April, 1967

computers and automation

Pg 11

Mirror

by

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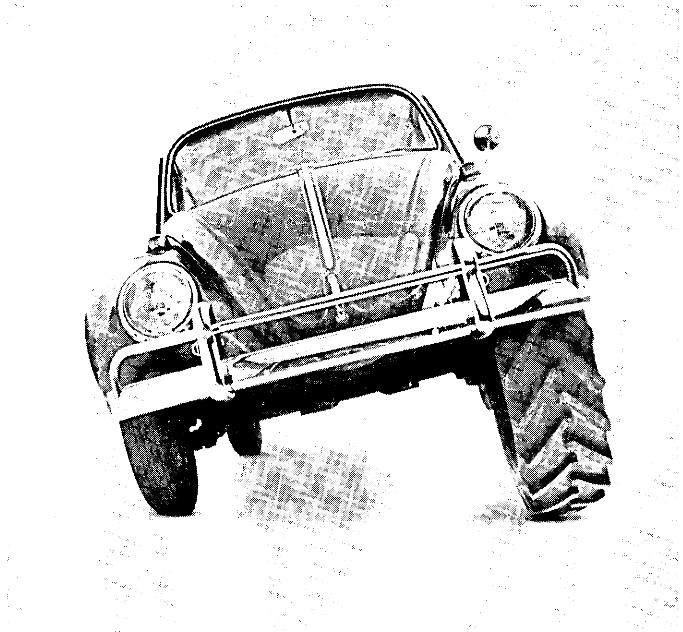

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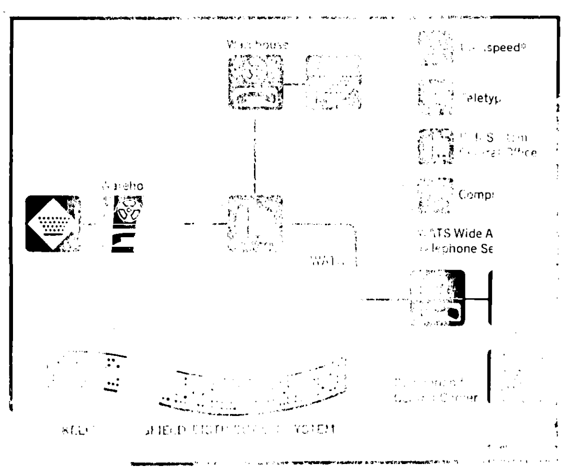

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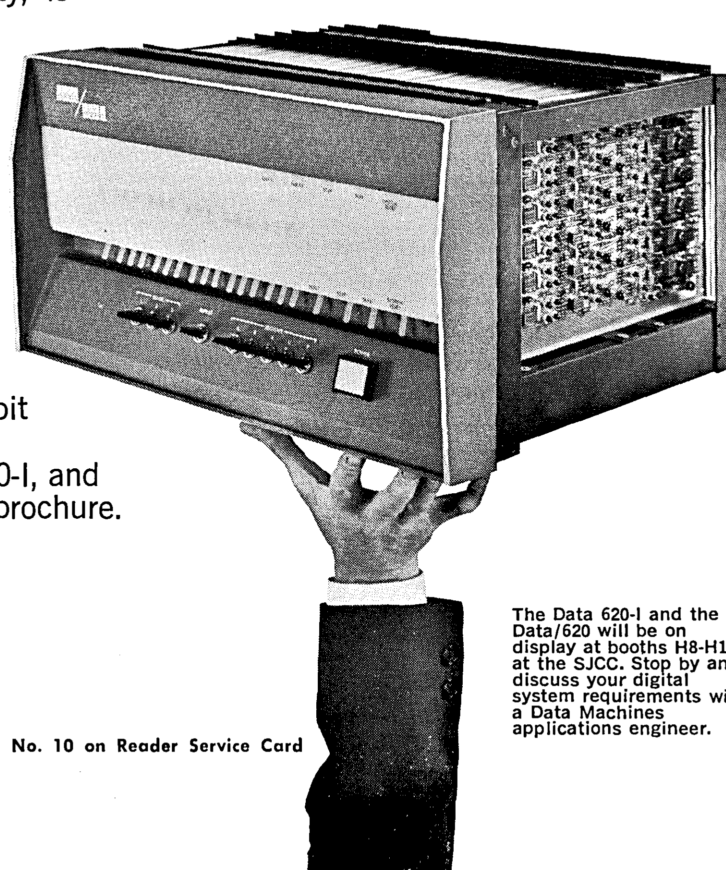

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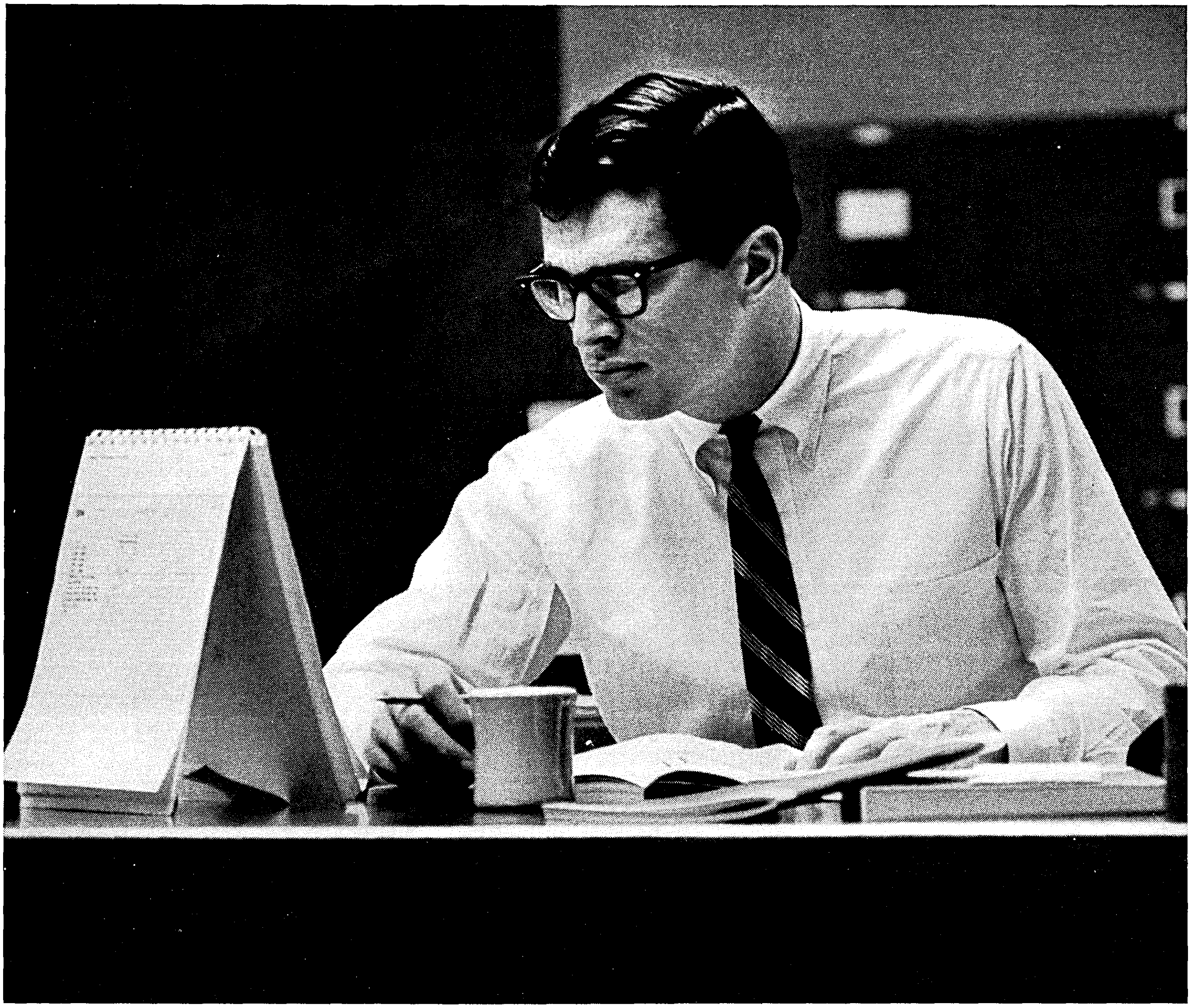

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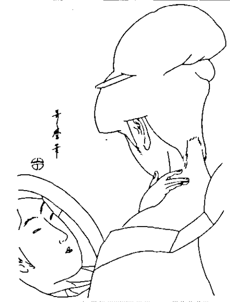
For more information, see page 60.



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EDITORIAL

Time Sharing, Batch Processing, and Direct Access

In this issue in Multi-Access Forum we publish an important and interesting letter from B. A. M. Moon, Director of the Computer Centre, University of Canterbury, Christchurch, New Zealand. Among other questions that he raises are:

1. If immediate man-machine interaction in scientific and technical research and design problems is so important, why has there not been more of it in the past?
2. If small computers are going to be needed at the terminals of large time-shared machines anyway, would not the greatest economy in many cases be simply to dispose of the central machine and leave each user in intimate contact with his own smaller computer?
3. Can we get the benefits of time sharing without time sharing?

These questions have points of resemblance to the following questions:

"Are apples or oranges better"?

(*Answer:* It depends on many factors.)

"Is it better to have a pain in your head or a pain in your foot?"

(*Answer:* The answer depends on two factors essentially: if the pains are equally intense and equally serious, certainly the foot pain is preferable.)

"Is it better to have the right equipment or the wrong equipment to do a job?"

(*Answer:* Of course, the right equipment is better — though in this case, the issue has been avoided by inserting answer-begging words in the question.)

Most of the answer to Question 1 is that as long as computers were very expensive, it cost too much to give the persons working on problems in design and research direct access to computers. However, as costs have gone down — due to both time sharing and the arrival of small computers — direct access (man-machine interaction) became economically feasible and was immediately desirable, because of latent but ineffective demand.

The answer to Question 2 is clear. If most of time sharing reaches the point where a small computer is needed in the console, then clearly we should get rid of the big computer, the intricate software for control, and the long communication lines for access, and we should in nearly all cases settle either for single-console access to a single computer, or for two or three nearby consoles, short communication lines, and simple supervising software in the computer.

I am convinced that the answer to Question 3 is:

In a great number of places, we can get the benefits of time sharing without time sharing; the pendulum of that fashion has swung too far.

In fact, we could rename much of "time sharing" as "direct access" and have the substance of it. We should translate a great many of the arguments for time sharing into arguments for direct access.

Nevertheless we should remember that:

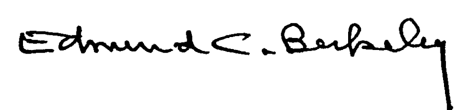
- Batch processing is almost certainly the right procedure for a great many jobs, such as production runs of large computations according to established needs and fully reliable programs.
- Time sharing of a powerful computer and a large file of information, centrally located, and with long communication lines, is vitally necessary for some problems — probably not many — such as the airlines reservations problem.
- Direct access is a desirable, and economically feasible, facility for the programmer who is troubleshooting a program, the engineer who is experimenting with different ways of solving a problem, and some other people.

In fact, we can foresee not a cleavage between time sharing, batch processing, and direct access to single computers, but a mingling. The time is coming when normally the big computer will have a load of batch processing jobs for background, and direct access in the foreground, not only for the operator, but for one, two, three, or even a dozen input lines from various *nearby* consoles and small computers. The resident software supervisor in the big computer will find this hardly any more trouble than to meet the requirements of twenty input lines from magnetic tape units or similar peripheral input/output devices.

There is a phrase I like to remember from the book *Silas Marner* by George Eliot, which was said by the landlord of a tavern, who used it to settle arguments among his contentious patrons:

"Ye're both right and ye're both wrong, as I allus say, — the truth lies atwixt and atween you."

The right solution to a particular problem of a computing facility consists of considering all the important factors, and making a sensible well-reasoned choice, with little regard to fashion.



Editor

MULTI-ACCESS FORUM

TIME-SHARING: A VIEW FROM NEW ZEALAND

I. From B.A.M. Moon, Director
University of Canterbury
Christchurch, 1, New Zealand

Somewhat detached here from the principal centres of investigation, we have watched with interest the growing activity in the use of time-shared computer systems, helpfully reviewed in recent issues of *Computers and Automation*.

In using computers in a scientific or technical environment, the main reason advanced in support of the time-shared system seems to be the opportunity for man-machine interaction in the solution of design or research problems which it offers. In some situations there are further advantages, such as the opportunity for dynamic interaction through the computer between research workers with common problems.

At present the remote console is usually a typewriter, considered to be a limiting factor in many cases, though perhaps more apparent than real because we have become accustomed to the sorts of high-speed input/output devices needed with batch-processing systems. Nevertheless, in writing of the next step, Hal Becker (*Computers and Automation* for Oct., 1966) suggests the provision of card readers, line printers, and even small computers at the remote terminals.

All this raises the cost, an important point noted by Hans Jeans (also *Computers and Automation* for Oct., 1966), who observes further that so far in time-shared systems "cost is seldom emphasized as a design criterion."

While the well-known "Grosch's Law" indicates that there are economies in the use of large-scale central processors, the increased cost of terminal devices and terminal servicing complexity, which may increase exponentially with the number of terminals, indicate that overall the cost advantage may not lie with the large system.

Jeans, arguing further, suggests that the modest system may be no more than most subscribers will need (at least perhaps for those kinds of situation where intimate man-machine rapport is important), a case advanced further by both Rudy Stiefel and George Zimmerman (*Computers and Automation* for Nov., 1966).

If this be true and if small computers are going to be needed at the terminals of large time-shared machines anyway, perhaps the greatest economy in many cases would be simply to dispose of the central machine and leave each user in intimate contact with his own smaller computer. The really big computational tasks would continue to be run on really big computers by batch processing methods.

An interesting question at this point then, is: If immediate man-machine interaction in scientific and technical research and design problems is so important, why has there not been more of it in the past? The opportunity has existed for a number of years; in fact the IBM 1620 and some other machines were designed expressly for this purpose. The cost has not been prohibitive (and may decrease), compared with the cost of a share in a large time-shared system.

Yet our experience, at least, with a 1620 has been that users do not desire to use it in this way. Even when given every opportunity for "open-shop" use, they appear much to prefer to enter source statements on prepunched cards, rather than at the console typewriter and to design production runs for lengthy calculations with a minimum of operator intervention. For this reason, we intend to install shortly an IBM 360/44, a fast batch-processing system with even less operator intervention.

Does this mean that the attractiveness of a time-shared system in which each user has his own console typewriter is a psychological rather than a technical one, or did computer users simply fail to appreciate what the 1620, say, had to offer?

When our 360/44 is installed and the 1620 enters a merited semi-retirement we intend to investigate this point — to initiate a project in which we approach its console typewriter as if it were one of the fifty such typewriters attached to a time-shared system fifty times as fast. In this way we may get the benefits of time-sharing without time-sharing, or else discover that time-sharing has something else to offer which is fundamental and important.

Do we seem naive or does the distance of our view give it at least a little perspective?

II. From the Editor

Thank you for your letter, which I was very glad to read. I think you have raised some important questions, which have served as the basis for our editorial in this issue.

Personally, I think "time sharing" expresses the wrong emphasis, and that "direct access" expresses the right emphasis. I have found in a year's personal use of a time-shared console to a big computer much frustration, and in several years' use of "direct access" to a small computer much satisfaction and only a small amount of frustration.

TECHNICAL LIBRARY SERVICE FOR BLIND COMPUTER PROGRAMMERS SEEKS TYPE-COMPOSING TAPES

I. From David L. Neblett
Project Director
Computer Training for the Blind
Washington University
724 South Euclid Ave.
St. Louis, Missouri 63110

We are organizing a technical library service for blind computer programmers. This service will eventually provide technical articles from various sources in Braille to enable these individuals to keep abreast of this dynamic field. We are using the IBM 360 computer to make the translation into Grade II Braille. (Grade I is letter for letter and Grade II is similar to shorthand notation.)

I would like to know if you use composing tapes or any similar method in printing that could be used for computer input. Would you make them available to us?

In any event we are interested in subscribing to "Computers and Automation." Please enter a subscription and bill us.

II. From the Editor

Thank you for your subscription and for your letter telling us about your service for blind computer programmers. We are sending you some of the punched paper tape produced at our typesetter's, Wellesley Press, One Crest Road, Wellesley, Mass., 02192, for typesetting. They and we will gladly arrange that tape like this be sent to you each time our magazine is set, if this kind of tape actually meets your requirements. Please let us know.

ADDRESSES OF COMPUTER ORGANIZATIONS

I. From Hans Lutke, Engineer
117 Berlin
German Democratic Republic

Your editorial on "The Thirst for Computer Knowledge" in the outstanding *Computers and Automation* for July 1966 encourages me to ask the address of the International Federation of Information Processing Societies. I am interested in their glossary related to computers. This glossary would be of considerable value in my work, in either the English or German language.

Please be so kind as to deliver my wish to said Federation or let me know their address. In either case, I am much obliged to you.

II. From the Editor

Thank you for your letter. The address you wish is: International Federation for Information Processing, 345 East 47th St., New York, N.Y. 10017. We believe they will be able to help you if you write directly to them.

III. To our Readers

As a regular service to readers of *Computers and Automation* anywhere in the world, we are glad to provide the address of a computer-related organization, if we know it. Any request should be addressed to the editor.

If you are a part of a computer-related organization, and you are not sure that *Computers and Automation* knows the address, please send it to us. In this way we can help increase communication and cooperation in the field of computers and data processing.

MODERN INDIAN STORY: ELECTRONIC FIRMS LOCATE ON RESERVATIONS

(Based on a report in the Feb. 27, 1967 issue of Electronic News, **published at 7 East 12th St., New York, N.Y. 10003)**

It is a safe prediction that more electronics firms will be springing up on Indian reservations. One reason for this is that the Department of the Interior has been nudging these firms a little with one hand, and offering them sweeteners with another. Social factors are also a consideration. The most important fact, however, is that electronics companies which have pioneered in employing Indians have already demonstrated that they can produce and deliver. Other types of firms are also showing interest.

Interior Secretary Stewart L. Udall has briefed industry representatives on the advantages of operating in Indian areas and of cooperating with the Bureau of Indian Affairs Industrial Development program. He has shown that Indians are easily trained for skilled operations, and represent an abundant labor supply. The Bureau provides on-the-job training programs under which the Bureau contracts to pay up to 50 percent of trainee wages in plants on or near reservations.

Indian trainees are recruited and screened by specialists in the Bureau in cooperation with local offices of the State Employment Service. The Bureau also offers services in getting firm and tribe together.

Various tribes also put up money to help finance plants. To date they have set aside more than $12 million to be used for loans for this purpose.

A typical experimental plant on a reservation is the Fairchild Camera & Instrument Semiconductor Division located on a Navajo reservation at Shiprock, New Mexico. The firm employs about 450 assemblers and mechanics, and has a $700,000 contract with the Bureau of Indian Affairs to provide on-the-job training. The firm is negotiating with the Navajo to build a $1½ million permanent facility there, which however is contingent on the provision of proper housing by the Government. Dr. Robert Noyce, group vice-president of Fairchild, said the company regards the experiment as successful bcause "in the Indian culture there is an emphasis on producing when you work!" He admitted labor cost was a factor in the decision to employ Indians, but declared social benefit was also a consideration. "Probably nobody would ever admit it, but I feel sure the Indians are the most underprivileged ethnic group in the United States," he said.

A major problem is educating large groups of people on the reservation. The people are so widely dispersed, with cities mere crossroads and without centralized housing, that it is difficult for a large industrial enterprise to employ a great number of people in one location.

In another experiment, a group of Seminoles are devoting their talents to assembling components at a $500,000 Amphenol Connector division plant near Hollywood, Florida. The plant is expected to ship approximately $7 million worth of computer, instrument, and communications equipment connectors this year, with an expected increase to $10 million in 1968.

As an outgrowth of these successes, an Employment Training Center for Indians will open this month in Madera, California. It will be directed by Philco-Ford Corp. under a contract with the Bureau of Indian Affairs. This Center is aimed at alleviating chronic unemployment and hard-core poverty among Indians, and is a major departure from other programs to increase opportunities for the unemployed. The concept involves comprehensive family training. The center will provide education, training, urban adjustment orientation, and job-placement for all family members of employable age. Family and vocational counseling, pre-vocational and vocational training, and health services, will be provided for trainees and their families, at no cost to them.

Specialized training for jobs, job placement, and follow-up, are included. Philco-Ford is committed to place all trainees who complete the program. It is expected that more than one job will be generated for each family.

The center will initially enroll 30 Indian families from all parts of the country. An additional 200 single trainees will be added by July 1.

Theodore S. Hoffman, president of Hoffman Information Systems, Inc., has been appointed a consultant on economic development with the Bureau of Indian Affairs. He will advise the Bureau on development and use of Indian talents and resources; promotion of locations on Indian reservations for industrial plants, commercial endeavors, and tourist enterprises; encouragement of Indian-owned-and-operated commercial ventures; and mobilization of credit and financing for such activities.

CYBERNETICS IN THE U.S.S.R.

Robert W. Brainard and William D. Hitt
Battelle Memorial Institute
Columbus, Ohio 43201

The Soviet Union is making a considerable effort to integrate cybernetics with the beliefs and institutions of Soviet society. In the Soviet Union cybernetics has kept a solid scientific meaning as the science of control and communication in man, machines, and organizations with emphasis on the use of automatic computers; and the subject is being applied to a very broad range of activities, including factory production control, economics, law, medicine, and education.

The Soviets consider that cybernetics is relevant to contemporary scientific and technological problems, and reinforces certain statements of dialectical materialism, a philosophy of development of societies and similar complex phenomena.

Official recognition and acceptance of cybernetics in the Soviet Union began in 1958 with the establishment of the Scientific Council on Cybernetics by the USSR Academy of Sciences.

The most ambitious application is in the field of economics, where a national program aimed at establishing a cybernetic system for controlling the entire economy is being vigorously developed.

At the heart of this proposal is a dynamic mathematical model of the entire Societ economy. Planning and control would be implemented through an integrated nation-wide network of computer centers. Soviet experts predict that this program, when introduced, will raise the national economic output by one-third, and will double the present rate of economic growth.

Introduction of cybernetic methods could result in fundamental changes in Soviet economic theory and practice. The use of such methods raises the possibility that the Communist party might eventually lose its control over the economy — that the formulation of economic objectives will be taken over by technicians.

Some specific economic applications of cybernetics in the Soviet Union are:

- Systematic control of planning and administration of large construction enterprises.
- Selection by computer of the optimum method of transporting a raw material between its producers and its consumers.
- Simulation of production processes in machine and tool design.
- Development of a city master plan which even specifies the optimum time period for urban renewal.

In fact, the control of the total national development is considered a part of cybernetics.

In the legal field, the Soviet objective is to use cybernetics to provide a scientific basis for law and law enforcement. Numerous Soviet writers have suggested that cybernetics can be used to codify the laws and to analyze their internal consistency. Although the application of cybernetics to legal problems looks promising, few, if any, cybernetic techniques have yet been used in actual practice. The major impediment is the technical problem of converting legal information into computer language.

Some work has started recently on collecting and analyzing legal statistical data in an effort to identify conditions that produce crime. The aim is to find means for detecting criminal tendencies at an early stage. Considerable effort is also being made to automate the analysis of fingerprints, handwriting, facial features, and of substances such as metal shot, glass, and paint.

In the field of medicine, Soviet practitioners look to cybernetics to convert medical practice from an essentially qualitative art to a quantitative science. They say man can be regarded as a cybernetic system that is subject to the same general laws of control and communication as inanimate systems.

A great deal of effort has been directed toward automating medical diagnosis. Several medical centers are reported to be using diagnostic machines. No remarkable results have yet been reported in literature on these developments, nor on the development of automatic selection of treatment.

Cybernetics is also being applied in the field of public health, with emphasis on the collection and analysis of medical data. Some interesting work is being done in establishing optimum diets and hygienic norms of work and rest.

In the field of education, particularly in the area of programmed instruction, the Soviets have borrowed extensively from Western methodology and textbooks. Interest in programmed instruction is high, and a rapid increase in its use is anticipated. Teaching machines are under active development, particularly in the military and higher academic institutions.

In general, there are fundamental differences between the U.S. and U.S.S.R. in the development and application of cybernetics. The environment in the U.S. appears to be more conducive to creative breakthroughs in cybernetic theory, while the Soviet environment appears to be more conducive to large-scale application of cybernetics.

COMPUTERS CHECKING ALL UNITED STATES TAXPAYERS FOR FIRST TIME

Norman P. Teich
Honeywell Electronic Data Processing
Wellesley Hills, Mass. 02181

Computers are checking all Federal income tax returns for the first time this year; *not some of them,* but *all of them.*

By mid-April, filing deadline for most taxpayers, seventeen Honeywell 200 computers in the seven Internal Revenue Service (IRS) regional service centers will have received for processing more than 100 million tax returns representing more than $130 billion in collections.

According to IRS Commissioner Sheldon S. Cohen, all returns are processed in the service centers before being sent to the National IRS Computer Center in Martinsburg, West Virginia. At the National Center, the returns are matched against the master files, which include a record for every single tax paying entity in the country. The files bring together in one place for thorough scrutiny all tax transactions of all taxpayers — no matter where they live or when they filed their returns. Every taxpayer has only one account and all information affecting his tax status is matched against that account and no other.

This nationwide system was developed during the past five years. Its need became obvious when IRS projected its workload and realized it would become virtually impossible to collect and account for tax revenues — while effectively enforcing tax laws — unless a significantly different approach for administering the system was developed.

The magnitude of the job to be accomplished can be realized from a few simple statistics: in 1930, only six million tax returns representing $3 billion in revenue were filed; this year, more than 100 million returns will be filed and $130 billion collected.

Tax returns are "perfected" at each of the seven regional centers by tax examiners whose job it is to make sure all information asked for is entered on the form in the correct places. The information is then transcribed onto punched cards and fed into the Honeywell 200's, which verify the returns' mathematical accuracy and make some preliminary calculations on deductions, exemptions, etc.

Magnetic tape records of the returns are then prepared and sent to the National Computer Center, where they are matched against the national master files. Each taxpayer's account includes the taxpayer's permanent tax number, a continuously updated multiple-year digest of tax data about the tax account, data on all returns for which the taxpayer is liable, when and where returns have been filed, the amount and status of each liability and any audit results.

The National Computer Center, when it has completed its job, produces a number of magnetic tape reports which disclose who failed to file returns, owes taxes for previous years, has refunds coming or filed duplicate claims for refunds. Also revealed are any discrepancies or unusual characteristics of a return that would suggest a need to examine it further.

Refund tapes listing amounts to be returned to taxpayers are sent to U.S. Treasury Department disbursing offices where refund checks are printed and mailed. Other tapes are sent to the regional service centers, where they are used to prepare tax bills, delinquency notices and other communications to taxpayers, and identify returns that are to be considered for audit.

IRS' nationwide system — now complete — provides for the first time a comprehensive, uniform, nationwide check on failures of individuals or businesses to file returns. It also improves mathematical verification of returns, increases the ability to detect improper refund claims, and enables more complete checking of data reported on information documents — such as dividend and interest payments — against information on tax returns.

In addition it will insure proper application of credits and reduce processing errors. The capacity and memory of the system benefits taxpayers who may have overlooked prior year's credits or advantages provided by law and enables credit of undelivered refund checks to tax accounts.

IFIP ADMITS HUNGARY AS 26th MEMBER COUNTRY

International Federation for Information Processing
IFIP Congress Office
23 Dorset Square
London, N.W.I., England

The total membership of the International Federation for Information Processing was brought to 26 nations with the formal admission of Hungary at the eleventh General Assembly of IFIP. Hungary is the fifth eastern European country to join the Federation. The other four are U.S.S.R., Poland, Czechoslovakia, and Bulgaria.

At the meeting, both Yugoslavia, whose admission is under consideration, and Mexico issued invitations for IFIP Congress 71 to be held in their respective countries.

As previously announced, IFIP Congress 68 will be held in Edinburgh, Scotland, August 5-10, 1968.

"INDIVIDUAL PRIVACY AND CENTRAL COMPUTERIZED FILES" — COMMENTS

I. From Sherman C. Blumenthal
Sr. Systems Planner
Union Carbide Corp.
New York, N.Y. 10017

The following letter was sent to Senator R. F. Kennedy, Senator J. Javits, and Congressman Leonard Farbstein, relating to your editorial in the October 1966 issue of *Computers and Automation:*

The invasion of privacy of the individual citizen by various government agencies is an increasingly disturbing phenomenon to many thoughtful people. Deliberate and widespread patterns of government snooping of questionable legality have come to light. This includes such reprehensible practices as the monitoring of first class mail in the Post Office, unauthorized wiretaps by the Federal Bureau of Investigation and the Internal Revenue Service, and a suspicion of ubiquitous, rampant and virtually undetectable electronic eavesdropping.

Most disturbing of all, perhaps, are recent proposals to establish a centralized computer data bank, collecting all the information about each individual available throughout the government in a single file. The existence of this capability will whip imaginative bureaucrats into a frenzy of unrestrained abuse. The temptations are simply too great for us to believe that the desire for information will not outpace the ability to restrict its use.

I have enclosed what I believe to be an excellent editorial on this subject from a recent issue of *Computers and Automation.* As a practicing professional in the computer sciences I can vouch for the reality of this threat to individual freedom. This development should be stamped out now, firmly and forever, by enacting legislation along the lines suggested in the editorial.

II. From the Editor

Thank you for the copy of your letter to the Senators and Congressman. We are pleased that you thought the editorial worth sending on to them.

"BOOTSTRAPPING A CAREER IN THE COMPUTER FIELD" — COMMENTS

I. Fred V. Rubenstein
Los Angeles, Calif.

As an avid reader of *Computers and Automation* I have been active in promoting many of the philosophies you touch upon in your C&A editorials. If possible, I would very much appreciate receiving ten copies of your September 1966 editorial entitled "Bootstrapping a Career in the Computer Field." I have shown my copy (still intact in my personal file) to several of my associates who enjoyed your message. How nice it would be to circulate copies among some of our high school and college students.

Some of us are interested in contributing articles to your magazine. Please indicate what the appropriate steps would be to submit an article to *Computers and Automation.*

II. From the Editor

We appreciate your kind remarks, and we are happy to provide several copies of the September 1966 editorial. If you want still more, we suggest you make arrangements with some local copying service.

We would like to have an article from you; some information for prospective authors is enclosed (see the notice "Articles for *Computers and Automation* in this issue).

ECPI PROGRAM WRITE-UPS AVAILABLE

A. Estipona, Technical Director
Electronic Computer Programming Institute, Inc.
Empire State Bldg.
New York, N.Y. 10001

In order to facilitate testing of 1401 and 360 programs written by our students, Electronic Computer Programming Institute (ECPI) has developed two resident core dump programs for its IBM 360 16K model 30. It has occurred to us that these programs may have a wider appeal and we are therefore willing to supply a write-up and an object deck to all requestors. Both programs reset themselves each time they are executed and need only be loaded once. In addition, both programs permit periodic dumps to be taken by inserting the coding given in the write-up at the appropriate point in the user's source program. When this option is used, all registers are restored and control is returned to the user's program.

Our 1401 dump program is designed to overcome the problem of obtaining the contents of the read area when taking a storage dump in the Compatibility mode. The program solves this problem by being loaded prior to testing and remaining resident in high core. A storage print, starting at the read area and continuing to 14,999, may then be obtained whenever needed simply by altering to the starting address of the dump program (15,000). The primary restriction on the use of the program is that any programs to be tested must not have a CTL card greater than 55 (12K). This is to prevent the dump program from being cleared when the user's program is loaded.

For testing of 360 programs, ECPI uses a supervisor generated by the BPS 8K tape System. To obtain a storage print after a student's program caused a program check interruption, we used IBM's storage print program. However, since this program included its own supervisor, it was necessary to re-load our supervisor before we could resume testing.

To avoid this extra step, we developed a resident storage print program which is placed immediately behind the supervisor and loaded with it. The program modifies the instruction address in the new Program Check PSW so that linkage is automatically provided to the storage print program in the event of a program check. The contents of the sixteen registers, the interruption code, the address of the next sequential instruction, and the contents of main storage are printed in hexadecimal format on SYSLST. Control is then returned to the program loader in the supervisor. The two restrictions on the use of the program loader in the supervisor must not go beyond address 2999 and programs to be tested must not begin before address 4000. The program as assembled, will print the contents of storage beginning at address 0000 and ending at address 16,000.

As an additional feature, both programs can be modified to print fewer positions of storage by modifying the beginning and ending address constants. Additional information on this aspect is provided in the program write-ups.

The write-ups and object decks may be obtained by writing to me.

JOVIAL BULLETIN ESTABLISHED — PAPERS SOUGHT

David K. Oppenheim
Abacus Programming
3507 Barry Ave.
Los Angeles, Calif. 90066

A new information bulletin has been established to deal with the Jovial programming language. The new Jovial Information Bulletin (JIB) will be published under the auspices of the Special Interest Committee on Programming Languages of the Association for Computing Machinery, and will be distributed (along with the Algol Bulletin, the PL/I Bulletin, and the Cobol Information Bulletin) as a supplement to *SICPLAN Notices,* the Committee's informal monthly newsletter.

As editor of "The JIB," I am seeking contributions concerning Jovial that may be of interest to Jovial users and implementers, as well as to computer programmers in general. Suggested topics include:

- Comparisons of Jovial with other programming languages, outlining advantages, disadvantages, etc.
- Interesting applications of Jovial, including real-time and non-real-time applications.
- Language features that are compiler or machine dependent and are not generally available in Jovial systems.
- Information about Jovial processors, including machines involved, current status, language restrictions or extensions, interesting processing techniques or outputs, and error checking capabilities or incapabilities.
- Algorithms for processing Jovial source-language programs, as well as algorithms in Jovial for which the language is especially applicable.
- Philosophy and techniques of Jovial programming, including coding, debugging, and operation, machine-independent programming methods, use of and extensions to the compool, etc.
- Improvements, extensions, and deletions that would be desirable in Jovial.

In addition to contributions on these and other topics, I would like information from: those in charge of programming groups or computing facilities that use Jovial as a programming or documentation language; those with development or primary maintenance responsibility for an existing, developmental, or planned Jovial compiler or processor; those interested in receiving copies of "The Jovial Information Bulletin."

Please address all comments and contributions to me at the above address.

(Please turn to **FORUM**, page 53)

c & a PROBLEM CORNER

Walter Penney, C.D.P.
Problem Editor,
Computers and Automation

Readers are invited to submit problems (and their solutions) for this column to: Problem Editor, Computers and Automation, 815 Washington St., Newtonville, Mass. 02160.

This month's problem:

Claude Liffey picked up a piece of paper from one of the desks and was studying it when John Lawthorne came in.

"Did you forget we were going to have lunch together today?," his fellow-professor asked.

"Oh, I'm sorry. One of the students in my programming class left this behind and I was trying to figure it out. Must have gotten a little too engrossed." He handed the sheet to John (see Figure 1).

"I was going to punch up a few cards and run the program just to see what would come out," said Claude. He watched as his companion hit a few keys on the desk calculator, then wrote a number at the bottom of the sheet.

"No need to do that. Here's the value of z that would have been printed out," he announced.

What did he write?

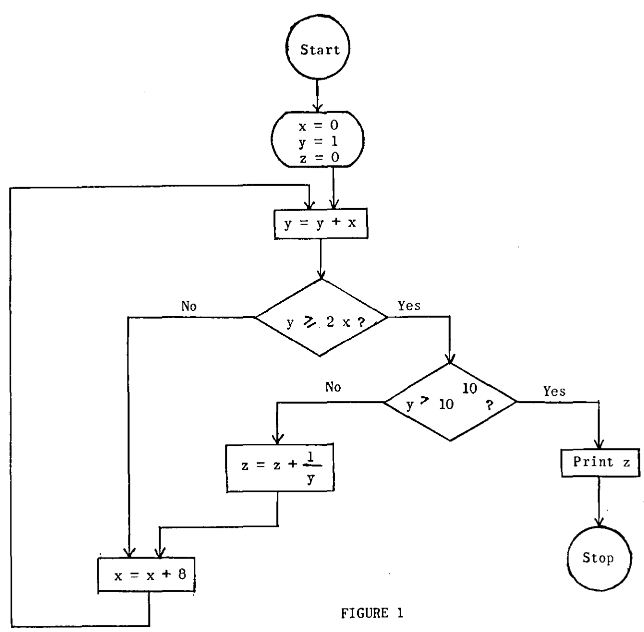


FIGURE 1

Solution to last month's problem:

The number was 1 0 0 1 1 0 0 0 1 0. Whether interpreted as a decimal or binary number (i.e., 610), this leaves the same remainders when divided by 3, 5 and 7. But when divided by 11, only 1,001,100,010 (decimal) leaves a remainder of 9.

TOP 100 COMPUTER USERS AMONG INDUSTRIAL FIRMS HAD OVER $2 BILLION WORTH OF COMPUTERS AT WORK BY MID-1966

Over a third of the market for computers among industrial firms consists of the one hundred top accounts.

These hundred (the "EDP 100") have over $2 billion worth of computers installed, and they account for 34.7% of the total value of computers used by industrial corporations. Indeed, these hundred companies use nearly 16% of the $13 billion worth of computers currently installed in the world (not counting military applications which are classified).

These figures are derived from a study of the value of computer and related data processing equipment in use by the 500 largest industrial corporations in the U.S. and the 200 largest foreign-based industrial concerns, as compiled by Fortune magazine, July and August, 1966. The study was conducted by International Data Corporation. The top 100 computer customers -- the "EDP 100" -- are listed below.

Preparing the Base

To qualify as "industrial corporations", and thus be included in this study, firms must have received at least 50% of their revenues from manufacturing or mining during the most recent fiscal year. American Telephone and Telegraph, a utility, would therefore not qualify, even though it is probably the largest computer user outside the Federal Government. However, Western Electric, its manufacturing affiliate, is included in the EDP 100.

Also, companies whose primary products are digital computer systems -- such as IBM and Control Data -- were not considered for the EDP 100. There is virtually no way to separate computers used for computer product development, programming, and sales support, from those actually used for internal business in such firms.

Interpretation

The world's largest manufacturing corporation, General Motors, heads the list as the world's largest computer user among manufacturers. It was using $175 million of computers as of June 30, 1966, the cutoff date for the study. Next down the list was General Electric, with $85 million of computers, followed by Boeing with $80 million, Lockheed with $75 million, and Ford with $72 million.

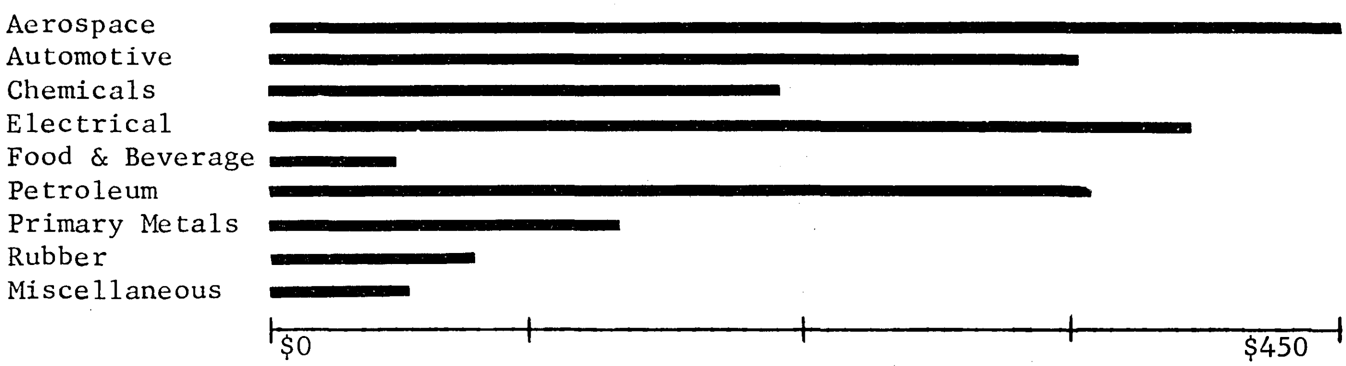
Other firms tend to line up by size within their industry classifications, but there are quite distinct characteristics of computer usage among different industry groups. As Table I indicates, 12 aerospace firms on the EDP 100 list account for 21.8% of the computers included in this study.

Foreign Use

Although 35 of the EDP 100 are foreign-based, they use only 18.8% of the computers. To some extent, this indicates relative immaturity of the foreign market; one of the reasons for the higher growth rate currently being achieved in this market is that foreign firms are catching up with their U.S.-based firms in the value of computers used to support their business activities.

For more information about complete IDC survey results, designate 4 on the Readers Service Card.

TABLE 1 EDP 100 DISTRIBUTION OF VALUE OF COMPUTERS WITHIN INDUSTRY GROUP ($ Million)



REAL-TIME PROCESSING POWER: A STANDARDIZED EVALUATION

J. Burt Totaro, Associate Editor
Auerbach Standard EDP Reports
Auerbach Corporation
Philadelphia, Pa. 19107

"Most current computer systems offer several different types of random-access storage devices, with speed and storage capacities (and prices) that vary by several orders of magnitude. How can the user determine what computer system can best serve his growing real-time needs?"

A clear trend in the computer industry today is toward the use of computer systems that employ large-capacity random-access storage devices and perform "real-time" processing in a wide variety of application areas. Real-time processing in its broadest sense can include any type of processing that for practical purposes is instantly responsive to external events and is capable of influencing the further course of these events. Thus, both missile guidance and simple on-line file inquiry systems can be considered real-time activities.

Applications

Random-access devices and the real-time processing they permit have become so important that many current computer systems require some kind of mass storage device in every equipment configuration that is sold. These devices can aid considerably in improving the performance efficiency of a system's hardware and software. Fast-access storage devices make possible efficient real-time processing in such diverse applications as:

- Inventory control
- Airline reservations
- On-line savings
- Process control
- Credit checking
- On-demand management reporting
- Conversational programming.

The performance advantages and application flexibility gained with real-time processing in random-access-oriented systems have forced almost every current or prospective computer user to come to grips with questions such as "Are we ready for real-time processing?," or "What computer system can best serve our growing real-time needs?" The user contemplating installation of real-time hardware or addition of another real-time application to his system cannot easily find answers to his questions because the subject matter is complex and the consequences of any decisions are far-reaching. Evaluating, selecting, and utilizing real-time equipment is especially difficult because up to this time there has been no effective method — short of full-scale (and expensive) simulation — of measuring the performance of planned real-time systems.

New Estimating Technique

This article discusses a new standardized estimating procedure for measuring the ability of computer systems to locate and update randomly addressed records in real-time applications. It is based on a standard random-access benchmark problem, which is similar in concept to the standard sequential benchmarks.[1] Using a detailed programming technique that is standard, objective, and yet flexible, the new estimating procedure measures computer systems in their performance of the random-access benchmark problem. The resulting performance times serve as a valuable guide to the overall performance of those systems which are oriented toward the use of random-access devices. They also serve as a useful tool in comparative system evaluations, since all systems can and will be measured in basically the same standard manner.

Real-Time Benchmark Approach

One of the most common real-time jobs in commercial data processing installations is the processing of randomly (and often remotely) entered detail transactions against a master file stored in random-access storage devices. The detail transactions supply the information used to update the master file by inserting new records, deleting old records, and modifying

[1] "Standardized Benchmark Problems Measure Computer Performance," John R. Hillegass, Auerbach Corporation, *Computers and Automation*, January 1966, pages 16-19.

the contents of existing records. Usually an activity report is prepared concurrently to reflect the modifications made to the on-line master file. Figure 1 illustrates this type of application. An on-line savings system is a typical example of this form of real-time processing.

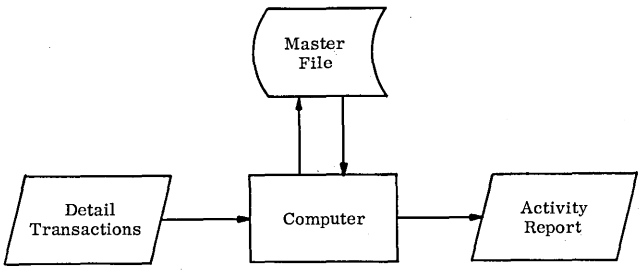


Figure 1. Run Diagram of Random-Access Benchmark Problem

The application parameters that have the greatest effect on throughput times in real-time processing are: organization of the master file in random-access storage, source and frequency of real-time detail transactions, amount of computation required to update each master-file record, and method of handling the activity report. With regard to these parameters, the random-access benchmark problem (like any standard benchmark problem) includes certain necessary assumptions and parameter specifications. The following paragraphs explain these basic assumptions and general parameters.

Master File Organization

The master file is assumed to be stored on one or more random-access storage devices in sequential order by item number. It is further assumed that the master records will be accessed through use of the indexed sequential access technique, with a complete cylinder index permanently resident in core storage and a track index stored on the first track of every logical cylinder.[2]

Thus, when a detail transaction enters the system, the cylinder index in core storage is searched to find the number of the cylinder that contains the desired master-file record.

Seek Operation

A seek operation is then performed on the random-access device to locate the desired cylinder. Next, the first track of the cylinder is read to obtain the track index, which reveals the exact track and block number within which the desired record is stored. Using this information, the desired master record is read into core storage for updating.

As mentioned, the master file is assumed to be distributed in strict sequential order through the random-access storage medium. One reason for this assumption is to make the storage of the master file as application-independent as possible and thereby extend the general applicability of the results. It is further assumed that there are no known differences in the activity (i.e., frequency of access) of individual master-file records, so that no performance advantage can be gained by organizing all highly active records in the same or consecutive cylinders. Experience has shown that the master files in many application areas are organized in just this straightforward fashion, especially in their earliest versions of implementation.

Detail Transactions

The random-access benchmark problem primarily measures the speed at which a given system can locate, read, update, and write randomly specified master records on random-access storage devices. In order to ensure that the benchmark will accurately measure the throughput capabilities of random-access devices engaged in file-updating activities (and to ensure that the times for this primary activity will not be muddled by extraneous and widely varying considerations), no attempt has been made to include timing considerations involved in obtaining the Detail Transactions. Instead, the Detail Transactions are assumed to be arriving in random sequence and at a continuous rate from either local or remote input devices.

When the transactions enter the central computer system, they are stored in a transaction queue in a communication area of core storage by a real-time program or simple data input routine resident in a "foreground" portion of core storage. The random-access benchmark problem, then, obtains its Detail Transactions by accessing the common communication area of core storage. It is assumed that the Detail Transactions arrive at a sufficiently high rate so that one or more transactions are always waiting to be processed; i.e., the transaction arrival rate is never allowed to be a limiting factor upon the computer system's throughput.

Through this assumption, the applicability of the results of the standard benchmark test is again kept broad. To the random-access benchmark problem, it makes no difference whether the Detail Transactions enter the system via a local card reader, via a simple remote inquiry device, or via a complex data communications network. Detail Transactions are considered to be device-independent. The random-access benchmark problem primarily measures a system's ability to locate and update randomly addressed master records. It does not attempt to measure the efficiency of the system's data communications network.

Required Computation

The amount of computation required to update each master-file record is determined by the number of computational steps required to perform the program functions specified in a series of detailed flowcharts. The general flowchart in Figure 2 summarizes these detailed flowcharts and indicates the basic computational processes that must be performed. Because of the imbalance between computational speeds and the access times for most current random-access devices, the central processor time required to perform the specified computations will generally be a small portion of the total time required to update one randomly addressed master-file record. The amount of computational time can, however, affect the number of disc or drum revolutions required to complete the processing cycle for a single master record.

The central processing time for each system is clearly indicated in a Worksheet Data Table that lists both processor and input-output times required to perform each logical function of the standard problem. Standard throughput performance graphs show both the elapsed job time and the total amount of central processor time used in processing the master records. Comparing elapsed and central processor time will show the amount of central processor time available for use by other jobs. This information is of vital interest when measuring computer systems that are capable of multiprogrammed operations. These graphs and worksheets form part

[2] A "cylinder" is that group of tracks or data storage locations that can be accessed when the movable access mechanism of a random-access storage device is positioned at one discrete position. A fixed-head drum unit or disc file would, therefore, consist of only one actual cylinder since all of the data it holds can be accessed without repositioning of the access mechanism. In practice, however, the cylinder concept can be — and usually is — applied to fixed-head devices by subdividing the total body of data tracks into a number of logical "cylinders" so that the two-level indexing scheme, as used in this benchmark problem, can conveniently be applied.

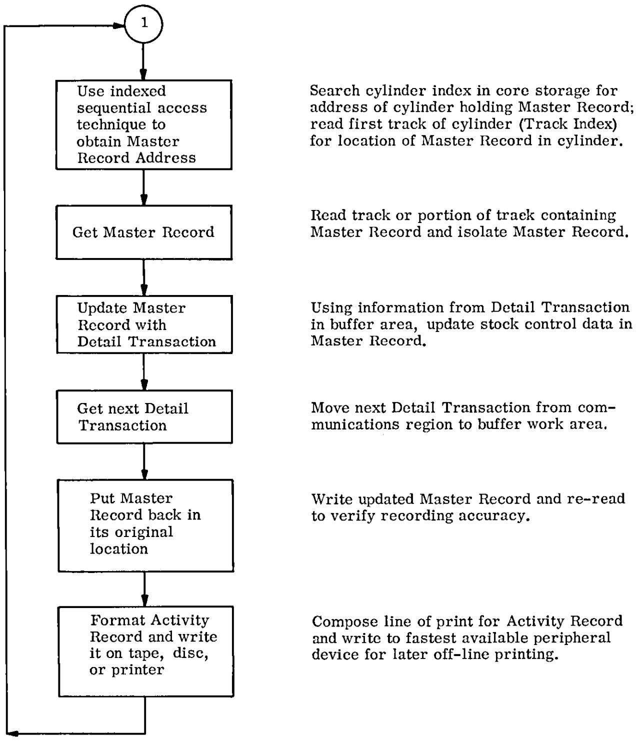


Figure 2. General Flowchart for Random-Access Benchmark Problem

of the standard method of presenting the results for all real-time systems measured.

Activity Report

The standard format of the Activity Report record is rigidly specified. This record of master-file activity will generally be written either on a magnetic tape unit or on a random-access device that is not used for master-file storage. The Activity Report itself is assumed to be printed off-line at some later time. (If a system does not have the capability to use magnetic tape units and cannot add additional random-access devices, the Activity Report record will be printed on-line, though this mode of operation may severely reduce the system's throughput.)

It is further assumed that the Activity Report record will be made available in core storage for access by a separate routine for possible transfer back to the remote terminal that entered the Detail Transaction (as in most inquiry/response applications). Decisions concerning the use of either magnetic tape or random-access devices for the Activity Report records, and amount (if any) of record blocking, are made in such a way as to achieve the best possible throughput rates.

Standard Configurations

Real-time performance estimates derived from the random-access benchmark problem are meaningful only in relation to the hardware equipment configuration that "performs" the benchmark. Therefore, three standard system configurations have been specified, and each computer system's performance is evaluated in one or more of these standard configurations. Standard configurations permit valuable performance and price comparisons to be made between different computer systems, and also permit computer users to evaluate performance results in relation to the standard configuration that most resembles their current or proposed random-access system.

The small-scale standard configuration requires (among other devices) at least 5,000,000 bytes of on-line random-access storage for master-file storage; the medium-scale standard configuration must have at least 20,000,000 bytes; and the large-scale standard configuration requires at least 100,000,000 bytes.

Most current computer systems offer several different types of random-access storage devices, including magnetic drum, magnetic disc, and magnetic card or strip devices. The speed and storage capacities of these devices (and their prices) can vary by several orders of magnitude. The principal guideline that is followed in choosing the particular random-access storage devices to satisfy the auxiliary storage requirements of each standard configuration is economy, both in terms of the monthly rental price per unit of storage and the throughput potential of the selected devices. Other guidelines are that the selected device must be fully software supported and must have reasonably high reliability.

Benchmark Description

Like the widely-utilized generalized sequential file processing problems, the random-access benchmark problem represents a typical inventory control application. The basic processing performed in an on-line inventory control application will closely resemble the basic processing performed in many other real-time processing applications. The sequential file processing problems generally use master files stored sequentially on magnetic tape, accept sorted Detail Transaction records (usually from punched cards), and print the Activity Report on an on-line printer. The random-access benchmark problem, by contrast, uses master files stored on random-access devices, accepts Detail Transactions in random order, and writes the Activity Report on auxiliary storage devices.

Aside from these basic differences in the method of sorting and handling the files, the sequential file processing problems and the random-access benchmark problem share many characteristics, including the entire computational procedure that updates the active master-file record. Thus, valuable cost and throughput comparisons can be made between sequential and random processing techniques.

Format

The basic form of the random-access benchmark problem is represented in Figure 1. Record layouts for all files are specified in detail, but the format and packing of the master-file records can be slightly modified to permit more effective utilization of the hardware being measured.

The detailed processing steps in the random-access benchmark problem are clearly specified by flowchart diagrams (as summarized in Figure 2), but the exact programming procedures used to code these processing steps are left to the analyst performing the estimate. Thus, the analyst can take full advantage of the hardware features and peculiarities (such as variable word length, special arithmetic capabilities, input-output overlaps, special random-access instructions, etc.) of the system he evaluates. This technique adds to the validity of the resulting performance measurements, since the hardware is always used to its best advantage, just as programmers strive to use it in actual applications. Automated estimating procedures, by contrast, tend to be overly general and can be hard-pressed to supply custom-tailored measurements that take into account each system's unique characteristics.

Presenting the Results

The estimating process is separated into a series of logical steps, the results of which are summarized in the Worksheet Data Table (Figure 3) that is prepared for each computer

WORKSHEET DATA TABLE 2 — RANDOM ACCESS BENCHMARK PROBLEM							
	TASK		CONFIGURATION				REFERENCE
			IVR		VIIIR		
	Flowchart Block	Function	Central Processor Time, msec	Dominant I/O Device/Channel Time: Master File, msec	Central Processor Time, msec	Dominant I/O Device/Channel Time: Master File, msec	
1 Random Access Benchmark Problem Timings, msec	E.1 — E.4	Housekeeping	1.51		1.52		4:200.712
	E.5	Seek and Read Track Index	0.76	41.3	3.35	49.1	
	E.6 — E.8	Search Track Index	0.15		0.20		
	E.9 — E.12	Get Master Record	0.70	17.5	0.99	17.5	
	E.13 — E.22	Update Master Record with Transaction	0.30		0.30		
	E.23 — E.30	Get next Transaction	0.51		0.51		
	E.31 — E.34	Write updated Master Record	0.95	50.0	1.56	50.0	
	E.35 — E.39	Format and write Activity Record	0.91		0.91		
	Total Time per Master Record, msec		5.79	108.8	9.34	116.6	
2 Random Access Benchmark Problem Core Storage Space, Bytes	Standard resident routines		8,000		17,000		4:200.715
	Fixed overhead		128		128		
	Benchmark program		4,740		4,740		
	File and work areas		1,712		2,608		
	Cylinder Index		1,890		1,985		
	Track Index		1,400		6,300		
	Total Core Space, Bytes				32,761		
3 Random Access Benchmark Problem File Characteristics	Master Record size, bytes		88		88		4:200.716
	Block size, bytes		616		1,260		
	Blocks per track		5		5		
	Tracks per Cylinder for Master File storage		8		18		
	Cylinders for Master File storage		378		397		
	Devices for Master File storage		3		4		

Figure 3. Example of a Worksheet for a Third Generation Computer

system. Each logical step (or program segment) is keyed to a series of flowchart blocks that describe the step in detail. Central processor and input-output times are always listed separately in the Worksheet. Separate times are listed for each system configuration measured in its performance of the random-access benchmark problem.

Input-output time is represented on the Worksheet by a single column of figures for each configuration measured. This column shows the dominant I/O device time or the dominant I/O channel time, whichever is greater. Generally, this column of figures, Dominant I/O, will reflect the master record physical I/O time, i.e., the time required to locate, read, write, and write-check one master-file record (with the time required to perform each operation specified individually). Writing of the Activity Report record will usually be completely masked behind the dominant master record I/O operations.

Estimated Total Time

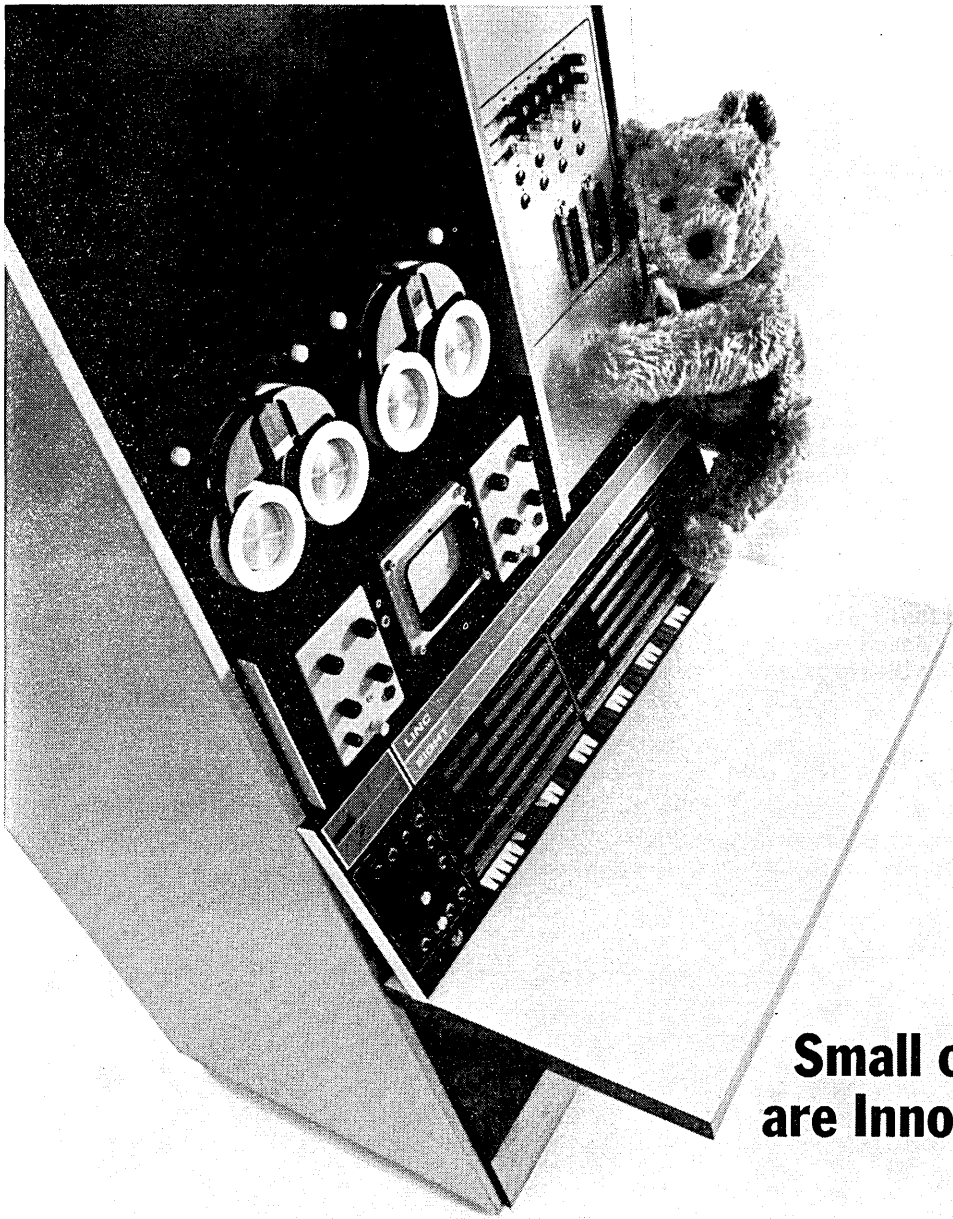
The Worksheet Data Table also includes a figure called "Total Time per Master Record, msec" for both the Central Processor and Dominant I/O columns. The higher of these two total figures represents the estimated total time, expressed in milliseconds, to process one randomly addressed master-file record according to the specifications of the random access benchmark problem.

The central processing and elapsed I/O timing figures presented in the Worksheet Data Table are summarized and extended on system performance graphs which indicate the time, in minutes, required to update from 100 to 100,000 master-file records.

Applying the Results

Since the results of the random-access benchmark problem are presented in logical timing "kernels" keyed to logical sections of the standard problem flowchart, a systems analyst can easily obtain performance estimates for his specific real-time processing jobs by substituting or adding his estimated timing kernels for program segments that are unique to his problem programs. Thus, he can arrive at a new total time (central processor and I/O) to process one randomly-accessed master record in his specific program.

This new real-time performance estimating technique has already been successfully applied to a number of third-generation real-time systems, including six models of the IBM System/360. In applying the real-time measures to current systems, widely diverse random-access devices have been used for master-file storage, providing a good test of the flexibility of the technique. The estimating procedure has shown itself to be objective, flexible, easy to use, easy to modify, and capable of producing valuable measurements of real-time processing power.



Small computers are Innovation machines

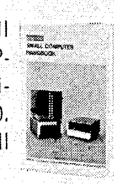
The power under the direct control of the scientific investigator with small computers is enormous. Not just the power to calculate. Not just the power to analyze. But the power to innovate.

Small computers — and by that we mean laboratory size or smaller general purpose machines — are most frequently used on-line, in real time, intimately hooked up to the experiment. Inputs to the computer are direct from the experiment. Outputs are instantaneous detail, or instantaneous sampling, or instantaneous averaged results, all provided while the experiment proceeds.

Two things can now happen. First, the investigator can change the method of data taking, or the sequence of data taking, based on the results he sees emerging. He can sample more frequently than he thought necessary, or can look in detail, at an unexpected result. Second, he can influence the experiment, either by himself or automatically by the computer, based on the results he sees emerging.

If he waited to complete the experiment and analyze the results at the computation center, the opportunity to innovate would be gone.

Small, real-time, on-line, general purpose computers are intensely personal, highly approachable, responsive scientific innovation machines. It will be the rare laboratory that will not have one in the next few years.



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COMPUTER PERFORMANCE PROJECTED THROUGH SIMULATION

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"The implementation of a data processing system is as complex as any function faced by management — and evaluation of computer hardware can no longer be realistically accomplished simply by comparing hardware performance data."

Increasingly, computer management is recognizing the need to employ scientific methods to assist in the complex tasks of hardware and software selection and evaluation. Prominent among the scientific techniques available today is an integrated series of computer programs called SCERT (*S*ystems and *C*omputer *E*valuation and *R*eview *T*echnique). The SCERT Program has been used extensively for over four years by diversified groups of commercial and government organizations throughout the United States, Canada and Europe.

Proper management of the total environment in data processing requires realistic prediction of computer performance at a number of different points in the total cycle of selection and implementation.

Feasibility Analysis

Today's computers have the inherent capability to do just about anything from playing chess to completely controlling complex manufacturing operations; but this capability does not necessarily prove feasibility. The planning for new computer applications should include precise measurements both of the cost of implementing and processing, and the response that the computer hardware and system design can provide.

Computer Selection

Proper computer selection is a need easily recognized by all levels of computer management. Those associated with the industry for any length of time have seen the explosion of implementation costs caused by the selection of inadequate hardware. Frequently, a bad computer selection requires complete restarting of the whole implementation process. Just as important is the delay of important missions and programs. Far less frequently, improper selection can result in too much hardware power with obvious excess cost. The ability to accurately predict performance when selecting is a vital need in most organizations.

Hardware and software systems now offer different approaches to the solution of any one problem on a computer. Measuring the performance of alternative designs in terms of cost and response can lead to an optimum design selection.

Program Design

As computer hardware has become more reliable, the capacities available to programmers have expanded. A predictive tool was needed to allow the programmer to optimize the capability and capacity utilization of the programs. Just as important is the proper selection of programming language from the several now available for a typical computer system.

EDP Management

Finally, computer management needs a predictive tool to measure operational and programmer resources. Such a tool should enable them to measure increasing and/or peak workload before the fact, and to plan for obtaining proper hardware at a realistic time.

Why Simulate?

The evaluation of computer hardware can no longer be realistically accomplished by comparing instruction execution times, peripheral speeds, memory sizes and other unrelated hardware performance data. Other approaches to performance prediction, such as benchmark processing and instruction mix statistical data, are inadequate for the evaluation of computers performing in a multi-programming mode of operation.

Simulation is a scientific tool that provides for the analysis of complex structures, procedures or systems by modeling the systems and examining the impact of alternative decisions based on predictive results. The more complex the simulation, the greater the need for a computerized model.

The planning, installation and implementation of a data processing system is as complex as any function faced by management. The number of decisions and alternatives presented at every stage of planning and implementation makes simulation a useful tool. From early stages, when alternate gross automation plans are presented, to the complex decision for proper hardware/software selection, each decision is best made in light of the eventual impact of the alternatives on the final performance of the system.

The Design of SCERT

There are two basic premises underlying the design of SCERT. To properly evaluate the relative ability of computers to process projected (or actual) applications, the total workload to be placed on the computer hardware must be considered. This first premise is particularly true when processing employs on-line real-time concepts or when the hardware and software under consideration is operated in a multi-programmed mode.

To provide for the simulation of the total processing workload, the primary consideration is to allow for a rapid but accurate definition of processing requirements. Obviously, SCERT was going to be employed in situations where the processing workload only existed at a high level conceptual design. But in other cases, SCERT would be used to study systems where the programming had been accomplished and the systems were already running on computer hardware. The input to SCERT which describes processing therefore must have a broad range of adaptability but, at the same time, have the capability of being prepared in a minimum amount of time with a minimum amount of analytical effort.

Analytical Language

This design goal was met by the development of an analytical language which is structured similar to programming languages, but at a much higher level. The language has three divisions: (1) the environment division, which provides background data on the system to be simulated; (2) the file division which describes the general characteristics of all files involved in the computer processing; and (3) the systems division which specifies the actual processing to be accomplished on the computer.

In a typical situation, a trained SCERT Analyst can define a computer system consisting of approximately 100 runs in one week or less.

Hardware Independence

A second basic premise in the design of SCERT is concerned with the hardware independence of the input specifications. Optimum use of SCERT would allow for the evaluation of a defined system on any conceivable configuration of computer hardware and its related software. SCERT would have the responsibility for adjusting the system to conform to the particular hardware being simulated. This is accomplished in two ways:

1. Factor Library

   An important part of the SCERT Program is the Factor Library. This Library represents a technical data base which contains the significant electronic and mechanical performance factors for virtually all commercially available computer hardware. The Library also contains performance characteristics of most of the software packages available. This software includes data on compilers, operating systems, Input/Output Control System packages, and sort-merge packages.

   SCERT uses the Factor Library based on component model numbers defined at simulation time, and constructs a model of the hardware to be simulated, parametered by the specified software. SCERT then produces its first output report which shows general cost and environmental characteristics of the hardware, and serves to confirm the actual configuration being simulated.

SCERT ANALYSIS PART 1   COMPUTER COMPLEMENT REPORT

FOR SYSTEM XEL66

COMPUTER COMPLEMENT NUMBER R66

MODEL NUMBER	MANUFACTURER	QUANTITY IN SYSTEM	PURCHASE PRICE $	MINIMUM MONTHLY RENTAL	ENVIRONMENTAL REQUIREMENTS FLOORING SQ FT	COOLING BTU/HR	POWER KVA
CENTRAL PROCESSING UNIT COMPUTER MAIN-FRAME							
2050H	IBM/360	1	846,950	17,140	571	37,140	18.0
MAGNETIC TAPE UNITS							
24023	IBM/360	10	366,500	7,600	180	35,000	16.0
24035	IBM/360	4	243,200	4,940	144	22,000	8.4
CARD READER							
2540	IBM/360	1	35,000	660	96	2,600	1.2
PRINTER							
1403N1	IBM/360	1	41,200	900	55	4,600	1.4
RANDOM ACCESS UNITS							
23011	IBM/360	1	96,000	2,250	75	3,800	1.5
23111	IBM/360	2	52,600	1,150	50	4,000	1.5
TOTAL EDP SYSTEM			1,645,450	34,640	1,171	109,140	48.0

THE PRICING AND ENVIRONMENTAL FACTORS FOR THE FOLLOWING EQUIPMENT HAVE BEEN ADDED TO THE DEVICES LISTED ABOVE

2150	IBM/360	1	CONSOLE WITH 1052 CONTROL
28041	IBM/360	1	MAG TAPE CONTROL 2 CHANNELS
28411	IBM/360	1	DISK STORAGE CONTROL
6980A5	IBM/360	1	SEL CHANNEL 2050 H-S 1ST
6981A5	IBM/360	1	SEL CHANNEL 2050 H-S 2ND
7161	IBM/360	1	SIMO READ/WRITE FOR 2402

THE FOLLOWING SOFTWARE HAS BEEN UTILIZED WITH THE ABOVE COMPUTER COMPLEMENT

S50H2	SOFTWARE	1	OPERATING SYSTEM SORT 2 CHANNEL
ZOS005	SOFTWARE	1	OPERATING SYSTEM 360 SEQUENTIAL MODE

2. Presimulation Algorithms

   The second way hardware independence is achieved in SCERT is through presimulation algorithms. These algorithms structure the processing descriptions so that they are compatible with the particular computer being simulated. The major algorithms accomplish the following:

   a. A computation of internal processing time and memory requirements. As a by-product, a computation of the number of program steps required to perform the internal processing.

b. The assignment of all files to available peripheral devices and channels.
c. The restructuring of files in terms of record format, optimum file blocking and buffer areas.
d. The calculation of throughput timing for all input/output functions and their memory requirements.
e. The calculation of pre- and post-run overhead time such as program insertion, setup, error correction, and re-run.

Simulation Methodology

The SCERT Program employs three distinct simulation methods. The first of these derives the elapsed running times for each computer run or real-time event. If the system being simulated is only concerned with sequential batch processing in a non-multi-programmed environment, this stage of simulation is the only one employed.

This first stage of simulation is called a throughput simulation. SCERT literally explodes the processing requirements into the maximum number of unique throughput possibilities, and then simulates the flow of processing for each unique situation, thereby producing a projection of net running time.

The result of the throughput simulation is then reported in a "Detailed System Analysis," which is produced for every computer run simulated. It also contains certain other data useful for the implementation of the system such as optimum file blocking and channel assignments.

SCERT DETAIL SYSTEMS ANALYSIS

FOR RUN NUMBER C203 — FREQUENCY D 1.00

COMPUTER COMPLEMENT NUMBER R66 — ALL TIMES ARE IN MINUTES

PART 1 INPUT/OUTPUT ANALYSIS

FILE NUMBER	NO. OF RECORDS	RECORD SIZE AVG	MAX	RECORDS PER BLOCK	NO. REELS	I/O MEDIA	BUFFERED TIME	UNBUFFERED TIME
INPUT FILES								
CC07	279,820	150	220	17	4	MT 01	9.17	4.42
CC10	9,880	95	75	75	1	MT 02	0.38	0.01
OUTPUT FILES								
CC07	279,820	150	220	17	4	MT 02	13.03	0.55
CC08	39,490	135	135	22	1	MT 01	1.61	0.07
CC09	6,210	135	135	10	1	MT 02	0.30	0.10
CC11	1,750	135	135	10	1	MT 02	0.08	0.00
TYPE	1,600	1	1			TY N	-	2.66
TOTAL UNBUFFERED INPUT/OUTPUT TIME								7.81

PART 2 INTERNAL COMPUTATION ANALYSIS

FUNCTION	PROGRAM STEPS	MEMORY USED	INTERNAL TIME	
ARITHMETIC COMPUTATION	192	1,200	3.63	
DECISION AND CONTROL	954	4,845	0.44	
DATA HANDLING	1,050	5,422	1.24	
INPUT/OUTPUT ROUTINES	1,640	8,200	5.06	
INPUT/OUTPUT AREA	0	28,505	0.00	
TOTAL INT. COMPUTATION	3,836	49,407	10.37	
TOTAL PROGRAM TIME				18.18

PART 3 SPECIAL TIME ANALYSIS

	OVERHEAD TIME	
PROGRAM INITIATION	2.01	
END OF JOB REWIND	1.05	
TOTAL PROGRAMMING RUNNING TIME		21.24
SET-UP AND TAKE-DOWN	5.00	
TOTAL ELAPSED TIME		26.24

Real-Time Simulation

If any or all of the defined processing is of random, real-time processing, SCERT enters the second stage of simulation. This stage proceeds in two steps. The first of these builds a model of the total timeframe during which these real-time events will occur, and then analyzes the loads to be imposed during this timeframe on all potential queue points in the hardware complex. Another SCERT report is then produced, "The Real-Time Hardware Utilization Analysis." This report summarizes the use of each major component involved in the real-time processing and shows the statistical probability distribution of queue sizes in the hardware complex.

SCERT REAL TIME ANALYSIS, PART 2 HARDWARE UTILIZATION (MINUTES)

FOR SYSTEM XEL66

COMPUTER COMPLEMENT NUMBER XXX — PERIOD: 030.00 MINUTES

PART 2A MAIN COMPUTER SYSTEM

		NET UTILIZATION	PERCENT UTILIZED	PROBABLE QUEUE LENGTH EXPECTED	WORST
CENTRAL PROCESSOR		11.53	38.44	0.62	5.66
DATA CHANNELS	01	9.45	31.51	0.41	3.90
	02	11.70	39.01	0.63	5.76
	03	6.88	22.96	0.27	2.97
RANDOM ACCESS MODULES					
814	01	4.17	13.90	0.15	2.11
	02	4.10	13.68	0.14	2.10
	03	4.08	13.62	0.14	2.08
863	01	10.79	35.98	0.51	4.61
	02	10.43	34.77	0.47	4.26

PART 2B COMMUNICATIONS NETWORK

ROUTE	TERMINAL				
A	90	0.97	3.24	0.16	6.94
	97	10.74	35.83	3.72	46.34
	TOTAL	18.66	62.21	1.64	12.08
B	91	0.91	3.03	0.03	1.18
	TOTAL	0.23	0.79	0.00	0.45
M	96	9.26	30.89	1.67	21.73
	TOTAL	2.13	7.10	0.07	1.51
N	95	10.25	34.19	5.10	66.24
	TOTAL	3.74	12.48	0.14	2.16
O	98	6.76	22.53	0.29	3.35
	TOTAL	3.11	10.46	0.11	1.92
P	92	11.53	38.45	2.17	24.95
	TOTAL	4.85	16.18	0.19	2.59

The second step in the real-time simulation charts the flow of all defined real-time events. The result of this step is called the Systems Response Real-Time Analysis. Here each event is analyzed in terms of the expected and worst case responses to be achieved by the computer and the total communications network.

SCERT REAL TIME ANALYSIS, PART3 SYSTEM RESPONSE DATA (SECONDS)

FOR SYSTEM XEL66

COMPUTER COMPLEMENT NUMBER XXX — PERIOD: 1,800 SECONDS

EVENT NO.	RESPONSE FROM	TO	COMPUTER RESPONSE IN: 99%	95%	50%	TOTAL RESPONSE IN: 99%	95%	50%
A00	90A	90A	9.26	4.93	1.79	29.20	17.20	7.94
A10	90A	90A	11.62	5.89	2.33	30.10	18.10	8.22
A20	90A	90A	8.94	4.60	1.45	61.50	26.60	12.98
A30	90A	90A	8.24	4.11	1.49	34.30	19.57	9.54
A40	90A	90A	9.81	5.16	2.27	15.90	9.93	5.67
A50	91L	91L	10.57	5.41	2.44	269.78	136.15	47.24
		91L	11.75	5.96	2.61	255.51	121.25	31.96
C00	97L	97L	4.92	2.44	0.85	198.99	68.04	19.10
C10	97L	97L	10.13	5.33	2.32	200.66	77.39	21.20
C20	92P	92P	9.68	4.60	1.22	39.80	19.84	10.75
C30	92P	92P	8.26	4.05	1.07	40.00	19.97	11.15
C40	92P	980	12.59	6.28	2.17	55.71	30.93	14.50
		92P	18.10	8.82	2.74	41.73	26.31	12.14
C50	980	980	12.75	6.07	1.64	33.20	18.64	9.42
C60	980	980	5.80	2.82	0.86	44.10	27.18	12.72
C70	980	980	6.13	3.13	1.20	41.14	24.89	11.23
C80	980	980	20.67	10.09	3.11	62.60	33.46	14.12

Time-Oriented Simulation

This stage of the simulation is entered whenever the system is capable of a multi-programming or multi-processing mode of operation. The results of this stage are summarized in the SCERT Multi-Programming Analysis. In this stage, SCERT builds a model representing the total horizontal capacity of the computer(s) and then simulates the arrival of program runs to the system based on priority and prerequisites. As the various runs are scheduled, the simulation derives the interferences and overheads of the multi-programmed environment and extends the elapsed time for the individual runs accordingly.

SCERT MULTIPROGRAMMING ANALYSIS

FOR SYSTEM XEL66

COMPUTER COMPLEMENT NUMBER R66

TIME ZONE	START TIME	PROGRAMS IN MEMORY	ANALYSIS OF LIMITING FACTOR	THROUGHPUT ANALYSIS	CHARACTERS OF MEMORY USED
01	00.00	A000 A001 A002	PERIPHERAL SHORTAGE I/O SATURATION	I/O BOUND	96025
01	01.50	A000 A002 A003 B001	MEMORY CAPACITY COMPUTE SATURATION	COMPUTE BOUND	119048
01	02.55	A000 A002 A003 B004 B005	O/S LIMITATION	COMPUTE BOUND	113062
01	04.57	A002 A003 B004 B005	NOTHING IN QUEUE	COMPUTE BOUND	110456
01	04.90	A003 B004 B005	NOTHING IN QUEUE	COMPUTE BOUND	92650
01	05.50	A003 B005	NOTHING IN QUEUE	I/O BOUND	88929
01	06.75	B005	NOTHING IN QUEUE	COMPUTE BOUND	83740
01	07.00		COMPUTER IDLE		
02	08.00	A100 A110	MEMORY CAPACITY	COMPUTE BOUND	118623
02	09.25	A100 A200	PERIPHERAL SHORTAGE	COMPUTE BOUND	109856
02	09.95	A100 B100 B101 B102	NOTHING IN QUEUE	COMPUTE BOUND	121212
02	11.75	A100 B101 B102	NOTHING IN QUEUE	I/O BOUND	119452
02	12.60	A100 B102	NOTHING IN QUEUE	COMPUTE BOUND	115660
02	14.50	B102	NOTHING IN QUEUE	COMPUTE BOUND	105526
02	15.00		COMPUTER IDLE		
02	14.00		TOTAL ELAPSED TIME		

How SCERT Is Used

The predominant technical and management studies in which SCERT has been successfully employed are:

1. **Hardware Selection**
   The variables in a hardware selection study are the various computer configurations. SCERT is used to help select that particular configuration which will process the defined workload in acceptable timeframes and which achieves the best cost/performance ratio.
2. **Hardware Enhancement**
   This kind of analysis is normally done when an installed configuration has reached, or is forecast to reach, a saturation point. SCERT evaluates the impact of enhancements on overall performance. The variables are the different potential enhancements in hardware, software, and systems methodology. Decisions can be based on cost/performance data.
3. **Systems Design**
   SCERT is also used for the analysis of alternate systems approaches on either a fixed or variable hardware configuration. SCERT is used to simulate the alternate approaches, and decisions may be based on computer performance and response or cost considerations.
4. **Management Review**
   A frequent question asked by computer management concerns the efficiency of an installed operation. SCERT is used to simulate a data processing operation that is programmed and running on a computer. The simulations are accomplished in both the review mode (where actual blocking and channel assignments are defined) and in the evaluation mode (where SCERT is allowed to optimize file blocking and channel assignments). An analysis of the results will tell the data processing manager how efficiently his installation operates and what improvements could be made to existing programs to increase their effectiveness.
5. **Software Selection**
   This type of study is frequently made along with a hardware selection study to analyze the variable software available with a given configuration of hardware. SCERT is used to simulate the impact on performance and implementation costs between various available programming languages. It is also used to simulate the impact on total performance of various levels of operating systems.
6. **System Specifications**
   A natural by-product of SCERT is its portrayal of systems processing requirements in a non-hardware form. SCERT is frequently used to simulate a proposed systems design prior to the time of asking computer manufacturers to furnish hardware bids. An

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SCERT SYSTEM SPECIFICATIONS

     FOR SYSTEM XEL66

******************************** INPUT FILE DATA ********************************
*                                                     GROUP                      *
*                  FILE   CHAR/RECORD FIELDS/RCD      RATIO        FROM RUN      *
*                  VOLUME  AVG   MAX  ALPH   NUM AND MODE        NUMBER (S)      *
*                                                                                *
* CC07  MAST  MT  279,820  125   220   20     5                 C202,L104,       *
* CC10  WORK  MT    9,880   75    75   11     4                 C202,            *
* CC06  WORK  MT        1  130   130   19     7  ALL   L                         *
*                                                                                *
**********************************************************************************
                                    V
                                    V
********************************* PROGRAM ****************************************
*                                                                                *
*  RUN C203 RUN    1 TIME  DAILY        FUNCTION- UPDATE,EXTRACT,COMPUTE         *
*                                                                                *
*                                                                  TIMES         *
*                         NO.  NO.         FUNCTIONAL NO. AVG.  NO. EXECUTED     *
*SORT/MERGE CRITERIA FLDS CHAR  FILE       ACTIVITY FLDS SIZE LEGS PER LEG FILE  *
*                                                                                *
* MATCH                  1   10  CC07      COMPARE     1    5    2       1 CC11  *
*                                          MOVEMENT   27    5    2       1 CC11  *
*                           TIMES                                                *
*FUNCTIONAL NO. AVG.  NO. EXECUTED         EDIT        5   10    1    1750 CC11  *
* ACTIVITY FLDS SIZE LEGS PER LEG FILE     COMPARE     6    5    2     875 CC11  *
*                                          COMPARE     2    5    3       1 CC10  *
* MOVEMENT  27    5   2     875 CC11       ADD/SUB     4    5   11     898 CC10  *
* MOVEMENT  15    5   3       1 CC10       MOVEMENT   11    5   11     898 CC10  *
* COMPARE    6    5  11     898 CC10       MOVEMENT   27    5    1       1 CC09  *
* COMPARE    2    5   1       1 CC09       MOVEMENT   27    5    2       1 CC08  *
* COMPARE    2    5   2       1 CC08       COMPARE     6    5    2   19745 CC08  *
* EDIT      12   10   1   39490 CC08       MULT/DIV    2   10    1  279820 CC07  *
* MOVEMENT  27    5   2   19745 CC08       COMPARE     2    8    3       1 CC07  *
* ADD/SUB   18   10   1  279820 CC07                                             *
* MOVEMENT  25    8   3       1 CC07                                             *
*                                                                                *
**********************************************************************************
                                    V
                                    V
***************************** OUTPUT FILE DATA **************** PRINT DATA ******
*                                                  GROUP        LINES            *
*                 FILE   CHAR/RECORD FIELDS/RCD -  RATIO PAPER  PER   NO.        *
*                 VOLUME  AVG   MAX  ALPH    NUM AND MODE SIZE PAGE HDRS SPG     *
*                                                                                *
* CC07  MAST  MT  279,820  125   220   20     5            TO C202,              *
* CC08  WORK  MT   39,490  135   135   27     5                                  *
* CC09  OUTP  PR    6,210  132   132   27     -             66   25    4    2    *
* TYPE  OUTP  TY    1,600    1     1    1     -                                  *
* CC11  WORK  MT    1,750  135   135   27     -                                  *
*                                                                                *
**********************************************************************************
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automatic output of these preliminary simulations are the systems specifications (which have been used by computer manufacturers as an ideal form for communicating processing requirements for bidding purposes).

7. **Programming Management**
   One of the outputs produced by SCERT provides, possibly for the first time, a reasonable vehicle for the management of programming workloads. As a by-product of its presimulation algorithms, SCERT projects

SCERT ANALYSIS PART 4 PROGRAMMING REQUIREMENTS REPORT

FOR SYSTEM XEL66

COMPUTER COMPLEMENT NUMBER R66

PROGRAM RUN NUMBER	PROJECTION OF NUMBER OF INSTRUCTIONS IN THE PROGRAM: PROGRAMMED BY USER	FURNISHED BY THE MANUFACTURER: SUBROUTINES	FURNISHED BY THE MANUFACTURER: UTILITY ROUTINES	PROGRAMMING EFFORT IN MAN MONTHS
C202	2,195	1,674		9.4
C203	2,267	1,570		11.7
C204	1,832	1,570		8.7
C205	2,192	1,778		11.5
C431	272	1,154		0.9
C432	-	-	8,000	-
L104	3,121	1,570		15.7
D151	450	1,986		2.5
D152	2,169	1,674		10.5
D153	1,363	1,674		6.5
D302	1,034	1,778		5.1
D303	4,153	1,570		21.2
D306	1,094	1,674		5.5
D307	1,684	1,466		6.8
D308	-	-	8,000	-
D320	1,778	1,466		7.6
F104	519	1,362		2.2
F110	2,192	1,570		10.2
I520	4,159	1,570		20.4
I521	1,813	1,674		7.6
I522	-	-	8,000	-
P100	2,989	1,466		14.8
P210	5,506	1,466		27.2
P300	2,969	1,466		14.8
P000	987	1,674		4.0
TOTAL	46,758			223.8

the programming effort required to implement each computer run simulated. This projection can provide a standard measurement to allocate programmer workloads and to derive a degree of relative efficiency and effectiveness for a programming staff.

WORLD REPORT — GREAT BRITAIN

I saw a bored Alexei Kosygin replying perfunctorily to official speeches of welcome when he visited the Elliott-Automation development plant at Borehamwood, North of London, early in February. But ten minutes later I saw an animated, interested textile machinery engineer, Alexei Kosygin, discussing the possibilities of a computer-controlled laser beam system to cut out textile patterns at very high speed and with the greatest economy of cloth.

There seemed little doubt that the Soviet Premier has a good grasp of what automation can do for industrial processing. Whether he is quite so interested in replacing his armies of bureaucrats by business computers remains to be seen. One rather piquant detail of his visit was the praise he lavished on the design of Elliott's 920 M microminiaturised computers for fire control, navigation, and other military applications. Since these computers are based on integrated circuits developed under license with Fairchild Camera, it is doubtful whether the U.S.S.R. would be allowed to buy them, even for the "Concordski." However, in the present milder climate and provided the ultimate use could be specified, who knows?

There has been a spectacular sale of a single \$2¼-million computer installation to East Germany by International Computers and Tabulators for use in business and scientific computing by the internationally-known Carl Zeiss optical works at Jena. The configuration is one of the largest 1907s yet specified, and has a mass of tape decks, visual display consoles, magnetic card files, and plotters. With it goes \$600,000 worth of data preparation equipment to the main import/export agency in Berlin.

This is the largest data processing complex ever exported from Britain, and it brings the total value of sales to the Iron Curtain countries in the past twelve months to around the \$15m mark.

It seems slightly ironical that, while the British computer industry is rejoicing at these export successes, the imbalance of imports into Britain against exports is still cripplingly heavy. In 1966 the import figure was about \$70m, overwhelmingly IBM 30's, 40's, and 50's from France and Germany.

At the same time, IBM has scored a resounding success on the university front with the sale of a 360/67 to the joint computer departments of Newcastle and Durham Universities. Asked why he did not go for British machines, Dr. Page of Newcastle said he could not wait until the end of 1968 for an English Electric System 4-75, and he would not take an ICT machine because it had no paging facility.

Dr. Page has been given specific promises of multi-access software from IBM by the end of October this year, though he did claim already that it would not be as efficient as had been hoped.

The same theme comes from the Central Electricity Generating Board which has taken delivery of a 360/75. The software is not running as smoothly as it should, according to Dr. L. Rotherham, Member for Research. The existing IBM 7094 II is being retained for as long as necessary, Dr. Rotherham said, adding that the 360/75 "was about twice as effective." In the meantime, the Board has ordered five ICT 1905 machines, worth about \$1.4m each, one for each of the Regional Centres. Interfacing these with the 360/75 is going to be quite a problem. An attempt at compatibility between the smaller 1904 of the Stationery Office and the 360-compatible System-4 computers of the Post Office is to be made by an independent programming group.

A design and research collaboration agreement between Scientific Data Systems, General Electric Company of the UK, and the CEA organization in France has broken down, and GEC Computers and Automation is being absorbed by Elliott-Automation. The latter will work off the seven outstanding contracts involving machines from the SDS range and is unlikely to pay much more than the value of the contracts for the goodwill, programming know-how, and sales team. One Elliott man hinted that some contracts had already cost GEC a mint of money on the systems design side. He told me that it was most unlikely that his company would continue the connection with SDS. It was not needed since Elliott is in about fifth place worldwide as a builder of process control computers.

British European Airways, extremely happy with its twin 490 (UNIVAC) seat reservation system, is going to base a four-stage integrated management system on its main computer centre. Extra equipment — computers, visual displays, booking consoles — will be needed at each annual stage. By 1970, something like \$30m worth of hardware will have been utilized to control passenger schedules, crew rosters, freight, etc., and to provide advanced simulation powers for management's forward planning.

The competition for the additional hardware has been thrown open to all comers but it is already certain that the central machines, if they prove to be overburdened (as is most likely) will be replaced by UNIVAC 494's.

Ted Schoeters

Ted Schoeters
Stanmore
Middlesex
England

RECOVERY FROM ERROR

Jan B. Hext
Basser Computing Department
University of Sydney
Sydney, Australia

"A recent computer installation for handling air-traffic required that no interruption last more than 30 seconds during the first five years of operation. Such demands for nonstop service are becoming increasingly common in the range of on-line applications currently being developed."

Ten years ago, if computing went wrong, recovery was a comparatively simple business. For instance, if the machine broke down, or there was a flash of lightning, or you pressed the wrong button, the usual procedure was to start all over again.

Hardware Failure

Of course, if the program had been running for several hours, this was annoying. With such programs it was standard practice to dump the contents of all registers on to magnetic tape every 15 minutes or so, and to recover from breakdowns by a return to the last dump.

In some installations, if there was a power cut during a magnetic tape transfer, the tape was liable to snap. If this, or any other fault, occurred while the dump was in progress, the dump itself became useless. It was therefore important to ensure that the previous dump was not overwritten until the new one had been successfully made. Ideally the dump would alternate between two tapes. The same principle still underlies all file updating techniques, in which the original file is never overwritten until the updated version has been safely established.

Program Failure

But hardware failures were not the only source of trouble. Far more errors were caused by program failures, and so recovery procedures had to be available for them also.

On the "open shop" system, the techniques were few and simple. On failure, a red light would flash up, indicating trouble; maybe a few diagnostic tit-bits would be punched on paper tape; and then the machine would come to an abrupt halt. To cope with these regrettable emergencies there would be a set of post-mortem routines available, which the user could supply to the machine in order to retrieve further diagnostics.

Then there were those programs that produced no failure at all, but quietly went into an infinite loop. Once again, with Joe standing by, this caused no great trouble. He would guess at what was happening and take on-the-spot corrective action. This might involve throwing a switch to alter the course of the program. Or maybe he could use a built-in facility, which would enable him to determine the cycle which was being repeated.

In the age of leisure, Joe could even inspect various registers by means of lights or display tubes; he could alter little bits here and there, and then restart at any point he chose. As a last resort, he could step through his program one instruction at a time, watching to see what happened. It was all a matter of patience, not hurrying too much, being careful to press the right buttons.

Naturally Joe enjoyed having full control of the works: it was a good and thoroughly desirable state of affairs. Unfortunately, however, in the middle of his debugging session, George would come breathing down his neck and he would get a little flustered. Soon he would press the wrong button, and then he would have to recover from his recovery.

Batch Processing

Allowing Joe to dither over which button to press, or which post-mortem to use, soon became too wasteful of valuable machine-time. Moreover, waiting while Joe made his on-the-spot corrections was wasteful of George's time too. Shortage of machine-time, man-hours and patience eventually led to the batch-processing system. Under this scheme, programs were supplied to the computer in batches and then processed concurrently under control of a Supervisor routine with a minimum of outside intervention. As a result, Joe was kept away from the computer and all his programs were handled by one or two trained operators.

Batch-processing had a profound effect on systems design, and not least on recovery procedures. As before, the need for recovery arose from two causes — hardware failure and program failure — and means had to be devised for coping with each.

If there was a power failure, or some other such breakdown, recovery depended on knowing what program was in progress at the time and being able to restart the run at that

Dr. Jan B. Hext graduated in Mathematics from Cambridge University, England, in 1962, and stayed on to take a Ph.D. in Computer Software. He recently joined the lecturing staff of the Basser Computing Department at the University of Sydney, Australia, where a network of six computers is currently being installed.

program. This was quite straightforward, as the Supervisor would normally type out the name of each program as it was entered.

In some installations, to avoid back-tracking after a breakdown, means were devised for dumping all active registers immediately when a power failure was detected. A flywheel, or some other device, ensured sufficient current for the dump. The problem was then reduced to that of re-starting from a standard dump and no computation was wasted.

The commonest hardware failures occurred in peripheral equipment, especially with magnetic tapes. If reading from magnetic tape produced parity failure, some units automatically made a second attempt; if the source of trouble was a speck of dust, the repeat would very probably be successful. But if a peripheral failure persisted, the hardware recorded it in a special register. It was then the programmer's responsibility to inspect this register and to take action if failure had occurred. If the Supervisor found such trouble, it would inform the operator by means of the on-line typewriter.

"Keep the System Going"

In batch-processing, the second type of recovery — recovery from program failure — had one major goal in view: to keep the system going. A program failure must not be allowed to bring everything to a halt. For example, overflow, which in early machines caused an abrupt full stop, would now be recorded in a special register which the program was left to inspect for itself.

More drastic errors, such as an attempt to read cards from the line printer, returned control to the Supervisor, which would terminate the offending program and carry on to the next. It would probably print out a standard set of diagnostics by way of a post-mortem.

One of the greatest dangers was that a program might overwrite part of the Supervisor. This was so catastrophic, and programmers attempted it so frequently, that special hardware was introduced to prevent it. By means of this hardware, the Supervisor restricted a program to an allocated area, and any attempt to stray outside the area was immediately cut short.

If a program went into an infinite loop, intervention was necessary. In some systems, the programmer had to specify a time-limit to the operator; then, if this was exceeded, the operator would interrupt the system and cause the Supervisor to take over. In other cases, the programmer had to specify a time-limit in his program heading. The Supervisor would then check his run-time automatically and intervene if this was exceeded. It was important to distinguish between his "run-time" and his "elapsed time," since his program might be held up for long, unpredictable periods, e.g. in waiting for a magnetic tape to be mounted. Such a delay would not be included in his run-time.

His program heading could also specify a limit on his output volume. This was important because it was usually possible to output vast volumes of garbage in comparatively short run-time. His program heading could also include a re-start address, to which control would be transferred after certain types of failure. This allowed him to use his own post-mortem routines.

Third Generation Requirements

The change from open-shop to batch-processing thus introduced a new level of complexity in recovery techniques. The most important aspect was that as far as possible recovery must be handled automatically by the computer itself, using a combination of hardware interrupts and Supervisor routines. Today, with "third generation" computers being installed third generation recovery problems are also being introduced. The big issue now is how to recover from failures in an on-line, multi-programming environment.

The problem is highlighted in situations demanding non-stop service to the users. For example, a recent installation for handling air-traffic required that no interruption last more than 30 seconds during the first five years of operation. Such requirements are becoming increasingly common in the range of on-line applications currently being developed. For them, the prospect of having to recover from breakdown is not attractive.

Precautions Against Breakdown

The problem becomes so acute that elaborate precautions are taken to avoid breakdown altogether. For example, one airline company with a reservations and message handling system in Sydney plans to use three independent power supplies. And should all three fail together, battery supplies will be available for an additional half hour.

Similarly, if the computer itself fails in any way, or if it simply requires routine maintenance, there must be one or more reserve computers ready to take over. Of course, such back-up computers do not sit idle until a breakdown occurs: they are normally occupied with less critical work, which can be suspended when necessary.

In cases where it is vital that all errors be detected immediately, two computers can be run "back to back," each duplicating the work of the other. Then, if their outputs differ, the error is immediately spotted. In an extreme case, such as rocket control, where the recovery from such errors must also be immediate, three computers can be run together and a "majority vote" taken when two of them disagree.

In installations serving a number of consoles, precautions are usually more modest. The general aim is to combine the best features of open-shop and batch-processing; but great care is needed if the user's needs are to be satisfied.

Time-Sharing

From the user's point of view, the wheel has turned full circle. Once again Joe can bring his program to be run and retain full control of it himself. No longer need he hand it to an operator and wait for the results. Instead of the control panel, he now sits at his console and supposedly has the happy impression that the machine is entirely at his disposal. If his program goes wrong, he can correct it on the spot; if it loops, he can interrupt it or change its course. Admittedly, George is breathing down his neck once more, but all in all it feels good to have returned to open shop facilities.

However, although Joe thinks he has full control of his program, in fact he does not even know where it is. It may be in core, or on disc, or on tape — who can tell? Moreover, he has no original program on cards or paper tape: it was all type straight into the machine, and later overlaid with corrections. So in this respect his program is more remote from him than ever. He is utterly dependent on the computer to effect all recovery procedures for him.

Recovery by Computer

In order to do this, the system's basic need is to know the most recent copies of all his files. These may be on disc (or drum); but if the disc itself runs into trouble, it is preferable to have copies also on tape. In one such system, the entire contents of disc were dumped on tape each day. The process took two hours, but was the only means of recovery from loss of information on disc.

In other systems, such dumping is a continual process. Copies of all files are held on tape, together with the time and date when they were written there. Active files are also held on disc, where they can be amended and processed.

Dumping is then applied as soon as possible to updated or newly created files. But even with these precautions, recovery of a large number of active programs is by no means simple.

Another hazard of such systems is that in the frequent transfer of files from one device to another some information may be corrupted. The dangers and attendant recovery problems are intensified when several computers are interconnected — a situation that is likely to become quite common in the future. Although hardware incorporates many checks of its own, it may well prove necessary to include others in the software, possibly in the form of old-fashioned sum-checks.

Systems Testing

With sophisticated systems, a minor fault can often cause a major headache. To track it down may require a detailed investigation of both the hardware and the software. The testing of hardware is normally carried out by the Supervisor, whenever there is time available, and it is hoped that this will show up any faults; but a transient error may slip through. Software is less amenable to such systematic checking and will usually come under suspicion first, especially as hardware is becoming increasing reliable. But since software should be checked out once and for all when written, very little attention is paid to providing facilities for locating and correcting errors in a working system: in theory they never arise.

Yet even assuming that systems really are error-free after check-out, few ever remain static. New facilities will be added and existing ones modified. It may seem preferable to suspend all operations during software development; yet it is only under full working conditions that some parts will ever be fully tested. Besides, in some cases it is impossible to set aside time for development; systems testing and normal computation must be carried out in parallel.

One way to do this is to simulate the system by means of a program within the system; then software testing can be included as a normal job. But the complications are often too great to be worthwhile. Besides, there is a danger of confusion between real failures, simulated failures and simulator bugs.

Another technique is to write the system as a series of "bricks," marking some as "safe" and others as "under test," rather like a set of drugs. Those under test are automatically watched to ensure that they are not upsetting the system. If a brick becomes suspect it is replaced by a previous version which is known to be safe. This is no easy task; but something of the sort is needed if systems are to cope with the pressures of modern life.

The Prospects

Such are some of the problems with the up-and-coming generation of time-sharing systems.

Recovery from hardware breakdown would be a gloomy prospect indeed, were it not that the hardware is becoming more and more reliable. As the need for such recovery becomes correspondingly remote, and as recovery itself becomes increasingly difficult, the time may be near when the procedures will return to their earlier simplicity and attention will be focussed almost exclusively on eliminating the need to use them.

But software failures seem destined to survive longer. Only recently have the difficulties of producing reliable software been fully appreciated, and for the time being we continue to improvise from one crisis to the next.

The more distant prospect suggests techniques akin to those mentioned above, in which software bricks can be written and tested more systematically. But it would be preferable to ensure their reliability in the first place. As always, prevention is better than cure.

CAPITAL REPORT

The Office of the Secretary of Defense (OSD) has called for bids on a study to specify an information system to meet their expanding needs. The study is the initial step in a long-range project to develop an optimum management information system for OSD's seven Assistant Secretaries and their staffs.

OSD eliminated hardware suppliers from consideration because of a possible conflict of interest, and will have the Mitre Corporation monitor the work of the selected contractor. The Secretary's office indicated that they are looking for fresh and unusual approaches to management information reporting. They invite radically different systems and concepts, and want to exploit new techniques developed but not yet operational.

OSD wants the study to produce recommendations for a prototype system of radical design which could be implemented in approximately 24 months. The door was left wide open for bidders to submit their ideas, and no specific funding limit was given, but a tight December 31 schedule was set for completion of the initial study.

Congress is taking an ever-increasing interest in the EDP industry as the session gets rolling in the capital. Rep. Cornelius Gallagher (D-N.J.) wants more information from the Bureau of the Budget and the Executive Branch before scheduling hearings by his House Special Subcommittee on the Invasion of Privacy. He has been openly skeptical of proposals for the National Data Center, and has voiced demands for justification from its proponents.

Senator Edward Long (D-Mo.) has scheduled Senate hearings on the same subject by his Senate Subcommittee on Administrative Practice and Procedure. Rep. Jack Brooks (D-Texas) is planning on holding hearings sometime in this session to look into putting the Federal budget on tape, disk, or Nth generation media, and having all agencies submit their budgets in machine digestible form. Rep. Emanuel Cellar (D-N.Y.) will have his House Antitrust Subcommittee look into antitrust and monopoly problems in the computer industry sometime during the session, but says that it has nothing to do with the Justice Department's investigation of IBM.

Copywriting of computerized information routinely handled by abstracting services, libraries, and publishing companies distributing copyrighted works will be analyzed by the Copyright office. Rep. Kastenmeier (D-Wis.) asked them to get together with EDP industry leaders and find a solution to who pays what to whom and when for copyrighted data disgorged from high-speed printers.

The Federal Communications Commission wants EDP industry leaders and their legal staffs, EDP users, and others to get their arguments into its hands by October 2, so that it can go about deciding if regulation is necessary in the burgeoning field. Its recommendations carry significant weight in Congress, and it is concerned with questions of competition, rates, and the future adequacy of services.

The House Census and Statistics Subcommittee, chaired by Rep. W. J. Green (D-Pa.) says that it is going to see what it can do EDP-wise for the Bureau of the Census as well as the National Archives and Records Service, which is a part of the General Services Administration.

The Washington, D.C. Association for Computing Machinery chapter, which has many influential members from both government and industry, is taking a stand on the privacy questions surrounding the proposed National Data Center. It formed a committee and drafted a resolution for its Executive Council to look at which says that it doesn't want "promises and good intentions to be substituted for technical safeguards and effective laws: bureaucracy has a short memory."

All in all, the industry is being besieged from every possible angle in Congress' rush to solve the problems largely ignored up to this time. As the spate of hearings, investigations, and controversies rage, the industry has been prompted to begin looking for some way to answer the tough problems coming at it from all sides. AFIPS invited Rep. Gallagher to a policy meeting in Warrenton, Virginia near Washington to hear his views on how it should approach some of the problems.

There may be good cause for concern. Not too long ago, the New York Stock Exchange's computerized system fell down in heavy trading and an obscure bug in the program controlling final prices came to light. Scores of erroneous closing stock prices went out to hundreds of newspapers in the country, and it took two weeks to get their father/grandfather records straight. Anyone who has ever hung up the wrong master tape can visualize what could happen . . . a grain dealer in Omaha reporting the biggest sale ever to the Data Center over a remote, overloads the system. His confirmation message for data received begins, "John Doe, 123-45-6789, married, scar left knee. . . ."

Computer systems which match unemployed Washington, D.C. workers with jobs open in the area are being successfully used by the United Planning Organization, a non-profit agency funded by the Office of Economic Opportunity. Both the unemployed and the underemployed are being encouraged to register with UPO at ten neighborhood development centers in the Washington area. Their names, job skills, and other employment data is recorded on input forms and then put into a data bank. Similarly, jobs found by developers in the agency are recorded and entered into a separate data bank.

(Please turn to page 53)

LANGUAGE ENGINEERING

Hughes Aircraft Company
Los Angeles, Calif.

"Is it possible to make a machine which can reproduce all the speech sounds? At present levels of development, such a machine would occupy a considerable volume and would be a programmer's nightmare. But within the next 20 years, completely automated systems will be used, acting upon oral commands and responding with verbal answers."

Among the many research projects that exist today, each more fantastic than the last, few have more appeal to the imagination than the development of a machine or device which can truly listen and talk in a human language. Robots in science-fiction stories have had these functions, but our duplication of them in real life has lagged somewhat. Yet such a device would find many uses in our daily lives, and would be as much a servant to man as any of our other pieces of automatic, timesaving equipment.

The Human Speaking Mechanism

All peoples speak. Every known society has a spoken language. Language is a body of spoken words combined in a rather fixed fashion and understood by a considerable community. Moreover, speech involves psycho-physiological functions, the ability to make distinctive sounds that have meaning, accompanied by listening, which includes the ability to detect and recognize those sounds and to understand their meaning.

The human speaking mechanism, by combining manipulations of the vocal cords, oral and nasal cavities, tongue, mouth, teeth, and lips in various ways, can make hundreds of different sounds. However, only about 40 distinctive sounds are used in speaking English. These sounds, called "phonemes," are common to a number of other languages as well. There are both voiced and unvoiced sounds. The voiced include the vowels and many consonants, and are produced by vibrating the vocal cords with air from the lungs. Voiced sounds contain chiefly harmonics of the frequency at which the larynx vibrates, which ranges from about 70 to 250 cycles per second (cps) for men and as high as 350 cps for women, with an average of 125 cps for men and about 250 cps for women. The unvoiced sounds are consonants formed by the breath passing lips, teeth, or tongue, and the combination of these.

As a speaker talks, the vibrations set up are transmitted through the air, affecting the ear of the speaker as well as the ear of the listener. This feedback to the speaker is important because it aids in adjusting the pitch and amplitude of the speech sounds and also is believed to play a part in the thinking process. If the feedback is interfered with (perhaps through acoustical delays or loud competitive sounds) the speech will be disrupted.

Reproducing Speech Sounds

Is it possible to make a machine which can reproduce all the speech sounds? Although man retained his great interest in both the phenomenon of speaking and in machines ever since the ancient Greeks, it was not until the 18th century that these two interests really began to merge. In the 17th century, Bishop John Wilkins in England published phonetic symbols portraying the vocal tract positions for alphabetic characters. In 1779 the Imperial Academy of St. Petersburg offered a prize for a machine that could make the vowel sounds. The prize was won by Christian Kratzenstein who made five tubes approximately the size and shape of the vocal passages when producing these sounds, and energized by reeds.

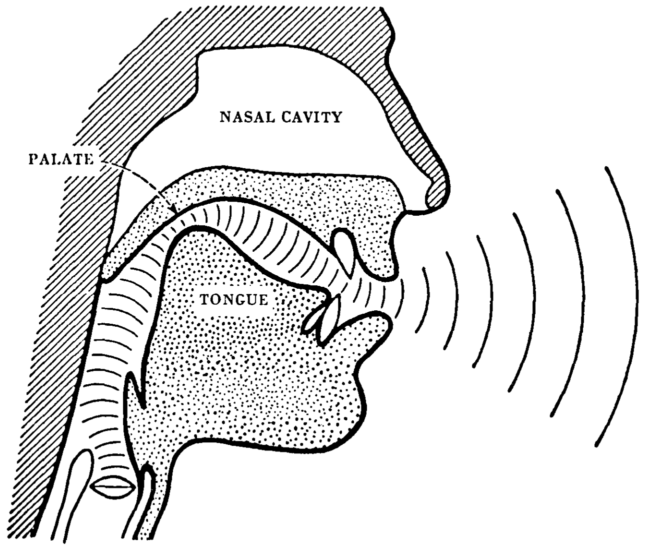
First Speaking Machine

The first successful speaking machine was built by Wolfgang von Kempelen in 1791. Working on it over a 20-year period, von Kempelen designed and constructed a mechanism capable of reproducing short phrases, as well as individual sounds. Speech was formed by manipulating mechanical elements which simulated the essential parts of the human vocal system. The machine was restricted to short phrases because of the limitation of the windbox to produce adequate air flow.

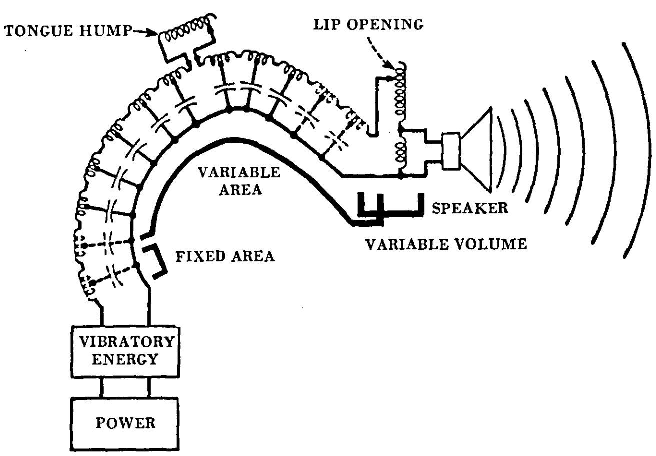
The interest in devices for simulating human sounds also continued in earnest through the 19th century. Helmholtz excited acoustic resonators by tuning forks; Willis produced vowel-like sounds by reed organ pipes; and Alexander Graham Bell went on to develop the telephone, a device that could actually *reproduce* speech sounds.

But it was not until 1922 that an electical device was made that could *produce* vowel sounds, and it was not until the 1930's that the continuous synthesis of speech was accomplished by Homer Dudley. His device, the VODER (Voice Operation Demonstrator), was exhibited at the New York

This article is based on a report in *Vectors,* Vol. 8, No. 3, and is used with permission from Hughes Aircraft Company.



Analogy between human and mechanical voice production



World's Fair in 1939. The Voder used two electrically-generated complex vibrations to create the sounds, a buzz representing the larynx tone (voiced sounds) and a hiss consisting of random noise (unvoiced sounds). Either of these sounds was applied to a group of bandpass filters which covered the range of speech frequencies. Each filter was separately controlled, and the outputs were combined, amplified and applied to a loudspeaker to form synthetic speech sounds.

Three Functions of Speech Communication Devices

Any device that is constructed with the intent of duplicating human speech communication must contend with three basic functions: (1) speaking, (2) listening, and (3) thinking (analyzing content and responding appropriately).

Dudley's Voder could "make words." A microphone can "detect," but can't "listen." Modern computers can approximate some thinking processes to a certain extent, and newer mechanisms are being developed that store information and make decisions based on this information. But to date no single machine has accomplished all functions. But progress is being made and such a machine may not be far in the future.

Detecting and Transmitting Speech

A machine that could accurately synthesize speech was a natural descendant of the machine that could analyze speech (the Voder). Dudley built such a device and called it the Vocoder (Voice Coder). It was the result of ten years of development. The basic principle of the Vocoder is that it detects human speech, then transmits a description of the speech signal in code, rather than the signal itself, to a duplicate machine which reconstructs the signal at the receiver. What was said comes out in an artificial but understandable and recognizable voice; only another vocoder can do this, so the system is inherently private.

One of the most successful vocoders ever developed was the Hughes HC-137, currently used by the U.S. Army. Hughes has designed and constructed several models of vocoders for military and foreign governments. It is an important communication tool for military police, defense and diplomatic work and other applications requiring transfer of private intelligence.

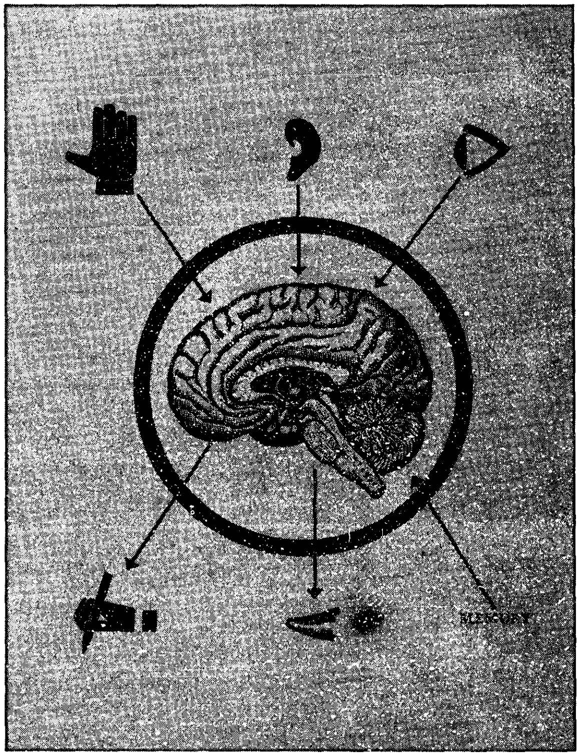
As mentioned, one of the major technical problems yet unsolved in the development of a "listening" machine is speech analysis. There are two phases or steps in this problem. The first step is to recognize the acoustic energy as speech, and not as just noise. The second step is to decipher the linguistic meaning contained in the speech signals.

PHONEMES

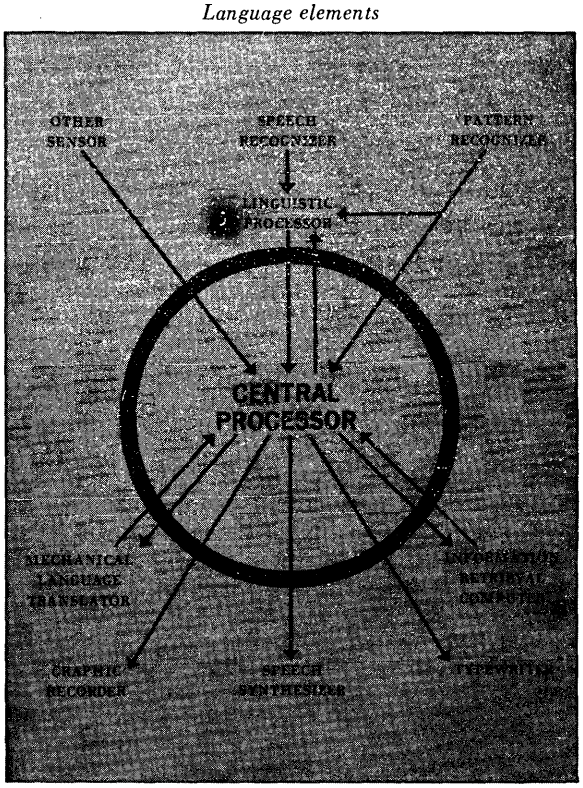
VOWELS	
/i/ as in "b*ee*t"	/ɔ/ as in "b*ough*t"
/I/ as in "b*i*t"	/o/ as in "b*oa*t"
/e/ as in "b*ai*t"	/U/ as in "b*u*ll"
/ɛ/ as in "b*e*t"	/u/ as in "b*oo*t"
/æ/ as in "b*a*t"	/ʌ/ as in "b*u*t"
/ɑ/ as in "h*o*t"	
LIQUIDS	
/l/ as in "*l*aw"	/r/ as in "*r*aw"
GLIDES	
/w/ as in "*w*et"	/j/ as in "*y*et"
NASALS	
/m/ as in "ra*m*"	/ŋ/ as in "ra*ng*"
/n/ as in "ra*n*"	
PLOSIVES	
/p/ as in "*p*in"	/b/ as in "*b*in"
/t/ as in "*t*in"	/d/ as in "*d*in"
/k/ as in "*k*in"	/g/ as in "*g*un"
FRICATIVES	
/f/ as in "*f*in"	/v/ as in "*v*at"
/θ/ as in "*th*in"	/ð/ as in "*th*at"
/s/ as in "*s*in"	/z/ as in "*z*oo"
/ʃ/ as in "*sh*in"	/ʒ/ as in "me*as*ure"
/h/ as in "*h*im"	
AFFRICATES	
/tʃ/ as in "*ch*in"	/dʒ/ as in "*g*in"

Limitations of Word Recognizers

Several attempts have been made to construct an automatic speech recognizer. One of the first was Audrey, acronym for Bell Laboratories' Automatic Digit Recognizer. Audrey was constructed to recognize the words denoting the digits from zero to nine. Its computer has stored in it the energy-frequency patterns for these ten words, and when the machine "heard" a word, the computer would compare it with the stored patterns to obtain a match. If the patterns matched, the computer would then light a lamp corresponding to that



Language elements



The Ultimate Speech Recognizer

It is likely that the ultimate speech recognizer will operate on both phonemes and words, though a problem arises in the fact that two persons saying the same word do not produce identical acoustical signals. As an approach to a solution to this problem, Hughes has continued with the design of a speech analyzer, AID (Acoustic Input Device), which could be used as the input to a linguistic processor.

Much work has been done on vocoders, speech analyzers and synthesizers, and language translators for various immediate applications. But to date no one has assembled a complete, integrated, automatic listening and speaking machine. Such a machine could be a self-organizing system, combining a speech recognizer, automatic translator, information processor, speech synthesizer, information retrieval computer, various other input-output devices, and governed by a central linguistic processor, programmed to control each of the subsystems. At present, this conglomeration would occupy a considerable volume and would be a programmer's nightmare, even if all the equipment were perfected and available as off-the-shelf items.

However, as some of these devices become needed, the advance in packaging and programming will culminate in a more compact and workable system. It seems likely most of the sensing equipment will be developed to the point where it can be contained within one unit. A language machine can then be installed into any existing computer facility, using the computer as the central processor.

Applications of Voice Commands

There are many man-machine functions which could benefit from voice-controlled machine operation, and in which voice communication would increase operating efficiency. Typewriter and punched card print-outs are fairly effective for displaying the output of most modern computers, but there are many occasions when an audible communication would allow faster machine response. In fact, any real-time information retrieval operation can be speeded up by voice control. For example, imagine using the telephone to ask a computer for a market forecast, for the answer to an engineering problem, or for the name of a book describing some obscure function, and then having the computer give the answer audibly.

Another example of an activity that would benefit is air traffic control. Voice communication with aircraft by the tower operator is necessary when many aircraft are attempting to use the airport facilities almost simultaneously, and when the tower controllers are kept extremely busy tracking aircraft and talking to the pilots. A language machine, working with the data processors most large airports already have, could ease this burden.

In the next few years simple versions of language equipment surely will appear as hardware and will be used for various purposes. Ultimately, completely automated systems will be used, acting upon oral commands and responding with verbal answers. At the current rate of development, such a system will probably be developed within the next 20 years.

digit. But Audrey, like most other word recognizers, is limited in its ability; it is most acute to the sounds of one individual and less responsive to others.

The success achieved thus far by word recognizers is limited because of their very small vocabularies. The construction of phoneme recognizers has also been attempted but with limited success. A phoneme recognizer has the advantage of dealing with a smaller number of distinct units than does a word recognizer, although the error probability is somewhat high at this level.

CALENDAR OF COMING EVENTS

April 4-7, 1967: Honeywell H800 Users Association (HUG) Spring Conference, Bellevue Stratford Hotel, Philadelphia, Pa.; contact R. E. Hanington, Philadelphia Electric Co., 2301 Market St., Philadelphia, Pa. 19103

April 4-7, 1967: Joint Conference of the Univac Users Association and the Univac Scientific Exchange, Fontainebleu Hotel, Miami, Fla. Contacts: UUA — Murray Hepple, Harris Trust, 111 W. Monroe St., Chicago, Illinois; or USE — S. C. Bloom, Univac, P.O. Box 8100, Philadelphia, Pa. 19101

April 6-7, 1967: Atlantic Systems Conference, Americana Hotel, New York, N.Y.; contact Dr. Gibbs Myers, The General Precision Co., Wayne, N.J.

April 7, 1967: Association for Computing Machinery, San Francisco Bay Area Chapter, Jack Tar Hotel, San Francisco, Calif.; contact A. E. Corduan, Lockheed Missile & Space Co., P.O. Box 504, Sunnyvale, Calif. 94088

April 7-8, 1967: The Purdue University Chapter of the Association for Computing Machinery, Purdue University, Lafayette, Ind. 47907; contact Vance H. Sutton, Chairman, INCUM, Computer Science Center, Purdue University, Lafayette, Ind. 47907

April 12-14, 1967: Electronic Information Handling Conference, Flying Carpet Motel, Pittsburgh, Pa.; contact Allen Kent or Orrin E. Taulbee, Co-Chairmen, Univ. of Pittsburgh, Pittsburgh, Pa. 15213

April 18-19, 1967: ECHO (Electronic Computing Hospital Oriented) Annual Meeting, American Hospital Association Headquarters, 840 N. Lake Shore, Chicago, Ill.; contact Howard Abrahamson, Director of Data Processing, Fairview Hospitals, 2312 South Sixth St., Minneapolis, Minn. 55409

April 18-20, 1967: Spring Joint Computer Conference, Chalfonte-Haddon Hall, Atlantic City, N.J.; contact AFIPS Hdqs., 211 East 43 St., New York, N.Y. 10017

April 19, 1967: Eighth Annual Southwest Systems Conference, Systems and Procedures Association, The Towne House, Phoenix, Ariz.; contact Robert V. Montopoli, UNIVAC Division of Sperry Rand Corp., 3443 N. Central, Suite 410, Phoenix, Ariz. 85012

April 20-22, 1967: Oregon Association for Educational Data Systems, Spring Conference, Portland State College, Portland, Oregon; contact Phil Morgan, Room 015, College Center, P.O. Box 751, Portland, Oregon 97207

May 3-4, 1967: Annual National Colloquium on Information Retrieval, Philadelphia, Pa.; contact R. M. Hildreth, Publicity Chairman, Auerbach Corp., 121 N. Broad St., Philadelphia, Pa. 19107

May 3-5, 1967: Electronic Components Technical Conference, Marriott Twin Bridges Motor Hotel, Washington, D.C.; contact C. K. Morehouse, Globe Union Inc., Box 591, Milwaukee, Wisc. 53201

May 4-5, 1967: The Montreal Chapter of the Computer Society of Canada EXPO '67 Seminar, Windsor Hotel, Montreal, Quebec, Canada; contact Raymond A. Beaudoin, Programme Committee, Computer Society of Canada, P.O. Box 1772, Station B, Montreal, Quebec, Canada

May 8-10, 1967: National Rural Electric Cooperative Association's Third Annual Data Processing and Automation Conference, Executive House, Chicago, Ill.; contact Tracy E. Spencer, Management Services, N.R.E.C.A., 2000 Florida Ave., N.W., Washington, D.C. 20009

May 18, 1967: Association for Computing Machinery Technical Symposium, San Fernando Valley Chapter, Century Plaza Hotel, Century City, Los Angeles, Calif.; contact B. G. Dexter, Jr. TRW Systems, One Space Park, Redondo Beach, Calif. 90278

May 18-19, 1967: 10th Midwest Symposium on Circuit Theory, Purdue University, Lafayette, Ind.

May 23-26, 1967: GUIDE International, Americana Hotel, New York, N.Y.; contact Lois E. Mecham, Secretary, GUIDE International, c/o United Services Automobile Assoc., 4119 Broadway, San Antonio, Texas 78215

May 31-June 2, 1967: A Symposium on Automatic Photo-interpretation, Washington Hilton Hotel, 1919 Connecticut Ave., N.W., Washington, D.C.; contact George C. Cheng, Symposium Coordinator, Pattern Recognition Society, P.O. Box 692, Silver Spring, Md. 20901

June 12-14, 1967: International Communications Conference, Leamington Hotel, Minneapolis, Minn.; contact R. J. Collins, Dept. of Electrical Engineering, Univ. of Minn., Minneapolis, Minn. 55455

June 14-17, 1967: Annual Meeting of Council of Social Science Data Archives, University of California, Los Angeles, Calif.; contact William A. Glaser, Bureau of Applied Social Research, 605 West 115 St., New York, N.Y. 10025, or Ralph Bisco, Institute for Social Research, P.O. Box 1248, Ann Arbor, Mich. 48106

June 20-23, 1967: DPMA International Data Processing Conference and Business Exposition, Sheraton-Boston Hotel, Boston, Mass.; contact William J. Horne, Conference Director, United Shoe Machinery Corp., 140 Federal St., Boston, Mass.

June 26-27, 1967: Computer Personnel Research Group Fifth Annual Conference, University of Maryland, College Park, Md. (near Washington, D.C.); contact Dr. Charles D. Lothridge, General Electric Co., 570 Lexington Ave., New York, N.Y. 10022

June 26-30, 1967: 8th Annual Joint Automatic Control Conference (JACC), University of Pennsylvania, Philadelphia, Pa.; contact G. K. L. Chien, IBM Corporation, Monterey & Cottle Roads, San Jose, Calif. 95114

June 28-30, 1967: 1967 Joint Automatic Control Conference, University of Pennsylvania, Philadelphia, Pa.; contact Lewis Winner, 152 W. 42nd St., New York, N.Y. 10036

July 31-August 4, 1967: MEDAC '67 Symposium and Exhibition, San Francisco Hilton Hotel, San Francisco, Calif.; contact John J. Post, Executive Secretary, AAMI, P. O. Box 314, Harvard Square, Cambridge, Mass. 02138

August 22-25, 1967: WESCON (Western Electronic Show and Convention), Cow Palace, San Francisco, Calif.; contact Don Larson, 3600 Wilshire Blvd., Los Angeles, Calif. 90005

Aug. 28-Sept. 2, 1967: AICA (International Association for Analogue Computation) Fifth Congress, Lausanne, Switzerland; contact secretary of the Swiss Federation of Automatic Control, Wasserwerkstrasse 53, Zurich, Switzerland

Aug. 29-31, 1967: 1967 ACM (Association for Computing Machinery) National Conference, Twentieth Anniversary, Sheraton Park Hotel, Washington, D.C.; contact Thomas Willette, P.O. Box 6, Annandale, Va. 22003

Sept. 6-8, 1967: First Annual IEEE Computer Conference, Edgewater Beach Hotel, Chicago, Ill.; contact Professor S. S. Yau, Dept. of Electrical Engineering, The Technological Institute, Northwestern University, Evanston, Ill. 60201

Sept. 11-15, 1967: 1967 International Symposium on Information Theory, Athens, Greece; contact A. V. Balakrishnan, Dept. of Engineering, U.C.L.A., Los Angeles, Calif. 90024

Sept. 25-28, 1967: International Symposium on Automation of Population Register Systems, Jerusalem, Israel; contact D. Chevion, Chairman of Council, Information Processing Association of Israel, P.O.B. 3009, Jerusalem, Israel

Oct. 18-20, 1967: Eighth Annual Symposium on Switching and Automata Theory, University of Texas, Austin, Tex.; contact Prof. C. L. Coates, Room 520, Engineering Sci. Bldg., Univ. of Tex., Austin, Tex. 78712

Nov. 14-16, 1967: Fall Joint Computer Conference, Anaheim Convention Center, Anaheim, Calif.; contact AFIPS Headquarters, 211 E. 43rd St., New York, N.Y. 10017

May 21-23, 1968: Spring Joint Computer Conference, Sheraton Park/Shoreham Hotel, Washington, D.C.; contact AFIPS Headquarters, 211 E. 43rd St., New York, N.Y. 10017

Aug. 5-10, 1968: IFIP (International Federation for Information Processing) Congress 68, Edinburgh, Scotland; contact John Fowlers & Partners, Ltd., Grand Buildings, Trafalgar Square, London, W.C. 2., England

ACROSS THE EDITOR'S DESK

Computing and Data Processing Newsletter

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APPLICATIONS

WEATHER FORECAST FOR ONE-HALF OF THE WORLD

The U.S.N. Fleet Numerical Weather Facility (FNWF) supplies over 500 forecasts each day for one-half of the world, predicting meteorology and oceanography conditions up to 72 hours in advance of its occurence. Recently five Auto-Lift Drum Memory Systems were purchased from Bryant Computer Products Division of Ex-Cell-O Corporation and installed at the FNWF, Monterey, Calif. Officer in charge Captain Paul M. Wolff, U.S.N. said, "The Bryant Computer Products Auto-Lift Drum Memory Systems are used to store all the operational functions for pre-processing and post processing as well as storing all the library records for the facility."

In order to make the forecasts, the FNWF collects information on current conditions from over 4000 observation stations. They must make about six billion computations on the information received before they can relay forecasts in the form of charts and maps to several hundred operating Navy units that the FNWF services.

This is accomplished by observations collected from regional teletype weather circuits, terminating in computers at High Wycombe, England and Fuchu, Japan. This data is then immediately transmitted by high-speed communication links to a collection center at Tinker A.F.B., Okla. From there, it is relayed together with western hemisphere data at 6000 teletype words-per-minute to the FNWF. Oceanographic observations and meteorological data for selected naval operating areas are collected by outlying computer networks and transmitted again by high-speed communication links to the FNWF.

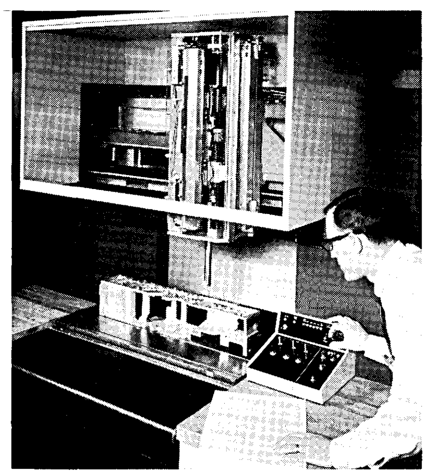
Here the observed data is recorded onto magnetic tape and an Auto-Lift Drum memory by one of the three separate computer systems installed at the facility. Captain Wolff said that the memory systems allow expansion of the data processing center's capability and give the over-all system more computing speed.

IBM DEVELOPS COMPUTER-LINKED PRECISION MEASURING SYSTEM

A computer-controlled measuring system — which automatically and precisely guages two- or three-dimensional parts — has been developed by IBM Corporation at Kingston, N.Y. The measuring system is used for quality control checking of its own manufactured parts and printed electronic circuitry.

The computer-controlled measuring machine (shown in the picture, above right) automatically measures parts and processes measurement data. Measurements from this Precision Measuring System — analyzed and summarized in a quality report — can be studied a few seconds after measurements are taken.

The measuring system has a number of features. It allows the operator to set up the part imprecisely since it calculates and corrects for workpiece skew. The most revolutionary feature is the adaptive scheme which is used to get increased accuracy from the mechanical system.



The system was described in a paper — "A Computer-Controlled Measuring System" — presented by Alan Frane, of IBM's Kingston laboratory, at the Fourth Annual Meeting and Technical Conference of the Numerical Control Society.
(For more information, designate #41 on the Readers Service Card.)

HOSIERY INDUSTRY HELPED BY COMPUTER

The increase in high fashion hosiery styles has meant a bigger inventory control headache for the hosiery manufacturer and retailer.

L. A. Brabender, vice president and general manager of the National Mills Division of U.S. Industries, Inc., Memphis (Tenn.) plant, reports, "A new computer has helped us cure this headache and has saved us money in the bargain." National Mills is one of the nation's largest hosiery manufacturers and markets stockings under its own Round-the-Clock brand, as well as many leading private label brands.

A computer-based store stock replacement system has been evolved which keeps customer store inventories at a maximum service level to meet shopper demand. The system also regulates the distribution of hosiery from National's distribution plant at Memphis and schedules stocking production at the company's mills in Grenada and Batesville, Miss. Mr. Brabender says National's computerized stock replacement program was a first in the apparel industry.

The IBM System/360 Model 30 computer provides data on what is being sold and where; it can predict hosiery sales trends by region and even by individual store. To set off the merchandising control cycle, an IBM card is placed in each box of hosiery shipped by National to a store customer. When the box is opened for sale, the card is returned to National's headquarters and processed via the computer to initiate an immediate replenishment order. Computer-prepared information tells packaging personnel at the firm's Grenada, Miss., mill exactly what stockings to package, which labels to put on the boxes and what packaging materials to use.

At the same time, the computer keeps track of the store's shelf stock by style and color and of the mill and warehouse inventory supplies. Because the computer stores data on what has been sold the previous week by stores across the country, it can predict the stockings that should be knit, dyed, packaged and shipped this week and the next. The computer also considers seasonal trends and other sales variables to predict customer demand for styles and colors months into the future.

ASE HAS COMPUTER-BASED DATA RETRIEVAL SLSTEM

A computer-based data retrieval system now enables officials of the American Stock Exchange and member firms to obtain immediately price range and volume data on stocks and warrants traded during the latest six weeks. The new procedure replaces a 35-year old manual operation. The new electronic system was developed in cooperation with The Bunker-Ramo Corporation and is called Record Room Interrogation System (RRIS).

Data is made available to record room personnel on a Bunker-Ramo Cathode ray tube input/output device (BR 203). In addition, on push-button request, the RRIS will simultaneously prepare a print-out summary of stock information.

Range and volume records for the six latest trading weeks are maintained at Bunker-Ramo's New York City data center (TeleCenter) on storage drums of a Univac 418 computer, from which it is called out instantaneously through the BR 203 in response to a telephone call to the Record Room from a member firm. Query of records is made through the BR 203 device which has seven function keys for seven separate types of market data. There are two inquiry devices in the Exchange's Record Room and another in the Stock Watch section.

The Record Room Interrogation System has been designed to compile trading records from time of entry at the Trading Post. The system is programmed directly from the ticker tape; a TeleCenter computer digest tape data; posts the data on magnetic tape; and transfers the material to the Univac 418. These functions are performed at the close of each business day, so that trading data is ready for dissemination the following morning.

COMPUTER ANALYZES CHEMICAL SAMPLES AT MONSANTO PLANT

Some 1000 chemical samples a week now are being analyzed by computer at Monsanto Company's Chocolate Bayou Plant near Alvin, Texas. Use of the computer, and IBM 1800 data acquisition and control system, has dramatically improved the precision of laboratory analysis and reduced the time required for completion of tests. A major improvement is in the precision of analysis achieved. Average improvement of results has been tenfold. In one instance, sampling with a variation of 4 per cent in results was changed to a variation of only .02 per cent.

Another saving is in the time required for analysis. Computer-control permits a faster run through the chromatograph (an analytical instrument which determines the nature and concentration of compounds in a sample). Significant time also is saved in calculation of results. A chart with 100 chromatographic signals takes 2½ hours to interpret manually. The computer does the job in 3½ minutes.

The system, jointly developed by Monsanto and IBM, monitors 40 gas chromatographs. It is designed for routine operation by laboratory personnel. In the picture below, a lab technician is shown using a table-top keyboard to tell the computer what technique to follow.

The IBM 1800 computer, located adjacent to the control lab, is programmed to run the sample through a testing instrument and interpret its data. Results are printed on an output typewriter and furnished manufacturing personnel.

Although several computerized laboratory systems have been developed recently, the system at Monsanto is said to differ significantly in several respects. The system carries out a complete method of analysis, including external standards, internal standards, normalization and grouping. It is programmed to handle 150 methods and permits programs to be changed without taking the computer off its regular work. It is also self-documenting and capable of keeping its own files. No external records are required. The system's flexibility also allows the addition of essentially any advanced type of analytical method.

Products of the plant include ethylene, propylene, benzene, naphthalene, phenol, alkylbenzene, acrylonitrile and butadiene.

G-E USING COMPUTER TO AID IN-HOUSE MANUFACTURING OPERATIONS

At General Electric Company's Computer Equipment Department in Phoenix, Ariz., a computerized methods engineering system for sheet metal production may portend a significant new development for metalworking shops both large and small. The Phoenix plant produces a broad range of sheet steel chasis, panels and other components for G-E electronic computers. More than 45 tons of sheet steel are processed each week, on a 6-day, 24-hour per day schedule. Production is handled by three numerically-controlled A-15 turret punch presses supplied by The Wiedemann Division of the Warner & Swasey Company. Lots range from 1 to 1000 pieces.

To handle production control and raw material inventory for this complex metalworking operation, G.E. uses one of its own G-E 400 line computers. All of the various production parameters and workpiece specifications are stored on magnetic tape. When a job order comes to the shop for a particular component, the data tapes enable the computer to "regenerate" a production plan, including paper work, for the job under optimum conditions for the individual lot size and current shop conditions. The computer even produces the N/C control tapes for the machines which will run the job.

William L. Lord, Manager of Shop Operations at Phoenix, says, "Regenerative planning with the computer provides the best production plan for a particular set of production conditions. It is much faster than the old method of individual manual job planning which sometimes required a cycle time of a week to ten days to complete. With the computer it is virtually an overnight service."

AIR FREIGHT CONTROL SYSTEM DEVELOPED BY AIRBORNE FREIGHT CORPORATION

A new system for the control of air freight shipments, in which an advanced data processing operation is integrated with an extensive network of private communications lines, has been announced by Airborne Freight Corp., San Francisco, Calif. J. D. McPherson, president of the international air freight firm, said that the system is the first of its kind in the industry and represents a major breakthrough in the control of air freight, promising an entirely new dimension of service to air freight users.

The total control system is named DART, from the initials describing its basic function, Direct Airbill Retrieval and Transmission. With DART, all Airborne stations, located throughout the nation, are directly connected with an IBM 360 computer, in San Francisco, via more than 43,000 miles of Airborne's private communications lines. After more than three years of developmental work by Airborne air freight traffic specialists, IBM data processing technicians, and Pacific Telephone communications engineers, DART now is operational.

More than 220 programs have been written to instruct the IBM 360 computer. Essentially every step of each shipment handled by Airborne will be controlled or influenced by DART. Some of DART's advantages are: computer-accurate airbills, automatic alerts, instant proof of delivery, positive follow-through and fast tracing. Via DART, every station in the Airborne system can query the computer on the status of any shipment, during any portion of its journey, and receive a reply through retrieval, from the 360's memory system, of the detailed information fed into the computer at every significant point in the move.

The economics of DART indicate that no increase in rates will be required, the Airborne president said.

NEW CONTRACTS

FROM	TO	FOR	AMOUNT
Federal Aviation Agency	Raytheon Company, Wayland Laboratory, Wayland, Mass.	Developing, producing, installing and testing automation equipment for modernizing the nation's long-range, air route traffic control centers; the equipment, described as the Computer Display Channel (CDC) of FAA's advanced National Airspace System (NAS), is a key element in the Agency's emerging semi-automatic air traffic control system	$44.8 million
NADGECO Limited, London, England	Cubic Corp., San Diego, Calif.	Production of 37 computer peripheral systems for the NATO Air Defense Ground Environment system (NADGE)	$3.7 million
U.S. Air Force	Sylvania Electric Products, Inc., a subsidiary of GT&E, Needham, Mass.	Expanding the data processing capabilities of Minuteman II intercontinental ballistic missile systems	$3 million
Air Force Systems Command's Electronic Systems Division, Hanscom Field, Mass.	Sylvania Electric Products, Inc., a GT&E subsidiary	Installation and system testing of special purpose electronic receiving equipment	$2.1 million
Recognition Equipment Inc., Dallas, Texas	Scientific Data Systems, Santa Monica, Calif.	Twenty SDS 910 computers to be used in Recognition Equipment's Electronic Retina® Computing Readers	$1.6 million
Grumman Aircraft Engineering Corp.	Fairchild Space and Defense Systems, Syosset, N.Y.	Design, development and preproduction quantities of data converters for the avionics system of the EA-6B aircraft	$1,449,914
Trans World Airlines, Inc.	Recognition Equipment Inc., Dallas, Texas	An Electronic Retina® Computing Reader to automate computer data input	about $750,000

FROM	TO	FOR	AMOUNT
International Computers and Tabulators, Ltd., London, England	Data Products Corp., Culver City, Calif.	Model 5045 DISCfILE random access memory systems to be used in conjunction with the new advanced ICT Atlas computers	over $420,000
Data Products Corp., Culver City, Calif.	Ampex Corp., Redwood City, Calif.	100 Model TM-7 digital tape units which will be incorporated into the line of L/P M1000 and L/P M640 Off-Line Print Stations manufactured by Data Products	$400,000
Oak Park and River Forest High School, Oak Park, Ill.	Ampex Corp., Redwood City, Calif.	Manufacture and installation of an audio teaching system	$358,000
Houston Lighting & Power Company, Houston, Texas	Leeds & Northrup Co., Philadelphia, Pa.	A computer control system encompassing, for the first time, a coordinated overall system operation including both energy dispatching and transmission dispatching through one integrated system. The system will be built in cooperation with the Philco Houston Operations of the Philco Ford Corp.	—
United States Steel Corp.	C-E-I-R, Inc., Washington, D.C.	Development of special network planning and mathematical programming "packages" for U.S. Steel's new B8500 computer	—
Aro, Inc., Tullahoma, Tenn.	Systems Engineering Laboratories, Inc., Fort Lauderdale, Fla.	An SEL 810A computer system to be used for total data acquisition of wind tunnel testing of the C5A engine for the U.S. Air Force; delivery scheduled for May to Arnold Air Force Station, Tenn.	—
Board of Education, Orange, N.J.	System Development Corp. (SDC), New York Metropolitan Operations Center, Paramus, N.J.	Technical assistance in the planning of an Educational Resource Center	—
Great American Insurance Companies, New York, N.Y.	Mohawk Data Sciences Corp., Herkimer, N.Y.	65 Mohawk Data-Recorders to be installed in Great American's home office and 16 regional offices throughout the U.S.	—
American National Insurance Co., Galveston, Texas	Ampex Corp., Redwood City, Calif.	A Videofile document filing and retrieval system to automate the handling of insurance policy files	—

NEW INSTALLATIONS

AT	OF	FOR
Continental Telephone Corp., St. Louis, Mo.; Bakersfield, Calif.; Syracuse, N.Y.	Four of six computers; three Honeywell 200's and three Honeywell 1200 systems; total value about $3 million	Computing rates for long-distance and special calls, and for performing all customer billing, including toll calls, local service charges and special service charges; later the system will be expanded to perform general accounting, data communications, forecasting of demand for construction planning and trouble analysis applications
Michigan State University, East Lansing, Mich.	Sigma 7	Operating the controls of MSU's 55-million electron volt nucleus smasher
Potter Instrument Co., Inc., Plainview, N.Y.	BIT 480 general purpose computer	Use in developing special systems that will link Potter's data processing peripherals and allied products with a central processor such as the BIT 480
B. B. Walker Shoe Company, Asheville, N.C.	NCR 315 computer system	Order processing, billing, inventory, sales analysis, cost and general accounting
Irani Associates, Inc., Miami, Fla.	IBM 1130 (equipped with COGO language)	Engineering calculations, construction costs analysis, etc.
Archdiocese of Brooklyn Data Center, Health & Hospitals Division of Catholic Charities for the Counties of Brooklyn and Queens	RCA 301 computer	Providing detailed information data to doctors on patients in six New York hospitals; also hospitals' payroll and personnel records will be computerized along with routine accounting procedures
Martin Marietta Corp., Denver, Colo.	Control Data 6400 computer system	A variety of technical and scientific data processing applications, including research and development, design analysis, and production support
Tokyo Shibaura Electric Co. (Toshiba), Tokyo, Japan	GE-635 computer system	Scientific and engineering calculations, and some business data processing applications
Mohawk Data Sciences Corp., Herkimer, N.Y.	Honeywell 200 computer	General accounting and production control operations
Rex Chainbelt Inc., Milwaukee, Wisc.	The first of six System/360 Model 20 computers	Primary stage in the company's development of an advanced management system
Palo Alto Data Center, Control Data Corp., Palo Alto, Calif.	Control Data 3800 computer system	Increased capacity and capability; Data Center provides computer services on a rental basis to business firms and institutions
First Federal Savings and Loan Association, Charleston, S.C.	NCR 315 computer system	Savings, mortgage, payroll and general ledger applications

AT	OF	FOR
Rock-Mill Inc., Rockford, Ill.	IBM 1130 computer	Numerical control contouring work; prepares coded tapes which control milling and other precision machines
Bonneville-Sylvan Life Insurance Co., Salt Lake City, Utah	Honeywell 200 computer	Life insurance and service bureau data processing work
Fort Worth Division, General Dynamics Corporation	EAI 8800 Analog/Hybrid Computing System and an EAI 640 Digital Computing System valued at over $500,000	Simulation of complex aerospace weapons systems; initially in developments for the F-111 family of aircraft

ORGANIZATION NEWS

ENCYCLOPAEDIA BRITANNICA ACQUIRES INTEREST IN EDUCATIONAL TECHNOLOGY FIRM

Encyclopaedia Britannica, Inc., Chicago, Ill, has acquired an interest in TECHNOMICS, Inc., a one year old California company engaged in the application of computer-centered technology to the fields of general education, governmental administration, public health, welfare, and medical programs. The agreement involved a stock purchase in which Britannica bought 200 shares of convertible preferred stock with the option to buy an additional 100 shares. All stock now is controlled by TECHNOMICS and Britannica. Price was not disclosed.

TECHNOMICS, Inc., was formed in December, 1965, by a group of psychologists, educators, system and computer experts from the RAND Corporation and the System Development Corporation. They have developed numerous computer applications in education and training and have applied system analysis, cost-benefit analysis, operations research techniques, gaming and simulation to the problems of development of large systems for military, health, education, and public welfare needs. President and chairman of the board is Dr. Norton F. Kristy.

MEMOREX ACQUIRES DISC PACK CORP.

Memorex Corp., Santa Clara, Calif., has acquired the balance of the outstanding equity of Disc Pack Corp., Laurence L. Spitters, President of Memorex has announced. Previously, Memorex had owned 40% of Disc Pack Corp. Acquisition of the balance involved an issuance of 15,000 shares of Memorex Common Stock or 1.5% of the total Memorex shares outstanding.

Memorex is the nation's second largest manufacturer of precision magnetic tapes for computer, instrumentation and television recorders. Disc Pack Corporation, located in Hawthorne, Calif. is presently engaged in the development of precision memory disc packs for use as information storage devices for IBM and other new computers. Production of disc packs is expected to begin later this year.

LEASCO TO ACQUIRE DOCUMENTATION, INC.

Saul Steinberg, President of Leasco Data Processing Equipment Corp., Great Neck, N.Y. (ASE) and Eugene Miller, President of Documentation Incorporated of Bethesda, Md. (OTC) announced that the two companies have reached an agreement in principle for a pooling of interests whereby Leasco would acquire Documentation Inc. The transaction will be based upon an exchange of shares at the rate of one share of Leasco stock for each seven shares of Documentation stock.

Leasco is in the business of leasing computers and other data processing equipment. The business of Documentation Inc. is the development and operation of computer information technology systems for government and industry. The present officers and staff of Documentation Inc. will continue to manage its business.

The officials of the two companies stated that the completion of the transaction was subject to the execution of definitive contracts, the approval of both boards of directors and of shareholders in the case of Documentation Inc.

DIEBOLD FRANCE ACQUIRES FRENCH PLANNING FIRM

Diebold France, S.A., the French subsidiary of The Diebold Group, Inc., has acquired controlling interest of a French planning firm called IRCOM. IRCOM, established in 1963, specializes in economic and planning studies, market research, and construction feasibility studies. A substantial portion of the firm's business consists of planning assignments conducted on behalf of the French government. One of the current assignments of IRCOM is a large study of the impact of automation on the French economy being conducted on behalf of the French government.

Diebold France, S.A. is jointly owned by The Diebold Group, Inc., New York, N.Y., and Rothschild Frères, the senior bank of the French Rothschild Group. The Diebold Group, an international management consulting company specializing in the business applications of advanced technology, maintains offices in six European cities.

STANDARD REGISTER SIGNS KNOW-HOW AGREEMENT WITH GERMAN FIRM

The Standard Register Company, Dayton, Ohio, has concluded a know-how agreement with Hessdruck, a printing company located in Braunschweig, Lower Saxony, Germany. Hessdruck is the third largest business forms printing house in Germany. In business for over 65 years, it produces continuous business and transportation forms and also has flat printing facilities, serving all Germany.

Under the terms of the agreement, Standard Register will provide the German firm with technical and administrative advice and assistance relative to the production of manifold business forms and the printing equipment necessary. Hessdruck will also have marketing rights in Germany for the sale of Standard Register mechanical forms handling equipment.

The signing brought the total of foreign firms having know-how agreements with Standard Register Company to 14.

NCR PLANS TO ACQUIRE MICROCARD CORPORATION

The National Cash Register Co., Dayton, Ohio, announced that it has entered into an agreement to acquire the Microcard Corporation of West Salem, Wisc., in exchange for an undisclosed number of shares of NCR common stock. Microcard, a privately held company, is a leading producer of microfiche information storage systems.

Robert S. Oelman, NCR chairman, said acquisition of the Microcard Corporation would complement NCR's recently announced line of PCMI® microform systems (see Computers & Automation, January, 1967, p. 56). The agreement to acquire Microcard is subject to certain tax rulings and audits, the NCR chairman said. Under its terms, Microcard would become a wholly owned subsidiary of NCR and would remain under its current management headed by A. L. Baptie, president.

DATANAMICS CORPORTION OF AMERICA ACQUIRES COMPUTER PERSONNEL CONSULTANTS, INC.

Datanamics Corporation of America (Chicago, Ill.), a data processing service organization, has acquired Computer Personnel Consultants, Inc., also of Chicago. Datanamics president, David S. Pemberton, in announcing the acquisition, said, "By adding the proven procurement ability of Computer Personnel Consultants to our present array of data processing skills and equipment, we can now offer total data processing service to our customers."

CPC is an established name in the personnel consulting and recruiting field. It has developed a specialized practice in the data processing, operations research, mathematical sciences and related personnel areas.

DATA SYSTEMS ANALYSIS, INC. ESTABLISHES HEADQUARTERS IN PARIS, FRANCE

Data Systems Analysts, Inc., announces the opening of its European Headquarters in Paris, France. These facilities will provide on-line, real-time and communication systems engineering and programming services. DSA's activities also will include conventional EDP consulting services. Data Systems Analysts, Inc., corporate headquarters is located in Pennsauken, N.J., with regional offices located in River Edge, N.J.; Phoenix, Ariz.; Amsterdam, Holland; and Paris, France.

EDUCATION NEWS

COMPUTERS IN THE CLASSROOM BECOMING ROUTINE IN NEW YORK CITY

Students at Jamaica High School, Jamaica, N.Y., like hundreds of other boys and girls in New York City high schools, are studying computer mathematics. The New York City Board of Education reports that 22 of its high schools now offer this course to juniors and seniors. According to Dr. Bernard E. Donovan, superintendent of schools, the city's high school system makes more extensive use of computers in the classroom than any other high school system in the nation. This use is being expanded experimentally to include junior high school students.

In the picture, Stephen Orphanos, a mathematics teacher at Jamaica High School, Queens, is working with a group to program the IBM 1130 in the foreground. The student at the left, Steven Gabriel, already has written a number of programs for the computer. One of them allows the IBM 1130 to speed through many of the school's accounting jobs.

SYSTEMS RESEARCH INSTITUTE ESTABLISHED IN EUROPE BY IBM WORLD TRADE

An institute for advanced computer research and education at postgraduate, professional levels has been announced by the IBM World Trade Corporation. It is located in Geneva, Switzerland and begins full activity this year. About 80 of IBM's top systems engineers in Europe will be accepted by the institute in 1967.

The IBM European Systems Research Institute will extend studies of theoretical computer concepts, provide opportunities for research, and offer courses in advanced mathematics, the design and operation of computer systems, and other subjects.

A permanent staff of teachers will be assisted by visiting lecturers from IBM's Systems Research Institute in New York and other professional IBM people in Europe and the United States. Professors from leading universities in Europe also will lecture from time to time.

ACLS AND NYU ESTABLISH A NATIONAL CENTER FOR BIBLIOGRAPHIC DATA PROCESSING

The American Council of Learned Societies (ACLS), a federation of 32 scholarly organizations representing modern languages, literature, history, philosophy, religion, the arts and humanistic elements of the social sciences, is working with New York University to develop and exploit computer technology specifically for researchers in these fields. With the aid of a $144,000 grant from IBM Corporation, the ACLS and NYU have established a national Center for Bibliographic Data Processing. Dr. Frederick Burkhardt, ACLS president, stated that the work of this center will be to "tailor computer technology to the specific needs of humanists and give them the help and multiplied capabilities that computing has given researchers in the sciences and other fields."

Under the cooperative program, NYU's Institute for Computer Research in the Humanities (ICRH), an existing research center and national clearing house for information in this field, will supply computer indexing and other special services for the publications of ACLS societies and other interested scholarly organizations. Through the societies and their publications, the ACLS will encourage humanities scholars to take full advantage of computer technology in their research and study. It also will speed the distribution of developments in computing for the humanities to the academic community and to computing centers throughout the nation.

The major NYU project is the compilation of a massive electronic data bank of cross-referenced indexes for 30 cooperating scholarly journals. Only separate annual or cumulative indexes for individual journals are available now. This cross-referenced data bank, Dr. Burkhardt said, ultimately will provide far more comprehensive bibliographic information than scholars normally obtain in their own library searches. "One day", Dr. Burkhardt said, "it may be possible to keep individual 'interest profiles' on record for large numbers of scholars and periodically or on request supply them with all information in the data bank matching their specific interests." NYU researchers now are trying to overcome the technical barriers to such a system.

NYU investigators also are trying to develop computing "short-cuts" for humanists similar to the special programs that handle the findings of square roots and other routine problems for engineers and scientists. Dr. Jack Heller, director of the Heights Academic Computing Facility and a prime mover behind the establishment of the ICRH said, "We want to give musicologists, linguists and other humanities scholars similar computer 'software' to handle the routine procedures in their work."

COMPUTER RELATED SERVICES

COMPUTER ANSWERS QUESTIONS ON COPPER & COPPER ALLOYS

At the 1967 Institute of Electrical and Electronic Engineers Show in New York last month, a special computerized information retrieval system provided instantaneous access to worldwide technical literature on the technology of copper and its alloys at the booth of Copper Development Association, Inc. Electrical and electronic design engineers were able to ask questions on specific phases of copper technology, watch a data display screen as the computer was queried, and then, within seconds, see the answer displayed on the screen in the form of reference numbers. The engineer then is able to turn to the volumes containing extracts of the documents referred to, which show the actual data in which he is interested.

The demonstration unit, with a desk-size computer showed — on a small scale — exactly how the retrieval system at CDA's Technical Data Center actually operates. The Center, established in 1965, is at the Columbus (Ohio) Laboratories of Battelle Memorial Institute. The CDA Technical Data Center's objective is to provide engineers, who select and apply materials, with complete and up-to-date technical data on the properties, processing and applications of copper, brass and bronze. The copper and brass industry Technical Data Center, and the computer-based services it provides, are the first of their kind in the metals industry.

Information and data from both published and unpublished sources are collected, reviewed by specialists at the Columbus laboratories of Battelle Institute, and selected documents are evaluated by one of seventy engineers in the industry who are the staff of experts that guide the program technically. After evaluation, the information and data are edited into an "extract" containing all of the text, tables and figures judged to have long-term usefulness. This document then receives a serial number which is stored in the computer memory behind each appropriate term of the more than five thousand terms in CDA's "Thesaurus of Terms on Copper Technology".

Engineers needing data of this type may make use of the facility simply by requesting specific information from CDA, CDA member companies, or the CDA Technical Data Center. By completing a CDA Interest Check List Card, engineers obtain periodic reports and data sheets in their fields of interest which are generated by the CDA Technical Center. There is no charge for either of these services.

NEW PRODUCTS

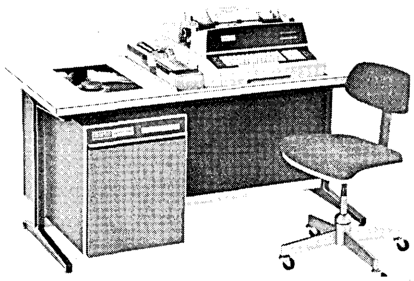
Digital

FRIDEN INTRODUCES 5610 COMPUTYPER DATA PROCESSOR

A third-generation business machine, known as the 5610 Computyper® Data Processor, has been developed by Friden, the business machine division of The Singer Company, San Leandro, Calif. This small-scale data processor uses micro-integrated circuits for speed, compactness, and reliability and has many of the capabilities of larger, higher-priced machines.

The 5610 has two separate memories. For data storage, it has sixty registers (plus additional capability with auxiliary units). Totals can be read out at any time and in any format. The second memory contains 1118 alphanumeric characters exclusively for internal program storage.

Programming is speeded up and simplified by the 5610's own universal programming language, SWIFT (SoftWare Implemented Friden Translator), a language composed of 38 simple alphabetic command statements, such as add, divide, branch, and type. Programs can be written in everyday English (or German, French, etc.). The 5610 itself automatically translates SWIFT English into machine language.



— To the left of the Input-Output Station is a horizontal tape transport. The electronic processor, below the transport, is the control center for the complete 5610 system

The 2205 Input/Output Station transmits data to the electronic processor and prints out finished documents. Input is automatic through punched tape, edge-punched cards, tab card, or program control. Variable data can be manually entered via its electric typewriter keyboard. Output is in the form of printed documents and by-product tape/cards which can be used for further processing.

The 5610 has its own diagnostics capability. If a malfunction should occur, a Friden product service specialist merely loads a special diagnostics program and the 5610 searches for the fault and types out the location. Corrective action can be taken quickly with minimum downtime.

The new Friden data processor is geared primarily, but not limited to, business applications. Five auxiliary on-line input/output devices are available to expand the capabilities of the 5610 system to meet individual applications. These include a Tape Reader, Automatic Card Reader, Selectadata® selective reader, Tape Punch, and Card Punch Control.
(For more information, designate #42 on the Readers Service Card.)

MATHATRON 4280

An all new, desk size computer/calculator has been introduced by Mathatronics, a division of Barry Wright Corp., Waltham, Mass. This compact, low cost digital machine, designated Mathatron 4280, is designed to solve complex mathematical problems in engineering and scientific applications.

Mathatron 4280, with over 4000 bits of storage, accepts standard algebraic and decimal numbers and includes automatic operators for square root, log, anti-log, sine, arc-tangent and parenthesis.

Up to 82 individually addressable storage registers are available with internal programmable memory of 480 program steps. Master programs can automatically branch to sub programs, execute them and then continue along the original path.

Input/output devices include direct entry numeric keyboard, alpha-numeric typewriter keyboard, punched paper tape, serial strip and page printers, and electronic interface. Mathatron 4280's, with prices starting at $6990, are available with a 90 day delivery time.
(For more information, designate #43 on the Readers Service Card.)

DATA MACHINES INTRODUCES THE DATA/620 I COMPUTER

Data Machines, computer manufacturing division of Decision Control, Inc., Newport Beach, Calif., has expanded its DATA/620 computer series with the intorduction of the DATA/620 I, a low cost, system oriented digital computer. Burton A. Yale, Director of Marketing, said that the DATA/620 I was designed to perform many system and automation tasks previously considered too difficult or expensive for computer solution.

The DATA/620 I can be easily interfaced with special purpose system components through its Party Line input/output system. It also is functionally adaptable to the characteristics of the system or process through its Micro-EXEC facility, a proprietary hardware technique for micro-step sequencing which permits subroutine processing at nanosecond speeds.

The DATA/620 I, built with integrated circuits, occupies 10½" of a 19" x 24" relay rack, weighs less than 100 lbs., and requires 350 watts. The computer has hardware registers for arithmetic and addressing speed, over 100 machine commands, six addressing modes, and over 100 register change commands. The processor is supplied with memories operating at 1.8 μsec cycle time and ranging from 1024 to 32,768 words of 16 or 18 bits. The DATA/620 I is fully equipped with field proven software, modular in design, and includes the current languages, such as FORTRAN, Assembler, Aid, etc.
(For more information, designate #45 on the Readers Service Card.)

BURROUGHS E5000 ELECTRONIC ACCOUNTING MACHINE

Burroughs Corporation, Detroit, Mich., has announced its new Electronic Accounting Machine, Burroughs E5000. This new machine brings increased accuracy and productive power to the major accounting functions of banks and savings and loan associations. With the combination of solid state electronics and single stripe magnetic ink ledgers, the E5000 offers faster automatic account number verification, old balance pickup, and new balance recording. In addition, the machine automatically aligns ledgers, prints proof totals, recognizes overdrafts, controls stop payments, and returns the posted form to the operator.

The E5000 consists of an operator control console and compact posting desk where the transistorized electronic system is housed. The console includes the automated form handling carriage, dual print heads, multiple totals, a full numeric keyboard, transaction identification keys, operator control lights, and full posting line visibility. These features reduce operator training time, fatigue, and errors.

Burroughs program control center directs and controls the E5000 carriage movements and arithmetic functions. One knob switches the control center to the desired accounting program. Additional program control centers can be used to expand the functions of the E5000.

The new Burroughs machine allows banks to automate such major accounting routines as demand depositis, service charge computations, installment and mortgage loans, savings and general ledgers. It is delivered to customers preprogrammed to their specifications.
(For more information, designate #44 on the Readers Service Card.)

CONTROL DATA ANNOUNCES 3150 COMPUTER SYSTEM

Control Data Corp., Minneapolis, Minn., is now marketing a new medium-scale data processing system, the Control Data 3150 Computer System. The new system, latest addition to Control Data's 3000 Series Computers, is a complete, self-contained, mass-storage oriented computing configuration. The 3150, consisting of field-tested and proven hardware and software components, provides a standardized approach to computer system design not found in comparable systems. It is designed to satisfy, equally well, the data processing requirements of business, the sciences and engineering.

The new Control Data 3150 Computer System includes: a central processor with desk console, I/O typewriter, 16K memory (1.75 μsec. cycle time), two twelve-bit data channels, one twenty-four-bit data channel, peripheral controller electronics, one Control Data 405 Card Reader (1200 cpm), two Control Data 854 Disk Storage Drives with two Control Data 850 Disk Packs, and one Control Data 3254 Line Printer (300 lpm).

As a standard option, the Control Data 501 Line Printer (1000 lpm) may be ordered in lieu of the Control Data 3254 Line Printer. The Control Data 3150 Computer System may be expanded by the addition of memory, the BCD/Floating Point Option, and standard Control Data 3000 Series peripheral devices supported under Control Data's Mass Storage Operating System (MSOS).
(For more information, designate #46 on the Readers Service Card.)

Software

SDS ANNOUNCES CIRC PROGRAM FOR CIRCUIT DESIGNERS

CIRC, an SDS-developed computer program to assist in circuit design engineering, was released to SDS computer users in March, it has been announced by Lou Perillo, director of marketing, Scientific Data Systems, Los Angeles, Calif. The CIRC program, developed for use with SDS 900-Series computers, reduces circuit breadboarding and testing time by permitting engineers to simulate, evaluate and modify their designs on the computer. (CIRC was used extensively by SDS engineers in the design and development of the new Sigma line of computers.)

The program enables engineers to analyze circuits containing 50 or more nodes and also provides non-linear models that accurately simulate semiconductor components. Circuit equations are written automatically and answers are provided via the computer's input/output typewriter or line printer. One of the major advantages of CIRC is that the engineer communicates with the program in his own terminology.
(For more information, designate #51 on the Readers Service Card.)

RCA INTRODUCES NEW COMPUTER EMULATOR SYSTEM FOR USE WITH SPECTRA 70'S

Radio Corporation of America, New York, N.Y., has introduced a new emulator system for use with RCA Spectra 70 computers in handling programs of another company's computers. The system, third to be introduced by RCA, will permit Spectra 70/45 customers to run IBM 1401 and 1460 programs as if they were run on the older systems, according to William R. Lonergan, Division Vice President, Product Planning, RCA Electronic Data Processing.

A major advantage of the emulator system is that it permits programs to run much faster on new third generation systems than they did on original second generation systems. As an indication of results that have been achieved, RCA reported that internal performance of the 1401 emulator on the Spectra 70/45 exceeds its design-goal performance by about 30% and that representative programs are internally executed four times faster on the 70/45 than on the 1401.
(For more information, designate #48 on the Readers Service Card.)

GE-400 SERIES GETS BOOST IN SOFTWARE CAPABILITY

A major boost in the software capability of its GE-400 series of computers has been announced by General Electric Co., Phoenix, Ariz.

The new software package, called Direct Access Programming System (DAPS), provides multi-programming, and communications capabilities to the medium-scale GE-400 computers. It permits the use of the GE-400 systems for information retrieval, file inquiry and updating, program debugging from remote locations, order reporting and inventory level reporting from remote locations, load-sharing among computer centers, and/or source data collection, accumulation and transmission.

Through the use of DAPS, the GE-400 user is able to consolidate computerized business functions into a single data base and to access needed information directly through remote terminals. These terminals may be GE-115 small-scale computers, teletypewriters, DATANET-760® CRT terminals, or any combination of these.

DAPS is available to GE-400 users free of charge.
(For more information, designate #50 on the Readers Service Card.)

MISSIL SOFTWARE SYSTEM

MISSIL, a new management information system software package for small computer installations, has become available through Bonner & Moore Associates, Inc., Houston, Texas. The system is designed for use with the new IBM 1800/1130 line of computers. According to Bonner & Moore, MISSIL is the first true management information system language designed for these "compact" computers.

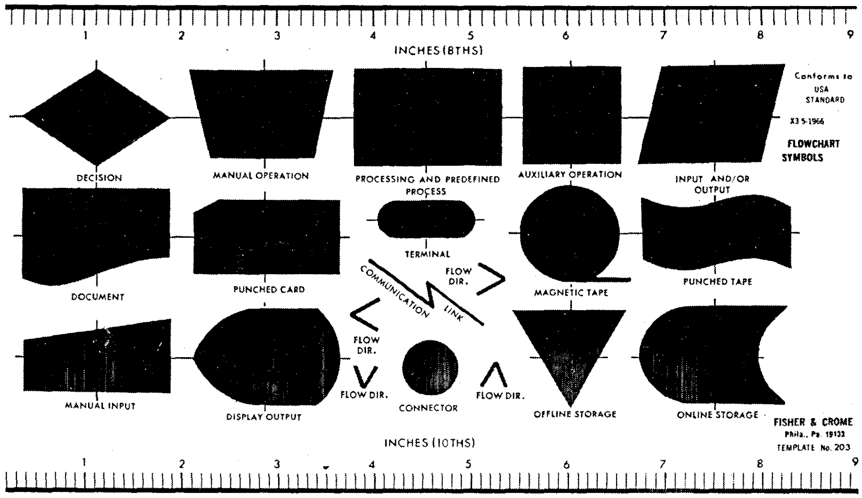
MISSIL (Management Information System Symbolic Interpretive Language) is designed to handle all matrix generation, file management and information system requirements from file maintenance and preprocessing of the original data to the preparation of final action reports. At the same time, it is designed to permit maximum use of computer capabilities consistent with the skills and abilities of the user, according to Bonner & Moore. (In mid-1967, a system now being developed will permit MISSIL communications with MOSS, the IBM-supplied linear programming system.)

MISSIL was developed from Bonner & Moore's DRI and DART proprietary codes, which were widely implemented on second generation hardware, and is compatible with software systems which will be released for IBM's new System/360 computers. A user manual for MISSIL is available now.
(For more information, designate #49 on the Readers Service Card.)

Newsletter

FLOW CHART TEMPLATE

Fisher and Crome, Inc., Philadelphia, Pa., now is in production on the illustrated Flow Chart Template redesigned to conform to the panies involved in data processing are switching to this new flow chart symbol standard. Template #203 (shown in photo) is the most common-



U.S.A. Standard X-3.5-1966. These symbols are the standardizations reached in the recent meeting of the government Defense Agencies. As a result of this meeting, most com- ly used size and sells for $2.50 each. Other sizes also are made and quantity discounts are available. (For more information, designate #47 on the Readers Service Card.)

Data Transmitters and A/D Converters

ITT ANNOUNCES CRYPTOGRAPHIC SCRAMBLER FOR PROTECTION OF TELEPRINTER TRAFFIC

A small electronic device that scrambles teleprinter messages to protect them from unauthorized interception during transmission was shown at the International Security Conference (February) by International Telephone and Telegraph Corp. The CRYPTEL 240 cryptographic machine scrambles messages for storage on punched tape prior to transmission. A similar machine is used to decipher the messages at the receiving end. The ciphered messages are completely compatible with standard teleprinter transmission schemes.

Deciphering of received messages, which are punched on tape, is done automatically, when convenient, according to the order of priority given in the clear-text heading of each message.

The basic cipher key in the CRYPTEL 240 device is a set of pins on a pinboard giving different codes that can be changed within minutes by non-technical personnel. The number of different settings is approximately 250 trillion, trillion (2.5 x 10^{26}). The protection given exceeds all commercial requirements.

— Electronic pegboard permits the user of this teleprinter scrambler to select any of 250 trillion trillion codes for protection of his message

With the exception of control switches, no moving parts are used in the equipment. Ruggedness and high reliability have been obtained by using integrated semiconductor circuits mounted on printed wiring boards. Initially, marketing of the device will be by ITT World Communications, Inc., the international communications subsidiary of ITT.
(For more information, designate #52 on the Readers Service Card.)

GENERAL ELECTRIC'S TDM-220 DATA SET

The new General Electric TDM-220 Data Set, designed to interconnect data handling equipment to transmission links, operates at rates of up to 2400 bits per second.

Because of quick accessiblity and modular construction, individual electronic boards can easily be taken out of the enclosure for testing and inspection. The TDM-220 harness arrangement allows each board being examined to continue operating as part of the system while it is out of the cabinet.

The GE equipment converts binary serial data into vestigial sideband AM signals suitable for transmission on standard 3 KCPS voice channels, over cable, open wire, carrier telephone or microwave radio.
(For more information, designate #53 on the Readers Service Card.

Input-Output

AUTOMATION COMING TO THE GARMENT INDUSTRY

A first step in bringing automation to the garment industry is being taken by Catalina Inc., Los Angeles swimsuit and sportswear subsidiary of Kayser-Rothe Corp. of New York. Officials of both Catalina and California Computer Products Inc. report that an automated pattern "grading" system (see Computers and Automation, November 1965, p. 40) has passed the pilot stage and gone into operation at the garment firm's facilities, Los Angeles. (Grading is the reproduction of a designers original sample pattern in the various sizes in which a particular garment will be made.)

The system involves computers, programmed tape, a plotting instrument that draws patterns and a curve-follower with a photo electric element that "digitizes" pattern shapes for the computer. Though Catalina is the only company presently using CalComp's grading equipment, the computer firm has set up a pilot service bureau operation to make computerized apparel for both men's and women's firms. It turns out shirt patterns for Arrow and Pendleton, suit patterns for Genesco and Hart Schaffner & Marx, Bra patterns for Warner's etc.

California Computer Products, Inc., also has developed an automated marking system to go with the computerized grading system. (Marking is the tracing of a pattern on fabric in such a way as to assure most efficient use of the material.) The dual-purpose machinery now is ready for marketing, CalComp says, with a lease price of $7500 per month.

The marker automatically reduces patterns to one-fifth scale and back up again. It plots a ready-to-cut marker up to 88 inches in width and 210 feet in length. It provides for pattern identification, cutting instructions and garment number annotation. It also provides complete control of patternpiece spacing for various cutting situations — will make adjustments to see that pieces are just touching or overlap by 1/16 of an inch, or whatever the instructions are.

CalComp spokesman James Pyle estimated that any apparel firm doing from $5-$10 million volume on up annually, with a number of style changes to cope with each year, and where fit is critical, could afford CalComp's $7500 monthly tab. The price includes equipment, delivery, CalComp programming and technical assistance. Mr. Pyle said digital information from CalComp's grading and marking machinery can be adapted to equipment of the eight largest computer firms.
(For more information, designate #54 on the Readers Service Card.)

BURROUGHS INPUT AND DISPLAY SYSTEM

A new Burroughs information entry and visual display system to provide instant, two-way comminication with a computer, has been announced by Ray W. Macdonald, Burroughs Corporation president. The Burroughs Input and Display System makes the processing power and memory of a computer available to offices and working areas located away from the computer by means of direct communication. Communication capabilities of the new system provide for information transmission speeds between the computer and the display unit of from 1600 to 18,000 characters per minute.

The Burroughs Input and Display System is available in two models: one is a self-contained model with a single display/keyboard and control unit (which contains the power supply and memory logic of the system); the second model has a central control unit and up to four separate display/keyboard units. Resembling the combination of a television picture tube and a typewriter keyboard, the system has a 9 x 12 inch screen and can display 25 lines of data. Up to 80 characters of information, or the maximum amount of data recorded in a single punched card, can be displayed on each line of the screen.

The new system uses the stroke write character formation method, empolying up to 12 strokes to form any of 64 alphanumeric characters and three special characters. Through the keyboard, the operator can enter information directly into the computer, update or alter information stored in computer memory, call out information from the computer for projection on a display screen and modify computer programs. (For more information, designate #55 on the Readers Service Card.)

KIMBERLY-CLARK INTRODUCES PAPERS SPECIALLY DESIGNED FOR OCR SYSTEMS

Kimberly-Clark Corp., Neenah, Wisc., has introduced Energy OCR bond and Energy OCR ledger, papers specially desinged for high speed optical character recognition data processing systems. Both new grades are dust and lint free, a prerequisite for the optical reading process because smudges and dirt particles cause the scanner to reject information it cannot recognize. The cleaner sheet reduces data memory gaps and improves system accuracy, said Charles DeZemler, marketing manager for Kimberly-Clark business papers.

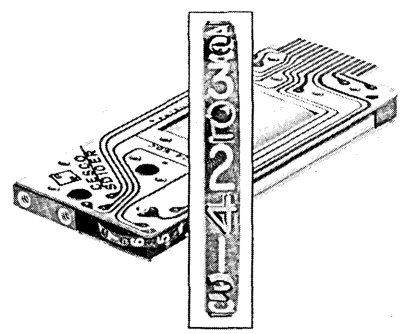
Other physical characteristics of Energy OCR bond and ledger are a consistent smooth and level surface, controlled porosity, high brightness and high rigidity. The surface qualities of the paper help produce sharp, clear images and accurate printouts. Rigidity, without brittleness, permits rapid handling and feeding of original data sheets; and controlled porosity was designed into the sheet because vacuum feeding is used on some OCR systems on the market. The high brightness of the OCR grades is achieved without artificial brightening agents, allowing use of the paper with any light system, including ultra-violet light.

Energy OCR bond is available in regular finish, white only in 16 and 20 lb. basis weights; Energy OCR ledger is sold in smooth finish, white only, in 24 and 32 lb. weights. (For more information, designate #58 on the Readers Service Card.)

CESCO DIGITAL PRINTER OFFERS HIGH RELIABILITY, UNATTENDED USE

A digital printer which offers a printed record without use of any type of inking device has been developed by California Electro-Scientific Corp., Santa Ana, Calif. It is for sale to original equipment manufacturers and others who wish to include a recording device in their instruments or systems. The new CESCO series MP printers are the first counters to offer within one component any desired combination of three features — direct visual readout, printing for permanent record and electrical readout for remote control or verification.

Key to the printer is a compact single decade design which can be combined into any desired numerical or alphabetical grouping. The



embossed imaging area superimposed above is included in each decade. Each is constructed for parallel entry and can be adapted for serial entry.

Elimination of the inking device is made possible through the use of "Action" Brand carbonless paper, a product of the 3M Company. This carbonless paper is imaged by the single pressure of the embossed letter or numeral of the decade. This pressure triggers a chemical reaction within the paper, creating uniformly sharp, smudge-resistant images without the use of carbon paper, ribbons or other inking devices. The series MP printers are designed specifically for "Action" paper. Both single and double ply rolls are used.

The printer has an unusually wide number of applications, including such diversified uses as recording of narcotics dispensing in hospitals, quality control measures on manufacturing lines, measuring scale readings and others. In one application, by telephone companies, the printer has been used to trace obscene phone calls. The printer decade senses the hot line, comes to agreement with the particular combination of relay contact positions at the central office and prints out the originating telephone number on the "Action" paper.
(For more information, designate #57 on the Readers Service Card.)

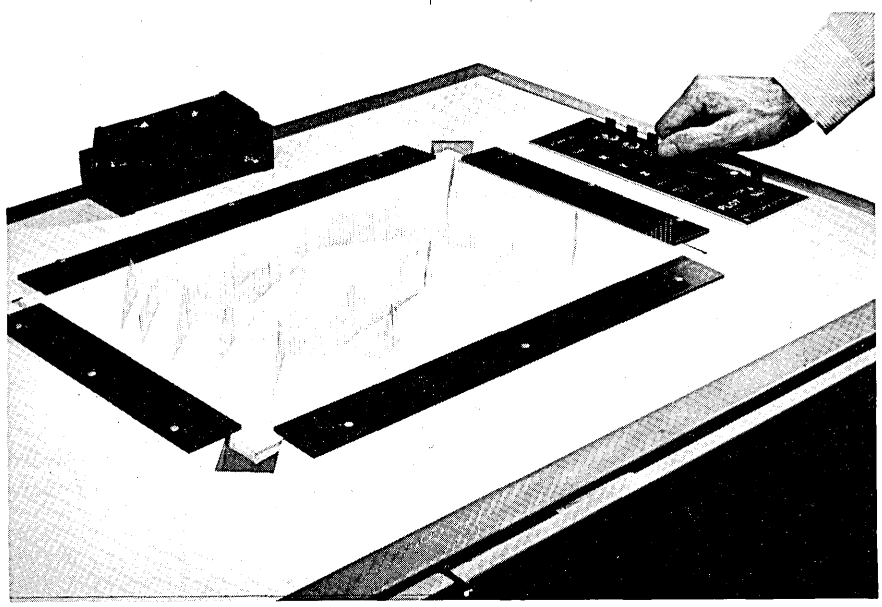
BETA INSTRUMENT CORP. ANNOUNCES NEW FAMILY OF PRECISION CRT DISPLAYS

A new family of Precision CRT Displays — Model Series PD1000, PD1100 and PD1200 — now are available from Beta Instrument Corp., Newton Upper Falls, Mass. These high resolution cathode ray tube displays utilize all solid state circuitry for application in film and hard copy printing recorders, flying spot scanners, film readers, radar displays, computer output displays, TV monitors or any application requiring a precision programmable light source.

The displays employ 5-inch flat-face magnetically deflected cathode ray tubes. Stability and reliability is achieved through the use of highly regulated power supplies, temperature stable components and temperature stabilized circuits. The PD 1000 series has a .0015 inch spot size; the PD1100 series, a .001 inch spot size; and the PD1200, a .0005 inch spot size. The basic displays include Deflection, Blanking and Linearity Correction circuits. Circuit options include Video Amplifiers, Phosphor Protection Circuits, X-Y Sawtooth Generators, and resolved sweep generating circuitry.
(For more information, designate #59 on the Readers Service Card.)

SPATIAL DATA PLOTTER

Multi-purposed three-dimensional graphs now can be produced from electronic processing equipment, automatically, with the new Spatial Data Plotter developed and manufactured by Spatial Data Systems, Inc., Goleta, Calif. This desk-height console system, designated Model 501, used with a digital computer, constructs a physical likeness of three-dimensional data, fast and simply. Resolution is 1/100 inch.



The 11 x 17 Plotter will plot (with correct buffer electronics) 3-D data from electronic processors, magnetic and paper tape, and punched cards. Accepted by the basic unit are 7-bit code; 6 bits (representing positive and negative increments of X, Y and Z); and 7th bit (indicating a plotting point). Plotting is limited only by the size of the X-Y positioning mechanism. The surface of the plotting board can be annotated before/after plot is made, with ink or pencil. Full visibility of the chart surface at all times gives complete readability as a curve is generated.

The end product of this new instrument is light-weight board which supports a group of wire pins. X and Y dimensions on the board are represented by each pin's position; Z dimension is pin height. All dimensions are step-motor positioned. The designer states that up to 10,000 pins per hour may be placed in the board, automatically....as close as 25 to the inch. The wire pins are automatically prepared from an internal wire supply within the Spatial Data Plotter.

Among the areas of application cited by the company for this first-of-a-kind three-dimensional plotter are: Public Works construction; Exploration (geophysical); Military/Cartography (relief maps); and Defense/Underseas operations (ocean depth soundings).
(For more information, designate #56 on the Readers Service Card.)

Components

HYDRAULIC SERVO PACKAGE DEVELOPED FOR COMPUTER PERIPHERAL EQUIPMENT

A new hydraulic servo power package, featuring very low noise level and elimination of external leakage, has been developed and manufactured by Lawrence Systems Corp., Willow Grove, Pa. The device is used to power disks, drums, actuated read-write heads and removable media systems in environments where standard units would produce annoying noise and where oil leaks would be unsightly and hazardous to personnel.

Noise has been minimized through design of components to eliminate pulsations, special LSC tuning techniques, and reduction of velocities. Suspension of the moving elements from the main frame with vibration isolators prevents mechanical vibration from being transmitted. Although the equipment is virtually leakproof, any seeping oil runs back into the reservoir to eliminate the possibility of leakage onto the floor.

The hydraulic servo package comes as an integral, completely self-contained unit. To insure single responsibility for the complete hydraulic system, Lawrence Systems Corp. provides a line of low friction, high speed electro-hydraulic actuators to position read-write heads on moveable head disk systems.
(For more information, designate #60 on the Readers Service Card.)

AUTOMATIC TAPE LOADER, MODEL SS-004

The Automatic Tape Loader, a new product from Sabre Systems, Inc., Burbank, Calif., is designed to wind and rewind magnetic tape from standard reels to non-standard reels in a precision manner. The supply reel accommodates reel diameters up to 14 inches; the take up reel will accommodate reels from 1 inch to 10½ inch diameters. NAB hubs are standard and special adaptors are provided for non-standard hubs.

Tape stacking and tension are controlled. A tape footage counter measures the amount of tape wound and the device will stop automatically when a full load of tape is wound onto the take up reel. Tape widths of ½ and 1 inch are standard; widths of ¼ inch to 2 inches can be supplied.
(For more information, designate #61 on the Readers Service Card.)

COMPUTER TAPE TESTER MODEL 3200

General Kinetics Inc., Arlington, Va., will be displaying its new magnetic tape tester this month at the Spring Joint Computer Conference in Atlantic City, N.J. The new product is designed for users of the new generation of 3200 fci (1600 BPI) computer tape.

In a single pass operation the Model 3200 checks the tape in accordance with quality standards chosen for the specific installation or application. The total surface of the tape is tested using nine overlapping tracks in the IBM 5+4 array. Flaws are indicated on a counter and on a circular graphic recorder.

Built-in cleaning devices upgrade the tape quality prior to testing. An illuminated work station is provided for visual inspection and manual repair of tape flaws. The modes of operation include: Evaluation, Rehabilitation, and Certification.
(For more information, designate #62 on the Readers Service Card.)

HONEYWELL MEMORY EXERCISER

A general purpose memory exerciser for production and development testing of sub-microsecond core memory systems has been introduced by Honeywell's Computer Control Division, Framingham, Mass. The new Model 3602 memory exerciser provides a range of full cycle speeds from 400 nanoseconds to 500 milliseconds. The machine will test and stop on error memories with 100 nanosecond access time. It performs error check and generates a new address in 200 nanoseconds. The device, an integrated circuit system, generates up to 65,536 addresses of 40-bit words.

The Model 3602 has timing stability of ±1% and "jitter" of ±0.1%. Operating modes are load, unload, unload and load on alternate passes, unload and load the complement on alternate passes, unload and load the complement on the same cycle and check on alternate passes, and cycle complement. Individual data bits can be selected to complement, check normal or bypass error. When an error is detected, the exerciser can be programmed to stop or produce an error count pulse and continue. Error checking may occur on load, unload, or load and unload cycles.

The new Model 3602 memory exerciser will be shown for the first time at the Spring Joint Computer Conference.
(For more information, designate #63 on the Readers Service Card.)

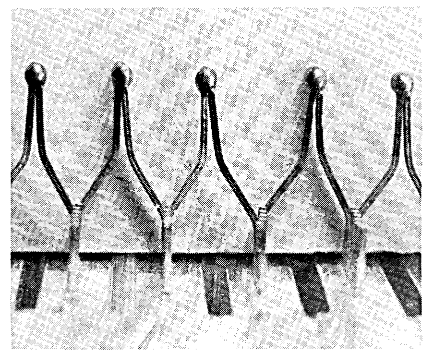
RESEARCH FRONTIER

ELECTRON BEAM USED TO WELD COMPUTER MEMORY ARRAYS

A sharply focused beam of electrons is being used to perform tiny precision welds on critical electrical connections for computer memory arrays, IBM Corporation has reported. This application of electron beam welding is believed by IBM to be the first such use of this technique in manufacturing computer memories. The technique is now being used on the production lines at IBM's Kingston, N.Y., computer manufacturing plant. Developed from a concept originated at IBM World Trade Corporation's Laboratory in Germany, it makes possible even faster and more reliable interconnection of electrical terminals.

The beam welder is used to connect the terminals of ferrite core planes with those immediately above and beneath them in a memory array. Using the electron beam technique, these precise welds can be done in a continuous operation. Conventional welding normally requires that each terminal be welded individually.

Welds produced with the electron beam process are uniform and look like ball-shaped nuggets, as seen in the photograph. This uniformity of appearance makes it easy



to spot a poor weld during quality control inspections. In the welding operation, the tips of a column of electrical terminals in the stacked core plane array are automatically and sequentially passed through the beam of electrons until the entire side of the array has been welded. The beam strikes each terminal approximately fifteen thousandths of an inch from its tip. All four sides of the array are welded in this way.

BURROUGHS CHOSEN TO BUILD ILLIAC IV

An inherent speed limit is a characteristic of most of today's computers: they must process data one step at a time. Burroughs Corporation has been chosen by the Defense Dept. to build a computer that will simultaneously solve the various aspects of a complex problem. The experimental computer, called Illiac IV, will be capable of 1-billion calculations per second — about 500 to 700 times faster than present computers and more than 100 times faster than any computer known to be under development.

Such "parallel processing" is possible because Illiac will have four control units working with 256 arithmetic units. This is like having 256 computers combined into one machine. Another reason for the tremendous jump in speed is that the computer will have a new kind of integrated circuit, known as large-scale integration, or LSI. The LSI circuits, to be furnished by Texas Instruments, Inc., will have about 100 circuits per chip, reducing electron travel time. In present computers there are five to ten circuits on a tiny silicon chip.

Illiac will be used to simulate the atmosphere for weather forecasting and to simulate both economic and military logistic systems. The University of Illinois, the Defense Department's prime contractor for parallel processing computer research, is negotiating the final details of the contract with Burroughs; it is estimated the contract will be worth about $10-million. Burroughs expects to ship its first Illiac in about two years.

BUSINESS NEWS

RCA FINAL FIGURES IN EXCESS OF YEAR-END ESTIMATES

Final figures for sales and earnings by the Radio Corporation of America in 1966 have exceeded earlier year-end estimates, and "sales and profit momentum is continuing strongly in the first quarter of 1967," RCA's 47th Annual Report announced. The year 1966 was the fifth consecutive year in which new records were established in sales and earnings, substantially higher than the totals for the previous year. Sales for each month of 1966 were higher than in the same month of any preceding year.

Profits after taxes in 1966 rose to $132,407,000, a 29% gain over 1965. Net sales of $2,561,460,000 exceeded the two and a half billion mark for the first time, and were 22% greater than the 1965 total.

The Annual Report said that barring an economic change of major proportions, RCA expected to advance to higher levels of sales and earnings in 1967. It observed that since 1961 RCA's sales have risen by 63%, while after-tax earnings have increased by 259%

Shareholders were told that, as the company continues to penetrate new electronic markets, RCA was expanding its commitment to the computer business as a principal growth area of the future. The report said that domestic orders for RCA computers and associated equipment rose by 53% over the 1965 level. However, the report noted "a change in the pattern of outright sales compared to equipment leases". This trend, as well as increased spending for future growth, contributed to a loss in RCA's computer business for 1966, it said.

Nevertheless, RCA executives expressed the belief that the computer business "may well contribute as substantially to RCA sales and earnings in the 1970's as color television and other home instruments do today."

TRW SALES, EARNINGS SET RECORDS FOR 4TH CONSECUTIVE YEAR

TRW Inc., Cleveland, Ohio, reported 1966 sales, net income, earnings per share and dividends paid, as the highest in the company's 66-year history, setting new records for the fourth consecutive year. TRW Board Chairman J. D. Wright and President H. A. Shepard announced that consolidated sales last year were $863.9 million, 30% above the $664.5 million posted in 1965. Net income increased 21% from $29 million to $35.2 million. Earnings per share were $3.70, compared with $3.15 per common share a year earlier. Cash dividends increased from $1.20 to $1.40 per share.

Three-fourths of TRW's sales gains in 1966 came from growth in internal operations, with the remainder attributed to domestic and international acquisitions, according to Mr. Wright. The company's 1967 outlook was described as "indicating further growth as a result of strong demand for both commercial and military aircraft components, and a heavy backlog for equipment and systems work relating to space, communications and electronics". The TRW executives expressed the belief that the company should reach the billion-dollar sales level in 1967, three years ahead of earlier predictions.

BUNKER-RAMO REPORTS 1966 EARNINGS

The Bunker-Ramo Corporation had a net income of $1,097,536, including extraordinary credits of $832,677, on revenues of $54,376,381 in the year ended December 31, 1966. Corresponding figures for 1965 were a net loss of $12,791,133 including extraordinary charges of $6,300,238 on revenues of $43,045,146.

NCR'S 1966 SALES, EARNINGS REACH NEW HIGH

The National Cash Register Company reported that its 1966 world-wide revenue from sales, services and equipment rentals totaled $871,305,000, a new record for the twelfth consecutive year and an 18% gain over the $736,849,000 recorded in 1965.

Reported net income also reached a new high, rising to $27,219,000, a 10% increase over the $24,725,000, reported in 1965. On a per-share basis, earnings were $3.10 on each of the 8,793,963 shares outstanding at year end compared with $2.81 per-share in 1965.

The financial results were announced by Robert S. Oelman, NCR chairman, following a meeting of the company's board of directors. Mr. Oelman said the year's results reflected a heavy volume of equipment deliveries in all major lines of products as well as record income from equipment rentals, service, and the sale of business forms and other supplies. Also, the year was marked with continuing progress in the electronic data processing field and in the sale and installation of the company's "total" business systems most of which are rented.

COMPUTER APPLICATIONS SALES, EARNINGS UP

Computer Applications, Inc., New York, one of the largest software and service bureau firms in the country, reported that sales for the three months ended December 31, 1966 totaled $7,062,533, compared with $3,339,000 in the first quarter of fiscal 1966.

Net income was $115,150, up from $46,518 in the comparable period in fiscal 1966.

FORUM

(Continued from page 13)

REVIVED "ANNUAL REVIEW IN AUTOMATIC PROGRAMMING" — PAPERS SOUGHT

Christopher J. Shaw
System Development Corp.
2500 Colorado Ave.
Santa Monica, Calif. 90406

Publication of the "Annual Review in Automatic Programming," which last appeared in 1964 under the editorship of the late Richard Goodman, is being resumed under the direction of an international board of editors. They include Professor Louis Bolliet of the University of Grenoble (Boite Postale 7, Saint-Martin-D'Heres (Isere), France), Professor Robert W. Floyd of the Carnegie Institute of Technology (Schenley Park, Pittsburgh, Pennsylvania 15213), Mr. Mark Halpern of Lockheed Missiles and Space Company (3251 Hanover Street, Palo Alto, California 94304), Mr. Christopher J. Shaw of System Development Corporation (2500 Colorado Avenue, Santa Monica 90406), and Professor Andrei P. Yershov (Computation Center, Novosibirsk 90, U.S.S.R.).

The editors plan to publish substantial, authoritative, and well-written papers, in English, reporting on advances or describing the state of the art in automatic programming (which is defined as the use of the computer itself as a tool in developing and applying computer programs).

The series, to be published by Pergamon Press, will resume annual publication in late 1967 or early 1968. To meet this schedule, noteworthy papers from 5,000 to 25,000 words in length are urgently needed. Contributions, inquiries regarding contributions, or suggestions for contributions may be directed to any of the editors.

CORRECTION

On page 18 of the February 1967 issue of *Computers and Automation,* Mr. Carl H. Reynolds was erroneously listed as the President of Computer Usage Company, Inc. His correct title is President of the Computer Usage Development Corporation, Mt. Kisco, N.Y., a subsidiary of Computer Usage Company, Inc.

CAPITAL REPORT

(Continued from page 32)

Daily matching runs produce listings of specific job openings and lists of qualified registrants for each position. Matching of skills versus job requirements is done on up to 50 characteristics. The system has been functioning for several months in daily use. Many unemployed registrants have been successfully trained in EDP data collection, keypunching, and clerical EDP processing techniques, and assist in system operation. The reports are used by employment counselors to speed referral.

Several benefits have come out of prototype system operation. Qualified but unemployed registrants are trained in modern data processing techniques. It is unlikely that they would have had the chance to receive such training elsewhere. The job hunting search and match process has been measurably speeded up with computers. Searches run on a daily basis give registrants a chance at any opening for which they are qualified. Last but not least, the unemployed (who are constantly told that computers are putting them out of jobs) get first-hand knowledge that computers are being used to do just the opposite: find them better jobs faster.

Senter Stuart

MONTHLY COMPUTER CENSUS

The number of electronic computers installed or on order at any one time has been increasing rapidly during the past several years. New models have been offered in the computer market, and familiar machines have gone out-of-production and subsequently been retired from active use and dismantled. Some new computers have been received with open arms by users — others have been given the cold shoulder.

To aid our readers in keeping up with this rapidly changing profile of computer use, COMPUTERS AND AUTOMATION presents this monthly report on the number of general purpose electronic digital computers made by U.S.-based companies which are installed or on order as of the preceding month. These census figures include installations and orders outside the United States. The figures are compiled and updated each month by the International Data Corporation, Newton, Mass. 02160, a market research firm specializing in the computer industry. We hope they will serve as a useful "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 the International Data Corporation. This market research program compiles and maintains a worldwide computer installation locator file which identifies, by customer, the installation sites of electronic computers. The resulting census counts are submitted to the individual computer manufacturers for their review and voluntary confirmation.

AS OF MARCH 10, 1967

NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS
ASI Computer	ASI 210	Y	$3850	4/62	26	0
	ASI 2100	Y	$4200	12/63	7	0
	ADVANCE 6020	Y	$4400	4/65	13	14
	ADVANCE 6040	Y	$5600	7/65	8	12
	ADVANCE 6050	Y	$9000	2/66	6	8
	ADVANCE 6070	Y	$15,000	10/65	5	6
	ADVANCE 6130	Y	$1000	2/67	5	20
Autonetics	RECOMP II	Y	$2495	11/58	34	X
	RECOMP III	Y	$1495	6/61	7	X
Bunker-Ramo Corp.	BR-130	Y	$2000	10/61	160	X
	BR-133	Y	$2400	5/64	33	33
	BR-230	Y	$2680	8/63	15	X
	BR-300	Y	$3000	3/59	33	X
	BR-330	Y	$4000	12/60	29	X
	BR-340	Y	$7000	12/63	20	X
Burroughs	205	N	$4600	1/54	40	X
	220	N	$14,000	10/58	33	X
	B100	Y	$2800	8/64	178	10
	B250	Y	$4200	11/61	84	1
	B260, 263	Y	$3750	11/62	225	2
	B270, 273	Y	$7000	7/62	166	2
	B280, 283	Y	$6500	7/62	130	3
	B300	Y	$10,000	7/65	144	72
	B2500	Y	$5000	2/67	1	48
	B3500	Y	$14,000	5/67	0	50
	B5500	Y	$22,000	3/63	62	9
	B6500	Y	$33,000	2/68	0	12
	B8500	Y	$200,000	2/67	0	3
Control Data Corporation	G-15	N	$1600	7/55	280	X
	G-20	Y	$15,500	4/61	25	X
	LGP-21	Y	$725	12/62	160	X
	LGP-30	semi	$1300	9/56	134	X
	RPC-4000	Y	$1875	1/61	64	X
	160*/160A/160G	Y	$2100/$5000/$12,000	5/60;7/61;3/64	463	X
	924/924A	Y	$11,000	8/61	28	X
	1604/1604A	Y	$45,000	1/60	59	X
	1700	Y	$3500	5/66	54	175
	3100	Y	$10,000	12/64	92	34
	3200	Y	$14,000	5/64	66	X
	3300	Y	$19,500	9/65	55	52
	3400	Y	$18,000	11/64	19	X
	3500	Y	$30,000	9/67	0	9
	3600	Y	$48,000	6/63	45	X
	3800	Y	$49,300	2/66	16	13
	6400	Y	$52,100	5/66	12	20
	6600	Y	$117,000	8/64	24	18
	6800	Y	$130,000	4/67	0	4
Data Machines, Inc.	620	Y	$900	11/65	42	20
Digital Equipment Corp.	PDP-1	Y	$3400	11/60	59	X
	PDP-4	Y	$1700	8/62	56	X
	PDP-5	Y	$900	9/63	115	X
	PDP-6	Y	$10,000	10/64	24	1
	PDP-7	Y	$1300	11/64	124	28
	PDP-8	Y	$525	4/65	650	180
	PDP-9	Y	$1000	12/66	3	60
	PDP-10	Y	$7500	7/67	0	11
El-tronics, Inc.	ALWAC IIIE	N	$1820	2/54	14	X
Electronic Associates, Inc.	8400	Y	$12,000	6/65	15	9
General Electric	115	Y	$1800	12/65	285	580
	205	Y	$2900	6/64	42	X
	210	Y	$16,000	7/59	48	X
	215	Y	$6000	9/63	54	X
	225	Y	$8000	4/61	203	X
	235	Y	$10,900	4/64	72	1
	415	Y	$9600	5/64	209	53
	425	Y	$18,000	6/64	80	40
	435	Y	$25,000	9/65	25	16
	625	Y	$50,000	4/65	21	15
	635	Y	$56,000	5/65	20	18
	645	Y	$90,000	7/66	2	9
Honeywell	DDP-24	Y	$2500	5/63	87	X
	DDP-116	Y	$900	4/65	165	40
	DDP-124	Y	$2050	3/66	32	35
	DDP-224	Y	$3300	3/65	52	8
	DDP-516	Y	$700	9/66	30	125
	H-120	Y	$3900	1/66	400	310
	H-200	Y	$8400	3/64	1040	150
	H-400	Y	$8500	12/61	101	X

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-800	Y	$28,000	12/60	90	1
	H-1200	Y	$8000	2/66	85	95
	H-1400	Y	$14,000	1/64	12	X
	H-1800	Y	$42,000	1/64	20	1
	H-2200	Y	$12,000	1/66	33	60
	H-4200	Y	$20,500	3/67	0	9
	H-8200	Y	$35,000	3/68	0	5
IBM	305	N	$3600	12/57	132	X
	360/20	Y	$2000	12/65	2025	6100
	360/30	Y	$7500	5/65	3400	4250
	360/40	Y	$15,000	4/65	1850	1550
	360/44	Y	$10,000	7/66	44	180
	360/50	Y	$26,000	8/65	260	680
	360/65	Y	$50,000	11/65	55	260
	360/67	Y	$75,000	10/66	7	50
	360/75	Y	$78,000	2/66	20	40
	360/90 Series	Y	$140,000	6/67	0	10
	650	N	$4800	11/54	160	X
	1130	Y	$1200	2/66	1350	4700
	1401	Y	$6600	9/60	7645	X
	1401-G	Y	$2300	5/64	1615	X
	1410	Y	$14,200	11/61	812	55
	1440	Y	$4800	4/63	3440	100
	1460	Y	$11,500	10/63	1730	X
	1620 I, II	Y	$4000	9/60	1665	15
	1800	Y	$7600	1/66	155	315
	701	N	$5000	4/53	1	X
	7010	Y	$22,600	10/63	216	6
	702	N	$6900	2/55	7	X
	7030	Y	$160,000	5/61	6	X
	704	N	$32,000	12/55	28	X
	7040	Y	$22,000	6/63	118	2
	7044	Y	$32,000	6/63	130	4
	705	N	$38,000	11/55	49	X
	7070, 2, 4	Y	$27,000	3/60	316	X
	7080	Y	$55,000	8/61	85	X
	709	N	$40,000	8/58	8	X
	7090	Y	$63,500	11/59	44	X
	7094	Y	$72,500	9/62	116	2
	7094 II	Y	$78,500	4/64	128	2
National Cash Register Co.	NCR - 304	Y	$14,000	1/60	25	X
	NCR - 310	Y	$2500	5/61	15	X
	NCR - 315	Y	$8500	5/62	425	125
	NCR - 315-RMC	Y	$12,000	9/65	60	45
	NCR - 390	Y	$1850	5/61	690	25
	NCR - 500	Y	$1500	10/65	1000	800
Philco	1000	Y	$7010	6/63	16	X
	2000-210,211	Y	$40,000	10/58	16	X
	2000-212	Y	$52,000	1/63	12	X
Radio Corporation of America	RCA 301	Y	$7000	2/61	643	1
	RCA 3301	Y	$17,000	7/64	72	4
	RCA 501	Y	$14,000	6/59	96	X
	RCA 601	Y	$35,000	11/62	5	X
	Spectra 70/15	Y	$4100	9/65	94	130
	Spectra 70/25	Y	$6700	9/65	60	55
	Spectra 70/35	Y	$10,400	1/67	18	135
	Spectra 70/45	Y	$17,400	11/65	60	105
	Spectra 70/55	Y	$40,500	11/66	2	14
Raytheon	250	Y	$1200	12/60	175	X
	440	Y	$3500	3/64	16	2
	520	Y	$3200	10/65	22	5
Scientific Control Corporation	650	Y	$500	5/66	9	6
	655	Y	$1800	2/67	1	4
	660	Y	$2000	10/65	6	3
	670	Y	$2600	5/66	2	2
	6700	Y	$45,000	10/67	0	1
Scientific Data Systems Inc.	SDS-92	Y	$1500	4/65	88	40
	SDS-910	Y	$2000	8/62	200	16
	SDS-920	Y	$2900	9/62	150	25
	SDS-925	Y	$3000	12/64	37	30
	SDS-930	Y	$3400	6/64	200	48
	SDS-940	Y	$10,000	4/66	11	28
	SDS-9300	Y	$7000	11/64	31	14
	Sigma 2	Y	$1000	12/66	8	200
	Sigma 5	Y	$6000	8/67	0	18
	Sigma 7	Y	$12,000	12/66	5	26
Systems Engineering Labs	810	Y	$1000	9/65	24	X
	810A	Y	$900	8/66	15	14
	840	Y	$1400	11/65	3	X
	840A	Y	$1400	8/66	6	20
UNIVAC	I & II	N	$25,000	3/51 & 11/57	24	X
	III	Y	$20,000	8/62	70	X
	File Computers	N	$15,000	8/56	15	X
	Solid-State 80 I, II, 90 I, II & Step	Y	$8000	8/58	230	X
	418	Y	$11,000	6/63	110	35
	490 Series	Y	$35,000	12/61	144	55
	1004	Y	$1900	2/63	3200	60
	1005	Y	$2400	4/66	600	220
	1050	Y	$8000	9/63	290	26
	1100 Series (except 1107)	N	$35,000	12/50	9	X
	1107	Y	$55,000	10/62	35	X
	1108	Y	$65,000	9/65	44	70
	9200	Y	$1500	6/67	0	900
	9300	Y	$3400	6/67	0	500
	LARC	Y	$135,000	5/60	2	X
				TOTALS	44,078	24,638

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, customers ordering a new computer model intended to replace a computer model in the same product line may continue to use their current peripheral equipment, which can account for 30-70% of the value of the total computer system.

BOOKS AND OTHER PUBLICATIONS

Neil Macdonald
Assistant Editor
Computers and Automation

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

Reviews

Integrated Circuit Engineering Corp., Staff of / Integrated Circuit Engineering: Basic Technology, 4th ed. / Boston Technical Publishers, Inc., Central Square, Cambridge, Mass. 02139 / 1966, hardbound, 391 pp., $20.00?

This 4th edition updates for the practicing engineer the information required for the proper utilization of integrated circuits. It includes a detailed Table of Contents (10 pages), and contains a wealth of technical data and illustrations. A valuable book.

Jones, Martin V. / How to Estimate the Investment Cost of Electronic Data Processing Equipment — AD633878 / Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. 22151 / 1966, paperbound report, 32 pp., $?

This report, originally produced by Mitre Corp., Bedford, Mass., "seeks to provide practical guidance to analysts charged with estimating the investment cost of electronic data processing equipment of Air Force Command and Control Systems".

Lakoff, Sanford A., editor, and 14 authors / Knowledge and Power: Essays on Science and Government / The Free Press, 866 Third Ave., New York, N.Y. 10022 / 1966, hardbound, 502 pp., $9.95

This book discusses the problems created by advances in science and how government deals with them. The introduction chapter is "Science and Social Thought"; then Part I is "Cases and Controversies"; Part 2 is "Governing Science"; Part 3 is "Knowledge and Power: The Overview". There is no mention of the computer in the index. It includes a name index and a subject index.

Landers, Richard R. / Man's Place in the Dybosphere / Prentice-Hall, Inc., Englewood Cliffs, N.J. / 1966, hardbound, 266 pp., $5.95

The "dybosphere" (pronounced "dib-bo-sphere"); is the world which is dominated by machines serving men, machines with humanized properties, and machines that are in many ways dominant over man. The author is manager of the Reliability Department of the Electronics Systems Division of Thompson Ramo Wooldridge in California. The four parts of the book are: Expedition to the Dybosphere; Mechanizing Man; Humanizing Machines; and Life in the Dybosphere.

The book seems to contain much interesting and useful information and comments.

McCameron, Fritz A. / COBOL Logic and Programming / Richard D. Irwin, Inc., Homewood, Ill. / 1966, photo-offset and paperbound, 246 pp., $4.35

COBOL is a really important, business-problem-oriented, computer-programming language. The author is a professor in the accounting department of Louisiana State University. The chapters include: The Electronic Computer; COBOL Structure and Data Organization; COBOL Data-Manipulative Logic; COBOL Control Logic; COBOL Coding — The Identification, Environment and Data Divisions; COBOL Coding — The Procedure Division; Advanced Control Logic. This book is "for beginners"; its objective is to "present the basic nature of COBOL" so that the reader can understand both how it is used as well as how it is composed.

McFarland, Walter B. / Concepts for Management Accounting / National Association of Accountants, 505 Park Ave., New York, N.Y. 10022 / 1966, printed, 166 pp., $?

Chapters include: Project Profit Planning; Profit Planning by Products and Markets; Planning and Measuring Financial Performance for Coordination and Control; Measuring Financial Performance for the Enterprise as a Whole; etc.

This is an authoritative book, based on work done by the research director of the National Association of Cost Accountants, Walter McFarland.

McCulloch, Warren S. / Embodiments of Mind / M.I.T. Press, 50 Ames St., Cambridge, Mass. 02142 / 1965, hardbound, 402 pp., $12.50

This well-known scientist characterizes his area of work as experimental epistemology. The selections in this book deal with that subject, and were written over a number of years, addressed to scientists, engineers, philosophers, and laymen. Essays include: "What is a Number, that a Man May Know It, and a Man, that He May Know a Number?"; "Why the Mind Is in the Head"; "What the Frog's Eye Tells the Frog's Brain"; "Machines That Think and Want"; etc. Index included.

This is a fascinating and informative book.

Perstein, M. H. / Grammar and Lexicon for Basic Jovial — AD 635473 / Clearinghouse for Federal Scientific and Technical Information / Springfield, Va. 22151 / 1966, paperbound report, 102 pp., $?

The author is a staff member of System Development Corp., Santa Monica, Calif., "This is the reference manual for Basic JOVIAL" programming language.

Singh, Jagjit / Great Ideas in Information Theory, Language and Cybernetics / Dover Publications, 180 Varick St., New York, N.Y. 10014 / 1966, paperbound, 338 pp., $2.00

A summary of work being done in the computer field to discover the "nature and genesis of human intelligence" by the winner of the 1963 U.N. Kalinga Prize. He proposes that to understand language, information theory, and automata, the reader need only know simple elaborations of four commonplace principles: "the principles of the race track, the slide rule, the chartroom, and the club."

Statland, N., and 5 authors / An Approach to Computer Installation Performance Effectiveness Evaluation — AD 617 613 / U.S. Department of Commerce, Washington, D.C. / 1965, paperbound, 165 pp., $1.00

The four sections of this report are: Introduction; Summary of the Auerbach Performance Evaluation Concept; The Auerbach Process in Action; Structure of the Auerbach Procedure for Computer Installation Effectiveness Evaluation.

Tippett, James T., 4 other editors, and 85 authors / Optical and Electro-optical Information Processing / The M.I.T. Press, Cambridge, Mass. and London, England / 1965, printed, hardbound, 780 pp., $30.00

The Proceedings of a symposium on optical and electro-optical information processing held in Boston in 1964. The book covers recent advances in the field particularly in relation to information processing. 39 papers are included. The final chapter is a critique of the symposium.

This is an important and useful book, but specialized.

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Edmund C. Berkeley
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NEW PATENTS

Raymond R. Skolnick
Patent Manager
Ford Instrument Co.
Div. of Sperry Rand Corp.
Long Island City, N.Y. 11101

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.

December 13, 1966 (Continued)

3,292,153 / Robert S. Barton, Altadena, Calif. and William K. Orr, Wheaton, Ill. / assignors to Burroughs Corp. / Memory System.

3,292,163 / Douglas C. Engelbart, Palo Alto, Calif. / assignor to AMP Inc. / Magnetic-Core Logic Circuits.

December 20, 1966

3,293,609 / Thomas B. Martin, Collingswood, N.J. / assignor to Radio Corporation of America / Information Processing Apparatus.

3,293,610 / Harry A. Epperson and Samuel Goldstein, Los Angeles, and James P. Nicklas, Woodland Hills, Calif. and Robert H. Stotz, Boston, Mass. / assignors, by mesne assignments, to The Bunker-Ramo Corp. / Interrupt Logic System For Computers.

3,293,613 / Andrew Gabor, Port Washington, N.Y. / assignor to Potter Instrument Co., Inc. / Information Recording System.

3,293,616 / Alvin P. Mullery, Chappaqua, and Ralph F. Schauer, Hawthorne, N.Y. / assignors to International Business Machines Corp. / Computer Instruction Sequencing And Control System.

3,293,619 / Hans P. Luhn, Armonk, N.Y. / assignor to International Business Machines Corp. / Information Retrieval.

3,293,620 / Andre M. Renard, Costa Mesa, Calif. / assignor to Ford Motor Co. / Thin Film Magnetic Memory Having Nondestructive Readout.

3,293,623 / Andrew H. Bobeck, Chatham, N.J. / assignor to Bell Telephone Laboratories, Inc. / Magnetic Memory Matrix Assembly.

3,293,626 / Robert E. Thome, Poughkeepsie, N.Y. / assignor to International Business Machines Corp. / Coincident Current Readout Digital Storage Matrix.

December 27, 1966

3,295,112 / Robert M. Stewart, Encino, Calif. / assignor to Space-General Corp. / Electrochemical Logic Elements.

3,295,115 / Richard L. Snyder, Fullerton, Calif. / assignor to Hughes Aircraft Company / Thin Magnetic Film Memory System.

January 3, 1967

3,296,598 / Donal A. Meier, Inglewood, and William Y. Wong, Los Angeles, Calif. / assignors to The National Cash Register Co. / Tunnel Diode Memory.

3,296,599 / Paul M. Davies, Manhattan Beach, Calif. / assignors, by mesne assignments, to TRW Inc. / Self-Searching Memory.

3,296,600 / Theodor Einsele, Sindelfingen, Germany / assignor to International Business Machines Corp. / Magnetic Core Switching Device.

3,296,603 / Leon S. Levy, Arthur E. Wennstrom, and William M. Cook, Los Angeles, Calif. / assignors to Hughes Aircraft Co. / Magnetic Core Circuit.

January 10, 1967

3,296,941 / Jerry Edward Rochte, Long Beach, Calif. / assignor to Beckman Instruments, Inc. / Logic Control System.

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3,297,993 / Genung L. Clapper, Vestal, N. Y. / assignor to International Business Machines Corp. / Apparatus For Generating Information Regarding The Spatial Distribution Of a Function.

3,297,994 / Walter Klein, Santa Ana, Calif. / assignor to Beckman Instruments, Inc. / Data Processing System Having Programmable, Multiple Buffers And Signalling And Data Selection Capabilities.

3,298,002 / Hewitt D. Crane, Palo Alto, Calif., and Edward C. Dowling, Harrisburg, Pa. / assignors to AMP Inc. / Magnetic Core Circuit Arrangement.

January 17, 1967

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3,299,291 / Raymond M. Warner, Jr., Scottsdale, and Geza Csanky, Mesa, Ariz. / assignors to Motorola, Inc. / Logic Elements Using Field-Effect Transistors In Source Follower Configuration.

3,299,409 / Robert A. Herman, Los Angeles, Calif. / assignor, by mesne assignment, to The Bunker-Ramo Corp. / Digital Apparatus.

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3,300,766 / Ralph J. Koerner and Edward J. Schneberger, Los Angeles, Calif. / assignors, by mesne assignments, to The Bunker-Ramo Corp. / Associative Memory Selection Device.

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3,302,180 / Leonard J. Donohoe and Arthur D. Fritz, Houston, Tex., and David E. Keefer and Nick G. Nicolau, Scottsdale, Ariz. / assignors to Texas Instruments Inc. / Digital Data Handling.

3,302,182 / John T. Lynch, Lionville, and Fred G. Wolff, Paoli, Pa. / assignors to Burroughs Corp. / Store And Forward Message Switching System Utilizing A Modular Data Processor.

3,302,185 / Andrew P. Cox, Jr., Lutherville, Robert H. Sapp, Baltimore, and Joseph Abruzzo, Severna Park, Md., / assignors, by mesne assignments, to the United States of America as represented by the Secretary of the Navy / Flexible Logic Circuits For Buffer Memory.

3,302,186 / Edward John Raser, Montgomery County, Md., and Alexander S. Lett, Putnam County, N. Y. / assignors to International Business Machines Corporation / Information Retrieval System.

3,302,187 / Heinz E. Voigt, Konstanz, Germany / assignor to Telefunken Patentverwertungsgesellschaft m.b.H., Ulm (Danube), Germany / Computer Storage Read-Out System.

3,302,190 / Robert E. Boylan, St. Paul, and Harley S. Kukuk, Egan Township, Dakota County, Minn. / assignors to Sperry Rand Corp. / Non-Destructive Film Memory Element.

Cover Story

The picture on the front cover represents a classic woodblock print drawn by the Japanese artist Utamaro and produced by the printer Isemago in 1796. The signature of Utamaro in Kanji script and the printing symbol of Isemago also are shown.

This representation was produced by a computer-controlled plotter of California Computer Products, Anaheim, California, on the occasion of a Special Electronic Instrumentation Show held at the United States Trade Center in Tokyo in March.

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.

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American Telephone & Telegraph Co., 195 Broadway, New York, N. Y. 10017 / Page 2 / N. W. Ayer & Son

Bryant Computer Products, Div. of Ex-Cell-O Corp., 850 Ladd Rd., Walled Lake, Mich. 48088 / Page 33 / Campbell-Ewald Co.

California Computer Products, Inc., 305 Muller Ave., Anaheim, Calif. 93804 / Page 62 / Campbell-Mithun, Inc.

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Datametrics Corp., 8217 Landershim Blvd., North Hollywood, Calif. 91605 / Page 58 / Gene Soltys Adv.

Data Machines, Inc., 1590 Monrovia Ave., Newport Beach, Calif. / Page 3 / Durel Advertising

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International Business Machines Corp., Data Processing Div., White Plains, N.Y. / Page 4 / Marsteller Inc.

International Data Corp., 355 Walnut St., Newtonville, Mass. 02160 / Page 53 / --

Randolph Computer Corp., 200 Park Ave., New York, N.Y. 10017 / Page 45 / Albert A. Kohler Co., Inc.

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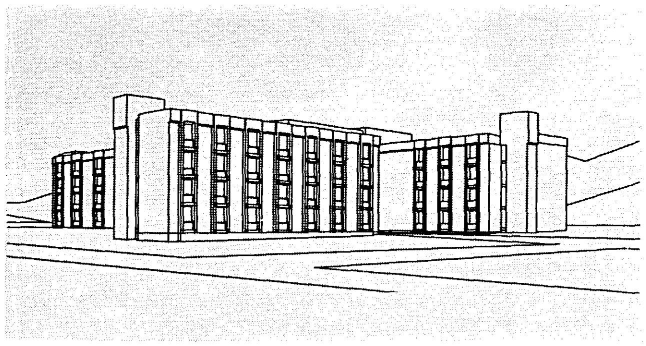

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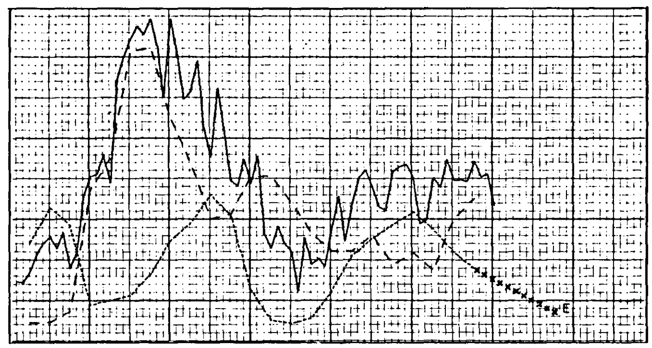

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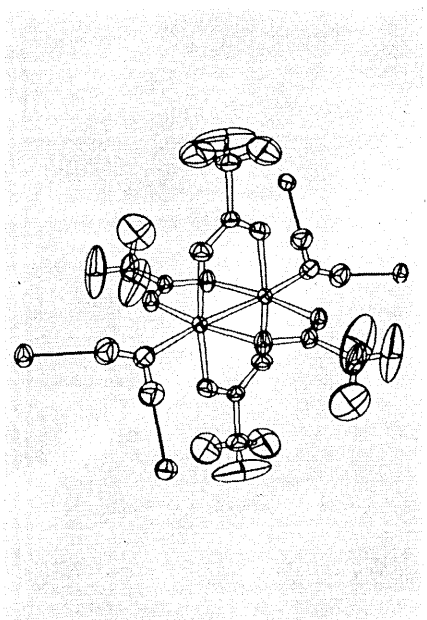

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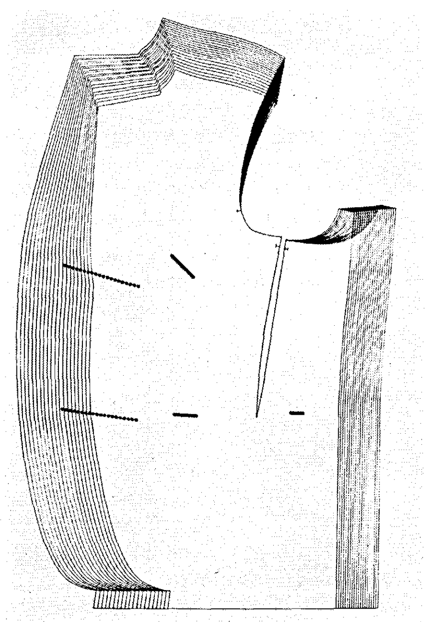

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