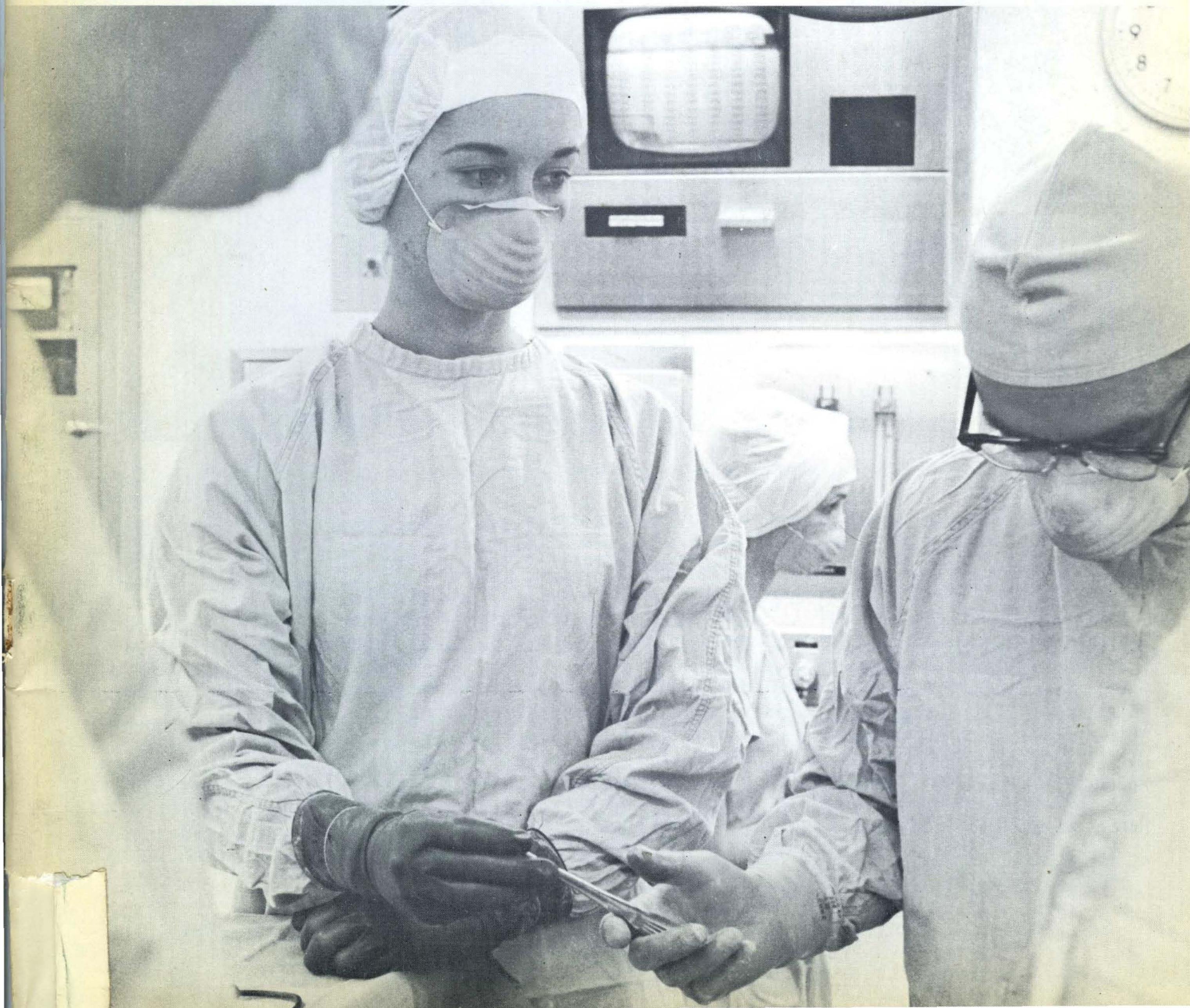
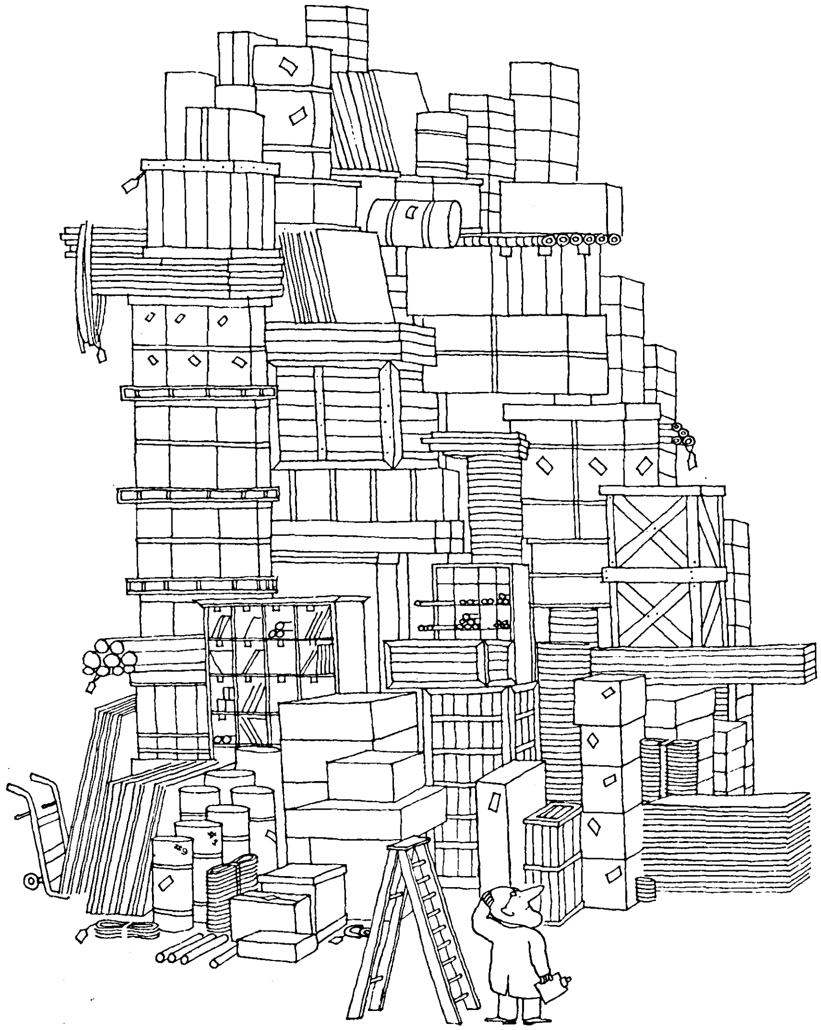
January, 1966

[redacted]

computers and automation

Electronic Computerized Surgical Monitoring System





How to put your finger on one item out of 36,000

A division of H. K. Porter Company, Inc., does it by dialing a computer center.

Any one of 36,000 items could be at any of seven warehouses and eight plants across the nation. When a product is sold, the information on punched cards is sent via Bell System Data-Phone* service over regular telephone lines to the Porter computer center in Pittsburgh.

The information is instantly recorded on magnetic tape and fed into the computer.

In a matter of milliseconds, the computer tells the production status or inventory location of the product. And the entire order is processed for shipment in one working day. (It formerly took up to fourteen days.)

As ordering information flows in, the computer updates the average monthly demand, economical production quantities, and safety stocks.

Replenishment orders are automatically produced when needed.

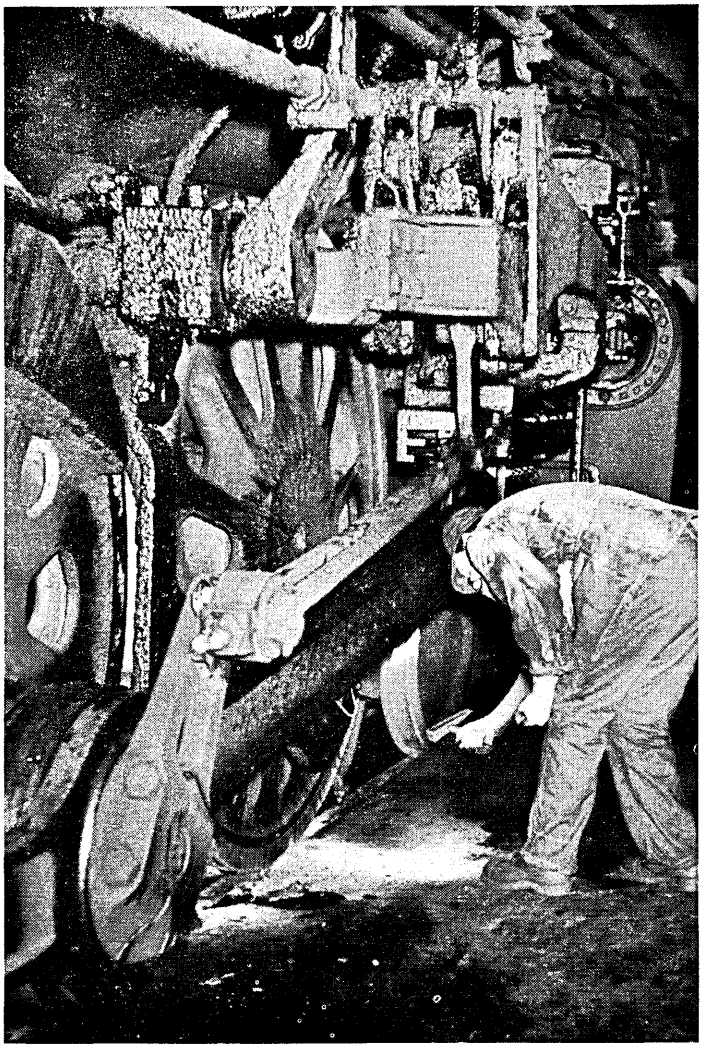
The result has been a cut in inventories. And customer service is at its best.

We can help you put your finger on the way to move information quickly and efficiently. Just call your Bell Telephone Business Office. Ask to have our Communications Consultant contact you.

Bell System
American Telephone & Telegraph and Associated Companies

*Service mark of the Bell System

Designate No. 1 on Readers Service Card



What does Old 99 have to do with Brady Tab Labels? It illustrates a point.

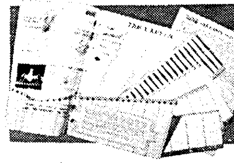
In their day, steam locomotive drive wheels rode on sweat-on steel rims or "tires". When a tire loosened with wear, it was replaced, saving the cost of an expensive drive wheel. Trouble was, these tires occasionally came loose and shattered with dangerous, expensive results. To detect a loosening tire, a "wheel tapper" at each station or whistle-stop would tap each drive wheel to determine the condition of the tire.

But long after "tired" drive wheels were replaced with solid steel wheels, wheel tappers continued to make their routine checks. Perhaps through habit or simply because no one told them not to.

Now the point we'd like to make is this: for years tab label people have been stocking only fraction of an inch sizes — 1/16", 1/8", 1/4" and so on. **Except Brady.** We stock Tab Labels in **tenths of an inch sizes** because most computors print out ten characters per inch. For those companies whose programs require fractional dimensions, we have those too.

Keen awareness of customers' special and changing needs plus willingness to meet them has long marked our service. There are no "wheel tappers" at Brady!

Our approach made so much sense to hundreds of suppliers of data processing supplies (chances are, your supplier among them!) that they now carry a local stock of Brady Tab Labels. And they can give you local service on your special made-to-order requirements, too.



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Designate No. 2 on Readers Service Card

Mayday!

Ever have days when you get this sinking feeling? Tape problems — transport problems — dropout problems?

Next time maybe we can help. Before you go down for the third time, call your nearest Computron Regional Office and shout "Mayday". Your Computron customer engineer will be on his way in a trice. He is fully qualified in all phases of EDP. He is not a salesman. He knows tapes — he knows computers — and he has had a great deal of experience in getting them to talk to each other.

Of course, many people have solved their data recording problems simply by switching to Computape.

In any case, we are at your service. For advice, application assistance, problem solving, or just a reel of tape, call your nearest Computron office.

A PRODUCT OF COMPUTRON, INC.
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Designate No. 3 on Readers Service Card

The front cover shows how an electronic, computerized, surgical monitoring system displays information about the physiological conditions of a patient during an operation at St. Mary's Hospital, Rochester, Minnesota. *For more information see page 39.*

computers and automation

JANUARY, 1966 Vol. 15, No. 1

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

In This Issue

Special Feature: Computer Performance Comparisons

In Every Issue

COMPUTERS AND AUTOMATION IS PUBLISHED MONTHLY AT 815 WASHINGTON ST., NEWTONVILLE, MASS. 02160, BY BERKELEY ENTERPRISES, INC. PRINTED IN U.S.A. SUBSCRIPTION RATES: UNITED STATES, $15.00 FOR 1 YEAR, $29.00 FOR 2 YEARS, INCLUDING THE JUNE DIRECTORY ISSUE; CANADA, ADD 50¢ A YEAR FOR POSTAGE; FOREIGN, ADD $3.50 A YEAR FOR POSTAGE. ADDRESS ALL EDITORIAL AND SUBSCRIPTION MAIL TO BERKELEY ENTERPRISES, INC., 815 WASHINGTON ST., NEWTONVILLE, MASS., 02160. SECOND CLASS POSTAGE PAID AT BOSTON, MASS.

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Workable Solutions to the Technological Revolution

The October 1965 issue of "Change" published by the Center for the Study of Democratic Institutions contains the following information:

—A local union with 1300 members at a certain plant in 1959 had only 350 in 1963; shortly with the plant automated, there will be only 25 men, yet the plant will be producing twice as much as before.

—In the tomato-picking industry a new machine does the work of 70 to 80 men; the machine costs only $25,000. There are now 20 such machines in California. It is expected that 700 will be in use next season displacing 56,000 workers.

According to Michael Harrington in the "The Other America," published by Penguin Books in paperback, 1964, there are 40 to 50 million people in the United States who are in poverty. They may be subdivided into the aged, the minorities, agricultural workers, unskilled workers, and persons rejected by our industrial system. Over 11 million of these persons are children under the age of 18.

At the same time that this sort of thing is happening, we find severe shortages of many kinds of trained skilled people. "How do I get a good computer programmer?" "Why can't the carpenter come before two months go by?" Recently a standard index of demand for engineers maintained by Deutsch and Shea, New York, N.Y., reached an unprecedented height. In "The Personnel Development Problem" by Dick H. Brandon (in "Computers and Automation," August 1965) figures were given showing an unfulfilled need by 1970 of some hundred thousand persons qualified in programming and analysis.

Thomas J. Watson, Chairman of the Board of International Business Machines Corp., said in November, 1963:

> Let's conclude the debate as to whether we have a problem. We have. The time has come to find workable solutions. If we do this, it will solidify us as a people and help insure our leadership in the world. If we fail, we may permanently alienate millions of citizens and possibly destroy our system while trying to defend some ideological details. . . .

There are a number of courses of action we can take; a great variety of proposed solutions to the problems lie in front of us. But we can group them roughly into three great kinds:

1. Do nothing
2. Do something
3. Do the right thing

Let's consider each of these.

The first kind of action is to do nothing about a problem. There is an old joke: Bill says to Joe, "What do you do when you feel like exercise?" and Joe replies, "I lie down until the feeling goes away."

In spite of this joke, to do nothing, non-action, is often sensible, practical, desirable, and even unavoidable. Suppose during a whole week of my vacation at the seashore the weather is rainy and cold instead of sunny and warm — what can I do about it? Literally, nothing — not until human beings work out control over the weather. Furthermore, to do nothing is easy; it is usually safe and comfortable; usually no one will find fault with you if you do nothing; and it allows you to continue to be busy with the things you were busy with before. Many of these reasons are reflected in sayings such as: "I'll mind my business, and you mind yours"; "One must cultivate one's own garden"; "Am I my brother's keeper?" But over and over again the course of nonaction lets some condition get worse and worse until it becomes intolerable, and people won't put up with it any more, and great violence and great waste occurs.

The next kind of action is to do something — to make a quick study of the problem, choose some action that can clearly make it better for at least a little while, and pour in effort to carry out that remedy. For example, suppose a city is clogged with traffic: a solution is to "apply a computer" so that traffic may be handled better and with less congestion. Or in the case of technological unemployment, for example, some people advocate retraining. They say, "Retrain the displaced person so that he can work at a different kind of a job. If an elevator operator has lost his job to an automatic elevator, give him a course, say, in card punching, and let him find a job as a key punch operator in a computer installation."

Such partial solutions as these are inadequate. If the advance of technology were to create always as many jobs as it destroys, and if the personnel requirements for the new jobs should be the same as the personnel requirements for the old jobs, then the problem would be relatively simple. But this is not true. The jobs that are created are always different, and regularly demand new types of skills, and usually demand much more intelligence. It takes time and effort for anybody to acquire a new skill adequately. And I have never yet heard of a way for greatly increasing the amount of intelligence of a given human being.

Solutions like these are stopgap solutions. They may help for a while; then the problem returns in a worse form. Over and over again, the temporary and partial reform allows the underlying conditions to get worse and worse until they are intolerable. The temporizing solutions have an added disadvantage: they blunt the sharpness of the human energy which would otherwise seek a better solution.

The third kind of action is to figure out and do the right thing.

For example, let's take the disease smallpox, which has practically vanished, due to the great Dr. Edward Jenner, who lived in England 1749-1823. According to Collier's Encyclopedia:

> His investigations on the similarity between cowpox and smallpox started in 1775. He observed that dairymaids who had cowpox did not contract smallpox. After much research he inoculated an eight-year old boy with cowpox and later with smallpox. The boy proved immune to smallpox. Jenner had done likewise with his own son . . . Jenner published his "Inquiry into the Cause and Effects of the Variolae Vaccinae" in 1798, and announced his discovery of the smallpox vaccination. At first it met violent opposition, but finally achieved an almost universal recognition. . . . In 1802 the government gave Jenner a grant of £10,000 and he was vaccinating 300 poor persons a day without charge. . . .

In this way smallpox was eliminated after having scourged human beings for centuries.

Other procedures might also have worked; in fact, sometimes there is more than one right course of action, right thing to do; but the important point is that Dr. Jenner worked out a scientifically correct course of action, for dealing with the problem of smallpox.

In the case of a city afflicted with traffic congestion, we can see clearly that the long-term balancing and managing of traffic input, output, and circulation is necessary — so that the great asset of a viable city can be preserved year after year for all posterity.

The same kind of right solution needs to be worked out scientifically for the problems of the technological revolution:

1. All the goods and services that society needs year after year should be scheduled for production using machines and persons as needed.
2. The persons needed for this production will be the employed. They should be paid a comfortable standard of living and perhaps more. The capital needed should also receive a reasonable return paid to its owners.
3. All the other people in society (the young, the old, the students, the housewives, the sick, the underprivileged and the underdeveloped) should be given a decent minimum standard of living and also incentives for making a better life for themselves — just because they are human beings.
4. The way in which the arrangements can be most reasonably worked out — the long term balancing and managing — should be given as a problem (a great Operation Match) to a computer. Any acceptable solution must not be rigid but also have built-in reasonable flexibility.

As Thomas J. Watson said, "the time has come to find workable solutions."

Edmund C. Berkeley

EDITOR

DEDICATION OF THE KEYDATA SERVICE MAY MARK BEGINNING OF NEW GROWTH INDUSTRY ... BUT WHEN WILL GROWTH BEGIN?

Keydata Corporation dedicated its Univac 491 based on-line commercial service bureau recently, labeling it as the first time-shared computer for business applications. The goal of the system is to provide up to 256 individual business firms on-line processing of invoices, inventory records, and other business transactions. Already 26 customers ranging from a $50 million-a-year wholesale liquor distributor (who is dumping its IBM 1440 and putting its data processing work on the Keydata's computer) to a $1 million-a-year clothing manufacturer have signed up for the system. Customers are going on-line one by one during a build-up of the system's processing load ... with four to six expected to be serviced by the end of the year.

Keydata is a subsidiary of Charles W. Adams Associates, the highly regarded programming and comsulting firm. Adams Associates have been extensively engaged in development and implementation of advanced techniques for on-line computing and man-machine communications. The Keydata service was first put into operation by the Adams Associates in July, 1963, with eight stations connected on-line to a Digital Equipment PDP-4 computer. This system was used for the acquisition and processing of data related to the settlement of some 40,000 complex legal claims in the Transitron stock snafu.

Design improvements and expansion of the executive routine (the master program that manages the operation of the on-line computer) were made during the last two years ... evolving the software through two generations. Regular commercial service was planned for the Keydata by the Adams' people in early spring of this year, but unexpected performance difficulties with their computer at that time, a DEC PDP-6, caused delays. In a surprise move they returned their PDP-6 and took delivery of a Univac 491 computer at the end of July ... the first 491 to be delivered since its formal announcement in June. Working closely with Univac, they had the service "on the air" in early October.

Who can benefit from an on-line data processing service? Clearly any firm which puts a high premium on immediate processing of inventory level requests, order entry, re-order issuance, credit checking, etc., may find the Keydata service beneficial. On such jobs the Keydata service gives a response measured in seconds versus a day or two for regular service bureau-type performance on a batch processing computer. The main consideration in assessing the value of the service is whether the saving in time can justify the premium charges involved in the on-line hookup.

Premium charges over and above regular service bureau transaction charges on the Keydata service are due to on-line storage rental and data communications terminal and line charges. For example, in a typical Keydata hook-up, on-line storage capacity rents for $200 per month, the teletype terminal rents for $160 per month, and the private wire connection to get the user hooked up to Keydata's computer costs between $1.33 and $2.25 per month per mile. For a typical user located 30 miles from Keydata's service bureau the premium charge amounts to about $420 per month, or say $20 each working day. For businesses where the shortening of the delivery cycle by a day or two can mean significant improvement in inventory cost or customer satisfaction, this premium charge may be easily outweighed by the value of the benefits.

As Keydata's service is currently set up, manufacturing and distribution firms with $3-$5 million in sales appear to be the most direct customer prospects. Since there are approximately 15,000 such firms in the United States, the potential market for such on-line data processing services should be considerably greater than supplier capacity for many years to come.

At the current time line charges restrict the distance from which a customer can economically use an on-line computer service bureau. Therefore most on-line service bureaus will service customers located within 50-100 miles of the computer's location. Keydata expects to open a second center in New York next year. Other on-line service bureaus are springing up in Atlanta, Dallas, San Francisco, and Washington.

The critical factor in achieving success for the Keydata system will be the ability of the programmers and systems analysts of the Adams Associates in controlling the sophisticated real-time processor and its executive routine in order to achieve satisfactory customer service while preventing data errors, loss of records, etc., when the number of users begins to approach peak loads. Since Keydata is renting their 491 configuration for $30,000/mo., it would seem that the system needs at least 50-60 active customers before a break-even point can be reached. However we feel it is unlikely that satisfactory service for more than 30-50 subscribers can be rendered on the Keydata system before '67... mostly due to programming complexities.

Both computer manufacturers as well as other service bureaus will be watching very closely the success of the Keydata system in the coming year. A highly successful operation should greatly accelerate acceptance of on-line service bureau activities. Adams Associates, by absorbing the expensive development costs in pioneering an on-line service bureau operation, is not likely to see profits from Keydata for several years, but it will be making an important contribution to the computer community... and in particular to Univac by showing it can be done on a Series 490 computer.

NON-REAL-TIME COMPUTING

J. J. Brett, President
Universal Time Punch, Inc.
Cleveland, Ohio 44121

My congratulations on your special issue on real-time computing and supervisory monitor programs. But now, how about that vast market of applications where there is little or no economic justification for real-time computing?

A vacuum of appropriate hardware has existed for such a long time that computer users have all but given up on modular source-data recording devices. However, this vacuum is in the process of being effectively shattered. Paul Wagner Co. of California, Taller & Cooper Inc. of Brooklyn, New York, and Universal Time Punch are all manufacturing source-data gathering equipment to provide variable data in machine language.

As more of this type of equipment becomes available it behooves us to look a little more carefully into the economics of "Real-Time vs. Off-Line Data Collection." Some information is not needed immediately. Often the desired use is in a batch processing application, such as payroll, job cost analysis, or the many areas of manufacturing control (scheduling, machine loading and unloading, etc.) where data is not required to be processed until the end of a day, shift, week or month. Then the overall costs of communication and transmission systems may not be justified and the user may be better served by a source-data gathering system based on a group of inexpensive modular units.

In the past, most of the modular or non-wired systems depended heavily on pre-punching, as the information required for batch processing applications is usually known in advance. In most cases, this provided the bulk of the data for the source document. However, pre-punching did not provide the variable information needed to complete a source document. In the past this variable information had to be hand-written, then keypunched and verified.

Today, however, with equipment manufactured by the companies aforementioned, it is possible to purchase relatively inexpensive units to punch data directly into the source document as the data originates. They are particularly feasible for the company which does not require data the instant an operation is completed. Such a system obviously does not require the investment or the costs of a wired or cable system.

SAVINGS BANKS WITH ELECTRONIC LINKS FROM BANK FLOOR TO CENTRAL COMPUTER — SOME HISTORY

I. From James R. Terrell

Computer Development Department
Pitney-Bowes Inc.
Stamford, Conn.

In the September, 1965, issue of *Computers and Automation,* there is a short article on page 34 describing the computer operations of the Home Savings Bank of Boston. The article states that that bank "is the first savings bank in New England to begin operation of an electronic system that establishes a direct link between teller windows on the bank floor and customer records stored in an IBM computer on another floor."

The Society for Savings in Hartford, Connecticut, has had an on-line electronic system in operation since 1962. Not only is there a direct link between teller windows on the bank floor and the computer on another floor, there is a direct link between *all* teller windows and the computer including tellers at branches. This on-line system was pioneered by the Teleregister Corporation (now a division of the Bunker-Ramo Corporation) and utilized the Telefile computer for processing, magnetic drum storage for account records, transaction records, and teller journals with magnetic tape drives for back-up usage. At that time, I was at Teleregister as the programming supervisor for the development of the package of on-line routines for the banking project.

The Society for Savings was one of three initial bank installations which included the Howard Savings Bank in Newark, New Jersey, whose system went into operation in 1961, and the Union Dime Savings Bank in New York City. All three banks have branches with all tellers being fully on-line.

Perhaps the article in *Computers and Automation* intended only to stress that the Home Savings Bank was the first IBM on-line system in New England. However, it was not the first on-line system for a New England Savings Bank.

II. From the Editor

We very much appreciate the correction.

1966 INTERNATIONAL SYMPOSIUM ON MATHEMATICAL AND COMPUTATIONAL METHODS IN THE SOCIAL SCIENCES

International Computation Centre
Rome, Italy

An International Symposium on Mathematical Methods in the Social Sciences will be held in Rome from July 4 to July 8, 1966 under the auspices of the International Computation Centre. Professor F. Braudel (College de France), Professor B. de Finetti (University of Rome), Professor G. Th. Guilbaud (E.P.H.E.), Professor P. F. Lazarsfeld (Columbia University), Professor C. Levi-Strauss (College de France) and Professor J. Piaget (University of Geneva) are Honorary Members of the Symposium.

The Congress will be divided into four sections. Each section will consist of an invited address (one hour), a number of comments on submitted papers (fifteen to thirty minutes), and general discussion (half hour).

The following is the list of the four sections with their chairmen:

Anthropology: P. Maranda, chairman
Archaeology: J. C. Gardin, chairman
Psychology: C. Flament, chairman
Sociology: R. Boudon, chairman

The Proceedings of the Congress will contain invited lectures, the contributions to the symposia, and the program of the Congress. They will be available by October 1966. Only papers which have been submitted to the Organizing Committee in their final version by May 1966 will be included.

The official languages of the Symposium are French and English, with simultaneous translation.

For more information, write to the International Computation Centre, 23 Viale Civilta del Lavoro, Rome E.U.R., Italy.

THE COMPUTER AND THE ARTS

I. From L. Mezei

York University
2275 Bayview Ave.
Toronto 12, Ont., Canada

To the Editor:

Much unpublished activity is going on in the application of computers to the arts. I am seeking to compile a list of research projects using computers and involving visual design, architectural design, music, ballet, poetry, drama, film, and the like. If any of your readers has done any work in this area, I would greatly appreciate a brief description of his work.

Also, how much interest might be there in a conference on "The Computer and the Arts"?

II. From the Editor

In publishing this letter from Mr. Mezei, we would like to ask any interested reader to write to him direct, and to send us a carbon copy of the letter if convenient.

NATIONAL SCIENCE FOUNDATION GRANT TO THE ASSOCIATION FOR COMPUTING MACHINERY

The National Science Foundation has awarded a grant of $61,350 to the *Curriculum Committee on Computer Science* of the Association for Computing Machinery. Dr. William F. Atchison, of the Georgia Inst. of Technology, is Chairman of the Curriculum Committee. The primary purpose of the grant, which is entitled *Computer Science Course and Curriculum Development,* is to develop an undergraduate program for the training of computer scientists.

Preliminary recommendations for an undergraduate program have been developed and were published in the September 1965 issue of the *Communications of the ACM.* The Curriculum Committee has identified fifteen existing undergraduate programs and discovered many more in preparation. It will direct its efforts toward a comprehensive program which will point the way to a standard undergraduate curriculum.

Members of the scientific and educational communities are invited to communicate their views on this subject to Dr. Atchison at the ACM National Headquarters, 211 East 43 St., New York, N.Y., 10017.

COMPUTER ANALYSIS AND THRUPUT EVALUATION

R. A. Arbuckle
Manager of Product Marketing, Federal Region
IBM Data Processing Division
Washington, D. C.

Because of the many computer systems available today, we see many more comparisons being made by manufacturers, consultants, and other users, all of them looking for a technique easy to use and providing reliable results.

Conscientious attempts to evaluate computer systems give one the feeling that the results leave much to be desired. There is no one technique, or even a combination of techniques, which represents infallibility.

Frequently we see spread sheets used to compare various systems which list the central processor characteristics, input/output devices available, unique features of the system, and rated speeds of the system's components. What does such a mass of statistics offer to facilitate computer evaluation? It is almost impossible to evaluate similar systems from this information with any degree of reliability. Naturally, for two systems with significantly different characteristics it is usually easy even for a novice to select the more powerful one. It is also possible for someone who is well acquainted with computers of all types to categorize systems into classes of relative capabilities. To get a really good appraisal of two or three specific systems however requires much more information.

Criterion: Thruput

The real criterion for measuring system performance is thruput. Yet many evaluations use only internal comparisons to rate a system's overall performance. The internal power of a computer system can play a major role or a minor role in its actual overall performance, depending upon the applications and the efficiency of the programming systems.

More often, the effect of internal power is misjudged, even when other factors involved in a system's thruput performance are recognized. As the areas of scientific and commercial data processing have developed, and as actual system utilization has revealed, a merging of functions has taken place. Those characteristics once thought of as unique to each of the areas are now recognized as common to both. Nevertheless, in many cases systems are still being rated on some of the imperfect techniques discussed below.

Core Cycle-Time Comparisons

Because cycle times for fixed-word-length and variable-word-length systems have such completely different relationships, these comparisons usually are applied only to systems with the same general organization. There are many reasons why this technique is unreliable; a few points will serve to illustrate this.

Basic core cycle-time comparisons for variable-word-length systems overlook significant items such as character vs. digit organization, multiple vs. single position accesses, and other important internal differences. Fixed-word systems differ in basic structure such as decimal vs. binary orientation, and length of word actually accessed, in addition to other important features, such as serial vs. parallel adders and variable-word-length handling capabilities.

Add-Time Comparisons

Add-time comparison has been used frequently to rate computer power; again conclusions are usually misleading.

Many examples exist to show how diametrically opposite results can be obtained from the use of this technique vs. the first technique. Aside from the speed of adder circuits, in addition to core storage access times, the aspect of single-address vs. multiple-address organization has to be considered. The latter point is important, especially in variable-length systems since add times reflect instruction fetch time. Instruction length is also a factor.

Instruction-Time Comparisons

Instruction-time comparison is an extension of the previous technique which supposedly eliminates many of the short-

R. A. Arbuckle is currently manager of product marketing for IBM's Federal Region (Data Processing Division) Washington, D. C. He had previous experience with IBM in systems analysis, systems engineering, and as a sales and applied science representative. Prior to joining IBM in 1956, he worked with textile mills as statistical advisor for the Deering Milliken Service Corporation; in statistical quality control for P. R. Mallory Co.'s powder metallurgy section; as marketing research statistician with Eli Lilly & Co.; and as part-time instructor in mathematics and statistics for Purdue's Indianapolis extension. He received degrees from Baldwin Wallace College (BS-Mathematics) and Purdue University (MS-Statistics).

comings of the first two. This technique does admit that there are more instructions to consider than just additions.

In cases where systems have comparable instruction times for certain classes of instructions but very different times for other classes, it may be difficult to rate even roughly the relative internal performance without a knowledge of the frequency of instruction use. The application area certainly is a consideration in addition to many other factors, such as system organization and special features. Therefore, this extension is still misleading.

Instruction-Mix Comparisons

Instruction mixes are frequency distributions of instructions or instruction types which may represent specific jobs, classes of applications, or even attempts to characterize the entire general area of scientific or commercial data processing. They are an extension of instruction-time comparisons, on a weighted basis. An instruction mix derived from a dynamic trace, which lists the frequency of actual execution, is certainly an improvement over those listing only the frequency of occurrence.

The example given in Table 1 is a scientific instruction mix which represents a composite of a number of scientific and engineering applications, and it was intended to have it typify the general scientific area.

Instruction mixes seem to be very popular. One reason is that they are easy to use, and it is not time-consuming to make the evaluation. In addition, detailed instruction times are frequently available.

Some major limitations in the use of instruction mixes are generally applicable to both the scientific and commercial areas. These limitations are:

a. Determination of the times to use and interpret an instruction many times will be subjective. For example, in the scientific mix given in Table 1, floating-point times will be variable; average times are normally used. The miscellaneous category represents a composite time including shifts, immediate type instructions, logical types, etc.; an instruction mix in itself is represented. In the use of an instruction mix for the commercial area, frequently the field size will not be specified; or no specifications may be made for penalties applying to fields crossing word boundaries in fixed-word systems.

b. Most mixes, especially in the scientific area, do not include any consideration for input/output instructions, not to mention the effect of I/*O* system performance.

c. Instruction mixes are frequently based on, or were developed with respect to, one particular system; the frequencies listed reflect the use of that machine's instructions. For example, in comparing a system having only one accumulator and one MQ register with a system having multiple accumulators, the frequency of the load/store instructions will, in actual practice, be much lower for the latter system. Other major differences in organization which should be considered are:

1. Single-address vs. multiple-address logic.
2. Word sizes
3. Fixed-length vs. variable-length systems.
4. Index registers, as opposed to only indirect addressing capabilities.
5. Effect of data-base conversion time.

d. Instruction overlap facilities are hard to reflect accurately. All overlap schemes have some restrictions, usually depending upon instruction sequences, operand/instruction address conflicts, etc.

e. The result obtained, a weighted-average instruction time, may be a fair representation for an individual system in a particular application area; however, it is almost meaningless to use in a comparison when the number of instructions required by each system is not known. That is, the power of a system's instruction repertoire is neglected in such comparisons. This holds especially true for recently announced equipment such as IBM System/360.

The results of instruction mix analyses should be interpreted only as measures of *raw internal computing power* at best. These techniques are better than the techniques previously discussed but still only represent a quick "first estimate."

Table 1

SCIENTIFIC INSTRUCTION MIX

Instruction or Operation	Frequency of Use (Percent)
Floating Point Add/Sub.	9.5%
Floating Point Mpy.	5.6
Floating Point Div.	2.0
Load/Store	28.5
Indexing	22.5
Conditional Branch	13.2
Miscellaneous	18.7
Total,	100.0%

Kernel Problem Comparisons

A much better technique to appraise basic internal performance is kernel problem comparisons, in which sample routines are coded with the system's own instructions. The scientific area is generally easier to characterize because many standardized mathematical techniques are widely used in a variety of applications.

Here are some examples for the scientific area which have been used to evaluate internal performance and which characterize the general nature of internal processing:

a. Polynomial evaluations. These can be generalized by using the "nesting" technique. This calculation reflects indexing ability, as well as certain arithmetic speeds in a short loop of instructions.

b. Matrix operations. These are frequently used in scientific problems.

c. Evaluation of a particular formula hopefully includes combinations of the typical sequences of arithmetic operations.

d. Miscellaneous routines including interpolation, bit sensing, random number generation, etc.

In the commercial area more specific kernels are usually seen, reflecting the major types of internal processing that the specific user is or will be doing. Some types of examples used are as follows:

a. Comparison of detail transactions with master records, and sequence-checking of both files.

b. Internal processing for one or more activity types.

c. Formatting a typical line in a printed report.

d. Miscellaneous routines including table look-up, block transfers within storage, etc.

The kernel techniques of evaluation are growing in use because they have certain advantages. They overcome some of the major limitations associated with the previous techniques. They are machine independent, if selected without bias, and permit the use of a system's general instruction power as well as any special purpose instructions. Features can reflect differences attributed to addressing logic, use of special registers, indexing ability, efficiency of storage utilization, instruction overlap, etc.

Some of the major limitations of mixes have been resolved in this way but others remain. For example:

1. The influence of the wide range of I/O instructions required in practice is not considered.

2. Factors in evaluating systems with different organization may be overlooked. These are: (a) word size differences in the case of scientific comparisons; (b) effect of conversion time in binary systems; (c) fixed-word-length vs. variable-word-length systems and the field-size relationship to word boundaries — packing and unpacking.

3. Kernels with no weights assigned make it difficult to obtain an overall evaluation; significant variations in relative internal performance can exist between kernels. Even with weights assigned, how realistic are they? It is much easier to obtain realistic weights for instruction mixes in specific jobs or applications by using dynamic traces.

4. This technique reflects mainly hard-core calculations or processing, and ignores the effect on internal performance of the many functions of administrative type that may be necessary.

This type of analysis also requires caution in interpretation when evaluating overall internal performance. It could be considered to provide more than a first estimate. It is a refinement of the raw internal computer power provided by instruction mixes; however, it can be subjected to large discrepancies in actual practice, even nullifying the effect of programming systems.

While there are many variations of the basic techniques just discussed, all are classified in the category of desk evaluation of internal power. A few can provide excellent measures of relative internal performance for specific cases, but they are generally applicable only to compatible families.

The relative power of a system is not necessarily how fast it is internally, but how fast it can perform the complete job. In thruput evaluations, one must consider the interaction of internal performance, with I/O speeds and facilities, in addition to the most important factor of programming systems efficiency.

Benchmark Problem Thruput Comparisons

There are two types of benchmark problems: one estimates time, while the other reports actual running times. Certain benchmark problems, such as sorts, can be estimated fairly accurately; others can't. It is easy to fall back into the same pattern reflected in previous evaluation techniques; i.e., time only the main line considerations or the hard-core calculations and internal processing. I/O has to be considered, but this can be optimistic by assuming complete channel overlap and channel balance.

In scientific benchmark problems, it is common to ignore I/O by stating it will be hidden due to overlap. In commercial data processing benchmark problems, it is common to see timings quoted on the basis of tape or other I/O speeds; the assumption is that internal processing is usually a small part of the job can be accomplished during I/O — the tape-bound assumption.

The major limitation in estimating benchmark times is the lack of consideration for the effect of programming systems. A very powerful system in actual design can be degraded tremendously by this critical factor.

Run-time comparisons provide the opportunity to demonstrate and obtain actual "live" comparisons for systems' thruput evaluations. All the internal processing required for the problem is included, such as IOCS functions, other administrative type functions, as well as the main calculations and internal processing involved. The influence of I/O is measured by the effective speeds attained from various devices; overlap of channels and interference time is reflected; the interaction of the CPU with I/O is tested; and all of the success attained is largely due to the efficiency of the programming system in utilizing the many features incorporated in the system's equipment.

There are two major considerations involved as to how well either can evaluate thruput in actual practice:

1. Benchmarks do not usually reflect the user's actual jobs or complete jobs. Typically, they will be a part of an entire job, hopefully sufficient to serve as a close estimate of the total job. The volumes provided for the benchmark run may be restricted as well as the size of the records. Therefore, the approaches used by many systems for the benchmark case may not be possible in actual practice when the system is installed; for example, the use of long physical records on tape, a large blocking factor to increase the effective speed attained.

2. How well do the benchmarks serve to characterize the entire range of actual work to be performed? The interpretation of actual benchmark runs should be that the systems' performance is applicable only to that particular job. Many other jobs or runs can show significantly different comparisons, and relative performance on an overall basis may be completely reversed if these were included.

Actual Job Thruput Comparisons

Undoubtedly the best way to measure a system's performance is by running actual production jobs. With the widespread use of generalized compilers, providing compatibility at the source language level, it is feasible to run actual production jobs on systems with entirely different organizations.

This technique for evaluation does eliminate the questionable area of how well a benchmark problem reflects an actual complete job. However, the second consideration still remains: how well do the actual jobs selected reflect the overall performance which will be attained?

Some actual job comparisons have received widespread publicity. Both COBOL and FORTRAN comparisons have been made for a wide variety of systems. If the selection of a system is based on these types of comparisons, it is necessary to stress that many different types of jobs and conditions should be compared.

Thruput Evaluations

Until recently, it was difficult to evaluate potential thruput improvements attained by the use of faster system components. Assumptions had to be made as to how much of the job was represented by CPU and I/O time, in addition to the overlap obtained.

In the scientific area it was, and sometimes still is, assumed that the main consideration for improving thruput is to use faster CPU's. Conversely, in the commercial area, the emphasis is on faster I/O devices. It is true that for many specific examples these considerations are most important; however, the joint effect of CPU and I/O improvements can contribute to much better thruput overall.

Hardware Monitors or Channel Analyzers

Today we have the proper tools to make sound evaluations of thruput improvements; they are called hardware monitors or channel analyzers. Their results furnish an accurate breakdown of time for the CPU in use alone, the CPU delay due to I/O, and channel utilization. From these results, measurement of overlap can be obtained for channels operating together, as well as for concurrent operations of the CPU and channels.

Table 2

ANALYSIS OF TIME BY THREE JOB CATEGORIES

1. DISTRIBUTION OF TIME

Hardware Monitor's Measurement	Percent: Category: 1	2	3	
Central Processor Unit Only	45%	88%	22%	
Unit Record Only	6	2	9	
Tape Only	46	4	59	
CPU/Channel Overlap	3	6	10	
	100%	100%	100%	

2. THRUPUT IMPROVEMENTS

	1	2	3	Overall
2 X CPU Improvement Alone	1.29	1.79	1.12	1.40
2 X Tape Improvement Alone	1.30	1.02	1.42	1.24
2 X Joint Improvement	1.89	1.96	1.83	1.90

An Example

Here is an example taken from an IBM 7094 installation which is primarily engaged in processing many different types of small jobs. In this job shop type of activity, the user had a problem in that the 7094 was heavily loaded to the point where it was becoming difficult, if not impossible, to handle any expansion of the workload. At this stage, the hardware monitor was engaged to determine the problem area. Analyses were made of the individual elements of the configuration as well as the overall performance of the installation. It soon became apparent that the delays were not in the speed of the processor but in the input/output elements.

The first step in the analysis was to categorize the job types. Three such types existed, and results were collected for a large number of jobs. The results have been summarized in Table 2 and are explained as follows:

Job Categories: 1 represents FORTRAN II jobs less than 7 minutes long (50% of total time); 2 represents FORTRAN II jobs 7 minutes or longer (30% of total time); 3 represents miscellaneous jobs such as PERT, JOVIAL, etc. (20% of total time).

Measurements: CPU Only represents the percentage of time the CPU is in use by itself; Unit Record Only and Tape Only represent the percentage of time the CPU is delayed in waiting for the completion of their respective operations; CPU/Channel Overlap represents the time both are operating concurrently.

Thruput Improvements

Of course thruput improvements could be obtained by the use of improved programming systems and/or reprogramming of application jobs. But other improvements can be obtained from equipment. The second part of Table 2 shows improvement factors for each job category when making the indicated changes.

For CPU improvements alone, a factor of two was used for illustrative purposes only. The next member in this compatible family will not provide this improvement on an overall basis; however, it will be close enough to demonstrate a point. The tape improvement factor of two is more realistically attained with standard equipment available. This line shows improvements to be expected, retaining the original CPU.

The greatest individual improvements occur in the two job categories where the primary use is either CPU or tape. It is not startling then to see job category 2 significantly improved by a faster CPU alone; nor is it unexpected to see job category 3 the most improved by faster tape speeds alone.

It may be a surprise to see that either CPU or tape improvement alone provides the same overall improvement for job category 1. It is this particular type of job that is common to scientific job shop operations — a large number of very short running problems. The notion of scientific work being typically compute-bound is a fallacy.

Consider the joint effect of improving both CPU and tape speeds together. The fluctuation of thruput improvement factors among job categories levels out when the joint effect is considered as compared to either individual improvement alone.

Evaluation Analysis

This example is intended only to show the type of analysis which can be performed to evaluate possible thruput improvements. The evaluation can be attacked by the same arguments discussed previously: that the overall figures indicated may be far from realistic since only a portion of the user's total activity is included. However, the user could take actual measurements on as many jobs as desired. Sufficient data can be collected to be truly representative, and valid evaluations can yield estimates which have a high degree of reliability.

The example illustrates also the importance of I/O considerations in scientific work. Faster CPU speeds buy only a part of the improvement which might be expected; the joint effect of both considerations is a more important factor.

It is not only through faster equipment that thruput can be improved; the effect of tape blocking can make a significant difference. It is possible to gain more effective tape speed improvements by blocking on currently installed tape drives, than by going to the next faster model and retaining the use of short records. This tool permits the evaluation of other I/O devices, such as drums and disks. Also, different approaches can be better evaluated, such as directly connected I/O processors: e.g., a 7040 handling all I/O functions,

(Please turn to page 19)

Standardized Benchmark Problems Measure Computer Performance

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The need for standardized measures of computer system performance becomes evident when one considers:

- The wide range of commercially available computers,
- The wide variety of equipment configurations that each computer system can assume,
- The wide range of computer applications and possible techniques for handling them,
- The ever-present limitations on time and money for the selection, programming, and operation of the system, and
- The incomplete and unstandardized equipment specifications that the analyst who must select a computer system is usually forced to settle for.

Although no computer evaluation technique developed to date can guarantee selection of the one computer system that represents the best overall choice for a particular user's needs, there are some techniques available today that can go a long way toward ensuring that the next computer system you select will be a truly suitable, economical choice. One such technique utilizes standardized benchmark problems to produce directly comparable measures of digital computer system performance. This technique was conceived four years ago in connection with the development of *Auerbach Standard EDP Reports,* a comprehensive computer reference service that provides information, in a rigidly standardized format, on all aspects of both computer hardware and software. The technique has been applied to more than 60 different computer systems to date, and it has been widely accepted by computer manufacturers, the United States government, and private computer users.

This article describes the measurement of system performance on a file updating problem that is typical of many commercial data processing applications. The same basic technique, with appropriate modifications, is being applied to a variety of problems in both business and scientific data processing. The resulting published system performance data, which is necessarily based on certain standardized equipment configurations and problem parameters, can easily be adapted by the user to reflect his own equipment and applications.

Basic Philosophy

In order to provide reliable comparisons of computer system performance, the methods of measurement must be objective. The standardized benchmark problems must be precisely defined to minimize subjective errors. On the other hand, they should be flexible enough to exploit useful individual features such as variable word length, automatic editing, and block-transfer facilities. To meet these seemingly contradictory requirements, a two-pronged philosophy is necessary.

First, the external requirements of the process performed by the computer system are rigidly specified. This means that we define the type and format of the input that will be provided, the results that must be produced, and the basic procedure for generating the required output from the available input. The computer system must be designed and programmed to conform to these external requirements.

Conversely, the internal arrangements of the computer process are left flexible. This means that the estimator is free to choose the detailed programming method that best suits the specific problem and equipment configuration. He may choose to perform the computations and store the master file in decimal, binary, or any other suitable form; he may decide to read the input data and print the results either on-line or off-line; and he may make dozens of similar choices in determining the most efficient overall procedure.

The need for internal flexibility precludes the use of any "magic formula" for calculating system performance; modern computer systems are just too complex and variable in their logical structure to permit reliable automation of this part of the evaluation process. The estimator who derives the published system performance data must be an experienced programmer-analyst, and he will usually need to code and time a number of alternative cases to arrive at a procedure that is essentially optimum for the equipment being evaluated.

The File Updating Problem

In the standardized file updating problem, a master file is read and updated to reflect transaction data contained in a detail file. A record of each transaction is written in a report file. This type of run, involving two basic inputs (old master file and detail file) and two basic outputs (updated master file and report file), forms a large part of the workload in many data processing installations, in such applications as payroll, billing, and inventory control.

Problem and Equipment Parameters

Three major problem parameters can affect performance on a file updating run such as this:

- The activity factor, i.e., the ratio of items in the detail file to items in the master file. For example, if there is a detail record corresponding to every tenth record in the master file, the activity factor is ten percent.
- The sizes of the records in the master, detail, and report files. These can affect the times required for input, output, packing, editing, and radix conversions.
- The amount of computation that must be performed each time an activity occurs.

The modularity of current computer systems makes it equally important to consider the effects of several parameters involved in particular configurations of computing equipment:

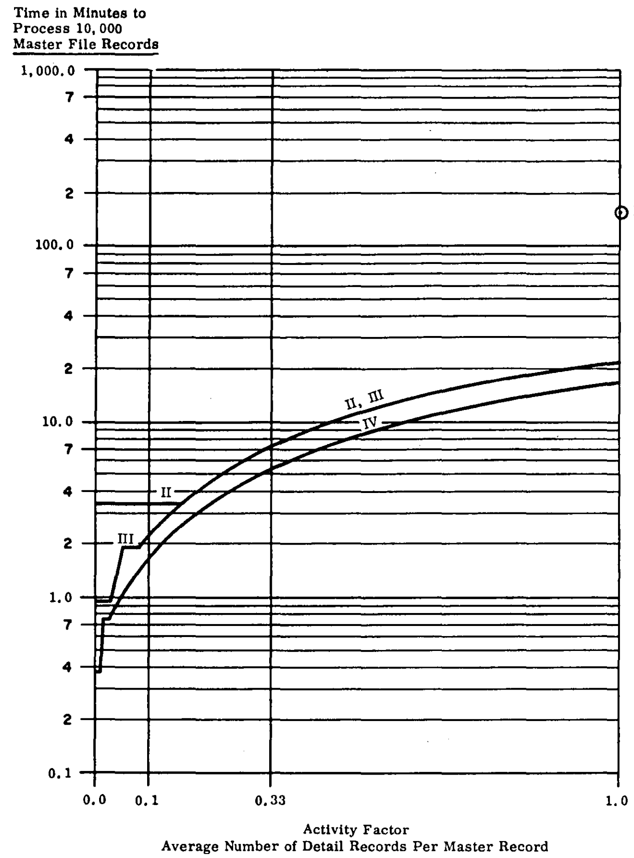
- Effective speeds of the central processor and all input-output devices. (The effective speeds of many I/O devices in particular applications will be significantly lower than their rated speeds.)
- Simultaneity, i.e., the ability to overlap internal processing with one or more input-output operations.
- Amount of internal storage available to hold the program, the data, and all necessary utility and service routines.
- Desirability of using special off-line equipment to handle card-to-tape and tape-to-printer transcriptions instead of reading the detail cards and printing the reports on-line.
- Inclusion of optimal features that may be available to facilitate multiplication, division, editing, indexing, etc.

The Estimating Procedure

The existence of all these problems and equipment parameters means that there are a very large number of possible combinations to be examined. To reduce the published system performance data to manageable proportions, a number of standardized equipment configurations are defined, and the results are presented in the form of graphs that show the effects of variations in the problem parameters.

CONFIGURATION III: 6-TAPE BUSINESS SYSTEM	
Internal Storage:	2, 000 one-address instructions (or equivalent) plus 8, 000 characters of data
Magnetic Tape:	6 units @ 30, 000 char/sec
Card Reader:	500 cards/min
Card Punch:	100 cards/min
Printer:	500 lines/min
Indexing:	Yes
Overlapped Read/Compute or Write/Compute:	Yes

Figure 1. Specifications for a Standardized Equipment Configuration



(Roman numerals denote standard System Configurations.)

Figure 2. File Updating Times for Several Configurations

An example of a standardized configuration is shown in Figure 1. The standardized configurations are designated by Roman numerals, and Figure 1 summarizes the specifications for Configuration III, a typical arrangement for a small-scale business data processing system with six magnetic tape units and an on-line card reader, card punch, and printer. Indexing and the ability to overlap magnetic tape reading or writing with internal processing are included when available.

In evaluating Configuration III for a particular computer system, the available peripheral devices whose rated speeds are closest to the nominal speeds specified in Figure 1 are selected. Any significant deviations from the standardized configuration are noted, and the rental price for the actual configuration is published. A dozen standardized configurations of widely varying size and orientation have been defined, and three to six of the most appropriate ones are evaluated for each computer system we analyze.

The basic timing elements that must be computed for the file updating problem are as follows:

- The input or output times required to read or write each block of the master, detail, and report files.
- The processor delays during input-output operations, which can range from nearly zero to the total input-output time depending upon the degree of simultaneity.
- The computation times involved in dealing with one block of the master file, one record in the master file, and one detail transaction.

In deriving the computation times, many methods for evaluating system performance are based on "guesstimates" to avoid getting down to the necessary level of detail. The standardized benchmark problems specify, by means of detailed block diagrams, exactly what computations must be performed. The computer instructions required to perform the specified computations are coded and timed. The previously discussed flexibility in the file arrangement and coding methods means that the analyst who codes the problem can take full advantage of the individual features of each computer — features like variable word length and automatic editing facilities. The resulting computation times are closely comparable to the actual execution times for coding written by a competent, experienced assembly-language programmer.

Applying the Results

All of the basic timing elements are worked out on the common basis of 10,000 master-file records. Then, these timing elements are combined, with due regard for the system's capabilities for simultaneous operations, and the total time required to perform the file updating run is plotted as a function of the activity factor, as shown in Figure 2. A logarithmic time scale is used so that the same coordinates can be used for all computer systems and a wide range of times can be accurately represented.

The Roman numerals in Figure 2 represent standard system configurations. Configuration III is the 6-Tape Business System whose specifications are summarized in Figure 1. Configurations II and IV represent smaller and larger magnetic tape configurations, and Configuration I is a punched card system that takes a much longer time to do the standard file updating job because of the relative slowness of the punched card output.

Figure 2 shows the times required for a particular third-generation computer system to process the standardized file updating problem for a certain master-file record length and a certain amount of computation per record. Other graphs show the times required for different record lengths and different computation volumes to give the user a good feel for the overall performance characteristics of each computer system.

Now, chances are that the problem and configuration parameters that are used to derive the published performance curves will not coincide exactly with your own data processing requirements. Therefore, how do you go about relating the published data to your own particular conditions? The "Users' Guide" section of *Auerbach Standard EDP Reports* explains the exact computational process used to develop the published estimates, and detailed worksheets summarize all the important timing elements that have been derived for each computer system. Using this information, you can easily make the necessary changes in configuration and problem parameters and adapt the published processing times to your own equipment and applications. The development of these standardized benchmark measures of system performance is time-consuming, but adapting the published results to other similar problems is quite simple for the user to do.

Trends in Processing Power

The performance of a number of commercially available computer systems on the standardized file updating problem is compared in Figure 3. This graph is designed to illustrate recent trends in commercial processing power. It summarizes some of the published results of our system performance analyses of 30 digital computer systems of the so-called second and third generations, all of which use solid-state circuitry and core or thin-film storage. Each white dot represents the performance of a computer system that was delivered before January 1, 1964 — a so-called "second-generation" system. Each black dot represents a more recent, or "third-generation," system; many of these have not yet been delivered. To keep the graph uncluttered and to permit you to focus your attention on the overall trends, no attempt has been made to label the individual points with the names of the computer systems they represent.

Figure 3 is a logarithmic plot of system rental, in dollars per month, versus file updating time — the time, in minutes, required to process 10,000 master-file records in the standardized file updating problem at an activity factor of 10 percent. Both the system rentals and the processing times, in all cases, are again based on Standard Configuration III.

What every computer user wants is more processing power per dollar. The diagonal lines in Figure 3 are lines of constant processing power per dollar, or constant price-to-performance ratio; the product of monthly rental and processing time is the same at all points along a given diagonal line. Furthermore, as you move upward from the lower left-hand corner toward the upper right-hand corner, each successive diagonal line represents a price-to-performance ratio that is higher by a factor of two than the next lower line. Obviously, then, the systems closest to the lower left-hand corner offer the most computing power per dollar; and you can see that the new third-generation systems represented by the black dots, as a

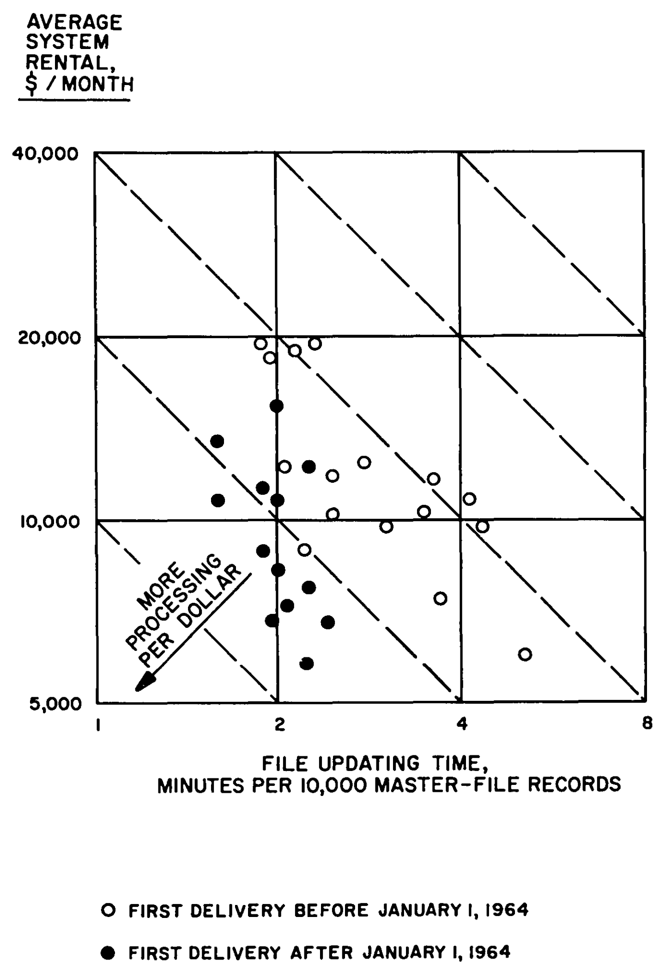


Figure 3. Trends in Internal Processing Power

group, look significantly better than their second-generation predecessors represented by the white dots.

Dollar for dollar, it appears that you can expect to get roughly twice the overall processing speed out of a wisely selected third-generation computer system in this sort of typical commercial application. Figure 3 also makes it clear that arbitrary selection of a computer system can be a costly mistake and that a properly conducted computer evaluation study can save you literally thousands of dollars per month.

Validity of the Technique

Do these standardized benchmark problems represent a valid, useful technique for measuring computer performance? Let's examine some of the evidence that makes us confident they do:

- First, all of the material to be published about each computer system is submitted to the computer manufacturer for a prepublication review. The manufacturers are invited to examine our technique and approach and to let us know if there are any errors in our analysis of their equipment or any way in which their equipment could be more effectively utilized in processing the benchmark problems. This review procedure helps to ensure the accuracy of the published results on each system; and, in nearly four years, the manufacturers (including those whose equipment has not fared well in the published analyses) have failed to find any basic fault that would tend to invalidate either the technique or the published results.
- Second, several of the major computer manufacturers are now checking out their proposed new computer lines on these benchmark problems, before announcing them, to make sure the proposed equipment compares favorably with what their competitors have to offer.
- Third, in the case of the benchmark problems that measure sorting and matrix inversion speeds, it is frequently possible to compare the processing times derived by your standard estimating procedures with the published timing data for the standard routines provided by the computer manufacturer to do the same jobs. The estimated and actual times usually agree to within 10 percent; where they do not, the discrepancies are nearly always due to the fact that the sorting or matrix inversion techniques employed by the manufacturers' routines differ from the straightforward techniques used in our estimates.
- Fourth, in the relatively few cases where it has been practical to actually run these benchmark problems on the subject computers, the agreement between the estimated and actual processing times has been quite close. It should be emphasized, though, that the published processing times are idealized times, with no allowance for set-up times, equipment failures, inefficient coding, operator errors, or idle time. We publish the basic performance figures and equipment costs, and it is up to the individual analyst to use his skills to do what no generalized service can do for him: make the necessary adjustments to arrive at overall cost comparisons for his own particular installation.

Whether you use these standardized benchmark problems or some other evaluation technique, the importance of making an objective, systematic study of all the possibilities the next time you are faced with the task of choosing new computer equipment can hardly be overemphasized. As Figure 3 plainly indicates, there is enough money to be saved — and enough potential grief to be avoided — through selecting the best equipment for your needs to make it well worth the time and effort involved.

COMPUTER ANALYSIS AND THRUPUT EVALUATION

(Continued from page 15)

directly connected to a 7090/94 used exclusively as an arithmetic processor.

Table 3

ANALYSIS OF TIME SPENT

Hardware Monitor's Measurement	Use (Percent)
CPU Only	1%
Tape Only	16%
Unit Record Only	56%
CPU/Channel Overlap	27%
Channel A	38%
Channel B	35%

Tracking Down a Bottleneck

In addition to guidance in determining equipment or different system approaches, these tools can assist the user in improving programming of applications.

Table 3 lists the results of an actual 7074 run. The bottleneck in the run can be traced to something in the unit record operations. Several possibilities may be the cause. If trouble is due to the use of card reader, printer, or punch on-line, then substitution of tape input/output should be considered.

On the other hand, frequent cases have been seen in the data processing area where the bottleneck is due to excessive use of the typewriter. In this 7074 installation, the operators were making excessive use of the typewriter for messages instead of holding down communications to brief operator statements. Experience has shown that, in a wide variety of jobs, use of the typewriter has been less than 10 per cent. The thruput in this particular job could be improved by a factor close to two if judicious use were made of facilities available.

Further examination of the results shows that other areas of improvement would result in marginal savings for this job, especially if equipment expenditures are required. The use of channels indicate they are well balanced; the degree of CPU/channel overlap was excellent since only 1 percent of CPU time has not been hidden. The only possible improvement indicated, without going to faster tapes, would be a reduction in tape-only time through increased blocking.

Turnaround

This discussion has deliberately omitted a factor very important to an installation's management, that of service to the users or "turnaround"; that is a subject in itself. However, even restriction to the types of comparisons discussed show that overall systems' performance is very difficult to measure with any degree of reliability.

It is extremely important to detect all the limitations which may exist, or considerations to be evaluated, when single performance ratios are quoted. The interpretation has to be placed in its proper perspective. Regardless of the variety of techniques used, it is easy to bias the conclusions in favor of a particular system.

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Teletype Model 33 and 35 page printers and automatic send-receive sets operate on the same permutation code approved by the American Standards Association for information interchange. This means they "talk" the same language as most business machines and computers.

The Voice of Data Processing In many data processing systems, this Teletype equipment is used as input/output devices for computers as well as for on-line communications. In addition, they can be used to punch messages and data off-line for later transmission on-line at full speed to distant points or directly to computers.

These sets have new 4-row keyboards that are familiar to any typist, and eliminate shifting between letters and numbers to further reduce errors. Also, fixed information can be stored on punched paper tape and combined with variable data to save retyping.

Data Processing Uses of Teletype Sets An eastern food processor uses Teletype page printers to receive transmissions from its midwestern branches reporting their daily sales and inventories. These statistics are processed in a computer which provides management with up-to-date information on inventory and sales conditions.

A Texas gas company uses Teletype page printers not only to communicate messages and accounting data, but also to transmit information about field measurement equipment to the home office.

Other Teletype page printer applications include: airlines for real-time reservations, railroads to maintain optimum freight car inventory, insurance companies for real-time processing of policy payments and claims, hospitals to forward patient-treatment information to centralized billing and accounting, and in many other communications systems to speed the flow of information.

Applications Brochure Available The many applications of Teletype page printers in real-time data processing are another reason why they are made for the Bell System and others who need reliable communications at the lowest possible cost. To obtain a copy of our "HERE'S HOW" brochure write: Teletype Corporation, Dept. 88A, 5555 Touhy Avenue, Skokie, Illinois 60078.

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THE VALIDITY OF BASING COMPUTER SELECTIONS ON BENCHMARK RESULTS

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Much has been said lately about the value of using benchmarks in selecting computer systems. The purpose of this article will be to discuss the validity of basing computer selections on the results of benchmark demonstrations. This discussion is based on the authors' experience in computer selection, as members of the Electronic Data Processing Equipment Office of the Electronic Systems Division, Air Force Systems Command.

Definition of Benchmark

The first point that must obviously be discussed is the definition of a benchmark. A commonly accepted definition of a benchmark is "a routine used to determine the speed performance of a computer system." Therefore, computer selections based on benchmark demonstrations can be no more valid than the routines used to determine the speed performance. Clearly, if the routine used as a benchmark stresses arithmetic functions, whereas my workload consists essentially of data manipulation functions, then the benchmark has served as a poor basis for selection, and I might well have been better off not using it. On the other hand, if the routine used as a benchmark is drawn from, and is representative of, the programs that make up the largest part of my workload, then I should have an excellent basis for selection.

Validity of Benchmarks

Benchmarks therefore can be of great value in selecting a computer system which best handles one's workload. But before valid results can be obtained, the proper benchmarks to be used must be selected.

To show why the selection of proper benchmarks is really important, it is worth considering some of the findings uncovered by use of some benchmark problems in a recent selection of scientific computers within the Air Force. Since the selection was conducted within the Air Force on actual problems, anonymity of both proposals and problems must be maintained. Therefore, the systems proposed will be identified as A, B, C, and D, and the specific benchmark problems will be identified as W, X, Y and Z. Only relative

Table 1

COMPILATION TIMES

Problem	System: A	B	C	D
W	2.53	2.47	1.27	1.00
X	3.19	2.67	1.00	1.30
Y	2.57	2.29	1.11	1.00
Z	3.19	2.79	1.00	1.03

Table 2

EXECUTION TIMES

Problem	System: A	B	C	D
W	1.00	1.10	2.10	2.57
X	1.36	1.00	2.09	2.00
Y	1.00	1.32	2.76	1.35
Z	1.12	1.00	2.12	4.05

times will be given. This anonymity does not affect what is reported here, since our concern is not with the specific selection, but rather the types of inferences that can be made from the example.

Benchmark Runs

In response to the request for procurement, four systems were proposed. Each of these systems compiled and executed four different benchmark problems. The relative results of these benchmark runs are shown in Tables 1 and 2.

From the compilation and execution relative times presented in Tables 1 and 2, we can draw the following conclusions:

a. The compiler speeds of systems A and B were extremely slow in comparison to the compiler speeds of systems C and D. This was due to the fact that systems A and B were utilizing a compiler which stressed object program efficiency and diagnostic capability in lieu of speed. This objective was met as can be seen in the execute times presented in Table 2.

b. System C employed a compiler which stressed compiler speed. The compiler sacrificed object program efficiency for compiler speed. The arithmetic computational speeds of this system should have been extremely fast since its cycle time was considerably faster than the other system; however, it was handicapped by the inefficiency of the compiler-generated object program.

c. System D demonstrated extremely fast compile time. This primarily was due to the fact that random access was employed to store compiler routines and consequently reduced the usual time-consuming tape search time connected with compiling.

Ranking of Computer Systems by Benchmarks

Now, from scanning the tables, it is clear that the measuring device (benchmark) used to determine the capability of a system *does* make a difference. The relative ranking of a computer system can be seen to vary from benchmark to benchmark. This should put to rest the misstatement which is often repeated "Any old benchmark will do; all you need is some constant measuring device." While it is true that a given benchmark remains a constant measuring device from system to system, it is not true that "any old benchmark will do," any more than it is true that you would use a tape measure to compare the weights of various objects. A constant measuring device may be measuring the wrong thing, and "any old benchmark" might similarly be measuring the wrong thing.

Nature of Workload

The tables show the necessity of fitting the benchmarks to the nature of workload that will be processed. However, it is not enough to just find benchmarks of the general type; the benchmarks should be as nearly identical to the workload to be processed as is possible. We can readily see that if we had specified our workload as consisting chiefly of compiling, then either system C or system D could be the best system to complete the workload in the minimum time, but we wouldn't know which one. Similarly, if we had simply specified our workload as consisting chiefly of execution of pre-compiled programs, then system A or system B would be the most satisfactory, but again we wouldn't know which one was best.

In order to know which one of a set of systems is best for you, you have to have a detailed knowledge of what your workload consists of. The results show that, from a workload point of view, any one of the four systems could be judged most satisfactory depending upon which problems are chosen as being most representative of the workload. If the workload is considered to consist essentially of compilations like those shown in problems W and Y, then system D would be the most satisfactory for completing the workload. However, if the compilations were more like X and Z, then system C would be the best system. Similarly, if the workload were considered to consist of execution of problems like W and Y, then system A would be the best system. However, again, if the workload consisted of execution of problems like X and Z then system B would be the best system.

Hopefully, the previous examples show why it is critical to select the proper benchmarks to reflect your workload.

Relationships between Workloads

However, not only must the proper benchmarks be found to reflect the workload, but the relationships between the workloads represented by the benchmarks must also be known. For instance, to assume that one's workload consists of compiling and executing problems similar to benchmark W is insufficient. If the compile and execute functions of benchmark W are run on all four systems, it is found that system D handles the compilation function best and system A handles the execution function best. However, which of these two systems is best? Unless, the relative relationship between these two functions is known, the best system cannot be determined. A similar example might be made for a workload consisting of execution only, say like benchmarks X and Z. If the relation of X type workload to Z type workload is not known, it would be impossible to really know if system A or system B would be best to handle the workload.

These have been simple examples. The problem becomes more complex as more benchmarks are used. One proposal is to simply take the sum of the time for each system to process all the benchmarks. But this is naive, unless each of the benchmarks is equally important in the total workload, which rarely happens. In such situations it is essential to know the percentage of workload represented by each benchmark, the relationship of the benchmark to the class of problems it represents in terms of equipment requirements, and several other critical relationships.

The purpose of this article is to claim that the use of benchmarks in selecting computer systems is completely valid, if the proper routines have been selected as benchmarks. The examples given have been used to demonstrate the need for understanding and selecting proper benchmarks which adequately reflect your workload.

This article has limited its discussion to benchmarks. However, similar arguments could be made for or against any other technique for comparing systems: namely, the results found are dependent upon the conditions and factors considered. If your conditions and factors are not identical to those established in the comparison, then you should be very skeptical of using the results of the comparison. The purpose in reading any articles on system comparisons should not be to obtain some hard and fast facts about the relative ranking of certain systems. Instead it is necessary rather to obtain information on how you can establish your own ranking of the systems you're interested in, based on your own workload and needs.

Reference

1. "Application Benchmarks — The Key to Meaningful Computer Evaluations," presented at the 1965 conference of the Association for Computing Machinery.

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c&a CAPITAL REPORT

A Special Report from C&A's Washington Correspondent

A world-wide, computer-based communication system, operating within the United Nations, has been recommended as a vehicle for distributing information for peaceful purposes throughout the world. The recommendation was made November 30 by the White House-appointed Citizens' Communications Committee, headed by Harold S. Geneen, chairman and president of International Telephone & Telegraph Corporation.

According to Geneen, the means for setting up the system exist, and large capital investments would not be required. As a new U. N. agency — called the Voice of Peace — the system would be a central point of information, query, storage and reference for participating nations on such vital subjects as medicine, agriculture, meteorology and education.

Simple message forms would be designed and used for inquiries to and from the Voice of Peace, and simple means of addressing and routing them can be devised. In addition to existing communications networks that operate with telephone, data sets, and teletypewriters, the radio and television systems throughout the world could serve to disseminate cultural and educational knowledge.

As part of our contribution to such a system, Geneen suggested that the United States create schools to train computer operators, programmers and other essential personnel in use of input and output devices for the system. Our Peace Corps could provide volunteers for training these people, he suggested. They would work on a rotating basis with a small cadre of permanent employees.

The Patent Office, in the Department of Commerce, hopes to award a contract this Spring to a firm that will build it a large system to store, retrieve, duplicate, and display the entire patent file, which currently contains more than 3,000,000 documents. Proposals were due in Commerce by January 4.

Research into such a system has been going on at the Patent Office for several years. The need is apparent from a few statistics: the Office presently disseminates over 27,000 copies of patents daily; this service totals more than 160,000 pages of information.

The system the Patent Office would like would combine microform storage with on-demand retrieval. Hard-copy printers would produce the requested copies from the retrieved microform. A major part of the contract effort would be concerned with conversion of the current patents to microform and reorganization of the material into specified sequences to permit the generation of microforms.

An experimental computer model built for the Air Force has clearly established the feasibility of using conventional English to communicate with a computer, according to General Electric, which described the system in a recent report. Although the model has not been perfected, GE said it points the way toward the design of a prototype computer that will work.

The computer model is called Deacon (Direct English Access and Control), and uses counterparts to conventional English to interpret sentences fed to it. With a limited vocabulary, GE said, the computer will make decisions about the spatial relationships of the words in a sentence and about the meaning of the words and the semantic implications of the structure in which they are found.

GE said Deacon's grammar still needs work and the input/output leaves something to be desired, but, it said, the model has shown "beyond any doubt that the basic techniques are adequate for the development of a system which will allow direct access and control of digital computers through the use of largely unconstrained English."

The Commerce Clearinghouse, Springfield, Va., has two reports that describe the Deacon system: No. AD 612 165, "Deacon Breadboard Processing," price $3.00; and AD 612 171, "Deacon Breadboard Grammar," price $5.00.

In an anti-trust suit that began three years ago, IBM Corp. was declared not guilty of monopolizing the tabulating card business by a November decision of a Federal Court in Chicago.

The $21,000,000 suit was brought against IBM by J. J. Hackett & Co., of Chicago, which said IBM refused to sell rotary card presses to other manufacturers; discriminated in prices and services to purchasers of its cards; and sells or leases computers at a discount on the condition that the user does not buy tab cards from anyone but IBM.

In its defense, IBM denied all of the charges and said its price differentials reflected differences in the cost of manufacture, sale or delivery that resulted from different methods or quantities involved. It said its lower prices were made in good faith to meet competition.

James Titus

JAMES TITUS

If you're renting more computer than you need, it's like burning money.

NCR's new 500 Series costs less than other low-cost computer systems. Its unique building-block design enables you to start small — then grow as your needs expand. You never pay for more than you need or more than you can use.

A basic NCR magnetic ledger system rents for $765 a month. A card system for $1195.

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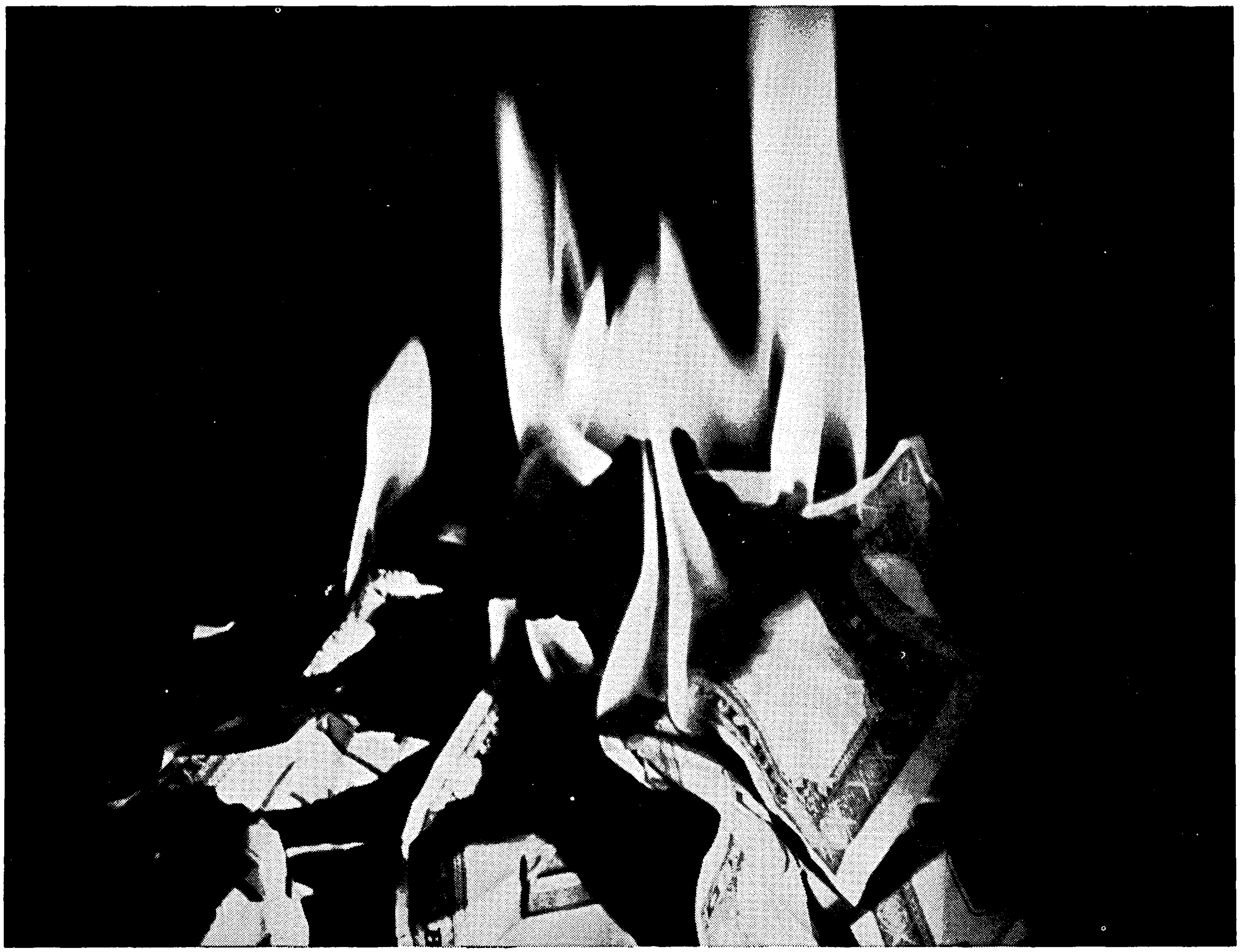
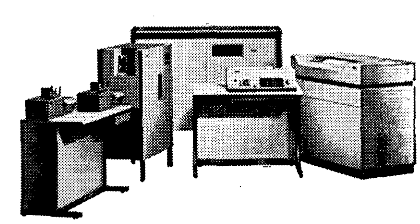
And it's more flexible. Only the "500" in the low-price field offers you your choice of all the computer languages — punched card and tape, magnetic ledger, optical print tape.

We could go on and on like this about the new "500" Series. A call to your local NCR office and we will.



NCR



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"ACROSS THE EDITOR'S DESK"

Computing and Data Processing Newsletter

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APPLICATIONS

SURGICAL MONITORING SYSTEM

An electronic surgical monitoring system which visually alerts physicians to sudden physiological changes in a patient's condition during neurosurgery, while storing this information for later computer analysis, has been developed by the Mayo Clinic and IBM Corporation. Dr. John D. Michenfelder, of the Anesthesiology Department and Dr. Colin S. MacCarty, head of the Department of Neurosurgery at the Mayo Clinic, said the system has been a key factor in helping surgical teams keep patients alive during critical neurosurgery procedures by providing more complete and accurate information than was previously possible.

The unique system instantly senses key physiological changes, such as heart rate and respiration, and displays them on a television screen. The system's ability to simplify physiological measuring enables surgical teams to respond instantly to any emergency situations which might occur during surgery. Dr. Michenfelder said the system at St. Mary's Hospital in Rochester, Minn., is believed to be the first in the nation to be manned solely by medical personnel from within the operating room.

According to Ferd Anderholm, manager of the IBM engineering effort, the system continuously records information during surgery using a typewriter, punched paper tape, magnetic tape and an optical oscillograph.

During surgery, electrical signals are transmitted from physiological detectors. These signals then are converted into digital information, stored in a central processing unit and printed out on a special typewriter terminal. The information, in turn, is scanned by a closed-circuit TV camera and displayed on the operating room screen. Doctors in surgery are

— This photograph shows how system would display information during actual operation at St. Mary's Hospital in Rochester, Minn.

able to determine in a brief glance at the 14-inch screen the status of such life-sustaining indicators as heart and respiratory rate, arterial pressure and body temperature.

Automatic readings of electrocardiograms (ECGs) and electroencephalograms, or brain waves, (EEGs) are also supplied by the system on a five-inch satellite oscilloscope screen located only a few feet from the patient.

A control unit allows the system to be regulated from within the operating room while surgery is in progress. The anesthesiologist can select the particular combination of physiological measurements most important to him at the moment by flicking a switch. The video monitor mounted on the operating room wall then displays the ECGs, for example, or readings on such indicators as blood pressure and respiration.

A second TV screen mounted outside the operating room also permits interested medical personnel to observe events during surgery.

The new system has been operating at St. Mary's Hospital since last May and has been used during surgery on more than 250 neurosurgical patients. A second neurosurgery operating room at St. Mary's was expected to be hooked to the system by the end of 1965, and all four of the hospital's neurosurgical operating rooms are expected to be added to the network eventually.

ELECTRONIC NETWORK PROCESSES CHRYSLER WARRANTY PROGRAM

An RCA 3301 computer system is the heart of a new electronic network placed in operation by Chrysler Corporation to provide its dealers and customers with instantaneous information on any car or truck covered under the company's five-year or 50,000-mile warranty program. Pertinent data on vehicles is received within two seconds on visual data display devices in the individual offices, something that previously took several days.

In addition to the RCA 3301, the computer-complex also includes an RCA 3488 random access mass memory device capable of storing 680 million data characters, magnetic tape stations for long-range information storage, and punched card equipment.

Vital statistics on three million Chrysler cars and trucks were fed into the computer system initially — data involving both the normal 12-month-12,000 mile warranty, and the 5-year-50,000 mile extended power train warranty. The master file includes the latest mileage, dollars spent on warranty claims, vehicle manufacturing date, serial number of the car or truck, the body type and a list of accessories.

To comply with the warranty agreement, the vehicle owner observes a few simple maintenance routines — an oil change at least every three months or 4,000 miles, new oil filter every second oil change, air filter cleaning every six months and replacement every two years. The extended warranty can be transferred through notification to Chrysler if a car or truck is sold before the coverage period expires.

The dealer can telephone or send a teletypewriter message to the nearest Chrysler regional office and ask for all available information on a car he is considering as a trade-in. Using an RCA visual data display device, the regional office can transmit by means of an electric typewriter unit, the request for facts and figures to the Chrysler home office. In a moment the "case history" of the car in question will be flashed on the TV screen in the regional office.

The dealer thus knows quickly whether the owner has observed the warranty regulations and by the same token whether the automobile has been cared for properly. For the car owner, this can mean a favorable resale or trade-in price.

The system, which connects the remote TV monitors to the Detroit-based computer via telephone lines, currently is operating between Detroit, Cleveland and Chicago. The network eventually will link regional sales offices in 23 cities across the nation.

RAINFALL SIMULATING SYSTEM

To carry out a scientific research study of water runoff and its control over watersheds, the University of Illinois is installing a rainfall simulating system — complete with 1600 square feet of terrain which can be changed to reproduce virtually any geophysical area.

The "rainfall" project is sponsored by the National Science Foundation and conducted under the direction of Professor Ven Te Chow, internationally noted authority on hydrology, fluid mechanics and water resources.

A major portion of the "rainmaker" has been built by Electronic Associates, Inc., West Long Branch, N.J., utilizing the PDS 1020 computer to provide computerized control.

In operation, the University of Illinois rainfall simulator will "create" storms of varying intensity over the 1600 square feet of changeable terrain. Rainfall intensity can be controlled over several specific points of the terrain simultaneously, made to sweep across the entire area, or simulate any storm pattern movement.

Water runoff from the model basin will be continuously monitored and processed within the PDS 1020 to provide an overall record of runoff vs. time for an infinite variety of basic terrain configurations and storm profiles.

Four hundred raindrop producers, each "raining" over an area of four square feet, will contain capillary tubes which produce changeable rainfall intensity — but under the operator's control. Each of 100 digitally-controlled valves will control four raindrop producers, achieving intensity equivalents ranging from zero to 13 inches of rain per hour.

Rainstorms to suit the needs of the researcher will be pre-programmed and stored in the PDS 1020. A paper tape will be prepared as a permanent record to repeat identical storms. The 1020 will read this pre-programmed tape into the system for continuous control of the rainfall. The computer also will continuously process information on water inflow and water depth in the outflow tank, and print out a complete record of runoff vs. time.

COMPUTER-CONTROLLED TRAFFIC SYSTEM

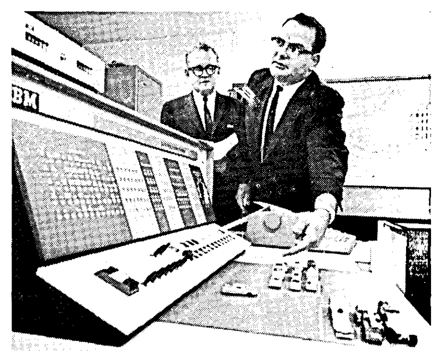
Drivers in San Jose, Calif., are spending less time behind the wheel since a new computer-controlled traffic system went into operation. The first phase of the new experimental system is now operational and is automatically controlling traffic signals at 32 intersections along a major three-mile highway and adjacent streets leading into the downtown section of the city.

The new computerized traffic system is the result of a cooperative study being conducted by engineers from the City of San Jose and IBM Corporation.

An IBM 1710 Control System receives information from 400 sensing devices buried beneath the pavement at the intersections involved in the study. As cars pass over these sensors a magnetic field is interrupted and a pulse is sent to the computer.

In this way, the computer is constantly aware of the number of vehicles, their speed, which lane they are in, the number and duration of stops, and the number of vehicles that pass a given intersection during each cycle.

Here is how the computer works. It receives enormous amounts of information about the flow of traffic from all sensors simultaneously; within seconds it consults the many possibilities in its memory about how to reduce delay time and decides on a logical course of action; it executes control by altering traffic signal timing cycles; it receives more information from traffic sensors to verify whether the action was successful before starting another cycle.



— Computer engineers Merle Mason, left, and Dennis Baughman, discuss methods of improving traffic flow in San Jose, Calif., with a new computerized control system. The board in background represents the streets involved in the joint study.

Gene Mahoney, San Jose assistant traffic engineer, says, "By using a computer, all data can be immediately collected and analyzed in one central location. We can produce more information in a matter of seconds about the flow, speed and other elements of traffic than a crew of trained observers could produce in hundreds of hours."

The study, now in its second year, has provided volumes of information about how traffic patterns react under control of a computer. San Jose city engineer, A. R. Turturici, said preliminary results show a significant improvement in the methods of handling the flow of 35,000 cars that use the highway daily. The next phase of the study calls for the more complicated task of controlling 28 traffic signals located in a 35 square block area in downtown San Jose.

COMPUTER-CONTROLLED BLOOD BANK

The blood bank of the Alameda-Contra Costa County Medical Association, Oakland, Calif., makes use of the Lockheed Missiles & Space Company's computer facility to control the bank's inventory of blood. The system, first of its kind in the United States, had a year's test run which indicated a saving in blood, time and money. A contract has been signed by Lockheed Missiles & Space Company and the Alameda-Contra Costa County Medical Association for computerized systems control of the two-county blood bank.

Under the Lockheed-designed system, 29 hospitals with 4600 beds report daily their usage and needs for blood. The Alameda-Contra Costa bank handles and stores 34,000 pints of blood a year. A computer organizes the information into daily reports showing where the blood is, where it is needed and which blood may be approaching discard because of prolonged shelf life, and other pertinent information.

Dr. Carl Goetsch, president of the medical association, said the system during the first year's trial paid for itself in savings of blood. The current outdating rate for blood at the bank is 6%, which is one-half of the average for the last several years and one of the lowest in the country. National average for all blood banks is estimated at between 15% and 18%

"In addition," Dr. Goetsch declared, "the knowledge that all of our blood users are linked into a precise system has given us greater confidence in our ability to meet emergencies and all but eliminates harrowing high speed journeys by law officers to rush blood to persons in emergency cases. Hospital inventories have been lowered, errors reduced and panic-type procurement eliminated."

Every day the Blood Bank polls each of its 29 hospitals for the changes in status for the blood on hand. Hospitals report, by identification number, bloods placed on cross-match (that is: assigned to a patient), bloods released from cross-match, or bloods transfused. This, plus the information obtained from the laboratory log book of bloods delivered to the box ready for shipment to hospitals, and the movement of blood as taken from the shipping tickets, is punched onto a paper tape which is then transmitted by dataphone to the Lockheed computer.

Input is processed during the night and reports go back to the bank at 6 a.m. the next morning. The paper tape received by the bank is run through a Flexowriter and all printed reports are on the desk of the blood bank management by 8 a.m.

One report covers an audit of expiration dates. Another is a daily inventory of every unit of blood at every hospital showing the remaining time before expiration, whether or not it is on cross-match and the blood identification number, the blood group and type, and the hospital at which it is located.

An 11-day report shows what bloods have passed the 10th day, enabling the bank to remove them from small outlying hospitals and bring them to the metropolitan centers where they are more likely to be used before expiration.

Every Monday morning a report shows weekly averages of blood transfused by blood group and location over the last three months. With this, it is possible to anticipate and solve stocking problems at hospitals.

A monthly report gives a complete survey of the preceding period for the start of the new month and for decisions by the management.

The control system has received widespread attention from other cities and other groups concerned with supplying blood to hospitals.

ANNOUNCE RESULTS OF "OPERATION CORRAL"

The Police Department, City of New York, has announced the results of "Operation Corral", a five-month experiment in the use of a real time computer in the identification and arrest of automobile and license plate thieves and scofflaws.

Assistant Chief Inspector George P. McManus, Chief of Planning, said, "In 158 days of the experiment, working eight hours a day, 'Operation Corral' checked on 183,950 cars. Of these, 2,982 were found to be wanted either on alarms for stolen cars or plates, or on warrants as scofflaws. 165 individuals were arrested, 102 on alarms and 63 as scofflaws. In addition, 68 'hits' were made on the license plate numbers of scofflaws with New Jersey registrations and 93 persons wanted here on revocation or suspension of license orders.

"One of the major objectives of 'Operation Corral' was to develop not only an instantaneous and multiple query and response identification of stolen vehicles but also to induce the public to comply voluntarily with the traffic laws and the regulations of the Motor Vehicle Department. In this regard, the record of fines paid and voluntary surrenders on Traffic Court warrants are being examined as are the volume of surrenders of suspensions and revocations received from the New York State Department of Motor Vehicles."

The experiment utilized a Univac real time computer which was based at the United States Building at the World's Fair.

A total of six members of the force handled the operation. This team consisted of two radio car patrolmen acting as an observation team, two radio car patrolmen acting as the apprehending team, and two acting as teletype operators feeding information into the computer regarding stolen cars and plates, scofflaws and revocation and suspension orders.

As automobiles passed a fixed point, usually upon a highway, bridge or tunnel, the observation team radioed license plate numbers to the team of two officers at the teletype machine. The patrolmen receiving the information teletyped the numbers into the computer, which provided an answer within seconds.

If a "hit" was made, this information was radioed to the apprehending team which stopped traffic, thus blocking the escape of the wanted car. The apprehending patrolmen then circulated through the stopped cars until the wanted car and driver was located. This method avoided the chase and cutting off of the wanted car.

Chief McManus pointed out that it is technically possible to eliminate the teletype personnel, by having the inquiry made directly from the police radio car to the computer via radio teletype. He also noted that should three teams of two radio cars each be placed on the streets of the city, it would be feasible to check two and a half times the number of registered vehicles in the city in one year.

During the experiment, 31 of the 102 arrested had criminal records, and several of the apprehensions resulted in investigations leading to additional charges in this and other jurisdictions, and additional arrests. 102 of the arrests resulted in 212 additional charges. Eighty-three per cent of the cases concluded have resulted in convictions. Among the additional charges placed were such crimes as possession of narcotics, possession of policy slips, grand larceny, robbery and forgery.

"These results indicate an important use of the computer as a modern-age tool for police," Chief McManus said. "The computer has a broad and valuable application in many areas of law enforcement and crime prevention. In this experiment it has supplied an important means of obtaining information for more efficient law enforcement. The results of 'Operation Corral' are now being studied, and upon completion, further recommendations will be made."

NEW CONTRACTS

FROM	TO	FOR	AMOUNT
National Aeronautics and Space Administration	Telecomputing Services, Inc., subsidiary of Whittaker Corp., Los Angeles, Calif.	Providing on-site data reduction and computing services at Goddard Space Flight Center, Greenbelt, Md., under a two-year Cost-Plus-Award-Fee contract	$4.4 million
State of New Jersey	MAI Equipment Corporation, New York, N.Y.	A data-processing equipment rental plan covering more than 200 IBM punched-card machines located at 30 different state installations throughout New Jersey	—
Grumman Aircraft Engineering Corp.	Autonetics, a division of North American Aviation, Inc., Anaheim, Calif.	Building 20 electronic checkout systems for Navy E2A Hawkeye early warning aircraft	$4.3 million
Redifon Ltd., Crawley, England	Ferranti-Packard Electric Ltd., Toronto, Ontario, Canada	Two Ferranti Argus 300 digital computers to be used as the control processors in a VC.10 simulator for the Ministry of Aviation and a DC.9 simulator for Air Canada	—
Department of Health, Education and Welfare	Stromberg-Carlson Corporation, Data Products Division, San Diego, Calif.	Equipment and services for the Social Security Administration's headquarters in Baltimore, Md. One contract is for an ultra-high speed computer document recorder; a second contract is for a standard S-C 4400	—
Department of Justice, Civil Division, Customs Section	System Development Corp., Santa Monica, Calif.	The design of a computer-based management information and retrieval system which will include analysis and organization of data on pending cases, statutes, pertinent court decisions	$58,000
Comite d'Organization des Dixiemes Jeux Olympiques d'Hiver, Olympic Organizing Committee	IBM France, a subsidiary of IBM World Trade Corporation	Processing and distributing the results of the 1968 Olympic Winter Games at Grenoble, France	—

NEW INSTALLATIONS

AT	OF	FOR	FROM	AMOUNT
United Air Lines, Chicago, Ill.	RCA integrated high-speed message switching system including two Model 4103 computer processors with dual operation and 24,000 word core storage. Total value of system estimated at $4 million	Processing flight information covering 1540 flights/day, involving more than 230 aircraft operating in 116 cities over 18,000-mile route structure; processing up to 200,000 messages a day, operating over 300,000 miles of telephone and telegraph lines	Radio Corporation of America, New York, N.Y.	Three-year lease — $1.8 million
Max Planck Institute for Physics and Astrophysics, Munich, Germany	2 PDP-8 computers	Controlling systems analyzing data in high energy physics research	Digital Equipment GmbH of Munich and Cologne	—

AT	OF	FOR	FROM	AMOUNT
Chicago Transit Authority, Chicago, Ill.	GE-415 computer	Revenue accounting, maintenance scheduling, inventory and stores control, responsibility reporting, payroll and other administrative operations	General Electric Co.	Over $500,000
USAF Weapons Laboratory, Kirtland, N.M.	Control Data 6600 system (value over $6 million)	Simulating and evaluating nuclear explosions	Control Data Corp.	Monthly rental, $118,428
TRW Replacement Division, Independence, O.	2 IBM System/360's, a Model 30 and a Model 40	Tighter inventory control at the central warehouse and more efficient replenishment of stock at the 40 branch distribution warehouses it serves	IBM Corporation	—
Reed Roller Bit Company, Houston, Texas	SDS 920 computer	Performance of two totally different types of jobs simultaneously — (1) monitor and control a melting process that produces tungsten carbide; (2) research studies aimed at improving the lifespan of oil field bits	Scientific Data Systems, Santa Monica,	—
Lincoln Laboratory, Massachusetts Institute of Technology, Lexington, Mass.	IBM System/360 Model 65	Completing phase two of a three-step program to establish an advanced time-sharing computer system	IBM Corporation	—
Defense Contract Administration Services (DCAS); Boston, Chicago, Los Angeles, New York and Philadelphia	Five H-200 computer systems (value over $725,000)	Handling data processing activities involving more than 50% of the approximately 220,000 Department of Defense contracts currently in effect with private industry	Honeywell EDP, Wellesley Hills, Mass.	Leased at approximately $3100-a-month each
Federal Pacific Electric Company, Newark, N.J.	IBM 1440	Use with another IBM 1440 as hub of nationwide communications system for the firm. System will include 17 IBM 1050 data communications systems	IBM Corporation	—
Bankers Life Nebraska, Lincoln, Neb.	RCA 301 computer system	Total management information system	Radio Corporation of America	—
French Atomic Energy Commission, Paris, France	EAI 8800 Scientific Computing System	Reactor simulation and training	Electronic Associates Inc., West Long Branch, New Jersey	$250,000
American Radiator & Standard Sanitary Corp., Canadian Div.	NCR 315 system	Order billing and payroll, accounts payable, inventory control, general ledger and expense accounting	National Cash Register Company, Dayton, Ohio	—
Fisher-Stevens, Inc., Clifton, N.J.	IBM System/360 system	Expansion of services to clients	IBM Corporation	—
Columbia Gas System Service Corp., a subsidiary of Columbia Gas Systems, New York City	PDS 1020 digital computer	Conducting complex engineering economic studies and reduction of problem-solving time from one day to 15 minutes	Pacific Data Systems, Inc., a subsidiary of Electronic Associates, Inc., Santa Ana, Calif.	—
Central Maine Power Company, Augusta, Me.	H-400 computer system	Use initially to keep basic records and prepare bills for company's 275,000 customers; also payroll, inventory control, transportation data, general accounting, etc. One of primary tasks will be to determine future requirements for electrical power	Honeywell EDP, Wellesley Hills, Mass.	—
NASA Manned Spacecraft Center, Houston, Texas	DATA 620 system	Shipboard duty	Data Machines, Inc., Newport Beach, Calif.	—
Institute for High Energy Physics, University of Heidelberg	PDP-7 computer	Use in one of its film analysis systems	Digital Equipment GmbH of Munich and Cologne	—
Consumers Power Company, Jackson, Mich.	Spectra 70/15 computer system including Videoscan III	Fast processing of billing and invoicing information	Radio Corporation of America, New York, N.Y.	—
Texas Instruments Inc., Dallas, Texas	IBM System/360 Model 50 and a Model 65	Hub of a total management information system encompassing all of TI's operations. Eleven IBM System/360s will be used in the system when completed in 1968	IBM Corporation, Los Angeles, Calif.	—
DPA, Inc., Dallas, Texas	Programmable Arithmetic Processor	Full range of arithmetic and data handling operations	Wyle Laboratories, El Segundo, Calif.	Over $500,000
Employment Security Commission, Augusta, Maine	RCA Spectra 70/25 data processing system	Data Processing in the areas of benefit payments, economic analysis and research and contribution reporting	Radio Corporation of America, New York, N.Y.	—
AGB Research Ltd., England	H-200 computer	Analyzing the reactions of up to 50,000 consumers to a wide variety of television commercials and commodities	Honeywell Controls, Ltd., Newhouse, Scotland	—
David Taylor Model Basin, Washington, D.C.	SDS 930 computer	Naval air weapons tests; in the future, to control wind tunnel experiments in real time	Scientific Data Systems, Santa Monica, Calif.	—
Jamaica Savings Bank, Jamaica, N.Y.	NCR 315 system	Handling deposit and mortgage accounts	National Cash Register Company, Dayton, Ohio	—
Minnesota Mutual Life Insurance Co., St. Paul, Minn.	IBM System/360	Updating all policy records on a daily basis	IBM Corporation	—

ORGANIZATION NEWS

DIGITRONICS TO DISTRIBUTE N. V. PHILIPS DATA PRODUCTS IN THE UNITED STATES

Pieter van den Berg, President of North American Philips Company, Inc., and Richard W. Sonnenfeldt, President of Digitronics Corporation, have jointly announced the conclusion of arrangements for Digitronics to distribute in the United States and its possessions, certain data handling equipment manufactured by N. V. Philips Telecommunicatie Industrie of Hilversum, The Netherlands. These products were previously distributed by North American Philips.

Products to be distributed by Digitronics include: Teletypewriter and Data Switching Systems of both the ES and DS types, the first utilizing wired logic techniques and the latter utilizing stored program techniques; Error-Correction and Detection Equipment; Incremental Magnetic Tape Storage Equipment; Modems for transmission of digital data over wire lines, and other new products as they are developed.

BRITISH-AMERICAN TEAM FORMS NEW CONSULTING FIRM

A new consulting firm, Brandon Computer Services Limited, has been formed in a joint venture by the American data processing consulting firm, Brandon Applied Systems, Inc., and a British market research and training organization, Business Intelligence Services Limited. The new firm is located in London S.E.1 and specializes in technical data processing consulting.

Brandon Computer Services Limited will provide the following specialized services to organizations using or considering the use of data processing equipment, and to equipment manufacturers: planning, feasibility study, development of standards, technical writing, training, installation audit, personnel selection and evaluation and systems design and programming.

Directors of the new firm are: D. H. Brandon, G. S. Lowry, G. H. Copeman, B. G. Allison, and W. Bonser. The staff of the new firm will be drawn from its American parent and from qualified British professionals.

CONTROL DATA ACQUIRES WALTEK LIMITED

William C. Norris, president of Control Data Corporation, and Kenneth D. Wallis, managing director of Waltek Limited, have jointly announced the acquisition of Waltek Limited by Control Data Corporation. The acquisition involved an exchange of an undisclosed amount of Control Data common stock for all the outstanding capital stock of Waltek.

Waltek is an electronics firm engaged in the assembly of electronic and electromechanical components, with primary skills and experience in the assembly of ferrite cores for computer memories. The firm is located in Hong Kong.

Norris said that the Waltek operation will initially produce core memories for Control Data's 6000 series computers.

ADAGE SIGNS OEM AGREEMENT WITH EAI

Adage, Inc., manufacturer of analog-digital conversion systems, has signed an agreement to supply linkage systems and associated conversion equipment to Electronic Associates, Inc., West Long Branch, N.J., according to I. R. Schwartz, Adage Vice President.

Adage links will provide the interface between the analog and digital processors in hybrid computer systems built by EAI.

HONEYWELL OPENS EDP CENTER IN BELGIUM MARKET

Honeywell Inc. has opened a computer service center in Brussels, Belgium, to serve the company's marketing efforts in that country.

The service center, equipped with a Series 200 computer, is the seventh of its type established by Honeywell in Europe in the past 18 months, according to Robert W. Blucke, director of international operations for Honeywell's electronic data processing division, Wellesley Hills, Mass. The new service center will provide customer support, marketing demonstrations and educational facilities.

DECISION SYSTEMS, INC. ACQUIRES COMPUTER SERVICE BUREAU ACTIVITY

The electronic data-processing service bureau activities of Rapid Computing Corp. has been acquired by Decision Systems, Inc., Teaneck, N.J. firm of computer consultants and programmers. Rapid Computing, which is engaged in the temporary help business, will continue this activity.

The announcement by Thomas A. Wood, DSI's president, did not disclose terms of the transaction. Mr. Wood said the acquired service bureau accounts would be combined with DSI's service bureau subsidiary, Decision Services, Inc., of New York. The subsidiary serves a variety of industrial and commercial clients and school districts.

COMPUTING CENTERS

STATE-WIDE COMPUTER NETWORK TO BE ESTABLISHED BY SAVINGS AND LOAN BANK

A state-wide communications system, designed to handle data processing for as many as 225 savings and loan associations is being established by the Savings and Loan Bank of the State of New York. S & L Bank acts as a central reserve and service bank for New York's state chartered savings and loan associations. Operation of the system is expected to begin in July at a central computing facility currently under construction in Fishkill, N.Y.

Those eligible to use the facility will be 140 state savings and loan associations and, because of the Housing Act of 1964, 85 federal associations. Thirty savings and loan members have made commitments to participate, according to Otto J. Rabstejnek, president of S & L Bank. "We expect this number to reach 100 shortly after the installation of the IBM computers," he added. "In any event, the system will be the largest of its kind in the country."

Mr. Rabstejnek also explained that New York State is the only state which allows savings and loan associations to have their own commercial bank. However, he believes that the success of the bank's service facility may encourage other states to follow the example set by New York.

Initially two IBM System/360 Model 30's with five disk storage devices will be linked by telephone lines to 100 transmission terminals at member locations. Additional terminals will be installed as participation by members increases. Each member will be able to use the computers as if they were actually on his premises. Because of this direct computer link, each member will operate on-line in real-time.

By far the biggest use of the computers will be for on-line savings accounting. Once participation totals 100 members, there will be over 2 million customer accounts stored on disk files in the Fishkill computer. Each of these records will be directly accessible at the members' locations through the IBM 1062 terminals.

The computing facility also will be used to handle mortgage accounting, Christmas Club accounts, money order reconciliation, general ledger and other jobs.

QUIKTRAN DATACENTER

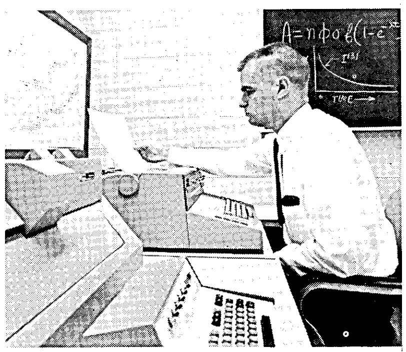
A single time-shared computer in Manhattan now is solving complex problems for 49 different users throughout the eastern and midwestern U.S. — and one in Switzerland. The computer, an IBM 7044, is the center of a user-controlled time-sharing system that has been in operation in the Time-Life Building (New York) since the summer. Another 7044 at IBM's Los Angeles Datacenter provides time-sharing to 30 users on the West Coast.

Each user has a typewriter-like terminal connected to conventional telephone lines to operate the remote computer.

A special set of computer instructions, called QUIKTRAN, assures each user immediate accessibility to the central computer regardless of who else is using the system. The QUIKTRAN program monitors all incoming requests from remote user terminals and allots to each block of information a fraction of a second of computer-processing time every second the system is in operation.

QUIKTRAN time-sharing is designed primarily to handle scientific, engineering and "one-shot" business problems — those, unlike batch-processing problems such as payrolls, which do not require repeated processing.

The flexibility of time-sharing has attracted users from many diverse fields. Present users include aerospace firms, banks, chemical companies, government agencies, universities, business consultants, manufacturing companies, service organizations and many other firms with completely different problem-solving needs.



— John Nostrand, a physicist at Union Carbide's Nuclear Research Center in Sterling Forest, N.Y., places a "call" to a computer at IBM's New York time-sharing Datacenter. The typewriter-like terminal transmits data to and from an IBM 7044 computer. The computer, programmed with the formula written on the blackboard, provides answers in seconds.

The Swiss user, IBM's Zurich laboratory, demonstrates the range and scope of the system by solving a variety of typical scientific, engineering and business problems on the New York computer. Linked by the typewriter-like terminal — an IBM 1050 data communications system — telephone lines and undersea cables, Zurich, like any other user, receives answers almost immediately.

Scientists, engineers and businessmen who use the computer do not need to know how it works and although many different people use the central computer at the same time, each remote user is unaware that he is sharing it with others. To each, the IBM 7044 is "his" to use as he wishes.
(For more information, designate #41 on the Readers Service Card.)

NEW PRODUCTS

Digital

GE-645 COMPUTER SYSTEM

General Electric Company has announced its largest and latest computer system — the GE-645, designed specifically for large-scale, time-sharing operations.

A a press conference in New York, Harrison Van Aken, general manager of G.E.'s Computer Department, stated that the prime value of the GE-645 lies in its ability to provide vast computer power in many forms to hundreds of people simultaneously at reasonable cost. In some applications of the GE-645, as many as 300 individual people may use the computer at the same time. More than 1000 terminals may be plugged into such a system.

The computer can respond in a variety of ways to its users according to their needs. It will answer in "real-time" or in milliseconds. It will answer "conversationally" to question and answer problem-solving jobs in seconds. And it will answer in the more traditional computer fashion by running a complete program or processing tedious jobs in "batches" lasting minutes or hours. Thus, one computer system can plot a missile trajectory in "real-time", solve a step-by-step engineering problem "conversationally", and run off a payroll accounting job all during the same period of time.

Moreover, the G-E time-sharing system will accommodate a variety of communications devices plugged into it operating at varying speeds: small-scale digital computers, teletypewriters, visual display devices, and analog computers.

Key to the enormous time-sharing capability of the GE-645 is a new operating program known as MULTICS (for Multiplex Information and Computing Service). It is being developed from research by the Massachusetts Institute of Technology, Bell Telephone Laboratories, and General Electric Company. MULTICS draws upon the design and experience gained with CTSS (Compatible Time-Sharing System) at MIT's Computation Center and Project MAC.

General Electric's implementation of the system on the GE-645 is known as MULTICS-645/I, details of which will be available in the near future according to G. E. officials.

The GE-645 has several characteristics which set it apart from existing time-sharing computer systems. Primary among them is its method of managing its vast memory through the use of a segmentation and paging technique.

No computer can store in its core the enormous quantity of data and programs which are required when operating in a large-scale time-sharing mode. More than 100 programs representing up to one million words may have to move in and out of the core of the computer at microsecond speeds.

General Electric's solution in the GE-645 has been to segment programs into manageable lengths for fast processing in the computer's core. The core in turn is divided into "pages" and symbolically addressed. As a result, programs can be allocated to non-adjacent sections of the computer's core. This arrangement means more efficient use of the computer's memory, a speed up in the movement of programs, and a significant increase in the number of users sharing the time of the computer.

The main switching center of the GE-645 is a general input-output controller (GIOC). A device new to commercial computer design, it manages the variety of communications going in and out of the central computer from terminals nearby or hundreds of miles away.

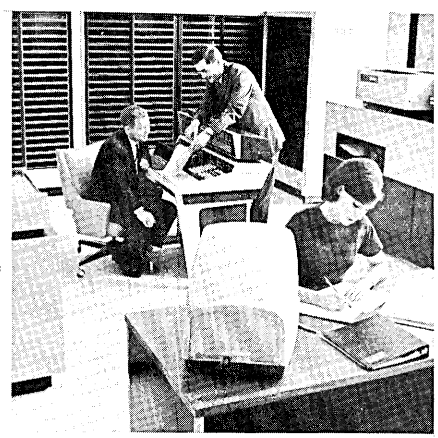
A high performance magnetic drum memory holds up to four million words, and is able to transfer approximately 500,000 words per second in and out of the central processor. It possesses a logic structure which allows it to keep automatic queue of the computer's requests for transfer of data.
(For more information, designate #42 on the Readers Service Card.)

TWO NEW TIME-SHARING SYSTEMS OFFERED BY CONTROL DATA

Control Data Corporation has announced the availability of two new computer systems, the Control Data® 3300 and 3500. The two systems combine extremely fast processing speeds with a new concept for computer memory storage to process a large number and a wide variety of problems on an "immediate access" basis.

The 3300 has a cycle time of 1.25 microseconds, and the 3500, which features Control Data's newly-designed INTEBRID® circuit, has a cycle time of .80 microseconds. To make maximum use of these speeds, magnetic core memory storage for both systems has been partitioned into 2000 word "pages". Each page is further divided into four sections. This provides a very efficient method of accomodating a wide variety of programs, regardless of their size or complexity. Programs are broken down into page segments, with quarter-page locations available for any part of any program that does not fit into a full-page. This includes small programs and subroutines.

A monitor or software technique (information traffic director) establishes program priorities, and, when necessary, transfers low priority programs to temporary storage devices. The user is aware only of the particular piece of equipment he is using at the time.



Central operations of the Control Data 3300 and 3500 time-sharing computer systems can be controlled from the system console (center foreground in the photo). A 3300 or 3500 time-sharing center includes full peripheral devices including monitor and display systems (foreground) optical page readers (upper right) card readers, high-speed printers, and special devices for industrial, commercial and scientific readout.
(For more information, designate #43 on the Readers Service Card.

LINK GP-4 DIGITAL COMPUTER NOW OPERATIONAL

General Precision's Link Group has disclosed that it has completed checkout of the GP-4 digital computer — the first operational, commercial computer where computing logic is entirely made up of monolithic integrated microcircuitry.

The twin double-bay cabinets housing the all-solid-state GP-4 general-purpose computer contain a central processor consisting of the main arithmetic and Boolean arithmetic units, plus the central control unit and instruction decoding logic. Parallel construction and 8,192 words of core memory for data storage and transfer in conjunction with 122,880 word disc memory for computer program storage, distinguishes the GP-4 as a computer for the performance of real-time simulation and industrial computation tasks. This built-in split-memory capability of the GP-4 design offers the speed advantages of memory overlap for instruction and data access.

The standard GP-4 computer is equipped with a Model 33 Teletypewriter for low-speed input to output, an NCR card reader, and a Datamec D-2020 45 ips IBM-compatible magnetic tape unit. Optional equipment includes a Dual Direct Memory Access (DMA) channel, Digital-to-Analog and Analog-to-Digital Converters, Discrete Input System and Disc Data Preselector. In addition, a full range of peripheral equipment, including card equipment, line printers, magnetic tape units, and incremental plotters, is readily available.
(For more information, designate #44 on the Readers Service Card.)

UNIVAC® 1108 II MULTI-PROCESSOR SYSTEM

Sperry Rand Corporation's UNIVAC Division has announced a major extension of its large-scale data processing line with a new multi-processing system capable of handling five times the capacity of their largest system, the present UNIVAC 1108. The new system, known as the UNIVAC 1108 II Multi-Processor, is capable of operating individual central processor units simultaneously in a single configuration.

An extension of the UNIVAC 1108 system, the Multi-Processor provides speed, capacity and modularity for large-scale, real-time and time-sharing requirements of business, engineering and scientific applications.

The 1108 II employs a modular design in which all central processor units operate with equality. As a result, each processor can function independently on a separate task or be allocated to portions of a single large problem. In either mode of operation, special interconnection components enable the processors to share storage and peripheral equipment of a system.

Modular magnetic core storage is used, which is available in increments of 65,536 word modules to a maximum of 262,144 words. Word length is 36-bits plus parity. Redundant storage features of the 1108 II allow two or more processors to reference the same program or data simultaneously.

Cycle time of each processor is 750 nanoseconds. Up to four logical banks for instruction or data reference overlapping, provide an effective cycle time of 375 nanoseconds.

Each processor is equipped with an individual set of 125 nanosecond control registers composed of integrated circuits. Control registers include multiple accumulators, index registers, input-output access control registers and special use registers. Each processor is capable of executing 1.3 million instructions per second.

Multiple data communications paths into the 1108 II are directed by Input-Output Controllers, independent wired logic processors utilized in multi-processing operations, providing up to 16 high speed data channels with independent access to main storage.

The Multi-Processor concept not only facilitates the extremely high computing speeds in the processing of several concurrent applications, but it also provides a "balance" between the computer and the hundreds of remotely-located peripheral units that may be used with it.

Deliveries of complete systems are expected to begin in the second quarter of 1966.
(For more information, designate #45 on the Readers Service Card.)

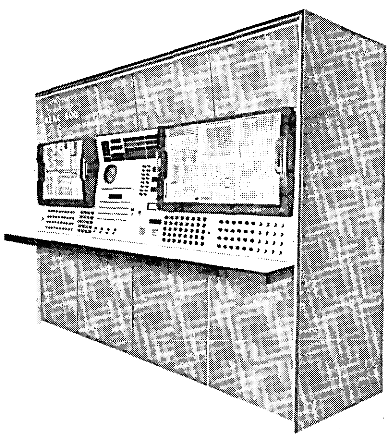
Newsletter

Digital-Analog

REAC 600 — NEW HYBRID COMPUTATION SYSTEM

Reeves Instrument Company, a Division of Dynamics Corporation of America, has introduced the REAC 600, a seventh generation computer. This high speed, solid state, large scale system, is capable of expansion to the most powerful hybrid facility presently available. It has diverse application in product analysis and systems simulation capability for the aerospace, aircraft, refinery, automotive, chemical processing, gas pipeline, biomedicine, railroad, research and other fields.

Design of this equipment includes sloping front panels, centrally located controls, displays



at eye level and patch boards that are visible from a seated position. In addition, ovens which are hinged for access to adjacent hardware enable the use of high density packaging without sacrifice of serviceability. All power supplies are an integral part of the main frame, but are thermally insulated from the remainder of the cabinet, making remote location and long cables unnecessary.

The frame is equipped with two patch boards comprising a total of almost 8000 usable holes. The analog signal board is a solid, completely shielded metal board and has the exclusive REAC ability to post patch without disabling the power supply. The control and parallel digital logic board is unshielded to improve high frequency performance.

A simple addressing scheme eases the job of going from flow diagram to patchboard. The second digit of all component addresses represents the sextant of the board that the component appears on — while still preserving a consecutive numbering scheme.

All operating mode controls are electronically buffered so that the equipment can be remotely addressed and, therefore, easily subject to hybrid operation. All components and assemblies are of the highest quality and in almost all cases have been prototype field tested.
(For more information, designate #46 on the Readers Service Card.)

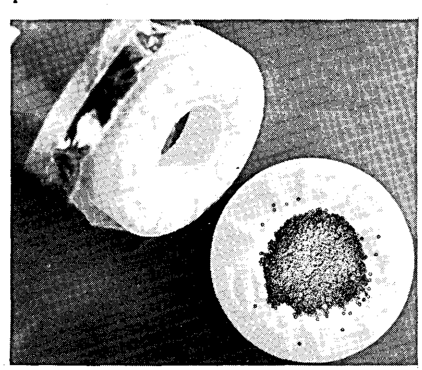
Memories

MINIATURIZED MEMORY DEVICES

Experimental computer memories among the fastest and smallest ever developed were described by IBM Corporation engineers at the 1965 Fall Joint Computer Conference held Nov. 30 - Dec. 2 in Las Vegas, Nev.

One unit, composed of metallic rings so small that three human hairs would barely fit through one of them, is the most compact core memory ever built. Another, utilizing electronic devices called tunnel diodes, is the fastest memory ever reported.

The memory rings, called ferrite cores, have inside diameters of 7.5-thousandths-of-an-inch and outside diameters of 12-thousandths-of-an-inch — about half the size of memory cores used in today's computers. The experimental cores are small enough for 17,000 of them to fit inside a candy Life Saver, as shown in the photo.



In operation, cores are magnetized and demagnetized electronically to represent 1's and 0's, the basis of computer language. By reducing the size of cores, engineers can reduce the size of memory units and increase the speed at which a computer retrieves these bits of information.

A memory system built by IBM to test the capability of the cores has a cycle time of 375 nanoseconds (billionths of a second), twice as fast as the fastest memory in System/360. The experimental memory has a density of 4000 cores, or bits of information, per square inch, making it the most compact core memory ever developed.

Another technological advance, the fastest computer memory ever reported, also was displayed by IBM. The experimental "scratchpad", so-called because it is a small and extremely fast memory used by the computer to store intermediate arithmetic results, makes use of semiconductor devices called tunnel diodes. Tests by IBM engineers have proved the feasibility of a tunnel diode memory with a cycle time of 25 nanoseconds.

Another development which holds promise for future high speed memories is a 32-bit monolithic module displayed by IBM for the first time. Two silicon chips are mounted on a half-inch-square ceramic substrate to form the 32-bit unit. Each chip contains 148 components forming 16 circuits, and each of the circuits stores one bit of information.

Engineers anticipate that computer memories constructed with the monolithic modules will be ten times as fast as today's, because faster switching speeds are attainable with semiconductors than with cores, and because new packaging densities offer the possibility of shortening the distance electrical signals must travel.
(For more information, designate #47 on the Readers Service Card.)

RCA ANNOUNCES NEW MEMORY FOR ADVANCED SPECTRA 70

The Radio Corporation of America has announced a mass random access memory device for Spectra 70 computers with a capacity of 560 million 8-bit bytes per unit at the lowest cost in the data processing industry.

Through an increase in recording density, the new Spectra 70/568-11 Mass Storage Unit accommodates a thousand bytes of information at a monthly cost of about 6/10 of a cent, according to Arnold K. Weber, Vice President and General Manager, RCA Electronic Data Processing.

With the new device, average access time to any given data character or numeral is less than 0.4 seconds. A Spectra 70/568-11 can house eight magazines, each holding 256 magnetic cards. Eight such models can be linked to a single Controller. A total of nearly 4.5 billion 8-bit bytes of memory storage can thus be accommodated by a single Controller. RCA's Spectra 70 Drum Memories and Disc Storage Devices can be linked to the Random Access Controller along with the Mass Storage Units.

The new "double density" Mass Storage Unit handles a two-way flow of data by means of electric typewriters, high-speed printers, punched cards or tape, cathode ray tube display devices and other visual display equipment. It can communicate with remote inquiry and input stations via telephone or telegraph lines.
(For more information, designate #48 on the Readers Service Card.)

LIBRAFILE 3800 MASS MEMORY

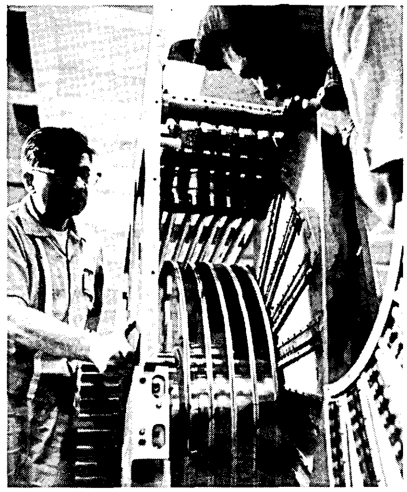
A new computer mass-memory with a storage capacity of 200 million bits, a data-transfer rate of up to 42 million bits per second, and an average access time of 17 milliseconds has been developed by the Librascope Group of General Precision, Inc. The new memory system, called the LIBRAFILE 3800 mass memory, was introduced at the Fall Joint Computer Conference, Nov. 30 - Dec. 2 in Las Vegas, Nev.

The LIBRAFILE 3800 is designed for use as a computer mass memory in large scientific computing centers, in message-switching centers, in military command-and-control installations, and in intelligence data processing systems.

The new memory is available in a basic 6-disc configuration with a storage capacity of 200 million bits. The memory has a fixed-head per track, two methods of search and retrieval, and retractable head plates.

A LIBRAFILE 3800 mass memory consists of two principal units: (1) a mass memory for data storage, and (2) a controller for interface, control, and read-write electronics.

The 3800's rotating memory element is composed of six aluminum discs coated with a cobalt alloy. The discs measure 38 inches in diameter and ½-inch in thickness. The discs, mounted on a common shaft, rotate at 1800 RPM. Data is stored on both disc faces. Word length is flexible.



— Technicain checks the installation of six large memory discs and head-mounting plates (at right) of the new LIBRAFILE 3800 mass memory system.

The LIBRAFILE 3800 memory is available with or without master-control electronics.

Information is retrieved either through fixed-address or record-content search. Search by record-content is an exclusive Librascope technique that permits any field to be used as an access key. Only the nature, and not the location, of data sought need be known. This feature eliminates costly flagging and table look-up programs, saves central-memory space, and permits simultaneous off-line search.
(For more information, designate #49 on the Readers Service Card.)

Software

UNIVAC 1050 COMPUTER PROGRAM SETS TYPE AUTOMATICALLY

Type for the printed editions of House of Commons debates will in the future be set automatically in English and in French with the aid of a UNIVAC 1050 computer according to an announcement by the Canadian Government Printing Bureau.

The new computer program, known as UNIVAC Automatic Documentation System Line Composition Phase I Program (UNADS-LINCO I), was developed specifically for use on the UNIVAC 1050 Computer, a product of Sperry Rand Corporation's UNIVAC Division.

UNADS-LINCO I composes text through the use of line justification and hyphenation routines plus commands which are interspersed with the input text. The command system offers the most advanced and versatile language available for specifying column measures, type fonts, line make-up, identification, and segmentation of output paper tapes.

The hyphenation routines use a grammatically-based set of rules, and are coupled with the justification routine which scans from right to left using the last word separation or hyphenation point within the justification range. This combination allows the system to set tighter and more accurate lines than are encountered in normal manual systems, or in many of the other computer-based systems.

The basic typesetting system uses a torn-tape approach where unjustified or "idiot" tapes of variable lengths are fed into the data processing system. The UNADS-LINCO I System in turn, produces tapes for actuating various configurations of typesetting equipment.

The UNIVAC 1050 System with a six-channel paper tape reader punch unit is the basic hardware system required for this application. Program loading can be either punch card or magnetic tape, depending on individual user needs.
(For more information, designate #51 on the Reader Service Card.)

IBM'S COMPUTER PROGRAM LIBRARY

IBM Corporation has announced the opening of the largest computer program library in the world at Hawthorne, N.Y. The building has been designed and built solely as a library to serve computer users. During the first year in its new headquarters, the library expects to distribute more than 400,000 computer programs, doubling its last year's operations.

The increased volume will be met through: highly computerized operations, from cataloging programs to automatic preparation of mailing labels; the added computing power of IBM System/360s, now being installed; and the use of a new, specially developed tape duplicator, which can copy over four billion characters of information a day — the equivalent of 7,000 average-length books.

Last year, over 1/3 million programs (of 2500 kinds) were distributed on reauest, without charge. (For more information, designate #50 on the Readers Service Card.)

Information Retrieval

REMSTAR®, RECORDS RETRIEVAL SYSTEM

Remington Office Systems, Division of the Sperry Rand Corporation, New York, N.Y., has introduced its most advanced Records Retrieval System. The new system, called REMSTAR®, is an advanced modular system combining closed circuit television with Remington's completely automated Records Retrieval devices. With the new REMSTAR System, Records Retrieval is made total — not only locating, but transmitting the record. Retrieval and transmission are fused into a single, seconds-quick operation.

The new REMSTAR System basically functions in the following manner: the files are centralized and housed in Remington's electromechanical filing devices and situated in a low cost file area. A REMSTAR Transmitter for tabulating aperture cards with microfilm images or hard-copy records is an integral part of this completely automated work station. Once the clerk receives a request, she retrieves the record, instantly, from the automated Records Retrieval unit, and drops it into the transmission slot. From that moment the viewer controls the record. The record is viewed on the REMSTAR Monitor, placed on or alongside the executive's desk (or wherever the record is needed). Once the viewing is completed, a Finish Button is pushed on the Monitor, and the record is released. If an immediate action copy of the record is needed, a REMSTAR Printer, serving one or more Monitor Stations, responds to the touch of the Monitor's Print-Out Button and, in seconds, produces an exact copy or copies of the image on the Monitor screen.

With the new REMSTAR System, complete file integrity is maintained as the document stays where it belongs, "In-File". The image and copy arrive where they'll be used.

A variety of automated file equipment for the REMSTAR System is available to meet the needs of any size business.
(For more information, designate #53 on the Readers Service Card.)

RECORDAK MICROSTRIP SYSTEM

The new Recordak Microstrip System, developed by the Recordak Corporation, a subsidiary of Eastman Kodak Company, is based upon a new micro-form: a foot-long plastic holder which contains up to 12" of 16 mm microfilm. The new concept is designed to reduce voluminous listings in directories, credit files, inventory lists, and rate tables to compact microfilm in immediately retrievable form. Average retrieval time is less than five seconds.

This system involves the use of indexed Microstrip holders which are stacked in nested, compact files at either side of the new Recordak Microstrip Reader. Each holder is end-tab indexed by content. File categories are distinguished by color coding. When a Microstrip holder is placed in the Reader, the desired single image is located by "tell-tale" indexing symbols. As the operator moves the image locator control pointer to the desired subject "tell-tale", its related image is displayed on the viewing screen of the Microstrip Reader.

Paper prints are reproducible from the images projected on the reader screen with the addition of a fully automatic printer accessory at the base of the Microstrip Reader. The operator presses the "print button". Within seconds, an enlarged facsimile print of the data displayed on the screen is delivered, squeegee-dry, for use as a working or confirmation copy.

According to Recordak, the new Microstrip System provides for great flexibility of operation. The film strips can be inserted into the plastic holders in lengths up to a maximum of a foot. Add-ons and deletions can be handled easily since the film channel within the Recordak Microstrip holder is designed to secure multiple short film lengths in fixed continuity film lengths in fixed continuity. (For more information, designate #54 on the Readers Service Card.)

FERRIS WHEEL ROTARY FILES

Acme Visible Records, Inc., Crozet, Va., recently exhibited its new product line of Rotary files. These wheel type files range from the smallest desk top rotaries to large capacity floor models which house in excess of 100,000 cards per unit.

Trays for index card sizes from the smallest 4" wide x 2" high to 11" wide x 8½" high are available. The file operator is provided with finger tip control over thousands of records.
(For more information, designate #58 on the Readers Service Card.)

MOSLER SCAN FILE SYSTEM

Anywhere from a few thousand to more than 100,000 conventional file folders may be stored at random and any one of these folders may be retrieved in 3 to 5 seconds with a new system introduced by the Mosler Safe Company.

With the Mosler Scan File system, coded folders are placed at random in the file and are selected from the file by the use of an electronic keyboard. When the keyboard receives the request for a folder, scanning heads on each tier simultaneously search at high speed for the desired folder. When the folder is located, it is pushed out from the remainder of the file. It

is then readily available to the operator. A signal on the control console gives the operator the location of the folder. If the desired folder is not in the file, a "not-in-file" signal appears on the console.

In addition to keyboard operation, the system can be operated completely automatically by punched tape. The tape can be a by-product of other processing operations such as computer runs or production typing and can also be prepared by conventional paper tape key punch. Any number of folders may be selected automatically by tape.

According to John Mosler, president, The Mosler Safe Company, the new Scan File system for the first time brings true automation to the file room. He said it is the only system to permit immediate retrieval of folders filed at random.
(For more information, designate #56 on the Readers Service Card.)

RANDOM CARD FILE EQUIPMENT

Randomatic Data Systems of Trenton, N.J., has introduced a new line of random card file equipment.

A two second automatic retrieval of randomly filed cards is accomplished by the binary coding of ordinary cards (tab size and 5" x 8") which are notched along the bottom edge in such a way as to not interfere with the cards being used in most other card processing equipment. Both notching and selection are accomplished on a simple 10-button electrical keyboard. The system can be learned by an operator in five minutes. Up to a million different codes can be selected with absolute distinction. In addition, cards may be group selected by code characters that they may have in common with each other. Cards may be made of any material — paper, film, or plastic; no special card attachments are required.

The file trays containing the cards are similar in appearance to an ordinary card file, except for the automatically adjustable dividers which control the upright position of the cards, irrespective of the number of cards in the file. Each file tray will contain 1,000 to 1,500 cards, depending on card thickness. Trays are modular in design so that any number may be inter-connected together for simultaneous operation from a single keyboard. A "memory logic" system is available as an accessory for the storing of information.

Three basic equipment systems are available: a single tray (table top) unit with built in punch and cable connected keyboard; a double tray unit, with a built in punch and cable connected keyboard, which may be interconnected to additional double tray units; and a table console featuring five built in trays with a cable connected keyboard and punching device. Card coding on the table model may be accomplished either "on line" or "off line".
(For more information, designate #57 on the Readers Service Card.)

Input-Output

CHAIN TYPE PRINTER ANNOUNCED BY POTTER

A newly-designed Chain Printer representing a radically new approach to the design of high-speed electronic printing was announced by Potter Instrument Company at the Fall Joint Computer Conference held in Las Vegas, Nevada.

The new Chain Printer, Model HSP-3502, is capable of printing at speeds up to 600 lines per minute. Up to 192 different characters in up to 128 columns may be utilized, allowing a change in code format by simply addressing the required font. Individual slugs may be changed by an unskilled operator in minutes. Alphanumeric, numeric, and symbolic printing capability is provided.

The heart of the new Potter Printer is a uniquely-designed, continuous, rotating chain. The chain contains individually attached, dual-redundant characters along its periphery. Printing is accomplished in two cycles — first in the odd column and then in the even column. This two-cycle print mode allows the option of utilizing a one-half line or full-line buffer. A one-half print cycle takes place in 40 milliseconds. Full cycle printing takes 100 milliseconds, or 600 lines per minute. A reflex buffer is also available for synchronous operation as required in data phone transmission.

Patented double-width, "controlled-penetration" hammers, each spanning two columns, halve the number of hammers and drive control circuitry required. The minimum power requirement for the hammers permits the use of a low-current power supply.

The 3502 has an exclusive automatic paper feed system which provides clear, sharp definition, precise vertical registration, and immediate visibility of the last line printed. Internal or external paper advance is automatic. Paper width is 2½ to 18½ inches. Number of copies is up to six interleaved, card stock or multilith master. Slewing speed is 17.5 inches per second.

— HSP-3502 Chain Printer

Electronics comprise integrated circuitry combined with all silicon semi-conductors. A building block configuration offers a variety of control and sequencing.

Designed for use with all computer and data processing systems, the 3502 can also be interfaced off-line with a magnetic tape transport for use as an off-line print station, or interfaced with a DATA-PHONE® for remote terminal system applications.
(For more information, designate #52 on the Readers Service Card.)

AMPEX MODEL ATM-13 COMPUTER-COMPATIBLE TRANSPORT

A new, compact digital tape transport which can record more than twice the amount of data on the same amount of tape used with previous recorders of its type has been placed on the market by Ampex Corporation, Redwood City, Calif.

The Ampex Model ATM-13 is designed for airborne, shipboard and land-mobile use in such applications as reconnaissance and geophysical work. It is the first recorder of its type to generate data which is computer-compatible, requiring no intermediate processing. Blocks of data recorded by the ATM-13 are spaced only three-quarters of an inch apart on the tape, compared with distances ranging from two inches to several feet on comparable recorders currently in use.

The ATM-13's short inter-block gap meets IBM and other computer requirements for tape inputs to processing systems. The short gap, made possible by the transport's start-stop time of six thousandths of a second, offers users substantial savings in tape and processing time.

(For more information, designate #59 on the Readers Service Card.)

BUSINESS NEWS

R & D COSTS IN U.S. EXPECTED TO BE $23 BILLION IN '66

Total research and development expenditures in the United States are expected to reach a record $23 billion in 1966 — a year that could be one of transition in the financing and performance of R & D, according to a recent forecast by Battelle Institute economists.

While the $23 billion figure for 1966 is a record, it represents the smallest relative annual gain for R & D outlays in the past decade. Final expenditure figures for 1965 are expected to approximate $22.2 billion.

Breaking down the total expenditure estimate for 1966 by source of funds, the Battelle forecast notes that government spending is expected to total $15.8 billion; industry, about $6.7 billion; colleges and universities, approximately $340 million; and other nonprofit institutions, about $235 million.

Federal expenditures are expected to increase by about $400 million over the $15.4 billion estimated to be spent in 1965. This reflects primarily a reduction in the rate of new obligational authority and a reduction in the rate of expenditures by the Department of Defense and the National Aeronautics and Space Administration. According to Battelle economists, the current reduction in the rate of federal outlays is not expected to deter the continued growth in total output of the economy. They say, rather, that the growing emphasis on basic research shown in the current budget should prove to be a sustaining influence on the continued growth of productivity.

In predicting the future growth of R & D, the economists believe that few if any industries have reached a point of diminishing returns on R & D investment. For 1966, the present cash flow position of industry suggests no reduction in the rate of industry expenditures for R & D. In fact, the $6.7 billion that industry is expected to spend on R & D in 1966 is $400 million more than the anticipated total of about $6.3 billion for 1965.

However, there are some indications that industry may be returning to pre-Sputnik levels of R & D effort. This is suggested by comparisons of industry spending and performance with gross national product and industry cash flow.

The Battelle estimates for expenditures by industry are derived from an examination of cash flow as distinguished from the standard surveys of industry spending plans. Battelle studies suggest that a major determinant of expenditures for research is internal cash flow (net profits retained by business, plus depreciation), because funds for investment in research cannot ordinarily be obtained from outside sources.

Industry financing of R & D averaged around 20 percent of cash flow prior to 1958, and estimates for 1965 show a return to this relationship. Between 1958 and 1965, industry R & D financing as a percent of cash flow climbed to a peak of 26 percent in 1961 before returning to the 20 percent level in 1965.

Total industry performance of R & D, which grew at an annual rate of 12.5 percent from 1953 to 1964, is expected to grow at a slower rate in 1966, reflecting the reduction in the rate of federal financing. Industry accounted for seven-tenths of total performance in both 1953 and 1964, with federal financing of industry performance growing from 39 percent in 1953 to 57 percent in 1964.

IBM, SPERRY RAND ANNOUNCE PATENT AGREEMENT

Sperry Rand Corp. has announced that it has reached an agreement with IBM to cross license on a non-exclusive basis all patents of the two firms in the field of information handling.

In making the announcement Sperry Rand stated that the agreement resolves all outstanding patent differences between the two companies. No payments were believed involved in the agreement.

Further details of the agreement were not disclosed inasmuch as Sperry Rand is continuing negotiations with other companies for the licensing of its patents.

RCA EDP DIVISION REPORTED IN THE BLACK

The President of RCA, Dr. E. W. Engstrom, reported, during a recent talk to Boston Security Analysts, that his firm's EDP Division is operating in the black for the second consecutive year.

Dr. Engstrom said, "The Spectra 70 family has made an excellent start this year. It is finding a strong market abroad as well as in this country. In our older, established product lines, orders for the RCA 3301 Realcom computer has increased during 1965. Among them have been a number of major multiple-system contracts.

"In order to accommodate demand for these and for the Spectra 70 models, we have stepped up the production capability of our computer plant in Florida and increased personnel by more than 50%."

Dr. Engstrom also said the first deliveries of Spectra 70 computers were on schedule and orders continue to rise.

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 85% 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.

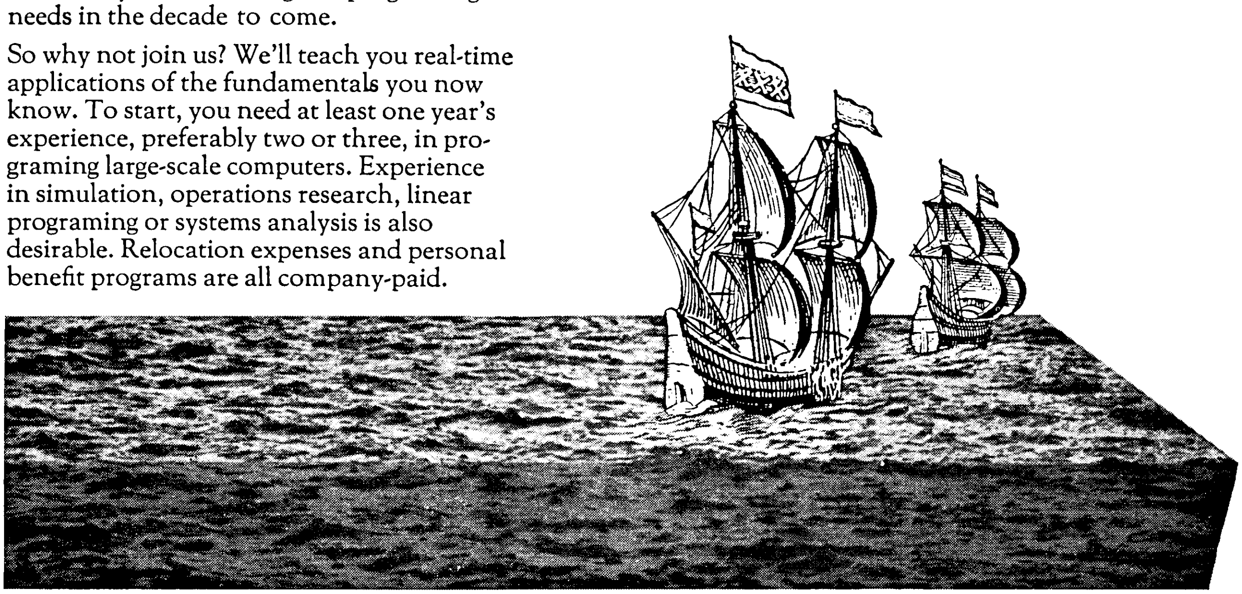
AS OF DECEMBER 10, 1965

NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS
Advanced Scientific Instruments	ASI 210	Y	$2850	4/62	24	1
	ASI 2100	Y	$3000	12/63	6	1
	ADVANCE 6020	Y	$2200	4/65	5	4
	ADVANCE 6040	Y	$2800	7/65	2	7
	ADVANCE 6050	Y	$5000	10/65	0	3
	ADVANCE 6070	Y	$10,500	10/65	1	6
	ADVANCE 6080	Y	$7000	1/66	0	0
Autonetics	RECOMP II	Y	$2495	11/58	48	X
	RECOMP III	Y	$1495	6/61	10	X
Bunker-Ramo Corp.	BR-130	Y	$2000	10/61	158	5
	BR-133	Y	$2400	5/64	9	7
	BR-230	Y	$2680	8/63	15	X
	BR-300	Y	$3000	3/59	38	X
	BR-330	Y	$4000	12/60	34	X
	BR-340	Y	$7000	12/63	20	X
Burroughs	205	N	$4600	1/54	52	X
	220	N	$14,000	10/58	44	X
	E101-103	N	$875	1/56	152	X
	B100	Y	$2800	8/64	100	30
	B250	Y	$4200	11/61	103	5
	B260	Y	$3750	11/62	248	16
	B270	Y	$7000	7/62	160	17
	B280	Y	$6500	7/62	97	17
	B300	Y	$8400	7/65	25	80
	B5000/B5500	Y	$20,000	3/63	48	10
	B8500	Y	$200,000	2/67	0	1
Clary	DE-60/DE-60M	Y	$525	7/60	344	4
Computer Control Co.	DDP-19	Y	$2800	6/61	3	X
	DDP-24	Y	$2500	5/63	70	8
	DDP-116	Y	$900	4/65	34	42
	DDP-124	Y	$2050	2/66	0	6
	DDP-224	Y	$3300	3/65	15	15
Control Data Corporation	G-15	N	$1000	7/55	325	X
	G-20	Y	$15,500	4/61	26	X
	160*/160A/160G	Y	$1750/$3400/$12,000	5/60;7/61;3/64	440	1
	924/924A	Y	$11,000	8/61	29	X
	1604/1604A	Y	$45,000	1/60	60	X
	1700	Y	$2200	5/66	0	24
	3100	Y	$7350	12/64	40	35
	3200	Y	$12,000	5/64	88	17
	3300	Y	$15,000	9/65	6	55
	3400	Y	$25,000	11/64	20	18
	3500	Y	$30,000	6/66	0	3
	3600	Y	$58,000	6/63	48	10
	3800	Y	$60,000	12/65	0	15
	6400	Y	$40,000	1/66	0	8
	6600	Y	$110,000	8/64	7	9
	6800	Y	$140,000	4/67	0	4
Digital Equipment Corp.	PDP-1	Y	$3400	11/60	60	X
	PDP-4	Y	$1700	8/62	55	2
	PDP-5	Y	$900	9/63	112	1
	PDP-6	Y	$10,000	10/64	9	6
	PDP-7	Y	$1300	11/64	36	44
	PDP-8	Y	$525	4/65	95	302
El-tronics, Inc.	ALWAC IIIE	N	$1820	2/54	21	X
Electronic Associates, Inc.	8400	Y	$7000	6/65	2	6
Friden	6010	Y	$600	6/63	295	170
General Electric	115	Y	$1375	12/65	0	410
	205	Y	$2900	6/64	42	10
	210	Y	$16,000	7/59	53	X
	215	Y	$6000	9/63	53	3
	225	Y	$8000	4/61	139	2
	235	Y	$10,900	4/64	60	8
	415	Y	$7300	5/64	87	62
	425	Y	$9600	6/64	48	50
	435	Y	$14,000	10/64	20	25
	625	Y	$41,000	12/64	10	25
	635/645	Y	$45,000	12/64	4	28
General Precision	LGP-21	Y	$725	12/62	95	X
	LGP-30	semi	$1300	9/56	255	X
	RPC-4000	Y	$1875	1/61	62	X
Honeywell Electronic Data Processing	H-120	Y	$2600	12/65	0	260
	H-200	Y	$5700	3/64	680	160
	H-400	Y	$8500	12/61	125	5
	H-800	Y	$22,000	12/60	86	3
	H-1200	Y	$6500	2/66	0	42

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	12	2
	H-1800	Y	$30,000	1/64	15	6
	H-2200	Y	$11,000	12/65	0	46
	H-4200	Y	$16,800	2/66	0	8
	H-8200	Y	$35,000	3/67	0	1
	DATAmatic 1000	N	$40,000	12/57	4	X
IBM	305	N	$3600	12/57	170	X
	360/20	Y	$1800	12/65	2	4000
	360/30	Y	$7200	5/65	400	3200
	360/40	Y	$14,500	4/65	350	900
	360/44	Y	$12,000	9/66	0	400
	360/50	Y	$28,000	8/65	12	360
	360/60	Y	$48,000	12/65	0	10
	360/62	Y	$55,000	12/65	0	5
	360/65	Y	$46,000	11/65	1	110
	360/67	Y	$49,000	9/66	0	22
	360/75	Y	$78,000	2/66	0	70
	650	N	$4800	11/54	255	X
	1130	Y	$850	11/65	2	1700
	1401	Y	$4500	9/60	6750	200
	1401-G	Y	$2000	5/64	1175	60
	1410	Y	$14,200	11/61	735	30
	1440	Y	$3300	4/63	2550	275
	1460	Y	$9000	10/63	2150	225
	1620 I, II	Y	$2500	9/60	1700	20
	1800	Y	$3700	12/65	0	125
	701	N	$5000	4/53	1	X
	7010	Y	$22,600	10/63	170	35
	702	N	$6900	2/55	8	X
	7030	Y	$160,000	5/61	7	X
	704	N	$32,000	12/55	40	X
	7040	Y	$18,000	6/63	110	8
	7044	Y	$35,200	6/63	95	22
	705	N	$30,000	11/55	61	X
	7070, 2, 4	Y	$27,000	3/60	340	7
	7080	Y	$55,000	8/61	75	X
	709	N	$40,000	8/58	11	X
	7090	Y	$63,500	11/59	45	1
	7094	Y	$72,500	9/62	130	6
	7094 II	Y	$78,500	4/64	97	25
ITT	7300 ADX	Y	$18,000	9/61	9	6
Monroe Calculating Machine Co.	Monrobot IX	N	Sold only - $5800	3/58	150	X
	Monrobot XI	Y	$700	12/60	580	100
National Cash Register Co.	NCR - 304	Y	$14,000	1/60	26	X
	NCR - 310	Y	$2000	5/61	42	X
	NCR - 315	Y	$8500	5/62	380	60
	NCR - 315-RMC	Y	$12,000	9/65	10	30
	NCR - 390	Y	$1850	5/61	1050	40
	NCR - 500	Y	$1500	10/65	70	600
Philco	1000	Y	$7010	6/63	20	0
	2000-210, 211	Y	$40,000	10/58	18	1
	2000-212	Y	$52,000	1/63	9	1
Radio Corporation of America	Bizmac	N	$100,000	-/56	3	X
	RCA 301	Y	$6000	2/61	620	7
	RCA 3301	Y	$11,500	7/64	47	20
	RCA 501	Y	$14,000	6/59	99	2
	RCA 601	Y	$35,000	11/62	5	X
	Spectra 70/15	Y	$2600	11/65	5	80
	Spectra 70/25	Y	$5000	11/65	6	70
	Spectra 70/35	Y	$7000	4/66	0	25
	Spectra 70/45	Y	$9000	3/66	0	80
	Spectra 70/55	Y	$14,000	5/66	0	22
Raytheon	250	Y	$1200	12/60	175	5
	440	Y	$3500	3/64	13	4
	520	Y	$3200	10/65	2	5
Scientific Control Dystems	660	Y	$2000	10/65	2	1
	670	Y	$2600	12/65	0	2
Scientific Data Systems Inc.	SDS-92	Y	$900	4/65	30	40
	SDS-910	Y	$2000	8/62	155	15
	SDS-920	Y	$2700	9/62	100	15
	SDS-925	Y	$2500	12/64	13	29
	SDS-930	Y	$4000	6/64	78	32
	SDS-9300	Y	$7000	11/64	18	7
Systems Engineering Labs	SEL-810	Y	$750	9/65	3	12
	SEL-840	Y	$4000	11/65	1	3
UNIVAC	I & II	N	$25,000	3/51 & 11/57	28	X
	III	Y	$20,000	8/62	87	1
	File Computers	N	$15,000	8/56	19	X
	Solid-State 80 I, II, 90 I, II & Step	Y	$8000	8/58	290	X
	418	Y	$11,000	6/63	53	28
	490 Series	Y	$26,000	12/61	80	58
	1004	Y	$1900	2/63	3200	190
	1005	Y	$2400	2/66	0	90
	1050	Y	$8000	9/63	255	115
	1100 Series (except 1107)	N	$35,000	12/50	12	X
	1107	Y	$45,000	10/62	29	2
	1108	Y	$50,000	9/65	4	20
	LARC	Y	$135,000	5/60	2	X
				TOTALS	30,729	15,805

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 conversion from existing 7040, 7070 and 7090 computers respectively.



CALENDAR OF COMING EVENTS

Jan. 31-Feb. 4, 1966: International Symposium on Information Theory, UCLA, Los Angeles, Calif.; contact A. V. Balakrishnan, Dept. of Engrg., Univ. of Calif., Los Angeles, Calif. 90024

Feb. 2-4, 1966: 1966 Convention on Aerospace and Electronic Systems, International Hotel, Los Angeles, Calif.; contact William H. Herrman, Hughes Aircraft Co., Culver City, Calif.

Feb. 9-11, 1966: 13th Annual International Solid-State Circuits Conference, Sheraton Hotel and Univ. of Pa., Philadelphia, Pa.; contact Lewis Winner, 152 W. 42 St., New York, N.Y. 10036

Mar. 21-24, 1966: IEEE International Convention, Coliseum & New York Hilton Hotel, New York, N. Y.; contact J. M. Kinn, IEEE, 345 E. 47 St., New York, N. Y. 10017

Mar. 24-26, 1966: 4th Annual Symposium on Biomathematics and Computer Science in the Life Sciences, Shamrock Hilton Hotel, Houston, Tex.; contact Office of the Dean, Div. of Continuing Education, Univ. of Texas Graduate School of Biomedical Sciences at Houston, 102 Jesse Jones Library Bldg., Tex. Medical Center, Houston, Tex. 77025

Mar. 29-31, 1966: ACM Symposium on Symbolic and Algebraic Manipulation, Sheraton-Park Hotel, Washington, D. C.; contact Miss Jean E. Sammet, IBM Corp., 545 Technology Sq. Cambridge, Mass. 02139

Apr. 12-14, 1966: International Quantum Electronics Conference (Sequel to 1963 Meeting in Paris), Towne House, Phoenix, Ariz.; contact Lewis Winner, 152 W. 42 St., New York, N. Y. 10036

Apr. 20-23, 1966: International Conference on Automated Data Processing in Hospitals, Hotel Marienlyst, Elsinore, Denmark; contact Conference Secretariat, Databehandlingskontoret, Juliane Mariesvej 6, Copenhagen Ø, Denmark

Apr. 26-28, 1966: Spring Joint Computer Conference, War Memorial Auditorium, Boston, Mass.; contact AFIPS Hdqs., 211 E. 43 St., Rm. 504, New York, N.Y. 10017

May 3-5, 1966: Bionics Symposium, Dayton, Ohio; contact Bionics Symposium 1966, P.O. Box 489, 300 College Park Ave., Dayton, Ohio 45409

May 3-5, 1966: British Joint Computer Conference, Congress Theatre, Eastbourne, Sussex, England; contact Public Relations Officer, Institution of Electrical Engineers, Savoy Place, London, W.C.2, England

May 10-12, 1966: 16th Annual National Telemetering Conference, Prudential Center, Boston, Mass.; contact Lewis Winner, 152 W. 42 St., New York, N. Y. 10036

May 16-20, 1966: Australian Computer Conference, Canberra, A.C.T., Australia; contact S. Burton, Honorary Secretary, P.O. Box 364, Manuka, A.C.T., Australia

May 18-20, 1966: 29th National Meeting of the Operations Research Society of America, Los Angeles, Calif.; contact Dr. John E. Walsh, System Development Corporation, 2500 Colorado Ave., Santa Monica, Calif. 90406

June 15-17, 1966: 1966 IEEE Communication Conference, Sheraton Hotel, Philadelphia, Pa.; contact Lewis Winner, 152 W. 42nd St., New York, N.Y. 10036

C&A CLASSIFIED COLUMN

Use economical C&A Classified Ads to buy or sell your computer and data processing equipment, to offer services to the industry, to offer new business opportunities, to seek new positions or to fill job vacancies, etc.

Rates for Classified Ads: 90¢ per word — minimum, 20 words. First line all capitals — no charge.

Blind Ads: Box Numbers acceptable at $4.00 additional to cover costs of handling and postage.

Send copy to: Computers and Automation, 815 Washington Street, Newtonville, Mass. 02160. Telephone: 617-332-5453.

Deadline for Classified Ads is the 10th of the month preceding issue.

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 computers 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, D.C. 20231, at a cost of 50 cents each.

August 3, 1965 (Continued)

3,199,082 / Luther H. Haibt, Croton-on-Hudson, N. Y. / IBM Corp. / Memory System.
3,199,084 / Arthur J. Gehring, Jr., Haddonfield, N. J., and Lloyd Wesley Stowe, Broomall, Pa. / Sperry Rand Corp. / Data Translator.

August 10, 1965

3,200,378 / Robert W. King, Endicott, N. Y. / IBM Corp. / Data Input / Output Device.
3,200,379 / Paul D. King, Pasadena, and Robert S. Barton, Altadena, Calif. / Burroughs Corp. / Digital Computer.
3,200,380 / Duncan N. MacDonald, Arcadia, Calif., Edward Glaser, Newtown Square, Pa., and Fred W. Bauer and John J. Dowling, Altadena, Douglas T. Kielty, Monrovia, and Paul D. King, Pasadena, Calif. / Burroughs Corp., Detroit, Mich. / Data Processing System.
3,200,381 / Peter Kuttner, Philadelphia, Pa. / Sperry Rand Corp. / Memory System Utilizing Thin Magnetic Films.
3,200,385 / Herbert Frazer Welsh, Philadelphia, Pa. / Sperry Rand Corp. / Magnetic Drum Recorder Including A Landing Track.

August 17, 1965

3,201,614 / Jack Saul Cubert, Willow Grove, Pa., and Francine Joy Weintraub, Somerdale, N. J. / Sperry Rand Corp. / Logic Circuit.
3,201,767 / Edward Michael Bradley, Stevenage, England / International Computers and Tabulators Ltd., London, England / Magnetic Storage Devices.
3,201,769 / Lawrence G. F. Jones, Baltimore, Md. / Sperry Rand Corp. / Information Storage Device.

August 24, 1965

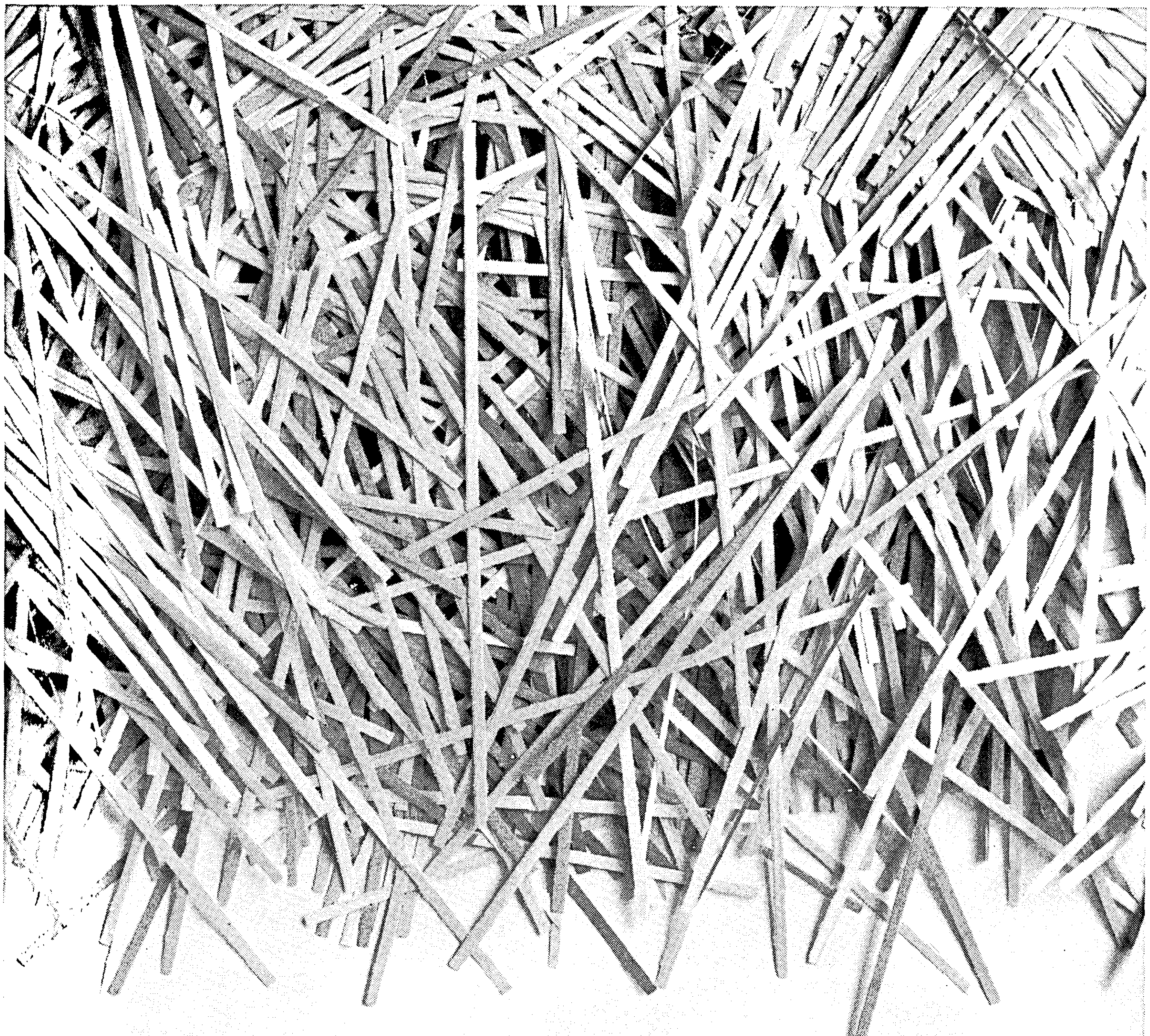
3,202,806 / Robert S. Menne, Morristown, N. J. / Bell Telephone Laboratories, Inc. / Digital Parallel Function Generator.
3,202,835 / John N. Barr, Detroit, Mich. / Square D Company, Park Ridge, Ill. / Electrical Logic Control Element.
3,202,971 / Gerrit Anne Blaauw, Poughkeepsie, N. Y. / IBM Corp. / Data Processing System Programmed By Instruction And Associated Control Words Including Word Address Modification.

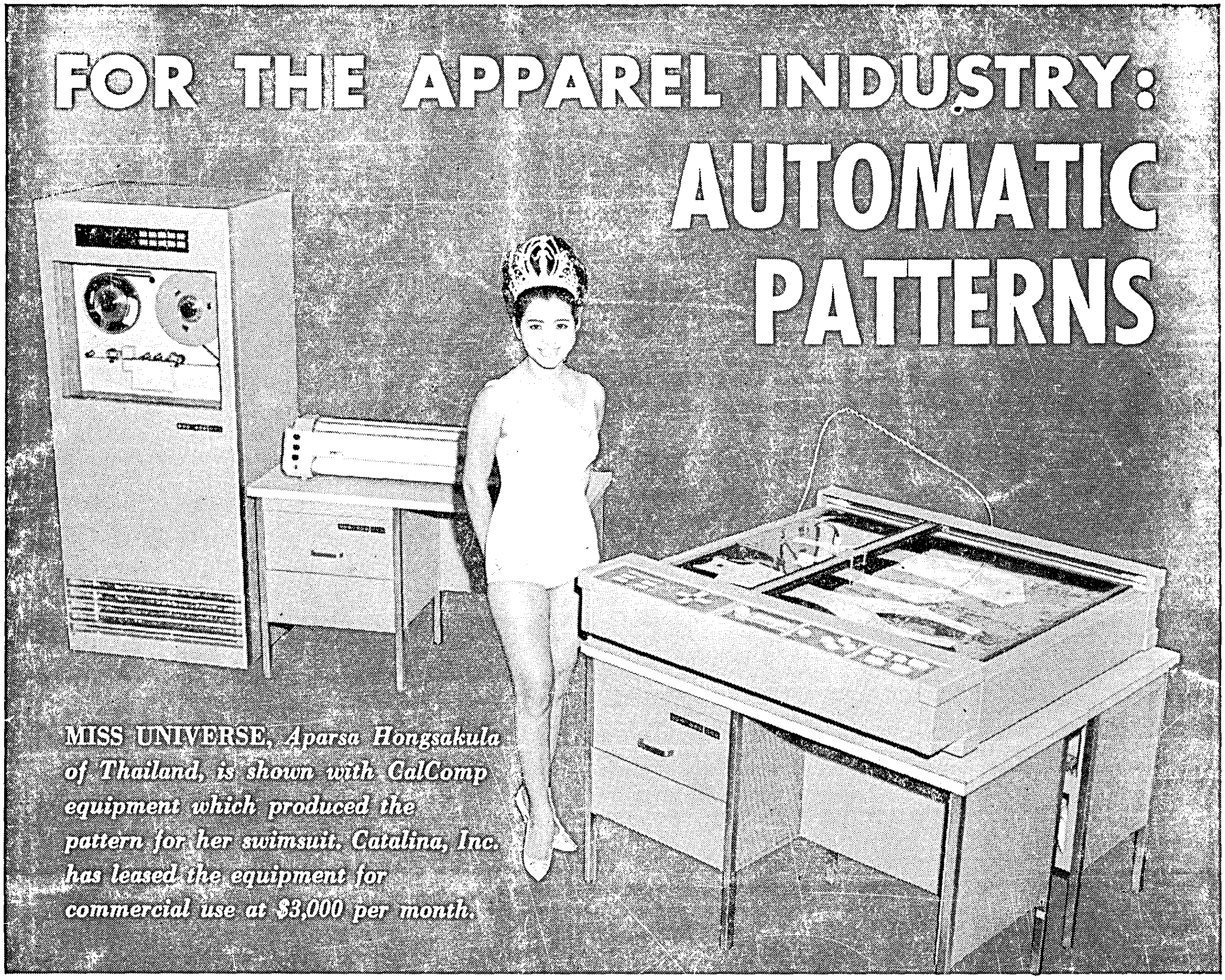
August 31, 1965

3,204,111 / Claude Chemia, Saint-Cloud, and Claude Manus, Gifsur-Yvette, France and Marcel Etter, Carouge, Geneva, Switzerland / Normacem, Paris, France / Logic Device.

ADVERTISING INDEX

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





MISS UNIVERSE, Aparsa Hongsakula of Thailand, is shown with CalComp equipment which produced the pattern for her swimsuit. Catalina, Inc. has leased the equipment for commercial use at $3,000 per month.

Another industry has learned that a computer combined with CalComp plotting equipment can speed production and increase operating efficiency.

Catalina, Inc. has demonstrated that a sample size swimsuit pattern can be "size graded" (modified and produced in various sizes) in about 1/6th the time required manually. One man in one day grades a maximum of 2 swimsuit patterns. A computer and CalComp's Curve Follower/Plotter grades a minimum of 12 patterns in a day —automatically and with precise accuracy.

The Curve Follower/Plotter, leased by Catalina, Inc. at $3,000 per month, eventually will be followed by an automatic "marker," now being perfected by CalComp to optimize the placement of pattern parts on material for maximum use of cloth.

The automatic pattern is but one way the CalComp equipment will benefit the apparel industry. "Piece work" efficiency—relating wages to time—will be plotted as a cost control tool. Sales charts of forecasts measured against current orders will provide a graphic hedge against over-production.

CalComp pioneered the development of automatic plotting of charts, graphs, maps or drawings from computer data—providing pictorial presentations instead of extensive, and often less meaningful, numeric or alphabetical listings. Among the many applications today: traffic studies, weather maps, brain waves, mechanical drawings, oil field contour maps, highway profiles and jet engine performance curves.

If you own, or have access to a computer, chances are you need a CalComp plotter, too. Write "Marketing" for further details.

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