was not accustomed to the programming language, and it took time and effort to set the computer to accept the programming language; (4) long "turn-around time"—the time between the programmer's finishing up a version of the program, sending it to the computer room, waiting for it to be run, running it, and returning it to him with indications of failures and errors.

The two shortest times, 4 hours for LISP and 16 hours for FORTRAN, were both achieved at Project MAC, at Mass. Inst. of Technology, Cambridge, Mass., making use of the Compatible Time-Sharing System on the IBM 7094 computer there. The FORTRAN time also would have been considerably less, if more written information had been available to the programmer about just how the system there handled certain operations.

In Table 4 is shown a rough indication of the amount of coding which a programmer had to produce in order that the problems would be accepted and run on the computer. Coding can ordinarily be measured by the number of punch cards (or equivalently, the number of coding lines) which the programmer needs to produce as compiler-readable language for the computer to operate upon. The Table shows that the number ranges from about 80 in the case of GATE to about 660 in the case of COBOL. In the remaining three programming languages, (the A-LANGUAGE, BELL MACRO-FAP and SLIP) the work was not completed, the main reason being certain features in the structure of the programming language.

From an examination of the actual programming of these sample problems, it can be seen that LISP:

—is the easiest to understand;
—is one of the easiest to use;
—was second in least number of coding lines;
—was the fastest to achieve programming and coding;
—was the fastest to achieve solution from the time that the programmer started to the time that the answers came out of the computer.

A Bridge Between LISP and Ordinary English

The main purpose of the present article is to make a bridge between the ideas and terms of ordinary English and the ideas and terms used by a programmer in LISP. The present bridge however is partial, and is not sufficient to produce a LISP programmer; for more information, see the references given at the end of this article.

In addition, it should be noted that LISP has now been implemented for at least five computers (IBM 7090, IBM 7094, PDP-1, Q 32, PDP-6) and each of these versions of LISP differs to some extent from the others. The form of LISP explained here is (approximately) one of these implementations, and differs to a small extent from the other implementations.

Features of LISP

When a computer has been adapted or programmed to accept instructions in LISP and operate in LISP, you can give the computer instructions expressed in LISP words that are close to English; and the computer will immediately perform calculations as requested. You can define new sets of computer operations, and give them names as you choose; the computer will immediately accept the new names, and calculate with them. If you choose, you can give the computer a compound definition that applies first to Case 1 expressed in an initial situation, and that applies then to Case N+1 expressed in terms of Case N; the computer will understand and execute the entire compound definition for all cases from 1 to N. You can tell the computer to operate on and modify the language LISP; and the computer will do so.

The combination of a language:

—that deals with lists, numbers, operations, and symbols;
—that is close to English;
—that is like mathematics;
—that can refer to and modify itself;
—that can directly control a computer;

makes an interesting and very powerful tool.

The LISP Interpreter

When any calculation whatever is given to any appropriately programmed computer, the machine

Table 3

ESTIMATED (OR ACTUAL)
TIME SPENT TO CODE AND RUN THE PROBLEMS

(1) Program-ming Language	(2) Time Spent to Code the Problems	(3) Time Spent to Debug the Problems	(4) Time from Start of Job to Complete, Correct Answers to all Problems from the Computer
ALGOL	2 hours	4 hours	7 days
COBOL	2 hours	6 hours	5 weeks
COMIT	3 hours	6 hours	6 weeks
FORTRAN	1 hour	15 hours	16 hours
GATE	2 hours	4 hours	7 days
IPL-V	5 hours	5 hours	2 weeks
JOVIAL	2 hours	6 hours	10 days
LISP	1 hour	1 hour	4 hours
MAD	3 hours	2 hours	3 days

—takes in signals or characters expressing the calculation intended;
—performs internal calculating operations; and
—puts out the result of the calculation.

In the case of a computer programmed with a LISP system, we say that the machine (the programmed computer):

—takes in an *expression* written in LISP;
—applies the *LISP interpreter* and *evaluates* the expression; and
—puts out the *value* of the expression.

For example, in multiplying 3486 by 6598 on, say, an ordinary Friden desk calculator, the information put in consists of:

(1) pressing the keys 3, 4, 8, 6 (in columns 4, 3, 2, 1, respectively, but in any arbitrary sequence) on the main keyboard;
(2) pressing the keys 6, 5, 9, 8 (in that particular sequence) on the multiplier keyboard; and, finally,
(3) pressing the key "MULT," which causes the machine to start computing.

In other words, the desk calculator takes in an *expression* equivalent to 3486 x 6598, *evaluates* it, and gives out the *value* 23000628 in the dials of the result register.

The LISP interpreter is an elaborate function inside the computer which essentially operates on two arguments given to it. The first argument is the name of a function. The second argument is a list of one or more arguments to which that function is to be applied. Of course, the LISP interpreter can respond properly to several hundred function names; it is not restricted like the ordinary desk calculator to responding to just one of the four arithmetical functions: addition, subtraction, multiplication, and division.

A Very Simple Example of LISP

What is a very simple example of LISP?

Suppose that we take a list consisting for example of the letters A, B, C, D, E in that order. Suppose we choose the problem:

Select the first element in that list.

The following expression:

(CAR (QUOTE (A B C D E)))

put into the computer (actually, the LISP interpreter, i.e., the computer adapted to interpret LISP) gives as the answer (or value):

A

Since the first one of the list "A, B, C, D, E" is "A," the computer has operated correctly.

Meaning of CAR

In order to understand what has happened, let us take a look at the various parts of the example.

What does CAR mean?

The word CAR is an expression in LISP which is a function. Its meaning is "the first of." CAR applied to any list of elements produces the first element in the list. The word "CAR" is derived from the initial letters of three words in the phrase "Contents of Address part of Register," and this phrase has to do with the organization of the computer registers to hold lists.

Meaning of QUOTE

What does QUOTE mean?

The expression QUOTE tells the computer that what follows is to be treated as itself, not as the name for something else. This meaning is like the meaning in ordinary English when we use quotation marks and say:

"Paris" has five letters.

and mean:

The word Paris has five letters.

In writing English we ought not to put (without quotation marks):

Paris has five letters

because Paris is a city, and it makes no sense to say that a city has five letters; what a city has is people, streets, buildings, etc.

In English one of the standard uses of quotation marks is to produce a name for an expression, instead of designating what the expression usually refers to. This is the use of QUOTE in LISP.

Use of Parentheses

The expression:

```
(CAR (QUOTE (A B C D E)))
```

uses six parentheses. They are very important. They designate scope or extent of expressions—i.e., where they begin and where they finish. In LISP, parentheses have to be precisely and properly positioned. In order to understand them here, we shall first number them in associated pairs:

```
(CAR  (QUOTE  (A B C D E)))
1     2       3         321
```

The first left parenthesis No. 1 tells the LISP interpreter that this is the start of a calculation. The final right parentheses No. 1 tells the interpreter that this is the finish of an expression. The interpreter evaluates the expression, and produces the answer or value.

The first parenthesis No. 1 marks the beginning of the scope of CAR, the extent of the expression to which CAR applies. The second parenthesis No. 1 marks the end of the scope of CAR.

The first parenthesis No. 2 marks the beginning of the scope of QUOTE, and the second parenthesis No. 2 marks the end of the scope of QUOTE.

The first parenthesis No. 3 marks the beginning of an expression which is a list, and the second parenthesis No. 3 marks the end of the list.

Always, all parentheses in the expressions of LISP language occur in pairs of left and right parentheses; generally, each pair of parentheses marks scope, the extent to which an expression applies. The parentheses in LISP are not optional sometimes as they are sometimes in mathematics: they are required parts of expressions.

Separation or Delimiting of Expressions

The expression:

```
(CAR (QUOTE (A B C D E)))
```

contains within it seven separate expressions CAR, QUOTE, A, B, C, D, and E. It is important that each expression be separated, marked off, or delimited from the others.

Four characters are used in LISP for separating expressions: left parenthesis, right parenthesis, comma, and space. In LISP the comma is completely interchangeable with the space; also, one or more spaces or commas are treated exactly as a single space. Accordingly, regularly, parentheses and spaces separate or delimit expressions.

In order to talk about the spaces in this expression we shall number them:

```
(CAR  (QUOTE  (A B C D E)))
    1        2  3 3 3 3    4
```

The first space (No. 1) tells the LISP interpreter that it has reached the end of the expression CAR. If the first three characters of an expression were CAR and the fourth character were any character except a space (or a parenthesis or a comma), say X, then the computer would treat CARX as either part or all of another expression different from CAR, and not to be confused with CAR.

The second space, No. 2, terminates the expression QUOTE, in the same way as the first space No. 1 terminates the expression CAR.

The next four spaces all numbered 3 and separating A B C D E tell the machine that the expressions separated by them are all part of the same list. In ordinary English, we might write "A, B, C, D, E" writing commas—but the LISP interpreter regularly takes in and puts out lists using spaces without commas.

The last space numbered 4 tells the LISP interpreter (in PDP-1 LISP) to proceed to the calculation, and to put out the result.

The Function CDR

We have illustrated CAR as a function in LISP. What are some other functions?

One of them is CDR, pronounced "could-er," which means "the rest of." CDR of the list A B C D E is the list B C D E. To express this idea as a LISP function, we use:

```
(CDR (QUOTE (A B C D E)))
```

Table 4

APPROXIMATE NUMBER OF PUNCH CARDS (OR LINES OF CODING) REQUIRED TO PROVIDE INPUT TO THE 7094 COMPUTER FOR ALL THE PROBLEMS

Programming Language	Approximate Number of Punch Cards (or Coding Lines)
ALGOL	110
COBOL	660
COMIT	300
GATE	80
IPL-V	590
JOVIAL	130
LISP	130
MAD	210
FORTRAN	Not used because of direct access thru console to Time-Shared 7090 at Project MAC

and the LISP interpreter gives as result: (B C D E).

The two parentheses around (B C D E) cause the LISP interpreter to treat this expression as a list of four elements. The first parenthesis marks the beginning of the list, and the last parenthesis marks the end of the list. This raises the question: Is A the same as (A)? The answer is "No." A is an element, and (A) is a list containing one element A.

The abbreviation CDR comes from the phrase "Contents of Decrement part of Register."

The Function CONS

Another function in LISP is CONS, pronounced with a soft s, like "conss," which refers to "the construct of" when applied to an element and a list, or two lists. CONS of the element A and the list B C D E is the list A B C D E. This would be correctly written in LISP as:

```
(CONS  (QUOTE A)   (QUOTE   (B C D E)))
```

and the value would be:

```
(A B C D E)
```

The function CONS puts back together what CAR and CDR take apart.

Conditions, Predicates, and Numerical Functions

If CAR, CDR, and CONS were the only three functions in LISP, then of course the language would be quite uninteresting, and hardly anything of importance could be accomplished. The first step towards a more interesting language and more important results is the treatment by LISP of what are called "conditional expressions."

Conditional Expressions

In LISP language a conditional expression has the following kind of pattern:

If statement P is true, take expression E. Otherwise,
if statement Q is true, take expression F. Otherwise,
if statement R is true, take expression G.

The truth values of the statements P, Q, R, are examined in sequence by the computer, until the first true statement is found. Then the expression paired with this true statement is taken as the value of the entire conditional expression. If none of the statements are true, the value of the entire conditional expression is undefined.

The conditional expression above would be correctly written in LISP as:

```
(COND   (P E)   (Q F)   (R G))
```

assuming that the expressions P, Q, R, E, F, G did not need any parentheses around them.

But this conditional expression would not be accepted by the LISP interpreter unless the computer had a way of determining whether the statements marked here by P, Q, R are true or false. And at this point we have not told the computer anything about the statements P, Q, R, and the computer has no way of evaluating this expression.

In order to illustrate how the computer can compute the result of an expression like this, we may put in known truth values in place of the unknown truth values of the statements P, Q, R. LISP recognizes two truth values, T for "true" and NIL for "false." These are so basic to the operation of LISP that LISP provides that QUOTE does not have to precede them. T is treated the same as (QUOTE T) and NIL is treated the same as (QUOTE NIL). (*Note:* This is because T has the constant value T and NIL the constant value NIL.)

To put in known truth values, in place of the conditions in COND, is ordinarily not useful except for illustration, with one important exception: in the case of the last condition occurring in the whole conditional expression (the condition which refers to all the remaining cases), T is regularly used.

For example:

```
(COND   (NIL   (QUOTE D))
0       1      2        21
        (T     (QUOTE E)))
        1      2        210
```

will give the result E. The conditional expression:

```
(COND   (T     (QUOTE D))
0       1      2        21
        (NIL   (QUOTE E)))
        1      2        210
```

will give the result D. The conditional expression:

```
(COND   (T  (QUOTE D))
        (T  (QUOTE E)))
```

will also give the result D.

If we give the computer:

```
(COND   (NIL   (QUOTE D))
        (NIL   (QUOTE E)))
```

then the computer will report an error and print out as a "diagnostic" for the error, a symbol which stands for "illegal COND."

Absolute Value

A specific, familiar example of a conditional expression in elementary mathematics is the ordinary definition of the absolute value of a number. The absolute value of a number X is a number which may be defined in precise English (resembling the LISP conditional expression) as:

If X is negative, take minus X.
Otherwise,
Take X.

Let's write this in LISP. In LISP we have available a function GREATERP, which is used in the expression (GREATERP X Y), standing for "X is greater than Y." This expression is true if X is greater than Y, and false if X is not greater than Y. In LISP we also have available the function (MINUS X) standing for "the negative of X." So the absolute value of X can be expressed in LISP as:

```
(COND   ((GREATERP O X)   (MINUS X))
1       23              3  3        32
        (T X))
        2   21
```

This expression as it stands would still not be accepted by the computer, because LISP would not "know" what number X stood for, and so it could not compute the result. So in order for this expression to be accepted by the computer, X would have to be replaced by a specific number, such as 36, or (MINUS 13), or 999975 (the decimal complement of 24), etc.

Another point: in the case of a number we do not have to use QUOTE, because a number is accepted as itself. For example, we do not have to write (MINUS (QUOTE 36)); we can write this simply as (MINUS 36). The LISP interpreter will however accept both (MINUS 36) and (MINUS (QUOTE 36)).

Predicates

In order to make use of COND in LISP, there have to be expressions which are true or false, and these are called "predicates." One of them is GREATERP, which we have just used. Two more are EQ and NULL, which will now be explained.

The Predicate EQ

EQ accepts two atomic symbols (we shall define this term a little later) such as "B" or "CONS" or "367," and compares them character by character. If the two atomic symbols are precisely the same character by character, then EQ is true, otherwise not. For example, it is true that "the atomic symbol A equals the atomic symbol A." So:

```
(EQ  (QUOTE A)   (QUOTE A))
```

gives as the result T standing for the truth value "true."

It is false that "the atomic symbol A equals the atomic symbol B." So:

(EQ (QUOTE A) (QUOTE B))

gives as the result NIL, standing for the truth value false.

The Predicate NULL

If P is a statement which can be true or false, the statement NULL P stands for the statement NOT-P.

If P is true, then NULL P is false; and if P is false, then NULL P is true.

For example, it is true that "the atomic symbol A is not equal to the atomic symbol B." So:

(NULL (EQ (QUOTE A) (QUOTE B)))

will give as the result T.

The predicate NULL also applies to lists. If a list L is empty (i.e., contains no elements), then NULL L is true; otherwise NULL L is false.

For example:

(CDR (QUOTE (A)))

is empty, and as a calculation it gives the result: NIL Therefore: (NULL (CDR (QUOTE (A)))) gives the result T.

In the same way:

(NULL (CDR (CDR (QUOTE (A B)))))

gives the result: T.

Numerical Functions

Predicates are functions that have for values either true (T) or false (NIL). There exist in LISP many kinds of functions besides predicates, including functions which may have numbers, letters, lists, etc., for their values.

We shall consider first some of the functions of numbers.

Among the numerical functions defined in LISP are PLUS, MINUS, TIMES, and QUOTIENT. PLUS takes any number of arguments. MINUS takes only one argument (producing the negative of a number), so that subtraction has to be performed using both PLUS and MINUS. TIMES takes any number of arguments. QUOTIENT takes two arguments, the first one being the dividend and the second one being the divisor.

For example:

Example of LISP Expression	*Result*
(PLUS 2 3 5)	10
(MINUS 5)	—5
(TIMES 2 3 6)	36
(QUOTIENT 15 3)	5
(QUOTIENT 334 333)	1
(QUOTIENT 333 334)	0

Defining and Using New Terms and Expressions

Among the powers of LISP is the power to define new terms and expressions as we may desire, and then to make use of them. This is like the power in mathematics when solving a problem to say "Let x equal" or "Let F (x) be a function such that. . . ."

The Expression CSETQ

The expression CSETQ in LISP evaluates whatever constant, or operation, or function you set it at. You could for example set it as the result of some other operation, and the computer would then give you the result of that operation.

The form of the idiom is:

(CSETQ . . . .)
      1   2

Here Blank 1 is filled with the name you choose for designation, and Blank 2 is filled with whatever constant, operation, or function you choose.

For example, you may designate the meaning of JILL by putting in:

(CSETQ JILL (CAR (QUOTE (49 64 81 100))))

The computer responds by putting out:

JILL

To verify what JILL stands for, you put in:

JILL

and the computer responds by putting out:

49

which is correct, since it is the first one of the list 49, 64, 81, 100.

You can use JILL in other expressions. For example,

(PLUS JILL JILL JILL)

will be evaluated as:

147

which is correct since $49 + 49 + 49 = 147$

DEX and LAMBDA

DEX (which is short for DEFINED EXPRESSION) and LAMBDA (which will be explained shortly) are two of the expressions (in one form of LISP) which enable us to define new functions, give them names, and make use of them.

For example, suppose you have PLUS and you would like to define DOUBLE. The DOUBLE of m of course is m plus m; the DOUBLE of y is y plus y; the double of 213 is 213 plus 213 or 426. What we want to accomplish is to lay down a rule like this: For any x, the double of x is x plus x.

We can establish this sort of definition in LISP and make use of it. We put into the LISP interpreter:

(DEX DOUBLE (LAMBDA (X) (PLUS X X)))

The computer will respond:

DOUBLE

telling us that this function is now available to us.

To double, for example, the number three, we put in:

(DOUBLE 3)

and the computer will give the result:

6

LAMBDA is to some extent equivalent to the English phrase "FOR ANY." Thus the LISP statement:

(DEX DOUBLE (LAMBDA (X) (PLUS X X)))

is in effect something like the

DEFINED EXPRESSION: DOUBLE (FOR ANY X) (PLUS X X).

What is the context of all this?

The general form of the LISP idiom which we are using is:

(DEX . . . . . (LAMBDA (. . . . .) (. . . . .)))
        1   2   3

The word "lambda" (the Greek name for the letter L) is a sign used by the symbolic logician Alonzo Church who in the 1940's pointed out the need for naming a function in mathematics (such as $y = x^2$ (a certain parabola) or $z = u^2$ (the same parabola)) independently of the algebraic letters being used to talk about it).

Blank 1 above is filled with any name that we wish to use for a function being defined. Blank 3 is filled with a defining expression, often a condition. And Blank 2 is filled with a list of variables which is called the "lambda list."

The order of the variables in the lambda list is the precise order in which those variables have to be mentioned when the defined expression is used. Most of the time these variables are specified or limited or bound in the defining expression that occupies Blank 3. Some of the time however the variables are not specified or limited or bound currently in the defining expression that fills Blank 3, but instead at some other point in another definition. Such variables are called free variables or parameters. However, before the computer will compute a result, any free variable must be bound.

Atomic Expressions

For a long time we have avoided discussing what are called atomic expressions or atomic symbols or atoms. But we have used them, both individually and as elements of lists. Examples are:

—single letters such as: A, B, C, D, E, F, ...
—numbers such as: 5, 314, 777772, ...
—names of expressions in LISP such as CAR, CDR, PLUS, ...

We now state a definition: In LISP an atomic symbol (or atomic expression or atom) is (1) an expression consisting of a string of numerals and capital letters of not more than a certain length or (2) an integer consisting of a string of numerals. This is generally true; actually, in the implementation of LISP on a particular computer, there may be one or more additional conditions: for example, in 7090 LISP, an atom may not be more than 30 characters long. Neither spaces nor parentheses may be used inside an atomic symbol.

The marker which precedes an atomic symbol is either a left parenthesis or a space. The marker which ends an atomic symbol is either a space or a right parenthesis. If by mistake we seek to make an atomic symbol containing one or more spaces or parentheses, the LISP program inside the computer will recognize the expression as two or more atomic symbols.

These symbols are called atomic because they are treated in LISP as wholes and within LISP are not split into individual characters.

For example, A, C, R, CAR, CDR have no relation to each other in LISP because no part of LISP can regularly either observe or report that these five expressions have some characters in common.

The predicate EQ reports on the equality of two atomic symbols; it is not defined for expressions that are not atomic.

The predicate ATOM is true if its argument is an atomic symbol; it is false if its argument is not an atomic symbol.

Recursive Definitions

A most important feature of LISP is the ability to make use of recursive definitions of functions. These are definitions which first define an idea in one or more special starting or finishing cases, and then define the idea in the general case in terms of a preceding or adjacent case.

For example in arithmetic a geometric series can be defined making use of a recursive definition:

> A geometric series is a series with a first term equal to *a*, and with any term equal to the preceding term multiplied by a constant *r*.

The Function REMAINDER

What is an example of a recursive definition?

In elementary school we learned what the "remainder" is when we divide one number by another. If we divide 26 by 7, for example, the 7 goes in three times, and since 7 threes are 21, we subtract 21 from 26, and the remainder is 5. Now how do we express remainder in English that can be translated into LISP?

Stated in precise English, and using a recursive definition (without making use of division), the remainder when the dividend Y is divided by the divisor X, is determined as follows:

(i) If Y equals X, the remainder is O; otherwise,
(ii) If Y is less than X, the remainder is Y; otherwise,
(iii) The remainder is the same as the remainder we would get if the result of Y minus X were divided by the divisor X.

To say this in LISP we again make use of the idiom:

```
(DEX  . . . . .  (LAMBDA  (. . . . .)  (. . . . .)
```

The expression "y equals x" is translated into (EQ Y X). The expression "y is less than x" is translated into (GREATERP X Y). Since there is no condition for the third case, we use T. The expression "y minus x" is translated into (PLUS Y (MINUS X)).

The entire definition is therefore translated into:

```
(DEX REM  (LAMBDA  (Y X)  (COND
  ((EQ Y X)  O)
  ((GREATERP X Y)  Y)
  (T  (REM  (PLUS Y  (MINUS X))  X))
  )))
```

If we give this expression to the LISP interpreter, it responds:

```
REM
```

telling us that the function REM is now available to us.

Testing with examples, we obtain the following:

Expression	*Result*
(REM 2 2)	0
(REM 5 7)	5
(REM 14 7)	0
(REM 32 7)	4

Functions of Lists

We have paid some attention to functions of numbers, and we have illustrated recursion using numbers. But LISP is more useful for dealing with functions of lists than for dealing with functions of numbers. So let us now look carefully at some more functions of lists.

The list functions which we have so far defined are CAR, CDR, CONS, and COND.

COND is a list function because it operates on a list, each element of which is a list of two elements. There is also the additional requirement that the first element of each of the doublets on which COND operates needs to be a predicate, which has a truth value of either true or false.

The Function APPEND

A useful list function is APPEND, which means "the putting together of," when applied to lists. APPEND of the list A B C and the list D E F G is the list A B C D E F G.

This would be correctly written in LISP and given to the LISP interpreter as follows:

```
(APPEND  (QUOTE  (A B C))  (QUOTE
    (D E F G)))
```

and the computer would print out as the result:

```
(A B C D E F G)
```

If there is just one element to be attached to a list, the element is changed into a list by putting parentheses around it, and then APPEND is applied:

```
(APPEND  (QUOTE  (A))  (QUOTE (B C D E)))
```

and the result is the list: A B C D E.

To produce the same effect with CONS, parentheses are *not* put around the element:

```
(CONS  (QUOTE A)  (QUOTE  (B C D E)))
```

and the result is the same list: A B C D E.

The LISP definition of APPEND makes use of recursion:

```
(DEX APPEND  (LAMBDA  (X Y)  (COND
  ((NULL X)  Y)
  (T  (CONS  (CAR X)  (APPEND  (CDR X)  Y)))
  )))
```

The Function LENGTH

If we want to define the "length" of a list, i.e., the number of terms it contains, the defining expression is even simpler and easier:

To find the LENGTH of a list M:
  If the list is NULL, take O. Otherwise,
  Add one to the LENGTH of CDR M.

The LISP expression is:

```
(DEX LENGTH  (LAMBDA  (M)  (COND
  ((NULL M)  O)
  (T  (PLUS 1  (LENGTH  (CDR M))))
  )))
```

The Predicate MEMBER

An element is a *member* of a list if it can be found among the elements of the list.

In precise English:

The truth of "element A is a MEMBER of the list X" is found from:

If X is empty, take NIL. Else,
If A is equal to CAR X, take true. Else,
Take the truth of "A is a MEMBER of CDR X."

In LISP, we express this as:

```
(DEX MEMBER (LAMBDA (A X) (COND
 ((NULL X) NIL)
 ((EQ A (CAR X)) T)
 (T (MEMBER A (CDR X))))))
```

For examples, we can put the following operations on the computer:

Operation and Explanation	*Computed Result*
(CSETQ JILL (QUOTE (A B C D))) This names the list (A B C D) as JILL.	JILL
JILL Verifying meaning of "JILL."	(A B C D)
(MEMBER (QUOTE A) JILL) Computing the truth of "A is a member of JILL."	T
(MEMBER (QUOTE K) JILL) Computing the truth of "K is a member of JILL."	NIL

The Function LAST

Another list function is LAST. The LAST element of a list is found from the operation:

If the list is empty, take NIL.
Otherwise,
If CDR of the list is empty, take CAR of the list.
Otherwise,
Take LAST of CDR of the list.

In LISP:

```
(DEX LAST (LAMBDA (L) (COND
 ((NULL L) NIL)
 ((NULL (CDR L)) (CAR L))
 (T (LAST (CDR L))))))
```

The Function UNION

Another function of lists is UNION. The union of two lists X and Y is a list which contains every element which is in one list or the other or both. But the order in which the elements is presented is first, all elements which are in the first list X and not in the second list Y, and second, all elements in the second list Y whether or not they are in list X.

In precise English:

The UNION of two lists X and Y is:

If X is null, take Y.
Else,
If CAR X is a member of Y, take the UNION of CDR X and Y.
Else,
Take CONS of CAR X and the UNION of CDR X and Y.

In LISP:

```
(DEX UNION (LAMBDA (X Y) (COND
 ((NULL X) Y)
 ((MEMBER (CAR X) Y) (UNION
   (CDR X) Y))
 (T (CONS (CAR X) (UNION (CDR X) Y))))))
```

For examples, we can put the following operations on the computer:

Operation	*Result*
(UNION (QUOTE (E B C D A F)) (QUOTE (A B C D)))	(E F A B C D)
(CSETQ JAIN (QUOTE (A B C D)))	JAIN
(CSETQ JASS (QUOTE (D A B C)))	JASS
(UNION JASS JAIN)	(A B C D)
(UNION JAIN JASS)	(D A B C)

Generality and Power

In conclusion, there are several comments which it seems to me should be made about LISP. The first comment is that LISP greatly enlarges our conception of the nature of mathematical objects. In prior centuries men became accustomed to noticing as interesting mathematical objects: numbers; the points and lines of geometry; the magnitudes and directions of forces; sequences of numbers, usually infinite and usually with fairly simple rules for the construction of successive terms; and much more.

Now with the advent of LISP our horizons in mathematics are considerably extended. With LISP we take into mathematics finite sequences of a great variety of structure (lists), and also a mathematical grasp on the processes of effectively computing with them (recursion, etc.). This new expansion of mathematical nature, of man's view of mathematical objects, is exciting.

Second, LISP is not only a mathematical language but also a language for instructing computers. So instead of humanly verifying a symbolic mathematical calculation, if it is expressed correctly in LISP, we can put it on a computer and have the computer verify it.

Third, there appears to be no barrier to putting into LISP any kind of logical or mathematical manipulation that may be desired. It seems to be a truly general language, with closely linked computing power.

Computation

What we are invariably doing with any LISP expression is giving the computer something to do, some computation to make, some command to be executed. Sometimes the computation is in terms of numbers and the answer may be a number. Sometimes the computation is in terms of lists and the answer will be a list or a number. Sometimes the computation is in terms of expressions, and the answer will be a number or a list or an expression.

If all the information has been given to the computer, and the instructions are complete and correct, the answer produced by the computer will be an applicable one. If not all the data has been given to the computer, the answer (or result of the computer's operation) is likely to be a signal of any one of many kinds, that the answer cannot be computed for a stated reason. Or perhaps the computer will go into a loop and keep doing something over and over and over without ever finishing. In such a case, the computer stop button has to be pressed, and a new beginning has to be made.

Incompleteness of this Explanation

Finally, it must be emphasized that the present explanation is very far from complete. There is much more to LISP than has been presented here. Following are some references. But it is hoped that this introduction will be of some help to people who are starting to understand LISP.

References

1. "LISP 1.5 Programmer's Manual," by John McCarthy and others, published by The M.I.T. Press, Cambridge 39, Mass., 1962, 105 pages.

2. "LISP: Its Operation and Applications," by Edmund C. Berkeley and Daniel G. Bobrow, editors, and 15 authors, published by Information International, Inc., 200 Sixth St., Cambridge 42, Mass., 1964, 392 pages.

Note: This article is largely based on the first paper in Reference 2.

THE COMPUTER SITUATION IN BRITAIN, SUMMER, 1964

R. H. Williams
Managing Director
Computer Consultants, Ltd.
Enfield, Middlesex
England

Table 1

COMPUTERS LESS THAN FIVE YEARS OLD INSTALLED AND ON ORDER IN BRITAIN

Key:

(1) Average price of system in £1,000's
(2) Date first installed anywhere
(3) Number installed in Britain
(4) Import value in £1,000's
(5) Home built value in £1,000's
(6) Number on order for Britain
(7) Import order value in £1,000's
(8) Home built order value in £1,000's

NAME	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
AEI 959	20	1964				1		20
AEI 1010	360	1961	7		2,520	1		360
TOTAL			7		2,520	2		380
Bull Gamma 10	30	1964				5	150	
Bull Gamma 30 (RCA 301)	120	1962	2	240		3	360	
Bull Gamma 150	50	1960	3	150				
Bull Gamma 300	22	1962	6	132				
TOTAL			11	522		8	510	
Burroughs E102	10	1962	1	10				
Burroughs 270	130	1962	5	650				
Burroughs 280	140	1964	2	280		3	420	
TOTAL			8	940		3	420	
Clary De 60	30	1961	1	30				
Collins C 8400	500	1964				2	1,000	
CE 55	2	1960	2		4	4		8
CE 102	10	1961	1		10			
TOTAL			3		14	4		8
EEL KDF 6	60	1964	1		60	7		420
EEL KDF 8	200	1964				3		600
EEL KDF 9	120	1963	11		1,320	9		1,080
EEL KDN 2	20	1962	3		60	2		40
EEL KDP 10 (RCA 501)	400	1961	8		3,200	2		800
EEL Leo III	200	1962	12		2,400	15		3,000
EEL Leo 326	300	1964				4		1,200
TOTAL			35		7,040	42		7,140
Elliott 502	135	1961	2		270			
Elliott 503	110	1963	4		440	4		440
Elliott 803	44	1960	98		4,312	10		440
Elliott Arch	25	1963	3		75	1		25
TOTAL			107		5,097	15		905
Ferranti Hermes	20	1964				1		20
Ferranti Poseidon	50	1964				1		50
TOTAL						2		70
Friden 6010	8	1963	6	48		16	128	
Honeywell 200	90	1963				1		90
Honeywell 400	120	1962	8		960	5		600
Honeywell 800	395	1962	2		790	2		790
Honeywell 1400	250	1963	1		250	1		250
Honeywell 1800	850	1963				2		1,700
TOTAL			11		2,000	11		3,430
IBM 305 II	70	1960	4	280		2	140	
IBM 360	50	1965				101	5,050	
IBM 1401	120	1960	148	17,760		76	9,120	
IBM 1401 G	50	1963				3	150	
IBM 1410	200	1961	9	1,800		5	1,000	
IBM 1440	30	1963	2	60		50	1,500	
IBM 1460	140	1963				4	560	
IBM 1620	20	1961	11	220		1	20	
IBM 7030 Stretch	1,500	1962	1	1,500				
IBM 7070	450	1962	1	450				
IBM 7074	500	1961	3	1,500				
IBM 7090	1,000	1960	4	4,000				
TOTAL			183	27,570		242	17,540	
ICT 1100	180	1960	14		2,520			
ICT 1101	180	1962	3		540	5		900
ICT 1300	55	1963	4		220	43		2,365
ICT 1301	120	1963	54		6,480	17		2,040
ICT 1500	100	1962	36	3,600		28	2,800	
ICT 1900	300	1964				3		900
ICT 2400	500	1961	3		1,500			
ICT Appollo	50	1962	1		50			
ICT Argus	20	1961	5		100	2		40
ICT Atlas	2,000	1962	2		4,000	2		4,000
ICT Orion	300	1963	6		1,800	6		1,800
ICT Pegasus 2	120	1960	13		1,560			
ICT Sirius	17	1961	15		255			
TOTAL			156	3,600	19,025	106	2,800	12,045
Monrobot Mk. XI	12	1961	8	96				
NCR 315	120	1963	14		1,680	7		840
NCR 390	25	1963	1	25				
TOTAL			15	25	1,680	7		840
PB 250	20	1961	2	40				
SEL/DB 40	50	1961	1	50				
TRW 130	35	1963	1		35			
TRW 330	60	1963	3		180			
TOTAL			4		215			
Univac SS 80	100	1960	5	500				
Univac 490	500	1961				2	1,000	
Univac 1107	850	1963	1	850		1	850	
TOTAL			6	1,350		3	1,850	
GRAND TOTAL			564	34,271	37,591	463	24,248	24,818
Total pre-1959 computers			247	5,435	13,261			
TOTAL			811	39,706	50,852	463	24,248	24,818

During the twelve months since we last wrote in **Computers and Automation** on this subject, there have been a number of changes in the computer field in Britain, but these, although important are not spectacular.

Table 1 shows the number of installations, and in particular indicates their monetary value. The latter is most important when considering trends. It is obvious to say that some computers are much larger than others, and cost a great deal more, but unfortunately, people tend to lose sight of this fact when they start counting heads.

There has been some discussion among British trade union officials, about the troubles to be expected from the introduction of automation, but labor difficulties in connection with automation, so far in Britain, have not reached troublesome proportions. Machines have not started taking over in Britain yet, although there was the sad news in the press recently that an unfortunate gardener had been killed by being pinned against a wall by a mechanical cultivator which had got out of hand. So far, anyway, no deaths are directly attributable to computers.

IBM have announced the System 360 computers, this time simultaneously all over the world; and this has led to a certain amount of well-informed and mis-informed comment. The general reaction in Britain is that these machines are not as far-thinking as had been expected, and some British computer manufacturers are stated to have heaved a sigh of relief. Our opinion is, that they will not be built and installed in anything like the quantity that might be expected, particularly with their two-year-away target date.

Within the next five years computers are likely to have more radical changes in their philosophy, using optical device memories of very large capacity; and of course, we have said for a long time that their price is undoubtedly going to be tailored down. As things stand at the moment, this would make the IBM System 360 unacceptable before long. There are real moves going on at this moment in this tailoring down of prices, and these are well beyond the theoretical and hypothetical stage.

Explicitly however, the facts and our opinion about computer manufacturers operating in the British market are as follows.

Associated Electrical Industries Limited

The computer activity of A.E.I. is in some doubt at the moment, and we would not be surprised if this was discontinued.

The company is a very large one with many ramifications, but it is essentially an electrical and electronic engineering concern, which suffers the usual difficulties of trying to sell commercial computers. They have made certain attempts towards producing and selling process control computers, but we do not think that this has been successful enough to justify the large capital investment involved.

Burroughs Machines Limited

Burroughs have an exceedingly good relationship with the British banks and various city companies. Traditionally, this has always held them in good stead as far as their accounting machine market is concerned, and has also been of significance in their limited computer activity. We feel that this computer activity is a little too limited, and unless there is a marked increase in their sales it does not bode too well for their future in Britain.

Clary Corporation Inc.

The Clary Corporation entered into an agreement three years ago to sell their DE 60 computer through a British organization, Block and Anderson Limited. This did not work out, and of recent weeks Clary have established a London office.

They have only a limited range of products, and we think they are very brave indeed to step out in this way. Unless they enter into some partnership agreement with at least a European if not a British organization, then we feel that trouble lies ahead.

Collins Radio Company

Collins Radio organization are establishing large scale computers in Britain in connection with their message switching and data transmission operations. They plan to sell time on these machines for remotely placed users, operating over data links.

We think that this has possibilities, but we also believe that Collins have very seriously under-estimated the administrative problems involved. It remains to be seen how far they are able to take care of this.

Table 2

COMPUTER INSTALLATIONS IN EUROPE*

	Number of Computers Installed	Import Value in £1,000	Home Built Value in £1,000
AUSTRIA	66	5,750	-
BELGIUM	142	12,917	-
DENMARK	74	6,143	486
FINLAND	19	1,464	-
FRANCE	791	48,566	39,232
GERMANY	993	46,894	45,911
GREAT BRITAIN	626	28,953	36,124
GREECE	50	5,400	-
HOLLAND	156	15,106	1,688
IRISH REPUBLIC	10	828	-
ITALY	592	56,821	11,431
NORWAY	54	5,268	-
PORTUGAL	16	2,120	-
SPAIN	23	2,118	-
SWEDEN	147	15,009	1,140
SWITZERLAND	160	20,252	-
TOTALS	3,919	273,609	136,012

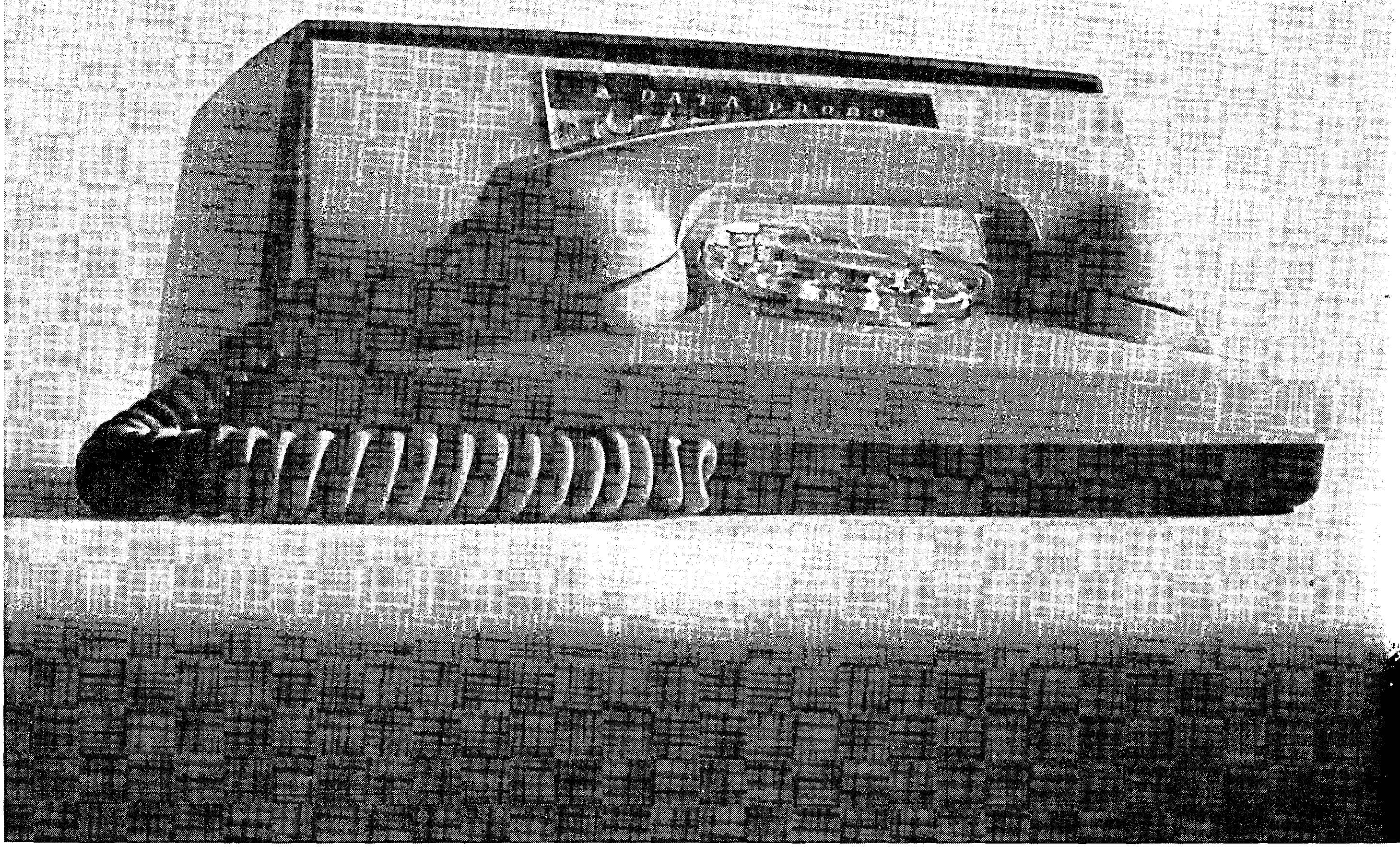
COMPUTER ORDERS IN EUROPE*

	Number of Computers on Order	Import Value in £1,000	Home Built Value in £1,000
AUSTRIA	50	4,380	-
BELGIUM	105	10,601	-
DENMARK	30	3,758	-
FINLAND	35	3,380	-
FRANCE	406	24,864	15,571
GERMANY	455	20,742	21,520
GREAT BRITAIN	381	20,442	29,707
GREECE	20	1,910	-
HOLLAND	134	15,792	1,486
IRISH REPUBLIC	39	2,250	-
ITALY	339	22,836	9,670
NORWAY	71	5,243	-
PORTUGAL	29	3,050	-
SPAIN	19	1,873	-
SWEDEN	121	11,321	1,200
SWITZERLAND	101	14,226	-
TOTALS	2,335	166,668	79,154

* Information as of January 1, 1964

WHAT CAN DATA-PHONE SERVICE DO FOR YOU?

It can transmit your business data over telephone lines at 100 to 2700 words per minute, at regular phone-call rates. Combine it with your present telephone service and you have fully integrated information handling that will help you improve customer services, reduce paperwork, keep costs in line and make decisions based on what is today, not what was yesterday.



Here's how DATA-PHONE service is helping business firms, large and small, all over the country . . .

A food processor is using DATA-PHONE transmission to centralize its statistical reporting. It used to take from eight to 14 days to gather and process company data—now takes less than two days. The firm can close its accounting books eight days earlier each month.

A large insurance company uses a DATA-PHONE network to transmit records of premium payments, claims, new policies and accounting information from 34 branch locations to a central data center. Data that once took six to seven days to arrive by mail is now reported daily. Operating costs have been reduced by one million dollars annually.

A savings institution uses DATA-PHONE service to connect all teller windows with a central computer. Tellers can check and update accounts immediately from any location—and can handle two customers in the time it used to take for one. Back-office teller work has been reduced by 90 percent.

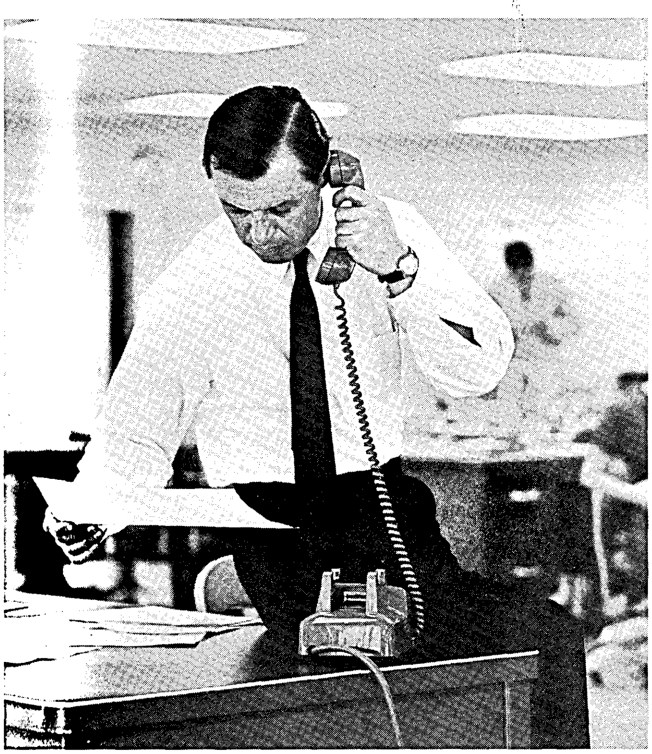
A southern hospital uses DATA-PHONE data sets to link various departments to a central data center within the building. The system has eliminated tedious clerical functions and makes it possible to give patients complete bills at discharge time, avoiding the annoyance of follow-up billing.

A national recording company now handles distributors' orders from DATA-PHONE-equipped sales offices linked directly to new, centrally located inventory centers. The firm is handling orders many times faster—and savings in warehousing and inventory handling are running better than $80,000 a month.

A drug wholesaler uses DATA-PHONE service to link its two supply locations together, thus offering pharmacies the equivalent of two full-line wholesale sources. The firm is now achieving a 99.5 percent level of order fulfillment, with no increase in dollar investment for inventories. Sales volume is up $100,000.

A major oil company makes use of DATA-PHONE service to transmit credit-card payments from its New York headquarters to a midwestern data center. Processing time between the two points has been reduced from several days to just a few hours—and the cost of airmailing the data has been eliminated.

An appliance manufacturer has used DATA-PHONE service to tie more than 40 independent supply centers into an automated network for ordering and supplying replacement parts. The time required to receive and deliver orders has been reduced from 14 days to 1½ days, with substantial savings resulting.



Talk with one of our Communications Consultants

He can tell you all about DATA-PHONE service and help you determine if and how it might serve you profitably.

His counsel will cost you nothing—and his recommendation might save your business considerable time and money. Call your local Bell Telephone Business Office and ask for the services of a Communications Consultant—and see for yourself.

BELL TELEPHONE SYSTEM

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Compagnie des Machines Bull

The Bull organization in Britain operates jointly with a British company as De La Rue Bull Machines Limited. This subsidiary company is not heavily involved in the financial troubles of the parent Bull organization.

At the same time, it does not appear to us that the British subsidiary is selling enough computers to justify the overhead expenditure in which it must inevitably be involved.

The parent company Bull has been seeking to rearrange its activities and join up with General Electric Company of America as a partner. These arrangements are, in our opinion, so complicated and of such a type that after taking into account the temperaments of the two nationalities involved, we cannot see this operating successfully.

Bull still enjoys a large punch card market, but even to retain this activity it must do something drastic about its computer situation. There are no signs yet, that they are tackling this problem realistically enough.

Computer Engineering Limited

This small British computer manufacturing company has now built a limited number of machines which are useful for scientific computer work at low cost. They do not appear to have developed enough tempo to deal with the need for forward development, but they may have been very quiet about their activities and could be planning some surprise.

English Electric-Leo Computers

This organization, which was a merger of Leo Computers Limited and the large English Electric Company, is made up of two of the oldest and most experienced British computer manufacturers. While they cannot compare in activity or size with IBM, their equipment covers a reasonable range in performance and cost, and they are making good steady progress compatible with their size. We would think that by now they should be making a reasonable profit and provided they are taking some care to cater for future generations of machines, they are probably the most successful current British computer manufacturer.

Elliott Brothers (London) Limited

This organization has always appeared to us to be over-diversified. They have relatively little capital reserves in relation to their very large number of operating companies. The Elliott range of computers is now restricted somewhat to the Elliott 803, now a little dated but still reasonably attractive, and the Elliott 503 now coming off the production lines.

With the 503, Elliott's are using magnetic tape for the first time, and we can only hope that by now the inevitable troubles which have been experienced by almost everyone with magnetic tape are a thing of the past.

They make some small "build-your-own" computer kits and some production control computers, none of which are sold in really large quantities. On the stocks are two new computers which are making progress, but are not yet installed.

Elliott Brothers are building the NCR 315 for the European market in their factory in London. We would hazard a guess that this activity will run down before long.

Ferranti Limited

Ferranti have sold out their commercial computer activity to I.C.T., but we have a feeling that they do not want to give up computers altogether, and they are certainly still engaged in military computer work. Now that the difference between commercial, scientific and military computers is only marginal this leaves them in a tricky position.

Friden Limited

Friden, as far as their computer activities are concerned, do not seem to be making spectacular progress, and we would guess (and we can only guess because they will not tell us) that their computer sales in Britain have been disappointing. Their Flexowriter activity is making good headway.

Honeywell Controls Limited

Honeywell have now established a computer factory in Scotland, and with the announcement of their 200 computer they have a satisfactory range of products. They have built up for themselves in Britain, modest but satisfactory computer sales and more important an excellent image. At the moment, they are expanding their European activities from Britain and we think that the future promises well.

IBM United Kingdom Limited

IBM have continued to make progress, but we think that the tempo is gradually slowing down a little. British business people still seem to be a little bothered by this organization, but most of those who have actually done business with them seem reasonably satisfied with the way they have been supported and with the products sold.

If they could engineer more of the British image into their activity, we think they would do a lot better. At the moment they enjoy about 30% of the installation position monetary-wise of computers in Britain, and 35% outstanding order-wise.

Although some moves in that direction are going on, no IBM computers are being built in Britain at present. Foreign-exchange-wise their equipment is very expensive to buy.

International Computers & Tabulators Limited

I.C.T. have been licking their computer wounds for some time now, and in our opinion the purchase of the computer division of Ferranti and E.M.I. was a case of buying a "pig in a poke."

They had troubles enough already without taking on these two activities.

They have two new computers on the stocks and the development work on these is making reasonably good progress.

From an over-all sales and order point of view, they are very near to IBM but their losses are substantial.

Monroe Calculating Company Limited

The Monroe organization, which is associated with several European companies, has not been as successful as they anticipated in the sale of their small Monrobot XI computer in Britain. This activity is now largely in a state of stagnation.

National Cash Register Co. Ltd.

NCR has made modest but not really satisfactory progress with its computers in Britain. The range of these machines is limited and they now only sell the NCR 315 and the 390.

Their accounting machine market however, is still satisfactory and with the rumor of new small NCR computers to come, we can anticipate their staying in business for some time yet.

Packard Bell Computer Corporation

Packard Bell has sold, through its agent Benson Lehner

(G.B.) Limited, a small number of Packard Bell 250 computers in Britain. These computers are also manufactured in Europe under license by S.E.T.I. and there are quite a few installed on the Continent. The company however, has retained its hold on the Packard Bell 440 and although it is planning to sell this machine outside America, no certain plans have yet been made.

Thompson-Ramo-Wooldridge Inc.

This company sells its computers in Britain through International Systems Control Limited which is associated with the General Electric Company of Britain. The machines are actually built in Britain and they enjoy some success, the emphasis being in the direction of production control.

Remington Rand Limited

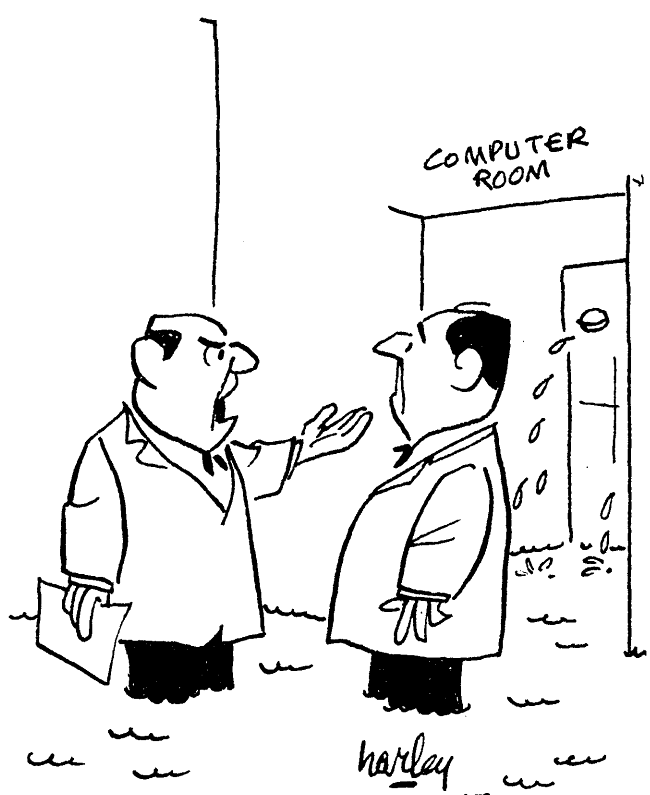
Remington Rand is still in the computer business in Britain, and while it has sold and has on order two or three large machines, its activity is not sufficient when considered with the heavy overhead commitments which it has. We think, with the changes at their computer executive level in America, that there will probably be other difficulties to be encountered in Europe as a result.

These possibly will have other repercussions in Britain. Remington are heavily involved in the installation of an air-line reservation system for British European Airways, and much will depend on the successful or unsuccessful outcome of this particular activity.

To better appreciate the over-all picture in Britain one should look at the situation as a whole in Europe.

While obviously, Table 1 is more up-to-date, Table 2, prepared by Computer Consultants Limited as of January, 1964, gives a broader view.

HYDROUS COMPUTATION



"I **told** you it was sensitive to insoluble problems!"

CALENDAR OF COMING EVENTS

Sept. 7-11, 1964: International Conference on Microwaves, Circuit Theory and Inf. Theory, Akasaka Prince Hotel, Tokyo, Japan; contact Dr. K. Morita, c/o IECE of Japan, 2-8 Fujimicho Chiyoda-Ku, Tokyo, Japan

Sept. 14-16, 1964: International Convention on Military Electronics (MIL-E-Con 8), Shoreham Hotel, Washington, D. C.; contact George C. Ruehl, 2118 St. Paul St., Baltimore, Md. 21218

Sept. 14-16, 1964: UNIVAC Users Association Fall Conference, New York Hilton Hotel, Rockefeller Center, New York, N. Y.; contact David D. Johnson, UUA Secretary, Ethyl Corp., 100 Park Ave., New York, N. Y. 10017

Sept. 14-18, 1964: 4th International Conference of Analog Computing, College of Technology, Brighton, England; contact The BCS/AICA Honorary Secretariat, Ferranti Ltd., Kern House, 36 Kingsway, London, W. C. 2, England

Sept. 14-19, 1964: Symposium on Component Parameters and Characteristics, Stockholm, Sweden; contact Prof. Herman R. Weed, EE Dept., Ohio State Univ., Columbus 10, Ohio

Sept. 17-18, 1964: 7th Annual Northwest Computing Conference, Univ. of Washington, Seattle, Wash.; contact Robert K. Smith, Northwest Computing Association, Box 836, Seahurst, Wash.

Sept. 17-18, 1964: 12th Annual Joint Engineering Management Conference, Pick-Carter Hotel, Cleveland, Ohio; contact The Institute of Electrical and Electronics Engineers, Box A, Lenox Hill Station, New York 21, N. Y.

Sept. 21-24, 1964: 1964 IFAC/IFIP Conference, International Conference on Application of Digital Computers for Process Control, Stockholm, Sweden; contact IFAC/IFIP Conference 1964, Swedish Conference Office, Box 320, Stockholm 1, Sweden

Sept. 28-29, 1964: First International Congress on Inst. in Aerospace Simul. Facilities, Paris, France; contact P. L. Clemens, VKF/AB, Arnold Air Force Sta., Tenn. 37389

Sept. 30-Oct. 2, 1964: Fall Meeting of the H-800 Users Association, Leamington Hotel, Minneapolis, Minn.; contact H. J. Juenemann, Sec'y-Treas., H-800 Users Association, Computation and Data Processing Branch, Div. of Research Services, National Institutes of Health, Bldg. 12, Room G-104, Bethesda 14, Md.

Oct. 4-9, 1964: National Symposium on Space Electronics, Dunes Hotel, Las Vegas, Nev.; contact Charles H. Doersam, Jr., Grumman Aircraft, Eng. Corp., Elec. Bldg. #5, Bethpage, N. Y.

Oct. 5-7, 1964: 10th Annual Communications Symposium (NATCOM), Utica, N. Y.; contact C. R. Glaviano, 45 Meadow Dr., Rome, N. Y.

Oct. 6-13, 1964: Symposium on Hazard and Race Phenomena in Switching Circuits, Bucharest, Roumania; contact Prof. E. J. McCluskey, Jr., EE Dept., Princeton Univ., Princeton, N. J.

Oct. 7-9, 1964: Electronic Information Handling Conference, Hotel Webster Hall, 4415 Fifth Ave., Pittsburgh, Pa. 15213; contact Knowledge Availability Systems Center, Univ. of Pittsburgh, Rm. 270, Hotel Webster Hall, Pittsburgh, Pa. 15213.

Oct. 11-14, 1964: 1964 Fall URSI IEEE Meeting, Univ. of Ill., Urbana, Ill.; contact Inst. of Electrical and Electronics Engineers, Box A, Lenox Hill Station, New York 21, N. Y.

Oct. 12-14, 1964: Systems and Procedures Association of America—Seventeenth Annual International Systems Meeting, Hotel Sheraton, Philadelphia, Pa.; contact John W. Donohue, P. O. Box 8207, Philadelphia, Pa. 19101.

Oct. 12-15, 1964: 19th Annual ISA Instrument-Automation Conference and Exhibit, Coliseum, New York, N. Y.; contact ISA Meetings Assistant, Penn Sheraton Hotel, 530 William Penn Pl., Pittsburgh 19, Pa.

Oct. 13-16, 1964: GUIDE International (Users Organization for Large Scale IBM EDP Machines) Meeting, Royal York Hotel, Toronto, Canada; contact Miss Lois E. Mecham, Sec'y, GUIDE International, c/o United Services Automobile Association, USAA Bldg., San Antonio, Tex.

Oct. 14-15, 1964: Association of Data Processing Service Organizations Fall Symposium, Statler Hotel, New York, N. Y.; contact ADAPSO, 947 Old York Rd., Abington, Pa. 19001

Oct. 15-17, 1964: Association for Computing Machinery Annual Southeastern Regional Conference, Atlanta Americana Motor Hotel, Atlanta, Ga.; contact I. E. Perlin, Georgia Inst. of Technology, 225 North Ave., Atlanta, Ga. 30332

Oct. 19-21, 1964: National Electronics Conference, McCormick Pl., Chicago, Ill.; contact National Elec. Conf., 228 No. LaSalle St., Chicago, Ill.

Oct. 19-23, 1964: 6th Annual Business Equipment Exposition (BEMA), Los Angeles Memorial Sports Arena, Los Angeles, Calif.; contact R. L. Waddell, BEMA, 235 E. 42 St., New York 17, N. Y.

Oct. 19-23, 1964: 4th International Congress on Cybernetics, Namur, Belgium; contact Secretariat of the International Association for Cybernetics, Palais des Expositions, Place A. Rijckmans, Namur, Belgium

Oct. 27-29, 1964: Fall Joint Computer Conference, Civic Center, Brooks Hall, San Francisco, Calif.; contact Mrs. P. Huggins, P. O. Box 55, Malibu, Calif.

Oct. 29-31, 1964: 1964 Electron Devices Meeting, Sheraton-Park Hotel, Washington, D. C.; contact Rolf W. Peter, Watkins-Johnson Co., 3333 Hillview Ave., Palo Alto, Calif.

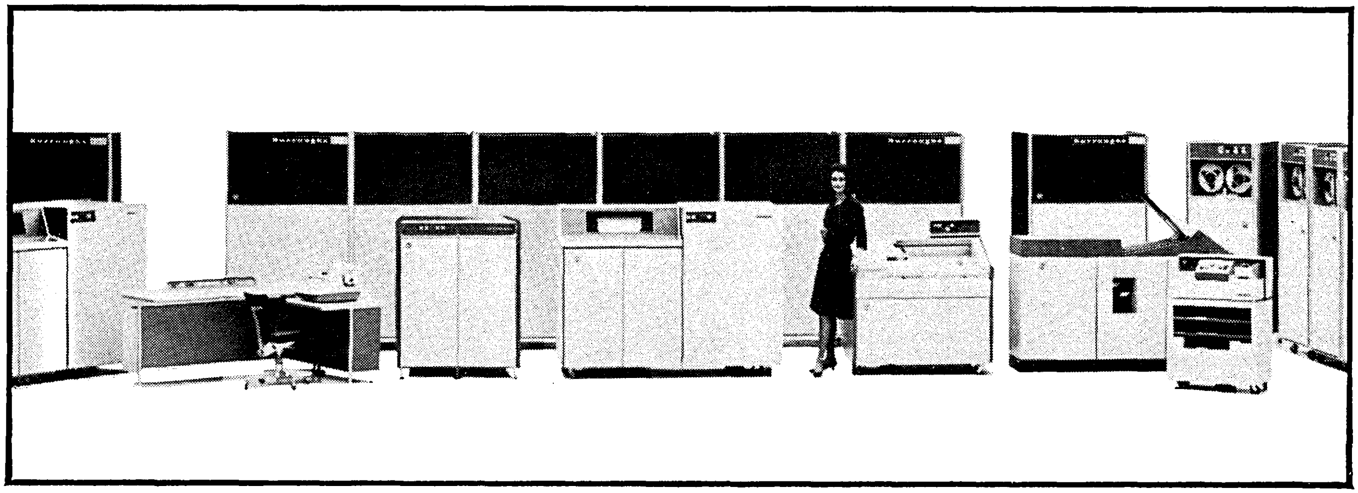
Nov. 4-6, 1964: Data Processing Management Association 1964 Fall Data Processing Conference and Business Exposition, Hilton Hotel, San Francisco, Calif.; contact Data Processing Management Association, 524 Busse Highway, Park Ridge, Ill.

Nov. 4-6, 1964: NEREM (Northeast Elec. Res. & Engineering Meeting), Commonwealth Armory and Somerset Hotel, Boston, Mass.; contact IEEE Boston Office, 313 Washington St., Newton, Mass. 02158

Nov. 9-11, 1964: Joint Western Mid-Western Region Meeting of the 1620 Users Group, Center for Continuing Education, Univ. of Oklahoma, Norman, Okla.; contact Paul Bickford, Univ. of Okla. Medical Research, 800 N.E. 13th St., Oklahoma City, Okla.

Nov. 16-19, 1964: 10th Conference on Magnetism & Magnetic Materials, Raddison Hotel, Minneapolis, Minn.; contact J. T. Elder, 3 M Co., 400 McKnight Rd., St. Paul 19, Minn.

BREAKTHROUGHPUT



the new Burroughs B 5500 Information Processing System

The B 5500 is a highly advanced data processing system that spans the medium, intermediate and large scale ranges of computer equipment. Its design concepts and software have been thoroughly proved in installations of the B 5000 and D 800 series which introduced multiprocessing of independent programs, efficient use of problem oriented languages, automatic system control and program independent modularity.

As a result, the new, more powerful B 5500 offers you these advantages:

MORE THROUGHPUT PER DOLLAR INVESTED:
The high performance of the B 5500 is made possible by its unique system organization which permits a high degree of simultaneous operation, including use of two processors to double computational performance. The Burroughs B 5500 works as a balanced system to accomplish more in the same period of time than more expensive computer systems.

REDUCED PROGRAMING COSTS:
Programing is simpler and less costly because of exclusive hardware/software features that enable the B 5500 to rapidly compile efficient programs written in COBOL, ALGOL, FORTRAN II, and FORTRAN IV.

REDUCED OPERATING COSTS:
The Master Control Program of the B 5500 is the most complete, most advanced, most tested automatic operating system ever used. The result is maximum operating efficiency, minimum human intervention.

EXTENSIVE CAPACITY FOR EXPANSION WITHOUT REPROGRAMING:
The modularity of the system is dynamic: You may expand or contract the system at any time without reprograming—or recompiling.

SUPPORT IN DEPTH FOR PROFITABLE OPERATION:
Burroughs Corporation has long provided back-up support for all products. Customers receive as normal practice:

• Systems counsel • Programing and operational training • Business and scientific application support • Experienced field engineering support

Get complete details by calling our local branch office. Or write to us at Detroit, Michigan 48232.

Burroughs—T.M.

Burroughs Corporation

Circle No. 15 on Readers Service Card

REEL LABEL

	JOB NO.	ADDRESS	DATE	INITIALS
FROM				
TO				
TO				
TO				

DESCRIPTION

MO.	DAY	YR.	HOLD / DAYS PROC.	REEL OF

FORM . . . . . .

A Style of Reel Label

PROGRAM NAME				NO.
MATERIALS INCLUDED:				
☐ DECK		☐ PROG. MANUAL		☐ MEMORY DUMP
☐ SYMBOLIC DECK		☐ OPER. MANUAL		☐ PROGRAM TAPE
☐ TEST DATA		☐ LISTING		☐ OTHER ________
REVISION RECORD				
NO.	DATE	LIBRARIAN	CHANGES MADE BY	AFFECTED SECTIONS
0				
				☐ OVER

Program Record Card

Inventory Number	Birth Date	Reel Size	Strip					
			Dates					
Date Out	Prog. No.	File No.	Program & File Name	Date In	Tape Date	Cycle	Rewrite Date	Pass Number
(Over) ☐			Inventory Number:____		TAB		Card____ Of____	

Tape Library Record Card

COMPUTER OPERATION STANDARDS

Dick H. Brandon
Brandon Applied Systems, Inc.
New York, N.Y.
and
Frederick Kirch *
International Data Corp.
Newtonville, Mass.

*Formerly of The Diebold Group Inc., New York, N. Y.

Machine operations are in many ways more difficult for management to control than programming. The machine controls its own operation for a good part of the time. Demands are placed on the operator as machine time is costly and delays caused by humans are disproportionately expensive. The operator may cost the company four dollars per hour; it is rare that the computer hour costs less than forty dollars, and more often the cost is close to four hundred dollars.

A programmer may spend days or weeks refining a program to save milliseconds in each transaction. In the same installation the operator may stop the machine to step out for a coffee break, thus negating many times over the effort of the programmer. This inefficiency, and the inefficiency which occurs during set up and take down, usually has its roots in the early training of the operator. When the machine was first installed, many of the programs were not ready for operation. The programmers spent many long hours on the console, testing programs. The manner in which these tests were operated and the inefficiencies of this critical period are usually carried forward into future operating practices. This is unavoidable if rigid discipline is not established from the beginning.

Basic rules of cleanliness, neatness and effective operation should be enforced. These rules should be written (as part of the standards manual) made available to all operators, and installed as early as possible. The following sections describe some of these rules, and indicate good operating practices and formal methods standards necessary in any installation. The functions discussed include:

- Housekeeping
- Machine Time Logging
- Control Functions
  - Scheduling
  - Data Coordination
  - Dispatching
  - Data Control
  - Report Distribution Control
  - General Machine Operation
  - Emergency Procedures
  - Supply Functions
  - Program Library Operation
  - Tape Library Operation

General Housekeeping

Much as you can tell the quality of a chef by examining his kitchen, you can tell the quality of an operating department by an examination of the machine room. The room reflects the attitude of the operators and supervisors. A neat room shows concern with appearance and sufficient interest to replace leftover paper, pick up loose cards, and clean desks and working surfaces. Operating standards should include rules to define policy in this area.

1. There should be no smoking in the machine room.
2. For safety and control there must always be at least two persons in the room when power is "on" in any unit.
3. For safety, all operators must wear tie clasps. Identification bracelets, large rings, and similar jewelry should not be worn while operating machinery.
4. Operators reporting for work under the influence of alcohol will be sent home.
5. Operating personnel under medication that tends to dull reflexes will be excused from machine operation and reassigned to other activities.
6. Program decks used for operation shall be returned to the program library immediately after using.
7. The operator is fully responsible for the operation of the machine to which he is assigned. He must, as a part of this responsibility, maintain the cleanliness and orderliness of the machine and its components.

Machine Time Recording

If equipment performance is to be accurately evaluated, careful records must be kept of the exact utilization of the machine. These records shall be maintained by the operator and recording methods should be carefully spelled out. The major objectives of careful recording of time include:

- The ability to analyze equipment utilization and measure actual equipment performance against expected performance
- The ability to evaluate individual performance of operators and of the entire operating staff
- Recording chargeable time for purposes of accounting, so that each user may be charged proportionately
- Recording chargeable time, so that the manufacturer can be paid the exact machine rental due rather than an inaccurate and costly estimate.

Methods of Recording Machine Time

A number of methods are available for recording elapsed machine time, and for charging it properly to the category of utilization and the user. These include:

- Manual recording of time assisted by a wall clock
- Manual recording of usage, with time stamped by a punching clock
- Manual recording of time assisted by an elapsed time recorder
- Machine recording of time assisted by the operator
- Addressable memory clock that records all information

Control Functions

The operating department has five basic control functions. These five functions are:

- Scheduling: assignment of job priorities, and the establishment of a daily equipment schedule
- Dispatching: insuring that the jobs are performed, in the scheduled sequence
- Data coordination: obtaining all required. input and output data and making it available to the operating group
- Data control: validation of output against predetermined checks
- Report distribution: insuring that all reports are deleaved, decollated, and burst as required, and distributed to the cognizant authority.

Scheduling

A schedule for the operation of a computer is usually established weekly, although the schedule reflects each day's processing. The schedule must account for all activities that can be anticipated: recurring production, special production on the basis of requests, testing, assembly, preventive maintenance, and training.

The first step in the establishment of a schedule is review and processing of daily requests for production and testing time. Requests are submitted on special forms.

After the total number of jobs to be run has been established, the scheduling group assigns priorities, on the basis of amount of time requested, urgency of the request, and user.

Dispatching

Dispatching is often performed by the supervisor of the operating group. It is his responsibility to see that the schedule is observed and delays properly accounted for. A routing slip is generally made out so that the operator will have the necessary instructions. The routing ticket must accompany the input and output data.

Data Coordination

Data coordination is often combined with dispatching.

The data coordinator's objective is to see that all materials required for a job are gathered in one place so that the operator can take over without delay. It is not economical to have the machine idle while the operator is out getting tapes or forms. The data coordinator must obtain the following information for every job, on the basis of documentation provided:

- Program deck
- Input cards
- Parameter cards
- Input tapes
- Blank cards for possible output
- Printer forms
- Carriage control tapes
- Program operating documentation

Data Control

The computer output is validated through the use of control totals. This function is an integral part of the responsibility of the operating group. The output must be verified to detect machine failures and omissions of operation, data, or other vital functions. For instance, controls are maintained on money fields. On non-money fields hash totals or check sums are carried and verified to a predetermined value.

Report Distribution Control

The trend toward exception reporting will reduce the volume of information required but will correspondingly increase the importance of accurate distribution and control of data.

Normal Console Procedures

The Manual of Standards should contain a section describing basic rules of normal console operation and responsibilities of the operator at each step. A number of rules are suggested below.

Use of Documentation

1. The operator shall at all times follow the directions in the operator's manual prepared for each job. If a direction contradicts the rules or good operating practice, or is inefficient or not well thought out, the operator should bring it to the attention of his supervisor so that it can be corrected. Any operator action performed independent of the operator's manual will be considered a severe violation of responsibility.
2. If the program reaches a programmed halt, the operator must look in the appropriate section of the operator's manual.

Program Set-Up

3. The operator shall perform all set up in the exact sequence prescribed by the operator's manual.
4. Tape set-up. The operator shall mount the required input tapes on the designated drives and free tapes on the drives designated for output.
5. Tape cases shall remain with the reels with which they came. The reel removed from the drive shall be replaced in its own case. Cases must remain with the reel so that damage can be traced.
6. All tapes when replaced in the case shall contain a "grommet" or other device to prevent the tape from unwinding.
7. Immediately upon removing output tapes, the file protect ring shall be removed.
8. When using a custom form, or a stock-imprint form, the operator shall use the programmed line-up routine to insure that printer-to-form alignment is within 1/32" of perfect registration. Reports produced outside this registration tolerance will be rejected, and must be rerun. The required carriage tape must be checked before it is mounted.
9. The operator shall place all designated card files, in the appropriate sequence, in the card reader; the operator shall insure that all parameter cards are correct, that a date card is included if required, and that the entire card file is free from imperfections, which may cause a card jam.
10. The operator shall insure that a sufficient supply of unpunched cards are in the card punch. This supply must conform to the proper card design specified.
11. The console must be set up in exact accordance with the instructions provided in the operator's manual.
12. If an engineering console is provided, or a separate set of switches are available which can change the mode of operation, the operator is responsible for insuring that these have been set properly.

Normal Operation

13. During normal operation the operator must watch the processing for malfunctions or unusual machine actions. The operator must replenish the supply of input and output cards without stopping the machine, if possible, and remove and replace cards the machine has read or punched.
14. The operator under no condition has the authority to alter memory of an operating program. The operator may not alter any program, program deck, or program tape without the explicit approval of both the operating and the programming manager. Under no condition should an operator run any program other than one authorized for operation on the current schedule.
15. If a machine failure, data error, program error or operator error occurs, the operator should follow the instructions outlined under emergency procedures. Under no condition is the operator allowed to rerun without authorization or to use any self-constructed or utility program in an attempt to correct the file.

Take Down Procedures

16. The operator shall remove all tapes after the program has completed its processing.
17. File protect rings shall be removed from tapes immediately upon their removal.
18. Upon the removal of a completed reel of output, the operator shall immediately affix an external label which identifies reel number, reel sequence, date, tape drive (for error tracing) and the operator's initials.
19. Cards shall be removed from the stackers and hoppers and replaced in the appropriate location. Inputs and outputs of the job must be returned to the data coordinator for subsequent processing or distribution. The program and its documentation is returned at the same time.
20. Time recording shall be done as specified.

Exception and Emergency Console Procedures

A specific section of the Standards Manual should be devoted to exception and emergency procedures. Exception procedures refer to occurrence of an unexpected machine-caused condition such as program error, machine failure, operator, error, or data error. Emergency procedures refer to the steps to be followed in case of a physical emergency: flooding, fire, or electric shock.

Exception Procedures

1. If a programmed halt occurs, the operator shall immediately note the halt number and the status of files, cards, tapes and the like. The operator shall then look up the halt by number, to determine the cause

and action to be taken. In the event the halt is "endless"—without corrective possibility, the operator shall notify the supervisor of the occurrence immediately, and proceed to the next program.

2. If a machine error occurs, and the machine stops, the operator shall immediately record the occurrence on the log. He must then notify his supervisor and the maintenance engineer. By reviewing the documentation he determines if the program contains a "restart" procedure. If so he must follow the restart instructions shown. If no restart procedure is available, the operator should start the run over from the beginning. A second occurrence shall be cause for terminating the run, and for turning the machine over to the maintenance engineer for unscheduled maintenance.
3. Whenever an exception condition occurs, the operator is responsible for noting all existing conditions on a "console condition" form. The same form of a program error, a data validity error, or an operator console error.
4. In the event of a program error, the operator shall notify his supervisor and the programmer responsible for the program.
5. In the event of a data error the operator shall notify his supervisor.
6. In the event of an operator error, the operator shall notify his supervisor; if the error has destroyed pertinent information, the supervisor shall also notify the programmer responsible, to assist in recapturing the required information.

Emergency Procedures

7. In the event of fire in the computer room, the operator must immediately turn the master power switch off. If time permits, the operator should remove all tape files, and store these and the current program deck and documentation in the fireproof tape vault or other designated storage.
8. In the event of a malfunction in the electrical system, the operator should immediately turn the master power switch off and notify the maintenance engineers and his supervisor of his action.
9. If an operator comes into contact with an exposed electrical lead and is subjected to electrical shock, the other operator should immediately turn off power on the unit or the entire system, whichever is faster. He should then remove the stricken operator from the immediate contact area and administer first aid.
10. Files which should be protected at all costs shall have a "red" external label. These files, including master program tapes and the like, shall always be stored in the fireproof/waterproof section of the tape library. If an emergency occurs with a "red" label file on the system, the operator shall attempt to return this file to the vault.

Supply Functions

A minor but important function of the operating staff is maintenance of the inventory of forms, cards, tapes and other materials required for the computer. It is uneconomical to run out of forms before a reorder is given. Rush orders are more expensive, and operation without a specific form can be a problem. However, the cost of an oversupply of forms can run into thousands of dollars and a reduction of excess supply results in an increased cash flow. Also, form redesign and change is very common in the data processing function and it rarely pays to order five years supply of a 10-part form. Redesign is often not attempted only because present inventory is too large, which often prevents the use of cheaper or better supplies.

Punched card inventories incur similar problems and the cost of oversupply also includes a significant space charge. Some companies use 100,000 cards per day; the storage space necessary to keep a month's supply on hand is excessive. Luckily, the cost of running out of a specific form is not as high; either a blank or other card format can be used or blank cards can be overprinted with a reproducing master.

Program Library

The librarian generally has two functions: the maintenance of the program library and the tape library. As a program librarian the main functions which he must perform are:

- Program record maintenance
- Release of programs to operators
- Maintenance of program revisions

Simple rules for this task are:

1. Upon receipt of a new program, the librarian must complete a program record card. The librarian should know that all information is present and has the correct revision number.
2. If a program is operational, the librarian shall release it to operations upon request of the data coordinator. The only material, however, which can be released is the operator's manual, and the program deck.
3. The librarian may release any or all documentation to the responsible maintenance programmer. This information will be recorded on the daily program sign-out sheet.
4. Upon being notified that a program is to be changed, the librarian shall place a stop order on the program. All requests for the program will have to be approved by the responsible programmer before the program will be released to operations.
5. After a program change has been made, the librarian shall review the materials, to insure that the change has been properly made to all elements of the program. If the change is proper, the librarian shall record the revision number and other appropriate information on the program record card. The preceding revision will now be destroyed by the librarian.
6. In the event of fire, or other occurrences which may damage the program library, the librarian shall transport all materials to the fireproof vault provided for such an emergency.
7. The program library shall be maintained in strict sequence, by application, frequency and program number.
8. When a program has been obsoleted or replaced by another system, the responsible maintenance programmer should notify the librarian, indicating that the program and all accompanying materials are to be destroyed.
9. If a specific program has not been used for over two years, and no indication of obsolescence is provided, the librarian may request that the responsible programmer indicate what disposition is to be made of the materials in the library.
10. At the request of the maintenance engineer, the librarian will accept responsibility for the storage and safety of diagnostic programs. These programs may be released only to an authorized maintenance engineer.

Tape Library

The duties of tape librarian are similar in respect to the maintenance of records and the release of information to the operating department. Specifically, the tape librarian must keep records on the history of each tape and information about the files and their retention cycles. He must protect the files and issue them only to authorized personnel at the proper time. The librarian shall maintain the records in accordance with the following rules:

1. All tapes must carry a pressure-sensitive external label to identify their contents.
2. The librarian will prepare a tape record card for each tape as it is added to the tape library. The tape record card shall show:
   —A history of the "stripping" of lengths of tape from the front of the reel to reduce the occurrence of errors
   —A sign-out record to indicate what information is currently available on the tape
   —The assigned tape inventory number
3. The tape record card shall be kept in tape inventory sequence; this sequence shall be assigned by the librarian.
4. As the tape retention cycle expires, the tape becomes available for use. At this time the librarian shall remove the external label. The tape record card shall be tagged to indicate that the reel is available for future use.
5. If a reel is to be saved for a special purpose or retained indefinitely, the requester shall fill out a "tape file save" request. This request is attached to the tape file record card and a tab attached to the card to signal unavailability.
6. If the tape develops errors in the first 100 feet (this is the most likely place to experience excessive wear, because of magnetic labeling procedures which double the wear at the front), the librarian shall strip a length of tape when the tape again becomes available for use. To indicate that the tape is to be stripped the librarian will attach a tab to the card. When the librarian strips the tape he must also replace the beginning marker. He then subtracts the amount stripped from the current length and enters the new length on the card.
7. Tapes saved by specific programmers or maintenance engineers are to be kept in a separate part of the tape library.
8. The librarian is responsible for an approximation of the number of passes to which each tape reel has been exposed. This may be done by having a magnetic trailer or label record on which a pass counter is recorded, or the librarian can update the tape record card as the tape is signed out and returned. After the pass count exceeds a certain predetermined figure (somewhere between 1000 and 2000 for mylar tapes), the tape, shall be sent to the manufacturer for reconditioning.
9. Tapes should not be released or taken to any area except the computer room.
10. There shall be no smoking in the tape library. Dust shall be kept to an absolute minimum.
11. In the event of fire or other emergency, the librarian shall lock all fireproof sections of the library and all materials shall be returned, if possible, to the proper section of the library.

Summary

Methods standards for the operating department are as important as the standards established for systems analysis and programming. Rules and procedures should cover all phases of operations, from computer setup to forms control and supplies.

Detailed standards should also be established for the operation of the program library and the tape library; these are vital functions which insure that operation continues properly, using the proper programs and the proper data files.

"ACROSS THE EDITOR'S DESK"

Computing and Data Processing Newsletter

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NEW APPLICATIONS

COMPUTER KEEPS TRACK OF MINOR TRAFFIC VIOLATORS

The Massachusetts Registry of Motor Vehicles has begun keeping track of minor traffic violators with their GE-225 computer system. The new computer operation will allow the state to mail out a greatly increased number of warnings to minor violators. Licenses will be revoked if motorists incur a third violation within a calendar year.

James R. Lawton, registrar of motor vehicles, points out that this warning system (which was something less than effective when done manually) is another means of reducing the number of deaths and injuries due to highway and street accidents within the Commonwealth of Massachusetts. To accomplish an effective warning system manually would have entailed quadrupling the staff.

Under the new system, which began operation July 1, a master file of mangetic tape is made of each violator. The name and address of each is printed out by the computer so that a prepared warning notice can be mailed. The list will be updated and warnings sent out weekly.

Although the General Electric 225 system has been in use at the registry for only a year (see Computers and Automation, July 1963, p. 32), it has already done exceptional service for non-enforcement applications — most notable among these being vehicle excise tax billing. (In 1963 excise taxes on autos produced $100 million, compared to $90.6 million in 1962.) Louis Pleau, system analysts, said that the computer would print out all excise bills in four months. The first bills, of this year, went out in March, a new record for speed in the history of the state's tax system.

During its first year of operation, the department has saved an estimated $12 million. Officials said that the new system produces savings in several ways:

1. Some $1.5 million is saved in outright costs of producing bills. Manually prepared bills used to cost 75 cents apiece to produce; they now cost 15 cents.

2. Some $3 million is saved because cities and towns get the benefit of 75% of the revenue in the first months of the year and thus do not need short term loans to meet obligations before tax money comes in.

3. About $1 million additional revenue is realized because bills go out early enough to catch residents who used to move out of state before bills could be prepared for them.

4. Some $5 million is added to income because billing is more thorough and more accurate.

Another fringe benefit of the new system already has been in the production of new vehicle lists on easily accessible magnetic tape. The registry computer system will print out an alphabetical list of autos as well as a list by license numbers and one by vehicle identification numbers. All three lists are updated once a year to provide more accurate source material for administrative and law enforcement officials of the Commonwealth.

Plans for future use of the system include a master list of accident locations. Mr. Lawton believes that such master lists, with easy availability of information, will be an immense aid to law enforcement agencies — local, state and federal.

STATE REDISTRICTING IN 30 MINUTES BY COMPUTER

A new system for redistricting a state in a matter of minutes has been developed by Electronic Business Services Corp., a subsidiary of Computer Applications Inc., New York, N.Y. The new EBS method was used to plot a new district alignment for New Jersey, one of six states ordered by a recent U.S. Supreme Court decision to redraw their district lines so that the population of each is equal regardless of geographical area.

In the EBS system, the geographical distribution of a state's population, based on latest decennial census figures, is first recorded on magnetic tape. The computer then scans and counts these population units as related to geographical coordinates. By using an analytical procedure called "diminishing halves", it systematically divides the state into the desired number of regularly-shaped districts having equal population. The resulting district arrangement meets the court's requirements that all districts have equal population, be contiguous and devoid of "gerrymandering".

Finally, a computer recording device called the SC-4020 (developed and built by General Dynamics Corp.) automatically converts this computer data to a visual pattern superimposed on a map of the state involved. The product is a complete district map, plus all the supporting data in statistical form. Such maps can be turned out both on paper and on microfilm with incredible speed. Conversion of the statistical data to map form in the New Jersey case required less than a minute.

Now that the computer program for this problem has been developed, the computer analysis for any state redistricting would require only about 30 minutes. (Previously, it had been estimated that redistricting of a state would take a staff of 20 at least four months.)

The same equipment and technology can create graphs, charts, maps and tables applicable to other political, industrial and commercial problems where geographical distribution of population, product sales, or other variables are to be analyzed and presented in graphic form.
(For more information, circle 31 on the Readers Service Card.)

COMPUTER TO HELP REFUEL JETS

At Kennedy International Airport, New York, N.Y., a General Electric-412 process computer will automate the control of the flow of jet aircraft fuel from huge bulk storage tanks through an underground network of piping to secondary holding tanks which each airline will tap to fuel its planes. The computer application is the first of its kind in this field.

The conventional tank truck delivery method is becoming outmoded by the tremendous increase in aircraft fuel consumption brought on by the greater number of jets and larger commercial planes in service. Giant airliners stopping at the airport consume about 1,000,000 gallons of fuel per day.

As part of the new system, a 50-mile underground network of transfer pipes, suction lines and ramp hydrants is being installed to speed up fuel distribution at the passenger terminals. It will eliminate most of the tank trucks needed for fuel handling and reduce vehicular traffic on the aircraft ramps.

To replace the present refueling methods a 40-tank secondary fuel storage area is being built from which airlines will tap their fuel supplies. This will be located nearer the passenger terminals, some two miles away from the bulk tanks. The 40 bulk tanks contain over 17,320,000 gallons of fuel. Future plans call for expanding the number to 70.

The task of the GE-412 process computer will be to scan the secondary tanks and electronically transmit supply and demand orders to the bulk area to keep the secondary tanks from running low. The data received at the bulk area will be electronically monitored and supply lines will automatically open, allowing the proper grade of fuel to flow between the two areas.

NEW CONTRACTS

NASA CONTRACT FOR $1.5 MILLION AWARDED SDS

A NASA contract for approximately $1.5 million has been awarded to Scientific Data Systems, Inc., Santa Monica, Calif. The contract is for twelve SDS Model DEE-3 Digital Events Evaluators. They will be used in performing automatic systems checkouts on Saturn booster rocket stages at the Marshall Space Flight Center, Huntsville, Ala.

LENKURT ELECTRIC RECEIVES NAVY CONTRACT

Lenkurt Electric Co., Inc., (a subsidiary of General Telephone & Electronics Corp.) San Carlos, Calif., has received a U.S. Navy contract for a new high-frequency data system which transmits digital signals at 2400 "bits" of information per second. The contract was awarded for Lenkurt's 27A Duobinary-Datatel® system and other data equipment. The Fleet Numerical Weather Facility in Monterey, Calif., will use the equipment in the Pacific to speed the collection and dissemination of weather information in its computer-automated forecasting system.

LFE RECEIVES R & D CONTRACTS FOR MAGNETIC DEVICES

LFE Electronics, a division of Laboratory for Electronics, Inc., Boston, Mass., has received contracts totaling $154,000 for research and development projects using magnetic sheet and thin films.

A $49,999 study for Rome Air Development Center has as its objective the evaluation of existing LFE computer memory techniques with respect to building a solid state medium speed random access mass memory.

Under the terms of a $50,594 contract from the Bureau of Ships, LFE will build a feasibility model of a large wall-size electro-optical matrix display using thin magnetic films as electrically controlled light valves. The device can be used to display graphic and alphanumeric information commonly available as outputs from computers and associated memories.

A third contract is for continuing research into the creation and controlled motion of domain walls in ferromagnetic thin films, including the application of wall motion effects to logic devices. It is for $53,498 and is from the U.S. Air Force Cambridge Research Laboratories.

The contracts will be performed by LFE's Solid State Electronics Laboratory in Boston, under the direction of Dr. Harrison W. Fuller.

CUC RECEIVES CONTRACT FROM MANHATTAN LIFE

To expedite the conversion to its new General Electric 225 computer, The Manhattan Life Insurance Company, New York, N.Y., has contracted with Computer Usage Company, Inc., programming specialists, to assist the Home Office Planning Department in setting up a master file for all existing policies. The conversion requires about sixty programs, two thirds of which are being handled under the CUC cotract.

The master policy file on tape will integrate data from various punched card and tape files. These data include premiums, options, outstanding loans and other items.

JET PROPULSION LABORATORY AWARDS SECOND CONTRACT TO CSC

Computer Sciences Corporation, Los Angeles, Calif., has received a new contract for computer programming services in excess of $250,000 from the California Institute of Technology's Jet Propulsion Laboratory.

The contract is the second to be received from JPL within two months. Both contracts provide for a continuing CSC effort on JPL's new Space Flight Operations Vacility (SFOF) which will be used to control National Aeronautics and Space Administration unmanned lunar and interplanetary space probes. Modifications to the SFOF system to be accomplished by CSC during the coming year will support future Mariner and Surveyor spacecraft launchings.

NEW INSTALLATIONS

I.I.I. ORDERS DDP-24 FOR NUCLEAR EVENT FILM READING

Information International, Inc., Cambridge, Mass., has ordered a DDP-24 general purpose digital computer from Computer Control Company, Inc., Framingham, Mass., for use in a fully automatic electro-optical film reading system. This is the first application of a DDP-24 to such a system. It will be used to control and monitor the film reading process. These systems manufactured by I.I.I. are used for the rapid reduction of large quantities of photographic data.

The film reading system will be installed at Edgerton, Germeshausen and Grier, Inc., Las Vegas, Nev., where it will be used to rapidly read and analyze nuclear burst data recorded on film.

NATIONAL LIBRARY OF MEDICINE INSTALLS COMPUTER-DRIVEN PHOTOTYPESETTER

The National Library of Medicine, Public Health Service, U.S. Department of Health, Education, and Welfare, Bethesda 14, Md., has announced the installation of a computer-driven phototypesetter as part of the Medical Literature Analysis and Retrieval Systems (MEDLARS). Called Graphic Arts Composing Equipment (GRACE), the computer-driven printer operates at the rate of 300 characters, or approximately 60 five-letter words, per second. GRACE was developed for NLM by the Photon Corp., Wilmington, Mass., under subcontract to the General Electric Corp. (which was the MEDLARS contractor) and bears the manufacturer's name of Photon 900 (see New Products).

GRACE is used by MEDLARS to print Index Medicus, NLM's monthly listing of the world's medical literature, and recurring bibliographies in special biomedical fields.

CONTROL DATA 3600 AIR SHIPPED TO NORWAY

Control Data Corp., Minneapolis, Minn., has announced the shipment of a large-scale CONTROL DATA 3600 computer system to the Institutt for Atomenergi and the Norwegian Defence Research Establishment, both located at Kjeller, Norway. The equipment was airfreighted from New York City.

The system will be used by physicists, chemists and engineers for specialized atomic energy research and nuclear experiments in the Institutt for Atomenergi, and for a very wide range of applications including ionospheric and other geophysical research at the Defence Research Establishment.

MUNICIPAL RETIREMENT FUND INSTALLS IBM 1440

As part of a major modernization program, the Illinois Municipal Retirement Fund (Chicago) has installed an IBM 1440 computer at its headquarters in the Hartford Building. The earnings and retirement records of 85,000 public employees who work for local governments in Illinois are now being maintained on the computer. IMRF is one of the large retirement systems created under state law for the public employees in Illinois. It provides retirement pensions and other benefits to public employees in over 2000 municipalities.

U.S. NAVY ORDERS L-2010 COMPUTER

The U.S. Navy Mine Defense Laboratories, Panama City, Fla., has ordered an L-2010 ruggedized computer from the Librascope Group of General Precision, Inc., Glendale, Calif. The Navy will use the 65-pound computer to solve complicated problems associated with navigation of minesweeper vessels.

N.Y. TAX DEPARTMENT INSTALLS UNIVAC III

The New York State Department of Taxation and Finance is installing a Univac III in Albany this month. The system will be used to audit taxes deducted from employee's salaries, audit estimated tax returns of self-employed persons and process all state income tax returns. The Univac III will not only check taxpayers' arithmetic, but it will also select for an individual audit by human experts any return that seems irregular.

ORGANIZATION NEWS

RCA EDP CENTER SOLD TO CHICAGO BANK

Central National Bank, Chicago, Ill., purchased the Radio Corporation of America's midwest electronic data processing Center, effective September 1. Frank E. Bauder, president of the Chicago bank, and Arnold K. Weber, vice president and general manager of RCA Electronic Data Processing, Cherry Hill, N.J., made the announcement in a joint statement.

Although the sale price was not disclosed, the original value of the equipment in the Chicago Center exceeds $1 million. Present data processing equipment at the Center is built around a large 501 data processing system and a 301 computer which is used as a peripheral device. This equipment is capable of reading and sorting up to 1500 checks and printing 100 customer statements a minute.

With the new acquisition, the Central National Bank will substantially increase its capacity to handle its own data processing requirements and will be able to offer full computerized services to its correspondent banks and commercial customers in the area. Additional banking services are planned for the future. The bank expects to continue servicing present customers of the Center through both existing and expanded programs.

GE, MACHINES BULL ANNOUNCE AGREEMENT

General Electric Company and Compagnie des Machines Bull have announced the completion of a financial, technical, and commercial agreement in the data processing field. Under the agreement, General Electric will make a substantial investment in three new companies which will take over the activities of the Compagnie des Machines Bull. These new companies will permit Bull and General Electric to meet more effectively the requirements of European as well as the world-wide data processing market.

Shares in the three companies will be held by Compagnie des Machines Bull, acting as a holding company, and by General Electric Company. General Electric Company's subscription to the capital stock of these companies will be approximately $43 million. GE also will participate in the financing of the continuing expansion of these companies.

Companies established by the agreement are:

Societe Industrielle Bull General Electric, (SIBGE), which will manufacture data processing equipment, and conduct research and development activities in the computer field — participation: Bull, 51%; General Electric, 49%.

Compagnie Bull General Electric, (BGE), which will act as a marketing organization — participation: Bull, 49%, General Electric, 51%.

Societe de Promotion Commerciale Bull, (PCB), which will engage in market research and market development activities in France — participation: Bull, 51%; General Electric, 49%.

It is anticipated that within the framework of an entirely French-owned and separate company, Compagnie des Machines Bull may carry on defense activities of a classified nature. Bull's contribution of the first three companies will exclude $7 million to be used mainly for participation in the establishment of the defense company.

CANADIAN SUBSIDIARY FORMED BY ITEK

Itek Corp., Lexington, Mass., has announced the formation of a Canadian subsidiary, Itek Business Products, Ltd., in Toronto. The wholly owned subsidiary will be an operating unit of Itek Business Products, a division of Itek Corp. It will provide full sales and service facilities for Itek's products in the offset printing, microfilm, and photocopy fields.

Additional sales offices will also be established in other major Canadian cities. The subsidiary may also undertake a manufacturing effort at some time in the future. Itek Corporation concentrates on three major areas of operations; optical systems and reconnaissance; advanced information processing; and reproduction equipment and supplies.

NEW PRODUCTS

Digital

UNIVAC 1108 ANNOUNCED

Univac Division of Sperry Rand Corp., New York, N.Y., has announced the Univac 1108 data processing system, a new general purpose computer, more than five times faster than its predecessor, the Univac 1107 thin-film memory computer.

The control memory of the new computer is composed of integrated circuits. (An integrated circuit is a tiny piece of specially-modified silicon crystal that completely duplicates all the functions performed by a conventional electronic circuit using many diodes, transistors, resistors and capacitors.) Cycle time is 125 nanoseconds.

The internal memory of the Univac 1108 is divided into two separately-accessed banks which can be specified in modules of 32,768, 65,536, or 131,072 words. This dual access feature provides a cycle time of 375 nanoseconds. Add time is 750 nanoseconds.

Load memory lockout, a feature of the 1107, has been augmented in the Univac 1108 to permit lockout selection in gradations of 1024 words.

Both fixed and floating point operations are included in the 1108's fifteen double-precision operations. Double-precision fixed point arithmetic operations are addition and subtraction in a full 72-bit form. Double precision floating point arithmetic operations are: addition, subtraction, multiplication, and division with each operation using full 72-bit 1108 words.

An unusually large library of computer programs, ready for immediate use, will be delivered with the first production models of the Univac 1108. All programs that were previously developed for the Univac 1107 can be run on the 1108 without modification and without the use of translation or interpretation routines. In addition to these, twenty-six new instructions have been added to the software complement of the 1108.
(For more information, circle 32 on the Readers Service Card.)

Data Transmitters and A/D Converters

AUTOMATIC CALL DISTRIBUTORS

Bell Telephone companies are now offering automatic call distributing systems (formerly provided only on a custom basis) in two flexible models. These systems automatically distribute incoming calls to available telephone attendants. If all attendants are busy, calls are acknowledged by a recorded message and "stored" until an attendant is free. "Stored" calls are then released in the approximate order in which they were received.

Model ACD-60 has a capacity for 10 to 56 incoming telephone trunk lines and accomodates from 10 to 60 attendants; model ACD 200-A handles from 56 to 198 trunks, 60 to 200 attendants. With either model ACD system, a company can establish one central or several regional locations for answering calls from anywhere in the country.
(For more information, circle 33 on the Readers Service Card.)

DATAGUARD

A portable crytographic device that scrambles and decodes recorded messages electronically is available to business and industry as a security measure in message handling. The equipment has been introduced by Data Communications, Inc., Morrestown, N.J. Company officials foresee use of the device, called

DataGuard, in transmitting prices, and sales and credit information which require security handling.

DataGuard takes a message directly from a teletypewriter and scrambles it in random patterns. By using a random code, the device scrambles a word in a differnt way each time it is repeated in a message. Messages may be sent over wires or undersea cables and can be unscrambled only by a DataGuard receiving unit.

The equipment does not have to be kept in a locked room. The coder and decoder are operated by the use of a code-block — about 1/3 the size of a pack of cigarettes — which can be carried on the person of the man cleared for security information. DataGuard is small enough so that it can be carried by an executive on business trips and readily connected with telegraphic equipment.

The equipment will be leased, rather than sold.
(For more information, circle 34 on the Readers Service Card.)

Software

MAIL

General Electric's Information Processing Business (IPB), Phoenix, Ariz., is using a computer to untangle the problem of making selective mailings to customer and prospective lists and membership rosters. A new program, called MAIL, has been introduced at its seven computer processing centers around the country. The program is designed to give users a depth of selectivity not attainable through present mechanical means.

MAIL prints labels, envelopes and cards at the rate of up to 1200 per minute and produces selected listings as desired. The computer used for handling the new mailing is the GE-225.

Dr. H. M. Sassenfeld, general manager of IPB, describes MAIL as essentially an information storage and retrieval system. He said its computer file can be loaded with up to 10 million names and addresses. Each name carried on the list can be coded or cross-indexed in up to 24 categories, including such information as salary level, age, number and sex of children, type of automobile, and educational level. The computer then can automatically produce sub-lists based on any one of or combinations of the 24 different categories.

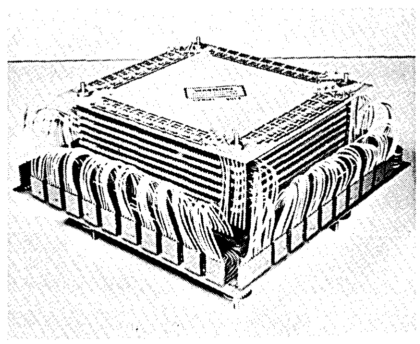
Dr. Sassenfeld also pointed out that the new system, besides being more selective, costs less to use. Once in operation, MAIL costs about one-half cent for each printed address. Name and address changes or deletions are made for less than one cent, compared to around eight cents by mechanical means.
(For more information, circle 35 on the Readers Service Card.)

Memories

BURROUGHS MEMORY DEVICES

Burroughs Corp., Electronic Components Div., Plainfield, N.J., has announced a complete line of memory devices, including ferrite cores and core stacks.

The new core (Type FC 2001), with fast switching speeds (approximately .30 microseconds) at moderate drive currents, is designed for use in memories having cycle times of 2½ microseconds at a nominal drive current of 650 milliamperes.



Core planes and core stacks, in either linear select or coincident current configurations, are available for operation at speeds of 2 microseconds, 5 microseconds and 7 microseconds, with capacity of 64 to 4096 words/2 to 64 binary bits. Planes and stacks can be furnished with either 80, 50, 30 or 20 mil cores — operating characteristics or size can be tailored to meet the specific application. Switching times for cores range from 3 to 4 microseconds.
(For more information, circle 37 on the Readers Service Card.)

GENERAL PURPOSE CORE MEMORY

Computer Control Company, Inc., Framingham, Mass., has introduced a new family of front-access TCM-35 coincident current core memories which offer 1.4 to 2 usec. full cycle times, 1.2 usec. maximum half cycle time, and 750 nsec. maximum access time. Data capacity ranges up to 8192 words; word lengths range up to 36 bits.

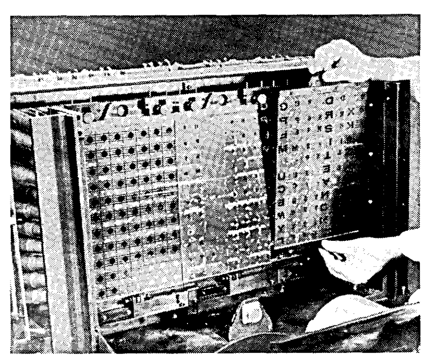
The all silicon circuitry permits operating temperatures from 0°C to 50°C with broad margins. The system, which includes a self-contained power supply, is from 24¼ inches to 35 inches high, depending upon storage capacity and options.
(For more information, circle 36 on the Readers Service Card.)

Input-Output

PHOTON ZIP-MODEL 900 COMPUTER PHOTOTYPESETTER

Photon, Inc., Wilmington, Mass., has developed a typesetting device which will produce on film or paper, text matter of typographical quality from the output tape of a computer or other electronic data processing system. The Photon Zip-Model 900 has a composition rate for 8-inch lines of approximately 150 lines per minute. The lines of composition are fully justified.

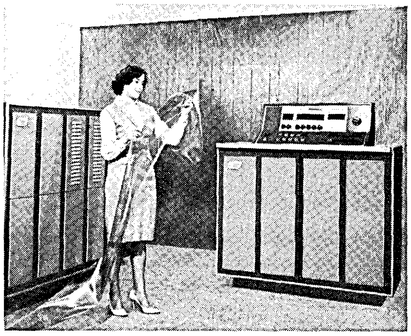
A choice of up to 264 different characters is available during continuous operation, and any combination of these characters can be mixed in the same line. Matrices are easily changed to provide additional characters.



— Matrix plates are easily changeable.

The Photon 900 system is divided into three units: Photo Unit, Control Unit and Tape Handler. The

Photo Unit contains all optical and mechanical parts for photographing, and the electronic assemblies required to control the photography. The Control Unit houses the control panel, the tape



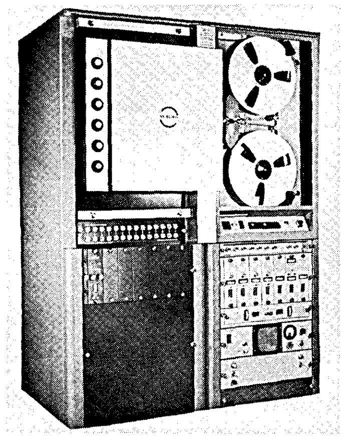
format translator, memory, arithmetic section, logic control section and confidence check section. The Tape Handler can be any type of standard magnetic tape unit that is commercially available for off-line operation.

Applications for the printout capabilities of the Photon 900 are in the output of computer which serve as storage and sorting mediums for the organization of directories, dictionaries, and other listings which must be reproduced periodically in revised or updated form. Other applications lie in the newpaper, magazine, book and general printing field. (For more information, circle 38 on the Readers Service Card.)

VI/SCAN, DATA PROCESSOR/RECORDING DEVICES

S. Himmelstein and Co., Chicago, Ill., has announced the availability of a new family of magnetic tape data processor/recording devices. These devices, called VI/SCAN, have capabilities for recording and real-time processing of scientific and engineering data. VI/SCAN systems, which include multi-channel scanning mechanisms in the tape path, have versatility for such applications as auto and cross correlation analysis, wide-range linear frequency multiplication or division and analog tapped delay line synthesis. VI/SCAN's will permit time division multiplexing without loss of data due to discrete sampling and also can be used for speech expansion and contraction without pitch changes.

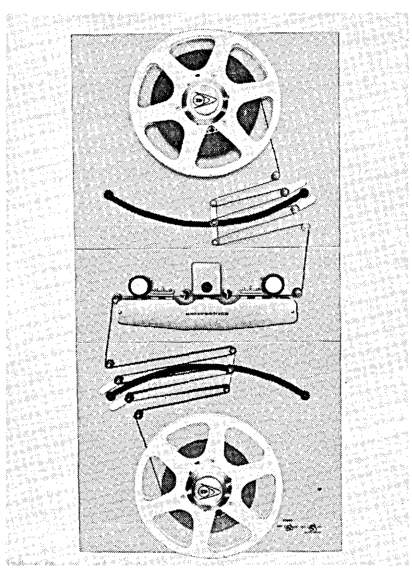
VI/SCAN I, the first standard unit with these characteristics, is designed for maximum flexibility



in processing IRIG format analog tapes. Handling either 1/2" or 1" tapes, it has six interchangeable, bidirectional scanning wheels operable at nine different scanning rates either with tape stopped, or in linear motion at any one of six different speeds. More than 700 combinations of processing parameters are provided with a maximum output bandwidth exceeding 3 megacycles and scanning velocities up to 1920 inches per second. A controlled air film which supports the tape over the scanning head virtually eliminates head and tape wear. (For more information, circle 39 on the Readers Service Card.)

1000 CPS TAPE HANDLER

Digitronics Corp., Albertson, N.Y., has announced the Model 6090, an ultra high-speed bidirectional tape handler designed to function with Digitronics Model B3000 Series Reader.



Model 6090 is capable of speeds up to 1000 characters per second with 10½-inch NAB reels. It will handle 5 through 8 level paper tape, paper mylar laminated tape or mylar tape, interchangeably. The new device is selling for less than $1600. (For more information, circle 40 on the Readers Service Card.)

Components

D1250 MAGNETIC TAPE DEGAUSSER

A new bulk degaussing system for magnetic tape has been announced by Magnusonics Industries, Inc., Farmingdale, Long Island, N.Y. The new degausser is designed for service in computer operations, tape libraries, and multi-tape instrumentation equipment. Discs may also be degaussed.

Automatic, uniform degaussing of a tape reel takes place when the reel is slowly rotated in the traveling magnetic field of the D1250 tape degaussing system. The magnetic field passes across the rotating reel four times to provide complete erasure. The degaussing cycle is automatically terminated and the degaussed reel may be left in place without impairing its neutral, erased, condition.

Complete erasure, to the gaussian noise level, can be effected on tape reels up to 14" in diameter on all tape widths up to 2". Erasure time is approximately 130 seconds.

No manual handling, adjustment or operator training is required. The Tape Degausser produces a field of 1450 gausses and draws only 5 to 7 amperes, when operated from a 117 volt, 50-60 cps, single phase source. Units for 220 volt operation are available. (For more information, circle 41 on the Readers Service Card.)

PEOPLE OF NOTE

WATTS JOINS SYLVANIA

Raymond N. Watts, Jr. has been appointed supervisor of technical publications at the Applied Research Laboratory of Sylvania Electronic Systems, a division of Sylvania Electric Products Inc. Sylvania is a subsidiary of General Telephone & Electronics Corp.

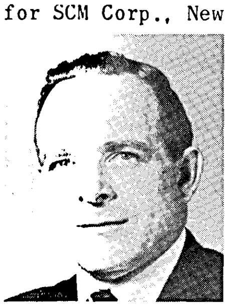
In his new position, Mr. Watts is responsible for the preparation of all technical documents in connection with the advanced technology function of the division. He succeeded Donald F. Corlett who resigned.

DR. ANDREW GABOR ELECTED VP OF POTTER INSTRUMENT

Dr. Andrew Gabor, Director of Research and Advanced Development of Potter Instrument Co., Inc., Plainview, N.Y., has been elected a Vice President by the firm's board of directors. Dr. Gabor is the inventor of numerous features integrated in the firm's line of digital magnetic tape transports and high-speed printers used as peripheral equipment for computers. He is recognized by the EDP industry as an authority on the application of high density recording techniques.

TWO NEW DIRECTORS AT SCM

Mr. Rhine Meyering, Jr. has been appointed Director-Data Processing, International Operations for SCM Corp., New York, N.Y. In this position, Mr. Meyering will be responsible for the global development of SCM's sales activities outside of the United States in the field of Automated Data Computing Systems.



Clarence R. Rydberg, (formerly with Friden, Inc.) has joined SCM Corp. in the newly established position of Director of Marketing, Data Processing Systems Division. He will be responsible for the direct sale, service, advertising and sales promotion of SCM's data processing products plus the sale of SCM products for use as components in systems of other manufacturers.

NEW LITERATURE

THE BUSINESS FORMS STORY

An informative booklet has been written on the growth of one of the United States major, yet lesser known, industries — the continuous business forms industry. Appropriately titled "The Business Forms Story", it is authored by F. J. "Rusty" Ring of Business Forms International Inc. The 33-page booklet is available (Single copies $2.00 each) from Business Forms International Inc., P. O. Box 11032, Fort Lauderdale, Florida.

GOVERNMENT REPORT ON COMPUTER APPLICATIONS

A report prepared by the Bureau of the Budget shows that 44 Federal agencies now have automatic data processing (ADP) installations with 1767 computers in use. Expenditures for ADP in the Federal agencies have tripled since 1960. Total cost of the computers and peripheral equipment passed the billion dollar mark this year for the first time.

The 360-page report, The 1964 Inventory of Automatic Data Processing (ADP) Equipment in the Federal Government, contains the first official information on essential computer applications in the Federal departments and agencies. It is available for $1 from the Government Printing Office, Washington 25, D.C.

MEETING NEWS

1964 ENGINEERING MANAGEMENT CONFERENCE

The 12th Annual Joint Engineering Management Conference, scheduled for September 17-18 in Cleveland, Ohio, at the Pick-Carter Hotel, will have as its theme "Engineering Managers Face Up to Automation". Chairman of the Conference Coordinating Committee, Jerome Fox of the Polytechnic Institute of Brooklyn, will open the conference with an address on the general objectives of engineering management in the past and future.

"Automation and its Impact" is the subject of Session I, which will be chaired by Norman Lieblich, president of Dynatrol, Inc. The co-chairman will be S. L. Wolfbein, director, Office of Manpower, Automation, and Training, U.S. Department of Labor.

Session II's subject will be "Engineering the Management of Automation" and will be chaired by Dr. L. T. Rader, former president of the Univac Division of Sperry Rand Corporation and now General Manager of General Electric's Industrial Electronics Division. The co-chairman will be S. L. Naismith, director of engineering technology, U.S. Steel Corporation.

Session III, on the topic "Automation — Matching Human Values and Economic Needs", will be chaired by H. M. Sarasohn, technical advisor, Corporate Engineering Staff, IBM Corporation. Co-chairman will be Henry Spitzhoff, vice president, Case Institute of Technology.

The final session will be a Round Table on the subject "Challenges of Advancing Technologies". C. H. Linder, IEEE President, will be moderator of the panel.

A PROCEEDINGS of papers presented at the conference will be distributed at the last session to all registrants. The conference is sponsored by IEEE, AICE, AIChE, AIME, ASCE, ASME, the American Institute of Industrial Engineers, the Engineering Institute of Canada, the the Instrument Society of America.

BUSINESS NEWS

RCA, SDS ANNOUNCE PRICE REDUCTIONS

Both RCA and SDS joined the recent wave of computer price "adjustments" following the announcement of the IBM System/360 and the expansion of the Control Data 3000 family of computers.

RCA reduced the sales and rental prices of its 3301 computer by 35% to 40% in a quietly made move this past April. Public attention was drawn to the RCA price reductions recently by news stories in the national financial press. Trade experts suggest the motivations for the price cuts are principally based upon the competitive price/performance ratio of the 3301 compared to the new IBM computer line.

SDS has announced a price reduction of about 15% on the lease price of all its computers under a new leasing arrangement. The new SDS leasing policy requires the customer to sign up for either a one or a four year lease, rather than the monthly rental basis most common in the industry. According to Max Palevsky, president of SDS, "with a firm commitment for a long-term lease, we can provide our equipment at a much lower cost. We can also include provisions that make it easy for the user to change his equipment without penalty if his computing requirements change or he wants to take advantage of technological advances." The purchase price on the SDS 920 computer has also been lowered about $10,000 to adjust the price/performance characteristics of this machine to the newly introduced SDS 925 computer.

BURROUGHS EARNINGS UP 17%

Burroughs reports net earnings for the six months ended June 30 were $3,998,000, compared with $3,400,000 in 1963, an increase of 17 per cent.

Revenues for the six months were $183,680,000 compared with $185,200,000 in 1963.

Ray R. Eppert, president, stated that defense billings for the six months were materially less than in 1963 but that commercial revenues increased 10 per cent over last year.

Eppert also said that incoming orders for commercial equipments are 17 per cent ahead of 1963. The increase is in all categories. Contracts received in June for electronic computer systems exceeded any month in the company's history. He further stated that June was a record month for general business machines and added that approximately 1000 orders for E2100 Direct Accounting Computer systems have been received since its release five months ago (see Computers and Automation, March 1964, p. 43).

HONEYWELL EARNINGS RISE IN HALF

Gross revenue and net income of Honeywell Inc. set records for the second quarter and for the first half of 1964, the company announced today.

Sales for the first six months were $320,751,427 and earnings were $17,390,841. This compares with sales of $310,033,152 and net income of $14,424,512, for the same period last year.

The automatic controls manufacturer had second quarter sales of $163,144,039 and net income of $9,130,798. This compares with sales of $162,450,852 and net income of $8,260,356 for the second quarter of 1963.

"The reception of the new Honeywell family of computers — the H-200, H-300 and H-2200 — continues to be enthusiastic and has caused us to enlarge our marketing staff substantially," Paul B. Wishart, board chairman, said.

"Deliveries of the Honeywell 200 started in July and will build up to sizeable shipments during the remainder of the year," Wishart said.

CONTROL DATA ANNOUNCES STOCK SPLIT

William C. Norris, Board Chairman and President of Control Data Corporation, has announced that Control Data has proposed an increase of authorized Common Shares to permit a 3-for-2 stock split to stockholders of record on September 15, 1964.

"The proposed increase in the authorized amount of Preferred Stock will also place the Company in a more flexible position for future financing, but the Board does not have any present plans for the issuance of any Common Stock or Preferred Stock," Norris said.

The 3-for-2 stock split was authorized by the Control Data Board of Directors at its meeting today, subject to the stockholders adoption of the Restated Articles of Incorporation at the forthcoming Annual Meeting of Control Data stockholders on Tuesday, September 15, 1964, at Minneapolis, Minn.

IBM EARNINGS UP 29%

IBM reports that consolidated net earnings for the six months ended June 30, 1964, were $214,991,353 after taxes. This compares with net earnings after taxes for the corresponding 1963 period of $166,144,199, an increase of 29%.

Net earnings before taxes amounted to $448,491,353 compared with $356,411,659 in the corresponding period of 1963.

As previously reported, in the first quarter of 1964 the corporation experienced an unusual concentration of outright sales of data processing equipment previously under lease. The proportion of outright sales for the quarter ended June 30, 1964 was substantially less than for the first quarter of this year, and was approximately the same as for the corresponding period in 1963.

The report stated that, due to the high concentration of outright sales in the first quarter, the six months' results do not represent an acceleration in the company's rate of growth.

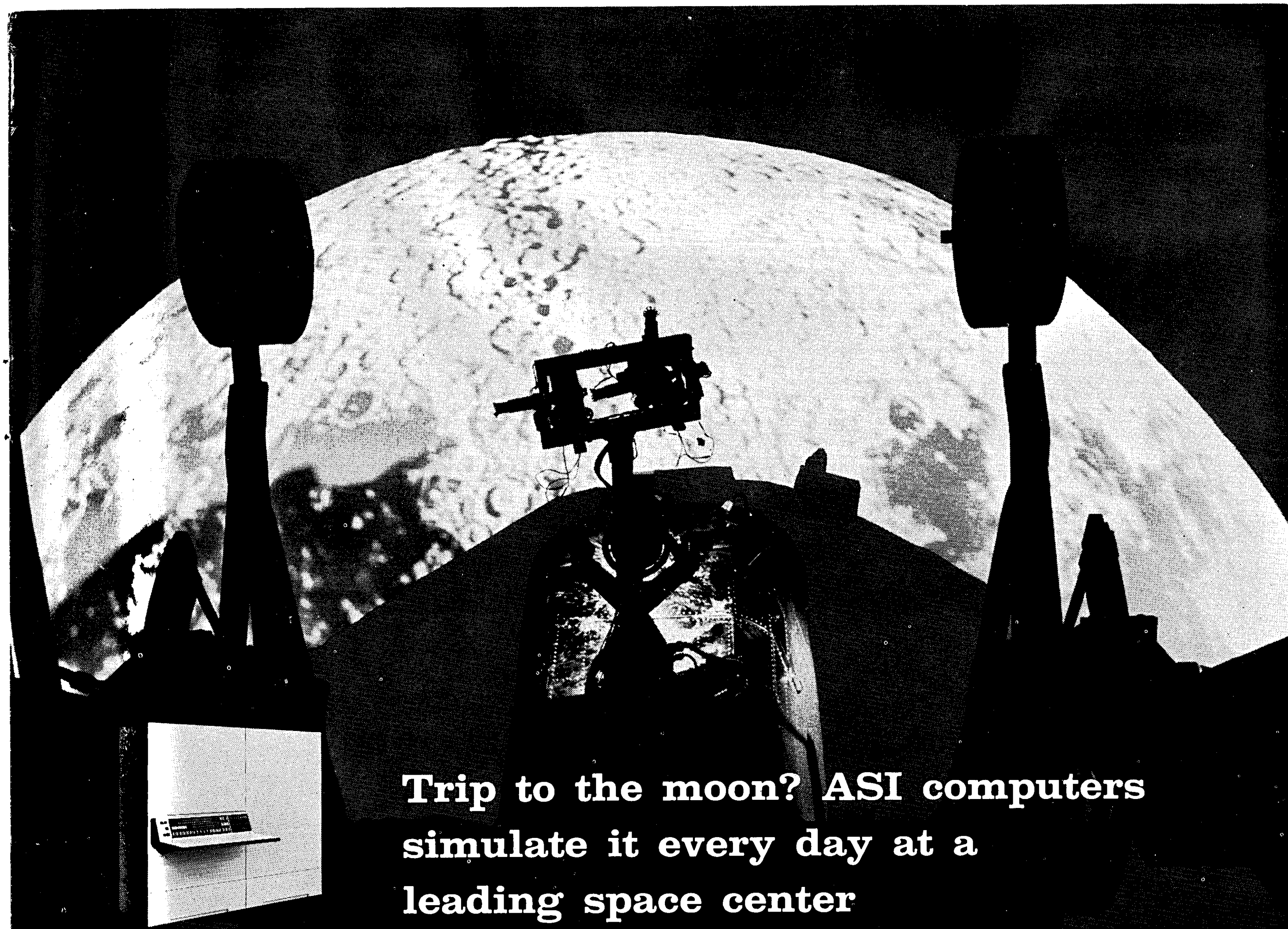
NCR'S 6-MONTH SALES UP 13%

Sales of NCR for the first six months of 1964 were $305,194,000, a 13% increase over the $270,495,000 recorded for the comparable period of 1963, Robert S. Oelman, chairman, has announced. Net income for the period also showed an increase of 13%, rising to $8,738,000, compared with $7,723,000 for the first six months of last year.

Commenting on the increase in sales, which were at an all-time high for the period, the NCR chairman said the higher volume reflected heavier machine deliveries of all the company's major products plus increases in the sale of supplies and in service income.

NCR has now installed more than 900 electronic data processing systems in industrial and commercial companies, government agencies, retail stores and banks, he said, adding that the company's computer installations are now almost double those of a year ago. An increasing percentage of these computer systems are linked with other types of NCR business machines through various machine "languages" to provide fully integrated business systems, Mr. Oelman said.

The NCR chairman said the outlook for the remainder of 1964 is favorable, with demand for NCR cash registers, accounting and adding machines, and electronic data processing systems at a high level. Incoming equipment orders, both domestically and overseas, are running ahead of last year's pace, he said, with a consolidated gain of approximately 10% over 1963.



Trip to the moon? ASI computers simulate it every day at a leading space center

Ask Ling-Temco-Vought! Advanced Scientific Instruments digital computers are a vital component of the LTV-Dallas moving base simulator presently being used for manned aerospace flight training. This simulator is one of the most realistic comprehensive simulators in existence. This simulator and associated ASI computers have already logged thousands of hours in solving problems for aerospace and low-altitude vehicles.

The new ASI 2100 is ideal for this application. Why? Because real-time simulators such as the LTV unit must exchange data with the computer at highest rates to assure simulator reactions that closely approach actual vehicle behavior. The 2100 input/output rate has large scale computer speeds of 500,000 words per second. At this rate even the most complex simulator does not strain the 2100's capacity to accept data.

True simulation demands instantaneous reaction to emergency situations. ASI's 2100 has 64 individual addresses for external interrupts, any one of which can be addressed by up to 16,000 external devices. As many interrupt locations as desired can have priority and various priority levels can be assigned to external devices to give them recognition over lower priority interrupts. This powerful priority interrupt structure enhances simulator flexibility in allowing external events such as emergencies to transfer operation into an entirely new mode.

Simulator systems must be adaptable to current problem demands at low cost. The basic 2100 is available for $2,590 per month or a purchase price of $87,800.

ASI's 2100 has modular compatibility both upward and downward. A change in the scope of any program will not render the existing hardware or software useless. An entire system can be radically modified (reduced or enlarged) and be back in operation immediately. Hidden costs such as having to write new programs simply do not exist. ASI programming software is standard; it is written in only one way to accommodate all possibie external hardware configurations, special or otherwise.

Some other outstanding 2100 features are:

- 2 usec memory cycle time
- 4 usec add time
- Three index registers

For full information ask us for a descriptive brochure.

ASI

ADVANCED SCIENTIFIC INSTRUMENTS / DIVISION OF ELECTRO-MECHANICAL RESEARCH, INC.

8001 Bloomington Freeway, Minneapolis, Minnesota 55420

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MONTHLY COMPUTER CENSUS

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

To aid our readers in keeping up with this mushrooming activity, the editors of COMPUTERS AND AUTOMATION present this monthly report on the number of general purpose electronic computers of American-based companies which are installed or on order as of the preceding month. These figures included installations and orders outside the United States. We update this computer census monthly, so that it will serve as a "box-score" of progress for readers interested in following the growth of the American computer industry, and of the computing power it builds.

Most of the installation figures, and some of the unfilled order figures, are verified by the respective manufacturers. In cases where this is not so, estimates are based on information in the market research reference files of COMPUTERS AND AUTOMATION. The figures are then reviewed by a group of computer industry cognoscenti.

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

AS OF AUGUST 10, 1964

NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS**
Addressograph-Multigraph Corporation	EDP 900 system	Y	$7500	2/61	11	1
Advanced Scientific Instruments	ASI 210	Y	$2850	4/62	20	2
	ASI 2100	Y	$3000	12/63	5	2
Autonetics	RECOMP II	Y	$2495	11/58	66	X
	RECOMP III	Y	$1495	6/61	21	X
Bunker-Ramo Corp.	TRW-230	Y	$2680	8/63	11	3
	RW-300	Y	$5000	3/59	40	X
	TRW-330	Y	$5000	12/60	30	X
	TRW-340	Y	$7000	12/63	8	16
	TRW-530	Y	$6000	8/61	22	4
Burroughs	205	N	$4600	1/54	63	X
	220	N	$14,000	10/58	43	X
	E101-103	N	$875	1/56	128	X
	E2100	Y	$535	8/64	0	980
	B100	Y	$2800	11/64	0	30
	B250	Y	$4200	11/61	88	19
	B260	Y	$3750	11/62	60	26
	B270	Y	$7000	7/62	80	36
	B280	Y	$6500	7/62	89	43
	B370	Y	$8400	7/65	0	13
	B5000	Y	$16,200	3/63	34	24
Clary	DE-60/DE-60M	Y	$525	2/60	235	5
Computer Control Co.	DDP-19	Y	$2800	6/61	3	X
	DDP-24	Y	$2500	5/63	36	18
	DDP-224	Y	$3300	12/64	0	5
Control Data Corporation	G-15	N	$1000	7/55	321	X
	G-20	Y	$15,500	4/61	26	X
	160*/160A/160G	Y	$1750/$3500/$12,000	5/60;7/61;3/64	375	26
	924/924A	Y	$11,000	8/61	27	4
	1604/1604A	Y	$38,000	1/60	60	X
	3200	Y	$12,000	5/64	9	62
	3400	Y	$25,000	11/64	0	19
	3600	Y	$58,000	6/63	22	32
	6600	Y	$110,000	8/64	1	3
Digital Equipment Corp.	PDP-1	Y	Sold only about $120,000	11/60	54	2
	PDP-4	Y	Sold only about $60,000	8/62	39	11
	PDP-5	Y	Sold only about $25,000	9/63	52	10
	PDP-6	Y	Sold only about $300,000	8/64	0	5
	PDP-7	Y	Sold only about $72,000	10/64	0	8
El-tronics, Inc.	ALWAC IIIE	N	$1820	2/54	24	X
Friden	6010	Y	Sold only about $20,000	6/63	145	95
General Electric	205	Y	$2900	9/64	0	10
	210	Y	$16,000	7/59	60	X
	215	Y	$5500	11/63	23	10
	225	Y	$7000	1/61	120	2
	235	Y	$10,900	12/63	16	19
	415	Y	$5500	5/64	6	105
	425	Y	$7500	7/64	1	45
	435	Y	$12,000	10/64	0	21
	455	Y	$18,000	6/65	0	9
	465	Y	$24,000	6/65	0	6
	625	Y	$65,000	2/65	0	2
	635	Y	$50,000	12/64	0	4
General Precision	LGP-21	Y	$725	12/62	120	59
	LGP-30	semi	$1300	9/56	440	5
	RPC-4000	Y	$1875	1/61	101	2
Honeywell Electronic Data Processing	H-200	Y	$4200	3/64	22	620
	H-300	Y	$3900	7/65	0	5
	H-400	Y	$5000	12/61	100	10
	H-800	Y	$22,000	12/60	62	7
	H-1400	Y	$14,000	1/64	6	6

NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS**
	H-1800	Y	$30,000	1/64	4	7
	H-2200	Y	$11,000	10/65	0	10
	DATAmatic 1000	N	---	12/57	5	X
H-W Electronics, Inc.	HW-15K	Y	$490	6/63	3	3
IBM	305	N	$3600	12/57	535	X
	360/30	Y	$4800	7/65	0	900
	360/40	Y	$9600	7/65	0	310
	360/50	Y	$18,000	9/65	0	280
	360/60	Y	$35,000	10/65	0	110
	360/62	Y	$50,000	11/65	0	22
	360/70	Y	$80,000	10/65	0	120
	650-card	N	$4000	11/54	395	X
	650-RAMAC	N	$9000	11/54	78	X
	1401	Y	$4500	9/60	7280	910
	1401-G	Y	$1900	5/64	160	860
	1410	Y	$12,000	11/61	355	165
	1440	Y	$1800	4/63	980	1050
	1460	Y	$9800	10/63	360	600
	1620	Y	$2000	9/60	1490	35
	701	N	$5000	4/53	1	X
	7010	Y	$19,175	10/63	48	40
	702	N	$6900	2/55	3	X
	7030	Y	$160,000	5/61	6	X
	704	N	$32,000	12/55	43	X
	7040	Y	$14,000	6/63	50	43
	7044	Y	$26,000	6/63	38	16
	705	N	$30,000	11/55	85	X
	7070, 2, 4	Y	$24,000	3/60	510	50
	7080	Y	$55,000	8/61	69	8
	709	N	$40,000	8/58	11	X
	7090	Y	$64,000	11/59	52	4
	7094	Y	$70,000	9/62	250	25
	7094 II	Y	$76,000	4/64	38	60
ITT	7300 ADX	Y	$18,000	7/62	9	6
Monroe Calculating Machine Co.	Monrobot IX	N	Sold only - $5800	3/58	158	X
	Monrobot XI	Y	$700	12/60	400	170
National Cash Register Co.	NCR - 304	Y	$14,000	1/60	26	X
	NCR - 310	Y	$2000	5/61	46	1
	NCR - 315	Y	$8500	5/62	191	124
	NCR - 390	Y	$1850	5/61	615	195
	NCR - 395	Y	$650	5/64	33	200
Packard Bell	PB 250	Y	$1200	12/60	155	8
	PB 440	Y	$3500	3/64	4	8
Philco	1000	Y	$7010	6/63	15	0
	2000-212	Y	$52,000	1/63	5	2
	-210, 211	Y	$40,000	10/58	19	2
Radio Corp. of America	Bizmac	N		-/56	4	X
	RCA 301	Y	$6000	2/61	502	130
	RCA 3301	Y	$16,000	7/64	2	28
	RCA 501	Y	$15,000	6/59	96	4
	RCA 601	Y	$35,000	11/62	4	1
Scientific Data Systems Inc.	SDS-92	Y	$900	12/64	0	1
	SDS-910	Y	$2000	8/62	74	36
	SDS-920	Y	$2700	9/62	60	10
	SDS-925	Y	$2500	12/64	0	5
	SDS-930	Y	$4000	6/64	3	13
	SDS-9300	Y	$7000	10/64	0	2
UNIVAC	I & II	N	$25,000	3/51 & 11/57	33	X
	III	Y	$20,000	8/62	72	42
	File Computers	N	$15,000	8/56	24	X
	Solid-State 80, 90, & Step	Y	$8000	8/58	340	1
	Solid-State II	Y	$8500	9/62	42	4
	418	Y	$11,000	6/63	6	8
	490	Y	$26,000	12/61	33	20
	1004	Y	$1900	2/63	1500	720
	1050	Y	$8000	9/63	60	262
	1100 Series (except 1107)	N	$35,000	12/50	15	X
	1107	Y	$45,000	10/62	19	11
	LARC	Y	$135,000	5/60	2	X
	1108	Y	$50,000	7/65	0	5
				TOTALS	20,741	10,097

X = no longer in production.

* To avoid double counting, note that the Control Data 160 serves as the central processor of the NCR 310. Also, many of the orders for 7044, 7074, and 7094 I and II's are not for new machines but for conversions from existing 7040, 7070, and 7090 computers respectively.

** Some of the unfilled order figures are verified by the respective manufacturers; others are estimated and then reviewed by a group of computer industry authorities.

NEW PATENTS

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

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

March 10, 1964 (Continued)

3,124,785 / Cravens L. Wanlass, Woodland Hills, Calif. / by Mesme assignments to Ford Motor Company, Dearborn, Mich., a corporation of Delaware / Magnetic Memory Core.

3,124,787 / William J. Bartik, Hatboro, Pa. / Sperry Rand Corp., N. Y., a corporation of Delaware / Ferrite Core Storage Device.

3,124,788 / Russell D. Rickets, Woodland Hills and Claus O. Silldorff, Venice, Calif. / Litton Industries of Calif., Beverly Hills, Calif. / Magnetic Head and Drum Memory System.

March 17, 1964

3,125,673 / William H. Puterbaugh, Waynesville, Richard M. Clinehens, Dayton, Roget W. Morin, Waynesville, Hans Schroeder, Bellbrook and Herman E. Austen, Trotwood, Ohio / The National Cash Register Co., Dayton, Ohio, a corporation of Maryland / Electrochemical Data Storage and Counting Systems.

3,125,674 / Benjamin Rabinovici, Rego Park and Charles A. Renton, N. Y. / Radio Corp. of America, a corporation of Delaware / Full Binary Adder Including Negative Resistance Diode.

3,125,744 / George E. Olson, Wappingers Falls, N. Y. / International Business Machines Corp., N. Y., a corporation of N. Y. / Magnetic Core Logical Circuit.

3,125,745 / Lewis J. Oakland, North St. Paul, Minn. / Sperry Rand Corp., N. Y. / a corporation of Delaware / Non-Destructive Bistable Magnetic Core Sensing.

3,125,747 / David R. Bennion, Loma Mar, Calif. / AMP Inc., Harrisburg, Pa., a corporation of N. J. / Shift Register.

3,125,750 / Gene R. Bussey, Albuquerque, N. Mex. / Consolidated Controls Corp., Bethel, Conn., a corporation of N. Y. / Multichannel Data Acquisition and Transmission System.

March 24, 1964

3,126,008 / Jay R. Geddes, Campbell, Calif. / International Business Machines Corp., N. Y., a corporation of N. Y. / Data Storage Access Mechanism.

3,126,487 / Otto A. Jorgensen, Pirtsford, N. Y. / General Dynamics Corp., Rochester, N. Y., a corporation of Delaware / Logic Device.

3,126,491 / Ronald K. Rockwell, Old Bethpage, N. Y. / Sperry Rand Corp., Great Neck, N. Y., a corporation of Delaware / Exclusive-Selector Gating Circuit.

3,126,524 / Thomas J. Blocher, Jr., Monroeville, Pa. / Westinghouse Air Brake Company, Wilmerding, Pa., a corporation of Pa. / Data Storage System.

3,126,526 / Frank J. Wood, Northampton, England / The Plessey Co. Ltd., Iford, England, a British company / Memory Matrix Frames.

3,126,527 / John H. McGuigan, Berkeley Heights, N. J. / Bell Telephone Labs., Inc., N. Y., a corporation of N. Y. / Magnetic Core Memory Circuits.

3,126,528 / Gregory Constantine, Jr., Poughkeepsie, N. Y. / International Business Machines Corp., N. Y., a corporation of N. Y. / Magnetic Switching Devices.

3,126,529 / Herman P. Hempel, Red Hook, N. Y. / International Business Machines Corp., N. Y., a corporation of N. Y. / Non-Destructive Readout.

3,126,530 / Frederick L. Post, Poughkeepsie, N. Y. and Samuel K. Raker, Wash., D. C. / International Business Machines Corp., N. Y., a corporation of N. Y. / Magnetic Core Device.

3,126,534 / William T. Siegle, Troy, N. Y. / International Business Machines Corp., N. Y., a corporation of N. Y. / Automatic Regeneration Memory.

March 31, 1964

3,127,590 / Karl Euler, Munich, Germany / Siemens & Halske Aktiengsellschaft, Berlin and Munich, Germany, a German company / Information Storage Arrangements.

April 7, 1964

3,128,390 / Charles Pettus, Vestal and Thomas Young, Endicott, New York / International Business Machines Corporation, a corporation of New York / Matnetoresistive Logical Circuitry.

3,128,452 / Ernest G. Andrews, Mountain Lakes, N. J. / Bell Telephone Laboratories, Inc., N. Y., a corporation of N. Y. / Magnetic Storage Circuits.

April 14, 1964

3,129,321 / Edward Rogal, North Scituate, Mass. / Universal Controls, Inc., N. Y., a corporation of Maryland / Data Collating System.

3,129,322 / Everett R. Sarratt, Baltimore, Md. / by Mesme assignments to Laboratory For Electronics, Inc., Boston, Mass., a corporation of Delaware / Digital Data Processing System.

3,129,336 / Gregory Constantine, Jr., Arlington, Mass. / International Business Machines Corp., N. Y., a corporation of N. Y. / Matrix Switch.

3,129,337 / Jakob H. Hohl, Adliswil, Zurich, Switzerland / International Business Machines Corp., N. Y., a corporation of N. Y. / Magnetic Core Switching System.

3,129,340 / Herbert B. Baskin, Peekskill, N. Y. / International Business Machines Corp., N. Y., a corporation of N. Y. / Logical and Memory Circuits Utilizing Tri-Level Signals.

April 21, 1964

3,130,324 / Donald Sherman Swallow, San Jose, Calif. / International Business Machines Corp., N. Y., a corporation of N. Y. / Three Level Logical Circuit Suitable For Signal Comparison.

3,130,326 / Victor J. Habisohn, Oak Lawn, Ill. / International Telephone and Telegraph Corp., N. Y., a corporation of Maryland / Electronic Bistable Gate Circuit.

3,130,390 / Arthur Cyril Moore, Malvern Link, and Alexander Scott Young, Malvern, England / by Mesme assignments, to International Business Machines Corp., N. Y., a corporation of N. Y. / Magnetic Storage Devices.

3,130,393 / Robert P. Gutterman, Bethesda, Md. / Sperry Rand Corp., N. Y., a corporation of Delaware / Information Storage Device.

3,130,399 / Archie J. Paul, Jr., Wappingers Falls, N. Y. / International Business Machines Corp., N. Y., a corporation of N. Y. / Information Handling Apparatus.

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3,131,291 / Walter K. French, Montrose, N. Y. / International Business Machines Corp., N. Y., a corporation of N. Y. / Associative Memory.

3,131,293 / Grant H. Bush, Poughkeepsie and James E. Carrington, Vestal, N. Y. / International Business Machines Corp., N. Y., a corporation of N. Y. / Computing System.

3,131,294 / Frederick C. Hallden, Floral Park, N. Y. / Hazeltine Research, Inc., a corporation of Illinois / Electronic Calculating Machine.

3,131,380 / Jean Francois Marchand, Eindhoven, Netherlands / North American Phillips Co., Inc., N. Y., a corporation of Delaware / Magnetic Core Storage With Dynamic Read-Out.

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3,132,264 / Jerome R. Dahme, Strafford, Pa. / Sperry Rand Corporation, N. Y., a corp. of Delaware / Dynamic Data Storage Device Employing Triggered Silicon Controlled Rectifier for Storing.

3,132,326 / Joseph W. Crownover, LaJolla, Calif. / by Mesme assignments to Control Data Corp., Minneapolis, Minn., a corp. of Minnesota / Ferroelectric Data Storage System and Method.

3,132,327 / Umberto F. Gianola, Florham Park, N. J. / Bell Telephone Labs, Inc., N. Y., a corp. of New York / Magnetic Shift Register.

May 12, 1964

3,133,206 / Richard H. Bergman, Riverton, Eldon C. Cornish, Pennsauken and Melvin M. Kaufman, Merchantville, N. J. / Radio Corp. of America, a corp. of Delaware / Logic Circuit Having Bistable Tunnel Diode Reset by Monostable Diode.

3,133,268 / Emik A. Avakian, Crestwood, N. Y. and Robert J. Buegler, Stamford, Conn. / The Teleregister Corp., Stamford, Conn., a corp. of Delaware / Revisable Data Storage and Rapid Answer Back System.

3,133,271 / Donald G. Clemons, Newark, N. J. / Bell Telephone Labs., Inc., N. Y., a corp. of New York / Magnetic Memory Circuits.

3,133,273 / Ronald Sydney Hopkins, London, England / Associated Electrical Industries (Woolwich) Ltd., a Limited Company / Magnetic Information Storage Arrangements.

May 19, 1964

3,134,016 / John J. Connolly, Pacific Palisades, Calif., Edwin L. Schmidt, Katonah, N. Y. and Harold F. May, Basking Ridge, N. J. / The Teleregister Corp., Stamford, Conn. / Data Storage System.

3,134,025 / Claude Battarel, Paris, France / International Business Machines Corp., a corp. of New York / Binary Logic Circuits.

3,134,029 / William B. Towles, Windermere, Fla. / by Mesme assignments to U. S. of America as represented by the Secretary of the Navy / Shift Register Circuit.

3,134,030 / Tich T. Dao, Gardena, Calif. / The National Cash Register Company, Dayton, Ohio, a corp. of Maryland / Flip-Flop Circuit With a Delay Between a Logical Input Circuit and the Flip-Flop.

3,134,092 / Edward Arthur Newman, Teddington and David Oswald Clayden, Heston, England / by Mesme assignments to International Business Machines Corp., N. Y., a corp. of New York / Electronic Digital Computers.

3,134,097 / Louis D. Stevens, San Jose and William A. Goddard and John J. Lynott, Los Gatos, Calif. / International Business Machines Corp., N. Y., a corp. of New York / Data Storage Machine.

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3,134,910 / Raymond C. Bassett, Jr., Fayetteville, N. Y. / General Electric Co., a corp. of New York / Logic Circuits Using Non-Linear Resonance.

3,134,963 / Robert A. Henle, Hyde Park, William W. Lawrence, Jr., Poughkeepsie, J. B. Pace, Hopewell Junction and Hermann P. Wolff, Poughkeepsie, N. Y. / International Business Machines Corp., N. Y., a corp. of New York / Esaki Diode Memory.

3,134,964 / Cravens L. Wanlass, Woodland Hills, Calif. / by Mesme assignments to Ford Motor Company, Dearborn, Mich., a corp. of Delaware / Magnetic Memory Device With Orthogonal Intersecting Flux Paths.

3,134,965 / Donal A. Meier, Inglewood, Calif. / The National Cash Register Co., Dayton, Ohio, a corp. of Maryland / Magnetic Data-Storage Device and Matrix.

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3,135,945 / Richard M. Swanson, Holmdel Township, Monmouth County, N. J. / Bell Telephone Labs., Inc., N. Y., a corp. of New York / Information Checking System Utilizing Odd and Even Digit Checks.

3,135,948 / Albert H. Ashley, Holliston, Mass. / Sylvania Electric Products, Inc., a corp. of Delaware / Electronic Memory Driving.

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3,136,977 / Richard C. Lamy, San Jose, Calif., and Allan J. Atrubin, Endicott, N. Y. / International Business Machines Corp., N. Y., a corp. of New York / Comparing Matrix.

3,136,980 / George A. Matthews, Beeston, Nottingham, England / Ericson Telephones Ltd., London, England, a British company / Magnetic Core Memory Matrices.

3,136,981 / Arthur Edward Brewster, London, England / International Standard Electric Corp., N. Y., a corp. of Delaware / Magnetic Information Storage Arrangements.

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3,137,843 / Wilmer B. Gaunt, Jr., Florham Park, N. J. / Bell Telephone Labs, Inc., N. Y., a corp. of New York / Magnetic Wire Memory Circuits.

3,137,844 / Siegfried J. Strobl, Center Square, Pa. / Sperry Rand Corp., N. Y., a corp. of Delaware / Magnetic Core Shift Register.

3,137,845 / Richard L. Snyder, Malibu, Calif. / Hughes Aircraft Co., Culver City, Calif., a corp. of Delaware / High Density Shift Register.

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3,138,703 / Gerald A. Maley, Poughkeepsie, N. Y. / International Business Machines Corp., N. Y., a corp. of New York / Full Adder.

3,138,719 / Norbert G. Vogl, Jr., Wappingers Falls, N. Y. / International Business Machines Corp., N. Y. a corp. of New York / Magnetic Core Logic Circuits.

3,138,761 / Paul I. DiMatteo, Levittown N. Y. / Dynell Electronics Corp., Plainview, N. Y., a corp. of New York / Electronic Memory Circuit Utilizing Feedback.

3,138,785 / Edward B. Chapman, Poughkeepsie, Kenneth F. Greene, Wappingers Falls and Bruno J. Ronkese, Marlboro, N. Y. / International Business Machines Corp., N. Y., a corp. of New York / Deposited Magnetic Memory Array.

3,138,786 / Edwin J. Smura, Apalachin, N. Y. / International Business Machines Corp., N. Y. a corp. of New York / Magnetic Core Matrix.

3,138,787 / William P. Hanf, Berkeley, Calif. / International Business Machines Corp., N. Y., a corp. of New York / Double Triangular Array Memory Drive.

3,138,788 / David Nitzan, Palo Alto and William K. English and David R. Bennion, Menlo Park, Calif. / AMP Inc., Harrisburg, Pa., a corp. of New Jersey / Magnetic Core Binary Counters.

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3,139,521 / Carl A. Johnson, Jr., St. Paul, Minn. / Sperry Rand Corp., N. Y., a corp. of Delaware / Locating Data in a Magnetic Recording System.

3,139,523 / Louzelle A. Luke, Coon Rapids, Minn. / Sperry Rand Corp., N. Y., a corp. of Delaware / Digital Data Comparator Utilizing Majority-Decision Logic Circuits.

3,139,531 / Abraham Franck and George F. Marette, Richfield and Berc I. Parsegyan, St. Paul, Minn. / Sperry Rand Corp., N. Y., a corp. of Delaware / Magnetic Shift Circuits.

3,139,606 / James C. Hathaway, Corona del Mar, Calif. / Collins Radio Co., Cedar Rapids, Iowa, a corp. of Iowa / Character Recognition Circuit Using Multiaperature Cores.

ADVERTISING INDEX

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