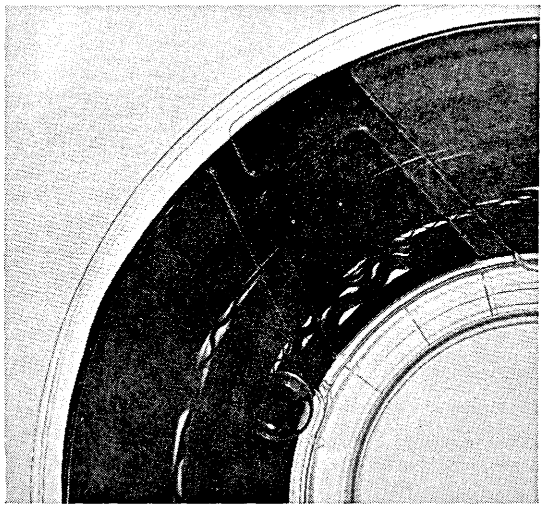
October, 1964

computers and automation

Computer/Data-Communications Center in Tokyo for the 1964 Olympic Games

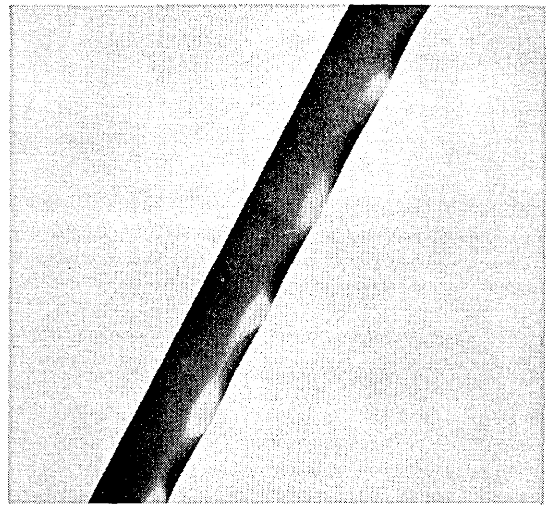
4 COMPLAINTS ABOUT COMPUTER TAPE

(And how Memorex solves them!)



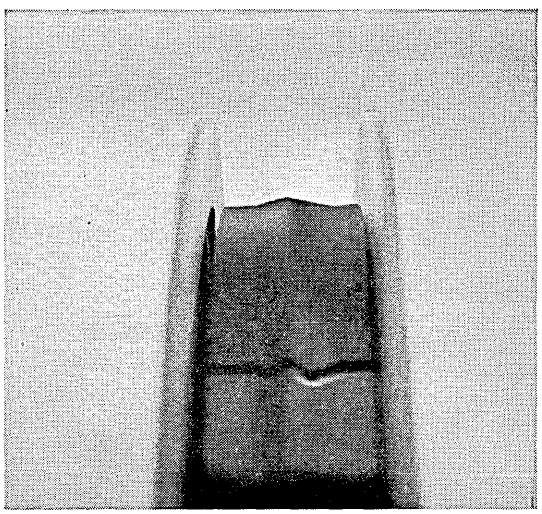
Complaint. Cinching during shipping, use or handling results when reel is wound under improper tension or exposed to temperature extremes.

Solution. Precision winding, special packing and careful shipping are examples of attention to detail that insure cinch-free delivery every time.



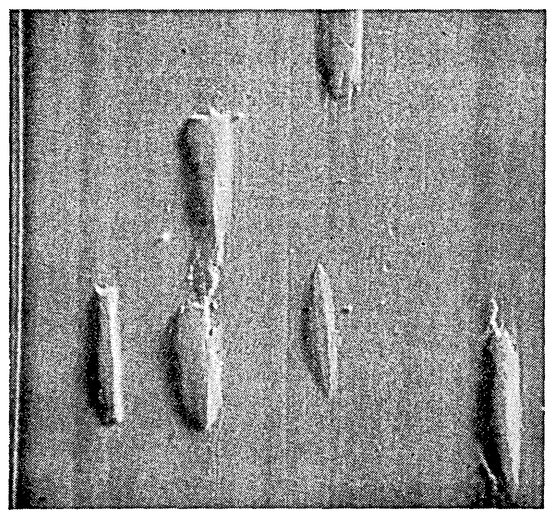
Complaint. Wavy edge caused by improper slitting.

Solution. Specially designed Memorex slitters and microscopic edge inspection of every reel prevent wavy edges. Fifty-one other quality control checks (many performed only by Memorex) guarantee every Memorex reel pre-test perfect.



Complaint. Semi-permanent ridging and loss of contact caused by microscopic scratches produced in manufacturing or use.

Solution. Memorex-designed manufacturing facilities include equipment unique to the industry which eliminates all fixed friction surfaces that potentially produce scratches.



Complaint. Dropout-causing clumps of redeposited coating (50X magnification).

Solution. Memorex has developed coating formulations and processing methods to achieve superior bond between coating and base, extra toughness, high flexibility, and a smoother surface. Result: Memorex tape is essentially redeposition-free.

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.

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MEMOREX

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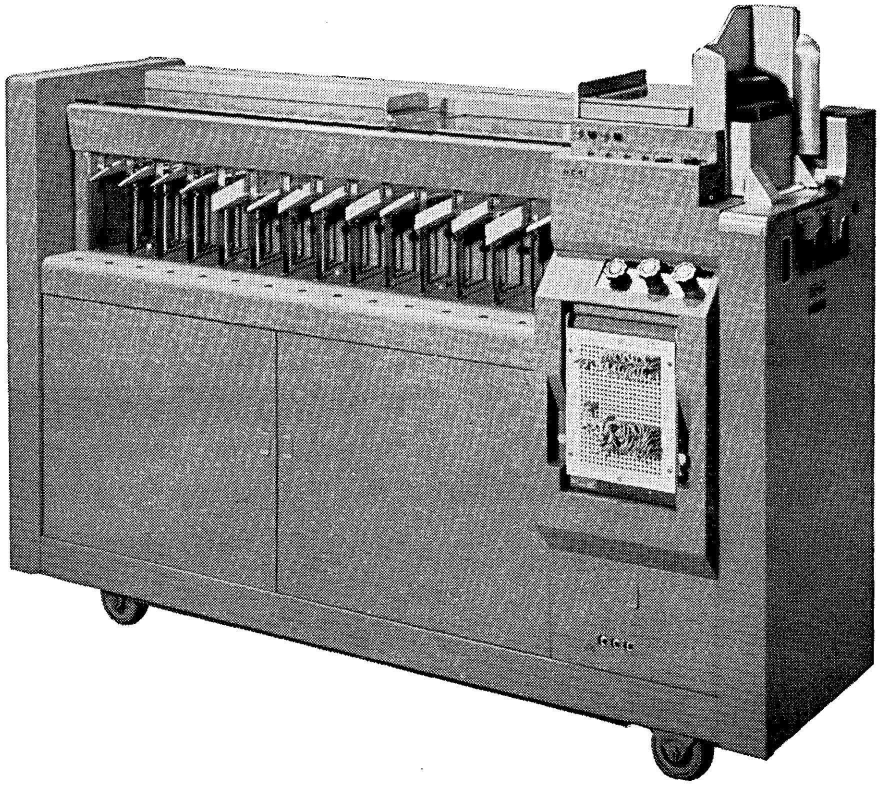

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The front cover shows the Computer/Data-Communications Center in Tokyo where the 1964 Olympic Games will be reported and scored. 7000 athletes from 100 countries are competing in 4000 contests, more than ever before. See page 26.

computers and automation

OCTOBER, 1964 Vol. XIII, No. 10

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

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People Who Do Not Work Well

In the *Wall Street Journal* of August 4 appeared a report "Output of Some Plants is Curbed by Shortage of Highly Trained Help." In the story, datelined Cleveland, reporter Ted Turpin says:

> Factory production is being held back by a severe shortage of workers.
>
> That statement may sound insane . . . While large numbers of unskilled workers look for jobs, and often find they have vanished, some companies say they're being forced to turn away business . . . because they can't find the skilled workers they need to raise output as rapidly as demand for their products would indicate.
>
> "We're turning down work every day," says Louis Zeitler, president of Die-Matic Corp., a Cleveland tool and die maker for metal-working manufacturers. The company expects to chalk up sales of $400,000 this year, but "we'd be doing at least $50,000 more business this year if we had enough skilled help." Right now Mr. Zeitler is looking for four machinists, so far in vain.

In the computer field, this is true also. I have never heard of a really skilled programmer who was looking for a job. In fact, I know of one new entrepeneur in the computer business who, while drawing no salary himself, paid for some weeks of programming to be done for him, by a programmer who is drawing an annual salary of $14,000.

In our own organization, which operates, produces, and distributes this magazine, we continually have a shortage of people whom we want to employ and use.

We use mainly two kinds of people. One kind consists of capable women of any age, for a variety of responsible work including typing, editing, keeping track of subscription changes, handling correspondence, etc. The other kind consists of capable boys (part-time employees) of high school and college age, for assistance in a variety of ways natural in a publishing office: opening mail, sealing mail, getting out mailings, filing, running office machines, keeping track of supplies, etc. We operate a flexible schedule, with different hours of work expected for every person according to the way he or she signs up a week or ten days ahead.

In our own case, it is simply astonishing to us to observe the general quality of persons who apply for our work. Over and over again women in their letters say they can type 50 and 60 words a minute; but when we give them an actual typing test in our office, they type less than 35 words a minute, and give excuses. Our hiring requirement is 40 words typed a minute for four minutes with not more than approximately five errors. In regard to boys, the ad we place in the local newspaper is:

> STUDENTS, intelligent, responsible, for odd jobs in publisher's office; Newtonville; 15-25 hours weekly. Box.........

Here are a couple of the actual answers we received recently:

> Dear Sirs:
>
> I am answer [sic] your recent advertisement in the News Tribune. I am sure that I am qualified for this job. I am 17 years of age and a junior in Newton High School.
>
> Yours truly,
>
> ....

> Dear Sir, I read the ad in the paper & would like to apply. I am a freshman in high school almost 15, 5" 11, & 190 lbs. I *love* to do work. My name and address is.................... [No Closing.]

Did these students never learn what an employer looks for in the replies he receives in the mail? evidence of accomplishment such as grades in school; prior work experience; some factual indications of qualifications; and particularly the power to read over a letter and correct the English? Of the letters we receive, about one in ten shows enough promise so that we telephone and arrange an interview.

Frankly, our attitude as a general rule is that we would rather get along without filling the job than employ someone who is much below our standards. A poor worker who has trouble learning is a substantial drain on a business. The person who checks such an employee's work can often do the work himself in less time than it takes to explain the work, teach it over and over, and then remedy the mistakes of the poor worker week after week. We are too small a business to be able to afford the high cost of poor work.

The root of the trouble is not really in the schools however; it is in the attitude of the community in which the school is located and which it reflects. It is the attitude towards work and learning of the family in which the student lives. A substantial portion of the mass entertainment of this society is harmful to learning and the constructive use of time: television, radio, playing outdoors with the neighborhood children, lack of good reading habits, etc. All this produces widespread failure to develop the

[Please turn to page 10]

FALL JOINT COMPUTER CONFERENCE 1964

Bill Estler
Palo Alto, Calif.

Upwards of 4000 persons representing a cross-section of the nation's professional and industrial concerns having computers are expected in San Francisco, October 26 to October 29 for the 1964 Fall Joint Computer Conference. It is sponsored by the American Federation of Information Processing Societies. The 1964 Fall JCC will occupy most of the San Francisco Civic Auditorium and adjacent Brooks Hall, the latter holding a trade exhibition with 200 booth displays.

The opening session of the conference on Tuesday, October 27, at The Civic Auditorium will be addressed by Dr. Richard I. Tanaka of the Research Branch of Lockheed Missiles & Space Co., Palo Alto, general chairman of the conference, and Dr. Edwin L. Harder of Westinghouse Electric Co., Chairman of the governing board of AFIPS.

The keynote address will be delivered by Brig. Gen. David Sarnoff, chairman of the board of Radio Corporation of America, a pioneer in radio-wireless communications and an early champion of computer developments.

The subjects of the sessions of the conference include:

Very-High-Speed Computers
Programming Techniques and Systems
Expansion of Functional Memories
New Types of Organization of Computers
Management Applications of Simulation
Digital Software for Analog Computation
Input and Output of Graphics
Mass Memory
Time-Sharing Systems
Computations in Space Programs
Hybrid/Analog Computation—Methods, Techniques, Hardware, and Design
Non-Numerical Information Processing

All interested persons are invited.

ELECTRONIC COMPUTERS IN CHINA

Florence Luscomb
Cambridge, Mass.

Electronic digital computers made in China since 1958 are now serving many branches of the national economy. Since 1960 those at the Academy of Sciences' Institute of Computing Technology have begun to make calculations for short-term numerical weather forecasting over large areas. Shortly after they have fed coded high-altitude weather data into the machines, meteorologists can use the results to forecast weather throughout China for the coming 48 hours.

From historical weather data fed into the machines, meteorologists were able accurately to forecast the 1960 drought in the middle and lower Yangtze River Basin. The unusually heavy rains which fell on north China in the summer of 1963 were predicted in this same way.

Computers have also begun serving agriculture. One of them was used to work out a more rational allocation of tractors for Hopei province's Kaocheng county. Eleven types of tractors were in operation on its 1,390,000 *mu* of farm land—assigned according to different soils, crops and kinds of farm work—but some were not being fully utilized. Calculations showed that only three types of tractors were needed to do all the different kinds of work required.

In May 1963 a master plan for routing the shipment of nitrogenous fertilizer to various parts of the country was worked out with the aid of computers. It saved more than 26 million ton-kilometers of transport.

Since 1959 computers have been used to do calculations for more than a dozen huge dams.

HOW MANY OPENINGS FOR SKILLED WORKERS?

A. E. Hunter
Chief, Research and Planning Section
Dept. of Employment Security
State of Minnesota
St. Paul, Minn. 55101

In the August 1964 edition of *Computers and Automation* R. W. Retterer in "Computers, Automation, and Society—The Responsibilities of People" states that there are ". . . job openings for 4 million skilled workers." The implication is then made that the training of "4 to 5 million persons unemployed" would cure the unemployment problem. It is evident that the training of the country's unemployed workers would help alleviate the unemployment problem. We question only the statement that there are 4 million openings for skilled workers in the United States.

No data have been brought to our attention indicating that there are 4 million job openings in all occupations, much less in the skilled occupations. We would appreciate a substantiation of this figure and would be extremely interested in any poll or survey that resulted in this figure.

"A Report on Manpower Requirements, Resources, Utilization, and Training" by the United States Department of Labor submitted to Congress March 1964 contained data regarding skilled workers. In this document it was reported that 7.7 million skilled workers were employed in 1950. By 1960 8.6 million skilled workers were employed in the United States. The number of employed skilled workers was projected to be 10.3 million in 1970 and 11.2 million in 1975. If there are 4 million job openings for skilled workers it can be concluded that nearly 1/3 of all skilled jobs cannot be filled. We can see no indication of this conclusion. It could also be concluded that by 1970 and 1975 the job openings would still be unfilled, or, even a larger number would be unfilled.

Again, we are interested in this statement and would appreciate an explanation.

WORK TO BE DONE

Georgia M. Nagle

Cambridge, Mass.

In your August, 1964 editorial, "People Who do Not Work," you are like a "voice crying in the wilderness." Some people are already suffering the consequences of automation because of the lack of advance thinking concerning the consequences.

If we could call a halt to all advances in the computing art and to further installations of automatic machines until some program was worked out to provide for the casualties, everyone would be compelled to give their best thinking to it and perhaps come up with at least the beginning of a workable program! Since this is not possible, the next best thing may be to agitate for symposia on a large scale, not only in computing circles but involving schools, churches, clubs, labor unions, etc., in order that we may all be enlightened not only about the dangers, but about the opportunities, and contribute to the solution in whatever ways we can—for some, this would mean fervent prayer. "More things are wrought by prayer than this world dreams of."

I would like to point out, however, that, while in certain areas there are now too many people for jobs, in other areas, such as public services and social services, it appears to me there is a greater dearth of help than I ever saw in my lifetime, except during World War II.

There is work to be done in:

1. Educating the disadvantaged of this country.
2. Educating the disadvantaged from other countries who, in addition, have language barriers, which can cause excruciating hardships.
3. Caring for and enlarging the lives of the mentally deficient or deranged, the handicapped, the elderly.
4. Saving and redeeming the lives of those helpless persons caught up in crime, alcoholism, drug addiction, failures in family life, etc.
5. Providing wholesome social activity for "all sorts and conditions of men," including all the above-mentioned groups.
6. Providing better public services—such as snow removal to make winter living more bearable for the afflicted and elderly; police protection so that people could walk the streets or in beautiful parks, even at night, without fear of injury or death; cleaner and more beautiful cities, with gardens and lovely (not hard-topped!) playgrounds for children, and places where people can sit for a while, in the midst of a busy day, to enjoy a few minutes of relaxation and beauty.
7. Extending, to the best of our abilities and resources, the blessings which we enjoy to other countries.

Carrying out these programs would utilize all the skills of everyone, from the most intelligent down to the person who would be only capable of the most simple job.

As a first step, I would like to see compulsory free education extended through college or through training in a trade of a person's choice. This would free many women from the obligation to work in order to put their children through college. It would put them back in the homes where they are needed to instill stronger values in their children and strengthen the home, and would free them for some of the social service needs in the community which are not now being met.

So, I would say it is necessary to re-channel, not only money, but the thinking and the energies of people, too, in order to bring about what could be, with the aid of the machine, something like Heaven on earth!

People Who Do Not Work Well

[Continued from page 6]

habits of thinking, carefulness, industriousness, and learning, which are always necessary for good organized work in any society.

In the society of abundance, which lies close at hand with the powers of computers and automation, what should we do about this attitude? What should we do about the kind of education which is needed to produce really helpful, really skilled workers, of many kinds?

Undoubtedly part of the answer is education. Some of this education will come from the schools as they improve. Some more of this education will come from government programs in depressed areas dealing with situations which the schools and local communities can hardly touch. Some more will come from voluntary efforts like the imagination-stirring Mississippi Summer Project aiding Negroes in Mississippi.

But some more of the answers is a change in the attitudes and choices of the American people in general—a change away from the mass entertainment mystique towards the habits and outlook of study and industry which characterize great segments of the population in many other countries.

Just as the first Soviet Sputnik in 1957 called into question many widely held beliefs in this country, so the permanence of our 4- to 5% unemployment level reflecting "people who do not work well" in our country, must call into question many existing American attitudes and choices.

Edmund C. Berkeley

EDITOR

PROCEEDINGS OF 1964
SYSTEMS ENGINEERING CONFERENCE

58 Papers, 550 Pages, Covering Latest Developments in these Areas of Systems Engineering:

- Systems Design and Optimization
- Digital/Analog/Hybrid Systems
- Data Processing and Handling
- Control Systems and Instrumentation
- Simulation and Modeling

The Proceedings of the 1964 Systems Engineering Conference, held in New York City in June, will be published on September 15.

A valuable and requisite addition to any technical library or bookshelf, the 1964 Proceedings will be available in limited quantity.

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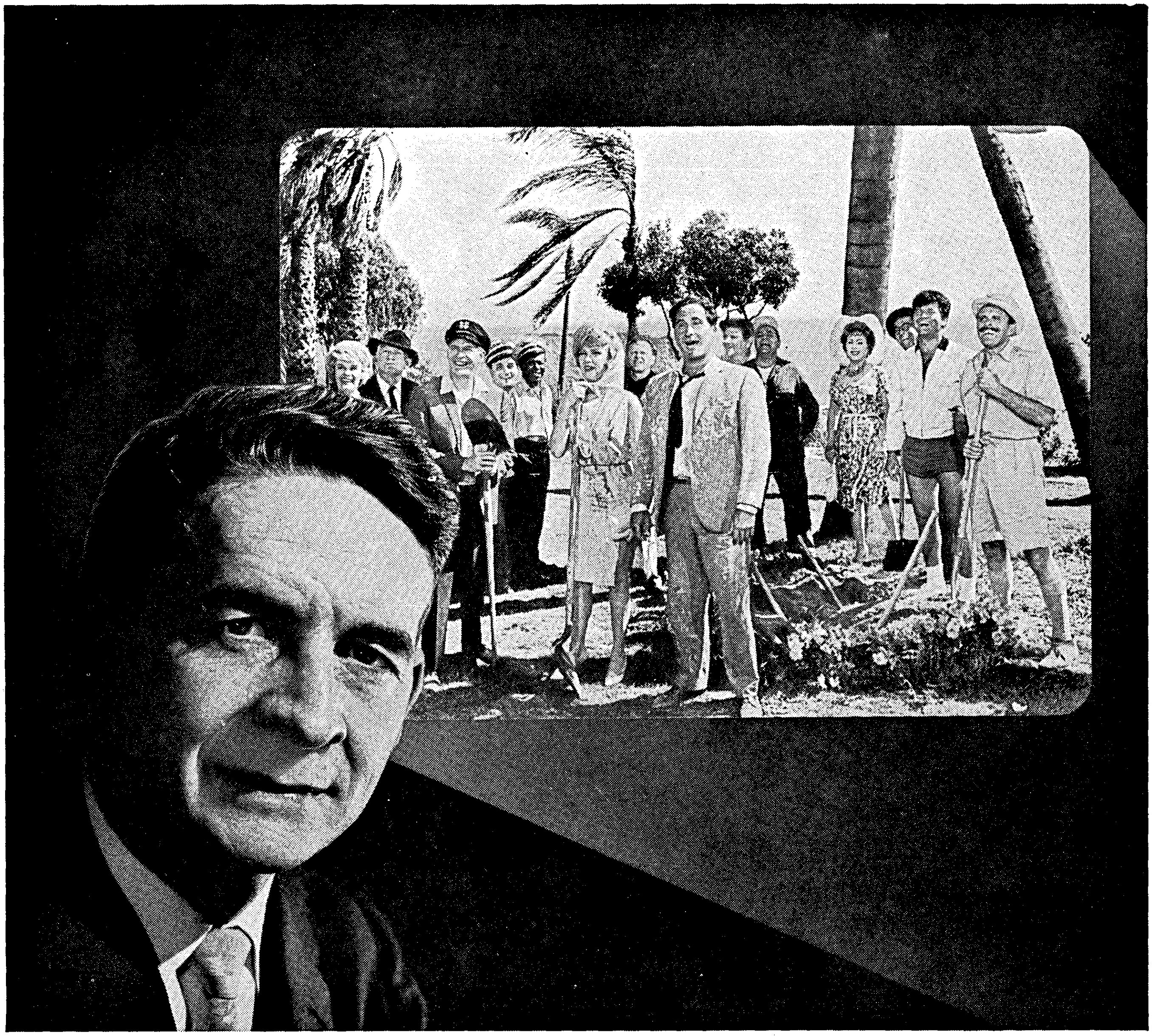

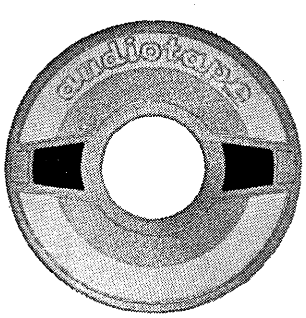
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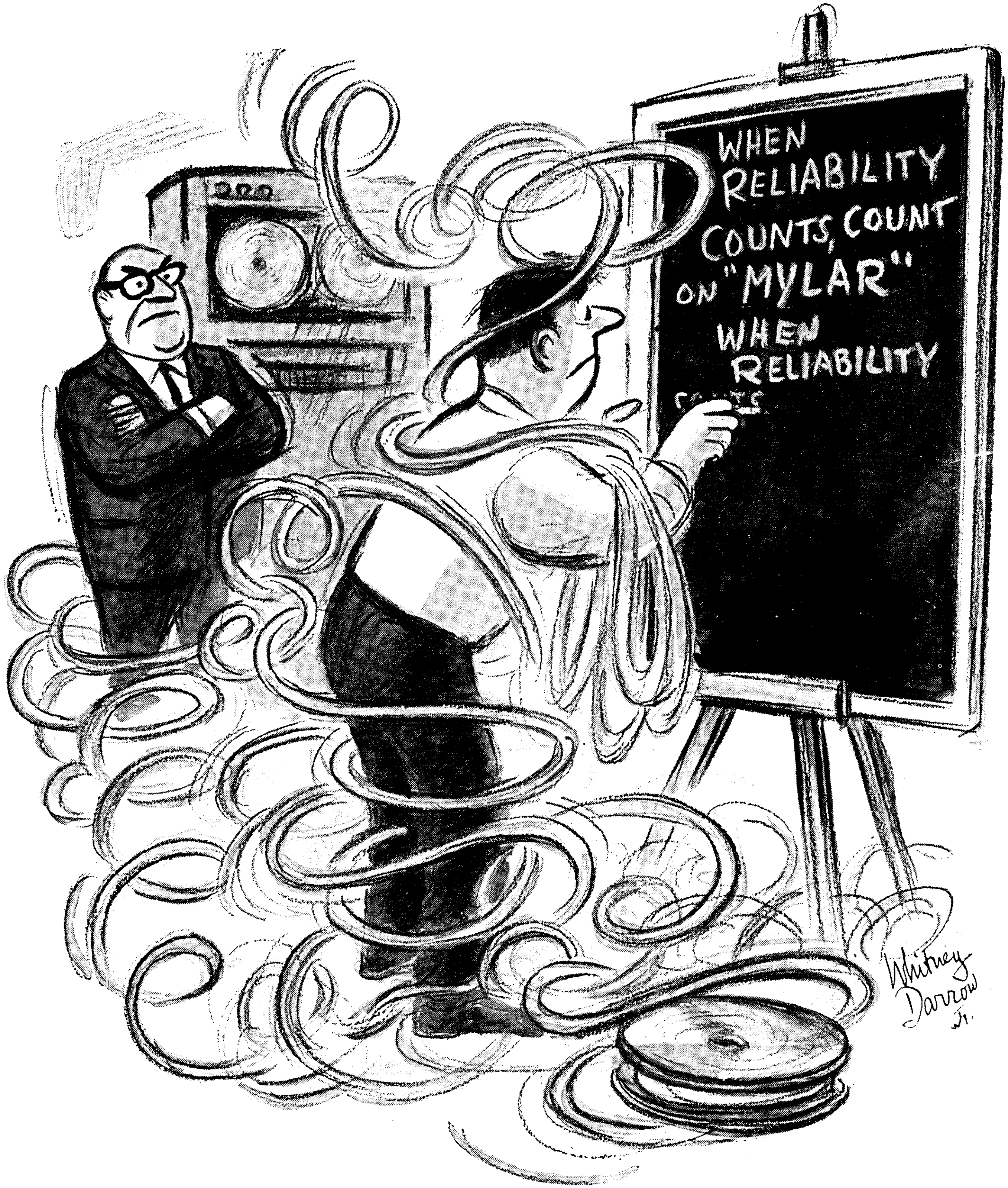

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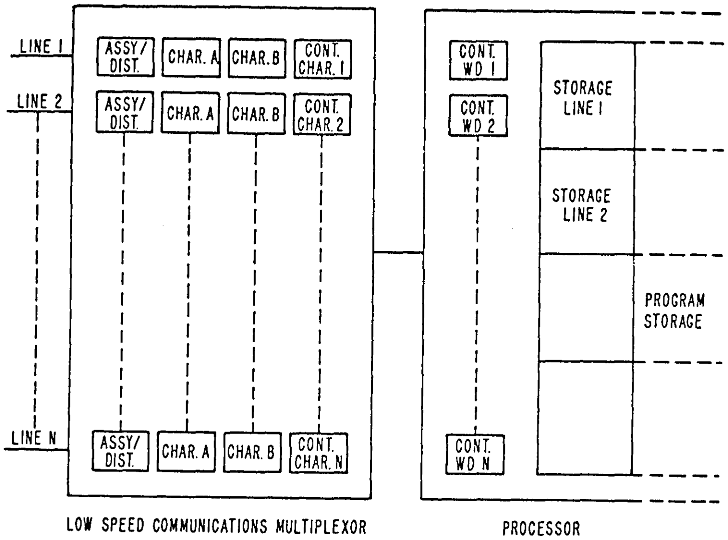

Figure 1. Low Speed Communications Multiplexor (LSCM).

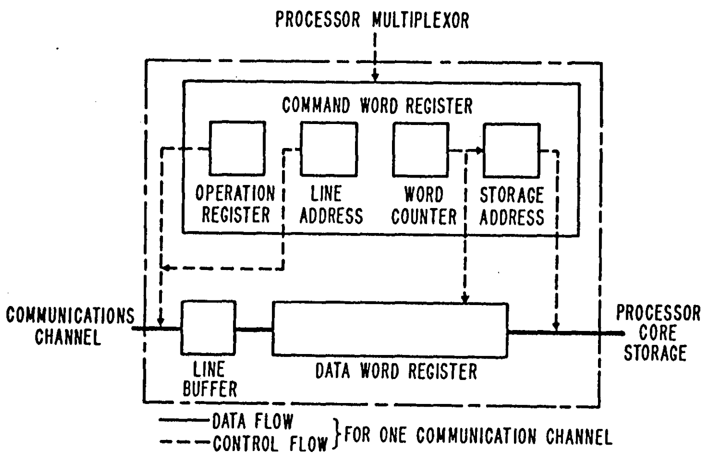

Figure 2. Real Time Data Channel (RTDC).

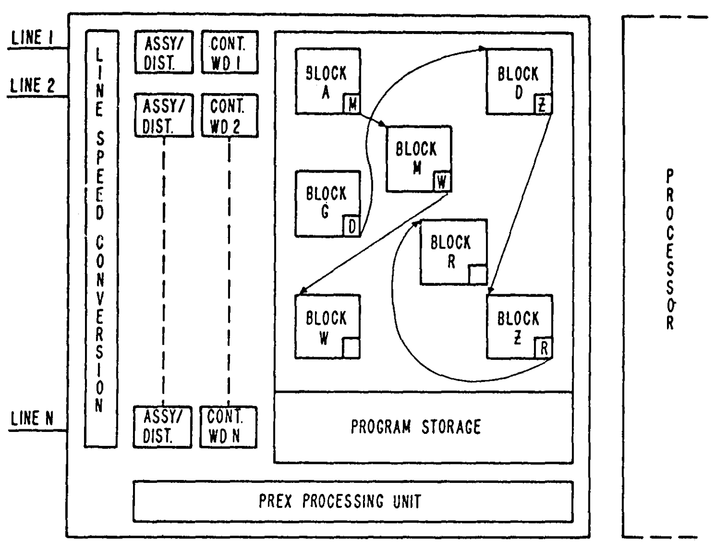

Figure 3. Programmed Exchange (PREX).

MATCHING COMMUNICATION FACILITIES TO DATA PROCESSORS

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A number of problems arise when data processing equipment is to be connected to communications lines in real-time systems. Four different solutions, utilizing essentially three basic approaches consisting of (a) a system modification, (b) an addition, and (c) an independent stored-program device, are here discussed. Each has certain advantages and disadvantages; the desirable choice depends on the system complexity and size, information flow rates, and the central processor requirements.

The problem of reliable and fast communications between one computer and another, between data-oriented terminals and a computer, or between terminal and terminal, has been solved in a variety of ways. Magnetic and paper tapes, cards, and printouts have been sent by almost any conceivable means. Until recently, system requirements were such that these systems were of the off-line type; the data was collected at the receiving end and fed to the computer in a batch. In the last few years, however, with the growth of communications and computer technologies, real time, or on-line, systems have become practical and desirable. A combination of the two technologies has brought about a number of solutions to the various problems such systems must face.

Real Time System Difficulties

The first problem encountered in matching computers to communication networks is the disparity in information handling speeds. Typical large computers, like the IBM 7090, execute instructions on 36-bit words in less than 5 microseconds, which is an effective speed of several million bits per second. Voice grade communications lines, however, deliver information at about 2,000 bits per second. This mismatch is, of course, useful; it allows the computer to process the information delivered to it while it waits for more. But the time between bits is not entirely available for processing required by the system. Since the bits arrive serially, a good portion of the time must be used for assembling these bits into characters, words, or messages before the real processing can begin. If a substantial number of lines, possibly running at different speeds and with different codes, are connected to the computer, the "overlap" time between bit arrivals is considerably lessened but the processing becomes tremendously more involved.

This is not the only problem that may be encountered. There would be a tremendous waste of processor time if, for example, a retransmission must be requested because a parity error is discovered after the computer word has been laboriously assembled. More sophisticated error detection or correcting codes, such as those of the cyclic variety, are probably best implemented in the processor, but parity and longitudinal redundancy checks can occupy too large a part of available processing time.

Precise timing is also a rather difficult problem in the main program. As a minimum requirement, some sort of external device is necessary when fractional stop bits are required by the channel. Furthermore, if the main program is in control of synchronous transmission, the outgoing bits must be delivered to the channel at precisely the right instant. Character synchronization must be maintained as well; thus, the central processor must be prepared to recognize or deliver the appropriate bit pattern.

While these functions are being performed, the computer must also maintain a list of lines and their statuses—idle, transmitting, or receiving. This is not a simple procedure even for a few lines, each with only a single remote station. But when there are many lines, each with a number of stations, this housekeeping can become very involved. Whether the system uses a contention system, a polling sequence from the central computer, or a hub go-ahead scheme, the computer must somehow identify each message with a particular remote terminal. Such a process can be extremely expensive in terms of memory space and processing time. Dial-out or dial-in systems present even more complications to be dealt with by the main program.

In many systems, some messages are sent by one terminal and destined for another. These need little or no processing; but this "message switching" can again tie up much of memory and process time. If the terminals are on lines of different speed, even more difficulty arises.

In any large and complex system, faults can occur in many ways. In a real time system, terminals can fail and transmit nonsensical messages, communications channels are subject to noise bursts and outrages, and even the central computer can go astray. Localizing the trouble is a major consideration. The central computer should be able to use the information available to it ("carrier off" from the subset, lost message sync, invalid format, etc.) to give a tentative diagnosis of the problem area. Such a feature would undoubtedly reduce the system down-time by a substantial factor. Unfortunately, systems costs are increased.

A number of common problems and desirable features for real time systems have been pointed out. This is by no means an exhaustive list; but to accomplish this much unaided for a system of any size, a computer would have to have the capabilities of a STRETCH. Even at that, the network housekeeping and processing would so tie up the computer that it would be unavailable for anything else, even with the cleverest programming.

Thus it becomes apparent that if a central processor is to be able to accomplish anything when connected to a communications net, some adaptation is necessary. The communications environment requires the performance of the functions mentioned above in addition to the normal data processing operations.

To accomplish the total system requirements, the performance of "exchange functions" is distributed between the program of the central processor and an external device. At one end of a scale of simplicity, this external device might consist of a special interface to a standard data channel or, at the other end of the scale, the external device might be a sophisticated stored-program machine. The total system complexity determines: (1) the specific "exchange functions" to be performed and (2) the precise distribution of these functions between the external device and the central processor program.

Methods of Solution

A hierarchy of exchanges can be defined on the basis of their capabilities in handling the functions and solving the problems delineated above. On the lowest level is the standard data channel which leaves all of the housekeeping work to the central processor. It is apparent that this is a rather unsatisfactory answer; too much time is wasted because of the speed mismatch. It is easy to show that servicing a single 2000 bit per second line on a bit-by-bit basis would take up approximately 10 per cent of the processing time in a machine as fast and sophisticated as the IBM 7090. Two such lines would take more than 20 per cent; the time increase is not a linear function of the number of lines because of the additional time required to determine which line delivered the latest bit.

The next level in the communications-computer connection might be a simple attachment or adapter for a data channel. This device might be expected to assemble the line information into computer words without regard to content or format and to deliver these words to the memory under control of the main program. Such a device alone would result in a significant saving in processing time. This attachment is expected to control or to acquire information about the line status and to deliver appropriate control signals. This would apparently be the minimum requirement for any system.

Proceeding farther in the direction of complexity and sophistication, the next step leads to a multiplexor. A multiplexor performs the basic functions of character assembly and distribution for each of a number of lines. Instead of waiting for the main program of the processor to initiate the reading of buffered information into memory, with the consequent possible loss of incoming data, the multiplexor generates an interrupt and the character is read directly into a predetermined location in the main memory.

Two multiplexors are described below. The first is used in a message switching system, and is designed to handle low-speed lines. The central processor in such a system need not be large; a minimum of processing is performed on the incoming and outgoing data. The second multiplexor, which handles telephone-speed lines, is basically a communications interface for a more powerful processor which performs a substantial amount of data processing.

The most elaborate device, in the present generation of computers, is the stored-program exchange. Capable of handling a large number of lines running at various speeds, this machine can convert as many codes as are used by the attached channels, assist in the isolation of any trouble, control polling and message priority in the entire system, and perform message switching. It is extremely flexible, sophisticated, and complex, and can perform a very large number of tasks because of its stored-program capacity. It can even be programmed to do some of the processing normally done by the central computer. Because it was designed primarily for communications network use, its organization is rather unusual.

Data Channel Communications Adapter (DCCA)

The minimum communications adapter mentioned above is a very simple device. Attached to a computer's data channel, it makes low-speed communications channels "look like" tape units or other ordinary storage devices.

This data channel communications adapter (DCCA) might have, for example, six 80-character buffers, each permanently assigned to a specific line. Capable of handling telegraph lines, data transmission terminals, remote inquiry units, or other specialized input-output devices, each buffer has a particular systems adapter for the type of device connected to it. It is impossible, therefore, to change the communications configuration arbitrarily without making changes in the DCCA.

When connected to telegraph transmitters and receivers, the data transmission rate is limited only by the common carrier's transmission rate. The DCCA converts the data received from the five-bit telegraph code into processor code as a systems function; no programming is necessary. Since most telegraph messages contain administrative information (date, time, etc.) not necessary for the computer, the data portion of the message is set off by special characters, such as parentheses. The message is stored in the appropriate buffer, until the buffer is filled or a closing parenthesis found. Only one data message is stored in a single loading of the buffer. Since priority operations might be occupying the data channel or the central processor, preventing the transfer of data, any data beyond 80 characters could be lost. Letters shift, figures shift, line feed, carriage return, and the like, are not needed by the computer; these characters are automatically deleted from an incoming message and added to any outgoing transmission.

As far as programming is concerned, the channel buffers in the DCCA are to be handled much like tape units. A two-digit address suffices; the first digit identifying the type of systems adapter, and the second the particular adapter and the transmit-receive status of the line.

Because telegraph code is so rigid, and because the DCCA has fixed buffering for each line, scanning and sampling are relatively simple functions. Actually, no scanning is necessary; sampling is accomplished by using the start-bit transitions to trigger a multivibrator-counter-gate arrangement.

This system is, of course, rather limited in its scope. However, since 80-character messages are assembled and code converted, a large load is lifted from the computer. This basic approach can be used in a large number of applications.

The simple modification of a data channel is usable only in extremely small unsophisticated applications. Generally, only a small number of lines can be handled with a bare minimum of control. As the number of lines grow, the computer is interrupted proportionately more often and this problem combined with the general organizational mismatch functionally prevents a satisfactory system solution.

Low-Speed Communications Multiplexor (LSCM)

The next logical step is the design of a special channel geared to meet larger communications problems. This channel might work with a small processor where the exchange function is a relatively large part of the total processing requirement such as a message switching application. On the other hand the exchange function may only be a minor portion of the processing requirement such as data collection for a large control system. Likewise, the special communications channel can vary in sophistication. The typical message switching application would normally have lines of similar speed, code and interface. The data collection application would probably have lines of varying speech, codes and interfaces. For the moment, the message switching application will be considered.

The basic exchange functions to be performed in this case are character assembly, character distribution, and network control (polling, dial-up, etc.). It is assumed that code conversion is not required since the lines are similar and the computer is code compatible. A small processor generally does not have an elaborate interrupt system and most probably no processing overlap capability. For this reason, it is not desirable to interrupt the processor more frequently than once per character period. The frequency of interrupt in this case is equal to n/T, where n is the number of lines and T is the character time. On the other hand, a large degree of character storage would have to be provided in the special channel if the frequency of interrupts is too low.

A logical approach is to design the communications channel system to perform the repetitive functions that would tend to interrupt the processor most often. When it is necessary to interrupt the processor, it is desirable to transfer as much information across the interface as possible. Rigid specifications are placed on the processor subroutine generated by the channel interrupt to insure efficient data transfer between the channel and processor.

The organization of the channel system is unusual (See Figure 1). Buffers are provided for the storage of up to three characters per line. A fourth per line buffer contains the line control character. Of the three data character buffers, one is used for character assembly and distribution, the others for character storage. The characters remain in the buffer until the processor interrupt is generated, allowing the data transfer. The status character allows the interchange of control information between the channel and the processor and serves also as a line status indicator to the channel.

The channel, which is modular in the number of lines serviced, samples each line several times per bit in order to minimize the effects of transmission noise on the received signal. The status character stores the present sample for comparison with the succeeding sample and also counts the number of samples. At an appropriate count, the sample is assumed valid and stored in the specified bit portion of the assembly buffer. When the complete character has been received, it is transferred to either available character buffer. The buffer configuration forces the computer to service a line at least once every two characters, minus one bit period, assuming the time to transmit the data across the interface is less than a bit interval. Since an instantaneous computer interrupt cannot be guaranteed, the system is designed to request interrupt whenever any line is found with both character buffers filled. The processor then has one character period to generate the interrupt before a character is lost. The character buffers that are loaded are indicated to the channel and processor by the setting of appropriate bits in the status character for that line.

The first system parameter which reduces the relative number of processor interrupts is the two-character-per-line buffer. The next step in reducing the number of interrupts is directed towards making the character transfer more efficient. When the computer is interrupted, many machine cycles are used by the accessed channel subroutine to set the status of the interrupted program and set the appropriate initial conditions before data transfer from the channel may commence. When a particular line indicates that both buffers are filled, it is probable that some of the other lines have assembled one character and are in the process of assembling the second. Therefore, to gain efficiency, whenever an interrupt is generated, all line buffers of the channel are scanned sequentially. All completed characters are transferred to the processor and placed in their appropriate locations in storage. Therefore, there are proportionately fewer requests for interrupts and less machine cycles wasted in initialization, leading to a more efficient processing operation.

In the message switching application under discussion, the processor is responsible for network control, message monitoring and editing and error control. In a real-time system, error control is quite sophisticated and requires a large number of instructions. Since the processor under consideration is fairly small with limited memory, only the programs which perform the necessary on-line operations are stored in core memory. Special functions such as error control routines are stored on a drum, file or tape and read into core only when requested by the main program.

The processor typically used in this type of application has a table look-up as well as arithmetic capability. The tables are used to store line status information such as which terminal is transmitting or receiving, what function is to be performed next, i.e., send poll character, wait for answer, etc. The processor also must interpret the format of the message header and determine the ultimate address of the message. The program finds the address sequence, looks in a table and finds the appropriate outbound line on which the addressed station is located and then places the message in the queue for that particular line. At the appropriate time, the message is sent two characters at a time to the line buffers and is ultimately transmitted to its destination. The arithmetic capability of the processor is used to maintain statistical records and might also allow automatic filing.

The dedication of the processor to an exchange function places several stringent restrictions on its program and memory organization. First, when the interrupt occurs, all lines in the channel are to be scanned sequentially. The processor must have a control word, similar in function to the channel line control character, for each line. When an interrupt occurs, the two characters are compared and appropriate action is taken. Second, a specific area of memory must be assigned to each line so that messages are assembled line by line; if memory were not assigned in this way, the program would have to contend with an indeterminate mass of data and would have to resort to a complex sorting technique to reassemble the characters properly.

The memory assignment is a problem which has a huge impact upon the system. For the system to function without overwhelming program complexity, specific areas of memory must be assigned to each line. There are two possible consequences of this restriction. First, the maximum message length must be limited so that the message can be completely contained in the assigned area. Second, if a maximum message length specification is intolerable, the processor must be equipped with a drum or file on which the additional characters may be stored. The second alternative is inefficient due to the extra machine cycles now necessary to move data from core to drum or file. The inefficiency is amplified immensely if a processing overlap feature is not provided.

From the requirements placed on the processor by real-time application, it is obvious that almost the full capacity of the processor is utilized in performing the specified line control, format monitoring and message routing. Furthermore, as the number of lines increases, the processing power and memory capacity of the small machine become completely inadequate. The obvious solution is to connect a more powerful processor. However, as the number of lines increases, a variety of communications facilities may be used. Different speeds, codes and interfaces will have to be accommodated. In addition, as the system grows, the number of functions to be performed will be somewhat proportional to system size.

After increasing the processor capability, the next step is the replacement of the special communications channel by a more sophisticated version. Ultimately, the most efficient solution to the real time problem is the replacement of the standard computer and special communications device with a stored program exchange, explicitly designed to meet the real-time requirements of the system.

Real Time Data Channel (RTDC)

A slightly different approach along the same lines for high speed lines and larger central processors uses a standard data channel replacement. The real time data channel (RTDC) communicates with the central processor and core storage through the ordinary processor multiplexor rather than through a data channel and the multiplexor. On the communications side, the RTDC handles up to 16 full-duplex high-speed lines, all operating at the same speed and having similar interface control requirements (See Figure 2).

The RTDC assembles the input data into computer words and transmits them to core storage under programmed control. For transmission, the words are serialized. Simple code conversion and LRC checking are also performed. A buffer, containing a data word and a command word for each line, provides space for these functions.

Both input and output lines are continuously scanned. When the scanner recognizes a service request from an input line, the data word for that line is read out of the buffer, the new bit is added to the low order end of the data word, and the data word is stored back in the buffer. Similarly, a service request from an output line causes the high order bit from the appropriate data word to be transmitted. Since each line must be scanned at least once per bit time, these operations must be performed fairly rapidly. With 16 full-duplex 2000 bit per second lines, a total of 64,000 transmit or receive bits must be handled every second, or about 15.6 microseconds per operation. If more than one data bit is handled on each service request, this speed can be reduced in direct proportion to the size of the line buffers by moving the bits from the main buffer to a subsidiary buffer connected to each line.

Operation of the RTDC is similar to that of a standard data channel. When a complete word has been transmitted, the appropriate command word for the line is read out of the buffer and put in the RTDC control register. The channel then takes the next data word from storage, and stores it and the command word in the buffer. When required, new commands are obtained from the core memory. Bit synchronization information is obtained from the common carrier subset, and word sync is maintained simply by counting the 36 bits, or six characters, which make up a computer word.

The RTDC system also performs a number of automatic control functions. It is designed to recognize the end-of-message (EOM) character in a received message; when this recognition takes place, the rest of the word is filled with the blank character, and a received status word is composed and sent to core storage to complete the message. This word contains the received EOM character, the address of the input line, and a special character which indicates the presence of an LRC (longitudinal redundancy check) error.

Two traps may be enabled with the RTDC. One trap indicates reception of the EOM character during reception; the other can be set by a number of conditions. It can be set by carrier failure on a receive line; by the failure to recognize an EOM on a transmitted message when the transmission word count is exhausted; or by the receipt of an RTDC go-ahead character.

An indicator is set for each line requesting a trap; priority circuits determine the execution, but no trap is executed until all line servicing is complete. When this is done, the command for the trap requesting line is read out of buffer storage and read into the channel registers where the appropriate trap indicator is turned on. Once this indicator is set, the RTDC must be released from trap status as soon as possible; after a very brief period, all of the line buffers will be full and the incoming data lost.

Because the RTDC replaces and looks like an ordinary data channel to the central processor, programming is much the same. There are two significant differences, however. First, all of the lines may be in use at the same time, rather than just one input-output device. Second, transmission and reception takes place simultaneously rather than in alternation. These require slightly modified execution of some of the instructions and commands.

Since the read instruction and the write instruction are redundant, one may be used to turn the RTDC on, the other to turn it off. The address field for either need contain only the channel address, since no density or I-O device address need be given.

The commands executed by the channel must therefore contain the address of the line to which the command pertains. This might be done by modifying the word count field in the word; word counts are not likely to be great either in transmission or reception. Five bits are necessary to specify one of the 32 connected lines; the remainder of the field will still be available for its normal word count function.

Certain obvious limitations of the RTDC should now be apparent. It will not handle a mixture of line speeds. There is an apparent limitation on the product of (line speed) x (number of lines) for a given systems dollar cost. This is a failing common to most matching devices, and does not detract from the value of the RTDC. A more serious drawback from a programming point of view is that messages sent to the computer must have a fixed length, or at least a maximum length, in order to use the ordinary channel commands. This implies fixed memory assignment for incoming data, and may consequently be wasteful and difficult to program. This difficulty is not present for output messages, which may be of any length.

This type of device will, nevertheless, satisfy the requirements of a large number of systems. A solution to the problems of more involved systems will be discussed next.

Programmed Exchange (PREX)

When the exchange functions require an appreciable percentage of the computer processing time, two possible solutions are indicated. The most obvious would be to increase the power of the processor. The second would be the removal of the exchange burden from the central processor by the addition of a second stored program device which uniquely performs the required communications-oriented functions.

A programmed exchange (PREX) is capable of operating in conjunction with another processor which would perform the main data handling requirements (as indicated above) or it may stand alone acting solely as an exchange and store and forward message switching device. Functionally, it must perform all the aforementioned communications functions, namely: line speed conversion, bit and character assembly and distribution, code conversion, network supervision (polling, selection dialing, etc.), editing and monitoring. Most important, PREX must be capable of detecting and indicating error conditions occurring in the remote terminals, communications facilities, and within PREX itself.

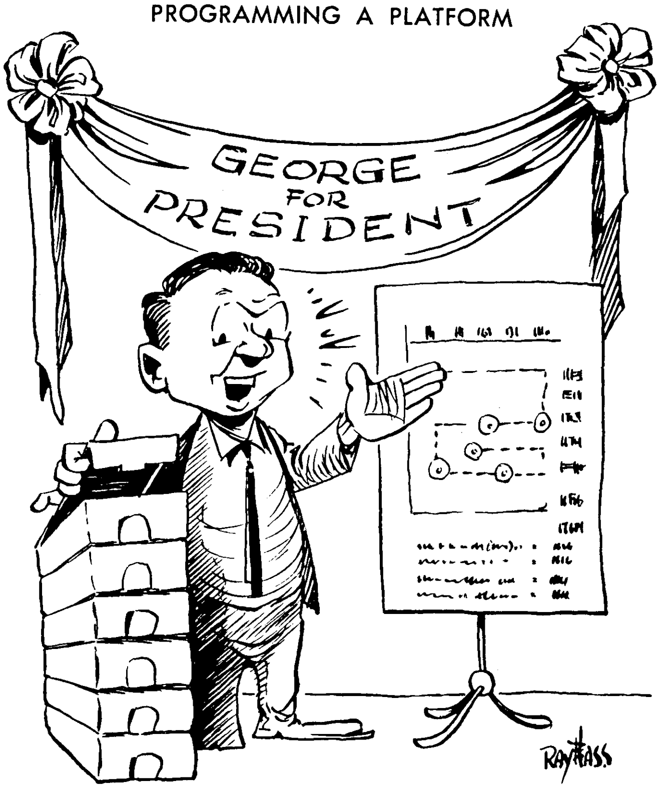
The organization of PREX is unique since it is specifically designed to function in the communications atmosphere (See Figure 3). At its communications interface, PREX is very versatile. It can handle a large variety of line speeds, transmission codes and facility interfaces. Changes in the above parameters can be made at any time with little or no difficulty. Its processing capability has several unique features. Each line is independently controlled and much of the required status information is automatically updated without program assistance.

The programmable portion of the machine has two interesting capabilities: (1) dynamic memory assignment and (2) automatic functional priority interrupts.

The dynamic memory assignment allows a large degree of flexibility in the assignment of queuing storage. In the other approaches considered, specific areas of memory are permanently assigned to each line, forcing either maximum message length restrictions or the requirements of additional auxiliary storage. In PREX, memory is assigned in small blocks of character storage positions as requested from its controlling program. The assignment is completely flexible in that any block might be assigned to any line or functional queue. To reduce the bookkeeping when the message length exceeds the block length (which ordinarily occurs in normal operation) the last character position of each block is reserved for the address of the newly assigned block. Therefore, the blocks may be assigned randomly. This is referred to as a chaining technique. The program is only responsible for the maintenance of the address of the first and last blocks of the queue since the intermediate blocks are internally chained. This technique removes the maximum message length restriction and allows the use of a relatively smaller memory compared to the size required by a fixed assignment system of equal storage capacity. The natural variation in hourly traffic on the line is efficiently handled, as memory is assigned to a line only as required by the current traffic.

In a real-time system, some operations are not under control of the PREX program and therefore must be handled as they occur rather than at the convenience of the program. Each internal and external function of PREX is assigned to one of the available priority levels. Each priority level contains an independent program. During normal operation of PREX, if at any time a function having a higher priority than the one being executed is requested, the program being executed is halted at the end of the current operation and all appropriate status information is automatically stored. At the completion of the higher priority program, the interrupted program resumes operation if no function having an intermediate priority is waiting. Interrupts can occur in any order, the only controlling function being that the highest requested priority will always take control at the end of an instruction execution. An example of the functional priority hierarchy is (from low to high): (1) polling (2) preparation and transfer of information from PREX to the central processor (3) dynamic memory assignment and (4) diagnostic techniques.

PROGRAMMING A PLATFORM



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IBM Data Processing Division
Poughkeepsie, N. Y.

Management has become significantly interested in the concept of what is variously called a total management information system, a real-time management system, or a communication-based management system. In essence, these terms refer to business information systems that differ a great deal from most existing batch-type systems.

One of the prime functions of these new systems is to provide management with *timely* information. And although the definition of the word "timely" varies from one business to another, one of the characteristics of all information systems is that they shorten the time interval between the completion of a business transaction and the introduction of that transaction into the information system. To reduce this time interval, a wide variety of communications are already in use, or are being considered for sending and receiving data from one location to another.

Planning Considerations

In order to make detailed plans for a communication-based management information system, a clear and precise statement of the objectives of the business is required. This statement of objectives serves as a cornerstone for building a communication-based management information system. Then as the system is developed, any potential conflicts of interest can be resolved in terms of the total system objectives.

What then are some of the specific planning considerations? Among them are:

1. Information Gathering
2. Data Reduction
3. Input/Output Terminals
4. Communication System Design
5. System Design
6. System Implementation

Information Gathering

Three types of information are required:

1. *Data*—Figures of volume of data processing—This information is needed for any reasonable system design; it may be expressed in terms of characters per punched card, characters per magnetic tape record, etc. At the same time, the character information must refer to the business system. Therefore, the volume figures must cover business transactions, accounting records, file sizes, etc.
2. *Traffic Statistics*—Measurement of the traffic passing through a communication system—How many characters is the length of an average message? What is the length of a maximum, as well as a minimum message? What is the nature of each point's traffic in terms of sending and receiving? Communication systems generally need to satisfy a peak load. Therefore, the information gathered should include the peak period as well as other periods. The distribution of traffic among receiving and sending locations may be significant.
3. *Information*—Knowledge other than pure volume figures or traffic statistics—This type of information includes such items as: planned company expansion at various locations; acquisitions of other companies; projected business growth; consolidation of functions or operations, etc.

Data Reduction

Having too much information may be as much a problem as having too little. In the case of having too little, reasonable estimates may be made based upon the limited information available. In a situation of overabundance of information, determination of what is needed and what is not needed is most important.

One guideline toward selecting information is to be found in the system objective classified as "response time." Response time is often one of the most significant objectives in the design of the system. It may be measured in terms of seconds, minutes, or hours; it generally relates to desired service. In turn, the information to be selected would be judged in the same way. The selection may be accomplished by visual inspection, a computer program, or in other ways.

Input/Output Terminals

A business system usually requires a variety of information transmission capabilities in order that a business event may be responded to almost as soon as it is introduced into the system. The needs of each location must be studied in terms of input/output requirements. These requirements may include:

1. Printed output
2. Keyboard entry
3. Paper tape input
4. Paper tape output
5. Punched card input
6. Punched card output
7. Magnetic tape input
8. Magnetic tape output
9. Visual display output
10. Audio output

Ideally then, each location's input/output capability would be individually tailored to fit the requirements of that location. The throughput capacity, as well as communication facilities required, would also be an influencing factor.

Communication System Design

Decisions about communication facilities rest on: present voice and data transmission; anticipated voice and data transmission; quality of voice transmission; volume; response time; economic arrangements versus unprofitable extremes; etc.

When it comes to connecting cities and lines, the common carriers and others can lend valuable assistance both from an analytical as well as a network simulation standpoint.

As other planning facets are considered, the significance of knowing the size and throughput capability of the communication network will be evident. The basic system design is influenced, for example, by whether the communication system is to deliver 100,000 characters per hour or 1,000,000 characters per hour.

System Design

All of the previously mentioned areas influence the basic system design. The factors affecting the design include:

1. Computer storage requirements.
2. Auxiliary storage requirements such as tape files, drums, etc.
3. Computing power needed.
4. Communication capabilities of the computer in terms of number and types of communication lines that can be attached.
5. Programming and operating systems.
6. Compatibility of computer equipment towards increases in power and storage from additional equipment in the future.
7. The possibility of capitalizing on the business experience available with a certain computer system design.
8. Cost—A major factor in system design is cost. If a system has been skimped because of cost, it may be that the system objectives cannot be met. On the other hand, a system designed with no attention to cost ignores the realities of business life.

It may appear that system design is performed only once, but actually many iterations of design occur before the final design results. Time must be allowed for these system design iterations.

System Implementation

Four areas of system implementation are: scheduling, training, testing, and conversion. These areas must be considered during the system design stage; it would be foolhardy to ignore implementation planning until just a few months before installation date.

Many different scheduling approaches, all the way from the yellow pad and pencil up to a large data processing system, are used to determine the critical path of an installation. One advantage of scheduling is that it forces the planner to list every activity that must be accomplished to meet the planned installation date. Each item on the schedule should then be labeled with its expected time-period, days, weeks or months. Next, the inter-relationship of each activity or item to all others must be considered so that each item on the schedule is accomplished in a desired sequence or network of events. Finally, a schedule needs continual revision to reflect the most current stage of completion of the individual activities.

Training

A second area of implementation is that of training. The success of many systems will depend upon the training provided for all individuals who will be involved with the system. A general training program is needed for many individuals to acquaint them with the concepts of the communication-based system. If new communication terminals are introduced into the company, a second kind of training is needed for the terminal operators. A third type of training program is in-depth training for the personnel of the data processing department. This type of training differs in direction and orientation from the first two groups. The success of a new system often depends critically on broad over-all training and terminal operator training.

Testing and Conversion

The next area of implementation is that of testing. In the past, testing of a system of this type has been overlooked and underestimated in terms of time, more so than any of the other factors needed for a successful communication-based system. Communication-based management systems introduce a degree of complexity to which most of us have had little or no exposure. Some of the reasons for this complexity are: random input and output; new and different terminals; more sophisticated requirements for programming and operating; greater concern over errors being introduced into the system, and therefore an increased emphasis on error checking routines; one-of-a-kind systems for which there is no prior experience; and finally, the sheer physical size of the system.

Conversion to a communication-based system is another major consideration in itself. What is the nature of the present-day system as contrasted with the future system? A parallel approach, which has been successful in the past, might be impossible to use with this type of system because of space, cost, and personnel considerations. Also, there may be no like-system to parallel.

The planning of a communication-based management information system is likely to require a high level of careful, informed, and intelligent planning for the success of the system to be assured.

A REAL TIME COMPUTING SYSTEM FOR SUPPORTING MANNED SPACE FLIGHTS

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The computer field today is expanding spectacularly on many fronts. One of these is the use of automatic real-time computers at the heart of large information-processing systems.

These systems require enormous efforts in programming and hardware design; so it is important that we study existing systems in order to guide the development of future systems that are even larger.

The system here discussed is the Goddard Realtime Computing System, which has been used to support all the National Aeronautics and Space Administration manned space flight missions to date.

The system is currently being augmented to support the forthcoming Gemini Non-Rendezvous flights; it has been used to provide prime computing support for the Saturn SA-5 and SA-6 flights, the first Gemini GT-1 flight, the Centaur flights AC-2 and AC-3, to mention a few. This article summarizes some of the experiences, difficulties, techniques developed, and lessons learned, during the design, implementation, and operation of the Goddard Realtime Computing System.

Objective

The principal objective of Project Mercury was orbiting a man in a spacecraft and returning him safely to earth. In order to accomplish this objective, it was necessary for NASA to implement a ground instrumentation system to provide all the functions for ground control and monitoring of the Mercury flight from liftoff to landing.

Early in the design of the system, it was decided to provide realtime control for the manned mission. This decision required:

—a realtime automatic computing system to provide realtime control of the manned mission from liftoff to landing;

—the realtime gathering and processing of data;

—transmitting and displaying the computed output quantities to the Mercury Control Center at Cape Kennedy and all this without human intervention. To meet these requirements new data transmission equipment and computer peripheral gear was required. A new concept in large scale realtime data processing was required to tailor computations to a computer cycle, and to manage the priorities of the computations performed automatically.

Precision

In all phases of the Mercury Mission it was vital that the many different forms of necessary calculations be performed with exact precision and the data be made available almost instantaneously. For example, in twenty-five seconds after booster burnout and spacecraft insertion into orbit, the computers were required to furnish data for evaluating whether or not the mission should be permitted to continue and recommend a GO or NO GO, based on tracking information.

Inputs

The inputs to the computing system are the tracking devices in the Mercury network. Two principal types of precision tracking radars are used to automatically track the spacecraft, the AN/FPS-16 and VERLORT radars. The AN/FPS-16 is a precision C-Band tracking radar with a 12 foot dish. It has a narrow beamwidth of approximately 1.2° and is the most accurate tracking device in the Mercury network. The S-Band or VERLORT radar is a VERY LONG RANGE RADAR. It has a 10 foot dish and a beamwidth of approximately 2.5°. Another tracking device is the active acquisition aid. It has a quad-helix antenna, operates on telemetry frequencies, has a broad beamwidth of 20° and normally acquires the target first. During a mission, data from the worldwide Mercury Tracking Network are transmitted via data circuits to the Goddard Communications Center. From the Communications Center, the data is transmitted to the Goddard

Computing Center. Here realtime equipment places the radar data from each tracking station automatically in the core storage of the computers. For early missions a duplexed configuration of IBM 7090 computers were each connected by a DCC (Data Communication Channel) to radar sites and sources comprising the realtime tracking and instrumentation system. For later missions, a triplex configuration of IBM 7094 computers was used. During a manned mission it is a mission requirement that duplexed computers (one active, one standby) be used to support. These computers operate independently but in parallel to process the data. Should a computer malfunction during the mission the other computer may be switched online to support the mission while the malfunctioning computer is taken off-line and repaired. For extended missions of two weeks or more the triplex arrangement permits cyclical preventive maintenance on the computer systems. The data from the worldwide tracking net is processed in the Goddard computers and converted to parameters necessary for the control of the mission. This information is transmitted to the Mercury Control Center at Cape Kennedy. About 18 digital displays, 4 plotboards and a wall map are driven at the Mercury Control Center by the Goddard computers.

SHARE Operating System

The Mercury computing program is an automatic realtime computing system. A slightly modified version of the SHARE Operating System was chosen as the basis for programming the Mercury Computing System. The heart of the realtime computing system is the monitor system.

Monitor Control Program

The Monitor Control Program controls and coordinates the acceptance of input data (which arrives asynchronously), performs the proper computation on the input information, and provides the required output quantities at the specified time intervals. The primary control mechanism in the Mercury Monitor is the "program trap." A "trap" is a programmed interrupt in the normal flow of the computer program which will cause a transfer to a specific location. When the computer is enabled, it will immediately honor a trap and control passes to the priority table. Each ordinary processor is represented in the priority table. When a trap occurs, the monitor saves the condition of the machine so that it may be restored when this processor is reentered. The Monitor then performs such tasks as the following:

—Determines which subchannel caused the trap.

—Finds the specified trap processor, enters it and after completion returns control to the priority table.

—If the monitor finds it must return to the interrupted program, then the condition of the machine is restored and control is returned to the point in the interrupted program from whence it came. When completed, control passes back to the priority table.

—If no computing task remains, control is given to a diagnostic processor where it will remain awaiting the next trap.

The Monitor priority system is extremely flexible, since routines may be added or dropped or shuffled around in the priority table at compilation time to meet the needs of the external world.

Core Storage

At the present time the launch program which includes all abort modes occupies 32,000 core locations. The orbit and reentry phases use 65,000 core locations. The orbit and launch abort programs will not fit into core storage together. Currently our computers are equipped with memory units of 65,000 executable core locations.

Testing by Simulation

Any system, particularly a system as complex as the Mercury System, has to be thoroughly tested under conditions as close to actual operating conditions as possible. It is not enough to know that processors, and subroutines function properly; it must be established that all elements function together as part of an integrated subsystem or as a complete system.

An elaborate system for simulating a Mercury mission was implemented to test the system and train flight controllers. Data from all the launch sources were placed on magnetic tape which could be played from Cape Kennedy in realtime to the Goddard computers. This simulated the powered flight phase of the mission. Radar data was recorded on punched paper tape and transmitted from each radar site on scenario over the actual data transmission lines for a particular simulated mission. All displays at the Mercury Control Center are driven during simulation and all acquisition data is sent to the sites. This permits full network participation in simulated drills prior to a mission; it also tests the computer programming system in the hardware environment it was designed for.

Performance of the System

Many missions were successfully supported by the Goddard Realtime Automatic Computing System. Missions listed the computing system performed its basic functions normally and without exception.

The performance of the network in terms of its accuracy in determining orbits was a vital measure of its usefulness in performing mission control.

An indication of the accuracy of the total system is demonstrated by the calculation of time to fire spacecraft retro-rockets which determine its precise landing point. The spacecraft timing system is such that the rockets are fired at the integer second. With the spacecraft traveling at 5 miles per second, the landing point is known only to ±2.5 miles. The recovery forces are able to estimate their position to about ±2 miles. Thus the total uncertainty may be approximately ±5 miles. The associated table shows the landing points computed for the four manned missions compared with the reported pickup point of the spacecraft by the Navy.

The tracking information in MA-7 and MA-6 provided landing points within 15 to 20 miles of that reported by the recovery forces. This difference may have resulted from lift experienced by the spacecraft in reentry. The predictions for MA-8 and MA-9 are well within the area of uncertainty and show a nearly perfect retrofire and reentry. The major source of error in orbit computations was found to be caused by the uncertainties in the geodetic location of the tracking radars and the reference ellipsoid. Knowledge of these uncertainties has improved and the accuracy of orbital determination has improved concurrently to the point where spacecraft position in space can

MISSION	ASTRONAUT	COMPUTED No. Latitude	LANDING POINT W. Longitude	REPORTED No. Latitude	PICKUP POINT W. Longitude
MA-6	John H. Glenn	21° 31.2′	68° 52.9′	21° 25.6′	68° 36.5′
MA-7	Scott Carpenter	19° 24′	63° 53′	19° 30′	64° 15′
MA-8	Walter M. Schirra	32° 6′	174° 31.8′	32° 5.5′	174° 28.5′
MA-9	L. Gordon Cooper	27° 22′	176° 29′	27° 25′	176° 30′

be determined on the order of 200 to 300 yards. In considering performance as a whole, the computing system can be said to have performed considerably better than originally anticipated.

Simplification of Outputs

As in the design of all systems, in order to specify the computing requirements, it is first necessary to define the outputs and the inputs to the system. Although this appears initially to be a simple task, for a system like Mercury it turns out to be a difficult undertaking. For example, the parameters and displays necessary for the control and support of a mission are difficult to reach agreement on. Initially the neophyte wants everything displayed he can think of. He soon finds out superfluous displays complicate his job, and he does a more efficient job with a smaller number of really necessary displays.

It is important therefore to determine as early as possible the minimum amount of information required to control the mission. In addition, in order to control an automatic computation it is necessary to specify the parameters required to monitor its sequence and performance.

Having specified the "outputs" it is then necessary to determine the "inputs" to the system required to give the desired output parameters with the required accuracy and within the time frame required. These considerations lead to studies to determine minimum data rates required from radars to furnish required accuracies. Results of these studies must be balanced against cost of leasing worldwide communication links, knowing that costs advance exponentially as we cross thresholds of 60 word per minute, 100 word per minute teletype or 1000 bit per second links, etc.

Processors

The processors relating inputs to outputs must then be generated. In Mercury we found that this is always a compromise between using the best theoretical techniques available and tailoring these techniques to the computing cycle of the realtime computing system. In the design of a system such as this, one is constantly faced with the dilemma of sophistication versus simplicity. One must constantly analyze the benefits to be gained by using a new or more refined technique, as compared with the effort required to implement it. As a rough rule, you get 80% of the accuracy required with 20% of effort, while the last 20% requires 80% of the effort.

Importance of Modular Design

At the time of implementation of the Mercury system a new dimension in the computer programming art was required for the Real-Time Operational Computing System. Most of the task fell into the research and development area. For such a system a great deal of attention must be given to choosing a set of standards and requiring the programmers to adhere to them. It is also important to choose a compiler language that has the growth potential and flexibility to be able to accommodate a much larger system than originally anticipated. When geared to a computing cycle, the language must also optimize the machine capabilities. In Mercury we learned the importance of modular design and avoiding restraints that require costly redesign of the programming system after a period of unsuspected growth. New techniques had to be developed for debugging the operational program in the realtime environment.

For a system such as Mercury, programming tasks had to be distributed in blocks such that a number of programmers could work independently on separate tasks and when completed they had to be integrated into the major system.

A comprehensive testing program for unit test of the individual program outside the system and in the system was developed. From our Mercury experience we cannot emphasize enough the value of simulations in readying a computer program for a mission. For a large system such as Mercury where the input data arrives on an asynchronous schedule it is impossible to test all possible combinations of the estimated 10^{20} paths through the program.

Estimates of Programming Effort

As is normal for a large programming system, the estimates of the programming effort required were badly underestimated in the beginning. This, added to the creeping trend towards increased sophistication, caused the system to grow much beyond the level anticipated, and caused us much concern. Having lived with the system now for three years, we recognize and accept the fact that the system is constantly changing. We get more intelligent and knowledgeable about the system after every simulation and mission. Equipment and hardware continually improves, and unfortunately all such changes require programming changes. Freezing the system is a nice goal, but from a practical viewpoint, for a system like Mercury, it is unrealistic.

Changes to the Program

One lesson learned early in the operation was that programming changes to the system had to be rigorously controlled. One man was designated KEEPER OF THE SYSTEM. He is responsible for adding or deleting all changes to the final program which is used to support the mission. He is also responsible for the final testing of the system.

Communication Among People

Another important coordinating activity that is vital to the success of implementing and keeping the system operational is good communication between programmers and hardware engineers. Equipment changes almost always require programming changes and they must be coordinated. Format changes and computer and peripheral gear changes must be made known early to the programmers. To control these aspects as well as schedule changes, and to plan equipment and program changes, two committees were formed which met weekly. The Computer Working Group handled scheduling and information interchange on all computer and digital transmission gear attached to the computer. The Program Working Group dealt with schedules, program review, technical difficulties, etc., concerning computer program aspects. Both committees had representation from both the programming and hardware groups.

One thing learned very early was that it is very difficult to schedule the programming effort, mainly because it is difficult to anticipate the debugging process. Convenient milestones for pacing the effort turned out to be simulation and mission schedules. It is obvious that when the booster is on the pad, the system has to be ready to support the mission. As it happened, it was the rule rather than the exception that as shot day approached, people would work around the clock to debug faults found in the program.

Documentation

Documentation is extremely important in a system such as Mercury. A system for daily, weekly and final documentation of programming effort was inaugurated and carefully monitored. It is enlightening to learn the high cost of published documentation.

The difficulties encountered in this area are: first, getting the programmers to document daily and thoroughly; second, determining the level of detail required in the documentation; and third, trying to hold the cost of documentation within reasonable bounds of the budget.

Personnel

With regard to personnel, experienced programmers with two or three years of 700 machine series experience were difficult to find. We were continually searching for programming talent. In order to fulfill our demand, on-the-job training had to be given to new programmers to complement the staff. Attrition due to programmers getting married, getting new jobs, or leaving for various reasons was a continual problem. We found that a great demand for our programmers with realtime experience developed outside our system, causing some of them to leave for better salaries. Better career opportunities had to be provided for programmers to keep them. We noticed particularly that programmers with too much work appeared happy, those with too little appeared discontented. We realize that this is probably not the general case.

Motivation was no problem; the interest potential of the job seemed to make dedicated people of all concerned. Everyone felt he was contributing to the success of the manned space effort.

We have the normal problems with computer time and competing for it. Since the space program demands quick reaction efforts in implementation of hardware and program changes, we have the normal frustrations of completing the paper work to get the changes underway to meet schedules.

Change in "Orbit Expert" from Person to Computer

It is probably of interest to note that at the point in time when Mercury implementation began, orbit computation was an art not a science.

Normally the orbit expert would stand in the middle of the computing room, edit the data arriving from the tracking sites and would choose one of several orbit processors to determine the orbit. But Mercury couldn't wait for trajectory information; it was needed immediately to control the manned mission. So it was decided to program all the logical decisions the orbit expert makes (called judgement factors) and permit the computer to make these decisions. These judgement factors such as edit criteria, etc., were rough at first but were refined on the basis of subsequent manned missions. This philosophy could have application in other areas.

Good Management

In summary the Goddard Automatic Realtime Computing System represents a milestone in the development of large computer systems. (Much research and development has been done on the new frontiers of realtime computing, receiving digital data from remote points over worldwide distances, and Realtime Monitor control.) The system has performed well on all missions that it has thus far supported.

It is hoped that some of the experiences gained in the implementation and operation of this system can be used as guidelines for the coming newer and larger systems.

If there is one thing we have learned from Mercury it is that good management is essential. As in any undertaking, the secret of success lies in having good people, technically qualified, dedicated, and enthusiastically performing tasks at all levels of the project.

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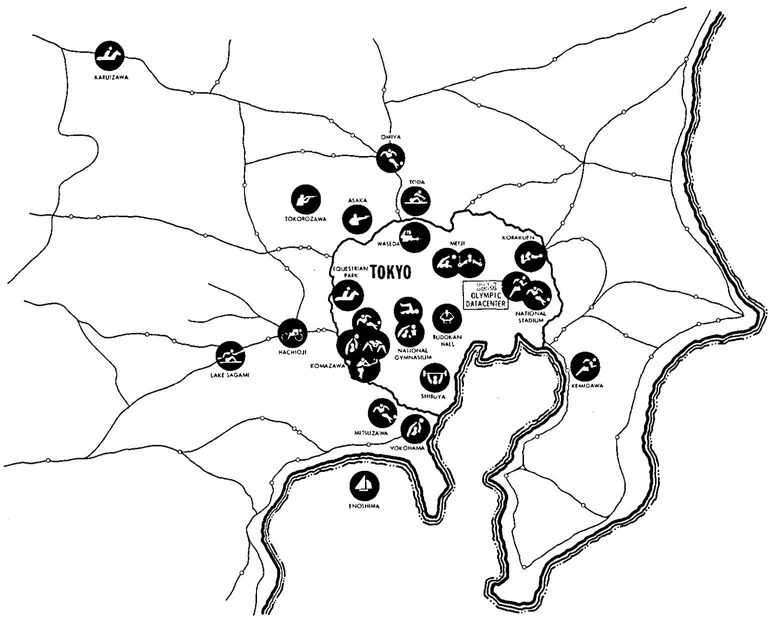
DATA COMMUNICATIONS ROUND-UP

Neil Macdonald
Assistant Editor

DATA COMMUNICATIONS AND THE 1964 OLYMPIC GAMES

The 1964 Olympic Games in Japan are the largest in history. 7000 athletes from 100 countries are competing in 4000 contests; and 5000 judges and officials are also involved. The events are at 32 different sites; at least 11 events are outside Tokyo. The farthest is Karuizawa, upper left, in the picture, 94 miles away, where equestrian events will be held. A total of 62 IBM 1050 "typewriter-like" data-communication terminals have been installed at event sites to send immediate scoring information to the Olympic Data Center. As many as 25 contests, at various event sites, will be taking place at the same time. Computers at the IBM Olympic Data Center will report winners of the races within seconds after they end. Minutes later, the computers will provide exact times and final ranking of all competitors in each race. They will also note if the winner set an Olympic or world's record.



The registration of 12,000 participants alone creates a significant data-handling problem. But when the contestants are competing at 32 different sites spread as far as 94 miles from Tokyo, control becomes extremely complicated.

The IBM system will allow immediate transmission of scores and other information from each of the 32 event sites to central computers for processing.

In events such as gymnastics, diving and horsemanship, where style is a key element of an athlete's performance, the computers will also take into account the points awarded by each judge and automatically calculate the final score.

Funneling concurrent contest information into the system will be 62 IBM 1050 data communications systems, most of them installed at the finish lines or judges' areas of the 32 event sites. Following the conclusion of a contest or an individual performance, a numerically coded message containing times or style points will be immediately keyed in at these typewriter-like units.

Data from the outlying terminals will feed directly into a switchboard at the IBM Olympic datacenter, located in the Press Building adjoining the National Stadium. Linked to this switchboard will be 133 telephone lines, 63 of which will carry digital information from the IBM 1050 terminals, the others control and communications transmissions. It is anticipated that more than 100,000 messages will be accepted at the IBM Olympic datacenter during the 14-day competition, and that perhaps three to four times that many messages will be returned to the various site locations.

The computer systems include an IBM 1448 transmission control unit, a 1440 computer, a 1410 computer, and a 1301 disk storage unit capable of storing 56 million characters of information. In all, there will be eight IBM computers at the datacenter handling messages and processing scores.

As data is received, the 1448 transmission control unit translates the information into computer language. This data then is checked for accuracy of transmission by a 1440. The message is confirmed by causing the sending 1050 to print, in red, a duplicate of the original message plus the athlete's name. These are obtained from the disk storage units. If the confirmation is correct, the computer is instructed to process the entry.

After the messages have been translated and verified in this manner, the 1440 automatically forwards them to the memory of the 1410. The 1410 checks the codes in the individual messages and calls forth from the 1301 disk storage unit the instructions required to process the score. And as soon as the last athlete's time is recorded for an event, the 1410 calculates the final unofficial standings of all competitors.

To get contest information disseminated simultaneously throughout the Olympic complex, 14 high-speed IBM 1443 printers have been installed in a dozen locations, including the National Stadium, the Olympic Village and the Television Center of the Japan Broadcasting Corporation. Condensed "flash" results also will be printed throughout the Olympic area using the printout capabilities of the 1050 terminals. Except for names and numbers, printout is in three languages: French, English, and Romaji (Japanese written in the Roman alphabet). Complete printed results will occur within minutes after each event ends.

IBM's preparations for the Olympics began two years ago. More than 150,000 machine instructions have been written and tested, representing a total of 203 complete programs. Millions of bits of information including detailed data on all competitors — even horses and boats — and rules governing the scoring of each contest, have been recorded in advance on the disk storage units for instant access by the computers.

Preparation and operation of the IBM system is, for the most part, being handled by personnel from IBM Japan, a subsidiary of the IBM World Trade Corporation.

The IBM Tele-processing system in Tokyo is representative of the data processing techniques being applied in science, industry and government.
(For more information, circle 49 on the Readers Service Card.)

GENERAL ELECTRIC'S PROVING GROUND FOR COMPUTER-COMMUNICATIONS SYSTEMS

Lacy Goostree
General Electric Computer Dept.
Phoenix, Arizona

General Electric has some 1,500 plants, laboratories, warehouses, service shops, and offices scattered from border-to-border, coast-to-coast. It manufactures and sells more than 200,000 different products, from computers to zymometers. Since it is one of the world's most diversified companies, communications needs to be one of its most important processes.

GE has been studying its own communications problems for years. It recently established an Information Systems Services at New York Headquarters to expedite the meshing of people, computers, communications gear, and statistical methods. The GE Computer Department tested a line of data communications equipment a year before introduction to customers. One of the tests involved successful transmission of computer-to-computer "talk" some 13,000 miles via Telstar between Phoenix and Schenectady, N.Y. With more than 120 computers installed and operating throughout the company, General Electric appears to be the world's largest user of computers outside of the U. S. Federal Government. Few customers can present a problem to the GE Computer Department that the company itself hasn't solved somewhere in its own product departments. Those facts present the Computer Department with a proving ground virtually unmatched by anyone in the industry.

For example, the company's Meter Department at Somersworth, N.H., has established an integrated information system which makes more effective use of office and factory equipment. Through use of a GE-225 Computer and Datanet Equipment, the Meter Department has: reduced shipping time on standard, high-volume meters not in stock from eight weeks to five days; stabilized employment; reduced overall net expenses; improved customer service; reduced inventory; improved inventory turnover 20 per cent; and improved product quality.
(For more information, circle 50 on the Readers Service Card.)

VOCAL RESPONSE FROM COMPUTER

Shown in the above picture is an inquirer receiving a telephone reply to an information inquiry received from the IBM 7770 audio response unit. The 7770 obtains information from a computer in response to a dialed telephone inquiry; the 7770 provides an answer over the telephone in the form of spoken words, which are assembled correctly from a spoken vocabulary of up to 126 words stored on a magnetic recording drum (shown in uncovered panel), and transmitted back over the dialing telephone. The information needed to answer requests may be stored on an IBM 1311 disk storage drive pictured at left.
(For more information, circle 51 on the Readers Service Card.)

MULTI-PURPOSE KEYBOARD CAN TRANSMIT DATA FOR ANY TYPE OF BUSINESS

An all-purpose data transmission unit, whose keys can be made to represent any type of information, has been developed by IBM Corporation.

The IBM 1092 data entry terminal can send a wide variety of business facts to a remote computer for updating and action. Operators need no special computer knowledge.

Interchangeable plastic overlays fitting on the keyboard allow the 160 keys to vary in function depending on the application.
(For more information, circle 52 on the Readers Service Card.)

UP TO 480,000 BITS PER SECOND

Collins Radio, Co., Newport Beach, Calif., currently provides digital data transmission equipment, designed for use on 3,000-cycle, 48 kc, and 240 kc communication channels.

In using one up to twenty sub-carrier tones, at maximum data rates, the 3,000-cycle units can transmit 6,000 bits per second; the 48 kc units transmit 96,000 bits per second; and the 240 kc units transmit 480,000 bits per second.
(For more information, circle 53 on the Readers Service Card.)

IBM reports to the industry—the new SYSTEM/360

All-purpose system solves variety of problems.

IBM SYSTEM/360 can solve data processing problems in every area of business, science and industry.

You can use this one system for inventory simulation, market forecasting, linear programming, statistical analysis and other jobs.

Two types of channels help handle these jobs at faster speeds. Selector channels control high-speed I/O devices such as tapes and files. A multiplex channel serves multiple I/O devices such as printers and communications terminals. All channels are overlapped and have data rates of up to 1,200,000 characters per second or 2,400,000 digits per second.

SYSTEM/360 uses an eight-bit rather than six-bit character (plus one check bit in every character). Two 4-bit numeric characters can be "packed" in each 8-bit character. This saves storage space and increases the data transfer rate.

The new character size and the instruction set provide greater flexibility for manipulation of individual bits within a character, making it easier for the programmer to set up switches, masks and similar logic instructions for a program.

IBM SYSTEM/360 features new I/O devices

With SYSTEM/360 you can choose from the widest selection of I/O devices ever offered with one system. You select only the equipment you need. When you need more power or capacity, just add new I/O devices.

The new IBM 2400 Tape Drives (with a standard ½" tape) utilize a 9-track, single-density, 800-bit-per-inch tape format...with data rates 22.5 K to 90 K per second. With an optional read-write head, the same tape drives work with conventional seven-track tapes.

For even faster tape throughput, the new IBM 7340 Hypertape Drive gives you rates up to 340,000 characters and 680,000 digits per second.

Other new devices: With the 2841 Storage Control Unit, every record on disks and data cell units may have an individual format.

The 2311 Disk Storage Drive gives you direct access to over 7,000,000 characters of data on each disk pack.

The 2321 Data Cell Drive lets you put billions of characters on-line.

The new 2301 Drum Storage Unit reads or writes data at 1,200,000 characters per second with an average drum latency to any record of only 8.6 milliseconds.

Using the vast assortment of I/O devices offered with SYSTEM/360, you can put together a large variety of configurations...to handle any data processing problem.

Memory ranges from 8 K to over 8 million characters

With SYSTEM/360, IBM offers virtually unlimited memory at low cost.

In this new system, the main core memory alone ranges from 8 K to 512 K. With large, high-speed memory like this, less programming is required.

Big jobs now go faster—particularly when they involve tables, rates, large matrices and subroutines.

Up to 8 million characters of bulk core storage can be added, one or two million characters at a time. Every character is directly addressable and up to eight characters can be accessed in only eight microseconds.

The programmer uses the same instruction set for any SYSTEM/360 configuration. You don't have to revise most of your programs.

This new type of core memory gives you the largest, low-cost memory ever offered.

SYSTEM/360's operating system is tailored to your needs

The operating system of SYSTEM/360 is a comprehensive package of control and processing programs which support a wide range of configurations. From this modular package, you select the elements which match your needs.

Control programs initiate job operations, load programs, assign I/O units, handle stacked job processing and job scheduling.

Control routines perform all I/O functions required by the processing program. These routines also take care of channel scheduling, control of buffer areas in main storage and standard file labeling.

The operating system includes improved compilers for programs written in FORTRAN and COBOL as well as symbolic assemblers with macro-instruction capability.

A new programming language has been developed especially for applications which require both scientific and commercial capabilities.

Problems can be stated in terms related to English, mathematics or symbolic language. The operating system automatically translates source programs into machine language and then executes the program, if desired.

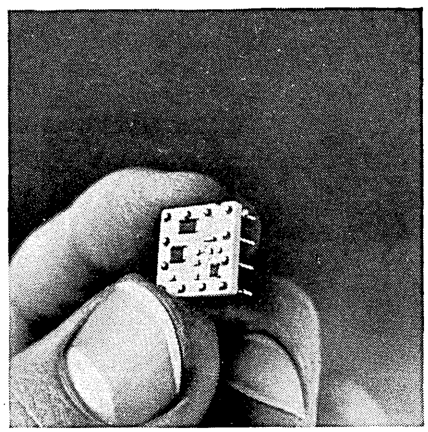
You get four new easy-to-use programming languages with SYSTEM/360—an assembler and compilers that speed both programming and processing.

New high-speed circuits used in IBM SYSTEM/360

In SYSTEM/360 we use a new "solid logic" technology, built around miniature circuits.

We manufacture tiny chip transistors, then assemble them into printed circuits only a half inch square—a fraction of the size of previous circuits. Finally, we permanently seal each circuit.

These tiny micro-circuits pack more computer logic in smaller space. And they speed operation inside the central processing unit.



New high-speed circuits contribute to the increased processing speed of SYSTEM/360.

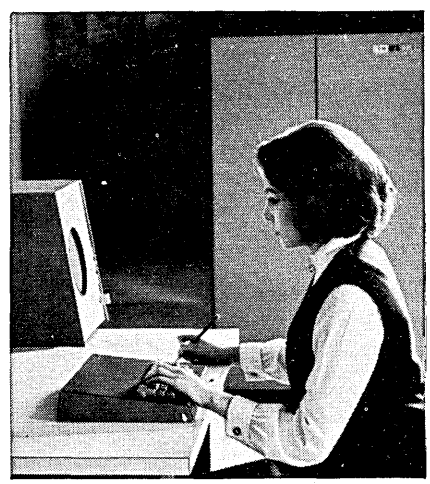
System offers complete data communication capabilities

SYSTEM/360 is designed to handle data communications and data processing operations.

It can be expanded, in stages, to take input from one to 256 communication lines. You may start with only one line and add as many as you need.

The system allows message data to arrive simultaneously with normal processing operations. Its fast, multiple interrupt plan minimizes the time needed to make a program switch, identify the interrupt and act on it. Control programs automatically relocate programs when necessary.

SYSTEM/360 also offers memory protection, dynamic storage allocation, direct access files of any size and speed, expandable core storage and multicode conversion.



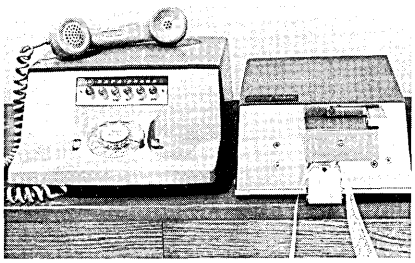
I/O devices like the IBM 1015 Display Unit keep you in direct contact with your central processor from any location.

IBM®
DATA PROCESSING

LOW COST DATA TRANSMITTER AT 60 WPM

Joseph L. Roller
Service Manager
Tally Corporation
Seattle, Wash. 98109

We were pleased to hear of the special October issue featuring data communications. Tally is very much involved in this market. I am enclosing our most recent literature concerning our data transmission equipment, and also enclose information concerning our Mark 10 data transmitter. I think this device merits some special attention in your issue. While there are faster transmission units on the market and there are cheaper transmission units on the market, there is no question whatsoever that our Mark 10 has the least cost per unit of information transferred. The Mark 10 transmits 60 characters per second (600 words per minute) with a sale price of $600 or a lease price of $25 per month. It uses Bell System Model 402 Data-Phones.



The success of the Mark 10 since its introduction late in the spring has exceeded that of any new product which we have introduced in four years. It has been delivered to and is in operation in such companies as Kaiser Aluminum, U.S. Envelope, California Packing, and American Metal Climax.

The Mark 10 is also available with unattended answering. The first installation of that type has been made for Edison Brothers in St. Louis. In this mode, the tape is placed in the read head during normal working hours; then the transmitting stations are polled by a receiving terminal at some later time, normally in the evening or night hours. The tape is automatically transmitted without an operator in attendance at the transmitting station.

We have also been active in data transmission between Europe and the United States. We have operating systems for Texas Instruments, Kaiser Aluminum, and the Washington Post between England and the U.S.; we will shortly make an installation between Tokyo and New York for Time-Life.
(For more information, circle 54 on the Readers Service Card.)

WEYERHAEUSER COMPANY NATIONWIDE COMPUTER-COMMUNICATIONS SYSTEM

In August, installation of equipment in Weyerhaeuser Company's new computer center in Tacoma, Wash., was completed. General Electric 225 computers will work first on current data-processing applications, and by the end of 1964, will be linked directly to the Wood Products Division nationwide communications system. Total cost of the computer-communications complex will be about $2.5 million.

Commercial teletype lines will interconnect the computer center and 62 distribution centers in 48 states. Cleveland will be the basic Eastern terminal point; queries originating at sales offices in the East will be channeled into a Datanet-30 communications processor there, to be scheduled automatically into the Tacoma computers for processing and response. The system will provide information retrieval from disk storage files, inventory status, and current sales figures. The system will generate mill schedules, production scheduling, and invoicing. The new communications system, when completed, will expand the company's communications capacity from its present 2.3 million characters per day to 8 million per day.
(For more information, circle 55 on the Readers Service Card.)

TAPE PUNCH AND TAPE READER UP TO 200 CHARACTERS PER SECOND

Teletype Corporation, Skokie, Ill., provides several data communications devices.

The "BRPE" tape punch and the "CX" tape reader units operate as a matched pair for use in tape-to-tape communications systems at 100 characters per second. They also can be used as input and output devices for computer and other data communications installations.

The CX reads either fully perforated or chadless tape and can be used to transmit data collected from the BRPE or slower speed equipment. The BRPE's tape output, in turn, can be relayed by the CX or by compatible equipment at slower speeds.

The CX and DRPE operate on parallel-wire signals which can be serialized by Teletype electronic equipment. With these facilities, and additional terminal equipment, the units can be used for high-speed communications over conventional voice channels.

The DRPE High-Speed Tape Punch can operate at any speed up to 200 characters per second. It responds to incoming parallel wire signals. It does not require energy from a motor to punch data into paper tape. Instead, this energy is stored in a tuned-reed while it is attracted to a magnet. A reed is linked to a punch pin for each code level. When the reed is released by its respective magnet, the punch pin is driven through the tape. It can punch 5, 6, 7 or 8 level codes.

There is no movement of parts when the unit is on line and awaiting a signal, resulting in minimum maintenance and longer unit life.

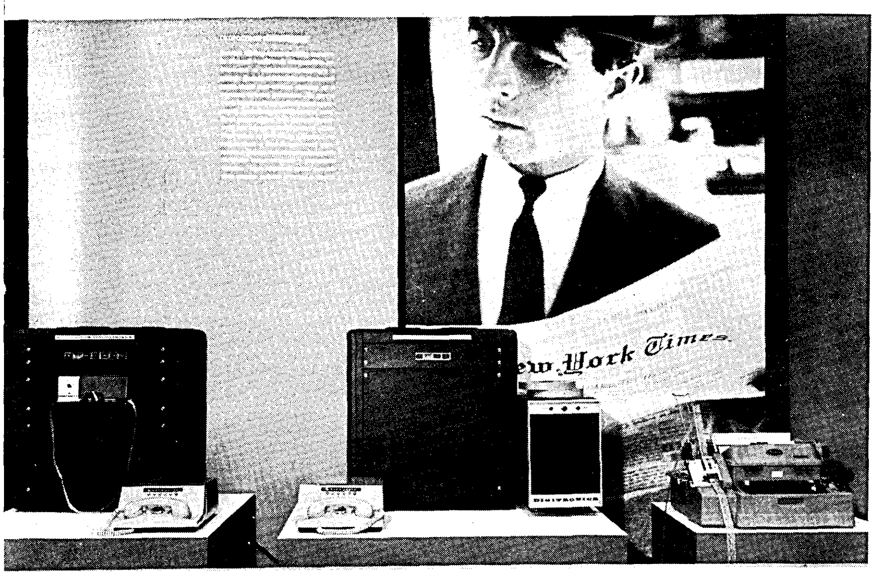
Teletype Corporation manufactures this equipment for itself, Western Electric, Bell System affiliates, and other customers.
(For more information circle 56 on the Readers Service Card.)

IBM 1050 DATA COMMUNICATIONS DEVICE UP TO 148 WPM

An IBM 1050 data communications system can transmit information recorded in punched cards, paper tape, or edge-punched documents, or entered through an operator's keyboard. It can receive information in the form of printed copy or punched cards, paper tape or edge-punched documents. It can be linked with a computer for inquiries or to update files, etc.

These functions are performed by six separate units, any or all of which can be combined to form a single, compact system. The 1050 sends and receives at up to 148 words a minute over public or private communication lines.
(For more information, circle 57 on the Readers Service Card.)

TRANSMITTING INFORMATION BETWEEN NEW YORK AND PARIS AT 1000 WPM



Above is shown a demonstration display of Digitronics Corporation, Albertson, N.Y., included in the United States Information Agency's "Communications-U.S.A." Exhibit currently touring the Soviet Union. Over 300,000 Soviet citizens visited the exhibit when it was in Leningrad.

The statement in Russian to the left on the wall translates as follows:

FAST SENDER

This "Dial-o-verter" system transmits information at 1,000-word-per-minute speed over regular telephone circuits. Information is punched on paper tape, then "read" by the machine and transmitted. At the other end, another unit receives the information and creates an identical punched tape. The demonstration here simulates the system as used by the New York Times, a newspaper published both in New York and Paris. Copy prepared in New York is transmitted overseas to Paris and the paper tape emerging from the machine there is fed directly into linotype machines which set the type to print the newspapers' European edition.

In the demonstration, the message is encoded, transmitted, received and printed out in Russian.
(For more information, circle 58 on the Readers Service Card.)

DATA-PHONE SERVICE OF BELL TELEPHONE SYSTEM

More than 240 million telephone calls are made every day in this country and the number is rising at the rate of approximately 10 million annually. But, machine-to-machine communication by phone may soon exceed even this rate of information transfer.

Data-Phone service, which transmits data in machine language over the regular telephone network, has been developed by the Bell Telephone System to provide management with full communications between business machines. At the end of 1961, there were about 2400 Data-Phone data sets in operation. During 1962, the number increased 92 per cent to more than 4600 sets.

One of the largest installations now serving business is in use by Hardware Mutual-Sentry Life insurance group. The company is transmitting information from 34 branch offices to its data processing center in Stevens Point, Wis., and reports that the data communications service is saving the firm more than $1 million annually in operating costs.

First Service Corporation, Minneapolis, a computer facility, is receiving data by telephone from 39 mid-western banks. At First Service's center the data is processed quickly and returned.

By using Data-Phone sets, Bergen Drug Co., Hackensack, N.J., is now achieving a 99.5 per cent level of order fulfillment with no increase in dollar investment for inventory. Linking its two supply locations together in what is considered the first system of its kind in the wholesale drug field, the company is, in effect, offering pharmacies service equal to two full-line wholesalers. As a result, Bergen Drug reports it is gaining over $100,000 annually in sales volume previously lost through traditional communications problems which impeded filling orders completely and promptly.
(For more information, circle 59 on the Readers Service Card.)

PAPER-TAPE/MAGNETIC-TAPE CONVERTER UP TO 150 CHARACTERS PER SECOND

The Mark 60 series of devices produced by Tally Corp., Seattle, Wash., provide a two-way translation of data between perforated and magnetic tapes. Each system consists of Tally readers, perforators, and control logic and a magnetic tape handler which both reads and writes incrementally.

The Mark 60 is a versatile system for data interchange between paper and magnetic tape. Functioning at speeds ranging from 60 to 150 characters per second, the Mark 60 will handle these jobs among others:

- Data transmission over telephone lines using either magnetic or paper tape
- Data reception from telephone lines using either magnetic or paper tape
- Conversion of information from any paper tape code to magnetic tape IBM format, 200 bits to the inch
- Conversion of information from magnetic tape to any paper tape code
- Formation of character parity and checking of parity on both paper tape and magnetic tape.

(For more information, circle 61 on the Readers Service Card.)

CALENDAR OF COMING EVENTS

Oct. 6, 1964: SWAP Conference, Kellogg Center, Michigan State University, E. Lansing, Mich.; contact Gordon V. Wise, Mgr. Public Relations, Control Data Corp., 8100 34th Ave., So., Minneapolis, Minn. 55420

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. 3-5, 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. 16-18, 1964: 17th Annual Conference on Engineering in Medicine and Biology, Cleveland-Sheraton Hotel, Cleveland, Ohio; contact Dr. D. G. Fleming, Case Inst. of Techn., Cleveland 6, Ohio.

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.

Jan., 1965: 11th National Symposium on Reliability & Quality Control, Fontainebleu Hotel, Miami, Fla.

Feb. 17-19, 1965: International Solid State Circuits Conference, Philadelphia, Pa.

Mar. 22-25, 1965: IEEE International Convention, Coliseum and New York Hilton Hotel, New York, N. Y.; contact IEEE Headquarters, E. K. Gannett, 345 E. 47 St., New York, N. Y.

April 21-23, 1965: Southwestern IEEE Conference and Elec. Show (SWIEECO), Dallas Memorial Auditorium, Dallas, Tex.

May, 1965: National Telemetering Conference, El Paso, Tex. (Tentative)

May 11-13, 1965: Electronic Components Conference (ECC), Washington, D. C.

May 24-29, 1965: IFIP Congress '65, New York Hilton Hotel, New York, N. Y.; contact Evan Herbert, Conover Mast Publ., 205 E. 42 St., New York 17, N. Y.

June, 1965: Automatic Control in the Peaceful Uses of Space, Oslo, Norway; contact Dr. John A. Aseltine, Aerospace Corp., P. O. Box 95085, Los Angeles 45, Calif.

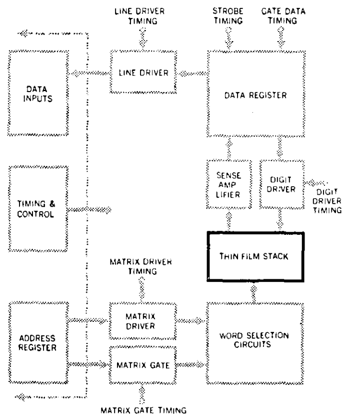
June 22-25, 1965: Sixth Joint Automatic Control Conference (JACC), Rennselaer Polytechnic Institute, Troy, N. Y.; contact Prof. James W. Moore, Dept. of Mechanical Engineering, Univ. of Va., Charlotteville, Va.

Oct. 10-16, 1965: 1965 Congress of the International Federation of Documentation (FID), Sheraton Park Hotel, Washington, D. C.; contact Secretariat, 1965 FID Congress, 9650 Wisconsin Ave., Washington, D. C. 20014

The A, B, C's of Thin-film Buying!

Now you can buy, in modular form to fit your program, the engineering, testing, and manufacturing experience that produced the reliable Fabri-Tek FFM-202 Thin-film Memory System.

A

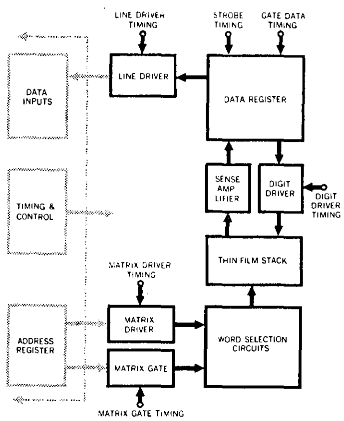


THIN-FILM STACK, ready to wire into your driver, selection, and sensing circuits.

Word-organized • High-speed destructive readout • Use with small memory systems designed for 100 to 500 nano-second cycle times • Each plane contains 128 words of up to 39 bits each

	Min.	Typ.	Max.	Units
Word Select Current	400	450	—	ma.
Digit Current	120	160	200	ma.
Output-Amplitude	—	1.2	—	mv.
Switching time	—	20	—	nsec.

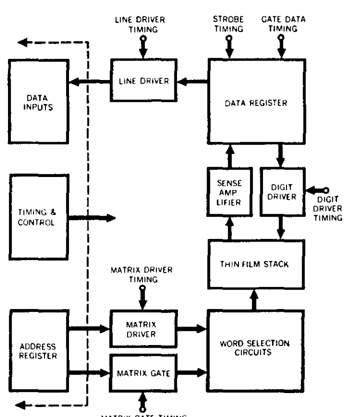
B



THIN-FILM STACK PLUS BASIC ELECTRONICS, ready to wire into your input-output and control circuits.

Logic levels: 0 ±.5 v. and −4 ±.4 v.
Voltages Required: +10, −10, −20, −4v.
Data Inputs: 40 ma @ 0 v. each bit line, including current to 120-ohm termination resistor to −4 volts.
Address Inputs: True and complement required at 65 ma—0 volts, including 120-ohm termination resistor to −4 volts.
Matrix Gate and Driver Timing Pulse: Each group of 256 words requires two 80 ma @ 0 v. pulses.
Digit Driver, Gate Data and Strobe Timing Pulse: Each 6 bits of memory word length requires a 70 ma. @ 0 v. digit timing pulse, a 70 ma. @ 0 v. gate data pulse, and a 45 ma. @ 0 v. strobe pulse. Termination resistors are included.
Line Driver Pulse: Each 9 bits of memory word length requires a 120 ma. @ 0 v. pulse. Termination resistors are included.

C



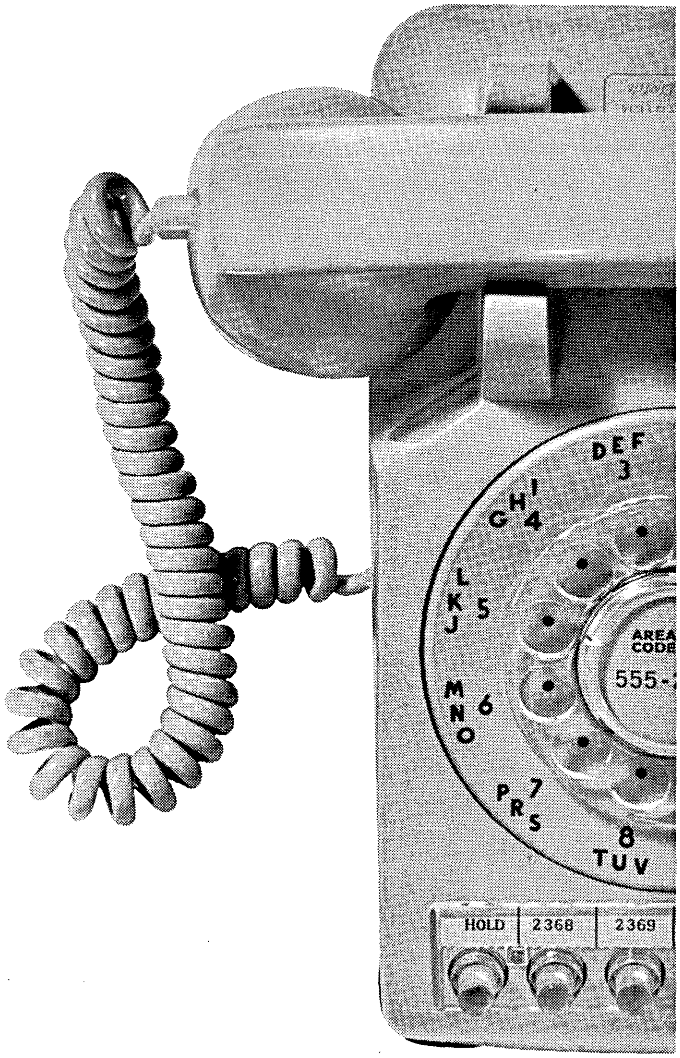
THIN-FILM MEMORY SYSTEM, complete with address register, timing and control circuits, power supply, indicators and self-test circuits.

300 nanoseconds cycle time • 150 nanoseconds access time • Up to 512 words of 36 bits each • Read only, write only, read-restore, read-modify-write modes • Operates with either random or sequential address selection • Double chassis, relay rack packaging

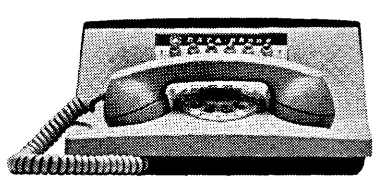
For complete specifications, and for options available with this Fabri-Tek thin-film modular approach, write, call, or wire Robert E. Rife, Fabri-Tek Incorporated, Amery, Wisconsin. Phone: COngress 8-7155 [Area 715]. TWX: 715-292-0900.

FABRI-TEK INCORPORATED

Circle No. 22 on Readers Service Card



If you're using your telephone service only for "people talk"... you may be only half using it!



Once, business phones were strictly for people-to-people communicating.

Not so today. Bell System DATA-PHONE service has changed that. It has made it possible to speed volumes of operating data—payrolls, invoices, inventories—over the same telephone lines you use to plan a meeting or arrange a business luncheon.

Combine DATA-PHONE transmission with your regular telephone service—and you achieve an integrated information-handling system that can help you save time, control costs and minimize paperwork throughout your operation.

One of our Communications Consultants will bring you all the details. Just call your Bell Telephone Business Office and ask for his services.

Bell System

American Telephone & Telegraph Co. and Associated Companies

Circle No. 28 on Readers Service Card

"ACROSS THE EDITOR'S DESK"

Computing and Data Processing Newsletter

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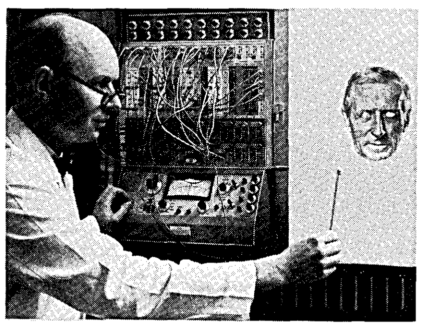
APPLICATIONS

USE OF ANALOG COMPUTERS PROMISES ADVANCES IN EYE RESEARCH

Researchers at the Presbyterian Medical Center, San Francisco, Calif., are developing an application using a small desktop analog computer to simulate a series of eye disorders such as strabismus, impairment of acuity and glaucoma.

A TR-20 all transistorized desk-top analog computer (designed and manufactured by Electronic Associates, Inc., Long Branch, N.J.) is now being used for eye muscle studies. The computer is connected to a two channel oscilloscope. The oscilloscope is placed on its side and the computer programmed to produce for a two channel output on the scope. An RF generator causes each dot on the scope to go in and out of focus as the eyes do. The computer was first set up to have thw two dots (eyes) sweep the room and a photo of a man's face was pasted over the oscilloscope for added realism. Later, the computer was manually controlled to have the mechanical eyes follow a pencil similar to the operation performed by an opthalmologist on his patient.

Using the TR-20, Carter Collins, a biophysicist researcher at the Medical Center, is constructing a working model of the human eye where neurophysiological correlates of the optic system will be translated into computer language. The eye model will also eventually incorporate receptors to receive visual stimuli, and effectors to duplicate actual eye movement.



— EAI TR-20 analog computer being used by Carter C. Collins, PMC Eye Research Institute, to simulate tracking and converging eye movements and some of the possible mechanisms of their malfunctions.

A matrix of photo cells or a scanning device similar to a television camera will be used to act as a retina in receiving images. Later, color filters will be added to simulate color vision.

According to Dr. Arthur Jampolsky, director of the Eye Research Institute at the Center, analog computers can eventually help in determining the detailed pathways and flow of neurophysiological information in the visual system. By using time expansion or compression — the speeding or slowing of processes — bold, new experimental approaches could be simulated and evaluated on the computer before an actual surgical procedure is undertaken.

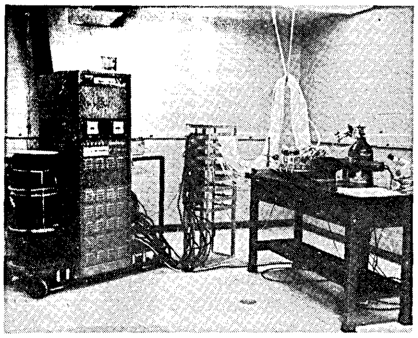
COMMUNICATION SYSTEM CONNECTS MEN WITH ATOM

A new communication system connecting men with the interior of the atom has been developed at the University of Chicago, Chicago, Ill. It permits a scientist to understand what is happening when an atom smasher goes to work on nuclear particles.

These particles are traveling near the speed of light. Their size would make an atom's diameter of four hundred millionths of an inch look gigantic. Such data sometimes took months, even years to get through photographic records.

The new communication system links: an atom-smashing cyclotron; a newly-developed atomic particle detector known as a "wire spark chamber"; the University's experimental computer, MANIAC III; and an oscilloscope.

Meaningful messages are transmitted from the micro to the macro world almost instantaneously. Development of a digitized spark chamber feeding information directly to a digital computer permits a physicist to see the results of some kinds of experiments while they are in progress and perhaps modify his investigative techniques on the spot. The scientist does not "see" a beam of invisible atom particles. The pattern of electrons hitting the screen tells what is happening.



— On the table at the right is a digitized wire spark chamber which detects and locates atomic particles. This information is carried over the white cables to the Core Memory Planes in the center rack. At the left is the scanning system of the University's computer, MANIAC III. The computer provides scientists with information about the trajectory of atomic particles in 1/10,000 of a second.

In the first complete trial of the communications system, a beam of mesons from the University's cyclotron was used. Mesons are particles from the atomic nucleus, heavier than an electron but lighter than a proton or neutron. They may function as the "glue" which holds the nucleus of the atom together. Such a fragment of an atomic nucleus is so small that it may pass through solid matter without even slowing down.

Richard H. Miller, Director of the Institute for Computer Research at The University of Chicago said, "The impressive performance with this complicated experiment has encouraged other physics groups to avail themselves of the information-handling ability of a computer in their experiments. We now have several requests to provide the computer for this kind of work."

Work on developing an atomic particle detector which could be linked directly to a computer has been progressing at several atomic research institutions around the world. There has been close cooperation among the scientists from the various centers. The successful University of Chicago experiment is believed to have given scientists the first method by which the trajectories of particles can be expressed immediately in numerical form. Miller's co-workers in the development of the automatic data retrieval system were Michael J. Neumann, Jurgen Bounin, and Herrick Sherrard.

Work is also under way at the University on replacing photographic cameras used in the conventional spark chamber with television cameras. The output of a television camera may be encoded in some form on magnetic tape, and the tape then becomes available for processing by a computer at a future time.
(For more information, circle 31 on the Readers Service Card.)

ABC's POLITICAL PUNDIT

An electronic model of a political pundit will be created inside a Burroughs B5000 computer November 3 — election day — in the American Broadcasting Company's bid to scoop its rival networks in predicting the winner of this year's presidential race.

Design of the model is progressing under the direction of

Dr. Jack Moshman, prominent mathematician and a vice president of C-E-I-R, Inc., the computer services company chosen by ABC to program a computer to produce an accurate forecast on the basis of early returns.

The model will get its reflexes from political analyst Oliver Quayle, whose firm will survey and choose the key precincts throughout the nation which will provide the information necessary to project the results. (Quayle's firm is an outgrowth of the old Elmo Roper and Lou Harris organizations.)

Dr. Moshman said that if ABC is to compete successfully in the November forecasting competition, the computer must be made to react to first, scattered returns in the way a skilled political analyst does, rather than merely as a statistical machine. "Our early forecasts will be made through a computer program that will behave like the kind of political professional who can drive past a voting booth in Toledo, sniff the air, and tell you how the vote will go in Akron," he said.

The program being developed for ABC is based on new techniques worked out especially for the coming election. C-E-I-R computer scientists, a team of mathematicians, statisticians, research analysts, and expert computer programmers, are now reviewing past election results, studying current political trends and events, and analyzing social and economic factors. The data will be transformed into mathematical formulas and computer instructions. The mathematical and statistical methods, as well as the computer programs, are all closely guarded secrets.

For its nationwide TV and radio network broadcasts, ABC will set up studios in the new Burroughs building, New York City, where the B5000 already has been installed. Burroughs-ABC activity will be in the street level Hall of Products where operations will be in full view of election night crowds.

A nationwide sytem of communications has been developed to channel the vote count from precincts, counties, cities and states to a collection center which will be in the Burroughs Building. Separate communications links will provide speedy information from selected areas. This information will be given to the computer simultaneously with information from the especially selected areas for projecting the final outcome of the presidential and other races in key states.

TELEMAX RESERVATIONS SERVICE

Telemax Corporation, New York, N.Y., has announced a new nationwide reservations service for hotels, motels, rent-a-cars, travel agents, cruise ships and tour wholesalers.

The new Telemax Reservations system will be composed of two Univac 490 Real-Time Computers, communications elements, peripheral equipments, and Unitel input/output devices. The computers and the peripheral units will be "on-line" with Unitel devices located in travel reservation facilities in the United States, Canada, Mexico, Bermuda and Puerto Rico. (The computers and the Unitel devices are products of the UNIVAC Division of Sperry Rand Corporation.)

A typical Telemax reservation transaction will be conducted this way: A request for specific travel or hotel accomodations — including appropriate names, dates and type of service — is initiated with the Unitel device. The messages is automatically transmitted over communications circuits to the computers which send back a printed response confirming the type of service or accomodations requested, if available. If the original request cannot be honored, alternate services or accomodations will be offered to the inquiring agent or traveler.

At the same time, the computers also automatically generate a notification to the organization on which the reservation has been made. This notice is transmitted over communications circuits and includes the name of the traveler, the date and time of his arrival, the class of service he has requested, and the rate and the period he will be using the service.

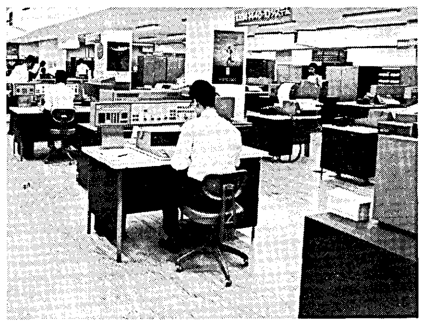
The initial system (which can be expanded as needed) will include the following elements: Univac 490 Real-Time Computers (2); Fastrand II Storage Unit (1); Control & Synchronizer for Fastrand II (1); Uniservo IIA (5); Uniservo IIA Control (1); Uniservo IIA Power Supply (1): Univac 1104 and Adapter (1); Transfer Switch Unit (10); Communications Line Terminal - Output (375); Communications Line Terminal - Input (375); and Unitels with printers (4000). (For more information, circle 30 on the Readers Service Card.)

IBM OLYMPIC DATACENTER

The Olympic Games in Tokyo this month will be the largest in history. The IBM Olympic datacenter, the largest computer installation in Asia, will provide up-to-the-minute results of the Games for worldwide distribution. The datacenter contains more than 100 units, including eight computers.

Registration information has been stored in the computers. The number of sports entered and the number of events entered in each sport are filed by country. Information on the 7000 individual contestants filed in the computers includes their country, weight, height, birthplace, birth date and events entered. For track and field, swimming and cycling, the athlete's best performance and where and when achieved is included. In equestrian events, even the name of the mount is noted.

The computers will use this information during the Games to provide immediate results on each of 4000 separate contests. More information will be generated through the IBM computer system than has been available during any previous Olympic competition.



— The IBM Olympic datacenter contains more than 100 units, including eight computers; another picture is on the front cover.

The IBM system will allow immediate transmission of scores and other information from each of the 32 event sites to the central computers for processing. There will be as many as 25 contests taking place at the same time. The computers will report winners of the races within seconds after they end. Minutes later, the computers will provide exact times and final ranking of all competitors in each race. They also will note if the winner set an Olympic or world's record.

In events such as gymnastics, diving and horsemanship, where style is a key element of an athlete's performance, the computers will take into account the points awarded by each judge and automatically calculate the final score.

NEW CONTRACTS

STANDARD OIL OF CALIFORNIA TO LEASE BUNKER-RAMO SYSTEM

Standard Oil Company of California has contracted for the lease of a Bunker-Ramo 340 control computer system for its Richmond, Calif., Refinery. The Richmond Refinery is the largest operated by Standard, and the largest refinery on the West Coast.

The 340 computer system will be applied to closed-loop control of the Refinery's 55,000 barrel-per-day fluid catalytic cracking unit. The Bunker-Ramo computer system planned is capable of expansion to handle additional processes.

U. S. ARMY AWARDS $1/4 MILLION CONTRACT TO TSI

Telecomputing Services, Inc., (subsidiary of Whittaker Corp.), Panorama City, Calif., has been awarded a quarter of a million dollar contract by the U. S. Army for data reduction services at Fort Huachuca, Ariz. The contract provides for the operation and maintenance of the Fort Huachuca Data Reduction Center in direct support of the U. S. Army's Electronic Proving Ground and Electronic Research and Development Activity.

The contract includes the training of Government personnel in data reduction operations, evaluation and development of data reduction systems and techniques; raw data conversion operations, data analysis, engineering and maintenance for data reduction equipment and the preparation of data reports.

DEPT. OF DEFENSE AWARDS CSC PROGRAMMING CONTRACT

Computer Sciences Corp., Los Angeles, Calif., has received a $230,000 programming contract from the Department of Defense. The contract provides for the design and development of a machine independent ALGOL translator system which will permit computer users to prepare and execute programs for a variety of small, medium and large scale machines including the IBM 7094, UNIVAC 490, CDC 3600 and SDS 910. The ALGOL translator will assist in the effective use of computer systems by expediting assignments of jobs to machines which may not be fully occupied at the time a job assignment is made.

RCA AWARDED $27 MILLION CONTRACT FROM NASA FOR 19 COMPUTER SYSTEMS

The Radio Corporation of America, New York, N.Y., has announced the receipt of a $27 million contract from the National Aeronautics and Space Administration to build 19 ground computer systems to be used for the checkout and launch of the Saturn 1B and Saturn V launch vehicles. The systems will be built at RCA's Aero Space Systems Division facility in Van Nuys, Calif., for NASA's Marshall Space Flight Center, Huntsville, Ala.

The systems include the RCA 110A computer, conventional input-output equipment, digital and analog stimulus and measuring equipment, and high-speed data communications equipment. Twelve of the systems will be installed at the Kennedy Space Center, Fla., and will be used to launch the Saturn 1B and Saturn V launch vehicles; nine of the systems will be installed at the Marshall Space Flight Center, Ala., for checkout of Saturn vehicles; three systems will be installed at NASA's Michoud operations near New Orleans, La., for factory checkout of the first stage of the Saturn V rocket; and two systems will be installed at NASA's Mississippi test operations near New Orleans for static testing of the Saturn V first stage.

The new contract brings to 26 the number of 110A systems procured by NASA for the Saturn program.

TWO 3C COMPUTER MAINTENANCE TRAINERS ORDERED BY NTDC

The U. S. Naval Training Device Center, Port Washington, N.Y., has awarded a contract to Computer Control Company, Inc., Framingham, Mass., for two Digital Computer Maintenance Trainers. The trainers, designated Device 6F2 by the Army Participation Group at the NTDC, will be used to train military personnel to operate, program and maintain general purpose digital computers.

BOOK-OF-THE-MONTH CLUB BUYS H-800

A contract has been signed by the Book-of-the-Month Club, New York, N.Y., for the purchase of a large-scale Honeywell 800 computer system. The system, purchased for $800,000, has been in continuous use at the firm's headquarters for nearly two years. The computer has been operating 24 hours a day, six days a week, to process up to 400,000 daily transactions involved in maintaining subscriber accounts, payments, new book announcements, billings and management report data.

At the contract signing, it was also disclosed that the company has leased a second computer, a small-scale Honeywell 200. The installation of the H-200 is designed to increase the productivity of management control information on the larger system by reducing the input-output functions it has handled in the past.

INFORMATICS INC. RECEIVES CONTRACT FROM ALEXANDRIA, VA.

The City of Alexandria, Va., has awarded a contract to Informatics Inc., Sherman Oaks, Calif., for the development of a computer-based Urban Planning Data System for that city. The contract is for $60,000.

Informatics Inc. will select data items for a 'databank' file. Using this file, the Informatics-developed computer system will be employed by the City to solve some of its more pressing problems in such areas as planning, public works, budgeting, urban renewal, health, welfare, and education.

AUSTRALIA ORDERS ON-LINE POWER PLANT DIGITAL COMPUTER FROM LEEDS & NORTHRUP

An LN 4000 Digital Computer System and all-electric boiler control equipment have been ordered from Leeds & Northrup Co., Philadelphia, Pa., by The Electricity Commission of New South Wales, Australia, for the first two units in their new Munmorah Steam Power Station near Sydney.

When installed, the computer will be the first on-line power plant digital computer in Australia. It will be used for performance monitoring, alarm scanning, data logging and efficiency studies at the plant. The boiler control system will incorporate the L&N Direct-Energy-Balance (D-E-B) method of control to regulate the two 350 MW generating units. Delivery of the equipment will start in the Spring of 1965; the two generating units will be in operation in 1966 and 1967.

3C COMPUTER SYSTEM ORDERED BY NASA

NASA's George C. Marshall Space Flight Center, Huntsville, Ala., has ordered a digital Coordinate Transformation Computer System from the Western Division of Computer Control Company, Inc., Los Angeles, Calif. The 3C's Digital Resolver (DR-20) is the heart of this system. The DR-20 can compute over 9000 3-axis coordinate transformations per second.

The system will be used in conjunction with a large analog computer installation to provide trigonometric functions and perform coordinate transformations to the digital accuracies required in the design simulation of various spacecraft and boosters.

U. S. ARMY AWARDS CSC MAJOR CONTRACT FOR LIFE CYCLE MANAGEMENT SYSTEM

Computer Sciences Corp., El Segundo, Calif., has been awarded a major contract from the U. S. Army Electronics Command to implement a comprehensive Commodity Life Cycle Management System. CSC will provide both the computer programming and management training program required to produce a fully operational computer system for the U. S. Army Electronics Command, a field agency of the U. S. Army Materiel Command. Such electronic commodities as communications equipment, radar, infrared devices, data processing equipment, avionics and navigation aids, special cameras and intelligence equipment will be constantly monitored by the system.

NEW INSTALLATIONS

BELL LABS ORDERS DDP-24 FOR SPEECH PROCESSING

Bell Telephone Laboratories, Murray Hill, N.J., has ordered a DDP-24 general purpose computer from Computer Control Company, Inc., Framingham, Mass. Bell Telephone will use the computer in a speech research program.

The DDP-24 will analyze speech waves and extract information from these sounds. Speech waves will be digitized by an A-D converter before entering the DDP-24. The computer will then process this information and display the results by oscilloscope or other means for further study.

The computer will also be used to generate artificial speech waves. Under program control, the DDP-24 will produce computed speech by passing digital information through a D-A converter.

In both of the applications, on-line control will enable the experimenter to modify the computations and to observe the effect of his modification.

TRAILER-MOUNTED PDP-6 TO BE USED BY BROOKHAVEN SCIENTISTS

The Physics Department of Brookhaven National Laboratory, Upton, N.Y., will use a trailer-mounted Programmed Data Processor-6 computer system for basic studies of the nature of matter. The system, manufactured by Digital Equipment Corp., Maynard, Mass., will process the results of a series of experiments beginning with studies of elastic particle collisions and broadening later into inelastic collisions and multi-particle events.

The trailer installation will permit experimenters to use the PDP-6 at several locations in Brookhaven. The system includes 16,384 words of 36-bit, 2-microsecond core memory; a 16-word, 400-nanosecond fast memory; a 4-transport Microtape system; a 3-transport conventional magnetic tape system; 400-character-per-second perforated tape reader; data control; the line printer; and interfaces to a second computer for the display, magnetic tape system, and a data link.

GLENDALE FEDERAL SAVINGS & LOAN TO INSTALL UNIVAC 490 WITH TELEREGISTER TELLER NETWORK

The Glendale Federal Savings and Loan Association is installing a UNIVAC 490 Real-Time Computer coupled with a Teleregister electronic teller network. The Teleregister network will connect all fifteen offices of the institution with the headquarters UNIVAC 490 which will instantly process teller window transactions. In addition to the forty-six teller window machines distributed among the 15 branch offices, each loan officer will have an inquiry device for immediate access to the computer.

RCA COMPUTER NETWORK VALUED AT $6 MILLION TO LINK USN AIR STATIONS

The Radio Corporation of America, New York, N.Y., has been selected by the Bureau of Naval Weapons to install a network of seven advanced computers as part of an electronic management information system linking key industrial naval air stations in the United States. The nationwide computer complex is valued at $6 million.

Rear Admiral Frank L. Pinney, Jr., Inspector General and Assistant Chief for Administration, Bureau of Naval Weapons, said, "Its purpose is to help assure constant fleet readiness for naval aircraft, missiles, survival gear and spare equipment, while achieving a multi-million dollar annual cost saving to the Navy."

The RCA data processing network — including seven large-scale RCA 3301 computers and 14 random access memory units — will be installed by the Bureau of Naval Weapons at the following naval air stations: Quonset Point, R.I.; Norfolk, Va.; Cherry Point, N.C.; Jacksonville, Fla.; Pensacola, Fla.; Alameda, Calif.; and San Diego, Calif. The first system will be ready for delivery in December. The total complex is expected to be in operation by the end of 1965.

COMPUTER SYSTEM TO CONTROL ALL EUROPEAN PRODUCTION FOR JOHNSON'S WAX

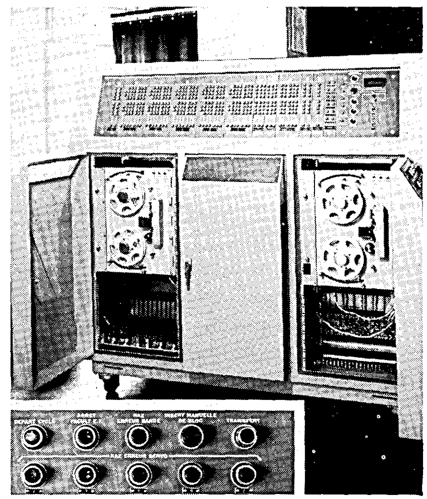
An inventory planning and control system for the entire European operations of Johnson Wax is being installed by S. C. Johnson & Son, Ltd., at Frimley Green, Surrey, England. The system is based on experience obtained at the parent company in Racine, Wisc., where an NCR 304 computer has been aiding in inventory planning and control for the past four years.

The new electronic system, built around a National Cash Register 315 computer and NCR electronic accounting machines, will insure that adequate stocks of both raw materials and finished products are available at the right place at the right time.

The company is currently consolidating its European production at two major plants, one at Frimley Green and the other in the Netherlands. There will be marketing companies in 11 European countries, with central control of all operations coming from the company's regional management center in London.

BUNKER-RAMO SHIPS TWO NUMERICAL CONTROL UNITS TO FRANCE

The first two numerical contour control units, expecially designed by the Bunker-Ramo Corp., Cleveland, Ohio, for use in Europe, have been shipped to French aircraft plants in Paris. Both machines are identical but will be used in different aircraft plants.



— One of the two numerical control units for automatic direction of machine tools in French aircraft plants. Inset shows the Class I operator control panel.

The machines were built to control automatically by punched tape a highly versatile type of machine tool capable of continuous-path contouring, drilling, boring, reaming, tapping and face milling.

The French numerical control units are built with metric coding and are programmed in increments of 0.002 mm. They have a traverse rate of up to 4 meters per minute. The two units have all the standard features of the Bunker-Ramo TRW-3000 control systems.

JAPANESE BROADCASTING FIRM ORDERS TWO HONEYWELL 200's

Nihon Hosokyo Kai (NHK), Japan's largest radio and television network, will install two Honeywell 200 computer systems at its Tokyo headquarters. The two systems will be used to maintain and process charges for both television and radio time leases. NHK also will perform all of its general accounting operations on the H-200's as well as process the payroll for 14,000 employees.

The two systems will include: two 28,000-character central processors, a total of eight magnetic tape units, four high-speed printers, a card reader-punch and a punched tape reader. The systems, valued at more than $600,000, are scheduled for installation in June, 1965.

ENGINEERING AND CONSTRUCTION FIRM INSTALLS GE-225

J. F. Pritchard and Co., Kansas City, Mo., an engineering and construction firm serving the oil and gas, chemical, petro-chemical and power industries, has installed a General Electric 225 computer. The computer will be used primarily for engineering design work, particularly in predicting the physical behavior of complex mixtures. Ultimately it will be used to simulate the operation of an entire processing unit.

UNIVERSITY OF MARYLAND INSTALLS PDP-5 COMPUTER

A Programmed Data Processor-5 computer has been purchased from Digital Equipment Corp., Maynard, Mass., by the University of Maryland for use in the School of Medicine. The University's PDP-5 has 4096 words of memory, a four-channel analog-to-digital converter, and a display control for a cathode ray tube oscilloscope on which results will be shown.

A research team in the school's Department of Physiology will use the computer to control the presentation of stimuli and to analyze the temporal patterning of electrical responses of single neurons in the auditory cortex of the brain. A second major activity in which the computer will serve is an attempt to speed up the measuring of nerve cells and their interconnection.

Other uses for the PDP-5 will be in a biological control systems course for graduate students of physiology and biophysics, and for experiment control, data recording, and data analysis in studies of heart muscle properties, ion fluxes across biological membranes, and temporal coding of information in the nervous system.

DDP-24's ORDERED BY ARMY AND BY JPL

Computer Control Company, Inc., Framingham, Mass., has received orders for a DDP-24 general purpose digital computer from the U. S. Army Electronics Command, Fort Monmouth, N.J., and from the Jet Propulsion Laboratory, Pasadena, Calif.

At Fort Monmouth, the DDP-24 will be used for scientific analysis of differential and analytical equations. It also will be used to process analog signals which have passed through an A-D converter.

JPL's Space Flight Operation Facility will use its DDP-24 as the digital computer portion of a ground data handling system. The computer will process television telemetry information from deep space probes.

DIGITAL-COMPUTER-DIRECTED CONTROL SYSTEM DELIVERED TO AEP SYSTEM

The largest digital-computer-directed control system ever built by Leeds & Northrup Co., Philadelphia, Pa., has been delivered to Canton, Ohio. At Canton, the fully transistorized system will automatically regulate the electric-power production facilities of the American Electric Power (AEP) System. This system provides electric service in parts of seven East-Central states.

The automatic load-frequency control and economic-dispatch computer equipment for which Leeds & Northrup has the overall responsibility will be tied in with the AEP System's new large scale computer center in Canton. Including associated digital and analog telemetering equipment, the $1 million dollar control system will link some 15 generating stations, including some 40 turbine-generators, serving customers in more than 2350 communities. It also will include control of some 38 tie lines with neighboring interconnected power systems.

SHOE MANUFACTURER TO INSTALL GE-415

The Wolverine Shoe & Tanning Corp., Rockford, Mich., has ordered a GE-415 electronic computer from General Electric Co. Wolverine, now the seventh largest shoe producer in dollar sales, operates five Michigan factories.

Prime purpose of the computer will be to enable Wolverine to improve its production scheduling to better meet the needs of its retailers and customers. It also will be used for market research and surveys, measurement of territorial sales performances, and the more routine accounting functions. The computer is scheduled for delivery in January, 1965.

ATLANTIS WILL USE PDP-5 ON INDIAN OCEAN CRUISE

The 2300-ton research vessel Atlantis II will use a Programmed Data Processor-5 computer on-line to collect, record, and analyze oceanographic data on a 9-month cruise through the Indian Ocean beginning in January, 1965. It will be the second Indian Ocean cruise for the Atlantis, newest ship in the Woods Hole Oceanographic Institute fleet — a 209-foot vessel built exclusively for basic research into the biology and geology of the sea.

The Atlantis computer will include an 8192-word core memory, automatic multiply and divide option, and multiplexed (20 analog channels), general-purpose analog-to-digital converter, data channel multiplexer, two Microtape Dual Transports and automatic control, automatic magnetic tape control and transport, 350-character-per-second perforated tape reader, 63-character-per-second tape punch, and automatic plotter control, in addition to a cathode ray tube oscilloscope display and light pen. Special provisions for shipboard installation included lifting rings and shock mounts.

CORRECTION: The article concerning Pacific Southwest Airlines (Computers and Automation, May 1964, p. 52) entitled "PACIFIC AIRLINES INSTALLS....." should have read "PSA INSTALLS INSTANT RESERVATION SERVICE". In the same article, second paragraph, last line, the figure "35" should have read "nearly 600 outlying ticket agents...."

ORGANIZATION NEWS

CAI TO ACQUIRE COMPUTER CONCEPTS

Computer Applications Inc., New York, N.Y., has entered into an agreement which will result in CAI acquiring Computer Concepts, Inc. of Washington, D.C. and Los

Angeles, subject to final approval of the stockholders of CCI. The transaction is expected to involve CAI stock worth more than $1 million at current market levels, a part of which payment is dependent upon performance of Computer Concepts over the next 2½ years.

The company will operate as a wholly-owned subsidiary of CAI, under the continuing direction of Howard I. Morrison, president. Mr. Morrison also will become a vice president of CAI and a member of its board of directors.

MAI ACQUIRES ASSETS OF CHICAGO LEASING FIRM

All of the data processing equipment owned and leased to users by the Operating Lease Division of Mid-Continent Leasing Corporation has been acquired by MAI Equipment Corporation, wholly-owned subsidiary of Management Assistance Inc., New York, N.Y. MAI president, J. M. Gonzalez, in discussing the terms of the agreement, stressed that this was a purchase and that there was no merger of the two companies involved.

Until the time of the acquisition, Mid-Continent had operated through this Division a leasing service supplying IBM punched-card equipment to customers primarily in the Chicago area. The lease contracts with these customers will remain in effect and will be serviced by MAI from its Chicago office.

COMPUTING CENTERS

TELECREDIT BANK CARD SYSTEM

A unique electronic bank card service, which may eliminate the need to carry cash, was inaugurated in August of this year in Southern California. Telecredit, Inc., Los Angeles, Calif., announced its new Telecredit Bank Card system in which member banks and merchants strike a lethal blow at bad check artists.

The Telecredit Bank Card is not a credit card but is a device which instantly certifies that a valid personal check is covered by funds. The concept, originated by Telecredit, Inc., is made possible through the use of equipment specially developed by IBM Corp. and Pacific Telephone Co. Member banks are offering this card free of charge to their checking account customers. (Eleven banks in Los Angeles and Orange Counties have announced they are now offering this new card to their depositors.)

The card system combines the use of two specially developed high-speed IBM computing systems, closed circuit television, and a new automatic communication center.

Here is how the new system works: Any member merchant verifies the card number and the amount of the check with the Telecredit central computing headquarters. Four seconds later an electronic approval is received. This approval assures the merchant that the bank stands behind the check. The formerly familiar tag "Non Sufficient Funds" and "Account Closed" are a thing of the past for this check. The IBM computer in Telecredit's headquarters will not reveal the bank balance of any individual. It will answer only the question of whether the proffered check is good for the designated amount.

The bank is able to stand behind this check due to the new updating process included in the Telecredit Bank Card system. On a daily (sometimes instant) basis, information is fed into the computer including account number, overdrawn accounts, closed accounts, unusual buildup in account activity and a variety of other information. This data is fed directly into the Telecredit computing center by the banks. The computer handles millions of pieces of data, separating this information in less than two seconds on request from a store. (More than 1500 retailers in Greater Los Angeles are now accepting the new card.)

Police records show the impact of Telecredit's original check approval process based on drivers' licenses. In 2½ years of operation Telecredit has been directly responsible for the apprehension of more than 1750 persons and has prevented the cashing of 100,000 worthless checks, while approving two million good checks.

Telecredit plans expansion of this new system throughout the rest of California and ultimately to an unlimited number of other states. (For more information, circle 32 on the Readers Service Card.)

IOWA'S NEW COMPUTER CENTER NOW OPERATIONAL

The State of Iowa's new computer center — which acts as a clearing house for various state agencies requiring data processing services — is now operational. Iowa is among the first states to centralize its electronic data processing activities.

The computer center is built around a GE-225 magnetic tape computer system. The system consists of a 225 central processor with a 16,384-word memory, two 41KC magnetic tape controllers, eight tape handlers, two 900-lpm printers, a 1000-cpm card reader and a 100-cpm card punch.

The new system is replacing two smaller computers formerly employed by the state. Although annual rental costs will be about $24,000 more than the two previous systems, it is expected that one new application alone — the redemption of state warrants for the Treasurer — will save almost three times this amount.

The Department of Public Safety and the Insurance Department also expect to realize significant savings through the use of the system. Among the first jobs for the system was the processing and recording of drivers' licenses for the Department of Public Safety. Another has been to handle the job of renewing and maintaining the licenses of the state's 23,000 insurance agents. (Annual renewal procedures which formerly took six weeks by manual methods were completed in four hours by the GE computer.) Twenty-one other state agencies are now using the computer center.

REGIONAL COMPUTER PLAN TO REDUCE EDUCATIONAL COSTS

An electronic attempt to reduce the cost of secondary and college education will be initiated in December by the Christian Brothers, (a Catholic teaching order), Lockport, Ill. At that time, the order will put into operation a computer center at Lewis College to serve the record-keeping needs of 45 Christian Brothers schools throughout a 15-state area of the Midwest.

The Christian Brothers Data Processing Center, as the facility is called, will process and maintain all academic and financial accounting data on more than

24,000 students now attending the schools. Besides keeping up-to-date records on students grades, tuition payments, laboratory and special fees, the computer — a Honeywell 200 system — also will analyze and compare student test data with local and national results, and will reallocate classroom facilities in the 45 schools to improve the effective use of space.

The center will be made available to the Diocese of Joliet and the Archdiocese of Chicago for educational data processing work. It also will perform computing tasks for local school systems and be operated as a service center which local business firms can use on a fee-paying basis.

Courses will be given in data processing at the center to faculty members and students at Lewis College. The facility also will be available to faculty members doing academic research.

EDUCATION NEWS

COMPUTER WORKSHOP FOR CIVIL ENGINEERS

A program planned for the civil engineer with little or no computer experience, will be conducted October 26-28 at Purdue University, Lafayette, Ind. Albert D. M. Lewis, associate professor of structural engineering and workshop chairman, said the primary objective is to give the civil engineer a basic understanding of digital computers and how they can be applied in his work. The Purdue School of Civil Engineering is workshop sponsor.

The workshop will lead off with an introduction to computers and computer programming, and will include instruction in computer programming and discussion of application of computers to civil engineering problems. The work is designed to provide a background that can be developed further with additional programming practice and study. A desk-size digital computer will be used to aid in programming instruction.

Further details on the workshop may be obtained through Professor Lewis, School of Civil Engineering.

FALL SCHEDULE FOR DATA PROCESSING COURSES ANNOUNCED BY BRANDON APPLIED SYSTEMS

Brandon Applied Systems, Inc., New York, N.Y., has announced the Fall schedule for its technical data processing courses. The courses will be conducted by Dick H. Brandon, president of Brandon Applied Systems, Inc. and author of the book "Management Standards for Data Processing" (D. Van Nostrand, Co., Inc., 1963).

The courses offered are: Management Standards for Data Processing — a two-day seminar in management control and data processing standards for managers and supervisory personnel; and Computer Selection and Characteristics Analysis — a two-day seminar on techniques and methods for equipment evaluation and selection for management personnel participating in data processing equipment selection.

The October dates for the Management Standards for Data Processing course are New York - October 14, 15 and Boston - October 27, 28. The Computer Selection and Characteristics Course is scheduled in New York on October 20, 21. These courses also will be offered in New York, Washington, and London during November and December.
(For more information, circle 48 on the Readers Service Card.)

NEW PRODUCTS

Digital

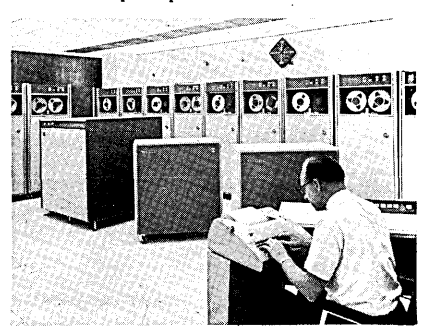
B5500 — THIRD NEW COMPUTER SYSTEM BY BURROUGHS IN 1964

Burroughs Corporation, Detroit, Mich., has announced its third new electronic computer system this year — the B5500 modular electronic data processing system. (The E2100, a desk-sized accounting computer, was announced at the beginning of the year; the B370 electronic data processing system, at the end of May.)

The B5500, which has up to three times more productive capacity than the B5000, integrates fast new hardware with an unusual controlling and operating system, providing full real-time capabilities. Multiprocessing techniques permit simultaneous handling of two or more programs. While printing out the results of one job, the computer can perform computation on other, different problems and take in raw data on still another task.

Simpler and less costly programming is made possible by hardware/software features that enable the B5500 to rapidly compile efficient programs written in languages for business data processing and for scientific and engineering problems.

The Master Control Program (MCP) virtually eliminates human error and uses the computer itself to assure efficient operation. The modular design permits expansion or contraction of the system at any time without the need to write new programs. The MCP balances the program "mix" against the hardware configuration and operates the computer in a manner that gets the greatest efficiency from all modules and peripheral devices.



— Burroughs B5500 modular electronic data processing system. One module of Burroughs disk file random access storage system is shown in left foreground. Up to 100 such modules, with nearly a billion characters of storage, can be used with a B5500 system. In right foreground are data communications control units.

A B5500 system configuration consists of the following units: one or two Processors; up to eight Memory Modules; up to four I/O Channels; one or two Magnetic Drums; up to 16 Magnetic Tape Units; one or two high speed Card Readers; one or two Paper Tape Punches; one or two high speed Line Printers; up to 960 million characters of Magnetic Disc storage; and up to 15 Data Communication Terminal Units with capacity of 399 Teletype Stations and 8 Electric Typewriters per terminal unit.
(For more information, circle 34 on the Readers Service Card.)

IBM SYSTEM/360 MODEL 92

IBM Corporation, White Plains, N.Y., has announced it will develop and build an ultra-high performance model of its System/360, using exploratory technologies. It will be known as the IBM System/360 Model 92. Model 92 represents a major extension, in terms of its computer power, of the IBM System/360 which was announced earlier this year (see Computers and Automation, May 1964, p. 32).

Dr. Louis Robinson, director of scientific computing for IBM's Data Processing Division, said: "The new computer is designed to meet the scientific and engineering community's continuing need for the fastest possible computation capability....."

Three factors which will make the Model 92 suitable for solving scientific and research problems of great size and complexity are:

— High operating speeds. The Model 92, executing floating point instructions, will be able to add two numbers in 180 nanoseconds and perform a multiplication in 270 nanoseconds.

— Memory capacity and speed. Up to 131,072 words of information (each 64 bits in length) will be available in the main core storage. A word will be available for use in one-half microsecond. Up to two million 64-bit words of additional high-speed, directly addressable core storage also will be available.

— Parallel operations. The processor is designed to execute many instructions concurrently, including up to three floating-point arithmetic operations.

IBM will enter into special contracts for various configurations of System/360 Model 92 which are based on a user's particular computing needs.
(For more information, circle 33 on the Readers Service Card.)

3C INTRODUCES DDP-116

A fast, low cost, 16-bit digital computer — the DDP-116 — has been introduced by Computer Control Company, Inc., Framingham, Mass. The basic computer has indexing, multi-level indirect addressing and priority interrupt.

The DDP-116 performs up to 294,000 computations per second. Basic memory cycle is 1.7 microseconds; add time is 3.4 microseconds. The memory is expandable to up to 32,000 words.

The computer is designed for both open-shop scientific applications and real-time data processing, such as telemetry data reduction, nuclear instrumentation, simulation, and process control.

User services and software, including an assembler, a complete set of subroutines, a maintenance and diagnostic package, are all part of the purchase price — which is under $30,000.
(For more information, circle 35 on the Readers Service Card.)

Data Transmitters and A/D Converters

"PARTY-LINE" SYSTEM FOR ON-LINE BANK COMMUNICATIONS

A "party-line" bank system which links tellers' machines at branch locations to a central NCR 315 computer has been developed by the National Cash Register Co., Dayton, Ohio. Instead of requiring individual telephone lines from each branch office to the central computer, a new NCR communications monitoring system permits several branches to share a single set of duplex voice-grade communication lines. NCR said this reduces data subset and over-all line costs as much as 50%. With the new "party-line" system, up to eight "communication line adapter-monitors," each serving as many as 8 branch locations, can be used with a single buffer unit at the central computer center.

In each branch a remote controller, providing for up to 16 NCR teller machines, continuously scans the lines from tellers' windows for a message signal. When a window machine has a transaction ready to be flashed to the central processor, the controller responds to a "clear" signal from a central monitor which is constantly checking the telephone line for transactions from other branch locations.

Information transmitted from the central computer is relayed back to the window machine in a similar manner. Each buffer unit in the system is capable of handling a mixture of incoming and outgoing savings deposits, withdrawals and account inquiries at a rate of 3000 transactions an hour.
(For more information, circle 38 on the Readers Service Card.)

Numerical Control

G-E ANNOUNCES LOW COST POSITIONING CONTROL

General Electric, Waynesboro, Va., has announced a new point-to-point and straight line milling control. The solid state Mark Century 120® control is a competitively prices low cost system.

The new positioning unit is being built in one configuration with five plug-in options. These include: 1) manual data input; 2) sequence number readout; 3) a choice of silicon-controlled rectifier d-c servo drives rated up to one horsepower; 4) steering-milling control allowing rough contour milling under manual operation and 5) Accupin® linear transducer for direct measurement of machine-tool position.

As standard equipment the Mark Century 120 control has solid state proportional d-c drives with feed rate control for straight line milling in addition to point-to-point capability; absolute data input based on a machine-zero reference point; and backlash take-up to improve final positioning accuracy of the machine.

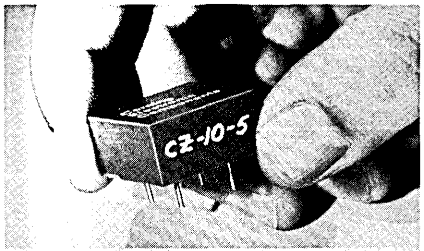
Data input resolution is .0001 inch. Tape commanded auxiliary functions are offered as standard equipment. Other standard equipment includes a photoelectric tape reader.

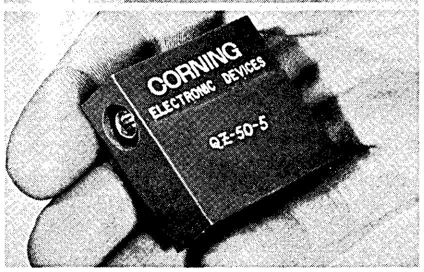
A single pressure-ventilated enclosure measuring 28 inches wide, 22 inches deep and 45-3/4 inches high houses all elements of the control including input devices, computing circuitry, and machine servo amplifiers. Any axis length up to 99.9999 inches may be handled with the new positioning control.
(For more information, circle 36 on the Readers Service Card.)

Memories

TWO NEW GLASS MEMORIES BY CORNING

Two new glass memories introduced by Corning Glass Works, Corning, N.Y., offer high speed serial storage of 10 to 250 bits. The memories operate at rates of





10 megacycles (top photo) and 50 megacycles (bottom photo) with access times of one to five microseconds. Their small size and light weight make them suitable for both commercial and aerospace applications as shift registers and scratch-pad memories.

The 10-mc memory can be obtained with attached drive and sense amplifiers using either discrete components of thin film circuitry. The 50-mc device is designed for use in advanced data processing equipment. Both memories are made from Corning Code 8875 "Zero TC" glass, a special composition with a nominal zero temperature coefficient of time delay.
(For more information, circle 37 on the Readers Service Card.)

Input-Output

ON-LINE PLOTTING CAPABILITY ADDED TO L-2010 COMPUTER

An on-line graphic plotting capability for use in shipboard, airborne, and field applications has been added to the L-2010 digital computer by the Librascope Group of General Precision, Inc., Glendale, Calif. The added capability has been achieved through a direct functional interface between the 65-pound computer and a point-to-point digital incremental plotter produced by California Computer Products, Inc., Anaheim, Calif.

In its new configuration, the L-2010 computer can simultaneously operate the plotter and an on-line tape typewriter. This permits the L-2010 to produce line drawings up to 30 inches wide and typewritten data reports at the same time. Output is performed at rates of 200 characters per second.

For use with the on-line plotter, the computer can be packaged in a desk-top case or it can be rack mounted. The plotter, typewriter, and other peripheral devices are cable-connected, providing a high degree of flexibility in adapting computer installations to aircraft, ships, or field vans.
(For more information, circle 42 on the Readers Service Card.)

PFR-2 FILM READER "UNDERSTANDS WHAT IT SEES"

A new, high precision, fully automatic Programmable Film Reader system (PFR-2) has been developed by Information International, Inc., Cambridge, Mass. The new PFR-2 rapidly converts photographic data into digital form and carries out analytical processes on this data. The unusual feature of the PFR-2 is that extremely high resolution (5 microns) is combined with a rapid processing rate. This makes the PFR-2 particularly applicable to rapid and automatic reduction of star charts, satellite tracking and other similar operations involving mass data on film. The new system is presently being manufactured for analysis of billionth of a second events recorded on film during nuclear explosions. The film data consists of electrical transients of several thousand megacycle bandwidth recorded as oscilloscope traces.

The PFR system is based on the principle of selective scanning of film by a rapidly moving light point under programmed computer control. The system "Understands what it sees" by means of specially developed III film reading programs. The PFR film reading systems merely read data of significance to the researcher — in contrast to other film reading techniques which employ flying spot scanners (that must read an entire display tube raster). This III technique results in elimination of further data processing to extract useful data.

The PFR systems consist of a programmable, high precision light source; a basic film reader that contains film holders and optical-electronic systems for processing film reading signals; and a high speed solid state scan control and monitoring unit that controls and governs the film reading processing by means of specially-developed film reading programs.

The high precision system makes use of a positional reference feedback technique that allows positions of images to be determined with respect to a highly accurate reference grid. The system uses a small field of high precision measurement, 0.8" x 0.8". This field may be rapidly brought to bear on all portions of the film to be read, by means of a mechanical digital positioner, which can move the film from any of 256 positions to any other of these positions.

The new Precision Programmable Film Reader is able to resolve more than 268-million data-points within the 0.8" square high precision area. Overall system accuracy, even under "worst conditions", assures the user that no measurements will deviate more than 0.0002 inch, or about 5 microns, over the entire field of view.

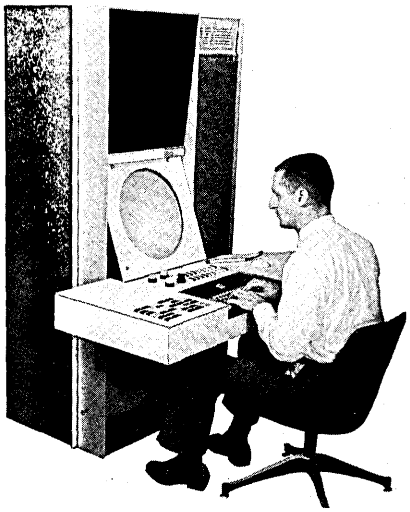
Because of the flexibility of specially developed film reading programs, the PFR-2 also has the ability to ignore or filter out extraneous material or noise on film, and to read data effectively even with grid backgrounds.
(For more information, circle 41 on the Readers Service Card.)

CONTROL FLEXIBILITY ADDED TO NEW CRT DISPLAY SYSTEM

Digital Equipment Corp., Maynard, Mass., has built a general-purpose experimental display system for the U. S. Army Signal Corps. The system is based on Digital's PDP-4 computer and Precision Incremental Display Type 340. The new system can display and modify information generated by a second computer or it can function independently. The information appears on a 17-inch cathode ray tube. While watching it, the operator can respond by using several types of console controls.

Information stored in the 8-microsecond core memory of the PDP-4 is presented on the Type 340 as dots, lines, curves, characters or shapes. The operator can generate new information or modify th that already in memory with push buttons, knobs, a typewriter keyboard, and a rotating ball added to the display console.

The new controls can execute a variety of functions, depending on the roles assigned to them by the operating program being used in the computers. The rotating ball, recessed in the console, can turn indefinitely in any direction, greatly extending the movement capabilities of joysticks and other lever-like devices used earlier with displays. The keyboard per-



mits the operator to feed in text without returning to the PDP-4 console typewriter. The display console also includes Digital's high speed light pen, which lets the operator single out displayed information that he wants to modify.
(For more information, circle 45 on the Readers Service Card.)

Components

U. S. MAGNETIC TAPE CO. OFFERS NEW MAGNETIC COMPUTER TAPE

A new magnetic computer tape has been announced by U. S. Magnetic Tape Co., Huntley, Ill., which is said to offer more durability, longer life and lower operating cost than other tapes now available.

This tape, based on a new proprietary formula, meets or exceeds the specifications of all widely used computer systems, says the company. It also is covered by the longest guarantee in the industry: 30 days' additional life beyond the normal "Read-Pass" guarantee given by other tape manufacturers.

The new coating formulation is said to produce a smooth coated surface of extremely low abrasive quality which results in extended life for computer heads, and in an unusually high yield of drop-out-free tape.
(For more information, circle 47 on the Readers Service Card.)

AUTOMATION

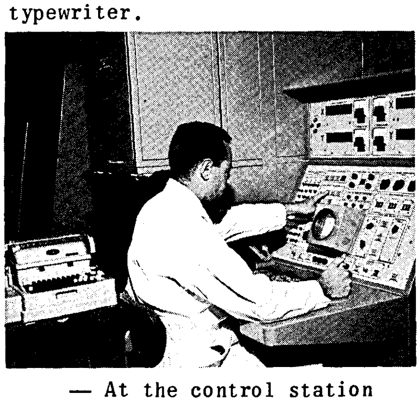
AUTOMATED MAP PREPARATION

An instrument for use in the process of making very accurate maps has been delivered to the U. S. Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va., by the Link Group of General Precision, Inc., Binghamton, N.Y.

The device is designated the Automatic Point Marking, Measuring, and Recording Instrument (APMMRI). It is able to automatically and more accurately perform the combined functions of a number of separate equipments presently in use. The APMMRI is so accurate that an actual distance of 3.5 miles can be measured to within 2 inches from a nine-inch aerial photograph, scaled to 25,000:1.

The Link-produced instrument uses two air-bearing X-Y tables — surfaces which are supported and guided by a thin layer of air and move in two directions — for positioning aerial photographic negatives or glass plate diapositives. A third smaller X-Y table, a modified microscope base, is provided for positioning a reference transparency for certain modes of operation.

The most significant achievement in the design of the system is the use of an electronic correlator which compares and automatically aligns conjugate detail. It operates in a closed-loop arrangementwith the air bearing tables to position the images to an accuracy of one micron. The points selected are then simultaneously marked and the coordinates are read out on an electric typewriter.



— At the control station of the APMMRI, an operator positions to a conjugate image point on two overlapping aerial photographs through joy-stick control.

Diapositives or negatives are mounted on the tables so that areas of interest are scanned by three synchronized flying-spot scanners providing video inputs to the closed-circuit TV monitors and the image correlation system. Images of these areas can be displayed singly or in combination, at the operator's option on a five inch monitor cathode-ray tube for direct observation or on two one-inch tubes which can be observed in a stereo-viewing mode.

PEOPLE OF NOTE

BURROUGHS APPOINTMENTS

Ray R. Eppert, Burroughs Corporation president, recently announced the appointments of R. O. Baily as corporate vice president and general manager, Equipment & Systems marketing, and R. C. Cavill as corporate vice president and general manager, International Marketing. Baily and Cavill will direct marketing of the corporation's full range of electronic data processing systems and general business machines in the United States and in over seas countries of the Free World, respectively. Baily joined Burroughs in Sioux City, Iowa, in 1947; Cavill joined at Toronto in 1939.

RAND MAN TO BE PRESIDENT OF SHARE

James D. Babcock, programming systems group, Computer Sciences Department, The RAND Corporation, Santa Monica, Calif., was elected president of SHARE at the group's twenty-third semi-annual meeting. Mr. Babcock succeeds James E. Rowe, manager of central data processing, Union Carbide Nuclear Corporation, Oak Ridge, Tenn.

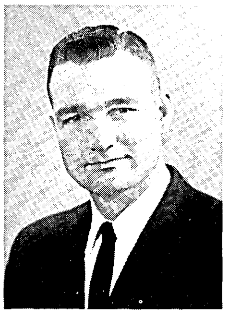
SHARE is an international organization for the cooperative pooling of computer programming techniques, representing over 200 companies and government agencies engaged in scientific and commercial data processing, using certain IBM high-speed digital computers.

C-E-I-R APPOINTS BURTON VP AND DIRECTOR

Warren E. Burton has been appointed Vice President and Northeast Regional Director of C-E-I-R, Inc. Mr. Burton will direct the operations of C-E-I-R's computer center in suburban Boston as well as its staff of scientists and mathematicians. The Northeast Region includes the New England states and Eastern Canada. Burton was formerly director of the firm's Computer Services Division.

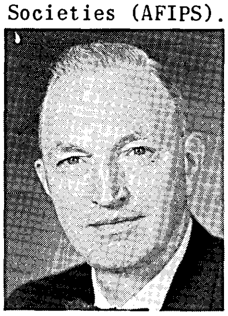
KEYDATA CORPORATION NAMES EMMONS TO HIGH POST

William F. Emmons, Jr. has been appointed Executive Vice President of KEYDATA Corp., a division of Charles W. Adams Associates, Inc., electronic data processing consultants of Bedford, Mass. He was formerly affiliated with IBM, the last three years as Data Processing Manager in its Boston office. Mr. Emmons will be responsible for directing the marketing and operating activities of KEYDATA's Boston facility as well as extending its services to major cities throughout the country.



AFIPS NAMES DR. E. L. HARDER

Dr. Edwin L. Harder has been elected Chairman of the Board of Governors of the American Federation of Information Processing Societies (AFIPS). He succeeds J. Don Madden, who has resigned to become full-time Executive Director of the ACM, one of the member societies of AFIPS. (see below) Dr. Harder is Manager, Analytical Dept., Westinghouse Electric Corp., and has staff responsibility for the application of computers in engineering and science throughout the Corporation. In addition to filling Mr. Madden's unexpired term, Dr. Harder has also been named Chairman-Elect for the new term starting in 1965.



MADDEN JOINS ACM AS EXECUTIVE DIRECTOR

The Association for Computing Machinery (ACM) has named as its first Executive Director, John D. Madden. Mr. Madden, who will headquarter in New York City, will develop and administer membership drives, implement liaison with chapters, and stimulate government support in society activities in an overall program to maintain the upward trend in ACM's growth curve. He has been a member of the National ACM Council since 1960.

MEETING NEWS

1964 BUSINESS EQUIPMENT EXPOSITION & CONFERENCE

The 1964 Business Equipment Exposition and Conference will be held October 19th to 23rd at the Los Agneles Memorial Sports Arena, (Calif.). The 80,000 square foot Exposition will be the largest show of its kind ever held in the West by BEMA (Business Equipment Manufacturers Association). The exhibitors number approximately 75. The show will run from 12 noon to 10:00 p.m. daily.

BEMA's Business Equipment Week conference program at the Hotel Ambassador, on Wednesday, October 21, will give executives a "Look at the Future". A panel of four experts will review technological advances that will change the way business will be conducted in the 1970s. On Thursday, a second conference session will examine the role of the computer in election reporting and the behind the scenes planning that goes into the "final prediction". BEMA's annual meeting and election of officers will be held on Thursday morning in the Ambassador preceding the conference program.

The week-long program also includes a series of three luncheons — each featuring an outstanding industry speaker.

Exposition and Conference tickets are free to business executives; luncheon tickets are priced at $5.00 each. Tickets are available from BEMA Headquarters at 235 East 42nd St., New York, N.Y. or from BEMA's Los Angeles Headquarters in the Hotel Ambassador.

SPECIAL ORIENTATION PROGRAM FOR STUDENTS AND TEACHERS AT FJCC 1964

The 1964 Fall Joint Computer Conference will have three days of orientation seminars during the full course of the national meeting in San Francisco (Calif.) October 27-29. The seminars are being held to increase general understanding of newer computer concepts and their applications in business and science, and to encourage students to consider career opportunities in data processing.

The daily sessions will be held at the Del Webb Town House on Market Street, within a block of the Civic Auditorium and Brooks Hall, where the conference and exhibits will be housed. There will be accommodations for approximately 400 students and teachers at each session.

Junior and senior high school students, lower level college students, instructors and school administrators are being invited to take part. While any in the above categories can attend sessions according to convenience, arrangements are being made for area accommodations as follows: October 27, San Francisco and San Mateo Counties; October 28, Alameda County; October 29, Santa Clara County.

Identical programs will be held each day, starting at 9 in the morning and concluding with a 4 p.m. session on the potential impact of computers on adult pursuits in the future.

DPMA 1964 FALL CONFERENCE AND BUSINESS EXPOSITION

The Data Processing Management Association 1964 Fall Conference and Business Exposition is being held November 3-5, in the new San Francisco Hilton Hotel (Calif.). The seminar and business exposition is expected to draw not only thousands of Association members, but thousands more local viewers.

This will be a management-level conference, as indicated by its theme, "Measurers for Management". Management's function will be emphasized in practically every phase of the Automatic Data Processing operation.

The Conference will consist of seminar sessions coupled with panel discussions and a business exposition. A feature of the exposition will be special election day coverage — right on the exhibit floor. Seminars on election forecasting methods will be conducted concurrently.

Information concerning registration and reservations can be obtained by writing to Data Processing Management Association, 1964 Fall Data Processing Conference and Business Exposition, 524 Busse Highway, Park Ridge, Ill. 60068.

BUSINESS NEWS

GOVERNMENT SPENDING FOR DP IN FISCAL 1964 UP 41% OVER 1963

The Federal Government, the nation's largest computer user, representing nearly 11% of all the computers in use in this country, has just completed its second inventory of DP equipment. The "1964 Inventory of Automatic Data Processing (ADP) Equipment in the Federal Government" has been released by the House Post Office & Civil Service Committee. The Bureau of the Budget, which prepares this report, has added several new sections to this year's inventory, including computer applications at each installation, average hourly usage per month and an indication of whether the equipment is leased or owned, and of whether it is operated by a contractor under a cost basis contract.

A number of significant statistics are provided by this report.

1767 computers were in use in the Federal Government in fiscal 1964, up from 1326 last year. This number is expected to rise to 1946 by the end of fiscal 1965, and climb to 2150 by fiscal 1966.

IBM supplied 940 of the Federal Government's computers in fiscal 1964, representing 54% of the total. This represents a sharp downward move from 868 IBM computers, or 65% of the computers used by the government during fiscal 1963. Next in the numbers of computers in 1964 is NCR with 191, followed by Control Data with 138, RCA with 97 and UNIVAC with 92.

Total costs for data processing in the Federal Government was $1106 million in fiscal 1964, up 41% from $785 million in fiscal 1963. The largest portion of this increase of $321 million is accounted for by $278 million used to purchase leased computers and related equipment. 1965 costs are expected to represent a slight reduction to $1053 million reflecting a lower level of computer purchases.

The Department of Defense accounted for 67% of the total government spending for data processing in fiscal 1964.

The percentage of purchased computers in the government rose from 21% in 1963 to 39% in 1964 and is expected to reach 46% by 1965. In fiscal 1964, 37 government agencies will operate 889 computer units...each computer unit being a separate administration site for a computer installation.

The number of man-years utilized for the management and operation of computer installations in the government has increased from 24,400 in fiscal 1959 to an estimated 53,600 in fiscal 1964, or only 120%, while the number of computer units has increased 195%, from 271 to 798, in the same period. The actual number of computers in use has increased 460%, from 403 to 1767, in the same period.

The 360-page report can be ordered for one dollar from the U. S. Government Printing Office, Washington 25, D.C.

COMPUTER SHIPMENTS REACH $2.25 BILLION IN 1963

Shipments of computers and office machines increased 3.2% to a $2.25-billion level last year, according to figures just released by the U.S. Department of Commerce. 1963 shipments of computing equipment hit $860-million; typewriters, $244-million; duplicating machines, $36-million; and other business machines, $366-million.

The value of parts and attachments for these business machines, sold separately by establishments making complete business machines, amounted to $366-million, a decrease of $54-million from 1962. This decrease was more than offset by a $118-million increase in computing and accounting machine shipments.

The 1963 data were collected on Census Form MA-35R, "Office, Computing, and Accounting Machines," and include reports from 211 establishments which manufacture business machines. The figures on quantity and value of shipments represent physical shipments from the reporting establishments and include products shipped on consignment.

In the case of products not sold but leased, the establishments reported an estimate of their value. These estimates approximate the value of the products if sold outright, and are based on the valuation placed on them for tax, insurance, or similar purposes.

CONTROL DATA REPORTS RECORD REVENUES

Control Data reports net sales, rental and service income for the fiscal year (ending June 30) was $121,439,690, up 84 per cent from the previous year. Net profits after provision for federal and state income taxes were $6,072,921, up 127 per cent over the preceding year.

In reviewing major contributions to Control Data's growth in sales and earnings, President W. C. Norris emphasized the Company's broadened product scope, new applications, and worldwide marketing. Cited were numerous industrial and commercial applications and installations of management information systems and industrial control systems. Typical examples were computer-directed systems for General Motors Corp., Sears, Roebuck and Co., and Union Carbide. Norris also commented on the Company's leadership in the large-scale computer market worldwide, and announced receiving an order from the National Center for Atmospheric Research at Boulder, Colo., for a CONTROL DATA 6600, world's largest, fastest, and most powerful computer.

GENERAL KINETICS DOUBLES ANNUAL SALES

Sales and rental income for GKI and its wholly-owned subsidiaries for the year ending May 31 totaled $2,361,799, compared to $1,017,696 for the previous year. GKI subsidiaries, GKI Tape Service Corp., Arlington, which began operations during the year, and Computer Test Corp., Cherry Hill, N.J., contributed significantly to the sales rise, the company reports.

Net income before taxes amounted to $132,784, compared with $33,778 a year ago.

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 SEPTEMBER 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	9	17
	TRW-530	Y	$6000	8/61	22	4
Burroughs	205	N	$4600	1/54	62	X
	220	N	$14,000	10/58	42	X
	E101-103	N	$875	1/56	125	X
	E2100	Y	$535	8/64	6	1010
	B100	Y	$2800	8/64	6	32
	B250	Y	$4200	11/61	93	18
	B260	Y	$3750	11/62	65	172
	B270	Y	$7000	7/62	83	30
	B280	Y	$6500	7/62	91	42
	B370	Y	$8400	7/65	0	16
	B5000	Y	$16,200	3/63	35	23
	B5500	Y	$35,000	3/65	0	1
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	20
	DDP-116	Y	$900	2/65	0	0
	DDP-224	Y	$3300	12/64	0	5
Control Data Corporation	G-15	N	$1000	7/55	320	X
	G-20	Y	$15,500	4/61	26	X
	160*/160A/160G	Y	$1750/$3500/$12,000	5/60;7/61;3/64	379	25
	924/924A	Y	$11,000	8/61	28	3
	1604/1604A	Y	$38,000	1/60	60	X
	3200	Y	$12,000	5/64	11	61
	3400	Y	$25,000	11/64	0	18
	3600	Y	$58,000	6/63	24	33
	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	43	11
	PDP-5	Y	Sold only about $25,000	9/63	55	10
	PDP-6	Y	Sold only about $300,000	8/64	1	8
	PDP-7	Y	Sold only about $72,000	10/64	0	10
El-tronics, Inc.	ALWAC IIIE	N	$1820	2/54	24	X
Friden	6010	Y	$600	6/63	152	171
General Electric	205	Y	$2900	9/64	0	10
	210	Y	$16,000	7/59	60	X
	215	Y	$5500	11/63	26	14
	225	Y	$7000	1/61	122	3
	235	Y	$10,900	12/63	18	18
	415	Y	$5500	5/64	10	110
	425	Y	$7500	7/64	3	46
	435	Y	$12,000	10/64	0	22
	455	Y	$18,000	6/65	0	9
	465	Y	$24,000	6/65	0	6
	625	Y	$65,000	2/65	0	7
	635	Y	$50,000	12/64	0	7
General Precision	LGP-21	Y	$725	12/62	125	55
	LGP-30	semi	$1300	9/56	435	5
	RPC-4000	Y	$1875	1/61	100	2
Honeywell Electronic Data Processing	H-200	Y	$4200	3/64	45	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	8	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	11
	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	510	X
	360/30	Y	$4800	7/65	0	1500
	360/40	Y	$9600	7/65	0	450
	360/50	Y	$18,000	9/65	0	350
	360/60	Y	$35,000	10/65	0	300
	360/62	Y	$50,000	11/65	0	75
	360/70	Y	$80,000	10/65	0	175
	650-card	N	$4000	11/54	390	X
	650-RAMAC	N	$9000	11/54	76	X
	1401	Y	$4500	9/60	7400	820
	1401-G	Y	$1900	5/64	200	800
	1410	Y	$12,000	11/61	430	150
	1440	Y	$1800	4/63	1100	700
	1460	Y	$9800	10/63	410	610
	1620 I, II	Y	$2500	9/60	1505	30
	701	N	$5000	4/53	1	X
	7010	Y	$19,175	10/63	49	39
	702	N	$6900	2/55	3	X
	7030	Y	$160,000	5/61	6	X
	704	N	$32,000	12/55	42	X
	7040	Y	$14,000	6/63	52	40
	7044	Y	$26,000	6/63	40	15
	705	N	$30,000	11/55	84	X
	7070, 2, 4	Y	$24,000	3/60	520	45
	7080	Y	$55,000	8/61	70	3
	709	N	$40,000	8/58	11	X
	7090	Y	$64,000	11/59	48	4
	7094	Y	$70,000	9/62	256	23
	7094 II	Y	$76,000	4/64	42	56
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	411	186
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	225	125
	NCR - 390	Y	$1850	5/61	668	185
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	3	X
	RCA 301	Y	$6000	2/61	510	135
	RCA 3301	Y	$11,500	7/64	2	32
	RCA 501	Y	$14,000	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	77	56
	SDS-920	Y	$2700	9/62	60	8
	SDS-925	Y	$2500	12/64	0	1
	SDS-930	Y	$4000	6/64	4	23
	SDS-9300	Y	$7000	10/64	0	5
UNIVAC	I & II	N	$25,000	3/51 & 11/57	32	X
	III	Y	$20,000	8/62	75	37
	File Computers	N	$15,000	8/56	24	X
	Solid-State 80, 90, & Step	Y	$8000	8/58	335	1
	Solid-State II	Y	$8500	9/62	43	3
	418	Y	$11,000	6/63	6	8
	490	Y	$26,000	12/61	35	21
	1004	Y	$1900	2/63	1850	750
	1050	Y	$8000	9/63	68	254
	1100 Series (except 1107)	N	$35,000	12/50	14	X
	1107	Y	$45,000	10/62	20	7
	LARC	Y	$135,000	5/60	2	X
	1108	Y	$50,000	7/65	0	8
				TOTALS	21,667	10,804

X = no longer in production.

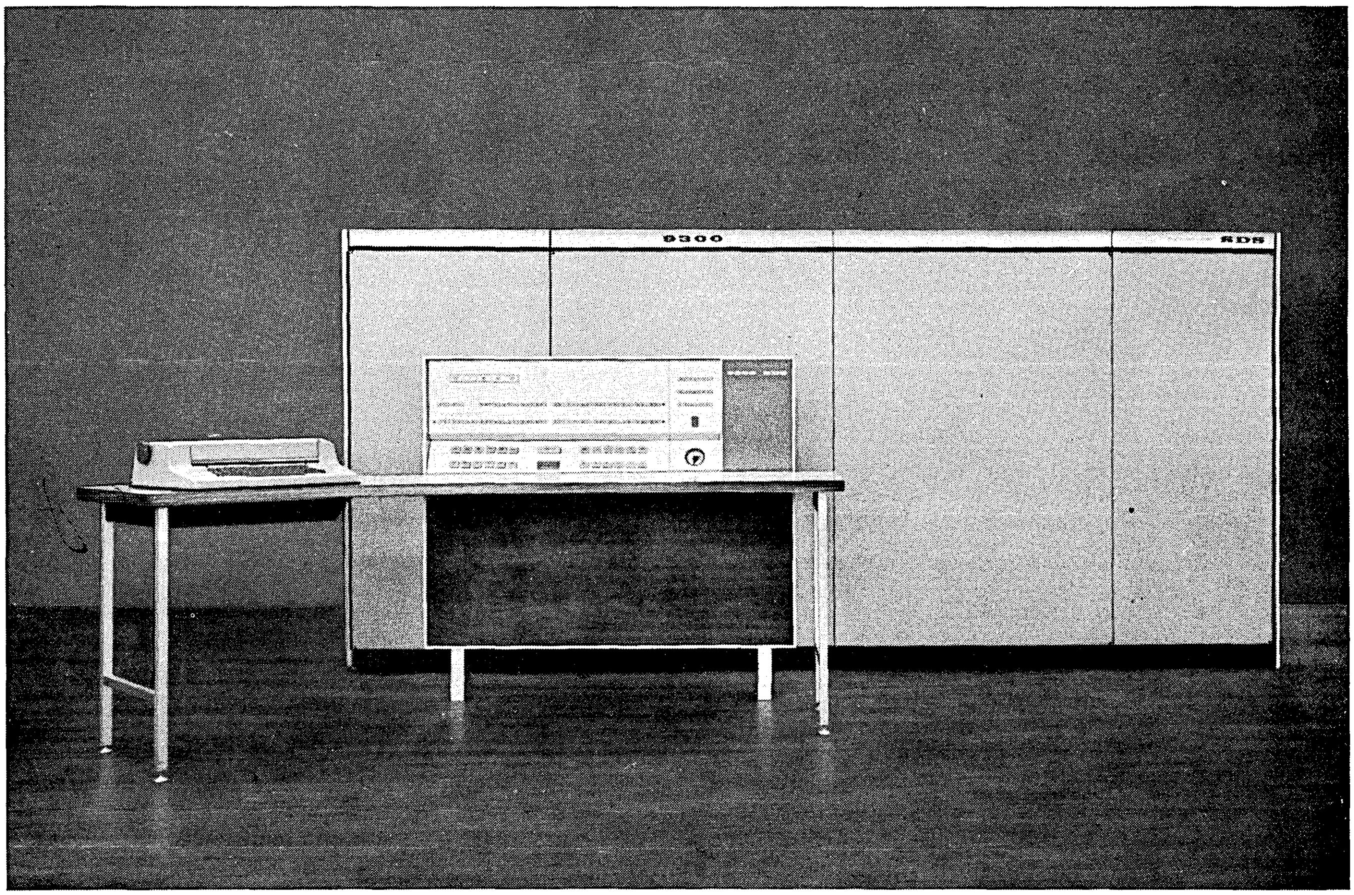
* To avoid double counting, note that the Control Data 160 serves as the central processor of the NCR 310. Also, many of the orders for the 7044, 7074, and 7094 I and II's are not for new machines but for conversions from existing 7040, 7070 and 7090 computers respectively.

** 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.

If your application is real-time and you care about availability, reliability and cost...

There is exactly one scientific/engineering digital computer you can buy...

This one:



Availability: The SDS 9300 is here. It's running. It's real. It's in production. If you'd like to see one in operation yourself, come out to our plant and run your own problem on the 9300.

Reliability: How do *you* project reliability? Component count? The SDS 9300 has the lowest count of any machine in its class (up to five times less!).

Cost: The SDS 9300 costs less to buy and less to operate. You can have a complete 9300 system (8K memory, I/O, four tape stations, high speed printer, card reader and punch) for $360,000. You'd pay at least 20% more for a less powerful and flexible machine.

Do you have all the facts on the SDS 9300? A brochure awaits your inquiry.

SDS 9300 — $177,500 with 8,192 words of memory, Control Console, 6-bit Time Multiplexed Communication Channel, and Input/Output Typewriter.

Basic core memory of 4,096 words, expandable to 32,768 words, all directly addressable. One standard and as many optional buffered input/output channels as needed, all of which can operate simultaneously with computation.

Memory cycle time: 1.75 μsec

Execution times, including all accesses and indexing:

Fixed Point (24 bits plus a parity bit)

1.75 μsec	Add
3.5 μsec	Double Precision Add
7.0 μsec	Multiply
5.25 μsec	Shift (24 positions)

Floating Point
(39-bit fraction, 9-bit exponent)

14.0 μsec	Add
12.25 μsec	Multiply

SDS SCIENTIFIC DATA SYSTEMS 1649 Seventeenth Street, Santa Monica, Calif.

Sales offices in New York, Boston, Washington, Philadelphia, Pittsburgh, Huntsville, Orlando, Chicago, Houston, Albuquerque, San Francisco. Representatives: Brogan Associates, Inc., New York; Ammon & Champion Co., Dallas; Cane, Jessup, Seattle. Foreign representatives: Instronics, Ltd., Stittsville, Ontario; CECIS, Paris; F. Kanematsu, Tokyo; RACAL, Sydney.

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BOOKS AND OTHER PUBLICATIONS

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

Tenenbaum, Morris, and Harry Pollard / Ordinary Differential Equations / Harper and Row, 49 East 33 St., New York 16, N. Y. / 1963, printed, 808 pp, $10.75

This elementary textbook is intended for mathematics, engineering and science students who need a full working knowledge of ordinary differential equations. The work consists of twelve parts divided into a total of sixty-five lessons, plus a bibliography, and a comprehensive index. Each lesson includes explanations with practical exercises, and answers. Topics include numerical methods, celestial mechanics, and LaPlace transforms.

Gill, Arthur / Introduction to the Theory of Finite-State Machines / McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N. Y. / 1962, printed, 207 pp, $9.95

This is a textbook which presents an introductory exposition of the concepts and techniques underlying the theory of synchronous, deterministic, finite-state machines. Among the basic aspects covered are: machine characterization, transition matrices, state and machine equivalence, machine minimization, identification experiments for states and machines, and fault identification. The text is directed to the advanced undergraduate and first-year graduate student. Emphasis is placed on analysis techniques; synthesis aspects are not discussed. Problems included in every chapter. Seven chapters include: "Transition Tables, Diagrams and Matrices," "Equivalence and Machine Minimization," and "Input-Restricted Machines." Bibliography and index.

Saxon, James A. / Programming the IBM 7090: A Self-Instructional Programmed Manual / Prentice-Hall, Inc., Englewood Cliffs, N. J. / 1963, printed, 210 pp, $9.00

This book is designed to teach readers with little programming experience how to program the IBM 7090 computer. The material is presented in 15 lessons; the information is carefully organized and explained. Included in the lessons are numerous problems, placed on right hand pages; the solution to each problem set is presented on the immediately following left hand page. Among the subjects covered in this book are: symbolic coding; use of constants and literals; use of index registers; sample of a complete program. Index.

Hoffmann, Walter, editor, and 25 authors / Digital Information Processors / Interscience Publishers, 440 Park Ave. South, New York 16, N. Y. / 1962, printed in Germany, 740 pp, $27.00

This volume presents a selection of contributions in German and English dealing with digital information processors in the sense of the information machine. It is addressed to computing specialists who wish to extend their knowledge into related fields. The subjects treated were selected because there seemed to be a special need for their study, or because they have not as yet been comprehensively treated elsewhere. There are sixteen articles; eight are in English, eight in German. Among the English-language articles: "Interrelations Between Computer and Applied Mathematics," "Micro-programming and Trickology," and "Machine Language Translation." Among the German-language articles: "Automaten und Denkprozesse," and "Neue technische Entwicklungen." Name index and subject index included. 173 figures.

Nonconventional Technical Information Systems in Current Use, No. 3 / Office of Science Information Service, National Science Foundation, Washington 25, D. C. / 1962, printed, 209 pp, ?

This report consists of descriptions of technical information systems currently in operation which embody new principles for the organization of subject matter or employ automatic equipment for storage and search. The descriptions used are essentially those submitted by the contributors. Seventy-three different organizations have contributed descriptions of eighty-seven nonconventional systems. The report is divided into three parts: "Systems Which Store References," "Systems Which Store Data," and "Systems Which Produce General Search Aids." A checklist of information to be included in descriptions of systems was sent to persons contributing to the report. The categories of this checklist are as follows: General, Input and Storage, Search and Output, Plans for Improvement, Publications; all of these categories are further subdivided. Also included: "Supplementary Guide to Individuals and Organizations," "Index of Geographical Locations," and "Subject Guide."

International Computation Centre, and 72 authors / Symbolic Languages in Data Processing / Gordon and Breach, 150 Fifth Ave., New York 11, N. Y. / 1963, 849 pp, $34.50

This work contains 50 lectures presented at a Symposium organized by the International Computation Centre, Rome, March 26-31, 1962. The lectures discuss the development of a general theory of symbolic languages, and the current and future roles of symbolic languages in the computer art. The papers are sorted into seven subject areas of which some are: "Theory of Languages: Syntactical Structure and Meta Languages," "Design of Languages for Commercial Problems," and "Problems of Programming Systems." Some of the titles are: "A Translation Technique for Languages Whose Syntax is Expressible in Extended Backus Normal Form," "Generalized ALGOL," "Rapidwrite—COBOL without Tears," and "Problems in Program Interchange-ability." Two general panel discussions also included: "Are Extensions to ALGOL 60 Necessary and if so, What Ones?" and "Is a Unification ALGOL-COBOL, ALGOL-FORTRAN Possible? The Question of One or Several Languages."

Langman, Harry / Play Mathematics / Hafner Publishing Co., 31 East 10 St., New York 3, N. Y. / 1962, printed, 216 pp, $4.95
This book is written for people who wish to play with mathematical ideas but have a minimum of technical knowledge and experience. Most of the book can be read by an intelligent person with no mathematical knowledge beyond elementary arithmetic. Explanations are given for a variety of types of problems and most of the exercises are original. Eleven chapters include: "Arithmetic," "Algebra," "Geometry," "Letter Division," "Skeleton Divisions," "Magic Number Arrangements," "Line Problems," "Geometric Dissections," "Visualization Problems," "Numerical Methods of Analysis," and "Miscellaneous Problems."

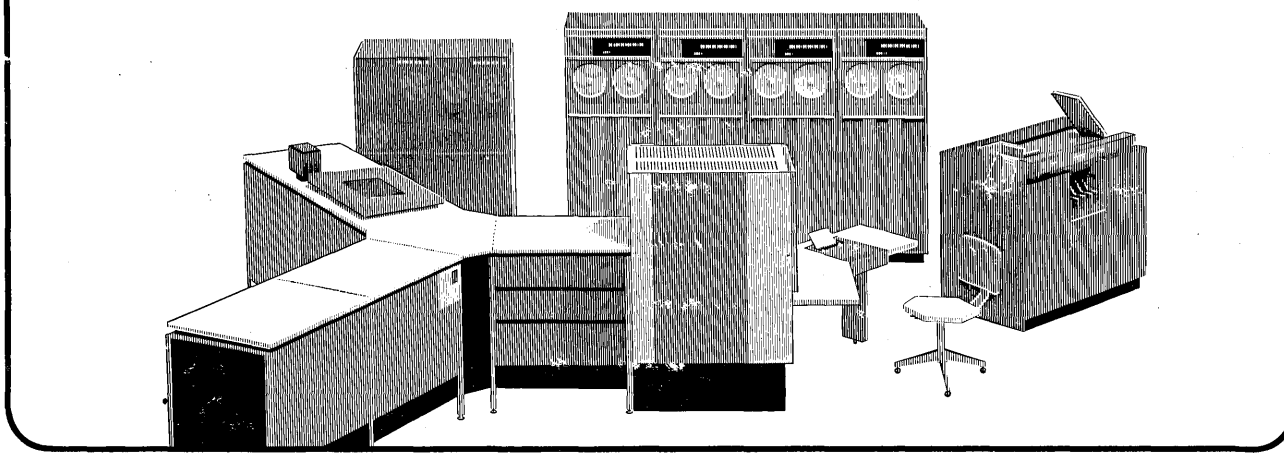
Walkowicz, Josephine L. / U. S. Department of Commerce, National Bureau of Standards, Technical Note 193: A Bibliography of Foreign Developments in Machine Translation and Information Processing / U. S. Government Printing Office, Washington 25, D. C. / 1963, photo offset, 191 pp, $1.00
This publication consists of 714 references to the literature, mainly Russian, translated by the Bureau's Research Information Center. The bibliography contains not only the usual author and subject index but a permuted title index, "provided as an experiment in the comparative efficiency of the two methods of indexing." It is computer-produced and has certain advantages of speed and economy in usage. An index of conferences and organizations cited, and a listing of original source documents, are also included.

Monroe, Alfred J. / Digital Processes for Sampled Data Systems / John Wiley & Sons, Inc., 440 Park Ave., S., New York 16, N. Y. / 1962, printed, 490 pp, $12.50
This book is written for the systems engineer faced with the problem of designing a system containing a digital computer. Emphasis has been placed on synthesis, not analysis. The book is restricted to systems that achieve system compensation by means of a digital-like device. It is necessary for the reader to have some knowledge of Laplace transform methods, servo-theory, statistics, and Z-transform calculus. Difference equations, explained in chapter two, are the fundamental tool employed throughout the book. Twenty-five chapters include: "Elementary Principles of Digital Computers," "Analysis of Samplers," "Linearity Constraints," "Treatment of Random Input Signals," and "Programming a Z-transform." Three appendices and subject index included.

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.

Addo-X, Inc., ADP Div., 270 Park Ave., New York 17, N.Y. / Page 7 / Albert Frank, Guenther Law, Inc.
American Telephone & Telegraph Co., 195 Broadway, New York 7, N.Y. / Page 34 / N.W. Ayer & Son
Audio Devices, Inc., 235 East 42 St., New York, N.Y. 10017 / Page 12 / Charles W. Hoyt Co., Inc.
Benson-Lehner Corporation, 14761 Califa St., Van Nuys, Calif. / Page 55 / Leonard Daniels Advertising
California State Personnel Board, 801 Capitol Mall, Sacramento, Calif. / Page 50 / Gerth, Brown, Clark & Elkus
Computer Control Co., Inc., Old Connecticut Path, Framingham, Mass. / Page 8 / de Garmo-Boston, Inc.
Computron Inc., 122 Calvary St., Waltham, Mass. / Page 4 / Tech/Reps
Cycle Equipment Co., 17480 Shelburne Way, Los Gatos, Calif. / Page 54 / Benet Hanau & Associates
Decisional Control Associates, 1590 Monrovia, Newport Beach, Calif. / Page 19 / Leonard Daniels Advertising
DuPont, Wilmington, Del. / Page 13 / Batten, Barton, Durstine & Osborn, Inc.
Fabri-Tek, Inc., P.O. Box 645, Amery, Wisc. / Page 33 / Midland Associates, Inc.
Honeywell EDP, 60 Walnut St., Wellesley Hills, Mass. / Page 56 / Batten, Barton, Durstine & Osborn, Inc.
Information Displays, Inc., RMS Division, 102 E. Sandford Blvd., Mt. Vernon, N.Y. / Page 25 / George Taubert
International Business Machines Corp., Thomas J. Watson Research Center, P.O. Box 218, Yorktown Heights, N.Y. 10598 / Page 50 / Benton & Bowles, Inc.
International Business Machines Corp., Data Processing Div., 112 E. Post Rd., White Plains, N.Y. 10601 / Pages 28, 29 / Marsteller Inc.
Memorex Corporation, 1180 Shulman Ave., Santa Clara, Calif. / Page 2 / Hal Lawrence, Inc.
National Cash Register Co., Main & K Sts., Dayton 9, Ohio / Pages 3 and 51 / McCann-Erickson, Inc.
L. A. Pearl Co., 801 Second Ave., New York, N.Y. 10017 / Page 54 / —
Potter Instrument Co., Inc., Sunnyside Blvd., Plainview, N.Y. / Between Pages 2 and 2A / Product Planning, Inc.
Proceedings of 1964 Systems Engineering Conference, c/o Computers and Automation, 815 Washington St., Newtonville, Mass. 02160 / Page 11 / Clapp & Poliak, Inc.
Scientific Data Systems, 1649 17th St., Santa Monica, Calif. / Page 52 / Faust/Day Advertising
Wang Laboratories, Inc., North St., Tewksbury, Mass. / Page 53 / Robert Hartwell Gabine



The low-cost Honeywell 300 is 50 to 150 times faster than the most widely used scientific computers

(and now you can have up to 262,144 characters of memory)

Honeywell 300 is a fast (1.75 microsecond memory cycle), low-cost (starts at $2,345 per month), binary (24-bit fixed, and 48-bit floating-point word) computer.

This makes it the fastest low-cost scientific computer on the market. True, there are faster systems, but only in the highest-priced, larger-scale models. There are also lower-priced systems, but they are considerably slower. As much as 150 times slower.

To this basic speed-cost advantage, you can add several other features that make the Honeywell 300 attractive: A separate control memory, plus an expandable main memory that can be accessed using an interlace technique, greatly speeds up the execution of instructions. The full complement of Honeywell peripheral units is available for use with the Honeywell 300. Furthermore, up to three peripheral operations can be conducted simultaneously with computing, or with a fourth peripheral operation.

The ability to work with individual characters permits fast, efficient input-output data editing, and an automatic interrupt feature permits efficient handling of communications and real time applications. Thus the Honeywell 300 is not only the most powerful, but also the most versatile system in its class.

For more information contact your nearest Honeywell EDP Sales office. Or write to Honeywell EDP, Wellesley Hills, Mass. 02181.

Honeywell
ELECTRONIC DATA PROCESSING

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