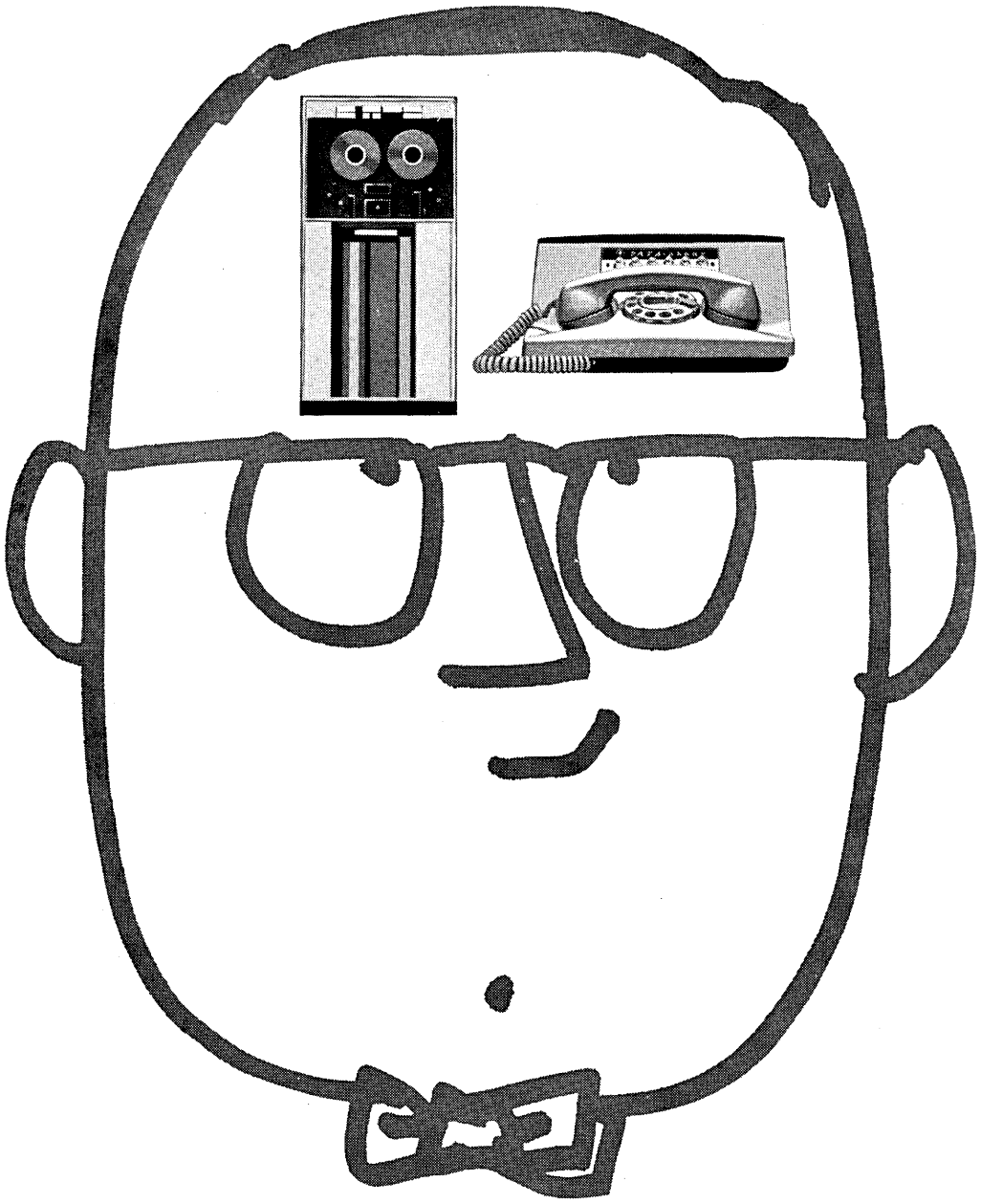
April, 1965

computers and automation

Testing Blood Under Computer Control



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Ten separate tests of patients' blood specimens are being evaluated in two minutes instead of three hours, under computer control. See more information on page 41.

computers and automation

APRIL, 1965 Vol. 14, No. 4

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

In This Issue

In Every Issue

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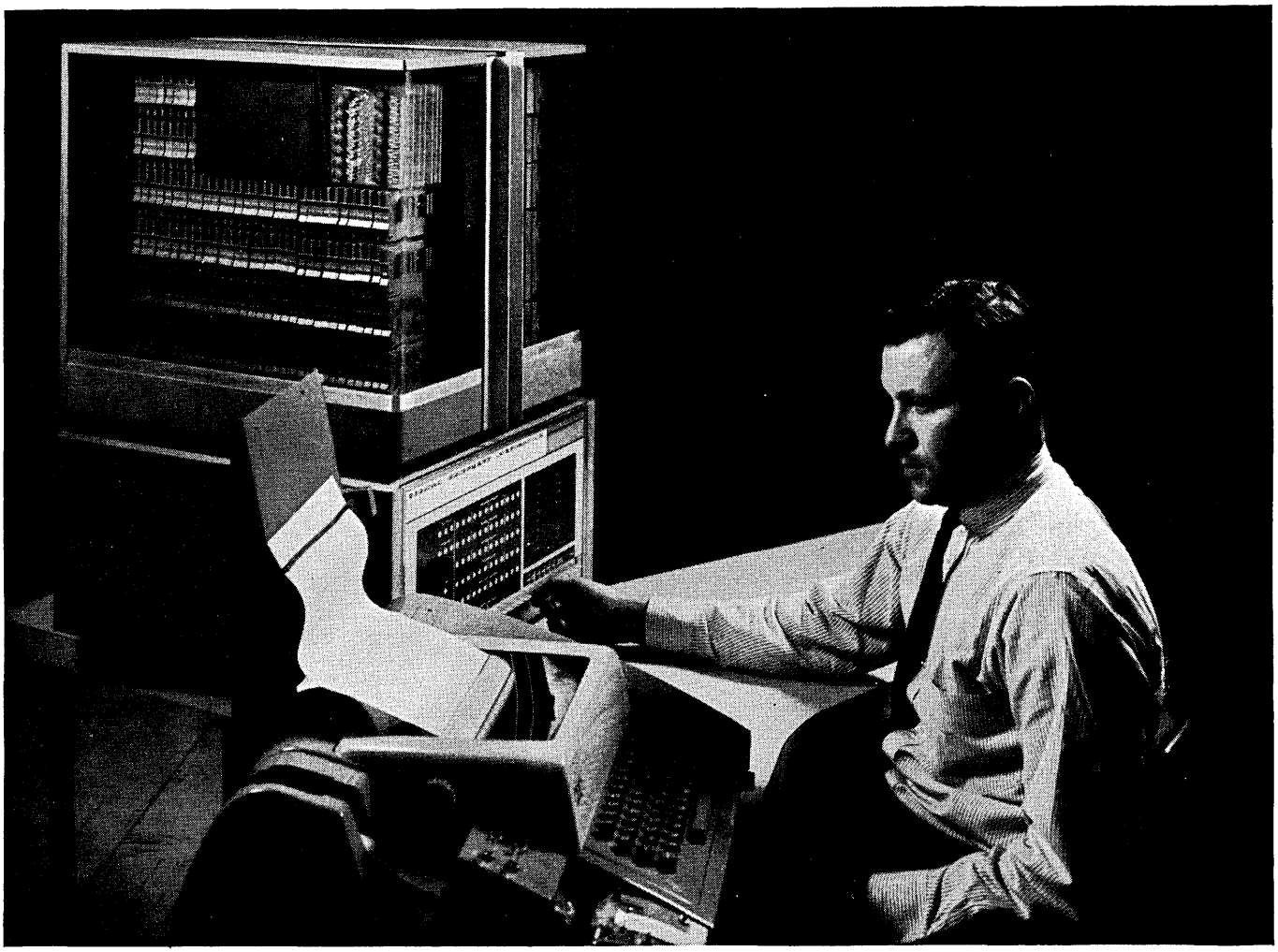

Besides FORTRAN, the software package includes an on-line debugging program which gives the user dynamic printed program status information and an on-line editing program which lets him add, delete, change or insert single lines or sections of his symbolic program. The system also contains a macro assembler, floating-point software, elementary function subroutines in single- and double-precision arithmetic, and utility, diagnostic, and maintenance routines.

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The Pervasiveness of Computers

It is remarkable how widespread and penetrating the influence of computers is becoming. For example, in the March 6 issue of "Business Week," out of 30 articles briefly described in the table of contents, 5 deal essentially with computers or their effects:

1. *A New Way to Prosper*
   The current profits boom is founded on productivity gains through automation that makes high volume more profitable. Corporate profits and cash flow are running ahead of all but a few post-war years. Unlike previous recent booms this one is not based on sharp rises in sales prices. Instead it comes from higher volume, tighter cost control, and automation.
2. *Wanted: Compatible Computers*
   Budget Bureau praises data processing industry for competition, but asks cooperation on such things as a common language.
3. *Economics—Changing the Rules on Growth*
   Brookings Study says gains in equipment efficiency make faster expansion possible. The growth rate has stepped up to 5% per year . . . yet wholesale prices remain stable. . . . The underlying factor that has made this remarkable performance possible is capital equipment that produces more output for a dollar's worth of investment.
4. *Production—When a Computer Needs a Friend*
   Experience is proving that thinking machines cannot replace human judgment. As a result once-high hopes fade for automated information retrieval systems. . . . To respond understandingly to the needs of a human intellect seems, for the present at least, to be beyond the realm of electronic art.
5. *Management—Picking Top Men: by Electronics*
   Electronic data processing equipment is being used more and more in executive recruitment. New systems can keep up to date records on both jobs and applicants.

Are we approaching the maturity of the computer field? or will computers become far more pervasive still?

Several factors point to the prediction that computers will become far more widespread and much more widely applicable than they are even now.

First, electronic data processing is an immensely powerful and versatile technique. It is revolutionizing pencil and paper, typewriter and cash register, books and records, etc., of all kinds. The motor car, jet plane, and space ship are revolutionizing the movement of man's body; in the same way, the computer is revolutionizing the movement of man's thoughts.

Second, we are still far from the limits of technological improvements in the hardware of computers and their software, and far from the limits of lowering costs. The least amount of hardware required to store and transfer one binary digit of information can be exceedingly small; and automated mass production can make that exceedingly cheap.

Finally, many present-day solutions to problems of processing information are obviously unsatisfactory and just waiting for improvements. For example, a human being is often still needed to prepare input for a computer; but in a few more years, a computer should regularly be able to optically read any characters on paper.

There is perhaps some parallel between motor cars and computers. The annual factory sales of automobiles in the United States (including passenger cars, trucks, and buses) is shown in the following table (information from the Automobile Manufacturers Association):

Year	*Number Sold (in Thousands)*	*Year*	*Number Sold (in Thousands)*
1900	4	1940	4472
1910	187	1950	8003
1920	2227	1960	7869
1930	3362	1963	9100

In the first ten years, sales multiplied 40 times. In the second ten years sales multiplied a dozen times; then in the forty years after 1920, sales multiplied 4 times.

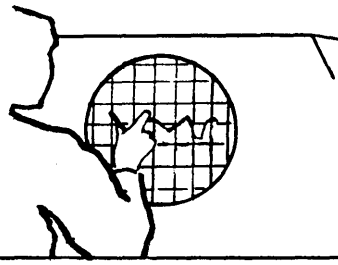
In the case of computers, in 1950 there was perhaps one commercial installation of an automatic digital computer, Univac at the Bureau of the Census. In the course of the next 15 years, the number of computers installed in the United States has reached about 18,000. But this figure applies to expensive machines; and in the future, the cost will go way down.

The number of automobiles is of course rather limited by the number of people in the country: most persons have no need for more than one car. But in the future, it will be normal for most persons of certain categories to use more than one computer, because they will be cheap and useful.

Considering various factors, it would seem reasonable to expect that the number of computers in the country will level off eventually at somewhere about the rate of 10 or 15 computers per hundred persons: for the present population level, about 20 million computers instead of 18 thousand.

Computers will become part of the fabric of society so completely and so pervasively that many articles published nowadays about computers will seem about as archaic as: "How We Used Trucks for our Deliveries Instead of Horses and Wagons."

Edmund C. Berkeley
EDITOR



c & a MARKET REPORT

DEVELOPMENT OF TIME-SHARED COMPUTER SYSTEMS: SOME COMMENTS

IBM made its first official move last month to regain face and grace in the time-shared computer systems field by introducing two new models of the System/360, the 64 and 66. IBM had suffered some well-publicized set-backs in orders for time-sharing applications in recent months, particularly to the GE 600 series. Their new models offer a memory-centered processing capability with improved multi-segmented memory protection, allocation and control so that the systems can handle multiple users at remote consoles more efficiently.

The 64 and 66 units can contain up to four processors, eight memories, and four channel controllers in a single configuration. The new memory allocation feature uses logic circuitry as an associative memory which keeps track of where blocks of information are located during actual processing. This allows the physical location of data in storage to be changed several times during the running of a single program without disrupting program execution.

The two systems use the same command structure as the rest of the 360 line plus extra instructions to direct the time-sharing features. Although the new processors can run 360 programs directly, these extra instructions require that programs prepared specifically for the new machines be re-compiled before operation on other members of the 360 line. The 64 uses the same two.μsec. memory as the model 60, and the 66 uses the same one μsec. memory as the models 62 and 70.

There is no technical reason why other processors in the 360 line cannot be used in similar time-shared multi-system configurations. We understand that IBM has been quietly offering the models 33, 44, and 55 which use model 30, 40, and 50 processors respectively in multi-system configurations. On the blue sky end, we understand there is a model 99 made up of several model 92 processors interconnected by memory... for those with over $500,000 a month to invest in computing power.

The first customer for one of the new IBM time-shared systems is apparently Lincoln Labs which has ordered a 66 configuration renting for about $120,000 a month. The system is due for installation in the summer of '66 under a three year contract. A 360/62 will be installed this fall at the Labs for program development and systems check-out work.

With time-shared computer systems in operation or being planned for MIT, Rand Corp., Dartmouth, Bell Labs, System Development Corp., and Carnegie Tech., time-sharing applications have found an articulate and aggressive group of supporters. But one should ask at this point, "Where is all the smoke coming from?"... from academic pipes?... from manufacturers anxious for the glamour associated with building avant-garde systems? ...or from the knowledgeable users of business and scientific systems who must ultimately accept time-shared operations before the potential applications have any real impact? To get some feeling for the answer to this question, we surveyed the managers of a number of large computer installations using both scientific and business applications. What did we learn? In nearly every case the managers were aware of the technical potential of time-shared applications in meeting the computer requirements of their organization. However they felt the state-of-the-art was still three to five years removed from the point when they could confidently venture into the use of a time-shared computer application. Most of these users were themselves "pioneers" in the use of computer systems six to eight years ago and as one data processing manager put it, "we've learned that you can tell a pioneer by the arrows in his back!"

Besides the limited operating experience with time-shared systems, there is another obstacle to their acceptance in existing organizations. This is the political/social implications of the centralized computing and data processing facility which a full-scale time-shared computer system operation implies. The heads of relatively autonomous divisions and departments cannot be expected to surrender easily the data processing "empires" they have developed to serve their operating groups. A vivid example of this phenomenon apparently occurred recently at the Northrop Corporation. GE landed a high-publicized order for a 625 system at Northrop in January. The system was to serve as a central computer facility for the company's diversified aerospace, defense, and business operations throughout the U. S. and abroad. The rational was that the central facility could make available to anyone in the corporation, regardless of their physical location, the most advanced computing capability available, both in terms of hardware, software, and base data files. However, when the full implications of this change were realized by operating management at the various divisions of Northrop, the company's "Czar of Data Processing" was squeezed out and the GE order was put under "re-evaluation".

Perhaps the single significant message for the computer manufacturer uncovered in our survey was that most

(Please turn to page 25)

COMMENTS ON "COMPUTERS, AND THE PUBLIC SECTOR OF THE ECONOMY"

I. From Larry H. Nebel

Jefferson City, Missouri

Thank you for the postage free envelope to cancel my subscription. I bought your magazine to keep up with the world of computers, not to keep up with how great you think the Godless Commies are. If you want to write about what great and wonderful men the Commies are, go to work for the Communist Worker, but don't try to pass it off as an editorial about computers. You did mention computers once in the piece of propaganda—in the very last sentence. I don't know if you have ever been conected [sic] with the Godless Commies before, But [sic] I intend to find out.

Please, if you are ever fired or if you quit, let me know because I think C & A could be a good magizine [sic] if it had an editor who at least believed in the United States instead of in Godless Communism. In fact, it would not be too bad if you would just write about what you are suppose [sic] to.

Please do not publish my letter unless you have all spelling and only spelling errors corrected.

If I have any money comming [sic] to me, please send it to me.

II. From P. G. Sexton

Assistant Professor, School of Mechanical Engineering
Georgia Inst. of Technology, Atlanta, Ga.

I recently subscribed to **Computers and Automation.** I assumed that it would be useful in keeping me abreast of developments in my sphere of professional activity.

The utter irrelevance of your editorial in the February, 1965 issue leads me to request cancellation of my subscription immediately.

An editorial that begins with praise of the Moscow subway, continues with a plea for disarmament and ends with advocacy of the supremacy of the socialist state may be of use as propaganda, but certainly has no place in a technical publication.

III. From the Editor

These former subscribers of **"Computers and Automation"** are probably unaware of the long history of discussion and argument in the computer field beginning in 1958 about the social responsibilities of computer people. They are probably also unaware of the Federation of American Scientists, the "Bulletin of the Atomic Scientists," and many other activities of scientists in the United States—all of which are directed to focusing the attention of highly educated professionals and specialists towards the vast social consequences of the outpouring of science in this century, and how to make them more beneficial to the world.

In a report made to the Council of the Association for Computing Machinery in 1958, the Committee on the Social Responsibilities of Computer People said:

> . . . the individual involved in computer activities, has in addition to all his other social responsibilities, those placed upon him by his computer activities—responsibilities towards society and the parts of it: his profession, his employer, his country, mankind as a whole, etc.
>
> a. He cannot rightly ignore these responsibilities. . . .
> b. He cannot rightly delegate his responsibilities. . . .
> c. He cannot rightly neglect to think about how his special role as a computer person can benefit or harm society. . . .
> d. He cannot rightly avoid deciding between conflicting responsibilities. . . .

In December, 1958, **"Computers and Automation"** reported the results of a survey of 49 technical magazines, in regard to their answers to a questionnaire about coverage of social implications:

> ( ) Our editorial policy is that our magazine should from time to time present discussion and argument about the social implications of the work of scientists and engineers in our field, and their social responsibilities—subject to the usual editorial considerations of space, wording, balance, etc.
>
> ( ) Our editorial policy is that our magazine should stick to the discussion of technical subjects, and not discuss or argue in any way the social implications of the work of scientists or engineers in our field, or their social responsibilities.

The replies were:

YES, or essentially YES:	30
NO, or essentially NO:	19

In the conclusion of that report we stated:

> The policy of **"Computers and Automation"** is to present articles, papers, discussion, and argument in regard to the social responsibilities of computer scientists and engineers in an appropriate way and as an integral and important part of our coverage of our field: "computers and data processors, and their applications and implications including automation."
>
> During the discussion printed in our pages from time to time during the past year, we have become convinced that the "ivory-towerness" of "science for science' sake" or "technology for technology's sake" must inevitably give way to the goals of "science for humanity's

(Please turn to page 25)

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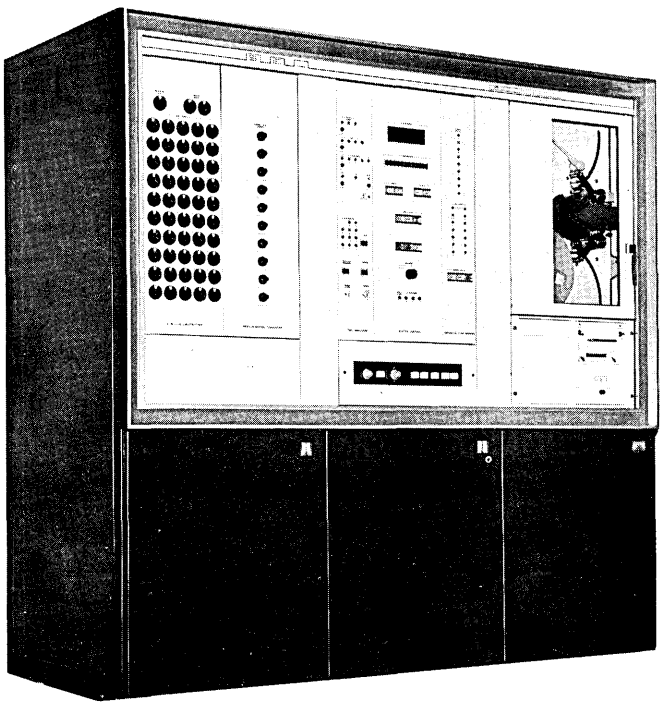

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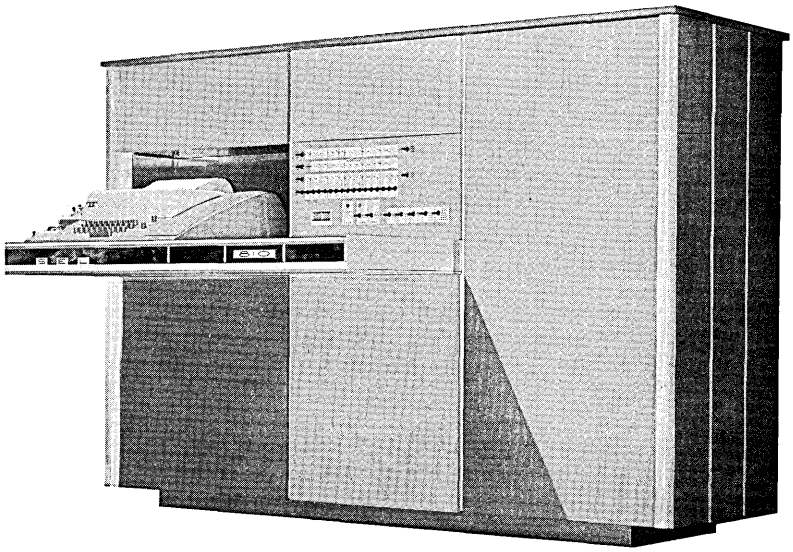

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SOUND MANAGEMENT AND EFFECTIVE USE OF COMPUTERS IN THE FEDERAL GOVERNMENT

William A. Gill
Bureau of the Budget
U. S. Government
Washington, D. C.

An evaluation of how effectively the Federal Government uses computers depends of course on the yardsticks employed and types of applications. Widespread uses of computers in space exploration, military operations, engineering, public resources management, a multitude of business-type functions, and many scientific endeavors have had many effects: improving services to the public; strengthening our defense posture; advancing the cause of science; reducing expenditures; and contributing to a stable work force in spite of an ever-increasing workload. In the aggregate, these achievements would appear to indicate a high degree of effectiveness. However, the Government is consistently changing or adding to the yardsticks used by management to measure effectiveness. With about four thousand computers now in use, including military applications, and with experience in general purpose computers dating back thirteen years, there is a wealth of utilization data the Government can draw upon. But much of the experience of the 1950's cannot be used to measure effectiveness in the mid-1960's. Advances in computer power, together with advances in man's ability to use that power more creatively as well as more prudently, make "effective use" a swift-moving target.

As the original and the biggest user of computers, the Government has learned that a determination of effectiveness does not consist of one measurement, but of several measurements; for purposes of this discussion they will be called "yardsticks." Perhaps an even more important lesson we have learned is that we must avoid measuring effective use using only one or a few instead of all the yardsticks available.

Effectiveness is sometimes viewed as the achievement of a desired objective; that is, if a man does what he sets out to do, he is effective. The Government accepts this view, but defines effectiveness also in terms of efficiency in the use of resources to achieve an objective. From this standpoint, we therefore measure computer effectiveness by (1) the accomplishment of a desirable and necessary mission, and (2) the degree of efficiency evident in the way in which computers and allied resources—especially people—are used.

The development of yardsticks has been underway for several years in the Government. A little over a year ago, the President directed the Bureau of the Budget to study the management of its automatic data processing equipment and related resources. One of the purposes of this study was to evaluate the yardsticks then in use and to point up mission yardsticks or the need for more or better criteria to use in applying yardsticks. The report of that study[1] discusses at length the measurements necessary in making effectiveness determinations. It highlights as well the dangers inherent in utilizing some of the needed yardsticks while ignoring others. In brief summary form, the twelve yardsticks implicit in the report are here outlined. And it

[1] Report to the President on the Management of Automatic Data Processing, February 1965 (issued as a committee print by the Senate Committee on Government Operations), Superintendent of Documents, Washington, D. C.

will be noted that we still face the task of developing further criteria needed in the Government-wide application of certain of these yardsticks.

Twelve Yardsticks

1. Is the computer master or slave? Until management, from top to bottom, comprehends the capabilities and limitations of the computer and desists in the tendency to abdicate to the computer technicians the decisions on computer applications, utilization will be less than effective. This is not said to downgrade the technicians; rather, it is said to highlight the importance of upgrading the competence of management to play its part in the teamwork that must exist if effective use of computers is to be achieved. Through special orientation measures and experience, many Government officials have learned to dominate the computer and, in collaboration with their technicians, are therefore multiplying their own effectiveness. And as they do so, they understand better the necessity for being alert to the need for providing leadership in using the other yardsticks which follow.

2. The data processing perspective: how broad? Government policies and guidelines provide that in each organization (department, agency, commission) there should be a top-level centralized body of information on all operating systems that involve the processing of data. It is the fundamental purpose of this data processing system inventory to enable management/technician teams to plan computer applications within the framework of *all* requirements and not on a basis of random bits and pieces. The discreet use of an inventory such as this has led to a number of mergers of several systems into one; it has been the basis for identifying opportunities for integrating closely-related systems; it has been the means for removing much of the guesswork out of long-range estimates of computer requirements; and another of its more important advantages has been to direct attention initially to the substantive operations of the organization where the bigger payoffs lie and thus divert attention from the relatively easy applications such as payroll, the returns from which are rarely significant in terms of total operations.

3. The function to be automated: is it essential? This is a familiar yardstick that is pertinent whether or not automation is a consideration. But if computer automation is involved in the perpetuation of an unessential function, both of two rather ridiculous results are usually achieved. First, we may increase the cost of performing the function, and, second, we produce an unneeded result a lot faster. A Government policy issued in 1961 requires that before any function is automated, a determination is required to be made that it is essential to perform. This policy applies both to the automation of things we were doing before the advent of the computer and those things we can do with computers which were not done previously.

A broad and potentially unlimited range of new functions is open to us, thanks to the computer. It is in this area that the yardstick of functional essentiality rises in importance. And it is in this area also where the choices are the more difficult to evaluate. Not so, of course, as to men in space or guided missiles. These are dictated by national policy. Computer navigation of ships and planes, computer control of gunfire, and computer-based aircraft warning systems are dictated by our need to defend ourselves. Massive paperwork and record-keeping systems, such as social security, would not serve the public adequately without computer assistance. Yet, the computer has such a wide range potential for data handling of unique and never-before-heard-of types; the tendency to have it do more and more things puts management in a position of making difficult and sometimes arbitrary decisions. In these cases the question "is it essential?" is still pertinent.

4. The data processing system—is it efficient? The fact that a data processing system is automated does not guarantee its efficiency. The application of the preceding yardstick, resulting in the elimination of unessential functions and tasks, is not all that can be done to improve system efficiency. There still remains the need to perform essential functions by employing only those procedures, methods and routines that produce quality products and services at least cost. This yardstick for measuring data processing efficiency is one for continuous use. Relaxation in the drive for system efficiency can be quite costly if compared with the benefits from keeping the pressure constant.

Among many illustrations that might be provided, one example of continuous improvement of a particular Government system well illustrates the potential payoff in a constant search for increased efficiency. The case in point is the Veterans Administration which in 1957 employed 17,000 people in its Government Service Life Insurance program. Today, employment in that program is well under 4,000 even though the workload has not materially diminished. Of the several contributing causes for this most significant accomplishment, two predominate: continuous system improvement was the principal cause; the effective employment of ADP equipment was the other. Underlying the achievement was, of course, the determination never to relax the system improvement efforts.

5. Modern advances in system design: are they employed? Whereas the preceding yardstick is addressed to the "functional efficiency" of a system, this one concerns a closely-related consideration: the "technical sufficiency" of system design. In effect the use of this yardstick is for the purpose of determining whether more advanced computer-inspired concepts, routines and techniques are used—if known and if feasible—in designing and redesigning systems. As this is written, there are no Government-wide criteria for measurements of technical sufficiency but plans are underway to develop them.

In scattered but numerous situations in the Government, system designers have either created or learned about and used concepts and techniques that have had the dual effect of upgrading the technical sophistication of a system and at the same time increased the responsiveness of the system to the needs of the clientele it serves. This technical upgrading has been accomplished in several ways, chiefly through the employment of advanced concepts built on mathematical and statistical techniques, but also through: (1) greater emphasis on the automation of input data at its source, including character recognition equipment; (2) more widespread use of data communication networks including computer-connected remote-inquiry stations; (3) merging two or more systems into one; and (4) integrating related systems, both within and across organization lines, so that those systems can operate independently or together, according to the need.

The Government faces two major problems in measuring the technical sufficiency of its data processing systems. One problem is to develop the measuring criteria for use Government-wide. The other is to insure that there is a more widespread understanding of the more advanced computer-based techniques and a place in the Government where agencies can go to get professional advice and assistance in the application of those techniques. The development of solutions to both of these problems is now underway.

In effect, therefore, we now have and use a variety of yardsticks for measuring the technical sufficiency of system

design in individual cases, but still lack a body of criteria for developing and applying a single yardstick on a Government-wide basis.

6. The selection of computers: was the right one identified? In the computer selection procedures used during the early years of the computer era (a "pioneering" period) a great many computers were selected on the presumption and the hope that ways would be found to use them. Except for that period, the Government has been doing an increasingly effective job of selecting computer equipment. In October 1961, it became Government policy that no decisions on computer selections were to be made until system specifications were developed. The term "system specifications" means a spelling out of what the system has been designed to accomplish. System specifications aid in determining the types of hardware capabilities needed but are not hardware specifications in the usual meaning of that term. Quite detailed for business-type activities, though necessarily less detailed in certain scientific-type applications, system specifications also help to insure that equal opportunity is afforded to all suppliers whose equipment might fulfill the system specifications.

From the Government's standpoint, observance of the existing policies on selecting equipment may in some cases delay delivery of equipment; however, getting the right equipment at the outset through knowing rather than guessing at true requirements, has advantages that more than offset the disadvantages inherent in waiting a bit longer for deliveries.

From the equipment suppliers responding to the Government's invitations to submit proposals, this concept has brought mixed reactions. They tend to prefer the concept of open competition, but system specifications usually are voluminous, complex, and costly to analyze. Suppliers have expressed the hope that the Government might achieve the same results under arrangements that are less costly to them. The Government is inclined to save the suppliers as much expense as possible. With this in view, the Government is now considering more uniformity in system specifications and the more widespread use of equipment selection through test (benchmark) problems, which will enable prompter and less costly responses by suppliers to the Government's invitations for proposals.

7. Meeting requirements for computer capacity: what sources are used? Early in the computer era the manufacturers were the only sources of this equipment. This situation has changed dramatically in the Government. With current inventory holdings being what they are, a Government agency is now required to meet its new or increased needs for computing capacity by exploring and, if feasible, using several sources: (a) by increased utilization of the equipment already in place if any; (b) by sharing equipment in place in other agencies or in a Government computer service center (the first of which is now being operated experimentally); or (c) by using equipment that has become excess to the needs of another agency, whether this excess equipment is owned or is rented and can be purchased at a reduced price. When none of the foregoing sources can be used, or are not feasible to use, then the agency is authorized to procure from a supplier. Evidences of progress in the application of this yardstick are increasing in number consistently, and are reflected by rising national averages in hours of use, significant increases in computer sharing within and between agencies, and definite indications that the annual rise in the number of computers in inventory, quite high during the past few years, is now diminishing.

8. The acquisition of computers from suppliers: rent or purchase? The Government has a policy, issued in 1961, which calls for considering the relative merits of purchasing over renting ADP equipment (the term "ADP equipment" means the computer and all equipment directly allied with its use, including punched-card equipment, communication equipment, character-recognition equipment, and any other input-output equipment). Our policy is selective. The agency purchases the equipment only if it is in the best interests of the Government to do so. At present roughly half of the "off-the-shelf" equipment in use is owned. Virtually all of our specially-built equipment is owned. Whether the ratio of owned equipment will become very much greater than at present is dependent upon a developing trend among equipment suppliers to reduce their rental charges for overtime use.

If the Government had not adopted its policies on ADP equipment purchasing and so had continued to rent its equipment, savings of $142 million in rental payments over a five-year period, resulting from computer purchases in fiscal years 1963 and 1964 alone, would not have been realized. If the Government had purchased equipment as a standard policy, rather than on a "selective" basis, much or all of the savings to be realized might well have been dissipated by a heavy inventory of surplus (and idle) owned equipment. The President recently approved continuance of current *selective* policies on ADP equipment purchasing.

9. Computer programers: how competent are they? The range in competence among computer programers, judging from the results of their work, apparently is quite wide. Expertise in the programing of a system is as essential as expertise in the design of that system. But what are the distinguishable differences between an expert job of programing and one that is less than expert?

The Government has learned that there are numerous and somewhat varied viewpoints as to what constitutes competent computer programing. It has been determined that Government-wide criteria for measuring the competence of programers are needed. The development of these criteria will soon be initiated.

10. Computer running time: is it adequate? Utilization in terms of hours is an essential consideration in making an over-all evaluation of effectiveness.

Our hours-of-use experience is, we believe, quite good and is becoming better consistently. Statistics for 1964 show a Government-wide average monthly utilization of 313 hours, or close to two shifts; this despite the fact that for good reasons (i.e., just delivered, on standby for emergency, etc.) a number of computers are justifiably used a half shift or less.

The Government's objective is to increase the *Government-wide* hours-of-use average to the highest practicable figure, but at the same time to evaluate hours of use in individual cases on the merits of the case itself.

11. Management information for evaluating ADP equipment utilization: is it available? To apply the foregoing ten yardsticks in making determinations on effective utilization of computers obviously requires a flow of utilization information, guidelines for the use of that information, and criteria against which the information is to be evaluated. There is now a Government-wide system for the flow of computer utilization information to the Bureau of the Budget. The recently concluded study of ADP management has revealed the need to expand upon the information now provided and to redesign the system to provide for meeting the management information needs of levels of management between the Bureau of the Budget and the computer installation. This effort is now underway.

12. The process of evaluating effectiveness in computer utilization: is it organized? As already stated, attempts to evaluate effectiveness in using computers involves coping with a fast moving target. What may have been judged as top effectiveness yesterday may deserve a lower rating

tomorrow. As the state of the computer art advances, so does the "state of the art" in computer utilization techniques and practices. Manifestly, our evaluation practices must be well organized, well directed, and frequently updated, both for the Government as a whole as well as for each of the agencies. Out-moded yardsticks will lead us into a state of complacency bordering on the unrealistic, and will result in unnecessary expenditures of public funds.

Guidelines for appraising agency practices in ADP management, provided to Government agencies by the Bureau of the Budget in August 1963, must now be updated and will be. Missing criteria, referred to above, will be developed as speedily as practicable. And it is anticipated that a formal continuing program for evaluation of computer utilization will be set in motion at the agency level, with provision for general coordination and review of the program by the Bureau of the Budget.

The foregoing twelve yardsticks for evaluating effective use of computers, each by itself deserving a much fuller treatment, are believed to be the major considerations in reaching conclusions as to whether utilization is good or less than good. Perhaps the most important fact concerning these yardsticks is that they are for consideration both individually and in the aggregate. While some of the yardsticks may eventually deserve a higher weight than others, not one is "light-weight" enough to drop out of consideration.

Pitfalls

A heavy concentration of attention on one or a few of the twelve yardsticks, with a consequent lessening of attention to (or virtually ignoring) the remaining ones, is both short-sighted and invites unnecessary costs.

For example, consider the yardstick on purchasing or renting computers. Anyone having a substantial interest in computer utilization has heard and read (and perhaps written and said) a great deal on this issue. For each advocate of a general purchase policy, an advocate of a general rental policy could be found. There can be no criticism of the fact that people take opposite sides on the issue of rent/purchase. But there are other equally important questions, any one of which might be of equal or greater importance. Why debate the question of whether a computer is to be rented or purchased when the computer in question may not be the one really needed or might not be needed at all?

Another example is the possible tendency to upgrade the competence of system designers while perpetuating a low level of competence among computer programers—or the reverse. Still another example is the undue emphasis sometimes placed on upgrading the technical sufficiency of a system, often at high cost, expressly to furnish end products that the recipients may not know how to use.

But it seems likely that the greatest pitfall of all is the inclination to advocate round-the-clock operations of computers for the sake of round-the-clock operations only. This philosophy encourages the automation of functions that should not be automated. It encourages the perpetuation of low-priority marginal applications that might be removed to make way for more profitable ones. It encourages therefore the pyramiding of added computer capacity on top of existing capacity and a potentially high degree of system inefficiency. In this kind of environment the computer would appear to be more the master than the slave, and this takes us back to Yardstick No. 1 which seems always to be a proper place to *begin* to determine how effective we are in using our computers.

This interesting and important article, though it does not once employ the word computer, bears significantly on the sound management of computer facilities. For surely if the rate of technological change could be measured in different parts of organizations, the rate of change in connection with computer facilities, both hardware and software, would be one of the highest.

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MANAGEMENT PROBLEMS IN A CHANGING TECHNOLOGICAL ENVIRONMENT

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The purpose of this article is not to discuss the well-known fact that rapid technological changes are taking place, nor the fact that these give managers serious problems . . . but rather the nature of technological change and why the existence of a rapidly changing environment creates management problems.

My own interest in this subject arises from observations and experiences which include associations with a family-owned business, several large industrial companies, an overview of government operated agencies and establishments, and a long participation in scientific and technical education and an intimate involvement with forces that produce technological change.

All organizations whose objectives are to perform a useful service involving technology or to produce products which are strongly influenced by technology must perform certain essential functions if they are to experience a healthy and successful growth. Failure to perform these functions sufficiently well leads to degradation of the organization, and in some circumstances, the result is a total collapse. The degree to which an organization's performance is influenced by how well the functions are performed depends very sensitively on the rate at which the technology and the environment to which it must attune is changing. I hold that these observations apply in principle to all organizations of the type being discussed, whether they be large or small, educational or industrial, governmental or social, as long as the quality of the service or product produced must be accepted by the public or that the organization be able to successfully compete with other organizations in its class.

The essential functions to be performed are:

(1) the distribution and sale of the service or product;
(2) the economical production of a quality product or service;
(3) the means for growth and prevention of product obsolescence; and
(4) the means for maintaining the vitality of the organization.

It is the responsibility of management to see to it that these functions are adequately performed within a rapidly changing environment. Functions satisfactorily performed today may be entirely inadequately performed tomorrow. This places severe demands on management at all levels. Top management, in particular, is being constantly challenged to acquire or maintain the depth of understanding that is essential in order to make the appropriate decisions and to provide the means and methods that will perform

the above functions in an optimum manner.

It is not my purpose today to describe how a given organization should perform these four functions to achieve high performance, but rather to discuss certain etiological factors which determine how well a given organization is likely to perform them in a rapidly unfolding or accelerating environment. There are four major factors that determine the quality of performance of these functions in any organization. They are:

(1) the capability of individual people;
(2) the structure and complexity of the organization;
(3) the capital and material resources available; and
(4) the effectiveness of management.

These factors of course are not independent but highly interdependent in their effect on performance. Though capital and material resources are an important and essential ingredient in the performance picture of an organization in fact, lack of capital equipment on a timely basis can create serious management problems and lead to inefficient performance, but this is not the category of problems that I wish to discuss. Therefore, I shall assume for the purpose of this discussion, that sufficient capital is available.

The greatest determinant of an organization's performance is the generation of and response to change as exhibited by its individual employees, the structure and flexibility of the organization, and most of all, its management. Since management selects the individual workers and determines the organizational structure, the responsibility for performance must ultimately rest with management. However, as far as performance is concerned, the three factors are interdependent. Nevertheless, it will be useful to discuss the nature of change and the reaction of each constituent to it and then examine some of the interrelationships.

The Generation of and Resistance to Technological Change

We are living in the first period in human history wherein the time span of a host of significant changes is considerably shorter than the productive lifetime of a single individual. This fact is the most important underlying cause of management and organizational deficiencies which decrease organizational performance. The reasons for this must receive more attention and be better understood. The fact that we are immersed in an era experiencing the greatest scientific and technological change that has taken place in all of history must mean that the forces which drive men to produce these changes must be appreciably greater than in former periods. Nevertheless, the forces which resist change are still predominant and I believe constitute the greatest single cause of poor performance and self-generated management problems in a fast-moving environment. In fact, the assumption persists in people's minds to a substantial degree that conditions governing the lives of their fathers will to a great extent mold their lives. Let us briefly examine the nature of the driving forces which produce change and the nature of the forces that resist change and thus tend to maintain the status quo.

The force for the production of technological change arises within an individual or group of individuals and can be stimulated by a number of motivating factors. Perhaps the most important of these are:

(1) the curiosity of an individual which urges him to seek new knowledge and understanding;
(2) the talent to create;
(3) dissatisfaction with the status quo;
(4) the desire to excel;
(5) the inner satisfaction which comes from accomplishing something new or producing something better;
(6) the desire to make better use of material and human resources;
(7) the obsolescence of products or traditional methods;
(8) general economic necessity or a threat to survival;
(9) the rate of accumulation of new technology;
(10) the drive for personal gain or acclaim.

The degree to which individuals possess the ability to create change or to respond positively to these motivations varies greatly. The greater the capability to create change, or to positively respond to it, the greater the departure of the individual from the norm. This means that strong forces for producing changes are possessed by the more rare individual. By far, the more normal or usual individual is one who exhibits pronounced resistance to change and pronounced satisfaction with the status quo, especially when the change is to take place in a field in which he has little knowledge or experience. The normal individual has a strongly built-in resistance to rapid change. Preconception and unchangeability are the rule rather than the exception in the midst of change. In today's environment, such individuals will be at a serious disadvantage in management.

Why do most individuals resist change? Here we should really refer to rapid change since a person will in all likelihood be induced to change if the inducing force is gentle enough and acts over a long enough time. In fact, there is an interesting physical principle that comes to mind in this connection. It is illustrated by the example of a beam of light passing from one medium to another medium in which its velocity of propagation changes. Normally, the beam reacts to this in such a way that part of the light is reflected at the boundary between the two media. However, if you want to reduce this reaction as much as possible so most of the light remains in the beam, you try to grade the boundary between the media so that the change in the index of refraction changes very slowly over distances compared to a wave length. The relevance of this, if any, is that physical systems react strongly to quick or sudden changes. In the individual, the reaction is the increased force of resistance to the change. In fact, the force resisting change is probably approximately inversely proportional to the rate of change. If the forces which resist change were better understood, it might be possible to produce more individuals and managers that would respond to change in the ways that are required to achieve high performance.

What are the important traits that cause an individual to resist change? I believe they can be listed as follows:

(1) For many centuries, individuals experienced little if any change, so that it was assumed that work and operations typical of one generation were continued in the next. As Alfred Whitehead points out, "This assumption subtly pervades the premises of political economy, and has permitted it to confine attention to a simplified edition of human nature. It is at the basis of our conception of reliable businessman, who has mastered a technique and never looks beyond the contracted horizon. It colors our political philosophy and our educational theory with their overwhelming emphasis on past experience. The note of recurrence dominates the wisdom of the past, and still persists in many forms even where explicitly the fallacy of its modern application is admitted. . . . Thus mankind was trained to adapt itself to fixed conditions."
(2) Pure laziness and mental inertia.
(3) Lack of knowledge and experience in the area of change (it is difficult for a person with very little

technical knowledge to be properly responsive in a rapidly changing technological area).

(4) The predeliction of an individual to think and do what he has always done before. This happens even among scientists who as a professional class have provided the greatest forces for change. Many individuals who are creative in their own right dogmatically reject new ideas and unexpected novelties of fact and theory even in their own field. Max Planck, who through his invention of the quantum theory, changed the whole course of theoretical physics, once said, "A new scientific truth is not usually presented in a way that convinces its opponents; rather they gradually die off, and a rising generation is familiarized with the truth from the start." Thus we note the curious paradox that within one and the same individual, we see forces producing change opposed by strong forces resisting changes produced by others.

(5) Pride and satisfaction of tradition and suspicion of innovation.

(6) A lack of willingness to learn about new technology or to communicate with knowledgeable people about it.

(7) The fear of exhibiting weakness or the lack of adequate knowledge.

(8) Fear of the consequences of departing from tradition.

(9) The inculcation of resistance to change through education of certain professions; for example, lawyers are characteristically trained to govern their actions by decisions made in the past, and accountants are trained to be precise about what takes place in the immediate present.

(10) The philosophy of a great deal of unionism which stifles the motivation to excel and encourages the resistance to change in everything except wages and benefits.

The more these forces of resistance to change predominate in individual workers and managers of an organization, the greater the reduction in performance and the more difficult will be the management problems in the organization.

The Effect of Organizational Structure and Complexity

Organizational structure cannot of itself guarantee a high performance organization. However the size, structure and complexity of an organization can have an important effect on its ability to adequately perform the necessary fundamental functions. It seems apparent that large size and great complexity of an organization make it less capable of high performance in a rapidly changing environment. It is somewhat surprising that this is so since one might think that large resources, great diversity of individual talents and the capability of mass endeavor would result in a high performance organization particularly well qualified to cope with the requirements of a rapidly changing environment. However, history and experience indicates the contrary, whether the organization be an industry, an educational institute, or a nation. Such a fact should give us the greatest concern. Is it inevitable that this be so? If it is inevitable, it is important that we understand the reasons in order that we limit the size and complexity of organizations to that for which optimum performance can be attained. If on the other hand, a large and complexly interconnected organization is not inherently relatively inefficient, why does history show that they are? This is a subject that needs concentrated study because the answers to these questions cannot be given with certainty, and an understanding is of fundamental importance for our national economy and the future of any large and complex world power. Was the fall of once powerful nations inevitable because of size, complexity, or other reasons? Is the decease of once highly profitable and powerful corporations a natural consequence of large size, large numbers of individuals, complex interconnections and "old age?" Are the same factors involved in the degradation of once fine educational institutions?

I would like to venture some thoughts about this. It is not hard to see many reasons why degradation in a large, complex organization can take place. In advancing these reasons, I shall take as axiomatic the general principle, amply verified in the evolution of biological systems, that a system can survive, grow and develop, only if the forces tending to produce changes in the system are strong enough compared to the resistance forces so that the systems can adapt to the changes rapidly enough to cope with the rate of change in the environment. The ability of an organization to change depends first of all on having a sufficient number of individual employees with the disposition and capability to effect changes since attributes to effect change are reflected in the resilience and responsiveness of the organization. Differences in the individual's indisposition to change is reflected in differences in the inertia and rigidity of organizations.

Because of the fact that the world population contains many more individuals that have strong built-in forces resistive to change than those with strong dispositions toward change, it follows statistically that a large organization will have more individuals and managers who will oppose needed changes than those who will try to produce the proper degree of change. We are all familiar with the general negative reaction to a new idea presented to the average group. Far more individuals will find reasons why the new idea is not a good one or will not work than those who are willing to try it. Since in a large complex organization there are many links and interconnections among individuals and managers, most of whom must accede to or help produce a change, the probability that the organization can respond rapidly or effect a change at all is quite low. The complex interconnection problem almost guarantees a slow and inadequate response to change and introduces rigidity into the organization, thereby making it extremely difficult to adapt to a rapidly changing environment. A good example of this is the United States Government.

In contrast to all this, we all know of high performance, small organizations composed of creative individuals disposed to change, that are highly adaptive to their environment and in fact, constitute the leaders in producing change. It would appear that as an organization, once highly creative, increases in size and becomes more complex and grows old, there is a greatly increased probability that it will become rigid and inflexible and lose efficiency because it cannot be sufficiently responsive to changes in its environment. I think it is almost certain that this can be proved on the basis of mathematical statistical theory. In any case, history is strewn with examples of institutions, businesses, corporations, and nations which have failed to survive for this reason.

Another important consequence of a large organization which materially affects performance is the dilution of individual personal interest in the objectives and productive excellence of the organization and a concomitant preoccupation of managers and individuals with their own positions in the organizational pyramid. This almost always leads to over-emphasized competitiveness among individuals or functional groups headed by managers which more often than not destructively affect the performance and produc-

tivity of an organization. Personal or group ambition often leads to the establishment or growth of duplicating work and activities which seriously decrease the efficiency of an organization. Stated in another way, too much of the energy of individuals and too many material resources are used at cross purposes. In general, the larger the organization, the greater is the fraction of the organization's internal energy that is not directed toward efficient productivity. Much of this energy is wasted and constitutes a deadweight or a powerful force resistant to change. These factors come into play because it is hard for an individual or a lower echelon manager to closely relate his contributions or actions with the success of the organization. In the U. S. Government, for example, the great majority of employees have no way of measuring their individual performance or activity with the over-all status or performance of the country. To the degree that this is the case, there will be an enormous amount of wasted internal individual energy which seriously decreases organizational performance. Coping with this is a substantial management problem in a large organization.

Another characteristic of organizations that make them react sluggishly to change and prevents them from being progressive is the almost inevitable tendency to make all the operations of the organization highly routine. There are great subtleties connected with this because some routine is a necessary requirement for stability; on the other hand, if perfect routine could be established to deal in an optimum way with all situations, the organization would operate on pure reflexes whereafter intelligence and understanding would no longer be required of the operators of the organization. The only hitch to the philosophy of perfect organizational routine is that the environment must not change or produce novel situations. Organizations with perfect routine require environmental stability, and environmental stability in turn is the product of routine. Thus an organization with too highly developed routine cannot make progress. It will ultimately succumb in a rapidly changing environment. We see therefore that the limiting case of perfect routine is unstable.

Nevertheless, there still exist very strong tendencies to introduce excessive rules and routine so that individuals and managers can operate with a minimum of thought and judgement. Decisions then become automatic. This arises from a hangover from the past where change took place very slowly and the environment was quasi stable. With the continually accelerating rate of technological development, routine must be minimized to the point where the organization can be optimally responsive. This means that intelligence, knowledge, understanding and judgement must be substituted for routine in proportion to the rate of environmental change.

It is entirely possible and perhaps inevitable, because of the dominant trait of resistance to change on the part of individuals, the degradation of performance produced by the self interests of individuals or sub-groups, the inflexibility and rigidity resulting from a myriad of complicated cross connections in the too large organization, and the complete inability to cope with rapid change by the reflex responses of a too completely routinized organization, that over a time period long compared with the average relaxation time associated with change, a large and complex organization will degenerate beyond the point of no return. In such a case, it may be impossible to reorganize and correct the situation without first destroying the old organization and building a new one.

Management in a Rapidly Changing Environment

A high performance organization can exist only through effective management.

It must be clear from what has gone before, and anyway, it would be intuitively evident by now that a rapidly changing environment places far more severe demands on management than a stable environment. Professor Lickert of the University of Michigan has made many studies of the qualities and characteristics of management that are required to achieve high performance in an organization, and he said in a lecture not long ago that "Management may have to run like hell to keep out of the way" if their organizations are to cope with the accelerating progressive technology. New knowledge, greater use of scientific principles, rapidly changing technology and increasing complexity of services and products, together with the necessarily larger number of sophisticated and competent professional personnel employed in organizations, present a continually increasing challenge to managers.

What is the objective of management? With what does management work and what are the characteristics and capabilities required to cope with its responsibilities in our changing environment? What part does the manager himself play as a generator of the problems of management? I will discuss each of these questions.

The objective of management in our era is no different than in the past, but the knowledge, characteristics and techniques are vastly changed. The objective of management, succinctly stated, is to achieve the highest goals or greatest productivity from available human and material resources in the least time and with the most economical use of materials. The human and material resources with which management must work are changing drastically. Material resources—equipment and facilities—have greatly increased in complexity, capability and cost, but the most spectacular change has occurred in the character and value of the personnel employed. A far greater number of professional and technical people with a wide variety of technical disciplines are now essential in order to keep up with the progressional parade. It is estimated that there will be ten million professional, scientific, and technical people employed by 1970. Of this group, scientists and engineers are increasing at a rate four times faster than the traditional professions of law and medicine.

Since we have noted that the greatest forces inducing technological change are to be found in the scientific, engineering and related professions, management finds itself more and more pushed by a minority to make productive changes and dragged by the majority who are resistive to change within the organization and at the same time faced with accelerating changes in the external environment.

With all this, it seems clear that management personnel must have three broad attributes if it is to obtain high performance from a modern organization. These are:

(1) a broad and commanding technical knowledge in the area of interest to the organization;
(2) an understanding of personnel and their motivation; and
(3) sensitivity to the need for and a disposition and readiness to make changes.

Again, because of the resistivity to change on the part of individuals and educators, it has taken far too long for managers to realize that it is not sufficient to be acquainted with classical management methods and techniques if the best results are to be obtained from a technically oriented organization. A broad and deep enough knowledge of the relevant technical areas is necessary for the successful manager to make sensible decisions, to anticipate the changes in technology, to know what kind of people to employ, to obtain the respect of the individual employees and obtain the maximum productivity. The manager of a technically based

organization without technical competence in the field of his operations is in about the same position as the teachers of America's secondary schools who were "educated" in the methods of teaching, but had pitifully weak and unreliable knowledge of the subject matter to be taught. Everyone now appreciates the disastrous performance of our secondary school system which resulted. It took the accomplishments of the Russians to jolt us into facing the facts and making a knowledge of subject matter the first priority. As an indication of how hard it is to effect constructive change, I am told that in some states, a professor of mathematics, or of almost any subject for that matter, is still declared ineligible to teach in a secondary school! This leads up to the fact that the "you name it, I'll manage it" doctrine is simply not good enough. Undoubtedly, it will take several generations more before its demise.

The personnel aspects of management constitute a large subject in itself. It seems clear on the face of it that there will be lack of productivity if management doesn't understand people well enough to select those who will form the nucleus of change in a sea of those who resist it, or doesn't understand what makes people react in the desired directions or what motivates people to attain the desired goals. The increase in highly intelligent and professional people required for high productivity presents new and different problems to management. The average manager has not acquired enough understanding of the professionally-trained person. It must be appreciated that the professional person has invested many years in study and/or creative practice and has acquired a penetrating and commanding knowledge of his field. In general, he knows far more about his field and its implications than the average manager, unless the manager is also a practicing professional in the same field. He tends to be analytical and critical of illogical and unreasoned procedures. Giving him the opportunity to make significant contributions in his field is vital, and more often than not, more important to him than a very high salary or working in a particular organization.

Management must have the knowledge, understanding and wisdom to select the proper personnel with the proper mixture of professions, disposition to change and motivate them to attain the highest productivity and performance. The importance of this problem is too often overlooked or glossed over by management. Some measure of its importance can be gleaned from the estimate made by Jerome Rosow that at today's salary levels, every new college graduate employed represents a minimum investment of a half million dollars and by the 1980's, each new professional man will represent an investment of over one million dollars over a life span of forty years. This subject warrants much more study and consideration than is usually given it by management.

I come now to one of the most important aspects of the management problem created by a changing technological environment and that is sensitivity, responsiveness and disposition of management itself to change. Many people who have concerned themselves with the management problems generated by change tend to think of the problems created by rapid changes in the environment as being something entirely separate from management. That is to say the technological changes generate the problems and management must cope with them and make the necessary decisions. This view places the manager in the position of being the problem solver for the problems generated by changes either internal or external to his organization, but he plays no part in creating the problems. This view is fallacious.

The most important point I wish to make is that management cannot be looked upon as separate from the source of problems generated by change. Management is an integral part of the source of problems resulting from rapid technological change. It is my own conviction that management is the most important source of problems.

The magnitude and seriousness of the problems management creates will be the greater, the less well developed the three attributes I have already mentioned are. These attributes must be regarded as important, and they cannot be acquired without hard work and professional study. A manager must have the proper aptitude in the first place and must earn a management assignment and not merely be appointed to it.

The third attribute requires special emphasis because it is not likely to be understood and appreciated by management. A manager who is not sensitive to the need for change and resists it will himself almost unknowingly be the generator of serious problems and an important contributor to poor performance in his organization. For reasons already mentioned, it will be easier and far more likely that he will resist change. Consequently, he must constantly school himself to be alert to the need for change and be more willing than others to institute changes with all their attendant risks and at times, their unpopularity.

One of the most important capabilities associated with the disposition to change and one which means more to the success or failure of an organization is that of foresight and anticipation. I do not know how to give a prescription for foresight or how to acquire it. I am sure, however, that one cannot possess it without possessing a sensitivity to and a disposition for change. I am also sure that it cannot be had or developed without a keen understanding of the technical areas in which foresight is required. Insight is the most important ingredient in foresight. Based upon understanding of the relevant information and data, foresight is in the nature of a coordinated prediction of what is to emerge in the future. The value of possessing this ability can hardly be underestimated in guiding a successful organization.

Management anticipation is also important and related to the disposition to change. Here we are dealing more with intuitive preconception. To be able to anticipate changes that will be made is of great value. A tennis player could hardly ever win a game if he couldn't anticipate to some extent where his opponent's next shot was going to come.

There is an interesting thing about resistance to change. When a person with reliable foresight has as a result recommended a change, finds his recommendation violently resisted on all sides, finally finds a way to put it into effect, and the change is successful, all resistance suddenly melts away. This has happened many times in science and technology and in business and government. All of us can think of innumerable examples. Doesn't this look as if there is a psychological problem to be looked into here? Can't something be done to reduce the individual's predilection to resist change? Especially managers?

In this discussion, I have stressed the importance of a disposition to change because it is a fundamental source of management problems and an important ingredient in the attainment of high performance and also because I do not feel that it has received the attention in management training that it deserves. Much of what I have said has psychological implications and the psychological aspects of the ingrained resistance to change seems worthy of more study. I am convinced it has enormous economic implications. I fully recognize that one cannot go too far on the side of disposition to change or an organization would become a weathervane and lose its essential degree of stability. However, I believe we are far from this point now and great improvement in progress could be made with managers endowed with less built-in resistance to change and all that this implies.

THE SELECTION AND TRAINING OF MEN AND WOMEN PROGRAMMERS IN A BANK

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This article discusses the selection of data processing personnel, and some of the conclusions that we have drawn after a brief four years' experience in this area.

Programers seem to be the key to data processing. We had no preconceived notions of whether we wanted male or female programers, and so we pursued the same selection procedure for both. Therefore, most of my remarks on this topic will be just as applicable to males as to females.

When we started our search for programers in early 1961, there was precious little information available to us on how to select these people; we soon learned that whatever information we did get had to be taken with a grain of salt. There was a general agreement on the part of the people we talked to that programers should be college graduates or, at the very least, should have completed two years of college—preferably with a major in math. Most agreed that intelligence and the ability for logical thought were of prime importance. We had, in our selection procedure, been testing for intelligence for some time, but the testing for logical thought was entirely new to us. We collected, from various sources, reams of logic problems, but no one seemed to know which ones were the best. Also, there was considerable variation of opinion on whether these should be limited-time tests or whether the examinee should be allowed to complete the problem in whatever time necessary. We also examined tests which some of the manufacturers had been using, although at that stage most of the manufacturers' experience had involved selecting programers for scientific applications. We felt that our programers would not have to be of quite that caliber. After mulling over all of the conflicting advice we had received, we came to the reluctant conclusion that there was very little real knowledge in this area.

Two Fine Decisions

At this point, we made what I now consider to be two very fine decisions: the first was to look primarily inside the bank for people to fill these jobs; and the second was to employ competent professional talent to assist us in evaluating our employee's ability to do the type of programing we needed.

Our competent outside help came from a psychologist, George Rowland, who has his own consulting firm in New Jersey, and who, up to that time, had been mainly active in the selection of scientific programers for the National Aeronautics and Space Administration and the United States Army. Consultations with him further strengthened our decision to look first inside the bank. The more we investigated the whole area, the more it appeared to us that some experience in bank work was not only desirable but, at least in the first phases of our program, was necessary. We felt then and we feel now that a person with acceptable intelligence and logical thought can learn to program faster and easier than he, or she, can learn the necessary essentials of banking.

Announcement and Selection

Our first step in finding competent people inside the bank was to announce to the entire staff that we would have programer openings and that these jobs would be among

the higher-paid clerical positions in the bank. We held an evening meeting to explain what our programing job would be. Two hundred of our then 700 employees came to the meeting to hear our description of a programer and to ask questions. It was explained that these jobs would be open to both males and females and that the pay would be based on the persons' ability and not their sex.

Meanwhile, our consultant had devised a battery of tests which would take approximately seven hours to administer. These tests included the Lowry-Lucier Reasoning Tests A and B, which I will talk more about later, and a battery of standard tests from the Psychological Corporation, which included tests of mechanical ability, space relations, abstract reasoning, numerical ability and clerical speed and accuracy. Ninety-eight employees volunteered to take the test on a Saturday. From these, 13 were selected to attend a programing school set up on our premises by the General Electric Company. These 13 were, for the most part, those scoring highest on the tests. The tests, however, were by no means the final selection criteria. In addition to the test scores, we considered the employee's prior work record as indicated by his or her appraisal forms and interviews with his or her supervisor. We also considered the motivation prompting the employee to desire the job of programer. This motivation was determined by interviewing each employee. All were given as frank an opinion as possible of what the programer's job entailed and what type of person was most likely to succeed in it. We were careful to point out that for a person who did not like detail work and who did not like to work generally unsupervised in a research-type of atmosphere the programing job could turn into a nightmare.

Estimate of Continuing Employment

In selecting our programers, we tried to determine the likelihood of employee's continuing employment. For the women, this meant looking into why they were working—were they working for a short-term goal or were they likely to be career employees? Where were their husbands employed and in what kind of jobs? Would their husbands' jobs be of the type that would keep them in our area and that would tend to discourage their moving to another city on the basis of the wives' employment? We also considered the length of service of each person and the all-around knowledge of banking that he or she had.

After weighing all of these factors and getting an evaluation of the test scores, we selected five men and eight women to attend the manufacturer's course in programing. Of this group of 13, none were college graduates, and only two had had any full-time college training. Of the men, one person was a tabulating supervisor, one a tabulating machine operator, two were paying and receiving tellers, and one a note teller. Three of the women were bookkeeping unit supervisors, one was a bookkeeping machine operator, one was a secretary, two were tellers and one worked on our night check-sorting crew.

Trained Programers

Of the 11 who eventually completed the course and went into programing, five were men and six were women. Of the original group of five men, we still have four, and of the original group of six women, we have three. The one man left to accept a higher-paying programing job with the Government. One woman left because she did not like programing work and wanted to go back to her teller's job; another left because of family problems that required her moving to another state, and another left to marry and move out of town. We have since added two men and three women to the program. These people, too, were brought in from other jobs in the bank with one exception, a female college graduate. Of this group only one woman failed to develop as expected and has since been returned to her former job of proof machine operator. In all cases, where a person has failed as a programer, the fault occurred in other areas of the selection process rather than in testing —either we shaved the test score requirement to get them in or we minimized personal idiosyncracies that should have been apparent to us. Our programers have, in three and one-half years, completed and put on line demand deposit accounting, payroll, profit sharing, savings, corporate trust, stockholder accounting, check credit, personal trust and dealer reserve accounting services, plus several management reports.

Differences Between Programers

As we reflect now, three and one-half years later, and try to evaluate the programers, we conclude that there are several differences between men and women programers. Yet, we still have no clear-cut preference between the two.

One major difference came out early in our experience. Because of a lack of space in our regular bank building, we had to rent space for the programers in a rather old building across the street. The building was in very bad shape, the heat was barely operational and snow came in through the windows on the north side. We set up our own system of electric heaters and fans in the offices; the system could best be described as barely adequate. The working conditions appeared to bother the female programers considerably more than the male programers, or at least they were more vocal about the situation.

We also found that it took the women longer to adjust to the programing-type of work and they definitely created more petty personnel problems than the men. They were more susceptible to rumors, more concerned about pay inequities, and in general spent more time in the personnel department than the men.

The most trying period for all concerned was the first six months when programs were being written without the aid of prior experience or a computer to test them on. During this period, when the programers could not see tangible results of what they were doing, the women appeared to be much more upset and unsettled than the men. On the other side of the coin, when it came to actual program-writing, the women proved to be every bit as good as the men, and possibly superior. Now that the computer is actually on line, these problems, for the most part, have disappeared or greatly lessened.

We now find very little difference between a woman and a man programer and would still fill the position by ability rather than by sex. During conversion periods, it is easier for men to work the necessary, long hours. In most instances the women are just as willing to work for the extended periods; however, they have problems at home that the men do not have. When it comes to working under pressure to get the job finished, we also find that men are better able to take the strain than women. However, men are constantly striving to move ahead and are more concerned with where they can go from programing. Women, although still concerned, are more apt to be satisfied to remain as programers.

Future Advancement of Programers

I have been asked the question many times by people from other banks as well as our own programers as to what is the future in the bank for a programer and where can a programer go from programing. I am afraid I do not really have a very good answer for this question. We do think that some of the men will end up in operations jobs with super-

visory responsibilities. We do not, however, envision many women in this type of job. About the only answer we have for the women is that four years ago we did not see any place for them to go past the Unit Supervisors job in bookkeeping. Now, however, they have more than doubled the salary they were making at that job and are in a job that at that time we had never heard of. Once again, we do not see any place for them to go, but who knows what will turn up in the next year or two in this rapidly changing field?

Testing Procedure Now

I mentioned that we used the Lowry-Lucier Reasoning Test, plus a battery from Psychological Corporation, all of which lasted about seven hours. Now, after relating test scores to performance, we find that we can drop completely the battery of tests and use exclusively the Lowry-Lucier Reasoning Tests. These tests seem to predict with a great degree of accuracy a person's ability to program. The tests contain two types of questions, both of which are designed to measure reasoning ability only. These tests are unusual in that they are both status-free and culture-free, for the person's home environment will not affect the outcome of these tests as it does in most tests, nor will the outcome be affected by whether the person has been reared in this country or in a foreign country. I think you will see this more clearly when I tell you a little more about the tests.

The Lowry-Lucier "A" is a test based strictly on days of the week. In order to answer any of the questions it is necessary only to know the days of the week, and they are printed plainly across the top of the test paper. The questions start out very simply by asking, "If Sunday is the first day of the week, and if today is the third day of the week, the day after tomorrow will be what day?" As the test progresses it becomes more difficult, such as: "If Wednesday were the first day of the week, and if the days were reversed, what day would be three days before the last day of the week?" The final question on the first test does get difficult, and I think you can see the logic needed here: "If the odd days of the week came first, in order, then the even days, and if the order were reversed, and if Monday were the first day of the week, what would be the fifth day of the week?"

The Lowry-Lucier B test is based on pictures of matchstick squares that you have seen in puzzles. This test asks questions about how many squares would be left after you removed how many matchsticks, or what is the minimum number of matchsticks you could remove to reduce the squares to so many.

These tests take a total time of 50 minutes and together with a simple intelligence or educational achievement test like the 12-minute Wonderlic can, in our opinion, be very accurate forecasters of programing ability. Note that I say "programing ability" because there is nothing in these tests to indicate motivation. For this reason, we use the tests as a screening device for ability. We will no longer consider anyone for programing—no matter how highly motivated they are—if they cannot get an acceptable score on these tests. Once a person has an acceptable score, we then base the final decision on our assessment of his motivation and personality.

We are very pleased with the productivity of both our male and female programers and are happy that we have only lost one programer to a higher-paying job. In this area I would point out that we have a salary scale for programers which is outside our regular evaluation program and which does not recognize sex as a factor. And, in fact, in our top salary bracket, which is that of methods analyst, we have two men and two women. We believe that when it comes to programing, women are here to stay.

C&A MARKET REPORT
(Continued from page 9)

of these users were looking for time-shared operating capability in the new computers they are evaluating. For example, a leading oil company recently ordered a GE 600 series computer to tie-in the company's corporate center to its refinery thirty miles away by a direct data communications link. This will allow people at the corporate office to program and operate the computer located at the refinery on an on-line basis. Although full time-shared operations are not planned on the GE system in the near future, it was to a large extent its ability to handle this mode of operation which gave the contract to GE rather than the two other leading contenders, IBM and Control Data.

The key technical limitations to time-shared systems at present are unproven software and the high cost of terminal stations. For really widespread use of time-shared systems, remote I/O terminals costing between $5,000 and $10,000 are needed. Current terminals with keyboard input and graphic display capability are $40,000 to $50,000 each. Another consideration is that most current input stations require input by typewriter-like keyboards. There are, however, only a small percentage of individual computer users such as programmers and research workers who can type with reasonable speed and accuracy. Some form of graphic input station would seem needed before time-shared systems can achieve practical acceptance by these types of users.

Associate Publisher

READERS' AND EDITOR'S FORUM

(Continued from page 11)

sake" and "technology in the service of human beings." Accordingly the responsibility of scientists is not only to do good work in the near-at-hand field of their employer's and profession's interests but also in the broader field of the interests of their country and the whole world. This is the same kind of responsibility that all human beings have—but a scientist or engineer has special knowledge and perhaps special wisdom, and so has a special opportunity to be a help or a hindrance in the social applications of his science, and a special duty to be informed and to spread information. The information area is particularly where a magazine can be of assistance.

Although much more could be said in rebuttal to Mr. Nebel and Mr. Sexton, perhaps two of the most important remaining points are these:

(1) Computers and data processing are a most profound, revolutionary, and powerful resource which, if human beings are wise enough, may well unlock undreamed of solutions to many difficult problems—including for example problems of conflict between economic systems and countries.

(2) If we in the United States are to shut our eyes on grounds of loyalty, patriotism, etc., to great accomplishments made by other peoples or other economic systems, we condemn ourselves to ignorance, misunderstanding, foolishness, and worse.

THE STOPPING OF MOVING OF CHECKS

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The next move forward in the business of checking accounts is to stop moving checks. There are two distinct phases to this; one is the retention of paid and cancelled checks by the paying bank, the other is retention by the first large clearing bank. This discussion will be about the first phase: the safekeeping of paid checks by the paying bank.

There is nothing new about paying banks retaining paid and cancelled checks. That is what they used to do over 50 years ago and what they still do today in many countries.

Present Control of Paid Checks

The way banks currently control paid checks, so they can be returned to the individual customer with his statement, is oriented to an outmoded manual system. We are tied to it because our customer must receive paid checks in order to reconcile his account. It exists because years ago when we took advantage of machine posting with its limitation of skeletonized information, we had to send the paid checks back with the statement so the customer could figure it out.

Today it is quite feasible to post a statement in the same order as the customer's check register; i.e., by check number. Today, sorting and collating of check information for posting purposes is done at fantastic speeds in a computer. None of this requires the physical sorting of the checks themselves. Conditions have changed, and it is time for banks to change their paid-check habits. It may be time also to change some of our man-made laws.

Our individual customer will welcome a change, too, even though he has always received his paid checks and has grown fond of shuffling them around. He will soon find out that he has been bamboozled by us for the last 50 years into sorting checks.

We may be haunted by some customers, however, whose natural inclinations to be miserly gives them an inner satisfaction when re-examining these slips of paper. The paid check becomes a status symbol, representing money in the bank.

It is time to reorient customers to the old days when a banker retained the instruments and sent out an organized statement. Fortunately, today we don't have to copy a ledger with pen and ink. We now have computers and high-speed printing of statements.

Changes to be Made

What are the changes a bank should make? It is time to put magnetic serial numbers on all checks at the time they are printed. It is time to pick up these numbers on magnetic tape in the first computer pass. It is time to give a customer a statement of paid checks listed in the sequence in which he issued them. It is time to help a customer locate an outstanding check, not by making him sort paid checks, but by sending him a statement identifying each paid check with its serial number and placing an asterisk at the place where an outstanding check would have appeared had it been paid. We do all this for many large corporate customers right now.

It is extremely important for a customer to have the secure feeling that any of his paid checks will be available if he needs them. The more important a paid check is, the safer should be its storage place. If banks are the accepted place to house securities, they are certainly the safest place to house paid checks. In fact, customers should be glad to buy a guarantee from you that a paid check will be available when needed.

In other words, banks should offer a service of safekeeping paid checks instead of returning them to customers with statements. Banks should list checks on statements in issuance order showing check serial number, date paid and dollar amount. Banks should maintain a location number record showing where each check is filed or where its image is stored on microfilm. Banks should retrieve paid checks both for customers and former customers.

Phase One

This first phase, to stop the movement of checks by the paying bank, is important because we can now exploit the full potential of magnetic common language by identifying each check with a serial number. This allows us to eliminate all the manual bungling and unnecessary costs involved in returning paid checks.

Each paying bank having a computer can enter into phase one right now. To do this requires that, in addition to paid check data, a check serial number and location number be recorded. Paid checks can be handled for signature examination and retrieval requirements, according to a bank's business risk policy. You might, for instance, separate and sort the high dollar items for special scrutiny. You might treat low dollar items quite differently. In any event, there would be no need to collate checks from day to day. This operation, even if you use a sophisticated terminal digit system, spells manual work—and manual work spells bungling.

Some questions are bound to be asked. How much does it cost to store checks and retrieve them? How many would have to be retrieved? How long should they be stored? Should they be microfilmed? What are the risks of undetected forgeries if the customer doesn't have his checks to look at?

We all have our own ways of figuring costs and estimating risks. We will have to compare what we do now with what we would be doing under a paid-check retention plan. In this comparison we must not forget to visualize our monthly statements flowing through an automatic folding, enclosing, and mailing machine at thousands of items per hour with the same five-cent postage on each one.

We must not forget that if we don't return paid checks, we can't make the mistakes we do now. All those errors evaporate when we don't return the paid checks.

Pilot Plan

One way to obtain a perspective on a projected system is to create a pilot plan and analyze the experience. At Bankers Trust we have done just this. We have 120 employee checking accounts whose monthly statements have been mailed without benefit of paid checks for almost three years. These accounts belong to officers, branch managers, and a cross section of our employees.

What has been our experience with them at the end of two and one half years of data gathering?

The daily balance for each account has averaged $573. The average number of checks paid monthly for each account has been 25. Total checks paid with dollar amounts under $100 were 92.3 per cent; under $500, 99.78 per cent; and under $1,000, 99.81 per cent. Projecting these figures to a larger-scale operation, it means that for every million checks paid and stored, only 77,000 would be $100 or more, only 2,200 would be $500 or more and only 1,900 would be $1,000 or more.

Total number of accounts requesting paid checks in the two and one-half years were 15, which represents an average of five out of 100 accounts per year. Let me repeat: an average of only 5 per cent of the accounts per year required us to look up checks. Ninety-five per cent of the accounts needed no checks at all.

The 15 accounts that needed paid checks made a total of 21 inquiries for them in the two and one-half years. The checks retrieved for these inquiries totaled 215. This means we retrieved on an average each month six checks for every 100 accounts.

From the standpoint of total checks paid, retrieval was on a basis of two and one quarter checks for each 1,000 held—or, to put it another way, two and one-quarter tenths of one per cent of the total volume over the two-and-one-half-year period. This percentage is almost identical with the number of checks that are retrieved for customers which they issued under our revolving credit plan.

Projection

Based on this experience and the data gathered, let us project what a bank might do if the safekeeping of checks became a service for the public in general. A bank might decide on a seven-year retention of low value checks, followed by cremation. It might decide to retain checks of higher value for a longer period. Our data from the 120 accounts shows that these high value checks of, for example, $100 or more each totaled 7 7/10 per cent of the total check volume. If you prefer $500 or more as a more significant limit, the percentage was .22 or about one-fifth of one per cent.

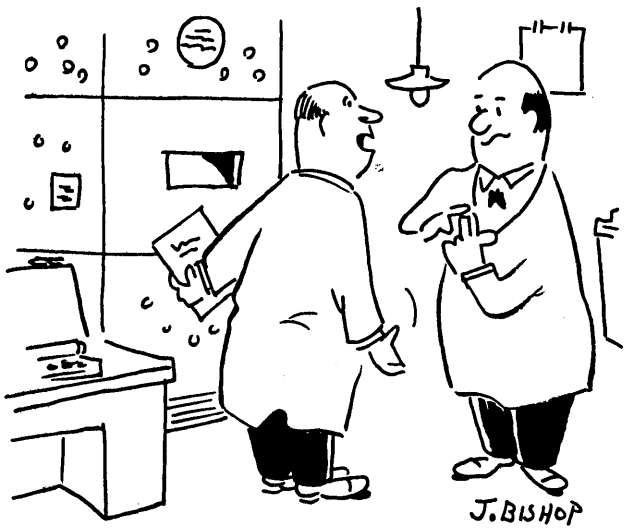
Obviously the customer must agree to this safekeeping arrangement (of handling checks) when this account is first opened. There should be no room for misunderstanding later on.

Phase Two

In addition to this first phase, there is also a second phase: that of leaving checks for safekeeping with the first large bank that handles them. This might be part of a national computer system. It ties in closely with paying bills by telephone, transmitting checks by facsimile, and the whole area of no checks at all.

It is imperative to keep in mind, however, that phase two cannot take place until phase one is well under way, and that phase one is a step any bank can take today. It will be an introduction to customers of improved ways of handling funds. It will be a first step toward orienting people to the time when communication lines and computers will work day and night moving funds—whether represented by magnetic ink on pieces of paper or impulses from touch-tone buttons on the telephone.

ERROR-CHECKING DIGITS



"Come, come, Haskins — it's time you placed more confidence in its answers."

BANKING AND THE INFORMATION UTILITY

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Within the next 25 to 30 years the banking industry probably will be transformed into a vast electronic information system of national and international scope. Today's banks may or may not maintain their identities under the transformation. It depends on the attitude and role that banking management assumes while its mode of doing business undergoes a fiery modern metamorphosis.

The metamorphosis is already in its incipient stages, as evidenced by:

1. Progressive fires kindled by the Special Committee on Automation of the American Banking Association;
2. Scattered brush fires throughout the banking community, such as the recent study by Bankers Trust pointing to the immediate practicality of terminating check flow at the paying bank;
3. Bonfires ignited by the communications industry with a match called bill-payment-by-phone and a lighting fluid known as touch-tone;
4. Flame fanning by the computer manufacturers with a technology that I.B.M. calls tele-processing and others call on-line real-time systems;
5. A credit card blaze which has spread within 15 years from the local charge accounts of individual stores, to the companywide credit of geographically dispersed firms, to the multipurpose cards of hotel chains and oil companies, to the general-purpose documents of American Express, Diners Club, Carte Blanche, and Bank of America, to semi-automatic credit bureaus like Telecredit in Los Angeles, to the still more comprehensive citywide, statewide, and nationwide computerized systems currently under discussion;
6. Sparks from an accelerated speed-up in the velocity of money and a hotly competitive money market.

I choose the metaphor of burning, not to be inflammatory, but to raise the question (and this may seem like the same thing) of what would remain after a complete conflagration. Would checks and money survive? Paper currency is highly flammable in the sense that its volume of flow has been increasing exponentially and is the biggest headache of banking operations today. Many are the tired vice presidents who have awakened refreshed after dreaming of the cremation of the check.

Reality—Ahead of Time

Can this be more than a dream? It does not require a great deal of technical expertise to see that it can be real. There are legal problems, to be sure, especially in the context of present laws (signatures, valid documents, etc.). But the engineering know-how and the physical hardware to displace checks are ready. What it takes is a network of simple, inexpensive terminals placed at retail outlets around the country and connected on-line to a complex of

central credit files stored on flexible computer systems with large, fast random-access memory. Memories are relatively cheap and are getting cheaper. Terminals like the touch-tone telephone set are fairly cheap, and they will get cheaper too. When it comes to cost comparisons, electronic communication should win hands down over proof and transit.

The Money Key

What form may the credit instrument of the future take? First there is the universal credit card. John Cocke has called it a money key. It is an encoded plastic card that unlocks, by insertion into a simple remote terminal, the current contents of the customer's money box stored in the files of the credit exchange. The card carries the account number of the owner, and the terminal identifies the vendor. The amount of the sale is entered into the terminal and the computer does a fast turn-around to be sure that the customer's balance and credit rating are adequate for consummation of the transaction. Possible safety measures range from a photograph of the owner pressed into the face of the card to a computer program that can recognize the owner's voice and detect an imitation. In the event of serious uncertainty or risk, the computer conducts an on-line interrogation before it makes its evaluation.

From the individual's point of view, the advantage of a single credit card over the check book, wallet, and plethora of cards many of us now carry needs no discussion. Operationally there are a few small problems. The concept of a money key depends on ready access to information in a central file and requires communicating and processing each separate transaction in real time. But the cost of real time is not justified for purchase of a newspaper, any more than the cost of a toll call is justified for a message of negligible information content. Furthermore, certain transactions will require communication with a distant credit exchange, as, for example, when J. G. Bowen rushes to Wichita from New York to visit his ailing mother and stops off at the Wichita florist for a cheery bouquet of flowers. Such long-distance transactions demand a proportionately larger threshold amount for justification, just as a long-distance telephone call normally demands a greater urgency or information content than a local call.

There are several ways that transactions whose amounts fall below threshold levels may be handled. Some can be accumulated locally and transmitted by batch in a delayed store and forward procedure. Others may be paid by cash in the traditional manner. There is no reason why all traces of coins and paper currency must be erased from this system of the future. J.G. presents his card to a terminal at the Wichita Bank and requests $100 to cover his expenses while he is in town. The $100 transaction warrants a long-distance connection, whereas a $5 transaction for the flowers may not. A small service charge makes the transaction profitable to the Wichita bank.

The Money Card

There is one cashless alternative that sounds like science fiction. Let us call it a money card. It is a solid-state device that electronically retains dynamic information on the working balance of its owner, together with static information on his identity and other characteristics. Instead of presenting J.G. with $100 in cash, the Wichita bank provides him with a money card of equivalent value. The card is produced by a special machine at the bank which may be one and the same with the terminal of the credit exchange. J.G.'s money key is inserted into this machine, the $100 amount is entered, an on-line inquiry is made at the credit exchange, a debit is registered, and the new money card pops out. Again the bank makes an appropriate charge.

The nice thing about the money card is that it replaces a wallet-full of bills and pocketful of coins with a single document that need never be "broken." The retailer simply inserts the customer's card into a specially engineered device that he has on the premises and enters the amount of a purchase. If this amount is less than the balance electronically recorded on the card, the purchase is approved and the balance debited. A money card belonging to the retailer is also inside the device, and it is credited simultaneously with the same amount. The retailer can transmit the balance on his money card to his credit exchange account via his own on-line terminal or the terminal of a local bank. He normally does this at the end of the business day. A few merchants take their money cards home with them at night and slip them under their pillows as they fall off to sleep.

Notice that the money card differs from the money key, not only in carrying its own balance, but also in not requiring connection to the credit exchange. This advantage is also a limitation. When a money key is misplaced, its loss can be noted by the credit exchange as soon as the owner discovers it, and use of the key is thereafter blocked. The misplaced or stolen money card, on the other hand, may be used repeatedly by its unlawful holder well after the loss has been discovered, but only up to the balance on the card at the time of the loss. This property the money card shares with cash. It could be made more like a traveler's check by making the coded characteristics of its lawful owner, which it contains, intelligible to the vendor. The vendor can also learn from the credit exchange whether the card has been reported missing. Whether he would or not depends on where the liability lies. If it lies with the owner, the money card is, essentially, variable cash. If, after the loss has been reported, the liability lies with the vendor, then the money card is a re-usable check. Like a traveler's check, it cannot bounce because of overdrawn funds if its balance was produced legitimately and covers the sale.

I think the main difficulty with the concept of a money card, outside of the legal thorns, is not the problem of designing the card itself, but rather the related problem of designing the special device that processes the card. This device must be simple enough to be within the cost reaches of small retailers, yet complicated enough to make tampering next to impossible. A device that was rigged to register credits to the customer's card instead of debits, without the benefit of corresponding charges to the retailer's card, would be a counterfeiting machine unparalleled in the annals of crime.

We could go on to discuss ways of safeguarding against counterfeiting, but this has already been a lengthy digression and the notion of a money card is in no way important to the realization of an automated credit exchange.

Automatic Credit Exchange

If anything stands in the way of realization of an automatic credit exchange, it is our own inertia, built up over many years, in becoming used to checks and cash. We can place the blame with our laws, but they reflect our attitudes, subject to a little lag. Attitudes can change quickly, however, under the duress of economic and competitive pressures. All it takes is one group to lead the way and make a success of it.

Long-Range Computational Requirements at M.I.T.

Let me try to draw an analogy from some very recent history that is still in the making. About six years ago, M.I.T. convened a faculty committee to study the long-range computational requirements of the institute and recommend a future course of action. At a place like M.I.T. you seldom find near unanimity, particularly in a

faculty committee, but this one was an exception. There developed during the deliberations an overwhelming consensus that M.I.T. needed a very large computer system with 100 or more on-line terminals spread throughout offices, laboratories, and classrooms around the institute.

Time Sharing

The proposed method for operating the system was called time sharing. It is different from customary batch processing in a fundamental way. The user does not completely define his requirements for a run in advance; he does not submit the run to a dispatching intermediary for merger on a batch tape with other runs; and runs are not fed to the computer serially with the user absent. Instead, the user enters his requirements directly to the computer from his terminal. He does not enter them all at once, but develops them gradually with the computer's help. The computer provides him with intermediate results and detects his errors as he makes them. It makes available to him a large programming library that has been constructed over a period of time. Although a large number of users are active at separate terminals simultaneously, the computer gives each the impression that it is continuously accessible and immediately responsive. This kind of relationship between man and machine has a big payoff in a variety of contexts, commercial as well as intellectual.

I think it is fair to say that the idea of time sharing was considered "far out" by most people as recently as 1959, even in the academic and scientific communities. In 1961 we held a lecture series to celebrate the M.I.T. centennial. The subject of the series was "Management and the Computer of the Future." John McCarthy reviewed the reasoning and conclusions of the faculty committee in a paper on time-shared computer systems, J. C. R. Licklider argued emphatically for starting work immediately on interactive computers, Robert Fano commented on prospects for an automated library, and a large number of other participants spoke enthusiastically, persuasively, and authoritatively on a range of future possibilities. Computer users appeared to be listening attentively, but managements in the computer and communication industries were yet to be convinced of the potentialities for a vast new market.

Since 1961 several relevant events have taken place. F. J. Corbato and his group at the Computation Center developed a supervisory program called C.T.S.S. that converted M.I.T.'s current computer into a time-shared operation. J. C. R. Licklider joined the Advanced Research Projects Agency of the Department of Defense to campaign energetically for interactive computers and time sharing throughout the country. And encouraged by Licklider and the promise of substantial financial support from the Defense Department, M.I.T. formed Project MAC (Multi-Access Computer, alias Machine-Aided Cognition) with Robert Fano as director. Using C.T.S.S. and a computer that was not intended for multi-access operation, Project MAC began time sharing in the summer of 1963.

100 Time-Sharing Terminals

Today the same computer, with the help of some additional equipment, serves over 100 terminals distributed around M.I.T. and its environs. About half of the terminals are model 35 teletypewriters and the other half are I.B.M. 1050 electric typewriters. There are also a few terminals with provision for graphical input and output to facilitate computer-aided engineering design. To maintain good response times, no more than 30 of the terminals are permitted to be active at any one time. Communication between terminals and computer is by voice-grade telephone lines via a special M.I.T. private branch exchange which was established for this purpose. The computer is also linked with the Bell System switched network and with the Western Union International Telegraph network, so that both T.W.X. and TELEX services are available. Demonstrations of the MAC computer have been held at terminals in California, Norway, Great Britain and Buenos Aires.

500 Time-Sharing Terminals

By next year at this time the number of active project MAC terminals may have increased by a factor of five. A new computer system, now on order, that was designed expressly for multi-access operation, should be installed and running by then. Planning for the new system is a cooperative venture with Bell Telephone Laboratories who have ordered four identical systems for their own use. Many other universities, companies and research establishments now have time-sharing systems in operation or in advanced stages of construction. These include: System Development Corporation; Carnegie Tech; the University of California; Stanford University; Cal Tech; the Rand Corporation; General Motors; General Electric; Westinghouse; I.B.M.; Case Institute of Technology; Dartmouth College; and Bolt, Beranek & Newman. As you would expect, major computer manufacturers are mobilizing and reorganizing for the blossoming market they now see ahead.

The story is far from over. Interactive computation could still turn out to be nothing more than a lovely, short-lived dream. But that possibility is infinitely remote to those of us who have been working regularly at a terminal. I could no more conceive of returning to old-style computation than I could imagine trading in my telephone for a carrier pigeon. My guess is that by 1969, within 10 years from the time that work on time sharing began in earnest, interactive computation will be firmly entrenched as the dominant mode of using the computer in research, engineering, and education throughout the country.

Automatic Credit

Automatic credit could move in just as fast, but probably will not because of legal barriers and financial inertia. It will come, however. Its convenience to the customer, its benefits to the retailer, and its other economic incentives are too striking to be overlooked by our "entrepreneurial" society. Within 15 years it may already be challenging checks for sovereignty.

Let us speculate on the form the development will take. Automatic credit bureaus will increase in number and expand in scope. They will find that supplying credit information has limited potential, and that consummating transactions is a logical and profitable way to grow. They will take over the customer's liability and begin to trade information with banks and other credit operations. Gradually, communication networks will connect the computers and memories of cooperating enterprises, and new organizations will be created to forge the links and provide compatibility.

As the system evolves, more companies and stores will begin to appreciate the economic advantages of eliminating their receivables and credit activities. Customers will be paying monthly bills by touch-tone, and mightily enjoying the consequent reduction in check writing and book balancing. They will be using separate dialing cards for each bill, plus another for their bank account, and they will welcome the opportunity to trade these in for one general-purpose card that pays the itemized bill of the credit exchange. This card will be an early form of the money key. It will eventually be the same instrument that the customer carries to identify himself and establish credit when he goes shopping. The customer will applaud its replacing the onerous packet of credit cards he totes around today.

By now the credit exchange will be feeling the need for greater liquidity. Since the customer is carrying his money

key with him at all times, the credit exchange can encourage him to pay for his purchases as he makes them by offering an instant discount. It can also permit him to specify a future date for consummation of the transaction at a proportionate reduction in discount. As Putnam Livingston has pointed out, the time value of money is certain to attract greater attention as automatic credit systems bloom.

On the other side of the ledger, employees will be requesting the automatic assignment of salaries to their accounts in the credit exchange. With the communication network at a high state of development, companies will have little reason to mail out pay checks. During the nighttime shift, their computer systems will feed the payroll directly into the information network. Payroll credits will be distributed to the proper accounts like messages through a message switching center. Since companies will have eliminated their receivables, they will be able to pay employees frequently, perhaps even daily, as a special service. This will make it easier for employees to avail themselves of instant discounts when making purchases. Ultimately, companies will send wage rates to the credit exchange, and then communicate with it only on an exception basis; for example, when an employee is promoted.

Faster, More Even Flow of Money

Thus the flows of money into and out of the units of our economy will tend to become smoother, more continuous, and more synchronized with the physical flows of goods and services and the productive processes that give rise to them. Float will vanish, and cyclical fluctuations of the economy will be dampened.

In the ultimate automated system, money flow will change from a movement of documents to an electronic transfer of information. Bank accounts of individuals and corporations will become electronic records containing data on future earnings to facilitate credit ratings and payroll processing, as well as data on past accumulations. Frequent statements will be transmitted to subscribers with detailed listings of transactions. A complete historical file of transactions will be maintained in electronic form for audits and error checks. The electronic records will be conveniently accessible to persons with the authority to see them, and inaccessible to others.

Money is Basically Information

The fact is that money is basically information, and the banking industry is what Anthony Oettinger called it in July, 1964: "A Fiduciary Financial Information System." Banking and finance are very important components of a very big information business that includes: education, research, statistical surveys, medical diagnosis, engineering design, marketing, management control, communications, security and commodity trading, publishing, libraries, traffic control, Federal fiscal and monetary operations and numerous other intellectual, economic, and political activities. The rapid and continuing growth of information processing technology is going to have a major impact on all of these activities. As they reach higher and higher levels of automation, they will want to share data and establish communication links for their mutual advantage. The information utility that I discussed in the Atlantic article will provide the necessary interfaces and make cooperation economically attractive.

The Information Utility

Early forms of the information utility are already in various stages of budding. Items: (1) time-sharing experiments like project MAC are educating present and future researchers in the power of interactive computers, and are pushing forward the state of the art; (2) the KEYDATA system of Charles Adams Associates is bringing time sharing into the commercial arena and extending it from the largest Government agency to the smallest liquor dealer; (3) the QUICKTRAN service of I.B.M. has been given national publicity in full-page newspaper advertisements, and this is just the start of time sharing at I.B.M.; (4) the TRADIVAC system is planning to accept and match orders to buy and sell securities over an electronic counter from brokers everywhere, and expects to be profitable as soon as volume exceeds 70,000 shares per day; (5) the company-wide computer systems of American Airlines, Metropolitan Life, and Westinghouse, to mention just a few, are continuing to create competitive pressures; (6) A.T.&T. has been sharpening its multi-edged sword, temporarily sheathed in government regulations which will be revised; (7) while another giant in the communications industry has been engaged in market studies to see if the water is ready yet.

Banking in the Future

If these are pointers to the future, what do they indicate for banking? The crystal ball is still clouded, but a few things seem clear. Checks, bills, credit cards and the elaborately composed titles of ownership and certificates of indebtedness that we have treasured will gradually wither and disappear. Float and lags in money flow will also vanish. Income and expenditure streams will assume greater certainty, and the economy will become internally more stable. The commercial customer will become more sophisticated in his investment behavior and money-market activities, and demand deposit balances will level out and possibly turn down.

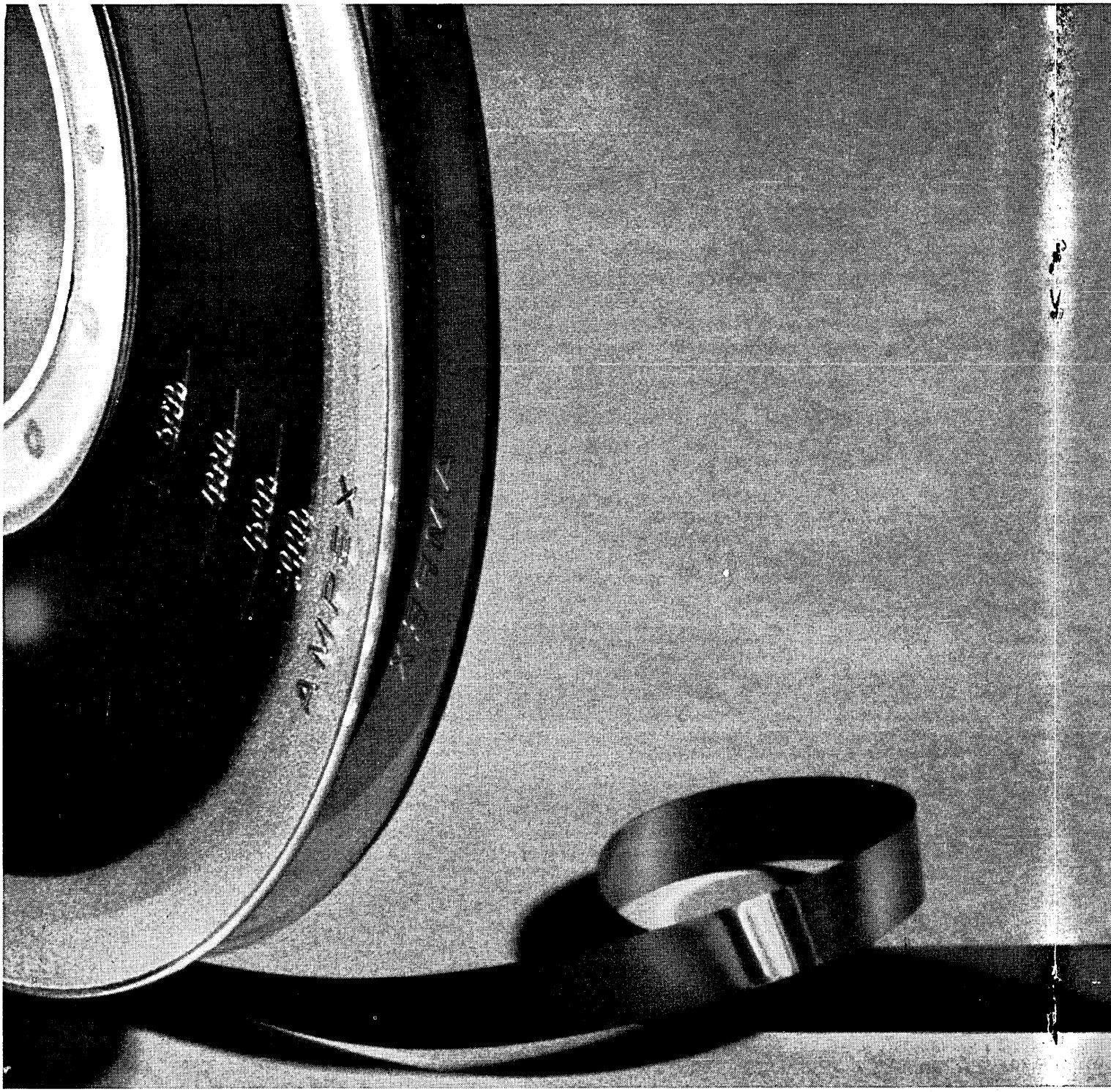
Some of these prospects sound fine: a return to sanity in paper handling and a consequent reduction in operating costs. Others seem ominous: a dwindling base for bank loans, and increased competition from the customer. But this is to judge tomorrow on the basis of the way things look today. Laws are going to change, Government regulation will change, the structure of interest rates will change, services and service charges will change, market operations will change, the procedures for negotiating loans will change, the process of underwriting new issues will change, and indeed the entire nature of banking and finance will change. My sketch of the future has deliberately left blank the identity of the credit exchanges and the information utilities, and it has said very little about who will be paying what to whom. These are open questions, and they will remain open questions until the participants begin to take their places on the starting line.

In many ways bankers have a running lead. They already enjoy a confidential relationship with their customers. They have a good understanding of the whole of American industry and finance. They are knowledgeable in international affairs. They are accustomed to processing large volumes of information. And they are familiar with the ways of networks, through branch and correspondent banking and membership in the Federal Reserve.

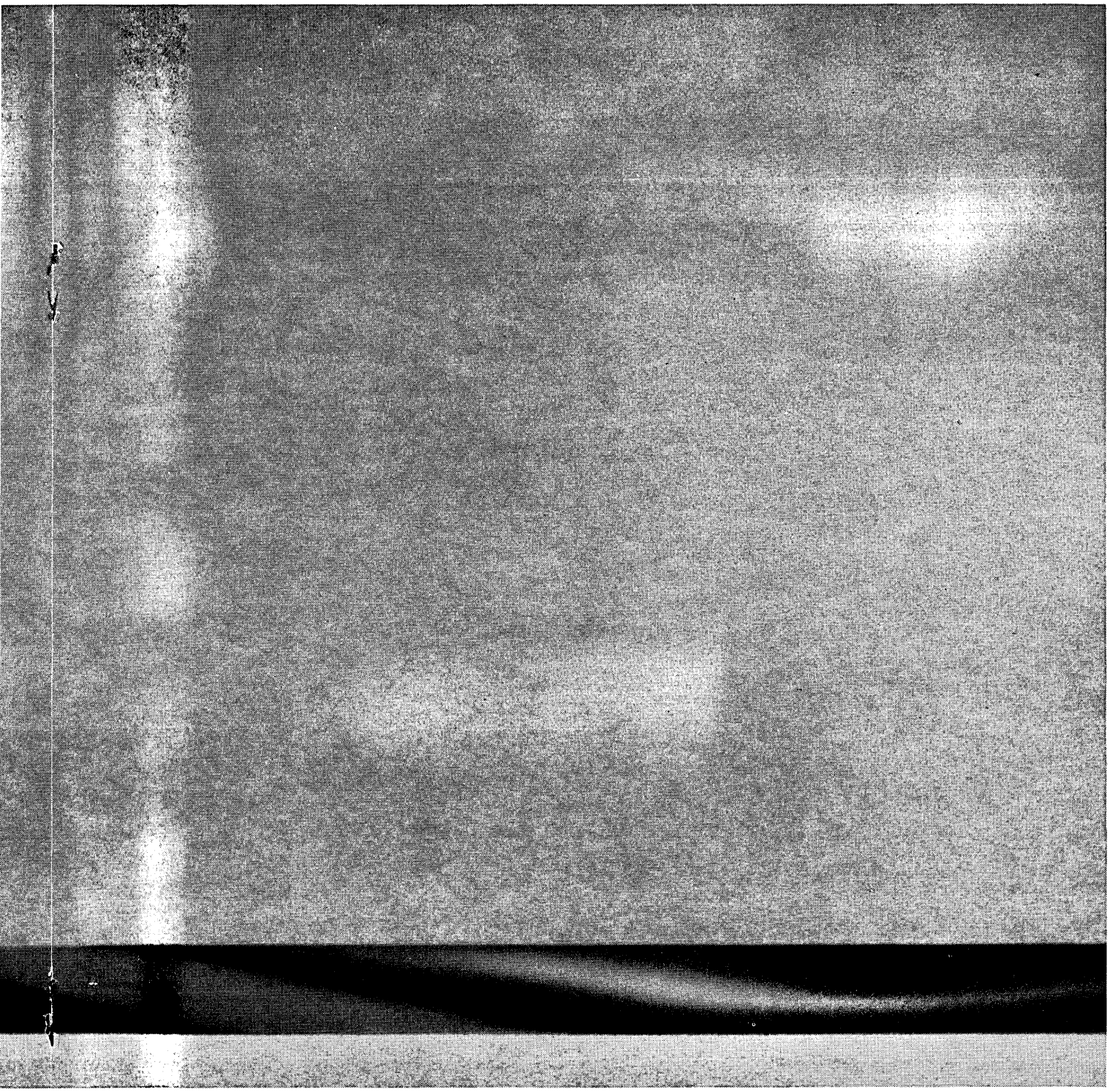
Bankers are on a threshold. In the past is their carefully cultivated reputation for conservatism and deliberation. In the future is their urgent need to stake out a claim and pursue it with purpose and foresight.

One of the laws of prudent thinking has been expressed as "those who lean too far into the future will fall flat on their faces." The practical wisdom of this advice for the reckless computer enthusiast needs no comment. Yet today we might add a small codicil:

> Those who do not bend forward, when moving into a stiff gale, will land on their backs; and those who do not look up to see where they are going, neither will they see who is ahead.



Two entirely new, long-wear, heavy-duty Ampex computer tapes are now available. The two (Ampex 838 for 800 bpi applications and 832 for 556 bpi applications) are the result of an intensive 2 year development program. Using an advanced oxide formulation, these new tapes feature a mirror-smooth surface that consistently gives the cleanest, most reliable performance ever possible. The proof of the new formulation is in the using: no other tape on the market does as much to reduce 'temporary errors' and static build-up. Even the reel is new: IBM compatible configurations are available on solid



Announcing: the most important advance in computer tape in four years.

flanged plastic reels with new aluminum hubs. Who benefits from this remarkable new tape? Anyone who uses IBM (including full width tested), IBM compatible, RCA 301, and most Univac computer systems. Try it. Test it. Use it. We think that you'll agree that the time spent in developing this remarkable new tape was time well spent. For a demonstration, call your Ampex representative, or write the only company providing recorders, tape and core memory devices for every application: Ampex Corp., 401 Broadway, Redwood City, California.

AMPEX

Circle No. 15 on Readers Service Card

Meet the "MR"

A 2-usec, all-silicon memory system that meets rugged environmental specifications

The Fabri-Tek Series MR memory system offers systems designers the well-known Fabri-Tek Memory technology in a new, ruggedized version using components meeting the requirements of MIL-Std 242D. Capacities from 32 to 32,000 words of any bit length are available. Full cycle time is 2 microseconds. (A 8192 X 21-bit system is illustrated here with the front door removed.)

The Series MR meets these environmental specifications:

- Operating temperature . . . —40° C to +71° C
- Humidity . . . meets humidity test procedure 1, Para. 4.4 of Mil-E-5272
- Shock . . . unit operates satisfactorily after being subjected to 15g of acceleration having a duration of 11 msec in each direction of the 3 mutually perpendicular axes.
- Vibration . . . unit operates satisfactorily after being subjected to vibration of from 10 to 300 cps along each of the 3 mutually perpendicular axes as follows: ± 2.5g acceleration from 10 to 36 cps, 0.036" double amplitude from 36 to 46 cps, ± 4g acceleration from 46 to 300 cps.

Ruggedized, die-cast aluminum frames support circuit cards. One card supports the adjacent card to resist severe shock and vibration environments. Easily accessible test points are brought out through the frame.

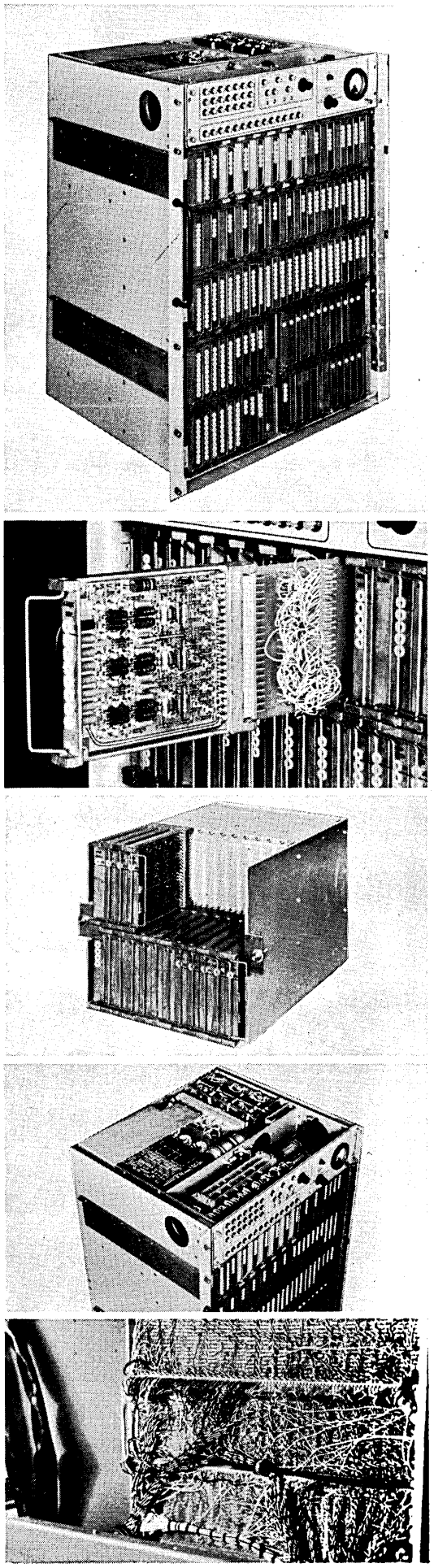
The memory stack assembly is removable. Lithium-ferrite memory cores meet extreme temperature requirements so it is not necessary to thermally compensate this stack for the maximum temperature limit.

The compact power supply is easily accessible. All voltages used can be adjusted in this section. Power supply transistors are "wind tunnel" cooled.

Instead of conventional printed-circuit board connectors, a single parent board is used and the PC connectors form an integral part of the parent board. System interwiring is all "Wire-Wrap"*.

*T.M. Gardner-Denver Company

If your memory requirement calls for environmental ruggedizing, the Series MR may be just what you've been looking for. Call, wire, or write Fabri-Tek Incorporated, Amery, Wisconsin. Phone: COngress 8-7155 (Area 715). TWX: 510-376-1710.



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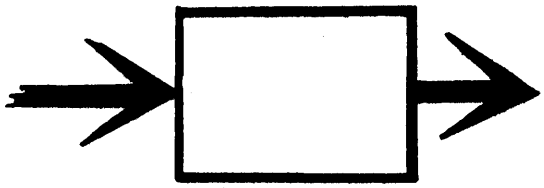
Circle No. 14 on Readers Service Card



Novel Variations in Computer Marketing

Surprisingly, for a new industry, the marketing of computers to date has been restricted by traditionalism. The computer salesman is a lineal descendant of the punched card salesman, who in turn came from the bookkeeping machine salesman of the early part of the century. All the other aspects of present computer marketing have similar traditional roots in the early "office revolution."

But if we look at other industries and other products, and release our imaginations, we can see a number of marketing innovations which may yet become popular in the computer field. Some depend, of course, on a substantial increase in the sophistication of users; others may be doomed by competition or impracticality. But they are suggested here as a possible way of bringing computer marketing out of the horse and buggy era of "business machines" marketing.

• *Time-Sharing.* This innovation is currently demonstrable. Its raison d'être is the simplification of engineering and scientific use of the computer; it is an extension of open-shop programing. It has advocates and opponents, but is becoming increasingly popular.

• *Rent-a-Computer.* An extension of time-sharing would be provision of local rental outlets where a computer may be rented like a car, by the day, week, or month. This service might be called U-Code-It, Rent-a-Comp, or Definers' Club.

• *Separation of Hardware and Software.* Hardware and software could be sold separately, or at least priced separately. Some users argue that they would prefer to pay only for the software they use. They would rather not pay for someone else's software, which comes from amortization over all systems.

• *User Underwriting of Software.* Once software is sold separately from the hardware, user groups could underwrite their own software developments. The Aerospace Industries Association sponsors the maintenance of APT III in this way. A formalization of SHARE, GUIDE, and other groups might well improve both the quality and effectiveness of software.

• *Price Reductions for Use of Multiple Computers.* The organization that uses more than one computer of the same kind is paying twice for the same software. Multiple computers could cost less if software were amortized over the users, not the computers.

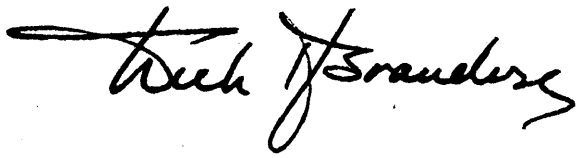
• *Separate Maintenance.* The cost of maintenance becomes apparent only when the machine is purchased. Analysis shows a maintenance cost ratio varying usually from 6% to 20% of monthly rental. But there is no reason why the renting user should not supply his own maintenance, as is done in several military installations, or contract with a separate maintenance company, as is done in the appliance industry.

• *Separate Supporting Services.* The cost of supporting services—programing, systems, education, or site planning—is now hidden. Yet it could be segregated and purchased separately as well.

• *Equipment Wholesaling.* By removing all the peripheral services and benefits, we essentially create a wholesale market for the pure hardware. Although this is not in existence today, one manifestation is developing rapidly: the used equipment market. In this case the seller provides the pure hardware and little else; all other services have to be purchased or obtained from other sources. (This market is expected to have a significant impact from 1967 on.)

• *Modular Construction.* An extension of the popular concepts of modularity and hardware compatibility lies in the "do-it-yourself" computer system. By buying components from various manufacturers and constructing a computer tailored to system requirements, it is possible that a better over-all hardware system will be constructed. This is now done by the "systems" companies, who construct systems comprised of existing hardware for control and special purpose uses.

Many other changes in marketing concepts could be made. However the average user already faces a complex process of selection; equipment configurations, vendors, costs, and other selection criteria must be balanced. With these variables in existence, the human salesman is not yet obsolete.



CONTRIBUTING EDITOR

DO NOT BUY

(or rent)

A DIGITAL COMPUTER

unless it has a SIMSCRIPT compiler. You can take our unbiased word for it since we make SIMSCRIPT compilers (in fact we are the only one who makes SIMSCRIPT compilers commercially). If you don't believe us, ask the multitude of cheerful fearless users who are no less extravagant in their claims . . .

I believe SIMSCRIPT *is an essential piece of software for any large computer installation.*

Dr. Daniel Teichroew
Head, Division of Organizational Sciences
Case Institute of Technology
Cleveland, Ohio

In the development of our tactical warfare simulation, we had originally planned to spend a year writing the program in FORTRAN. *By using* SIMSCRIPT *the program was operational in only three months. Elapsed time and programming man-hours were reduced by at least a factor of 4 to 1.*

Drs. William W. and Janice B. Fain
Aerospace Sciences
Douglas Aircraft Company, Inc.
Long Beach, California

In describing the (brand X) simulation language, one stalwart user reports:

I wrote a large communications simulation using (brand X). The resulting program took 20,000 words of core and severely limited the problem size that could be run. I then rewrote the program in SIMSCRIPT *and it took only 10,000 words of core. On identical problems, the (brand X) program required 26.8 minutes of 7090 time to execute, the* SIMSCRIPT *program took 3.6 minutes.*

Bernard Backhaut
ITT Communications Systems
Falls Church, Virginia

Since virtually all large computer installations do extensive digital simulation, and since SIMSCRIPT is the leading simulation language, why be without it?

Prudent people have entrusted us with the production of their SIMSCRIPT compilers for computers such as . . .

CLIENT	COMPUTER
CDC	CDC 3600 (with up to eight 32K memory banks)
IBM	IBM 709, 7090, 7094 (revised for IBSYS/IBJOB)
ITT	PHILCO 210, 211
Navy	UNIVAC 490

Naturally, we could stand to have contracts for some more.

Our compiler work is supervised by the incredible Dr. Markowitz himself (originator of the SIMSCRIPT language) so you can get your compiler straight from the horse's mouth, which is clearly better than getting it from elsewhere.

Since we take personal pride in the SIMSCRIPT language, we also take personal pride in the SIMSCRIPT compilers that we produce. Our compilers are based on machine independent techniques and translate SIMSCRIPT statements directly into the basic assembly language of the particular computer involved. They do not go through an intermediate language as in earlier implementations. We can therefore take advantage of the particular hardware characteristics plus eliminate inefficiencies introduced by an intermediate language. Both compile and execute times are significantly reduced and object programs use less core.

Our SIMSCRIPT compilers cost from $30,000 to $50,000 plus a small amount of computer time and can be delivered within six months.

Any large computer without SIMSCRIPT is ill-equipped. If you make a big machine, let us know. If you're going to buy a big machine, *keep your money out of sight until they promise SIMSCRIPT.*

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Circle No. 16 on Readers Service Card

CALENDAR OF COMING EVENTS

Apr. 6-8, 1965: 3rd Annual Symposium on Biomathematics and Computer Science in the Life Sciences, Warwick Hotel, Houston, Tex.; contact Office of the Dean, Div. of Continuing Education, Univ. of Tex. Graduate School of Biomedical Sciences at Houston, 102 Jesse Jones Library Bldg., Tex. Medical Center, Houston, Tex. 77025

Apr. 13-15, 1965: National Telemetering Conference, 15th Annual Meeting, Shamrock-Hilton Hotel, Houston, Tex.; contact Lewis Winner, 152 W. 42 St., New York, N. Y. 10036

Apr. 15-16, 1965: First International Conference on Programming and Control, U. S. Air Force Academy, Colorado Springs, Colo.; contact Prof. G. B. Dantzig, Operations Research Center, Univ. of Calif., Berkeley, Calif.

Apr. 21-23, 1965: 2nd Annual Meeting and Technical Conference of the Numerical Control Society, La Salle Hotel, Chicago, Ill.; contact Jerry Singleton, Numerical Control Society, 122 E. 49 St., New York, N. Y. 10017

Apr. 21-23, 1965: 16th Semi-Annual Meeting of Philco 2000 Users Group (TUG), El Tropicana Motor Hotel, San Antonio, Tex.; contact Omar Phipps, Philco Western Development Laboratories, Palo Alto, Calif.

May 3-8, 1965: Symposium on the Numerical Solution of Partial Differential Equations, Inst. for Fluid Dynamics and Applied Mathematics and the Computer Science Center, Univ. of Md., College Park, Md.; contact Inst. for Fluid Dynamics and Applied Mathematics, Univ. of Md., College Park, Md. 20742

May 5-7, 1965: 1965 Electronic Components Conference, Marriott Twin Bridges Motor Hotel, Washington 1, D. C.; contact John E. Hickey, Jr., Chilton Co., Chestnut & 56th Sts., Philadelphia, Pa. 19134

May 10-12, 1965: National Aerospace Electronics Conference (NAECON), Dayton, Ohio; contact IEEE Dayton Office, 1414 E. 3rd St., Dayton 2, Ohio.

May 13-14, 1965: Symposium on Signal Transmission and Processing, Columbia Univ., New York, N. Y.; contact Dr. L. E. Franks, Bell Tel. Labs., No. Andover, Mass.

May 18, 1965: SWAP Conference, Marriott Motor Hotel, Twin Bridges, Washington, D. C.; contact Gordon V. Wise, Control Data Corp., 8100 34th Ave. So., Minneapolis, Minn. 55420.

May 18, 1965: SWAP Conference, Marriott Motor Hotel, Twin Bridges, Washington, D. C.; contact Gordon V. Wise, Control Data Corp., 8100 34th Ave. So., Minneapolis, Minn. 55420.

May 19-21, 1965: 15th CO-OP Conference, Marriott Motor Hotel, Twin Bridges, Washington, D. C.; contact Gordon V. Wise, Control Data Corp., 8100 34th Ave. So., Minneapolis, Minn. 55420.

May 19-21, 1965: Power Industry Computer App. Conference (PICA), Jack Tar Hotel, Clearwater, Fla.; contact G. W. Stagg, American Elec. Power Serv. Corp., 2 Broadway, New York, N. Y. 10008.

May 20-21, 1965: Spring Technical Meeting of the Digital Equipment Computer Users Society (DECUS), William James Hall, Harvard University, Cambridge, Mass.; contact DECUS, Maynard, Mass. 01754

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 1-3, 1965: Reprogramming Conference, a Special Interest Symposium of the Association for Computing Machinery, Nassau Inn, Princeton, N. J.; contact Mrs. L. R. Becker, Applied Data Research, Inc., Route 206 Center, Princeton, N. J. 08540

June 10-12, 1965: Annual Southeastern Regional Conference of Association of Computing Machinery, Palm Beach Towers, Palm Beach, Fla.; contact Donald J. Beuttenmuller, Gen. Chairman, 243 Russlyn Dr., W. Palm Beach, Fla.

June 17-18, 1965: 3rd Annual Conference of The Computer Personnel Research Group, Washington University, St. Louis, Mo.; contact Prof. Malcolm H. Gotterer, Program Chairman, 120 Boucke Bldg., Pennsylvania State University, University Park, Pa. 16802

June 21-25, 1965: Information Sciences Institute, Seminar I: Image Processing, Univ. of Maryland, Computer Science Center and University College, College Park, Md.; contact Div. of Institutes, Center of Adult Education, Univ. of Md., College Park, Md. 20742

June 21-25, 1965: San Diego Symp. for Biomedical Engineering, San Diego, Calif.; contact Dean L. Franklin, Scripps Clinic & Res Found., La Jolla, Calif.

c & a CAPITAL REPORT

A Special Report from C&A's Washington Correspondent

The Budget Bureau has issued Circular No. A-71, which outlines the responsibilities for administration and management of computing equipment in the Government. The circular was sent to all agencies and departments with the White-House-approved "Report on Management of Automatic Data Processing in the Federal Government," which is available for 50 cents from the Superintendent of Documents, Government Printing Office, Washington, D. C. Ask for "Senate Document No. 15."

Circular A-71 outlines the duties of four separate agencies in the EDP area:

Bureau of the Budget: This agency will continue to provide over-all leadership and coordination of EDP equipment. To improve EDP practices, it will evaluate through the budget-review process the effectiveness of agencies' EDP management; foster Government support of standards development, both in the Government and through commercial channels (American Standards Assn.); support research in systems design; promote integration of EDP systems; and sponsor an EDP management information system.

General Services Administration: GSA has many duties in the computer area. In procurement, it must provide comparative information to agencies on EDP characteristics and performance, and act as the focal point for all Federal acquisition of business computers. In the area of computer usage, it must: look after replacement of equipment to avoid its use beyond "the point of economic advantage"; take responsibility for surplus equipment; prepare inventory reports on computer usage; promote computer sharing and joint use; and provide guidelines for equipment maintenance.

Department of Commerce: The central EDP point within the Commerce Dept. is the Natl. Bureau of Standards, which continues as the Government's technical EDP advisor. NBS will also take on the job of computer research and will monitor standards work and recommend steps to improve compatibility between computers procured by the Government.

Civil Service Commission: One of this agency's biggest jobs and biggest problems is to help staff EDP activities. Like many others, the Government is short of good programers, systems people, etc. In addition to this job, CSC is responsible for reassigning people adversely affected by computers.

Besides the above duties, the head of each individual agency and department in the Government has EDP responsibilities. He must: determine which applications are to be placed on computers; develop agency data systems that use the best design techniques; determine equipment requirements; and cooperate in computer sharing and the establishment of service centers.

The Navy's Bureau of Ships has published the last of four documents describing its information storage and retrieval system for technical reports. It is called SHARP. for Ships Analysis and Retrieval Project, and was developed by BuShips' Technical Library in cooperation with the David Taylor Model Basin.

Designed for the IBM 7090/1401 system, SHARP automates: (1) bibliographic searches; (2) subject matter searches; (3) combinations of both; (4) issuance of library catalog cards and accessions bulletins; (5) control of periodicals and journals; and (6) other aspects under development, such as generic computer searching, computer posting of descriptive terms in the indexing procedure, and registers of the interests of users. Details of the indexing scheme, search strategy, thesaurus, computer programs, and research work are reported. Modifications to the system and future plans are also outlined.

Copies of the 85-page report cost 50 cents each at the Government Printing Office, Washington, D. C. 20402. Order No. is NAVSHIPS 250-210-1.

Legislation pertaining to EDP that has been introduced in the current session of Congress is pretty much a rehash of that introduced in previous sessions. The "Brooks Bill," which would put EDP responsibility in the hands of the General Services Admin., has been reintroduced in the House of Representatives by Congressman Jack Brooks of Texas. Hearings are tentatively scheduled in March, but hope for the bill's passage is slight. It is labeled H. R. 4845.

Another piece of legislation that would affect EDP equipment is a bill to repeal the excise tax on business machines. It is H. R. 2190 and is now before the House Ways and Means Committee. There is currently a 10 per cent manufacturers' excise tax on business machines that is passed on to the buyer. However, this tax is not applied evenly to all computing equipment. A machine for coding documents that uses holes in its coding system is taxable as a punch card machine; another that is not dependent on holes for coding is not taxable.

Congressman Thomas B. Curtis, of Missouri, said when he introduced H. R. 2190: "The development of the electronic data processing industry alone has created a vast gray area between the taxable and the nontaxable which is not capable of clarification."

What's all the shouting about . . .

The fuss some people make, you'd think it was new. Well it may be to some, but random access has been a proven technique for years at NCR . . . and is now doing an excellent job for hundreds of satisfied customers.

CRAM provides processing benefits for both random and sequential systems. Master files can be updated on a completely random basis. Or if data is first sorted, master files can still be updated using random selective techniques. In this way, only active accounts are read. This eliminates the necessity for reading and writing the entire master file. And, with CRAM there is no tape rewind time.

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"ACROSS THE EDITOR'S DESK"

Computing and Data Processing Newsletter

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APPLICATIONS

TESTING BLOOD UNDER COMPUTER CONTROL

A fully automated process for testing blood has been put under computer control by the Kings County Research Laboratories, Inc., Brooklyn, N.Y. An IBM 1710 computer is being used to monitor, calculate and speed the results of patient's blood tests back to physicians.

The tests, which reveal to a physician information about a person's health through analysis of his blood chemistry, produce data on the functions of critical organs such as the liver, kidneys and thyroid gland. The tests also reveal the level of cholesterol in the blood. All of these blood testing operations are performed automatically.

Murray Blaivas, co-director of the Laboratory, said that these tests aid the physician in the practice of preventive medicine. "One distinct advantage of using the computer," said Mr. Blaivas, "is more positive test control. This gives us greater accuracy and reliability."

The new operation involves 10 separate tests performed simultaneously on one blood specimen. It averages only two minutes to complete the 10 tests. If they were done in the usual routine laboratory manner, it would take one technician two to three hours.

The process works in the following manner: A blood sample, received at the laboratory, is accompanied by a punched card identification tag. The punched card contains the patient's and his doctor's name. When the sample is received, an identification number is added to the card. All of this information is "read" by the computer which enters it into an assigned location on a magnetic disk. Also contained in the computer is a complete listing of standard and control values for all of the tests to be performed on the blood sample.

The actual testing of the blood sample is performed by Auto Analyzers, and 20 of these devices are currently monitored by the computer every 10 seconds to guarantee proper performance. The system is capable of handling up to 200 such units.

— A technician places blood specimens in an AutoAnalyzer. The testing equipment is monitored by an IBM 1710 computer (background).

When the tests are completed, the readings are automatically transmitted to the computer which compares the readings against those of known values and mathematically computes the results of the tests. These results are automatically printed out and the physician receives a printed report of the results.

This new technique guarantees increased accuracy over previous methods by greatly reducing the possibility of human error.

COMPUTER USED TO DOUBLE QUALITY OF MOON PICTURES

A digital computer is being used by scientists of the California Institute of Technology Jet Propulsion Laboratory, Pasadena, Calif., to double the quality of moon pictures taken by the Ranger VII spacecraft.

A new technique, called video data digital processing, has been devised to squelch system noise and distortions picked up during transmission of pictures from the spacecraft to earth. Using an IBM 7094 computer, scientists have been able to improve photographic details of the moon's surface, learn more about elevations and slopes of the terrain and draw contour maps of the lunar surface.

Newsletter

Ranger VII (which crashed into the moon on July 31, 1964) snapped 4308 photos before it was destroyed on impact. "By using the digital computer technique," says Raymond L. Heacock, one of the Ranger experimenters at JPL, "the quality and sharpness of several of the Ranger pictures had been improved by a factor of two....."

Dr. Robert Nathan, who developed the video data digital processing technique, said that the pictures were sent back from Ranger VII to earth receiving stations in analog form. These signals were used to produce man's first close-up view of the lunar surface. Simultaneously they were recorded on magnetic tape for later conversion to digital form and refinement by the computer, Nathan said.

The 7094 sees a picture as 300 lines. Each line is made up of 300 points which are represented by a combination of six binary digits. Thus each picture contains 90,000 points and there are 64 possible shades of gray for each point in the picture.

The computer then plays a brightness level matching game using numbers to represent the shades of gray between black and white. This makes it possible to correct for any uneven pick-up response of the spacecraft television cameras.

The computer compares one scan line with its two neighbors and can quickly spot and eliminate extreme changes that may be due to electromagnetic interference.

Once the computer process is completed the electronic data is transferred back onto magnetic tape and run through a film reproducer for re-creation as a visual image.

Dr. Nathan says that he has been able to use the computer to draw three-dimensional contour maps of the lunar surface. The 7094 accomplishes this by comparing light and dark areas in lunar pictures and computing the angle of slopes and relative roughness and elevations between them.

RESEARCH VESSEL SETS SAIL WITH COMPUTER AS NAVIGATOR

A research ship, the Atlantis II, operated by the Woods Hole Oceanographic Institution, Cape Cod, Mass., is sailing on a 10-month voyage to the Indian Ocean and beyond. She is manned by a ship's company composed of 25 crew members, 28 scientists, and a seagoing computer which will not only collect a huge store of oceanographic data, but will also navigate the ship via a new navigational system which makes use of the signals emitted by orbiting earth satellites.

Purpose of the round-the-world expedition is to chart currents, take a census of tiny marine life, probe the ocean floor and otherwise unravel the sea's mysteries. The Indian Ocean phase of the voyage is part of a 23-nation experiment sponsored by UNESCO, in an effort to help the poverty-stricken nations of the Middle East increase their food supply by utilizing the resources of the Indian Ocean. The 50,000-mile voyage will include such ports of call as Port Said, Bombay, the Seychelles Islands, Fremantle, Australia, and Tokyo.

The most revolutionary aspect of the voyage is a new method of navigating with the aid of artificial earth satellites. Though a human navigator carries on as usual, he is supplemented by a PDP-5 computer made by the Digital Equipment Corporation of Maynard, Mass. The computer takes over when an extremely accurate position is needed by the scientists.

"A computer is needed to handle the large amounts of raw data involved in navigation by satellite," said Joseph C. Michael, one of the expedition's oceanographic researchers. "Suppose you've taken a minimum of 30 fixes. It would take a man with a scratch-pad about a year to do the necessary mathematical drudgery. And then he'd only know where he'd been a year ago — not very useful. The PDP-5 computer, on the other hand, comes up with an answer in minutes."

In addition, the satellite-computer team is much more precise than conventional navigation methods such as Loran or visual sightings. Instead of a two or three mile diameter of possible error, the computer fixes the ship's position within a much smaller area.

Three navigation satellites orbited by the U. S. Navy supply the necessary signals. During the 20 minutes any one of the satellites takes to travel from one horizon to the other, the Atlantis II locks onto its frequency by means of a special radio receiver on loan from the Navy. The PDP-5 computer, making use of a phenomenon known as Doppler variation, then pinpoints the ship's position with uncanny accuracy.

When it is not navigating, the PDP-5 computer will be kept busy doing a variety of scientific chores. Operating on a 24-hour schedule, it will handle such tasks simultaneously. Up to 192 instruments can be tied into the computer directly, through a switchboard-like device.

Digital's PDP-5 is a self-contained computer that needs no special air conditioning equipment or other environmental control. It has a 6-microsecond core memory cycle time which gives it a computation rate of 55,555 additions per second and permits it to handle input-output data at rates up to two million bits per second.

Commenting on the unique navigational team of orbiting satellites and electronic computer, Dr. Paul M. Fye, Director of the Woods Hole Oceanographic Institution, said that the method has already been tried by certain Navy vessels, but that its operational use now for oceanography is a major advance in that field. Dr. Fye said, "The information we gather is far more valuable as we can pinpoint the almost exact location from which it was taken."

FCC PLANS ALLOCATION OF UHF TV CHANNELS WITH UNIVAC III COMPUTER

A computer program to assist engineers of the Federal Communications Commission to develop recommendations for nationwide assignment of UHF television stations has been developed and delivered to the agency by Sperry Rand Corporation's UNIVAC Division.

This is the first time that FCC engineers have used a computer for planning allocation of channels. The UNIVAC III, installed in 1963, has been used to process applications for the Citizens Radio Service, amateur radio operations, and for broadcast engineering and computational work.

McIvor L. Parker, supervisory engineer, Rules and Standards Division of the FCC's Broadcast Bureau, predicts that use of the computer program will make it possible to do several years work in a matter of hours. He points out, for instance, that a study of a small area of New England, which took three weeks by manual calculations, was completed in 40 minutes on the computer.

In brief, the coded instructions supply the computer with a list of some 1000 cities in which assignments will be sought for both commercial and educational TV, as well as cities already having a sufficient number of channel assignments. TV channel assignments are required to meet certain minimum geographic separations, which vary in different parts of the country.

Under the program, the computer will determine the distance between each listed city and all other listed cities within a radius of 250 miles, including those in Canada and Mexico. On the basis of distance information, the computer can determine which of the 70 UHF channels might be assigned to each city. It will then select the channel or channels which will leave the most channels available for assignment to other cities. This system of making assignments will result in the most efficient use of the available TV channels. The computer will print out the channels assigned to each city and the channels remaining, if any, which would be added to that city.

In the future, the computer will be used to find new assignments for places not included in the present assignment plan and to find additional assignments, if needed, in places appearing in the assignment plan. In the past, each such individual change has required an extensive engineering study. The computer can accomplish this in a fraction of the time required when manual means are used.

NEW INSTALLATIONS

L-2010 COMPUTER DELIVERED TO NAVY

A lightweight computer that can reliably solve complicated navigation problems and can plot mine locations under at-sea operating conditions has been delivered to the U. S. Navy Mine Defense Laboratories, Panama City, Fla. The L-2010, developed by the Librascope Group of General Precision, Inc., is the first machine in this configuration delivered to the Navy. The computer, weighing only 65 pounds, is designed to function "on-line" in real time with radar, sonar, printing, and plotting devices.

FIRST MICHIGAN COMPUTER GOING TO FERRIS COLLEGE

Honeywell Inc. has announced that Ferris State College, Big Rapids, Mich., will acquire for classroom purposes, parts of the first full-scale electronic computer used in Michigan.

A truckload of components from Honeywell's Datamatic 1000, a first-generation vacuum-tube system purchased about nine years ago by Michigan Blue Cross and Michigan Blue Shield, will be used by the college to broaden its electronic data processing curriculum.

A spokesman for Honeywell's electronic data processing division said the D-1000 parts being donated to Ferris College have more historic than commercial market value today due to their replacement in recent years by faster, less expensive, more capable systems. He said, "They do provide, however, an excellent insight for the student into the functioning of a typical computer."

The components became available because Michigan's Blue Cross-Blue Shield groups traded-in the D-1000 for a new Honeywell 800-III computer system supplemented by a smaller Honeywell 200.

Datamatic 1000 components being donated to Ferris College include the computer's main memory unit; magnetic tape reels; circuit "packages"; read/write heads from the magnetic tape drives; and other associated input/output and control equipment.

TESCO ORDERS CONTROL DATA 636 INDUSTRIAL CONTROL COMPUTER

George S. Hanson, Control Data Corporation Vice President of Marketing, announced that the Texas Electric Service Company (TESCO) has placed an order for a CONTROL DATA 636 Computer System. The main elements of the system consist of the process computer, analog and digital input and output section, multiplexer, magnetic core and drum storage (24,000 words initially), consoles, displays, alarm printers and three electric typewriters.

TESCO operates an electric utility system in north central and West Texas with headquarters at Fort Worth. This new computer system will be installed for generating unit No. 6 at the Morgan Creek station near Colorado City, Texas. This is the second computer installation associated with Texas Electric's steam-turbine generator plants.

The computer initially will provide for detection, scan, monitoring and alarm of nearly 500 measurements and status signals, scanning at the rate of 30 points each second. In addition, the system determines plant performance, logs pertinent data for operational information or permanent record, and displays and records trends of plant variables as needed.

BIOLOGY FOUNDATION INSTALLS LINC

The Worcester Foundation for Experimental Biology at Shrewsbury, Mass., has purchased a LINC computer from Digital Equipment Corp. for experimentation in its Laboratory of Neurophysiology. The foundation carries out research and experimentation concerned with the chemistry and physiology of the body.

The Worcester Foundation will use LINC to investigate electrical nerve messages in the brain which determine behavior. It will be used with various data gathering apparatus, including the electroencephalograph and other electrical recording devices, to study spontaneous and evoked brain potentials in the cerebral cortex and other brain areas.

ARMY CORPS OF ENGINEERS INSTALLS RCA 301

The U. S. Army Corps of Engineers, Kansas City District, has installed an RCA 301 computer for use in connection with water resources development along the Missouri River.

The RCA system will be applied initially to programs dealing with hydraulics, hydrology, structural and allied civil engineering problems. The 301 also offers the capability to computerize financial and accounting, property, real estate and personnel functions of the District.

The Kansas City District has responsibility for the work within a five-state area from Rulo, Nebraska, to the confluence of the Missouri and Mississippi, including all tributaries of the Missouri within this territory.

The Kansas City system includes a central processor with 40,000 characters of memory storage, a high-speed printer, six magnetic tape units, a card reader-punch and an on-line CALCOMP digital plotter.

IRISH INTERNATIONAL TO USE BUNKER-RAMO RESERVATION SYSTEM

Irish International Airlines has announced that it will install an electronic computer system this month to handle its growing reservation workload.

The airline reservation information system with on-line agent sets connected to heavy traffic generating offices of Irish International will be provided by The Bunker-Ramo Corporation of Stamford, Conn., under a leasing arrangement. It will be the first fully automated electronic availability and inventory system linking Ireland and Great Britain.

The system will handle as many as 11,000 queries an hour and will record sales and cancellations as they occur. More than 100 agent sets will be distributed throughout the Irish carrier's network. The counter-top input/output devices that will be used by the booking clerk to communicate with the computer will automatically update the information stored in the central processor.

The automatic communications network will connect the computer to booking offices at three locations in Dublin, as well as booking offices in Cork, Limerick, Birmingham, Glasgow, Manchester, and London. The central processing equipment will be located at Dublin Airport. The system is known as the Altamatic reservation system.

COAST GUARD BUYS PDP-5 FOR SEA AND SHORE DUTY

The Coast Guard has purchased a PDP-5 computer from Digital Equipment Corporation for use in reducing oceanographic data at sea and ashore. The data is used principally to construct a Geostrophic Current Chart in order to predict the speed and course of icebergs drifting into the major shipping lanes near the Grand Banks. The Coast Guard performs this work for the International Ice Patrol.

In addition to performing assignments at sea, the PDP-5 will be used ashore in Washington following the end of the ice patrol season to process similar data gathered elsewhere by other Coast Guard vessels.

A PDP-5 was tested for the work during the 1964 ice patrol cruises on board the Coast Guard oceanographic vessel Evergreen, when data was taken at nearly 500 oceanographic stations. Use of the computer shortened the calculation time from three hours per station by hand to 15 minutes by machine, and also eliminated the hand calculating previously done ashore after the ship docked.

WURLITZER COMPANY TO INSTALL SYSTEM/360

The Wurlitzer Company, Chicago, Ill., internationally known manufacturer of pianos and electronic organs, announced it will install IBM's new System/360 computer for a variety of applications from factory and retail store inventory control to installment receivable accounting. Other proposed uses of the computer include production control, payroll, and management reporting.

The System/360 Model 30 will be installed in the DeKalb, Ill., plant of The Wurlitzer Company. The company has five manufacturing plants in the United States and West Germany and also operates seven retail store groups spread from Chicago to New York.

NATIONAL TWIST DRILL & TOOL COMPANY INSTALLING UNIVAC 418 SYSTEM

National Twist Drill and Tool Company, Rochester, Mich., one of the nation's largest producers of rotary metal cutting tools, has disclosed plans of a real time computing system for processing of its production and order service operations.

Principal elements in the new system will be a UNIVAC 418 Real-Time Computer, a product of Sperry Rand Corporation's UNIVAC Division, and a teleregister video inquiry-display to be supplied by Bunker-Ramo Corporation of Stamford, Conn.

Two major applications will be implemented when the new system begins on-line operations in 1965. One is a real-time order service function; the other is a production control capability that will facilitate real-time reports on the condition of more than 15,000 orders. The new system will also produce statistical analyses for market research studies. Other potential applications are now being studied by the company for possible implementation in 1966.

$1.4 MILLION EDP ORDER FOR HONEYWELL

The Public Service Board of New South Wales, Australia, has purchased a large-scale Honeywell 800-III data processing system valued in excess of $1.4 million. The computer joins two smaller Honeywell 400 computers now installed at the Public Service Board, and makes that state government's computer center the largest in Australia.

The H-800-III system combines a large Honeywell 800 computer in an on-line link with a smaller Honeywell 200 computer. When installed in June, the system will process New South Wales' school certificate program and handle all rental accounting for the N.S.W. Housing Commission.

In addition, the system will permit the state government to centralize its entire accounting operation at its new automatic data processing center in Australia Square, Sydney.

SATURN V TEST SYSTEM USES PDP-5 COMPUTERS

NASA's Marshall Space Flight Center at Huntsville, Ala., has installed three general-purpose Programmed Data Processor-5 computers built by Digital Equipment Corporation, Maynard, Mass.

The three computers and peripheral equipment supplied by Digital form part of a ground-based testing complex for use in NASA's Saturn V program. The three PDP-5 computers will function as central control elements in an on-line data acquisition system in the center's Astrionics Laboratory. The system will test inertial components for the Saturn guidance system in a controlled laboratory environment. The data acquisition and processing was formerly performed manually.

Saturn V, a three-stage launching vehicle with a first-stage thrust of 7.5 million pounds, will be the prime booster for the first manned moon landing using the lunar-orbit-rendezvous method. The first flight is scheduled in 1966.

Each of the PDP-5s includes a 4096-word memory and an input/output tape teleprinter. Also included in the order is a 200-card-per-minute reader, Dual DECtape Systems, analog-to-digital converter, logic circuit modules for peripheral equipment interfaces.

KAMAN NUCLEAR INSTALLS CONTROL DATA 3400

Kaman Nuclear, Colorado Springs, Colo., has installed a large-scale Control Data 3400 computer system. Kaman Nuclear is one of the nation's foremost research and development organizations.

The 3400 system will be used to fulfill computational requirements in scientific and operations analysis, research and development, and to conduct commercial data pr processing. Specific applications to be run on the 3400 will be nuclear codes, weapon effects, trajectory studies, war game models, PERT networks, and business data processing.

ORGANIZATION NEWS

BENSON-LEHNER ACQUIRES TELECOMPUTING

The Benson-Lehner Corporation, Van Nuys, Calif., (a subsidiary of the United Gas Corporation of Shreveport, La.) has announced the purchase, for an undisclosed amount, of the entire product line of the Data Instruments Division of the Whittaker Corporation, which has been marketed under the trade name of Telecomputing.

According to Andrew S. Huson, President of the Benson-Lehner Corporation, the acquisition of these products will implement Benson-Lehner's product line in the semi-automatic data reduction field. This is a continuation of the product expansion program which began with an earlier announcement of the company's new line of graphic display systems.

The manufacturing and engineering operations of the Data Instruments Division will move to the Van Nuys facility of Benson-Lehner, coinciding with the completion of Benson-Lehner's plant expansion.

MAGNETIC RECORDING EQUIPMENT OPERATIONS CONSOLIDATED BY 3M

The 3M Company has announced consolidation of all its activities in the magnetic tape recording equipment field into the newly-formed Revere-Mincom division. All facilities and personnel of the former Revere-Wollensak and Mincom divisions are being assigned to the new Revere-Mincom operating unit.

Products of the new division include the Wollensak line of tape recorders, professional mastering equipment for use in the music, broadcasting and motion picture industry and complex Mincom high performance magnetic tape instrumentation recorders used by the military and the aerospace industry. It also makes drop out compensators used in the television industry.

TAPE CERTIFIERS, INC.

A new corporation, Tape Certifiers, Inc. (TCI), Gardena, Calif., now offers as a service to those in the Data Processing Industry, tape cleaning and certification.

TCI has assembled a staff consisting of personnel with many years of experience with the large tape and equipment manufacturers. Two years of research and development were the foundation upon which the TCI program was born. All phases of the program were tested thoroughly, including the advantages that were to be offered the industry using this service. The tape cleaning and certifying equipment was designed and built by TCI.

Restoration of tapes can be made by TCI to a 'like new' condition at a fraction of the cost of new tapes. 97% of all permanent and transient errors are removed (automatic ejection repair is used in permanent error areas).

TCI warrants that the tape certified will conform with the IBM magnetic tape specification or the customers specifications. TCI's program is offered to all in the data processing industry and can be tailored to fit the individual needs of the company using the service.
(For more information, designate #41 on the Readers Service Card.)

C-E-I-R ACQUIRES MARKETING RIGHTS FOR BANK DATA SYSTEM

Marketing rights for a system of computer programs developed for bank demand deposit accounting by BMA Data Processing, Inc., Salt Lake City, have been acquired by C-E-I-R, Inc., Washington, D.C.

The proprietary programs, in use for the past three years by a number of banks in the Intermountain West, will be available through C-E-I-R initially in the Los Angeles area and subsequently throughout the rest of the U.S., except for Utah, Idaho and a section of Colorado, where BMA retains marketing rights.

Robert D. Holland, executive vice president of C-E-I-R, said a bank data processing facility is now being set up at the company's research and computing center in Beverly Hills, Calif., and the service gradually will be extended through other C-E-I-R centers.

GULTON INDUSTRIES GRANTS LICENSE TO RCA TO PRODUCE COMPUTER MEMORY MODULES

Gulton Industries, Metuchen, N.J., announced the granting of a license to Radio Corporation of America under a Gulton patent relating to a new type of random access memory module for computers.

Dr. Leslie K. Gulton, president of Gulton Industries, said the new modules make possible major re-

ductions in the size and cost of the memory, permitting storage of vastly greater amounts of information in smaller space.

The Gulton patent, which expires in 1979, applies to the use of modules made of continuous thin sheets of laminated ferrite with conductor wires printed on both sides. Gulton Industires developed the memory modules in connection with its research in ceramics.

Payment to Gulton Industries is provided for on a royalty basis under the license, which is not exclusive to Radio Corporation of America.

SCIENTIFIC DATA SYSTEMS ACQUIRES CONSOLIDATED SYSTEMS CORPORATION

Scientific Data Systems, Los Angeles, Calif., has acquired Consolidated Systems Corporation, according to an announcement by SDS President Max Palevsky. Consolidated Systems was jointly owned by Allis-Chalmers Manufacturing Co. and Bell & Howell Company's subsidiary Consolidated Electrodynamics Corporation. Terms of the acquisition agreement were not disclosed.

Consolidated Systems will be operated as a wholly owned subsidiary of SDS. The company is manufacturer of electronic data systems for government, scientific and industrial organizations. During the past year, computers manufactured by Scientific Data Systems have been used extensively in digital data systems engineered by Consolidated Systems.

Consolidated Systems has offices throughout the country with principal executive and manufacturing facilities in Pomona, Calif. Scientific Data Systems has 21 offices throughout the country. Principal executive and manufacturing facilities are in Los Angeles, Calif.

COMPUTING CENTERS

COMPUTER CO-OPERATIVE FORMED BY IIT RESEARCH INSTITUTE

IIT Research Institute, Chicago, Ill., is organizaing a computer co-operative for Chicago area structural engineers. Computer technology is being utilized by the structural engineer because of the increasing complexity of the structural systems resulting from his search for optimum design.

The primary objective of the cooperative is to provide engineers with the means of sharing the cost of developing or expanding their computer capability. Such cost includes both the hardware (IITRI's IBM 7094 digital computer will be used) and the development of computer programs.

Engineers at IITRI will collect a library of structural engineering programs and make these available to the members. A member wishing to use a particular computer program will prepare the input data and submit it to the institute for processing. IITRI staff members will be available for consultation on the program. Formal courses will be offered to cooperative members and instruction on the use of programs added to the library will be given at regular intervals.

FOUR KANSAS BANKS FORM BANK-SPONSORED DATA PROCESSING CENTER

Four central Kansas banks have joined in a business venture new to the State of Kansas — a bank-sponsored data processing center. Data Center Inc. is a separate corporation formed by Hutchinson National, First National of Hutchinson, Security State Bank of Great Bend, and Peoples State Bank of Ellinwood.

An IBM 1440 was installed in company offices in late October. Demand deposit (checking) accounting was the computer's first task.

A. J. Collins, president of Hutchinson National and head of the Data Center board of directors, said the entire spectrum of banking applications for the four sponsoring banks will be phased in over the next 12 months. This includes preparation of payrolls, processing of savings accounts and installment loans, analysis of trust accounts, and preparation of management and sales analysis reports.

In explaining the Center's operation, Mr. Collins said that at the close of each business day, transactions of all four banks are delivered to the Center by messenger. During the evening, all master files are updated by the computer and detailed reports are returned to the banks in the morning. An average of two hours is required to process one day's checking activity for each bank.

While it is expected that several correspondent banks will utilize the Data Center, the services offered by member banks will not be limited to financial institutions. The member banks expect to offer the full range of computer service to business and industry throughout the surrounding area. Mr. Collins said that any company with a data processing problem is a potential client of the member banks.

EDUCATION NEWS

ENTELEK ESTABLISHES INFORMATION EXCHANGE CENTER

A center for the exchange of information about computer-assisted instruction has been established by ENTELEK Incorporated under a contract with the Office of Naval Research. ENTELEK is now compiling brief descriptions of lesson programs, including information on teaching logics and system characteristics. To register a CAI program with the project, write to ENTELEK Incorporated, 42 Pleasant Street, Newburyport, Mass. 01950

HIGH SCHOOL MATH TEACHERS TO ATTEND SUMMER INSTITUTE IN COMPUTER MATHEMATICS

Forty high school mathematics teachers from all over the United States will attend a National Science Foundation Summer institute in Computer Mathematics at State University College at Oswego this summer. The NSF Institute in Computer Mathematics is one of five

federally sponsored summer institutes or workshops to take place at the College at Oswego this summer.

A $40,560 NSF grant will provide the institute, and those selected to attend will receive full tuition, residence benefits and travel expense for the June 28-August 6 summer instruction period. The institute director is Dr. Robert Sloan, professor of mathematics at the College at Oswego and acting director of the college's Computer Center.

The institute program is designed primarily for secondary mathematics teachers who will teach beginning programming or computer-oriented mathematics courses. Each participant will take two courses during the six-week instruction period, "Introduction to Computer Programming", and either "Numerical Analysis" or "Statistics."

Great interest on the part of mathematics teachers around the nation has been evidenced in the Oswego Institute. So far, more than 550 applications have been received for the 40 institute grants available this summer. Applications were closed on Feb. 15.

IIT RESEARCH INSTITUTE OFFERS NEW SERIES OF SYMBOLIC CONTROL SEMINARS

A new series of symbolic control seminars is being offered this year at IIT Research Institute, Chicago, Ill., according to an announcement by Dr. Shizuo Hori, project manager of the APT Long Range Program. The seminars will be held periodically throughout 1965, he said, and are offered to assist companies and agencies in their evaluation, utilization and implementation of techniques for controlling automatic machines by symbolic statements in a command language. They are:

1. Introduction to Symbolic Control, providing background necessary for an understanding of N/C (numerical control) machines, computer programming, and APT (Automatically Programmed Tools), a symbolic control technique. It also covers some of the problems of N/C management as well as discussion of research developments affecting future N/C applications. The seminar dates — Feb. 18, May 13 and Oct. 19.

2. N/C Management, which will cover N/C organization, the use of computers as an aid to part programming, personnel selection and training, evaluation of N/C operations, effect of symbolic control on design and engineering practices, and a case history. Dates are June 11 and Nov. 2.

3. APT Part Programming: Basic instruction during a five-day course in the fundamental concepts and techniques of APT part programming. Definition of work-piece geometry, and motion statement for point-to-point and two and three dimensional programs will be explained. Although the course assumes some knowledge of machining practices and shop mathematics, previous computer programming experience is not required. Courses will be March 15-19, Aug. 30-Sept. 3, and Nov. 15-19.
(For more information, designate 42 on the Readers Service Card.)

NEW PRODUCTS

Digital

IBM 1130 COMPUTING SYSTEM

The first IBM computer to rent for less than $1000 a month has been announced by IBM Corporation, White Plains, N.Y. Its internal computing ability, however, is greater than systems costing several times as much.

The desk-sized 1130 is designed for individual use by engineers, scientists and mathematicians. With its range of peripheral devices, the 1130 also will be used in such fields as publishing, construction, finance, manufacturing and distribution.

An advanced storage technique is available with the 1130 computer. Data and instructions for computer processing are recorded on a magnetic disk similar in appearance to a phonograph record. Disks are protected by a plastic cartridge. Each IBM 2315 disk cartridge can hold the equivalent of more than one million characters of information.

IBM will provide, without charge, more than 50 application programs for use in such fields as civil engineering, publishing, mathematical and statistical problem-solving and petroleum exploration and engineering. Programs written in FORTRAN for the 1130 can be run on the IBM System/360 if there is the same type of peripheral equipment available in the System/360 configuration.

The application programs simplify use of the computer for individual engineers, business firms and consultants. The individual need only indicate which pre-written program he needs, supply data, and he will receive an answer within a few moments. He can communicate with the computer through its keyboard.

Information generated by the 1130 can be represented graphically with an IBM 1627 plotter linked to the computer (shown above in right foreground). The plotter can prepare charts, graphs and diagrams from tabular results calculated by the computer. A set of programs available with the computer enable it to smooth out point-to-point data and thus represent curves precisely.

To accomplish a variety of applications ranging from research to route accounting, the 1130 can be used with paper tape punch and reader, card read punch and a low-cost printer as peripheral equipment.

Main memory of the 1130 computing system is a magnetic core storage with capacity of 4096 or 8192 16-bit words. Memory cycle time is 3.6 microseconds.

A basic IBM 1130 computing system will rent for $695 a month

and includes a memory capacity of 4096 16-bit words, memory cycle time of 3.6 microseconds, and a paper tape reader and punch.

Deliveries of the 1130 are scheduled to begin in the fourth quarter of 1965. The 1130 computing system will be manufactured at IBM facilities in San Jose, Calif. It also will be manufactured by the IBM World Trade Corporation in Greenock, Scotland, for customers outside the United States. (For more information, designate #44 on the Readers Service Card.)

GE EXPANDS ABILITIES OF COMPATIBLES/400 FAMILY

General Electric Company, Phoenix, Ariz., has announced major expansions in the performance abilities of its Compatibles/400 family of medium-scale computers.

Chief among these is direct access, which is provided by new equipment that enlarges the capacity of the computers to store and communicate information.

The Compatibles/400 computer family also was given the capability to perform scientific computations at speeds up to 10 times faster than equipment in the same price class.

Finally, the memory speed of the GE-415 was boosted by more than 40 per cent. Memory speed has been cut from 2.3 microseconds per character to 1.45 microseconds.

Seven new devices introduced for the Compatibles/400 computer family include:

1. a large capacity disc storage subsystem (DS-25) storing up to 800 million characters; 64 simultaneous record "seek" operations are combined with four concurrent data transfer operations in each subsystem;

2. a smaller storage unit (DS-15) which holds a removable high-density disc cartridge — each removable disc holds almost 8 million characters and each subsystem can seek up to 8 different records simultaneously;

3. a magnetic drum (MD-30) which has a transfer rate of 370,000 characters per second with an average access time of 8.5 milliseconds; it stores up to 12 million characters;

4. a high-speed, single-line controller (DATANET-21) for handling data between several computers over communications lines at 40,800 bits per second;

5. a multi-line controller (DATANET-70) which can handle simultaneously the access of up to 248 remote stations into the central computer via Teletype, Voicegrade and TELEPACA communications facilities;

6. a magnetic strip mass storage unit (MS-40): each unit can hold more than 532 million characters, and eight of the units may be used together as a subsystem, providing random access to more than 4 million characters;

7. a floating point arithmetic unit is available for performing scientific and engineering computations at speeds up to 10 times faster than other equipment in the medium price class. A GE-415 equipped with this device, for example, can add binary numbers greater than 11 decimal digits in an average time of 17 microseconds and multiply in a little more than 21 microseconds. Division can be performed in 31 microseconds.
(For more information, designate #45 on the Readers Service Card.)

BURROUGHS INTRODUCES B300

Burroughs Corporation, Detroit, Mich., has expanded its commercial data processing lines with the introduction of a new computer, the B300. Corporation president Ray R. Eppert said the B300's electronic units, or modules, can be grouped into systems "literally custom-tailored to fit each customer's specific needs". "Because of its modularity," Mr. Eppert said, "a B300 can start out as a tabulating card computer, then be built up easily into a magnetic tape system, or be expanded into a disk file and data communications system, or to a MICR bank data or transit system. There's almost no limit to configuration options".

The B300 is available with a full range of peripheral units including new 1040 line-per-minute printers and 1400 card-per-minute punched card readers. These are fully buffered and can be used singly or in pairs. For bank operations the company has announced a 1600 line-per-minute lister with eighteen tapes, and a MICR sorter-reader which distributes 1565 checks a minute into sixteen categories on a single pass. A new three-speed magnetic tape drive offers not only higher speed, but permits an interchange of tapes between the B300 and most other data processing systems in current use.

— Burroughs "On-Line" Bank Computer System includes (1) the central terminal unit (2) the central processor (3) the disc file memory (4) magnetic tape units (5) high speed printer (6) punched card reader (7) a special typewriter by which the operator (8) and computer talk to each other.

The B300 includes a more powerful central processor with a memory size up to four times that of the basic Burroughs B200. B200 computer programs will operate on the B300 with greater efficiency and without modification.
(For more information, designate #43 on the Readers Service Card.)

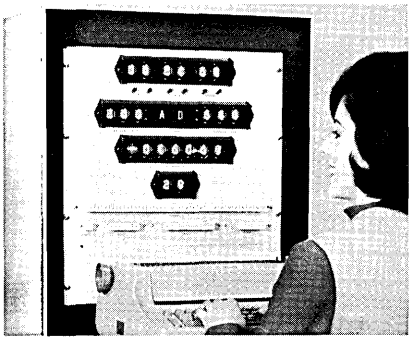
ITI 4900 REAL-TIME COMPUTER

A new digital computer, ITI 4900 Real-Time Computer, has been developed by Information Technology, Inc., Sunnyvale, Calif. The computer, designed from the users point of view, is aimed at the market of real-time system control and engineering computations.

One approach is the integrated software-hardware system. The basic machine language of the computer is based on symbolic coding. A repertoire of over 30 commands is built into the machine hardware, requiring no programming translator. This approach gives the user the command of the flexibility and capability of a stored program computer without the burden as found in programming conventional computers.

The ITI 4900 has a word length of six decimal digits or four al-

phanumeric characters. Three models are available, differing only in memory types. Both delay line and core memories are offered. Memory size is expandable with a minimum size of 100 words.



— ITI 4900 Real-Time Computer

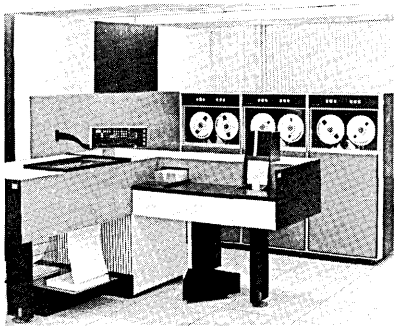
The basic computer measures only 18" x 21" x 9". A control console with full alphanumeric display is included in the basic computer. A minimum computer configuration uses Selectric keyboard printer for man-machine communication. A variety of peripheral devices such as tape units, card machines and high-speed printers can be integrated into the system. (For more information, designate #46 on the Readers Service Card.)

SERIES 200 ANNOUNCED BY HONEYWELL

Honeywell Inc., Wellesley Hills, Mass., has announced its Series 200, a broad range of equipment combining the latest technical advances with a new "applications" approach to computer hardware. The modular equipment, which includes Honeywell's successful H-200 computer, consists of five basic processing units and a large number of terminal devices that can be put together, building block fashion, to form virtually any size or type of data processing system.

Walter W. Finke, president of the firm's electronic data processing division, described the system as "applications-oriented" to meet the EDP requirements of business, government, scientific or specialized computer uses such as communications, time-sharing and computer networks.

The smallest Series 200 processor is model 120, a high-speed, low-cost unit primarily designed for small-to-moderate business data processing jobs. A main memory of 2048 characters is expandable to a maximum capacity of 32,768 characters. Cycle time is 3 microseconds per character. The processor has a minimum of three (and up to eight) input-output trunks, two or three read-write channels to permit multiple simultaneous peripheral operations, and six index registers. All reading, punching and printing controls are contained within the 120 processor. Model 120 is totally data and program compatible with every other member of Series 200.



— Typical configuration of the Model 120 includes 4096 six-bit characters of main memory, card reader/punch, printer and three magnetic tape units. Pivoting control panel swings around to face any part of the computer work area to facilitate operation.

Model 200, first introduced some 15 months ago as the Honeywell 200 computer system, has been the bellweather for the Series 200 line. A minimum model 200 processor has a main memory of 4096 characters expandable to a maximum capacity of 65,536 characters. Cycle time is 2 microseconds; a high-speed control memory has a 500-nanosecond cycle time. Model 200's full range of conversion and programming aids forms the basis of all series 200 software.

Covering the middle-range of Honeywell's new series is the model 1200; a medium-scale processor for mixed business and scientific applications. Model 1200 is completely program and data compatible with all other processors in the Series 200 product line. The Liberator technique also makes possible complete, automatic, one-time conversion into Series 200 language of programs originally written for the 1401, 1401-G, 1440, 1460, 1410 and 7010. Main memory cycle time is 1.5 microseconds. Storage capacity ranges from 8192 to 131,072 six-bit characters. Sixteen standard input/output trunks accommodate control units for as many as 64 peripheral devices. Four read/write channels make possible up to four simultaneous peripheral operations at the same time as processing.

The model 2200, first introduced last June, is the next-to-largest processor in the new Series 200 product line. Having a cycle time of 1.0 microseconds to a main memory capacity ranging from 16,384 to 262,144 six-bit characters, it brackets capabilities of both the medium-scale 1200 processor and the large-scale 4200 processor.

The largest processor in Honeywell's new series, the 4200, combines large-scale business data processing capabilities with powerful scientific operations that make it equally applicable to the broad-ranging problems of business, industry, science, government and education. A basic main memory capacity of 32,768 six-bit characters can be expanded to as many as 524,288 characters. Main memory cycle time is 750 nanoseconds per four characters; equivalent to 188 nanoseconds per single character. Either 32 or 64 input/output trunks are available with the 4200; 8 or 16 read/write channels make possible the simultaneous operation of 8 or 16 peripheral devices at the same time as processing. All programs written for the smaller processors in the Series 200 can be run on the 4200. This internal program and data compatibility is extended to competitive systems through Honeywell's Liberator technique.

Low-cost peripheral equipment, first developed in conjunction with the H-200, has been extended for Series 200. More than 45 specialized devices — including 13 models of magnetic tape devices, five high-speed printers, three types of operator consoles, mass memory drums, and 25 single-, multiple- and special-purpose communications devices — have been developed to complement the processors.

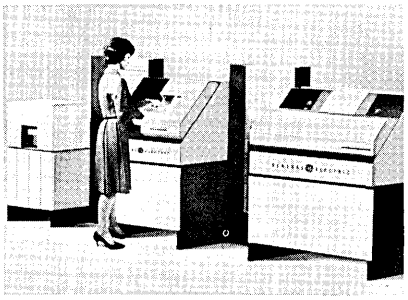
Series 200 is designed to compete with equal effectiveness in both the new-user and replacement computer markets. Its performance features and low cost make the system attractive to new users. At the same time, it is completely compatible with many installed computers — a valuable asset in the replacement market.
(For more information, designate #48 on the Readers Service Card.)

Newsletter

NEW GE-115 DEVELOPED BY OLIVETTI IN ITALY

General Electric Company has announced its entry into the small computer market with the introduction of the GE-115. The company, in doing so, has combined the engineering and marketing skills of its recently acquired European computer allies — Compagnie Bull-General Electric of France and Olivetti-General Electric of Italy — with those of its U.S.-based Computer Department in Phoenix, Ariz. The computer itself was developed by the Olivetti organization in Italy.

The GE-115 general purpose computer is designed for small data processing applications — as a remote terminal linked by communications lines to larger central computers, or a punch card processor replacing traditional punch card equipment.



— Italian design of new GE-115 computer. A typical system shows the small-scale computer (left to right) with a card punch, the central processor, a card reader, a power supply and a card printer.

The main memory is a magnetic core, random access device. Memory time of the GE-115 is 8 microseconds. Memory modules are available with 4096 or 8192 characters (of 8 bits each).

First quantities will be manufactured in Milan for shipment beginning in December of this year. Plans call for production at computer manufacturing sites in the United States and France as demand rises. Marketing of the new computer will be carried out through the existing channels of Bull-General Electric and Olivetti-General Electric. Also sharing in the marketing responsibilities will be GE's Computer Department, Phoenix, Ariz.; Canadian General Electric; Australian General Electric, and General Electric of Japan.

In addition, peripheral equipment for the GE-115 will wear international colors, according to Dr. Louis T. Rader, vice president and general manager of GE's Industrial Electronics Division. Key equipment to support the computer was developed in the three nations and will be manufactured in them. (For more information, designate #47 on the Readers Service Card.)

Software

A DEBUG-ORIENTED ASSEMBLER FOR THE 1401

An SPS assembly program for the IBM 1401, specifically designed to meet the programmer's need for efficient coding and debugging, has just been made available by Edu-Programs, Pacific Palisades, Calif.

At the grammatical level, the assembler detects and lists invalid operation codes and repeated labels, as well as correcting minor keypunching errors, as the source program cards are encountered. As soon as the program END card is read, undefined labels are listed. Thus, the major types of grammatical errors are known by the programmer-operator even before assembly is complete.

At the logical level, the assembler facilitates debugging by loading the object program into core (less than 10 seconds after the single assembly tape required is rewound!), and immediately commences execution on test data. Program listing and condensed deck punching options may be exercised concurrent with loading.

Speed is another feature of this assembler. A 4K program can be assembled in about three minutes, 3 to 4 times as fast as by a well-known 4-tape assembler.

Coding for this assembler is simplified by the following features: (1) almost all instructions which require a d-character can be coded by the use of special mnemonics generally consistent with those used in Autocoder; (2) the determination of word-lengths for constants not having a terminal blank may be delegated to the assembler; and (3) free-form coding may be used for numeric addresses.

The present version of the assembler requires a 4K 1401 with only one tape drive, advanced programming and column binary. If a second tape drive is available, the assembler may be used as a self-loading program tape. (For more information, designate #49 on the Readers Service Card.)

Data Transmitters and A/D Converters

MODEL 2020 CARD TRANSMITTER

Digi-Data Corp., Bladensburg, Va., has announced the availability of its Model 2020 Card Transmitter. Use of this equipment in conjunction with the 202C Data Phone permits transmission of punched card information over telephone lines at a rate of 85 cards per minute.

Primary advantages of this system are reported to be: the modest cost; small space requirements; and positive control of transmission errors. In particular, the modest cost of the equipment permits remote installations which previously were considered unfeasible. (For more information, designate #51 on the Readers Service Card.)

ESS GEE A/D CONVERTERS

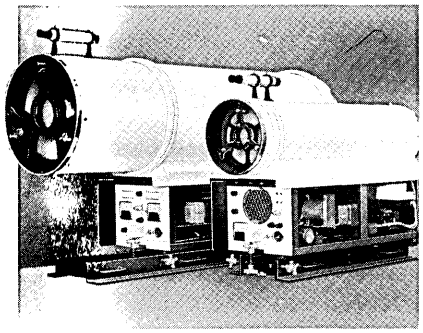
A new line of low cost, high speed analog to digital converters is now available from Ess Gee Inc., White Plains, N.Y. These new devices operate at up to 100Kc, and with accuracies up to 0.01% ± ½ bit. Maximum common mode noise rejection is provided through differential input amplification. Front panel digital display is provided utilizing incandescent lamps. Input signals from ± 1 volt to ± 10 volts may be selected for full scale range. Conversions are true bipolar operations and the digital outputs have nominal levels of "0" = 0 V and "1" = + 10 V.

Specifications of these new devices include: an input impedance of 3 Megohms with common mode rejection of better than 120 db at 60 cps; up to 12 bits and sign or 4 BCD digits plus sign output capability; sampling rates to 100 Kc, and operating temperature range from 0°C to +50°C. Total package weight is only 25 lbs. (For more information, designate #50 on the Readers Service Card.)

OPTICAL DATA TRANSMISSION SYSTEM

NASA's Marshall Space Flight Center Computation Laboratory at Huntsville, Ala., has completed acceptance tests on a 2-mile optical data transmission system built by General Electric's Radio Guidance Operation in Syracuse, N.Y. The Computation Laboratory will use the system to study the feasibility of digital data transmission via light beam and to determine terminal equipment requirements.

According to General Electric engineers, modulated light-beam communication has some unique advantages over more conventional techniques. Among these are inherently secure transmission of information, elimination of RF interference, low power requirements, and the availability of bandwidths into the gigacycle (thousand million cycles) range.



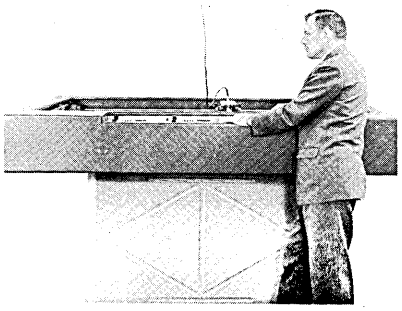
The picture above is a rear view of the 2-mile, 12 megacycle bandwidth, light-beam data link equipment delivered to NASA by GE. The electro-optical transmitter (right, with side panel removed) utilizes a gallium-arsenide light-emitting diode, thermoelectrically cooled to -40^{0} C, as the modulated infrared light source. A mirror system forms the light into a circular beam and directs it to the receiver (left) where another mirror system collects the energy for the photo pick-up device. Hand-knobs on each base and telescopes atop each unit aid in system alignment. The transmitter is 37.5 inches long and weights 106 pounds; the receiver is 52 inches long, weighs 125 pounds.

The NASA equipment is of modular construction to permit modification of performance and to take advantage of changes in the state-of-the-art.

Input-Output

B-L DEVELOPS NEW LARGE TABLE ELECTROPLOTTER (LTE)

Benson-Lehner Corporation, Van Nuys, Calif., has developed a new solid-state Large Table Electroplotter (LTE). The LTE System affords a complete contouring package for large-scale computer applications for exact delineations in minute detail of surface contours, weather maps, and topographical features. It produces report-quality graphs and maps rapidly and accurately from digital computer generated output tapes. From either program or



— Benson-Lehner's president, Andrew S. Huson, shown next to the Large Table Electroplotter(LTE).

operator control, it plots points, symbols, or alphanumeric characters, and draws straight or contour graphs from digital input data.
(For more information, designate #52 on the Readers Service Card.)

C-DEK

A flexible, solid state data gathering device named the C-DEK (Computer Data Entry Keyboard) is being manufactured by Colorado Instruments, Inc., Broomfield, Colo., and marketed by Systamethods Corp., Denver, Colo.

C-DEK output can be punched card, paper tape (any channel), magnetic tape, or on-line to a computer. The device can perform arithmetical functions and storage. It can deliver printed output while recording in computer language and can simultaneously produce multiple computer output languages such as cards and tape.

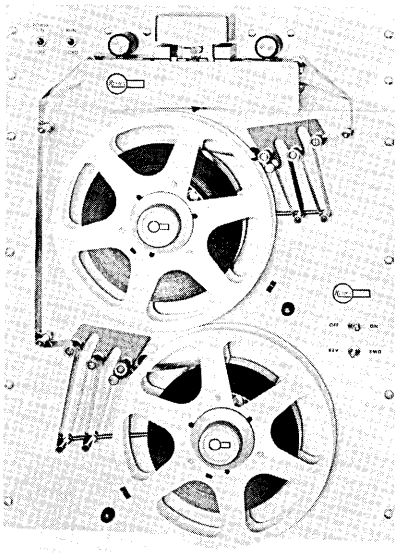
C-DEK is available with a card and/or badge reader, timeclock, typewriter, comptometer or can be linked with almost any electronic device, such as weighing scales.

Several applications can be performed on a single C-DEK by simply removing a program card and inserting another. Alpha as well as numeric information may be entered.

C-DEK is presently being used by government, and educational institutions to record scientific data and also is being used in computer programming.
(For more information, designate #57 on the Readers Service Card.)

IMPROVED MODEL READER/SPOOLER COMBINATION

A new REMEX Reader/Spooler, Model RRS-302, was introduced at the I.E.E.E. Show last month, by REMEX/Rheem Electronics of Hawthorne, Calif. The REMEX Model RRS-302 Photocell Punched Tape Reader/Spooler combination includes a medium high speed reader with a spooler on one space-saving panel, 7 inches high by 19 inches wide.



The spooler portion has on-off servo control of the pay out and rewind reel, and push-button or remote control rewind at a speed of 40 inches/second. The reader has self-adjusting brakes, hardened steel tape guides, photovoltaic sensing cells, and reading speeds up to 300 characters/second.
(For more information, designate #53 on the Readers Service Card.)

Newsletter

DREXAMATIC MODEL 2545 PUNCHED CARD READER

A high reliability punched card reader has been developed specifically for critical check-out operations on the Apollo guidance equipment by Drexel Dynamics Corp., Horsham, Pa. This instrument, designated the Drexamatic Model 2545 punched card reader, provides a maximum of 600 switch contacts for use with IBM type cards. In addition to its use for preflight missile and space vehicle check-out operations, this device has wide application in industrial and military automated quality assurance programs for high reliability components.

A static memory device, the reader uses standard IBM cards to program any sequence of operations in the automated testing of electrical components and systems, and in various production type batching processes. The program can be changed by simply inserting an IBM card with a different punched sequence of operations in the reader unit. Cards can be changed in a few seconds, and once the card is set, the memory status is completely independent of both power failure and severe environmental conditions.
(For more information, designate #55 on the Readers Service Card.)

MODEL B3000 PHOTO-ELECTRIC PERFORATED TAPE READER

A significant increase (from 700 up to 1000 characters/second) in the speed of its low-cost, photo-electric perforated tape reader, Model B3000, has been announced by the Digitronics Corp., Albertson, L.I., N.Y.

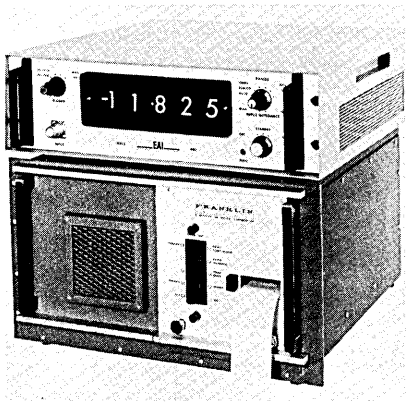
Model B3000 reader is bi-directional. It is all solid-state, has self-adjusting brakes and reads 5, 6, 7 or 8-level tapes. Silicon photo-diodes in the read head service all eight data channels, plus sprocket channel. Positive or negative-going output signals, variable tape guides and dual speed motors are optional.

Compatible spooler, Model 6090, can handle 10½ inch reels at 1000 characters per second. Other models are available for operation at lower speeds.
(For more information, designate #56 on the Readers Service Card.)

SERIES 6610 PRINTER ACCESSORY

Electronic Associates, Inc.'s (Long Branch, N.J.) new Series 6610 Printer Accessory now makes it possible to log data at the rate of 20 lines per second. Used with the Company's Series 6000, 6001 or 6101 Digital Voltmeters, the high speed printer can be provided with from 7 to 12 columns depending on particular user requirements. Seven columns are required for DVM information with the additional columns available for other data, such as scanner address.

The voltmeter/printer combination is designed to operate in any one of four modes: high speed automatic, where the printer controls the operation of the system at 20 lines/second; low trigger automatic, where the DVM controls the operation of the system at 2-3 lines/second; manual (single print) control, where a reading is taken each time the manual trigger button on the DVM is depressed; and external control, where the DVM read command is initiated by an external source such as a scanner.



System connection is accomplished by an inter-connecting cable between the voltmeter and the printer. A single connector on the rear of the printer contains all input/output connections and the interconnecting cable is wired for operation of columns 1 through 7 from the DVM.

The equipment prints 10 characters per inch across the paper and 6 lines of print per inch of vertical spacing. With this voltmeter/printer combination it is possible to read and record up to 20 dc voltages or 20 resistance readings per second.
(For more information, designate #54 on the Readers Service Card.)

Components

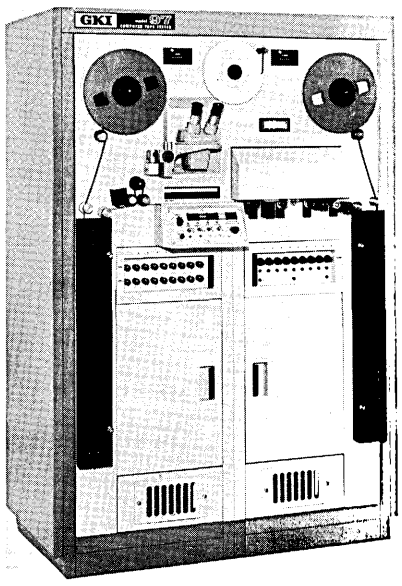
MODEL 97 TESTER

General Kinetics Inc., Arlington, Va., have begun shipments of their new Model 97 tester. This device has the ability to test nine tract tapes for use in next-generation computers such as System/360 and Spectra 70. GKI engineers described this as a necessary corollary to the movement into that generation for both manufacturers and users of tape. Manufacturers will use the Model 97 to certify new tape for sale as error-free. Tape users will use it to re-test tapes after use to insure that the error count is held within the limits that can be tolerated by its applications.

The new tester examines tapes for variations in signal, noise, and tape width which would cause error in normal use on a computer tape drive. Model 97 will stop on error in both directions which allows examination and repair of error regions in the reverse direction as well as the forward, thus eliminating the lost motion of a non-productive rewind pass.

The automatic retest feature of the Model 97 checks a potential error three times before recording it, thus discriminating between transient and genuine errors.

Model 97's circular chart error recorder is at eye level, and the built-in work station with its own illuminator enables the operator to do manual repairs to



tape on the machine. Track indicator lights show immediately on which tract of the tape an error or flaw is located. There also is a built-in microscope which permits the operator to examine the tape surface while it is being tested, and a single wrap capstan that provides damage-free starts, stops, and tape motion.

The Model 97 can be ordered with all of the features mentioned, or can be modified to suit the particular tape-testing needs of individual customers.
(For more information, designate #58 on the Readers Service Card.)

TYPE 226 COMPUTER TAPE

A new computer tape, with full-width pre-testing, has been developed by the Reeves Soundcraft Division of Reeves Industries, Inc., Danbury, Conn. The new Type 226 tape, according to Marketing Manager Robert E. Snare, gives the industry a product which may be used today, and which also will meet the increasing demands of future generations of computers.

He noted that the Reeves tape provides "protection against obsolescence in that customers will be able to use them readily on the forthcoming 9-track tape drives such as IBM's System/360 data processing equipment."

Each track, available on a 1.5 mil duPont Mylar base, is independently certified for 800 bits per inch. The new tape also uses Reeves' Micro-Plate process which combines an oxide formulation with a tough binder system to achieve greater reliability and longer tape and head life, while, at the same time, eliminating shedding and head fouling.
(For more information, designate #59 on the Readers Service Card.)

DURAL-HUB COMPUTER REELS

Memorex Corporation, Santa Clara, Calif., has introduced premium DURAL-HUB reels for computer tape — all-aluminum hub reels permitting aluminum-to-tape contact, greater flange stability and interchangeable color coding.

Memorex reports the more expensive DURAL-HUB(C) reels eliminate cracked hubs and accompanying reel replacement costs, operating interruptions and tape damage.

Precision center aperture of the new reel provides positive non-shimmy, no-wobble performance. Shock-resistant DURAL-HUB reel flanges provide added protection against shipping and handling abuse. Other design features keep pack more uniform, reduce likelihood of tape cinching, semi-permanent ridging, and wavy edges.

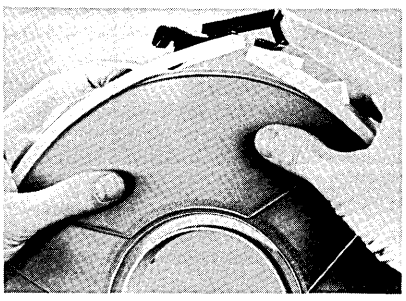
DURAL-HUB reels also have colored facing rings which facilitate tape librarying and storage. Eleven standard colors are available and special colors are available on quantity orders. DURAL-HUB reels are offered in both 8½" and 10½" sizes.
(For more information, designate #60 on the Readers Service Card.)

TAPE-SEAL COMPUTER TAPE STORAGE SYSTEM

The new Wright Line Tape-Seal computer tape storage system doubles capacity of tape storage areas, reduces dust problems significantly, and makes handling of tapes safer and easier. The system is manufactured by Wright Line, a division of Barry Wright Corp., Worcester, Mass.

These advantages are possible because of a polyethylene strip called Tape-Seal. This narrow, flexible strip encircles the tape reel, the edges of which fit into grooves designed into the Tape-Seal, and has an integral hook-latch that permits tapes to be suspended from the top. The grooves in the Tape-Seal hold the reel flanges apart to prevent tapes from being damaged by pinching. Bulky conventional containers and the wire racks required to support them are both eliminated. This means twice as many tapes can be stored in a Tape-Seal system as in the same space in other systems.

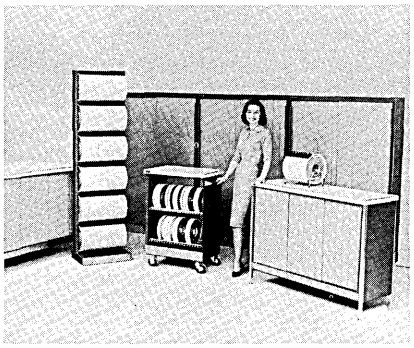
The Tape-Seal completely encloses the computer tape. When used in conjunction with solid-flange reels, there is no dust problem whatsoever. Tape-Seal (see photo below) can be removed



quickly and simply by lifting the locking latch with one finger. And unlike brittle plastic containers which are apt to break when dropped accidentally, the Tape-Seal will merely bounce.

The Tape-Seal system exposes 100 tapes to view when a single cabinet door is opened; all tapes can be immediately identified since labels on Tape-Seals are always in the same position. A spring-loaded stabilizing panel makes it easy to remove reels.

The complete Tape-Seal system includes: five-high storage cabinets, library storage units, trucks for transporting tapes from library to readers, Compustoralls



for in-department storage, small desk units to hold reels, and tape reel carrying cases for programmers
(For more information, designate #62 on the Readers Service Card.)

NEW COMPUTER REEL FROM DATA PACKAGING

A new reel constructed with hub and winding surface of precision turned aluminum has been announced by Data Packaging Corp., Cambridge, Mass. The new reel accepts any lockout ring.

Color-coding of the reel is accomplished by a plastic "Saturn" ring around the hub. The tape manufacturer's name and other labeling data appears on the ring.

Most benefits of the new reel derive from the rigidity of the aluminum hub and winding surface. Repeated perfect winds are possible because the winding surface is largely incompressible.

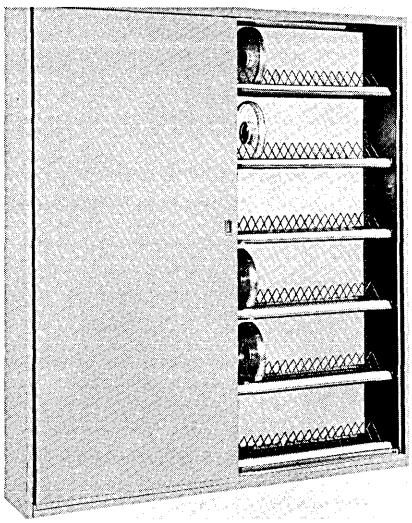
The hub and winding surface of the reel are of circular "I" beam construction, machined together for concentricity. The front and back faces of the hub are then machined parallel to assure squareness to the mounting

surface, and to provide positive parallel reference for the flanges. The flanges are coupled to the hub by elastic cement permitting differences in thermal expansion between the hub and the flange without distrubing flange parallelism. (For more information, designate #63 on the Readers Service Card.)

TAPE REEL STORAGE CABINET

Systems Sales Co., Binghamton, N.Y., has announced the availability of its Model #1902, duplex sliding door reel storage cabinet, for storage of all types of computer tape reels.

Model #1902 was designed to provide maximum storage in minimum floor space. One lock secures 252 reels. Opening a single door exposes 126 reels, with no blind spots behind doors.



The cabinet is equipped with overhead type airplane hangar style doors which operate on ball bearing rollers at the top, with guide channels below, to insure jam-free finger tip door control. The #1902 is furnished in a choice of matching computer manufacturer's colors. (For more information, designate #61 on the Readers Service Card.)

PEOPLE OF NOTE

AIR FORCE AWARD TO EDWARD F. WEITEN

The Air Force recently presented an award for outstanding achievement to a Lockheed Missiles & Space Co. engineer, Edward F. Weiten, whose work has saved the space program an estimated $900,000. Mr. Weiten won the award for his development of "a precise, efficient, and flexible Fortran Program for simulation of space vehicles". The system has produced savings estimated at $600,000 for computer run time reduction and $300,000 for reduced engineering costs, for a total saving of $900,000 since 1960.

The award, established by the Air Force Systems Command, consisting of a plaque and certificate, was presented to Weiten by Col. James T. McKee, Air Force plant representative at Lockheed.

DOBBS NAMED MANAGER SDC COMPUTER CENTER

Guy Dobbs has been named Manager of System Development Corporation's newly-formed corporate Computer Center. He will be responsible for supervising a central computer facility, which, when implemented in the near future, will serve the many diversified computation requirements of SDC's Santa Monica activities. The Computer Center will replace four different computers currently being used.

Mr. Dobbs was previously Assistant Director of SDC's Technology Directorate.

TARMAN ELECTED PRESIDENT & DIRECTOR OF MEISCON

C. William Tarman has been elected president of, and a director of Meiscon Corporation, Chicago-based subsidiary of Control Data Corporation. Tarman, formerly vice-president and general manager of the firm, succeeds James D. Harris. Harris will remain on the board of directors. Tarman was one of the original executives of Meiscon when the company was organized in January, 1963.

IBM ANNOUNCES EMPLOYEE AWARDS

A record $1,596,393 was awarded to employees of IBM Corporation last year for suggestions that cut costs or improved products and procedures. This is the largest amount awarded in the 36-year history of IBM's suggestion plan and the third year in succession in which employees received in excess of one million dollars for their ideas.

The highest award last year was received by William D. Reese Jr. and George P. Fletcher, field engineers in Arlington, Va. They shared $19,000 for improving the wiring and operating efficiency of magnetic tape drives for IBM computers.

The second highest award, $15,260, went to Peter L. Bowles and Donald L. Groover on the engineering staff of IBM's Space Guidance Center in Owego, N.Y. Their efforts in redesigning a part in the radar-navigation system used by aircraft of the Strategic Air Command resulted in considerable savings.

Over half of IBM's eligible employees participate in the suggestion plan. Last year, 142,000 suggestions were submitted. Nearly 40 percent of the employees who submitted suggestions received awards. Of these, 151 were awarded $1000 or more. The average award was $65.

NEW LITERATURE

LABORATORY AND EDUCATIONAL MODULES

A 120-page catalog describes Digital Equipment Corporation's fully coordinated set of transistorized digital computer circuits in three speed lines (500 KC, 5 MC, and 10 MC), especially packaged for educational and industrial training as well as practical digital systems test and design work.

The catalog contains logic diagrams and detailed specifications for over 45 modules and accessories. Also included is a 64-page insert, the Laboratory Module Handbook, which may be used as a basic primer or text on digital logic and applications.

The catalog is available at no charge.
(For more information, designate #66 on the Readers Service Card.)

"HANDS-ON" TRAINING PROGRAM

Advanced educators are using a "hands-on" training program as the most practical way of instructing students to use electronic computers and data-communications devices. A new brochure is available (from General Electric) describing how the U. S. Military Academy at West Point, N.Y., is organized to do this, using three GE-225 computers and a DATANET-30 data communications processor. Cadets formulate their own problems and program their efforts. Remote terminals located in various departments provide immediate access to centrally-located computers.
(For more information, designate #67 on the Readers Service Card.)

DATA PROCESSING, VOLUME VII

The proceedings of the 1964 International Data Processing Conference, held in New Orleans last June, are now available in a 353-page, hard-bound edition. Sponsored by the Data Processing Management Association, the Conference consisted of twenty-nine seminars ranging from an Executive Forum of general interest to high specialized technical seminars in virtually every major area of data processing.

Among the many current and important topics discussed in this book by nationally recognized experts, are Hardware Concepts of a Bio-Medical Computing System; Time and Work Reporting by Data Communications; Management Information Retrieval and Dissemination; Simulation Techniques, Uses and Validity; Controls and the Audit Trail; COBOL: Its Acceptance, Use and Future; Computer Selection and Acquisition; and Selection, Training and Evaluation of Personnel.

Copies of DATA PROCESSING, Volume VII, are available from Data Processing Management Association at $5.75 per copy.
(For more information, designate #65 on the Readers Service Card.)

USE OF INFORMATION TECHNOLOGY IN BANKING

A six-page brochure describing the use of information technology in banking has been published by AUERBACH Corporation and is now available. The new brochure describes the kinds of systems-design and consulting services that are available to help banks handle information more efficiently and derive more value from it. Separate sections of the brochure are devoted to banks about to develop automated systems and to those that already have an automated system.
(For more information, designate #64 on the Readers Service Card.)

BUSINESS NEWS

NCR '64 SALES SET RECORD

NCR worldwide revenue from sales, services and equipment rentals in 1964 set a record for the 10th consecutive year. They totaled $665,773,000 compared with $592,580,000 in 1963, or an increase of 12%.

Reported net income also reached a new high, rising to $22,503,000, a 12% increase over the $20,082,000 recorded in 1963. Of the $22,503,000 total earnings for the year, $12,048,000 represented domestic earnings, compared with $9,251,000 earned in the United States in 1963. The NCR chairman attributed the higher domestic earnings in 1964 to the favorable effect of higher sales volume and lower federal income taxes.

Total after-tax foreign earnings rose from $13,166,000 in 1963 to $14,118,000 last year. Of this latter amount, Mr. Oelman said, $10,455,000 was included in reported net income, representing foreign earnings remitted to the United States plus the earnings of NCR's Canadian subsidiary.

NCR has now installed worldwide approximately 1200 computer systems in retailing and financial institutions, in manufacturing companies, in government, and in the Armed Services, the company reports. Many of these utilize cash registers, accounting machines and adding machines as input devices.

During 1964 the company also carried out a major expansion of its network of data processing centers. In the United States, NCR now offers data processing services in 23 cities, an increase of 10 over a year ago. Another 17 NCR data processing centers are operated abroad. Through these centers, Mr. Oelman said, business firms without computer equipment can obtain complete data processing services by sending to the centers punched paper tapes, punched cards, or "optical" tapes created by basic business machines as a by-product of their regular operation.

AMPEX SALES CLIMB 8% IN 3RD QTR.

Record sales and net earnings after taxes for any third quarter and nine months were achieved by Ampex Corporation in the periods ended January 30, announced William E. Roberts, president and chief executive officer. Sales for the third quarter of fiscal 1965 totaled $38,356,000, up 8 per cent from $35,634,000 in the comparable period last year. Net earnings were $2,008,000, or 22 cents per share, up 10 per cent from the $1,832,000, or 20 cents per share, in the third quarter of fiscal 1964.

For the first nine months of fiscal 1965, sales totaled $107,338,000, up 6 per cent from $101,625,000 in the comparable period last year. Net earnings were $5,234,000, or 57 cents per share, on 9,250,418 average shares outstanding, up 7 per cent from $4,884,000, or 53 cents per share on 9,214,031 shares.

CALCOMP EARNINGS UP 11%

California Computer Products, Inc., Anaheim-based producer of digital plotting equipment, reports net earnings of $226,725 for the fiscal six months ended December 27, 1964. This compares with a profit of $184,330 on an adjusted basis, for the corresponding period last year.

Lester L. Kilpatrick, president, said that net earnings, as a percentage of sales, increased to 11.3% this year, while proprietary product sales rose from 49% of total sales for the first six months of fiscal 1964 to 74% of total sales for the same period this year. Revenue was $2,006,923, compared with $2,556,782.

Expenditures for developing new proprietary products in the digital plotting field were increased from $104,534 for the first six months of fiscal 1964 to $314,961 for the like period in fiscal 1965. Development efforts resulted in the introduction of three new products in recent months.

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.

In general, manufacturers in the computer field do not officially release installation and on order figures. The figures in this census are developed through a continuing market survey conducted by associates of our magazine. This market research program develops a documented data file which now covers over 80% of the computer installations in the United States. A similar program is conducted for overseas installations.

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

AS OF MARCH 10, 1965

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	22	0
	ASI 2100	Y	$3000	12/63	6	0
	ASI 6020	Y	$2200	4/65	0	4
	ASI 6040	Y	$2800	7/65	0	3
Autonetics	RECOMP II	Y	$2495	11/59	58	X
	RECOMP III	Y	$1495	6/61	15	X
Bunker-Ramo Corp.	BR-230	Y	$2680	8/63	7	2
	BR-300	Y	$3000	3/59	40	X
	BR-330	Y	$4000	12/60	35	X
	BR-340	Y	$7000	12/63	25	10
	BR-530	Y	$6000	8/61	15	X
Burroughs	205	N	$4600	1/54	60	X
	220	N	$14,000	10/58	39	X
	E101-103	N	$875	1/56	100	X
	B100	Y	$2800	8/64	26	28
	B250	Y	$4200	11/61	96	5
	B260	Y	$3750	11/62	130	110
	B270	Y	$7000	7/62	125	20
	B280	Y	$6500	7/62	62	28
	B370	Y	$8400	7/65	0	25
	B5000/B5500	Y	$20,000	3/63	35	3
Clary	DE-60/DE-60M	Y	$525	2/60	303	3
Computer Control Co.	DDP-19	Y	$2800	6/61	3	X
	DDP-24	Y	$2500	5/63	53	11
	DDP-116	Y	$900	3/65	0	24
	DDP-224	Y	$3300	3/65	1	13
Control Data Corporation	G-15	N	$1000	7/55	325	X
	G-20	Y	$15,500	4/61	28	X
	160*/160A/160G	Y	$1750/$3400/$12,000	5/60;7/61;3/64	418	7
	924/924A	Y	$11,000	8/61	28	1
	1604/1604A	Y	$38,000	1/60	60	X
	3100	Y	$7350	12/64	5	20
	3200	Y	$12,000	5/64	35	30
	3300	Y	$15,000	7/65	0	32
	3400	Y	$25,000	11/64	4	16
	3600	Y	$58,000	6/63	36	15
	3800	Y	$60,000	5/65	0	16
	6400	Y	$40,000	12/65	0	1
	6600	Y	$110,000	8/64	2	6
	6800	Y	$140,000	4/67	0	1
Digital Equipment Corp.	PDP-1	Y	$3400	11/60	60	2
	PDP-4	Y	$1700	8/62	54	6
	PDP-5	Y	$900	9/63	100	8
	PDP-6	Y	$10,000	10/64	4	8
	PDP-7	Y	$1300	11/64	6	18
	PDP-8	Y	$525	4/65	0	90
El-tronics, Inc.	ALWAC IIIE	N	$1820	2/54	24	X
Friden	6010	Y	$600	6/63	185	150
General Electric	115	Y	$1700	12/65	0	10
	205	Y	$2900	10/64	13	15
	210	Y	$16,000	7/59	56	X
	215	Y	$5500	11/63	40	6
	225	Y	$7000	1/61	136	4
	235	Y	$10,900	12/63	34	11
	415	Y	$5500	5/64	34	80
	425	Y	$7500	7/64	15	45
	435	Y	$12,000	10/64	6	22
	455	Y	$18,000	6/65	0	2
	465	Y	$24,000	6/65	0	1
	625	Y	$50,000	12/64	1	15
	635	Y	$65,000	12/64	1	18
General Precision	LGP-21	Y	$725	12/62	143	X
	LGP-30	semi	$1300	9/56	430	X
	RPC-4000	Y	$1875	1/61	98	X
Honeywell Electronic Data Processing	H-120	Y	$2600	12/65	0	80
	H-200	Y	$4500	3/64	290	480
	H-300	Y	$3900	7/65	0	8
	H-400	Y	$8500	12/61	108	5
	H-800	Y	$22,000	12/60	72	14
	H-1200	Y	$6500	2/66	0	15

NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS
Honeywell (cont'd.)	H-1400	Y	$14,000	1/64	9	2
	H-1800	Y	$30,000	1/64	5	8
	H-2200	Y	$11,000	10/65	0	25
	H-4200	Y	$16,800	2/66	0	3
	DATAmatic 1000	N	$40,000	12/57	3	X
H-W Electronics, Inc.	HW-15K	Y	$490	6/63	3	X
IBM	305	N	$3600	12/57	190	X
	360/20	Y	$1800	12/65	0	1500
	360/30	Y	$4800	4/65	0	2200
	360/40	Y	$9600	4/65	0	575
	360/50	Y	$18,000	7/65	0	260
	360/60	Y	$35,000	8/65	0	50
	360/62	Y	$50,000	9/65	0	22
	360/70	Y	$80,000	10/65	0	62
	650-card	N	$4000	11/54	275	X
	650-RAMAC	N	$9000	11/54	50	X
	1130	Y	$900	11/65	0	350
	1401	Y	$4500	9/60	8100	650
	1401-G	Y	$1900	5/64	700	140
	1410	Y	$12,000	11/61	770	105
	1440	Y	$3500	4/63	1450	750
	1460	Y	$9800	10/63	1025	190
	1620 I, II	Y	$2500	9/60	1700	30
	1800	Y	$6500	2/66	0	45
	701	N	$5000	4/53	1	X
	7010	Y	$19,175	10/63	65	25
	702	N	$6900	2/55	8	X
	7030	Y	$160,000	5/61	6	X
	704	N	$32,000	12/55	47	X
	7040	Y	$14,000	6/63	90	48
	7044	Y	$26,000	6/63	41	10
	705	N	$30,000	11/55	64	X
	7070, 2, 4	Y	$24,000	3/60	365	15
	7080	Y	$55,000	8/61	71	2
	709	N	$40,000	8/58	11	X
	7090	Y	$64,000	11/59	80	8
	7094	Y	$70,000	9/62	145	15
	7094 II	Y	$76,000	4/64	45	25
ITT	7300 ADX	Y	$18,000	9/61	9	5
Monroe Calculating Machine Co.	Monrobot IX	N	Sold only - $5800	3/58	155	X
	Monrobot XI	Y	$700	12/60	520	150
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	280	110
	NCR - 390	Y	$1850	5/61	800	90
	NCR -500	Y	$1500	9/65	0	150
Philco	1000	Y	$7010	6/63	15	0
	2000-210, 211	Y	$40,000	10/58	19	3
	2000-212	Y	$52,000	1/63	5	2
	2000-213	Y	$68,000	6/65	0	1
Radio Corp. of America	Bizmac	N	$100,000	-/56	3	X
	RCA 301	Y	$6000	2/61	565	35
	RCA 3301	Y	$11,500	7/64	18	30
	RCA 501	Y	$14,000	6/59	98	2
	RCA 601	Y	$35,000	11/62	4	1
	Spectra 70/15	Y	$2600	11/65	0	50
	Spectra 70/25	Y	$5000	11/65	0	30
	Spectra 70/45	Y	$9000	3/66	0	40
	Spectra 70/55	Y	$14,000	5/66	0	12
Raytheon	250	Y	$1200	12/60	165	10
	440	Y	$3500	3/64	9	13
Scientific Data Systems Inc.	SDS-92	Y	$900	3/65	0	25
	SDS-910	Y	$2000	8/62	113	25
	SDS-920	Y	$2700	9/62	73	8
	SDS-925	Y	$2500	12/64	1	15
	SDS-930	Y	$4000	6/64	20	20
	SDS-9300	Y	$7000	11/64	3	7
UNIVAC	I & II	N	$25,000	3/51 & 11/57	30	X
	III	Y	$20,000	8/62	86	8
	File Computers	N	$15,000	8/56	22	X
	Solid-State 80, 90, & Step	Y	$8000	8/58	310	X
	Solid-State II	Y	$8500	9/62	40	2
	418	Y	$11,000	6/63	13	8
	490	Y	$26,000	12/61	40	15
	1004	Y	$1900	2/63	2125	300
	1050	Y	$8000	9/63	135	205
	1100 Series (except 1107)	N	$35,000	12/50	13	X
	1107	Y	$45,000	10/62	24	4
	1108	Y	$50,000	7/65	0	15
	LARC	Y	$135,000	5/60	2	X
				TOTALS	25,224	10,055

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 IBM 7044, 7074, and 7094 I and II's are not for new machines but for conversions from existing 7040, 7070 and 7090 computers respectively.

NEW PATENTS

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

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

December 8, 1964 (Continued)

3,160,858 / Lester R. Adams, Endwell and Arthur E. Collins, Vestal, New York / IBM / Control System for Computer.

3,160,859 / Raymond M. Wilmotte, Princeton, New Jersey / — / Optical Information Storage and Readout Circuits.

3,160,861 / Sammy A. Butler, Peekskill, New York / IBM / Shift Registers.

3,160,864 / Richard L. Snyder, Malibu, Calif. / Hughes Aircraft Co. / Random Access High Speed Memory.

3,160,872 / Robert A. Anderson, Springfield, Mass. and David T. Brown, Poughkeepsie, New York / IBM Corp. / Binary Coded Decimal to Binary Translator.

3,160,875 / David W. Bernard, Norwalk, Conn. / Sperry Rand Corp. / Magnetic Encoder.

3,160,876 / Nathan H. Stochel, New York / Bell Telephone Labs., Inc. / Serial To Parallel Converter For Data Signals.

December 15, 1964

3,161,763 / Edward L. Glaser, Pasadena, Calif. / Burroughs Corp. / Electronic Digital Computer with Word Field Selection.

3,161,854 / Theo Hense, Wilhelmshaven, Germany / Olympia Werke AG., Wilhelmshaven, Germany / Digital Conversion and Storage System (Input Device for Electronic Computers).

3,161,855 / Charles H. Propster, Jr., and Emery A. White, Phoenix, Ariz., Allen J. Trangle, Minneapolis, Minn. and Joyce L. Barbe, Mesa, Ariz. / General Electric Co. / Electronic Data Processor.

3,161,859 / Albert H. Medwin, Whippany and Edward Luedicke, Somerville, New Jersey / Radio Corp. of America / Modular Memory Structures.

3,161,860 / Wilhelm Grooteboer, Duisdorf, near Bonn, Germany / International Standard Electric Corp. / Ferrite Matrix Storing Devices With Individual Core Reading and Interference Pulse Compensation.

3,161,861 / Kenneth H. Olsen, Bedford and Richard L. Best, Wayland, Mass. / Digital Equipment Corp. / Magnetic Core Memory.

3,161,867 / Carl L. Isborn, Richmond, Calif. / Beckman Instruments, Inc. / Logic Systems.

December 22, 1964

3,162,768 / Tenny Lode, St. Paul, Minn. / International Business Machines Corp. / Magnetic Core Deca-Flip.

3,162,769 / Hiroshi Yamada, Tokyo, Japan / Fuji Toushinki Seizo Kabushiki Kaisha, Kawasaki, Japan / Data-Transfer Gates.

3,162,774 / Robert O. Winder, Trenton, New Jersey / Radio Corp. of America / Network for Obtaining a Threshold Function Utilizing Majority Gates in an Array.

3,162,776 / Albrecht Gerlach, Freiburg im Breisgan and Karl-Heinz Wilke, Balingen, Germany / Clevite Corp. / Shift Register.

3,162,844 / Nathan A. Moerman, Roslyn Heights, New York / Potter Instrument Co., Inc. / Magnetic Memory Device for Comparing Digital Information.

3,162,845 / Raymond Stuart-Williams, Pacific Palisades, Los Angeles, Calif., by mesme assignments to Ampex Corp. / Magnetic Information-Storage Device.

December 29, 1964

3,163,775 / William Peil, North Syracuse, New York / General Electric Co. / Tunnel Diode Logic Circuit.

3,163,852 / Edwin W. Bauer, Poughkeepsie, New York / IBM / Magnetic Core Half Adder.

3,163,853 / Henry S. Belson, Philadelphia, Penna. / Sperry Rand Corp. / Magnetic Storage Thin Film.

3,163,855 / Andrew H. Bobeck, Chatham, New Jersey / Bell Telephone Labs., Inc. / Magnetic Memory Circuits.

January 5, 1965

3,164,730 / Roger A. Urban, St. Paul, Minn. / Sperry Rand Corporation, N. Y. / Esaki Diode Logic Circuit.

3,164,812 / Andrew H. Bobeck, Chatham, N. J. / Bell Telephone Labs., Inc., N. Y. / Magnetic Memory Circuits.

3,164,813 / Jan A. Rajchman, Princeton, N. J. / Radio Corp. of America, / Magnetic Device.

3,164,814 / Eugene J. Hebert, Jr., Elkins Park, Pa. / Philco Corp., Philadelphia, Pa. / Magnetic Devices.

3,164,815 / James E. Applequist, Los Angeles, Calif. / IBM Corp., N. Y. / Digital Data Detection Circuitry.

3,164,817 / Howard M. Fleming, Jr., Basking Ridge, N. J. / Monroe International Corp. / Memory System.

January 12, 1965

3,165,634 / Francois Henri Raymond, Saint-Germain-en-Laye, France / Societe d'Electronique et d'Automatisme, Courbevoie, France / Photosensitive Information Storing Devices.

January 19, 1965

3,166,739 / Munro K. Haynes, Poughkeepsie, N. Y. / IBM Corp., N. Y. / Parallel or Serial Memory Device.

January 26, 1965

3,167,377 / Milton H. Pelavin, Greenburgh, N. Y. / Technicon Instruments Corp., Chauncey, N. Y. / Digital Bead-Out Apparatus.

3,167,749 / James W. Sedin, Los Altos, Calif. and Robert E. Wesslund, St. Paul, Minn., by Mesme Assignments to United States of America, as represented by the Secretary of the Navy / Magnetic Core Shift Register Circuit.

February 2, 1965

3,168,721 / Manfred E. Clynes, Orangeburg, N. Y. / by Mesme Assignments to Technical Measurement Corp., North Haven, Conn. / Information Transfer Systems.

3,168,723 / Warren C. Foin, Buchanan, Ralph A. Gregory, Endwell and Frank B. Hartman and Richard A. Trachy, Poughkeepsie, N. Y. / IBM Corp., N. Y. / Data Compression Apparatus.

3,168,728 / Nachum Porath, Tel Aviv, Israel / Sperry Rand Corp., N. Y. / Bistable Indicating Device.

February 9, 1965

No applicable patents.

February 16, 1965

3,169,686 / Jacob Rabinow, Bethesda, Md. / by Mesme Assignments to Control Data Corp., Minneapolis, Minn. / Magnetic Tape Data Storage Device.

3,170,142 / Morton M. Astrahan, San Jose, Calif. and Bennett Housman, Poughkeepsie, Hrand L. Kurkjian, Hyde Park and Bernard L. Sarahan, Poughkeepsie, N. Y. / IBM Corporation, N. Y. / Data Processing Machine.

3,170,144 / Munro K. Haynes, Poughkeepsie, N. Y. / IBM Corp., N. Y. / Cryogenic Memory System With Internal Information Exchange.

3,170,146 / James R. Horsch, North Syracuse, N. Y. / General Electric Co., / Voltage Driven Magnetic Core System.

3,170,147 / William J. Bartik, Hatboro and Kurt Gruensfelder, Ambler, Pa. / Sperry Rand Corp., / Magnetic Core Memory.

3,170,148 / Floyd G. Steele, LaJolla, Calif. / Digital Controls Systems, Inc. / Magnetic Drum Memory System.

February 23, 1965

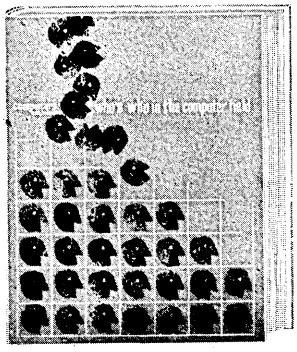
3,171,099 / Ronald Mitford Foulkes, Sale, England / Associated Electrical Industries (Manchester) Ltd. / Digital Computers For Data Processing Systems.

3,171,103 / William G. Rumble, Van Nuys and Westley V. Dix, Canoga Park, Calif. / Radio Corp. of America / Magnetic Plate Memory System.

here it is!

who's who in the computer field - '63/'64

A new comprehensive edition of the **WHO'S WHO IN THE COMPUTER FIELD** is available. This is the first edition in over five years. All entries are complete and accurate as of January, 1963. This handsome, clothbound book is the standard biographical reference on over 5000 leaders in **computer applications/ design/ education/ logic/ mathematics/ marketing/ programming/ systems analysis**



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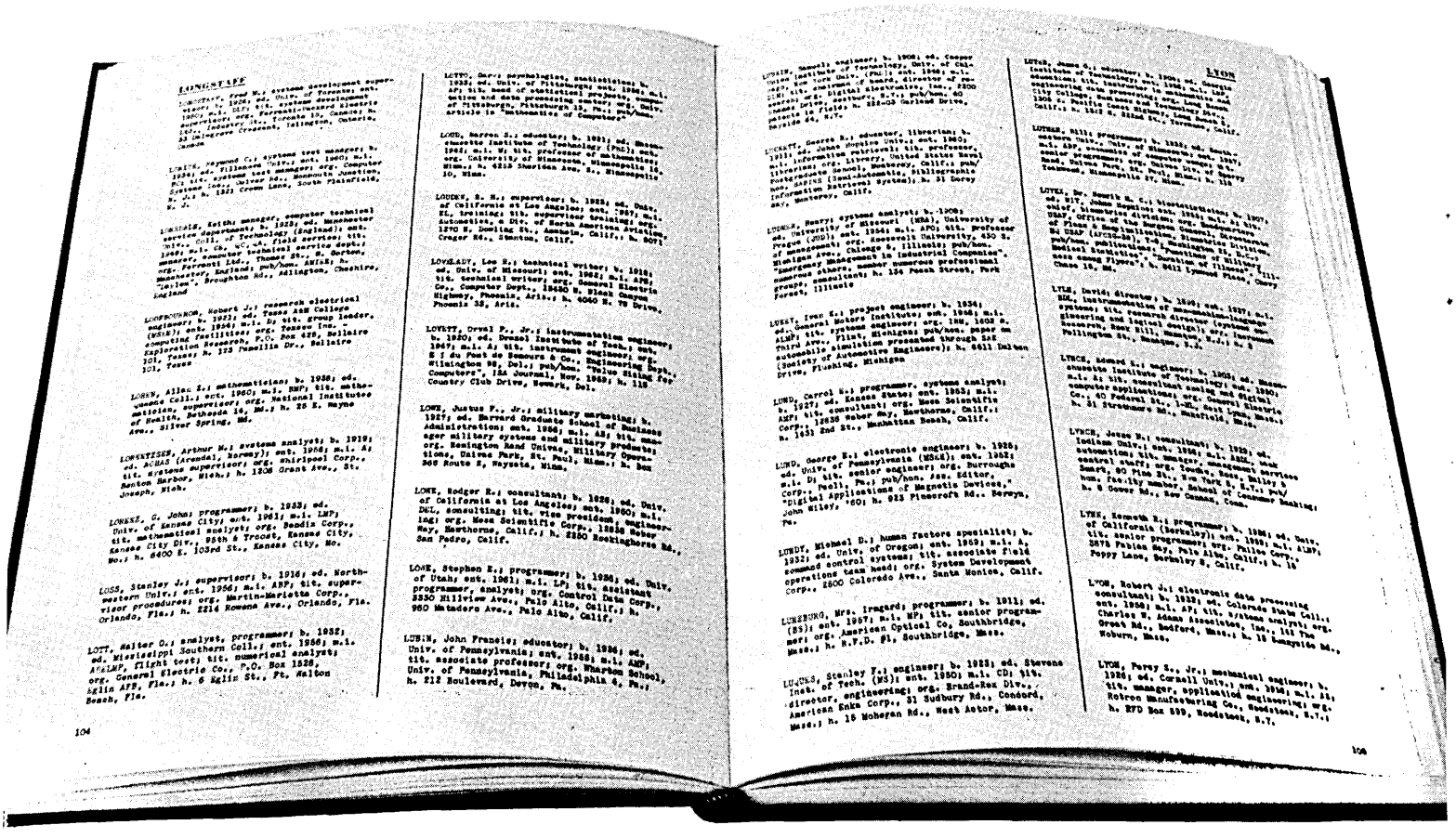

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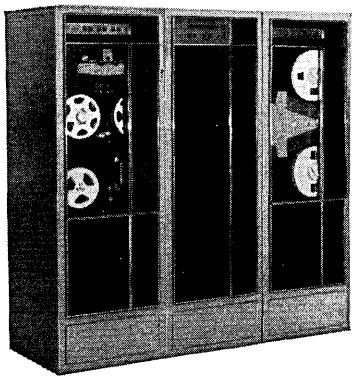

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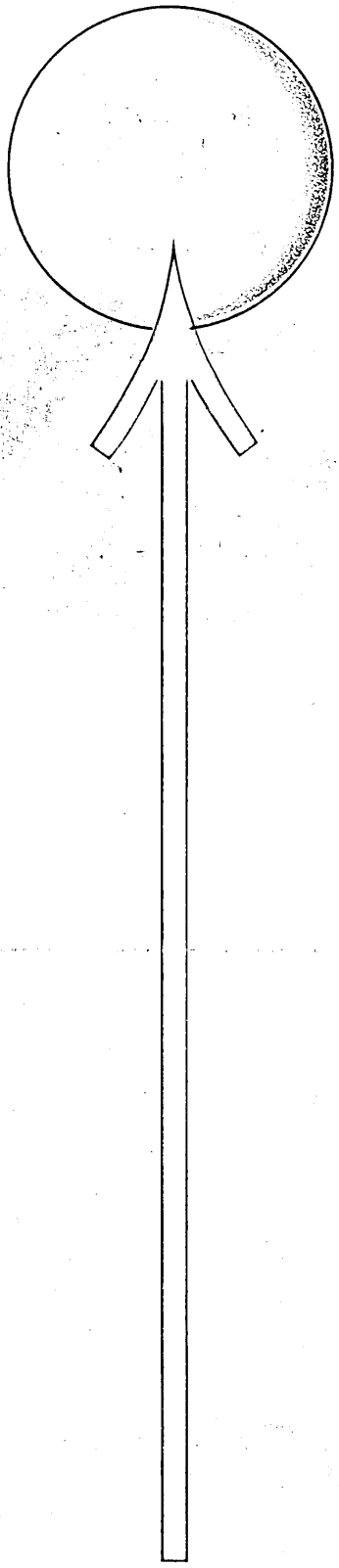

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