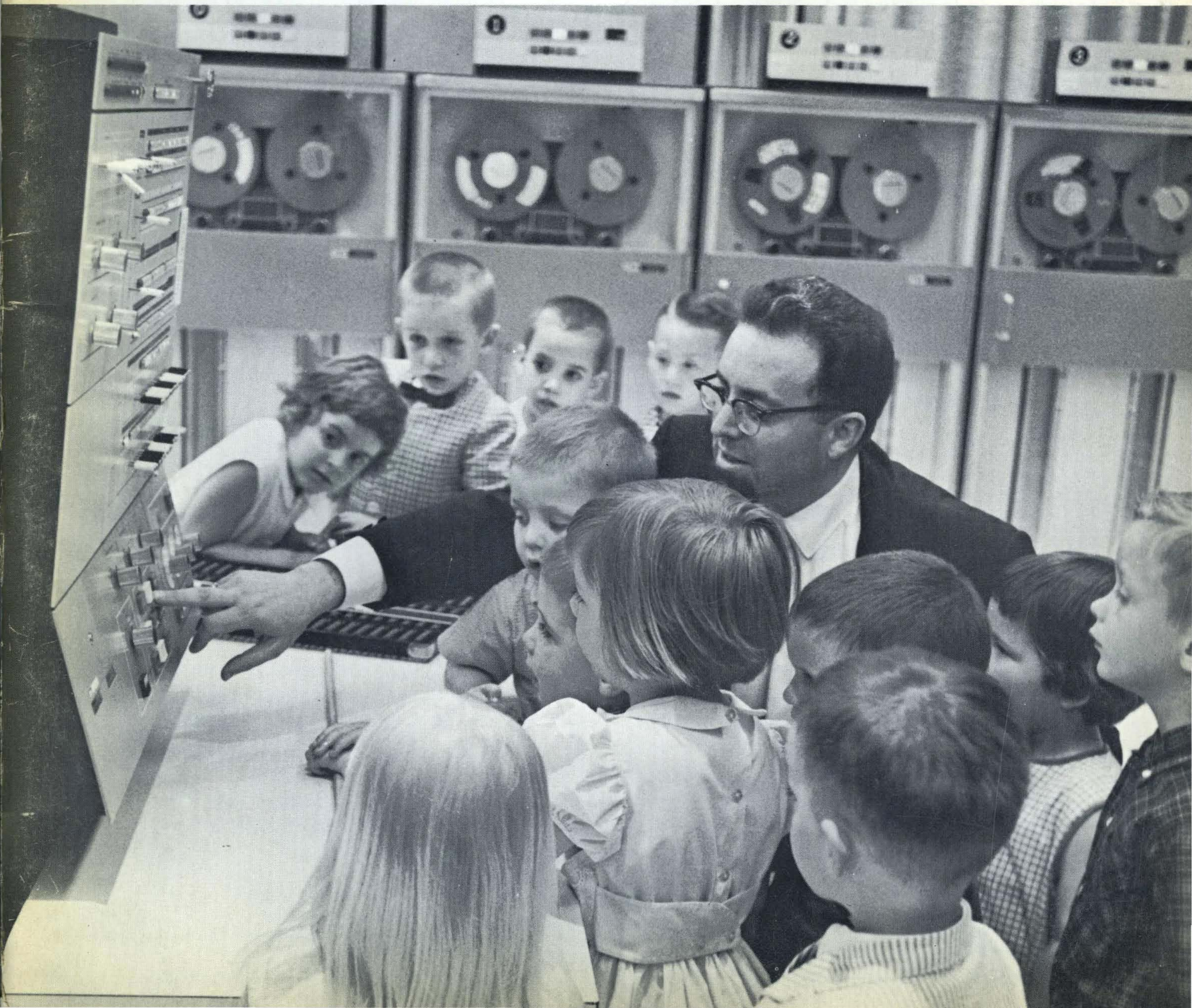
October, 1965

computers and automation

Introducing Pre-School Children to the "Workings" of a Computer



10 cps
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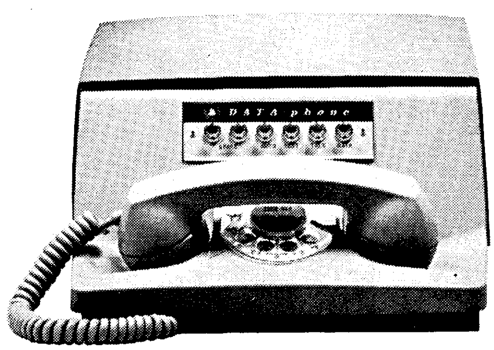

No problem

Bell System data communications services can move your business data at a wide range of speeds; speeds that are compatible with your data processing equipment.

Transmission can be over regular or private-line telephone circuits, across town or nation, by day or by night.

Data communications services can add new scope and usefulness to your present EDP system, or to one you may be planning.

Discuss it with one of our Communications Consultants. He's a trained specialist in data communications. Just call your Bell Telephone Business Office and ask for his services.

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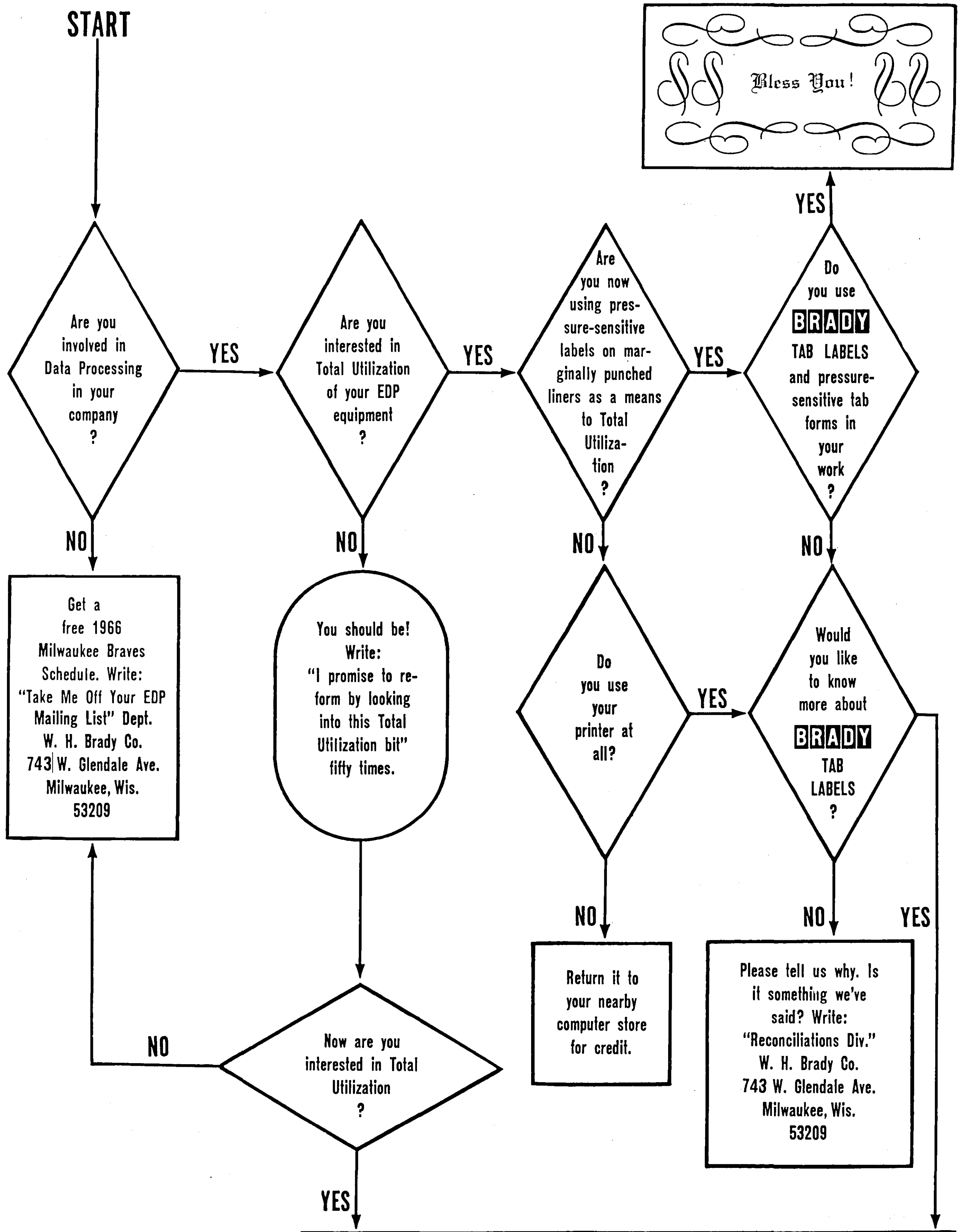

START
Are you involved in Data Processing in your company ?
YES
Are you interested in Total Utilization of your EDP equipment ?
YES
Are you now using pressure-sensitive labels on marginally punched liners as a means to Total Utilization ?
YES
Do you use BRADY TAB LABELS and pressure-sensitive tab forms in your work ?
YES
Bless You!
NO
Get a free 1966 Milwaukee Braves Schedule. Write: "Take Me Off Your EDP Mailing List" Dept. W. H. Brady Co. 743 W. Glendale Ave. Milwaukee, Wis. 53209
NO
You should be! Write: "I promise to reform by looking into this Total Utilization bit" fifty times.
NO
Do you use your printer at all?
YES
NO
Would you like to know more about BRADY TAB LABELS ?
NO
Return it to your nearby computer store for credit.
NO
Please tell us why. Is it something we've said? Write: "Reconciliations Div." W. H. Brady Co. 743 W. Glendale Ave. Milwaukee, Wis. 53209
YES
NO
Now are you interested in Total Utilization ?
YES

AN OFF-BIT HISTORY OF MAGNETIC TAPE... #8 of a series by Computape*

© Computron Inc. 1965

Did the Vikings introduce computer tape to our shores as early as 789 A.D.?

Dr. Jerome B. Dewdrop believes they did. According to Dr. Dewdrop, the occasion was the landing in Narragansett Bay of a group of Norse singers bound for the first Newport Jazz Festival. The group included, in addition to the Vikings, such long-maned attractions as Erik and the Reds, The Four Norsemen, and one Bea Stricelând, who sang "Melancholy Baby" accompanied by lyre.

As for the view that data processing equipment was *not* introduced until much later, as a result of the work of the 17th century mathematical wizard Descartes, Dr. Dewdrop poo-poohs it.

"An interesting theory," scoffs Dr. Dewdrop in his classic study entitled 'The Vikings and All That Jazz', "but just one more case of putting Descartes before the Norse!"

One of a series of documentaries made possible by COMPUTRON INC., a company even more interested in making history than fracturing it. Our Computape is so carefully made that it delivers 556, 800 or 1,000 bits per inch — with no dropout. Available with 7, 8, 9, 10, 16 channel or full-width certification to meet your systems requirements.

Now — if Computape can write that kind of computer tape history — shouldn't you be using it?

*Reg. T.M. Computron Inc.

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COMPUTAPE — product of the first company to manufacture magnetic tape for computers and instrumentation, exclusively.

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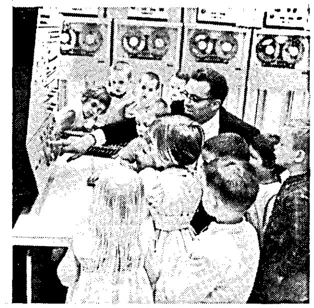

The front cover shows a computer being explained to a group of pre-school children. George C. Heller of IBM used some pieces of candy and other small objects to teach the children how a computer counts in the binary system.

computers and automation

OCTOBER, 1965 Vol. 14, No. 10

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

In This Issue

Special Issue on Real-Time Computing and Supervisory Monitor Programs

In Every Issue

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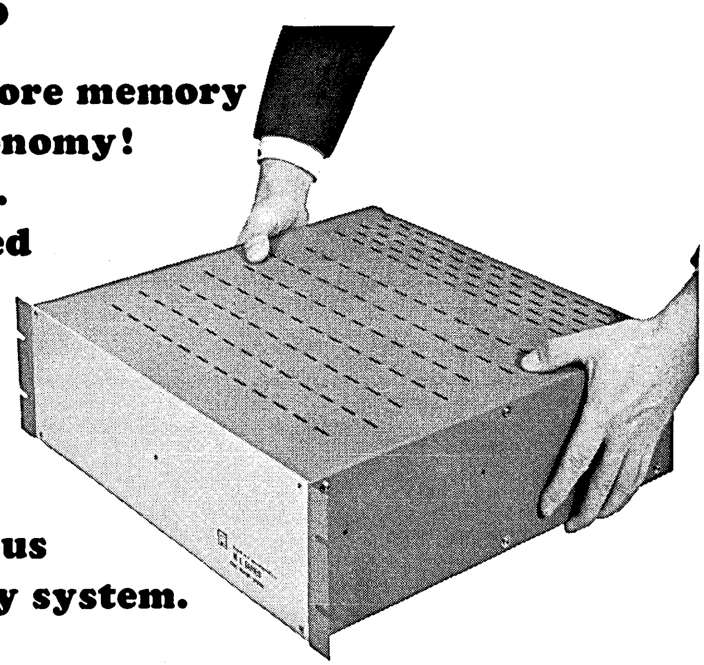
Introducing:

A standard integrated-circuit core memory system with "off-the-shelf" economy! Standard relay-rack packaging. Interfaces with either integrated or discrete circuits ■ Far less interconnections and components for increased reliability ■ Lower power dissipation, lower cost, and faster delivery than any previous coincident-current core memory system.



If you're looking for an optimized, standard memory system that can be ordered out of a catalog without lengthy specifications, tiresome telephone discussions, and several months of waiting—and have been looking for the economies of integrated-circuits to show up in core memory systems, then this is your answer!

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Memory-type—coincident-current, random access, ferrite core

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Capacities available—128, 512, 2048 words with from 2 to 26 bits per word in increments of 2 bits.

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Circuitry—Integrated circuits used in memory logic, decoding, timing and interface circuits.

Standard options available—address register, power supply, current-accepting input interface, high-power drive output interface.

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The Fabri-Tek Series MLA5 memory system has been engineered to provide maximum reliability and economy for a particular set of standard requirements. If you want faster, larger, or more versatile memories, just ask us. There is a Fabri-Tek core memory system to meet every memory problem.

For complete operational data and ordering information on the Fabri-Tek Series MLA5 Integrated-circuit core memory system: Call, wire, or write Fabri-Tek Incorporated, Amery, Wisconsin. Phone: COngress 8-7155 (Area 715). TWX: 510-376-1710.

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The Social Responsibilities of Computer People

One of the most world-changing developments of the 20th century is the Second Industrial Revolution: the electronic revolution in the handling of information, processing data, and computing.

The speed alone, of operating in reasonable ways on information, has increased a million times in 20 years.

What does this great change imply about what computer people ought to do? What about their social responsibilities as computer people?

Several computer people were discussing this with me a few weeks ago. We looked up the report to the Council of the Association for Computing Machinery, made by the Committee on the Social Responsibilities of Computer People, which was presented to the Council in December, 1958, almost seven years ago. Using that report as a starting point, we arrived at a current "position paper," and here it is.

Part 1. RESPONSIBILITIES

1. *Basic Responsibilities.* Each human being shares in a basic social responsibility — a duty towards society. This duty is in part enforced legally and in part assumed ethically.

2. *Special Responsibilities.* Each individual involved in computer activities has in addition to his other social responsibilities some special social responsibilities placed upon him by his computer activites — his knowledge, position, and experience in the computer field.

3. *Ignoring.* He cannot rightly ignore his responsibilities. He should consider what they are.

4. *Delegating.* He cannot rightly delegate his responsibilities to any other person or organization. He needs to assume them himself.

5. *Conflicts.* Where conflicts occur between different duties, each individual should face and resolve these conflicts for himself. He cannot rightly avoid deciding; he should think how to choose.

6. *Direction.* He cannot rightly neglect to think about how his special position as a computer person can be directed to benefit society and not harm it. He should consider how his special capacities can help advance socially desirable applications of computers and can help prevent socially undesirable applications.

7. *Action.* He cannot rightly do no work, spend no time, contribute no resources, devote no effort — towards promoting the use of computers for the greater advantage of society. He should translate his special social responsibility in the computer field into at least some kind of positive, continuing, significant action.

Part 2. AREAS

Among the areas where computer people can particularly help in the use of computers to the greater advantage of society, thus fulfilling their special social responsibilities, are the following:

1. Education — the use of computers to improve and benefit education
2. Employment — the stimulation of employment by the use of computers, and the mitigation of unemployment as a result of the computer
3. World Peace and World Law — the application of computers to increase the degree of world peacefulness, to promote the settlement of conflicts, and to develop international law and order
4. Underdeveloped Countries — the economic applications of computers in underdeveloped countries; the transmission of skills by means of computers
5. Public Understanding — increasing the degree of understanding by the public of what computers can do and will do; encouraging the better utilization of computers
6. Health — the use of computers in applications directed towards increasing health and mitigating disease

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You as a reader of this magazine are invited to discuss this position paper. Do you think it makes sense? Do you think it should be changed? How?

Edmund C. Berkeley
EDITOR

c & a MARKET REPORT

COMPUTERS NORTH OF THE BORDER

The Computer Society of Canada issued recently its second annual census of computers installed or on order in their country. The report provides some interesting statistics on the use of computers by our northern neighbor.

One striking feature of the new census is that in the fifteen months since the publication of the previous census the number of computers reported as being installed in Canada increased by over 50%, from 538 reported on March 31, 1964, to 820 reported on June 30, 1965. Whether this increase is due to a booming market for computers in Canada or to more thorough coverage of the total installation population by contributing members of the installation survey team of the Computer Society of Canada is not clear.

The quantity of computers on order (reported as 69 systems) is artificially low due to the fact that many organizations in Canada did not wish to report their plans for new computers for publication in the Computer Society of Canada report.

The report, called the Census of Computers in Canada, is a supplementary issue of the Quarterly Bulletin of the Computer Society of Canada, issued June 30, 1965. Among the information included in the report is:

(1) A table showing the number of computers by prime shift monthly rental, subdivided by industry (reproduced below);
(2) A listing of computers by user, subdivided by computer model and location;
(3) A listing of computers by province and city, subdivided by user and computer model;
(4) An alphabetical listing of the names and addresses of computer users in Canada; and
(5) A listing of the numbers of computers by their manufacturer, subdivided by province.

A copy of the Census of Computers in Canada can be obtained for $2.00 each from: The Book Department, University of Toronto Press, University of Toronto, Toronto 5, Ontario, Canada.

COMPUTERS INSTALLED (OR ON ORDER) IN CANADA AS OF JUNE 30, 1965

DISTRIBUTION BY INDUSTRY BY COMPUTER SIZE
(IN TERMS OF PRIME SHIFT RENT PER MONTH)

INSTALLED	UP TO $1999	$2000 to $4999	$5000 to $9999	$10,000 to $19,999	$20,000 to $49,999	over $50,000	TOTAL
MANUFACTURING	72	78	34	50	7		241
DISTRIBUTION	9	18	9	8			44
FINANCE (BANKS, TRUST COS. INSURANCE)	15	24	20	30	11		100
TRANSPORT & COMMUNICATION	7	27	12	14	2	1	63
UTILITIES	1	18	5	7	3		34
PETROLEUM	7	17	5	20	3		52
SERVICE BUREAU	8	36	4	13	5		66
INSTITUTIONS (UNIVERSITIES, SCHOOLS, HOSPITALS)	34	32	7	6	7	1	87
GOVERNMENTS	22	21	15	9	7	1	75
OTHERS	13	29	5	11			58
TOTAL INSTALLED	188	300	116	168	45	3	820
TOTAL ON ORDER	5	21	25	16	2		69
GRAND TOTAL	193	321	141	184	47	3	889

1966 SPRING JOINT COMPUTER CONFERENCE — CALL FOR PAPERS

The 1966 Spring Joint Computer Conference of the American Federation of Information Processing Societies will be held at the new Boston War Memorial Auditorium, Boston, Mass., April 26 to 28, 1966. You are invited to help create an interesting and informative technical program. Papers from all corners of the information processing field will be welcome. Sessions covering computer systems, hardware, software, and applications are planned. Papers describing original research, development, engineering design, software design, system selection and installation problems, state-of-the-art surveys, etc., are all appropriate. Every attempt will be made to achieve a balanced program.

Your contribution is cordially invited. If you plan to send a paper please fill out the attached card and return it immediately. Returning the card does not imply a commitment; however, it will be helpful in general planning. The deadline for papers is November 1, 1965. Send five complete copies together with a 150-word abstract to J. L. Mitchell, Chairman, Program Committee, 1966 SJCC, Post Office Box 460, Lexington, Massachusetts, 02173.

EDUCATION, AS RUTHLESS AS EVOLUTION

Mrs. Helen Solem
Hillsboro, Oregon 97123

In regard to Professor Galbraith's article on unemployment in your August issue: Professor Folkert Wilken in West Germany sees that more and better education is required, but he also sees that many people cannot or will not measure up to the new demands; and so he asks how can the wealth produced by machines be equitably distributed?

Since in all mankind's history there never has been an equitable distribution of any sort of wealth be it money, brains or health, it seems highly unlikely that things will change now.

The day is not far off when a great many people will have much more leisure time due either to direct unemployment or just shorter work weeks. It was reported recently in "The Wall Street Journal" that big steel doesn't care that unions are demanding the biggest share of profits ever: on the drawing boards are plans to automate as never before.

Education is undoubtedly the ultimate solution to the social problems automating creates. However, it seems to me that it will be as ruthless as evolution.

CANADIAN ENGINEERING MANPOWER STUDY

Andrew C. Gross, P.E.
Centre for Community Studies
Univ. of Saskatchewan
Saskatoon, Sask.

Currently I am working on a research project which will deal with engineering manpower in Canada. This study will focus especially on graduate Canadian electrical engineers, whether they reside in Canada, the U.S.A. or elsewhere. This project is to become a doctoral dissertation.

I would be most grateful if you could insert the following in your next issue:

A Study of Engineering Manpower in Canada

Mr. Andrew C. Gross, P.E., of the University of Saskatchewan and The Ohio State University is conducting a study of engineering manpower in Canada. His work will form the basis of a doctoral thesis. The research will focus on certain patterns of education, employment, and utilization among young electrical engineers. Personal interviews in three large establishments have been completed. Mail questionnaires will be sent to electrical engineers who graduated with a B.Sc.-E.E. or a B.Eng.-E.E. from Canadian universities in 1954, 1959 and 1964, regardless whether engineers reside in Canada, the U.S.A. or elsewhere.

The reason for my request is that a number of electrical engineers read your journal and their finding of such a paragraph would help greatly in increasing the response rate.

PORTION OF STATEMENT BEFORE SUBCOMMITTEE NO. 3 OF THE HOUSE JUDICIARY COMMITTEE JUNE 17, 1965

John F. Banszhaf, III
Computer Program Library
New York, N. Y. 10017

(Continued from September issue, page 27)

I have heard several proposals for dealing with this problem. Reed Lawlor, an attorney very active in this field, has argued that an otherwise legitimate use of a copyrighted work should not be stigmatized simply because a computer was used to accomplish the same result. He has briefly stated his view as follows:

> When the Copyright Law is revised, the copyright owner should continue to have the right to prevent the use of his copyrighted work in the printed output of the computer beyond the bounds of fair use, but he should not have the right to prevent the feeding of the work into a computer, since normally the output will be of a kind which would be fair use if no computer were used. (See letter to Hon. Edwin E. Willis, May 18, 1965.)

The Electronic Industries Association, in a letter May 8, 1965 has taken a very similar position.

I think their position is a sound one and I urge this subcommittee to give it careful consideration. If it is not a violation of the law to assign an assistant researcher to look through a series of articles to see if they are pertinent to a particular topic, why should it be a violation for a computer to do it? Are we to punish efficiency and compel scholars to waste valuable time wandering around the library looking for relevant material? It is already becoming plain that scholars cannot hope to keep up in their fields and that the traditional tools of library research are already becoming inadequate for the rapid recovery of all relevant information. If a junior librarian could lawfully write a one-sentence summary of a copyrighted work to guide researchers, why can't a computer do it also if it is able?

Authors and publishers have argued that such unbridled use of copyrighted works would put them out of business. I respectfully suggest that the copyright owner has adequate protection in his ability to control the printed output of the retrieval system. If it is illegal to reproduce a substantial portion of an author's article, it should be equally unlawful if done by hand, by photocopy machine, or as the output of a retrieval system. By controlling the output, it seems that the copyright owner can prevent all but a fair use of his work. By giving him control over the input as well, he can completely strangle a new and rapidly developing field which holds the only real hope of allowing scholars to continue to be aware of and draw upon the work of others. Notice also that the constitutional purpose of the copyright grant is to "promote the Progress of Science and useful Arts." I think it is clear that computer retrieval systems tend to promote the interchange and use of information which is the very lifeblood of science and the useful arts.

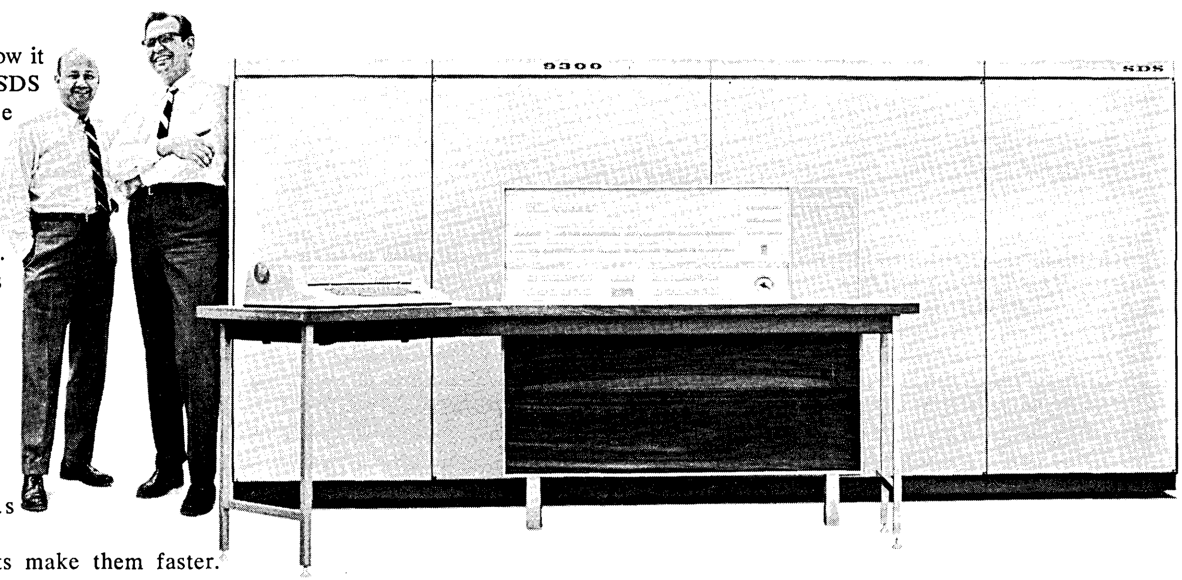
If the proposal I have just mentioned is not satisfactory, perhaps I can offer a compromise position. Under the bill, a magnetic tape reproduction of a copyrighted work is an illegal copy. This protection is necessary for copyrighted computer programs. Perhaps it should apply equally for all works. Perhaps it should make no difference, from the standpoint of protection, whether the tape contains a computer program, a learned article, or a James Bond story. If the computer owner makes a copy on magnetic tape of a copyrighted work, he has made a copy for his own use just as if he had microfilmed it. He possesses a permanent copy from which other copies can easily be made. Let that act constitute an infringement.

But contrast this with the case in which the computer only scans the written work lawfully obtained. During that scanning, "copies" of the work are created momentarily in the computer's memory. Consider also the case in which the computer examines material on a magnetic tape where the magnetic tape was obtained lawfully from the copyright holder. Once again there are momentary images of the work created within the computer's memory. These consist of brief electrical or magnetic changes within the machine which usually are rapidly erased to make room for new information. Nevertheless, they seem to fall within the new definition of "copies." By what reasoning can this be considered a violation? Yet, under the new bill they appear to be. Moreover, there would be a separate violation every time the work or tape was scanned. The sale of magnetic tape does not necessarily imply the right to create new copies within the memory of the computer.

I therefore respectfully suggest that the definition of "copies" be changed so as to exclude all works of a strictly transitory nature. If the issue is left to a later court decision, I suggest that needless doubt will be created and that the natural result will be that computer users will be hesitant to expend the very large sums of money necessary to establish a workable retrieval system.

With respect to works created by a computer, I think copyright owners need have no fear. The same standards will probably be applied as are applied to works created by human beings. If the derivative work would be a fair use if done by a man, it should be fair use when created by a computer. By the way, the bill seems to make no express provision for the day when the first computer-created work, be it a translation or an original musical composition, is offered for copyright registration. I hope that the word "author," as used in Section 201, will be deemed to include computers as well as people.

To make computers as good as these you've got to be simple-minded.



People ask us how it is possible for SDS computers to be faster, more reliable, and cheaper than other companies' machines.

The answer is simple.

SDS computers are simpler than other people's. They do the job with fewer circuits. Not nearly as many parts.

Fewer circuits make them faster. Fewer parts make them more reliable. Both make them cheaper.

It's hard to design simple computers. Much harder than designing complicated ones.

It's so hard that nobody will try to do it without a strong incentive.

Our incentive is greed. We believe that if we can make better machines than anybody else, and sell them for a lot less money, we can get rich in the computer business.

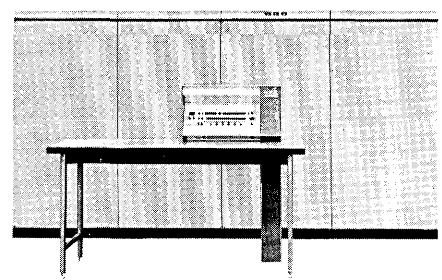
So far we're doing very well.

We've found a lot of people who are willing to pay less money for computers that do more work.

We make these six real-time computers and a lot of stuff to go with them:

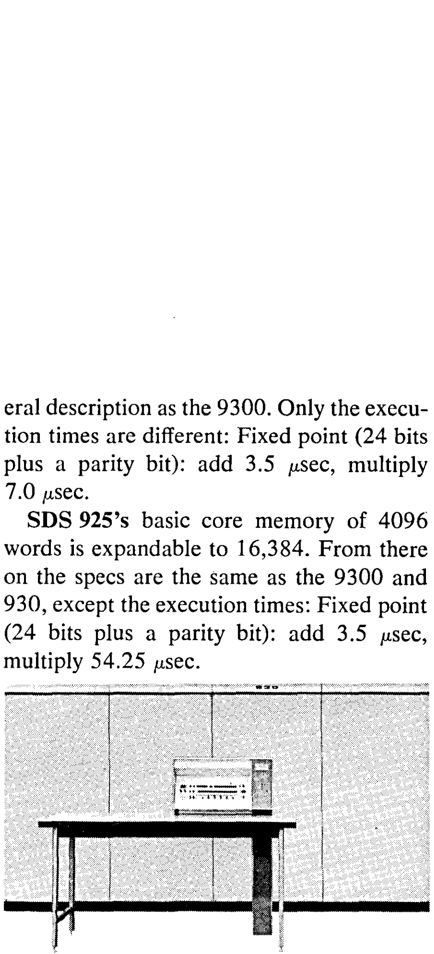
SDS 9300 is our biggest. It has a basic core memory of 4096 words, expandable to 32,768 words, all directly addressable. One standard and any number of optional buffered input/output channels with rates to 572,000 words per second. Input/output simultaneous with computation up to 1024 levels of priority interrupt. Memory cycle time 1.75 μsec. Execution times, including all addressing and indexing: Fixed point (24 bits plus a parity bit): add 1.75 μsec, double precision add 3.5 μsec, multiply 7.0 μsec, shift (24 positions) 5.25 μsec. Floating point (39-bit frac., 9-bit exp.): add 14.0 μsec, multiply 12.25 μsec.

SDS 930 is next. Same memory and gen-

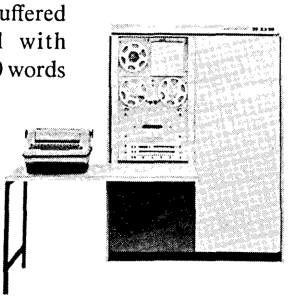


eral description as the 9300. Only the execution times are different: Fixed point (24 bits plus a parity bit): add 3.5 μsec, multiply 7.0 μsec.

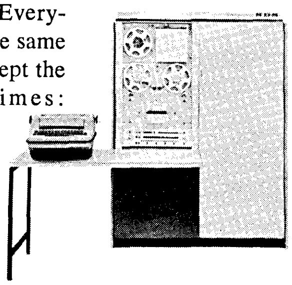
SDS 925's basic core memory of 4096 words is expandable to 16,384. From there on the specs are the same as the 9300 and 930, except the execution times: Fixed point (24 bits plus a parity bit): add 3.5 μsec, multiply 54.25 μsec.



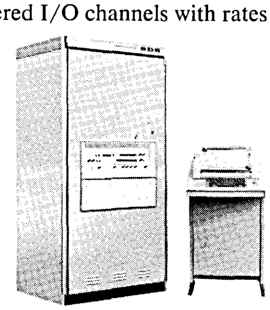
SDS 920 has the same memory capacity and priority interrupt as the 925. One standard and one buffered I/O channel with rates to 62,500 words per second. Memory cycle time 8.0 μsec. Execution times: Fixed point (24 bits plus a parity bit): add 16.0 μsec, multiply 32.0 μsec.



SDS 910 has a basic core memory of 2048 words, expandable to 16,384, all directly addressable. Everything else is the same as the 920 except the execution times: Fixed point (24 bits plus a parity bit): add 16.0 μsec, multiply 248.0 μsec.



SDS 92 is our integrated circuit baby. It has a basic core memory of 2048 words, expandable to 32,768, all directly addressable. Memory "scratch pad" reduces both program size and execution time. Hardware index register; indexing requires no additional time. One standard and any number of optional buffered I/O channels with rates to 572,000 words per second. Up to 256 levels of priority interrupt. Memory cycle time 1.75 μsec. Execution times, including all accesses and indexing: Fixed point (12 bits plus a parity bit): add 3.5 μsec, multiply 8.75 μsec, divide 22.75 μsec.



And here's some of the stuff that goes with them:

Fortran IV for all SDS computers (it's ASA Fortran IV, and then some).

SDS Rapid Access Disc Files (we call them RAD Files) which store from 528,000 to 8,000,000 characters, with access times as low as 500 μsec and transfer rates as high as 480,000 characters per second. RAD Files give the speed and capacity of drums at the price of discs.

SDS new high-reliability magnetic tape drive. Single capstan and full-vacuum columns eliminate tape wear and skew, maintain uniform tension. IBM-identical tape format and guide path assures compatibility.

SDS Business Programming Package permits SDS computers to perform decimal and character operations with the same ease as standard arithmetic.

Scientists and engineers have snapped these machines up. We have more computers working on line in real-time systems than any other company.

Some of them use their leisure to run payrolls. It's a nice change of pace after the hard work of real time.

How much do SDS computers cost?

If you ask us we'll tell you.

Scientific Data Systems

1649 Seventeenth Street, Santa Monica, California
Offices in principal cities throughout the world.

SDS

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THE ECONOMICS OF ON-LINE SYSTEMS: SOME ASPECTS

Walter F. Bauer

Informatics Inc.
Sherman Oaks, Calif. 91401

An amazing fact about on-line or time-sharing systems is that very little writing — and apparently thinking — has been carried out on the subject of system economics and cost vs. effectiveness. Some possible reasons for this are: these systems are new; they are regarded as research and development tools; they lack definition and structure. Some critics have suggested — perhaps facetiously — that some users desire to protect their projects by not exploring the facts.

Many of the writings — both formal and informal — on the subject have come from System Development Corporation, and are not specifically oriented toward cost vs. effectiveness but touch upon these matters in the discussion of design of the systems.

The objective of this article is to provide an introduction, to define the problem, and to discuss a number of aspects and considerations which are involved in the solution.

Why Make Cost-Effectiveness Analyses?

Some people might argue that cost-effectiveness analyses are irrelevant and unnecessary because the *convenience* of the user is the important factor. They could point out that our culture is oriented toward convenience, and that, for example, the automobile automatic transmission would never have come into use if there had been a prior requirement for a cost-effectiveness analysis.

The economic development of "convenience" items in our culture would probably disclose the following: The item was first a luxury item — no more than a convenience factor for which some people were willing to pay a substantial price. Later, the economics of manufacture and of application became such that the cost of the convenience item began to approach the cost of the "conventional" approach.

This kind of development will undoubtedly be the situation in on-line computing. Eventually, it will not be significantly more expensive to obtain a computer which has the special hardware features for efficient on-line use than to obtain one without these features. Also, eventually, we will learn to produce on-line system software almost as inexpensively as batch-processing software. Indeed, as discussed below, there may be little difference in the costs and complexity of the batch-processing system and the on-line system.

One cannot "prove" once and for all the economic advantages of on-line systems. In general, the parameters and factors involved in the application environment are so many and varied that one cannot arrive at a quantitative overall proof. However, for a given environment and a given set of application parameters, one can provide a set of powerful arguments which build a strong case for on-line systems. The principles involved can be examined carefully. The parameters and factors can be isolated and their implications understood. Furthermore, examples can be provided for certain cases which prove (or disprove) the efficacy of the system.

Some Systems Must Be On-Line

In many cases, the objectives of the user and the requirements for the system are such that an on-line system is mandatory: there is no other way of meeting the requirements. Examples of such systems are travel reservation systems, command and control systems, and stock quotation systems. These systems require that the user have ready access to the data in the machine; the answers would be of little use if he had to wait the minutes or hours required for batch processing. Therefore, in these cases, the question is not whether batch processing or on-line processing is better. Rather the question immediately becomes, what is the best design of the on-line system?

However, many systems allow a choice. Many early systems were designed to solve sophisticated problems of mathematics and physics. If a system were designed, for example, to be of specific help in the solution of non-linear integro-differential equations, the question immediately arises as to what percentage of the time the computer is to be used for the solution of such equations. Another question which arises is the importance of the timeliness of such solutions in view of the fact that batch systems can — given enough time — provide the answers.

User Efficiency vs. Cost Increase

The conclusion is inescapable, however, that costs for on-line systems will be greater than costs for batch-processing systems. It is true that programming costs for complex batch-processing systems will be nearly as high as those for on-line systems. It is likewise true that in the very near future

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the computer hardware required for on-line systems will become closer to that required for the batch systems.

However, the hardware costs for on-line systems will still exceed those for batch processing. Certainly the most clearcut increase in costs of on-line over batch lies in the user consoles and in the communication networks for remote control use often connected with on-line computer use. These increased costs, whether they be substantial or marginal, must be balanced against the increase in user efficiency. Unfortunately, the increase in user efficiency is hard to reduce to quantitative terms to make an appropriate analysis of cost-effectiveness.

Increased Programming Costs

An important factor which leads to increased programming cost is increased system complexity. Increased complexity of the system comes from these factors:

1. The programmer must make allowances for the multitude of "simultaneous" occurrences. Part of this is a design problem and part of this is a programming execution problem. It involves building the proper networks to react to the various random occurrences in the computer system which result from human inputs which, in turn, provide a multitude of interrupts to the system operation.
2. The computer works in one of two basic modes. In the "privileged instruction" mode the computer is performing computations on behalf of the system; in the "non-privileged instruction" mode, the computer is executing instructions on behalf of the individual user. The problem here again is to make sure that the complex programming system is properly responsive to the user's needs and that the various user operations are properly anticipated.
3. There is a basic problem of working storage overlay in such a system since there is a very large amount of programming data swapping between working storage and auxiliary storage. The system must be properly developed to enable this swapping with a maximum of user efficiency or program execution productivity while, at the same time, it gives all users a sufficient number of time slices within a given period of time to allow the system to be responsive.
4. The problem of management of memory becomes far more complex, since there will be many levels of data storage depending upon the frequency of usage. Also communication is needed among the various storage levels, and a logic of describing the data is needed which is consistent from the point of view of the many users and consistent from the point of view of the many storage levels.

The proponents of on-line systems, however, point out that many of these problems exist in sophisticated batch-processing systems as well.

Increased Computer Hardware Costs

Some of the factors in increased computer hardware costs are:

1. Working storage features such as memory protection, relocatability, and privileged instructions.
2. Multi-access capability to working storage. This involves increased circuitry to allow a great deal of freedom in overlapping the process of memory swapping with internal computation.
3. Increased storage capacity of medium-speed random-access equipment such as large-scale cores, magnetic drums, and disc files. In on-line systems a large amount of data must be readily accessible to the system. There can be no waiting for the location and transfer of programming pieces such as might be required in the case of sequential memory devices such as magnetic tapes.

Here again, the advocates of on-line systems point out that many of these increased computer hardware costs were being paid in the case of batch-processing systems. They also maintain that these computer hardware features were becoming more and more prevalent and in ever increasing use.

Increased Peripheral Equipment Costs

The main cost item here is the user station. This may vary from a teletypewriter station costing in the neighborhood of \$1000 to an elaborate console costing in the neighborhood of \$100,000. Whatever the cost, the increased costs here are clearly in excess of those required for batch-processing systems. Furthermore, it has become increasingly clear that typewriter user stations do not and will not provide the flexibility and speed required. The minimum-capability user station is a full keyboard plus a cathode-ray tube with the ability to "print out" approximately one page worth of information. This raises the question of whether hard-copy print-out stations will be necessary and whether they will cost more than the cathode-ray-tube user station. Any costs of buffering and communicating with the user station are again extra costs.

Increased User Efficiency

Balanced against the increased costs described above is the increase in efficiency which accrues to systems users. This increase in efficiency is seen in the reduction in turn-around time for the users. This applies whether the user is a programmer, who is checking out a computer program, or a data consumer, who is using the information stored and generated by the computer.

Increased efficiency in programming is easy to prove. In most installations, the programming costs are well known. A certain number of programmers do programming full time, and a certain number of programmers work part time; each one has salary plus employee overhead costs. It is easy to argue that "an increase in programming efficiency of n % saves s dollars".

The case for reduction in turn-around time or increase in convenience for the data consumer is different, and harder to defend. The case is like the difference between the executive who can see his staff only periodically as compared with the executive who can see his staff at any time he wishes.

Cost Accounting Procedures

As usual, there are two types of cost: "Overhead" and "Direct Charge". The former are not attributable to a given user, but benefit all users. The latter are directly attributable to the user. Although most of the identifiable costs, clearly fit into one category or the other, yet many fit in either category, depending on accounting philosophy. As with all accounting systems, the question is whether keeping track of small costs and attributing them to specific users is worth the extra cost of the required monitoring and accounting. On one hand, it would be desirable to give the customer a complete accounting of just what system capability he used and thereby reduce the overhead costs down to an absolute minimum. However, clearly, cost accounting can be excessive if carried to very low level of data processing function.

Overhead and Direct Charges

Certain costs are readily identifiable as overhead. One of these clearly is programming cost to implement the system initially or to maintain it. These costs are amortized over a given period of time and "written off" at periodic accounting periods. Swapping time is overhead since the individual user has little or no control over total system efficiency and the amount of swapping to be accomplished. The main-frame time required to switch from one computer user to the other and to react to the various console occurrences is again clearly overhead. At the other end of the spectrum, the main-frame time used in carrying out the user's data processing is clearly a direct charge. Debatable costs are: auxiliary memory costs, both with respect to data transfer and data retention, printer usage, and magnetic tape usage for final results. The computer's physical environment, the operator cost, and the cost of any consoles used for the system alone, are clearly overhead.

Customer Charges

Clearly, as stated above, main-frame computer use is directly chargeable to the customer. Similarly, he may be charged for the number of cells used and the amount of time used in the case of auxiliary memory. Some specialized on-line systems allow a charge per transaction. A common way of charging a customer in an on-line system is to charge him according to the amount of time his user consoles are in use. Interestingly, the resulting charge may bear little relation to the main-frame time used. This method of charging, in fairness, requires that the customer be supplied a good indication of how much main-frame time he can obtain if he is extremely efficient, or how much main-frame time he is likely to obtain per hour of console time.

The Future of Cost-Effectiveness Analyses

Considerably more work should be done in cost-effectiveness analyses. Many designers and investigators of on-line systems have leapt to the defensive when asked about cost-effectiveness of their systems. Many have replied, "The question is out of order."

Everybody recognizes that we are in the early stages of such systems. Quantitative, precise conclusions with supporting facts are not now available and possibly are not likely to be for the near future. However, cost-effectiveness analyses give many advantages:

1. Better systems will be developed, better balanced between design features and user capabilities;
2. Investor confidence will increase; and
3. The confidence of the system developer and the customer will also increase.

THE EVOLUTION OF REAL-TIME EXECUTIVE ROUTINES

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A growing portion of computer systems installed today involve a communications element or other real-time interface. In keeping with this trend, increasingly effective executive or supervisory monitor routines to control the systems have evolved.

How well the system operates in the real-time environment, and how efficiently the man-machine interface — when present — is accomplished, depends on the philosophy underlying these routines.

As computers capable of operating in a real-time environment are applied in ever-increasing numbers to a rapidly expanding list of applications, it has become evident that many of these applications do not involve the man-machine interface problem to as great a degree as message-switching or time-sharing systems do.

It is the function of this article to illuminate the evolution of one practical philosophy for an executive control system or routine that has functioned successfully in a variety of systems involving the man-machine interface problem.

This evolution has occurred in three general phases: (1) Pure Teletype message switching systems; (2) Message-switching systems coupled to batch-processing computers; and, as a further refinement of the second, (3) Time-sharing systems.

The Pure Message Switching Environment

To design an executive routine for a message switching system, one must first consider types of terminal devices and their operating speeds and characteristics. The transmission lines may be half duplex, capable of sending and receiving in only one direction at a time, or full duplex, capable of sending and receiving simultaneously. The transmission rate may be 5-channel, 75 bits per second, as in some Model 28 Teletype equipment, or 8-channel, 110 bits per second, as in Model 35 Teletype equipment, or a combination of the two.

Consideration must also be given to the arrangement of terminals on the lines. Is there one terminal device per line or several? Must the terminals be polled before they can transmit to the computer? Are answerbacks required to verify the operational status of the equipment before a transmission is initiated? Are the terminal devices all capable of sending and receiving? Are the terminals transmitting to the computer directly from the keyboard at operator typing speed or from perforated tape at a constant rate? These and other aspects of the configuration must be considered if an executive is to provide effective control of the system and efficient service to the people using and operating it.

Real-Time Clocks

In order to maintain control of any real-time system, it is necessary to make available to the executive routine a real-time clock capable of dividing the passing time into relatively small increments, normally microseconds to a few milliseconds. The executive routine will then use this time indication to maintain synchronization between the incoming and outgoing data and the programs responsible for these functions. In the General Electric Datanet*-30 Data Communications Processor — the real-time computer referred to in this and the following configurations — this timing information is obtained through the use of an addressable register which can be loaded, by the executive routine, with any value from a few microseconds to several hundred milliseconds.

The value chosen for this clock register is a function of the communications facilities used in the system. If the entire system uses one kind of equipment, such as Model 28 Teletype terminals operating at 75 bits per second, then the value chosen would be one that would provide the executive routine, via an interrupt, with a signal every bit time. In this example, a bit time would be 13.3 milliseconds. Since it is possible, however, for the communications facilities to run slightly faster than 75 bits per second, a value is chosen which provides allowance for this. An often-used value in this configuration is 12.0 milliseconds, which will allow a 10-per cent increase in the operating speed of the communications facilities.

Sending and Receiving Characters

When the clock register has counted down, it initiates a hardware interrupt. The instruction being executed at this instant will be completed and control is transferred to the first instruction of the executive routine. After reloading the clock register and capturing other register information necessary to restore the interrupted program, the executive will issue a "hardware scan" command. This command requires 3 word times (21 microseconds) for each Teletype line terminated in the computer. During this time it presents the next outgoing bit or accepts the next incoming bit, depending on the direction of the line.

It will be noted that when a line is operating at exactly 75 bits per second, a 12.0-millisecond interrupt cycle will periodically result in two interrupts within the same bit time. This presents no problem, as logic in the hardware scan command prevents the same bit from being sent or received twice within a bit time.

Upon completion of the hardware scan command, the next task of the executive is to determine if any lines have just received the last bit of an incoming character or just transmitted the last bit of an outgoing character. For this purpose, two bits in the words used by the hardware scan command are designated "character flags" and are turned on by the hardware scan command on completion of a character. One bit is the *receive* character flag and the other is the *transmit* character flag.

The executive initiates a subroutine which will examine these character flags and, when it detects one of them *on,* will take the appropriate action. An important point here is that not every line is checked for character flags every bit time. At 75 bits per second, it required 7.5 bit times for a complete character. Therefore, to avoid wasting time by checking every line for a character flag every bit time, the executive will select only a portion of the lines each bit time and, by rotating its selection, assure that all lines are character-serviced at least once per character time.

For example, assume a configuration of 21 lines operating at 75 bits per second. On the first cycle, the executive would select lines 1, 2 and 3 for character-servicing. The second cycle would service lines 4, 5 and 6, and so on. At the completion of the seventh bit time, all lines would have been character-serviced once, and the cycle repeats.

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It should be pointed out that the sending and receiving of bits to make up characters is a hardware function under control of the master executive. Program action on any given line is not required until the executive decides that it is time to character-service the line.

Again, it will be noted that, like the hardware scan situation mentioned earlier, a line will periodically be character-serviced twice within a character time. By virtue of the logic which prevents a bit from being sent or received twice, it is not possible for a character flag to be set twice for the same character.

Processing of Incoming Traffic

As the incoming characters are accumulated and placed in buffer areas, the executive's next task is to initiate periodically a routine that will examine these buffers to determine whether any of them are full enough to require that they be captured and written to the auxiliary storage unit, a disc or drum-storage unit.

Two approaches have evolved for this function. The first, or earliest, involved the periodic initiation by the executive of a storing routine. This routine examines all the incoming buffer areas. When one is found which contains traffic, the last random access record used for this line on the previous cycle is called in and as much of the new or continuing traffic packed into it as possible before it is written back to the storage device.

As records in the storage device are filled, additional records are linked or chained to them, thus providing a continuous character stream representing the incoming data. Once the buffer is emptied and the data stored in the storage device, the entire buffer area is again available for the accumulation of additional incoming traffic.

This time cycle chosen by the executive for this operation is such that an incoming line operating at full speed cannot exceed the capacity of the buffer area before the next cycle.

With the evolution of advanced queueing and core allocation techniques it was no longer necessary to perform a read-update-write operation on the mass-storage device to capture incoming data. It could now be accomplished with a single write and only at such time as there was present sufficient data or other cause, such as an end-of-message indication or emergency condition, to justify this scheduling of a mass storage unit operation by the executive.

In either of the above techniques, the executive's main objective is to capture the incoming data and remove it from the real-time environment. Once this is accomplished, the data can be further processed for delivery to its ultimate destination in what essentially amounts to a non-real-time mode. This allows the executive to schedule among the remaining processing routines all the real-time not required for the actual communication function.

These non-real-time functions will examine the data, determine its ultimate destination or destinations, verify it for correct format, establish its priority if necessary and place it in the proper outbound storage queues. The executive, either on a cyclic or an as-required basis, will initiate a routine that examines the status of the outbound lines and queues and retrieves, as required, data blocks from the mass storage unit and places them in out-going buffer areas for transmission to their destinations.

Additional Functions

In addition to scheduling and controlling the normal communications processing routines, the executive will, in many systems, be responsible for the initiation of functions that are required much less frequently during an operating shift or day.

An example of this is the automatic generation of hourly reports that reflect the current status of the system. These reports might include the number of messages sent and received by line, messages backed up in queues by line, or timing reports indicating the allocation of time — by percentage or actual time used — among the various operating routines. These figures can be used to determine the load on the system, indicate abnormal traffic conditions, and reflect the general system status.

Most message switching systems include provision for entry of control information from a human system supervisor. This information may be a request for a report or other information not included in the normal periodic reports, instructions for changing a line or terminal configuration, or other exception-type action desired by the supervisor for system operation. It becomes necessary then, to include in the executive routine the ability to recognize a request for an exception routine, schedule it, initiate it and assure that it is successfully completed.

Program Scheduling

Program scheduling is accomplished through the combined use of a table listing all non-real-time programs in order of frequency of usage and the real-time clock maintained by the executive itself. The table entry for each program corresponds to the next "time" that the program is to be executed.

From the time the system is started for the day's operation, the executive maintains a real-time clock accurate to fractions of seconds. When a program has finished its task for this cycle and desires to be called in again in, say, 10 seconds, it calculates a delta-time of 10 seconds, adds it to the time that it was called in on this cycle and places this new "time-to-go" value in the table.

The executive routine examines this table on every interrupt cycle to determine if it is time to call another program in. Any entry in the table with a time value equal to or less than the current time of day is an indication that the program "wants in." When this occurs, the executive must determine if the program is of high enough priority to interrupt the program currently running, or if it must wait until one or more higher-priority programs have finished. The rule is that any program can interrupt only those programs of lower priority. In the event that several program interrupts are initiated in a very short time it is the executive's responsibility to maintain the linkages necessary to "back out" and re-initiate the interrupted programs in the proper order.

The table entries for the exception routines that are called in and executed on an as-needed basis are set to very high time-of-day values so that they will never be called in under normal conditions. The program requiring or recognizing the need for an exception routine need only set its "time-to-go" entry in the table to any value less than the current time of day and the executive will initiate it when all higher priority programs have been satisfied. Upon completion of this exception program its "time-to-go" is restored to its previous high value.

The Addition of a Batch-Processing Computer

The addition of a data processing computer to the message switching configuration presents several additional functions requiring executive control. The amount and complexity of the information exchanged between the two computers may vary from the relatively simple task of placing information gathered by the message-switching computer in some specific area of a shared, dual-access file, for off-hours processing by the batch-processing computer, to situations requiring not only a shared file but a core-to-core transmission facility capable of extremely rapid transfer rates.

In most configurations where a two-way exchange of information is required, the message-switching computer is designated as the *master* and the batch-processing machine the *slave*. The real-time capabilities of the message-switching computer enable it to do a job of controlling the entire system which is far superior to the job the batch-processing computer could do.

Dual-Access Data

Usually, if the transfer of large blocks of data between machines is required, it is done by placing the data in the dual-access file, and with the exchange of a few control words via the core-to-core transmission facility, the receiving machine is told where the data is and how much is there. Normally, the batch processing machine is not allowed to initiate such a transfer unless the master executive has indicated that the file area is available and the receiving area in core is open for control words.

Exchange of data, both block data and control information, between computers can be accomplished in one of two ways, depending on the requirements of the system. It can be accumulated on either or both sides of the interface until there is sufficient quantity to warrant initiation, by the master executive, of a transfer. If real-time on the shared file is critical, the exchange can be delayed by the master executive until the peak period is past and the exchange can take place without interfering with the message switching file requirements.

An alternate method is to schedule, via the executive, a periodic check on the control words to determine if an exchange is desired by either machine. The interval between checks can be varied from milliseconds to several seconds or even minutes, if system requirements will allow. When an exchange, or transmission request, is detected, the proper routine is entered immediately and all information going in either direction is sent. An advantage to this approach is that the file and/or the core-to-core facility will never be tied up for extended periods.

In addition to the normal transfer of data between machines, it is desirable to provide the master executive with some means of determining the operational status of the batch-processing machine. If the data transfers are batched and a long period of inactivity occurs, the master executive has no means of establishing whether the batch-processing machine is running or even turned on. A periodic exchange of brief "hello" type messages will serve as an indication to both machines that the other is up and running. An added advantage of this exchange is that in the event of a malfunction in the batch-processing machine, the master executive will be aware of it in time to prepare for an orderly shutdown of some or possibly all of its communications activities.

The Time-Sharing Environment

The master executive resident in the communications computer in a time-sharing environment (such as the Dartmouth College installation and others) has all of the previously mentioned functions in one form or another plus the responsibility for control of all of the functions of the batch-processing computer — telling it what to do, when to do it, and for how long.

Two broad classes of time-sharing configurations are possible: (1) Dedicated time-sharing systems, where the data processing computer is concerned only with the execution of the user programs submitted from the remote terminals; and (2) systems capable of performing not only the time-sharing or "foreground" function but a certain amount of batch processing or "background" operation as well.

In the latter of these configurations, the master executive will maintain a matrix indicating the current status of all foreground and background operations. Use of this matrix permits efficient allocation of time in the foreground function among the current user programs which may be, individually, in any one of a number of states. In the event that the background and foreground functions both require access to the file, these requests will be scheduled and executed via the master executive.

The "conversational" nature of the man-machine interface in a time-sharing system calls for an increased emphasis on efficient control. Users entering various data required for their own problem solution cannot be expected to tolerate long periods of silence from the system. The master executive should include provision for indicating to the user that a delay may be encountered if the system is heavily loaded. A simple "wait" typed at the user's terminal should suffice for relatively short delays. For longer delays, users should be notified of the situation and asked if they would care to resubmit their problem at a later date.

As the complexity of time-sharing systems grows with the addition of new languages and capabilities, executive routines will be improved to provide the additional control necessary for these systems. The addition of new terminal devices for time-sharing users such as cathode-ray tube displays coupled with typewriter keyboards or light pens will require more sophisticated executive routines if an effective man-machine interface is to be maintained. As computers grow more powerful, faster, and capable of handling time-sharing users by the hundreds or even thousands, timing will become increasingly important to executive routines. It is only through proper control of the available real-time by a well-written executive routine that the greatest use may be made of the computational capabilities of a time-sharing or any other real-time system.

Two Separate Computers

A significant point in the preceding discussion is that in all configurations beyond the pure message-switching system two separate computers were used: a communications processor with extensive real-time capabilities and a batch-processing machine of some type. This separation of function provides several distinct advantages.

In most configurations considered, the failure of one machine does not necessarily require that the other come to a screeching halt also. Time is available for an orderly, systematic shutdown. This, in the case of a batch-processing computer failure in a time-sharing system, can be invaluable in terms of the prevention of lost time, lost tempers, and lost programs because "the system just quit working and hasn't said 'boo' for eleven minutes now."

While the multi-machine configuration may not always be the cheapest, additional benefit is gained in that the throughput capability of the batch-processing computer is not reduced by including among its tasks the executive routine and communication functions. Also, the real-time capabilities of the communications processor enable it to perform the executive routine and communication functions more effectively.

REAL-TIME PROGRAMMING IN THE SIXTIES: A STUDY IN BUSINESS ALIENATION

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Narrowing the Programming Gap

Almost three years ago I sought to identify publicly a problem that had long been evident to many of us concerned with development of real-time systems for business applications. There was, I suggested, a "programming gap" between the software packages then available from the equipment manufacturers and oriented towards sequential batch processing, and those which were needed to support real-time systems.[1]

It is gratifying to observe that in the three major programming areas then identified — programming languages, control programs, and testing programs — the manufacturers have, in large measure, successfully closed this programming gap. Where three years ago there was little recognition of the special software requirements for efficient utilization of direct-access storage in real-time business systems, today these needs are reflected in new versions of compilers, in the recently-announced operating systems, and in such systems as the Integrated Data Store.[2] Similarly, the importance of the communications interface and the opportunities and dangers inherent in multiprogramming have been recognized by the architects of the new software. If, perhaps, a particular need still remains for further progress in the enormously costly program testing area, by and large the year 1965 could serve as a technological benchmark attesting to the closing of the software gap in supporting real-time systems.

Sophistication

There is a degree of sophistication in these new programs that is in part attributable to the heightened demand for better support expressed by those companies that ventured in the early 1960's into real-time processing. But the increased complexity in today's software is due also to the fact that it is anything but simple to produce programs capable of exploiting effectively the powerful new families of equipment announced by several of the manufacturers in 1964. (These hardware announcements were themselves, of course, at least in part a response to the mounting user clamor for systems better suited to their real-time processing needs.)

It is not enough, though, to assert that today's new computers and the supporting software are bigger and more powerful than what has come before. This admittedly they are. But there is much more involved here than a question of degree. It is of critical importance that everyone concerned with the usage of computers in this decade understand that the third-generation equipment, and the accompanying operating systems and other programs, represents something more than a mere upgrading in speed and reliability as was

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the case with the earlier transition from vacuum tubes to transistorized machines. This new generation — with its microelectronics, its stored logic, and its integrated circuitry — evidences quantitative improvement well enough. But more significantly, the new technology embodies design features oriented toward an inherently *different* kind of commercial data processing: the communication-based, direct-access, highly-responsive, real-time business system.

The Future of Programming in the Corporation

If the software gap has, at least, been narrowed if not entirely closed as we leave the mid sixties, can this mean that the data processing millenium, or a reasonably good approximation of it, has finally arrived? Are we now — "we" meaning business management, systems people, programmers, and anyone else associated with computer applications — about to move forward into "broad sunlit uplands" of controlled development costs and enhanced productive efficiency?

Schism

The answer has to be "No!" For, as the programming gap narrows, an even more ominous schism begins to emerge — one present from the earliest beginnings of data processing but now beginning to widen discernably. This is the cleavage between the management of a business organization and its technical staff — or, more specifically, the growing rift in communication and understanding between executive and programmer. This schism encompasses virtually the entire range of the interface between the individual and the organization that pays his salary; but it is most striking in the interrelated areas of age (programmers and management represent different generations), tenure (programmers have little, executives a lot), education and experience (programmers are specialists, executives generalists), and loyalties (programmers to their trade, executives to the company).

These differences and others combine to contribute to a lack of interest on the part of many programmers in company goals and a reciprocal lack of interest on the part of management in the nature of the technical skills which must be harnessed. This has led, long before the advent of real-time systems, to what might be described as an alienation of the programmer in many companies, who the programming staff being regarded with suspicion and sometimes with disdain as consisting of "far-out," "cloud-nine" individualists.

Business and Profession

But, it may be queried, why is the role of the programmer so different from that of any other professional — say in law or accounting — who functions as staff to a business enterprise? This raises a point that may be argued, but it does appear that there are certain major differences, most of them a reflection of the newness of the computer field. For example:

1. An accommodation was long ago reached between business management and established professions like the law, to the point where the executive dealing with these professionals interacts with them with a feeling of confidence and personal rapport. In a literal sense, the representatives of the traditional professions and the company executives belong to the same clubs.
2. It is somewhat misleading to characterize programming as a full-fledged profession, even a new one. There has not yet evolved the agreed-upon discipline, the public acceptance, or the enforceable standards for entrance and practice essential to the legitimization of programming as a profession.

It is, therefore, not very profitable to try to draw an analogy between the functions and responsibilities of programming and those of the established professions.

Other Middlemen

But are there no middlemen available to span the gulf, to mediate between the programming specialist and his management? Cannot the systems analyst, for instance, serve as a buffer between the programming staff and executive management? Unfortunately, it seems that the systems analyst, like management, must be something of a generalist if he is to gain, as he should, a "big-picture" grasp of the systems he is working on. This is especially true of those systems people engaged in designing "total" information systems. To the extent that the systems analyst tends to take a broad perspective, he begins to identify more with management than with programming, even in the not infrequent instance in which the analyst is himself a former programmer. This suggests somewhat alarmingly that there are few "honest brokers" who possess both the desire and the technical ability to serve as a bridge between programming and management, since most programmers who "cross over" gradually cease to identify with — and, what is more important, to be accepted by — their former associates.

Alienation of the Programmer

The condition of programmer alienation is, of course, as old as the utilization of stored program computers for data processing. But it has heretofore been largely below the surface and so has not engendered much concern. True, the astute observer could detect that *something* was amiss by noting that one of the main reasons why programming project costs invariably exceed budget is because of lack of agreement between the technical and line people regarding project scope. An observer might also remark on the fact that the programmer turnover rate tops the list in many companies. Yet the nature of commercial applications has been such that, until a few years ago, a company could "muddle through" despite these and kindred problems.

Real-time Business System Development

But with the appearance of real-time systems on an appreciable scale in many industries in the 1960's, the ground rules for system development have changed irrevocably. Now management can no longer afford the hidden luxury of a communications block between the new and the old, the innovators and the guardians of the status quo, the outsiders and the insiders, the programmers and the rest of the company.

The new real-time systems have disturbed the uneasy peace that has prevailed up to now in commercial data processing because they are:

— More comprehensive
— More vital
— More complex

Comprehensive

They are more *comprehensive* in that the scope of the automatic system is now extended outward from the equipment site, thus enabling the computer to exercise its control at the time and place of each business transaction. The long-cherished goals of devising total systems (applying the capability of the computer to all major facets of a business enterprise) and integrated systems (in which all interacting elements of the organization are brought within the unifying cognizance of the computer) have, because of the comprehensive nature of real-time systems, become for the first time truly realizable.

Vital

The new systems are more *vital* in that they tend to be applied to the more fundamental aspects of a company's operations and to produce impact on these operations with an unprecedented immediacy. For example, nothing is more vital to a savings institution than its assets in the form of current balance data, the maintenance of which is now being entrusted to the real-time computer. Nor is anything more vital to an airline than information on the highly perishable commodity of seats available for sale, now being provided by the real-time systems. The requirements for reliability in the performance of both the hardware and software in environments such as these should be readily evident.

Complex

The element of *complexity* in real-time systems is manifest in both development and operation. This heightened complexity is in part a result of the comprehensive and vital characteristics of real-time systems, but it is equally due to the appearance of more sophisticated equipment and the resultant development of programs designed to exploit this equipment.

As has been stated, the new computers and the attendant new operating systems and other programs are a fact of life. They are with us now. The problem remaining is no longer one of obtaining computers and programs well adapted to real-time processing; it is, rather, one of coping with the increased difficulty of applying this powerful new technology.

The Widening Gulf

Thus, as the programming gap closes, the gulf between management and programming begins to widen because of the ever-growing amount of specialized knowledge that company programmers must absorb to remain abreast of vendor announcements. Even within a single machine family, this task of keeping up is truly onerous and is, moreover, one that virtually shuts the door to any meaningful grasp of the dynamics of real-time systems development and operation by anyone other than a highly-trained programmer of razor-sharp competence.

A Sample to Be Understood

A recently released IBM manual requires 73 pages merely to identify the main and auxiliary storage requirements for the System/360 operating system.[3] Before perusing this document, however, the conscientious reader would find it instructive to examine the preface. There he is advised that, before he reads much further, he "must be familiar with the following publications:"

IBM Operating System/360: Introduction
IBM Operating System/360: Concepts and Facilities

It is also suggested that it would be prudent for him to study also:

IBM Operating System/360: Job Control Language
IBM Operating System/360: Operating Considerations
IBM Operating System/360: Linkage Editor

It should be pointed out that not all of this material is applicable exclusively to real-time systems; even the more conventional data processing approaches are burdened by software proliferation. The rationale of the new software supplied by all the vendors is grounded in direct access, communications, and multiprogramming techniques — all concomitants of real-time processing but applicable in other situations as well.

Too Little and Too Late

Surely, it may be asserted, no one can seriously expect a company president, a department general manager, or even the manager of the systems and programming staff to master all this technical jargon (assuming that they are intellectually capable of doing so). After all, that is why there are systems programmers. This argument has validity. But it does nothing to alleviate the isolation of the programmer who can with justification pose the question: isn't there *anybody* in authority within this company with whom I can communicate?

The Chairman of the Federal Deposit Insurance Corporation, Mr. K. A. Randall, evidently thinks that somebody up there should be aware of what's going on. In a recent address before the Utah Bankers Association, he stated:

> But [the] opportunities for more effective internal controls over banking transactions come at a price, because the systems are vulnerable to accident and possible manipulation. Great care in programming is required in order to preserve enough of the record to permit its reconstruction. The ability to change or erase records without leaving a trace of evidence poses a constant threat. Only as management itself becomes knowledgeable about computer procedures, and less prone to surrender its responsibility to the technicians, can it confidently make optimum use of them.[4]

Unfortunately, it appears that management may be arriving at the station just as the train is pulling away. For it borders on the impossible for the company president to achieve any meaningful understanding of "computer procedures," and the same can be said of line management. After all, how much can reasonably be demanded of user management when even most manufacturers' field representatives possess only the most meagre and superficial grasp of the new products they are selling? The mastery of programming for business computers is, for better or for worse, a career job for programmers. We have come to live in a technological environment in which dillettantism is self-defeating and dangerous.

For many years, the American Management Association has held an annual conference devoted to Electronics in Management. These meetings, which have had considerable "upside" appeal, have no doubt contributed to the educational process to which Mr. Randall alluded, but they have been conducted at the "broad brush" level and thus addressed to a different set of problems from those we have been discussing. This year for the first time in its history, in a belated recognition of programming problems, the AMA did sponsor a session devoted exclusively to the state-of-the-art in programming.

Removing the Alienation

But so far no one — neither the AMA, the equipment suppliers, executives like Mr. Randall, nor the programming fraternity itself — has come up with any especially cogent or compelling ideas about how to remove the programmer's alienation. Most of us recognize that the wall between the programmer and the organization is there, and one no longer hears voiced the kind of pathetic optimism that initially surrounded COBOL and other efforts to make every man his own programmer. But the barrier rises higher with each passing year, and no one seems able to come up with an effective means either to demolish it or scale it.

A contemporary John L. Lewis would not venture into the mines to organize a block of labor which could exercise

(Please turn to page 34)

SUPERVISORY SYSTEMS FOR THE DARTMOUTH TIME-SHARING SYSTEM

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The Time-Sharing System at Dartmouth College, Hanover, N.H., was designed primarily for teaching and small research problems. Because resources for a large-scale computer system and a big systems programming staff were neither available nor desired, the System was designed around medium-scale hardware by a minimal programming staff consisting mainly of undergraduate students. The specifications of the System were necessarily kept quite simple, a requirement that undoubtedly encouraged the principal goal of the project — to keep the man-machine interface as simple and natural as possible for the man. Consequently, the System has been referred to as the "poor man's Time Sharing System," but its many enthusiastic users will testify that it is an extremely important new tool for their work.

Purposes

The main purpose for developing the System was to provide for teaching computing to almost all Dartmouth students, including those concentrating in the Social Sciences and Humanities. A second purpose was to tap the hitherto unrealized wealth of small computer problems related to the everyday research activities of a college faculty, small problems that would never be initiated if the turn-around time were as long as a single day. For both these purposes an extremely simple man-machine interface was necessary. Two aspects of the interface are the communication with the System, and the structure of the primary programming language. For this latter purpose, the simple algebraic language BASIC was developed, largely by Professor John Kemeny of the Dartmouth Mathematics Department.[1] It has proved much easier to teach than any of the standard languages, and has turned out to be more successful that anyone dared hope when the decision was made to invent "still another" programming language. But the purpose of this paper is to discuss the structure of the software system, and no more will here be said about BASIC.

Foreground and Background

The Dartmouth Time-Sharing System was not designed to be all things to all people. A central purpose was to provide fast and convenient service for small problems having relatively little input or output. For this purpose the system is handling now up to 40 teletype machines. But in addition to the teletype or *foreground* jobs, the System can also accept *background* jobs which need more memory, more time, or the use of the peripherals such as magnetic tapes. Thus, while the system was primarily designed to handle the small student or faculty job, it can accept in background the large or long-running problem.

Designed for Amateurs

The System has enjoyed an unusual amount of favorable publicity. The most important reason seems to be that it was designed for amateurs — and many hundreds of amateurs all over the country have successfully used it during the past year or so. In fact, it has been so successful that some persons are proposing the hitherto heretical view that even among professionals in such fields as Engineering a simple language and a painless man-machine interface are highly desirable. The System has been publicly demonstrated at the FJCC in 1964 and the IFIPS congress in 1965, and at many other smaller meetings and private showings. In recent months several projects in secondary education using BASIC have begun, suggesting that the simple language BASIC will play an important role in training students at secondary levels and even primary levels. This last possibility is supported by the extensive work already performed at three secondary schools in New Hampshire (Hanover High School, Phillips Exeter Academy, and St. Paul's School).

Dr. Thomas E. Kurtz has been Director of the Computation Center at Dartmouth College, Hanover, N.H., since 1959, and is now an Associate Professor of Mathematics at Dartmouth College. He received his B.A. from Knox College in 1950, and his Ph.D. in statistics from Princeton University in 1956. He is the author of *"Basic Statistics"* published by Prentice Hall.

[1]The initial version of the Time Sharing System itself was designed by Professor Kemeny and Thomas E. Kurtz. The current version of the System is available for limited experimentation, and the system software is also available. For further information contact Mr. Thomas C. Jackson, Supervisor, Kiewit Computation Center, Dartmouth College, Hanover, New Hampshire, 03755.

The development of the Time-Sharing System was supported in part by a grant from the Course Content Improvement Section of the National Science Foundation.

There is no logical reason why the simple approach cannot be implemented on larger scale systems. Rather, it seems that other time-sharing development projects have devoted themselves to the computer researcher, with little thought for education of students or the supplying of small problem solving for research work of all kinds both in and out of the universities.

Hardware

Given the resources of time, money, and personnel, it was clear that a suitable medium-speed computer had to be found. At the time, there was no commercial large-scale computer system *specifically* designed for time sharing, let alone a medium-scale system. Fortunately, the designers were able to design a two-computer system consisting of standard, on-the-shelf components currently being separately marketed. This system consists of the General Electric GE-235 (originally the GE-225), the General Electric Datanet-30, and a dual-access disk file. There are, in addition, the usual tapes, printer, and card equipment.

The two-computer concept enabled us to achieve several objectives: First, the computing speed is effectively doubled, since there are two computers operating simultaneously. Second, the memory size is effectively doubled, since the input-output buffering is confined to the Datanet-30. Third, the problem of memory protection for the master supervisor is easily solved, since it resides almost entirely in the Datanet-30 and it is impossible for any user to interfere with the system program in that processor.

The most serious drawback to this two-computer system is that it cannot be used in real-time situations requiring responses more rapid than human reaction times. But inasmuch as this was not contemplated as an application of the System, the two-computer system has proved to be quite serviceable.

Master

In a two-computer system, one computer must be the master. In our system it is the Datanet-30, a communications processor having a 16K memory of 18 bit words, and a memory cycle time of slightly less than 7 microseconds. Approximately 40 teletype lines are connected to one side of this computer; about half pass through the telephone system and the other half are directly connected. At the other end, the Datanet-30 communicates to the slave computer, the GE-235, through a Computer Interface Unit, and also is connected to one pole of the dual-access disk controller.

Slave

The slave computer, the GE-235, is a standard processor having a 16K memory of 20 bit words and a cycle time of 6 microseconds. It is connected to tapes, printer, card reader and punch through suitable buffering mechanisms. It has floating point hardware, index registers, is on the receiving end of the Computer Interface Unit, connects to the other pole of the dual-access disk controller, and has the necessary interrupt capability.

Mr. Kenneth B. Lochner, Jr., is chief programmer at the Dartmouth Computation Center. He received a B.S. I in history from Iowa State Univ., an M. S. in mathematics from Montana State College, and has passed his preliminary examinations for a Ph.D. in mathematics. He has been in the computer field since 1960.

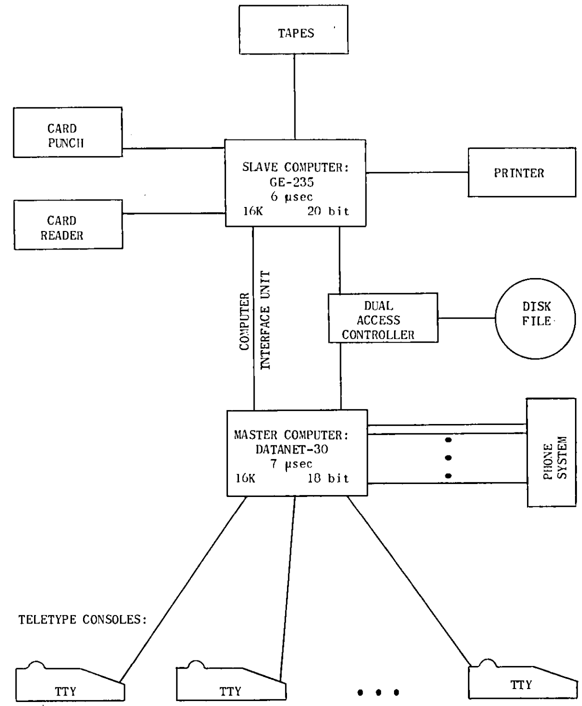

Figure 1. Diagram of the Dartmouth Time-Sharing Computer System

Disk Memory

The disk has a capacity of 18 million characters with an average transfer rate of 42,000 characters per second. In addition, the arm positioning time averages about 250 milliseconds. Either computer may access the disk, but not simultaneously. The disk file is used for storing system programs, saving user source programs for later use, and working space for each teletype machine and for background. The working storage is composed of three separate areas, one of which is used for file building, another for dumps including output, and the last for scratch work by user programs (see Figure 1).

Friendly Software

The design of a software system is necessarily dependent on the hardware to be used and on the job to be done. The software can be simple or complicated, depending on the degree of flexibility needed. In our case, the initial software was quite simple. As the system has developed, so has the complexity of the software. But throughout this evolutionary process the man-machine interface has been kept simple and friendly.

The software system includes compilers, editing routines, loaders, etc., but its most important parts are the supervisory routines. The following discussion is necessarily oversimplified, but should give a good idea of the various tasks performed by the supervisory routines. The supervisor can be divided into two main parts — the master computer (Datanet-30) supervisor, and the slave computer (GE-235) supervisor. (The latter includes the loaders, compilers, etc., but these will not be discussed beyond the present statement that they exist).

Master Supervisor

The master supervisor is always resident in the Datanet-30 and uses approximately 4K of the 16K memory; the remaining memory is devoted to buffer areas, constants, and lists describing the state of the various foreground and background jobs. The master supervisor performs the following functions:

HELLO and GOODBYE

The HELLO sequence is initiated when the user types HELLO. The master supervisor then asks for his user number, the name of the system he wishes to use, and whether he will be using a previously saved program or will be creating a new program. The user is then free to issue commands or add lines to the file he is building. When the user is finished, he types GOODBYE.

Analyze all Commands

Commands are typed lines not preceded by a line number. If the execution of a command involves the use of the GE-235, the user is put in the queue of users waiting for such service. The commands which involve the use of the GE-235 are SAVE, OLD, LIST (sometimes), RUN, TEST, and EDIT.

File Building and Local Editing

Each line starting with a line number is assumed to be an addition to a user's source program and is placed at the end of his source program file on the disk. The transfer to the disk is fully buffered. Local editing consists of back-spacing for one or more characters, or deleting the current line, and is performed entirely by the master supervisor before transfer to the disk.

Scheduling the Use of the Slave Computer

The slave computer (GE-235) does not carry out or initiate any major action except at the explicit command of the master supervisor. Thus instructions concerning the system to be used, which user is to be served (including the background queue), and the amount of time to allow a program to run are sent to the slave supervisor from the master supervisor via the Computer Interface Unit. The master can command the slave to read a source program from the disk, write a source program on the disk, resequence a source program, run a program, dump a running program, or continue a previously dumped program.

Output

The master supervisor handles all output to the remote consoles. Types of output include queries and error messages from the master supervisor, listings of the user's private catalog of programs, listings of the user's source program, error messages from the slave supervisor, output generated by the user program in the slave computer, and requests for data input from a running program.

Data Calls

If the user's running program has requested data input, the master supervisor sends a question mark (?) to the teletype. The next line typed in is then placed in the dump area on the disk to be included in the user's program when it is continued.

Emergency Stops

If the user wishes to stop some previously initiated action, he may do so by typing STOP, even if his teletype is receiving output at the time. If the user is in the queue waiting for service in the slave computer, he will be taken out of the queue; if his program is currently being run, it will be terminated.

Since the master supervisor is constantly in touch with the teletype and is always resident, the user can get almost instantaneous response to queries or commands that do not involve the use of the slave computer. This also means that the slave computer is usually working with only a small percentage of the active users — perhaps a fifth — and is concentrating on the tasks it performs best, namely, floating point calculations. The accompanying table gives some raw statistics concerning the activity in the master supervisor during one five-hour period last summer. Whether or not this sample is typical, we do not yet know; but it is clear that the master supervisor is responsible for a vast amount of activity, almost none of which directly involves the slave computer.

Master Computer Activity — Five hours — 30 teletypes

	Total	*Per hour*	*Per minute*
Characters received	106,000	21,200	353
Lines received	8,000	1,600	27
Characters transmitted	1,200,000	240,000	4,000
Lines transmitted	35,000	7,000	117
Disk operations	11,000	2,200	37
Commands	3,500	700	12

Slave Supervisor

The slave supervisor in the GE-235 has two forms, one of which is resident when foreground problems are being serviced, and another which is resident when background jobs are running. Both forms provide these functions: (1) Handle communication with the master supervisor (failure to respond to a message within 20 to 30 milliseconds results in the foreground supervisor being reloaded and the current job being aborted). (2) Dump and reload the running programs. (3) Provide for the running program service routines which take care of overlay calls and input-output transfer and error checking.

The foreground form of the supervisor requires about 4K of the 16K; the remaining 12K are used by the user's job. However, at most 6K will be dumped when the job is interrupted on orders from the master supervisor. Compilers, assemblers, and run-time routines occupy the 6K that is not dumped; these routines must be re-entrant, that is, they must be written so that a number of jobs can be using them at essentially the same time. At the start of each job's run in the slave computer, the supervisor checks to see if the correct system program (e.g., the BASIC compiler) is in memory, and if it isn't, reads it in from the disk before initiating or continuing the run.

The run continues until one of the following conditions occurs: the output buffer is full, the program needs some input data from the user, the run has terminated, or the master supervisor has issued a dump command. The 6K dump area (or some portion of it) is then written onto the disk; when the disk dump has been completed, the master is notified, and the slave supervisor is ready to accept another command.

The service routines of the foreground supervisor are of two classes: those which are always in memory and those which are called in when needed. All routines which service the foreground jobs are of the first class and thus are instantaneously available. Routines which are brought in as overlays can be called from the console typewriter and operate in parallel with the foreground job. Included in this latter class are such routines as: card to card, card to tape, background tape printing, card to printer, and scan-

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REAL-TIME COMPUTING WHILE TIME-SHARING

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Although the phrase, "real-time program", implies total preemption of the computer's time, many such programs in fact require far less than 100% of the machine's computing capacity. A typical application is an airplane flight simulation using analog equipment which must be set and sampled at frequent intervals in real time. For these applications, a typical program might require repetition every 100 milliseconds for a burst of up to 25 milliseconds. Once the computation has begun, it may not be interrupted, since a one-to-one relationship between program execution time and real time must be maintained. But the question naturally arises: What can be done to make use of the idle computer time? In particular, can the remaining time be used by time-independent programs run under control of a time-sharing monitor, allowing on-line console interaction? The answer is, Yes, provided that the monitor is organized so that excessive program interrupts are blocked out during the bursts of real-time computation. This paper describes the Time-Sharing Monitor for the PDP-6 computer and the modifications made to allow real-time and time-independent programs to be run concurrently.

Thomas N. Hastings has worked on developing time-sharing monitors for three years, previously at Project MAC, Mass. Inst. of Technology, and currently at Digital Equipment Corporation, Maynard, Mass. He has a B.S. and M.S. in electrical engineering from M.I.T. His theses dealt with computer recognition of letters and words.

What other advantages are gained by running real-time programs under control of a time-sharing monitor, in addition to greater use of the central processor? First of all, other real-time programs can be run simultaneously, providing of course that their real-time constraints are compatible. Secondly, programs can be debugged faster using symbolic on-line debugging techniques than with traditional off-line methods.[1] Thirdly, since real-time programs can be run like ordinary time-independent programs, representative computation times may be empirically determined using dry runs in the time-independent mode concurrently with time-dependent operation of other programs. For such dry runs, Input-Output instructions which refer to the analog equipment act as "no-operation" commands. Finally, program editing, assembling, and loading may be done concurrently with real-time runs.

The Time-Sharing Monitor

The PDP-6 Time Sharing Monitor[2] provides access to both hardware and software resources for the simultaneous use of a single system by many users at teletype consoles. The hardware resources[3] include any subset of the following: up to 256 thousand words of memory, a card reader, a line printer, 8 IBM compatible magnetic tapes, 8 addressable magnetic tapes (DEC tapes), a paper-tape reader, a paper-tape punch, and up to 64 teletypes. The software resources include a growing collection of Commonly Used System Programs called CUSPs. The CUSPs include FORTRAN II (FORTRAN IV will be added in early 1966), a macro assembler, a relocating linking loader, a text editor, a desk calculator, and a symbolic debugging program (DDT).

Another CUSP program (PIP) transfers data from any medium to any other, thereby eliminating the need for off-line satellite computers for doing card-to-tape and tape-to-line printer operations.

Eight systems have been in operation at installations throughout the world, beginning in May 1965. Program swapping capabilities with disc and drum will be added next year.

The Monitor itself is a collection of re-entrant subroutines which reside permanently in four to six thousand words of memory and which provide overall co-ordination and control of the total operating system. These monitor subroutines are called either by user programs or in response to commands typed into the monitor by users at their consoles. The monitor loads several user programs into different protected areas of memory in response to teletype commands. [illegible] user programs may be user-written or may be the [illegible] programs. A relocation register allows the monitor to [illegible] these programs anywhere and move them at any time. Each program is run for a certain length of time; then the Monitor switches control to another program in a modified round-robin manner. Higher priority is given to programs which have just finished waiting for an I/O device to complete operation. Switching is frequent enough so that all programs appear to run simultaneously.

In addition to controlling the user programs, the Monitor also controls the I/O devices. All devices appear identical to the user's program, thus simplifying program coding and allowing easy substitution of one device for another without recoding. The Monitor makes full use of the PDP-6 hardware interrupt system combined with ring buffering to overlap Input/Output operations with computation. The Monitor achieves further system utilization through multiprogramming. Thus, if any program must wait for Input/Output, the Monitor automatically switches to another program.

Priority Interrupts

The PDP-6 hardware priority interrupt system is designed so that each device is assigned by the monitor to one of the seven priority channels. Higher speed devices are assigned to the higher priority channels and lower speed ones to the lower. More than one device can be assigned to the same channel at the same time. Each time an I/O device needs service, it requests an interrupt of the program sequence. The request is granted immediately, unless a previous interrupt is still being serviced on the same or higher priority channel. If an interrupt request must be delayed, it is remembered by the hardware and an interrupt occurs when the equal or higher priority channels have been dismissed. As a rule of thumb, the number of instructions required to service an interrupt must be short for high priority channels. Magnetic tape requires only one instruction to be executed for each data word. Higher speed devices like parallel disc make their own accesses directly to memory. If a high-priority channel-service routine encounters a situation in which it must perform a lot of computation, it requests an interrupt on a lower priority channel, so as not to block out intermediate priority channels for an excessive amount of time causing data to be missed. The monitor uses the lowest priority interrupt channel for scheduling user programs and for interpreting monitor commands typed-in from remote consoles. Since user programs are run whenever there are no interrupts in progress, they are effectively run with priority lower than that of all of the PI channels. This priority level is called user level; the machine spends most of its time at this level.

If a monitor command takes a long time to complete or requires some I/O operation, it must defer execution to a lower priority channel. Since there are no lower channels, it requests an interrupt to user level, which will occur when the lowest priority interrupt has been dismissed.

Unfortunately, the time for scheduling programs and for processing monitor commands blocks out too much time from the user level to be satisfactory for the real-time programs. In fact, some of the longer interrupt service routines on the lower priority channels also cannot be tolerated. This was the problem that required modification of the PDP-6 monitor to provide real-time capabilities.

Priority Allocation for Real-Time Programs

To prevent long interrupts from occurring during time-dependent real-time computations, the real-time user programs are run as if they were interrupt service routines of fairly high priority. These programs are always kept in core ready to run. Only very short interrupts are assigned to higher priority channels. However, the real-time programs may not be debugged; so, to prevent their failure from disrupting other users' operations, the real-time programs are run with the hardware protection enabled, as are all user programs.

In addition, a clock is included as one of the devices on a priority channel higher than the real-time programs. The clock service routine determines when to begin running a time-dependent user and saves the hardware and software state of the old program before starting the time-dependent program. Normally, the real-time program indicates when it is finished by calling the monitor. Then the monitor restores the old job and dismisses the interrupt. Normal round-robin scheduling occurs as usual on the lowest priority channel.

If a time-dependent program does not return control to the monitor in time, the clock will interrupt and the monitor will print an error diagnostic on the user's console. The user must either ask for a longer time slot or must change his program so that it computes for less time.

Before a user can have his program run in the time-dependent mode, he must first determine the repetition rate and maximum burst time required by his program. In an aircraft simulation, for example, the repetition rate is governed by the accuracy required. The burst time may be determined empirically with a few dry runs. The size of the repetition rate affects the number of real time users who (or which) can run simultaneously, and so is left to a human administrator. Each user must have a repetition rate which is equal to or is a multiple of the system repetition rate. Next, the user must ask the monitor if there is a large enough time slot available for his particular burst requirements. This is done with a monitor console command. If the user's request can be accommodated, he is ready to start. The first few instructions in his program call the monitor asking for the time-independent mode to begin and specifying where control is to be transferred at the beginning of every burst.

Conclusion

Real-time applications are not precluded from operating in an on-line time-shared environment. In fact, the real-time programmer stands to gain from on-line access to a computer as does everyone else. However, this capability does require special handling both from an administrative and a program-scheduling point of view.

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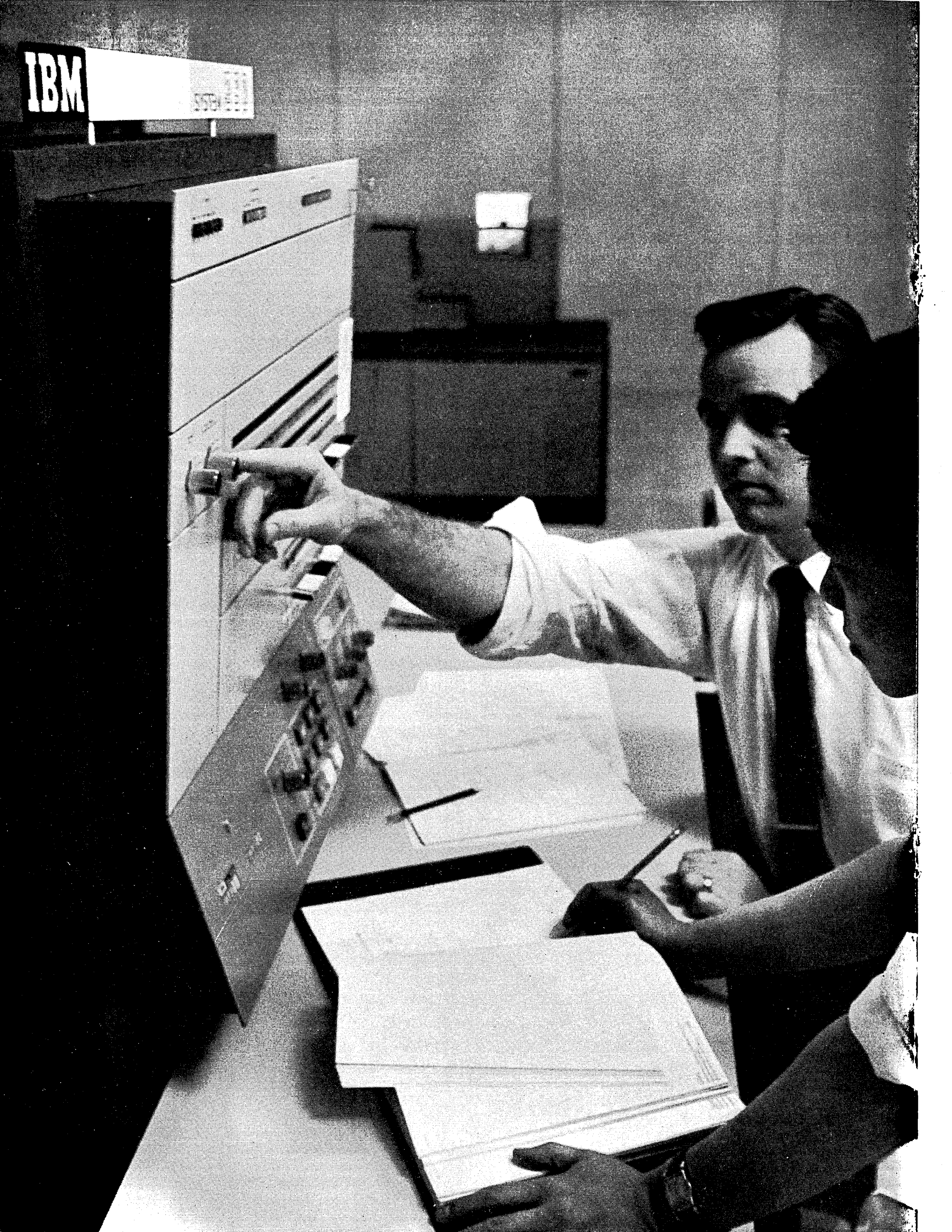
2. *PDP-6 Multiprogramming System Manual,* Digital Equipment Corporation, Maynard, Massachusetts.
3. *PDP-6 Handbook (F-65),* Digital Epuipment Corporation, Maynard, Massachusetts.



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THROUGHPUT

Standardizing Computer Selection

Everyone has noticed the increasing competition among the principal computer manufacturers, the "big eight." The second-and-a-half generation of hardware, the new languages, and the general replacement activity can hardly escape notice. And yet, because of the introduction of a new class of small systems, a whole new group of users is coming into existence. This group, the prospective users of the IBM 360/20, the Honeywell H120, the RCA Spectra 70/15, and the GE 115, face a confusing choice. Unfortunately, the size of the order is small, and the manufacturers cannot devote extensive resources to the order's fulfillment. This begins with the *proposal,* which is generally incomplete and not entirely responsive to the users' needs.

To assist these users, who will someday soon represent a numerical majority of installations, it is proposed to establish a basic standard for manufacturers to follow in presenting their products as a guide to selection. It is surprising that in an otherwise sophisticated industry, some standardization of this sort has apparently not yet been attempted.

A standard proposal format is suggested below. This format should, of course, be expanded; this expansion could quite properly be a role for the Business Equipment Manufacturers Association, or a like organization.

Proposal Contents

1. INTRODUCTION
   — History of the manufacturer
   — Qualifications of the manufacturer
   — Other customers served
   — General sales information
2. PROPOSED CONFIGURATION
   — Summary of equipment
   — Detailed list of components
   — Operating characteristics
   — Full equipment specification
   — Options or alternate configuration
   — Demonstrability
3. COST
   — Rental by component
   — Purchase cost
   — Cost of maintenance
   — Purchase option
   — Cost of supplies, paper, cards, ribbons, etc.
   — Cost of tapes or disks or other storage elements
   — Payment and charging method
4. SUPPORT SERVICES OFFERED
   — Systems
   — Programming
   — Installation engineering
   — Conversion
   — Education
   — Facilities
   — Software availability schedule
5. TERMS
   — Delivery
   — Options for delay
   — Reliability
   — Back-up availability
   — Contract or contract terms
   — Acceptance testing
   — Price protection
6. SYSTEMS ANALYSIS
   — Design by application
   — Performance or timing
   — Systems options
   — Supporting data
7. SALES INFORMATION
   — List of other installations
   — Vendor facilities available
   — Applications experience
   — Industry experience
   — References

The adoption of a standard proposal *format* would reduce user confusion tremendously. It would enable the average user to compare proposals more objectively, and to assess more accurately the value of each item offered.

Placing the responsibility on the vendor alone is not enough. The user must also communicate with the vendor, to define his requirements and problems succinctly and uniformly. It is therefore recommended that a standard *specification* be adopted as well, to allow the manufacturer an equally objective opportunity to obtain the required information. An outline of a suggested specification is given below. It parallels, in part, the proposal outline and also requires expansion.

Specification Contents

1. INTRODUCTION
   — History of the company
   — Summary of requirements
   — Schedule of selection process
   — List of current equipment
   — List of vendors invited
2. APPLICATIONS
   — Systems outlines

(Please turn to page 34)

c&a CAPITAL REPORT

A Special Report from C&A's Washington Correspondent

General Electric Company has entered a bid for a larger share of the Government Computer market by establishing its Federal Systems Operation in Bethesda, Md., just outside metropolitan Washington. The new facility, which comes under GE's Computer Department, is separate from its defense and aerospace marketing activities.

Heading the Federal Systems Operation is Ralph S. LaMontagne, who went to GE from Univac, where he held a top spot in marketing military computers. Before LaMontagne joined GE, the company had only a small staff in Washington, as liaison between the Government and the GE computer marketing group in Phoenix, Ariz. Now it has a full-fledged staff of salesmen, systems designers, application engineers, programmers, and systems managers.

According to latest official figures, GE placed 53 EDP systems in the Government by June 30, the end of fiscal 1965. Most of these were from its 200 series. This put it behind seven other firms: Burroughs, Control Data, Honeywell, IBM, NCR, RCA, and Univac. GE captured none of the "prestige" contracts, those in which a lot of computers are ordered at the same time, but GE did bring in a decently large order from the General Services Administration in September for a mixture of ten GE 415 and 425 systems to replace IBM 1401s and 1410s. Its most serious competitors for this contract were IBM, Burroughs, and Honeywell, but Washington people say GE handled the competition well. GE has publicly sworn to emerge as No. 2 in the computer industry.

The House of Representatives passed legislation in September to streamline the management of computers in the Government. The bill is called H. R. 4845; its author, Cong. Jack Brooks, said it improves the process of acquiring and using computers for the Government in three ways:

(1) It sets up a perpetual inventory of computers in the General Services Administration that gives Government managers fiscal and other management information on a current basis. Presently the Government has only an annual inventory.

(2) It encourages and improves computer sharing and establishes multi-agency service centers, aiming to use Government computers more fully.

(3) It brings about more economical procurement of computers, through volume acquisition of computer components.

The bill would also set up a "priority of purchase"; that is, the revolving fund provided by the bill would be used to buy those systems first that show the greatest purchase advantage to the Government as a whole. As it is now, the report said, an agency head may decide not to purchase a certain computer this year because the agency needs the money for more important matters. Under H. R. 4845, the General Services Administration, as overseer of the fund, would be able to buy the computer if it determined that it was more economical to buy rather than to lease, regardless of the situation in the agency that year. Thus, the decision to lease or purchase would be made on the basis of the entire Government, not just on the basis of one agency.

In its original form, H. R. 4845 would have covered computers used by Government contractors, mostly those working for the Department of Defense. But when the bill was still in committee, the Aerospace Industries Association and the Electronic Industries Association put in strong complaints, claiming that their equipment should be excluded. The committee amended the bill to exclude these users, but indicated the matter is not closed.

H. R. 4845 on the floor of the House encountered further opposition from Cong. Arnold Olsen, who fears that GSA will be able to tell other agencies what computers to acquire since it will hold the purse strings of the computer money pouch, and would give GSA power to interfere in the procurement and operation of computer systems.

"I do not think that the GSA should . . . be the agency to determine what electronic data processing equipment should be used or when it should be used," he said.

The Brooks committee looked hard at the present lease structure in the EDP industry while considering the bill and did not like what it saw.

"At present," it said, "the lease payments for most ADP (automatic data processing) components equal the cost of ownership in a relatively short period, seldom exceeding 45 to 50 months, although the useful life of most ADP equipment is estimated at between 5 and 10 years. In a recent study, the Department of Defense estimated that the lease payments on most ADP equipment equal the purchase price within 2½ to 4½ years. Whatever the reasons may be . . ., the ADP manufacturers . . . are accelerating the amortization of capital invested in leased equipment to the serious economic disadvantage of those leasing it for any extended period."

There are strong indications on Capitol Hill that Congress will soon look more closely at such subjects. Some of this scrutiny will probably take place in the Senate Government Operations Committee, headed by Sen. John McClellan, if it holds hearings on H. R. 4845. The committee's schedule is crowded this session, but under the prodding of Sen. Paul Douglas, who introduced a similar but stronger bill, hearings may be held.

The Bureau of the Budget in September released the latest inventory of computers in the Government. The 365-page report is formally known as the "Inventory of ADP Equipment in the Federal Government" (available for $2 from the Government Printing Office in Washington).

The Air Force remains the largest user of reported computers in the Government, (military and classified computers are not reported). The Air Force has a total of 775 computers installed as of June 30, 1965, twice as many as any other agency. Army, Navy, NASA, and the Atomic Energy Commission follow in that order. The Treasury Department and the Department of Health, Education, and Welfare use the most computers in the "civilian agencies."

Of the 2,188 computers installed in 1965, IBM accounted for more than 1,000. Next in order were: Control Data, 210; Univac, 202; NCR, 195; RCA, 132; Burroughs, 108; Honeywell, 66; General Electric, 53; Scientific Data Systems, 40; Digital Equipment Corporation, 31. In fiscal 1966, Burroughs and Univac will move up, Burroughs installing 73 B-263s, and Univac 113 Univac 1950s. This accounts for 186 of the estimated 263 computers expected to be installed by June 30, 1966.

This increase of 263 computers may well mark a plateau in Government use of EDP, with a lower net increase in computers each year. In 1964, the net change peaked at 536 computers; in 1965 it dropped to 326; estimates for 1966 put the increase at 263. With time-sharing coming in the Government, fewer computers will be needed in years to come.

Five major tables are in the inventory this year: a summary of computers by department; a detailed listing by department; a listing by location; a listing by make and model, and a directory of applications. There are also charts on the ratio between leased and purchased systems; hours used per month; man-years used in computer operations; and others.

Data processing equipment listed in this inventory includes all that used by the Government except military and classified computers. It also includes equipment operated by Government contractors under cost-type contracts.

JAMES TITUS

STANDARDIZING COMPUTER SELECTION

(Continued from page 32)

- — Flow charts
- — Volume and file data

3. REQUIRED FEATURES
   - — Hardware
   - — Software
   - — Support requirements
   - — Constraints
4. DESIRABLE FEATURES
   - — Services
   - — Facilities
   - — Operating characteristics
   - — Support
5. CONTRACT TERMS
   - — Terms to be included in a contract
6. SELECTION PROCESS
   - — Method to be used
   - — Schedule
   - — Factors to be weighed
7. CONTACTS
   - — Company contacts for further information.

The above outlines are suggested only as a beginning. It is important to the fraternity of new users, however, that an effort be undertaken in standardizing some of the sales activity in the industry.

Dick H. Brandon
Contributing Editor

REAL-TIME PROGRAMMING IN THE SIXTIES

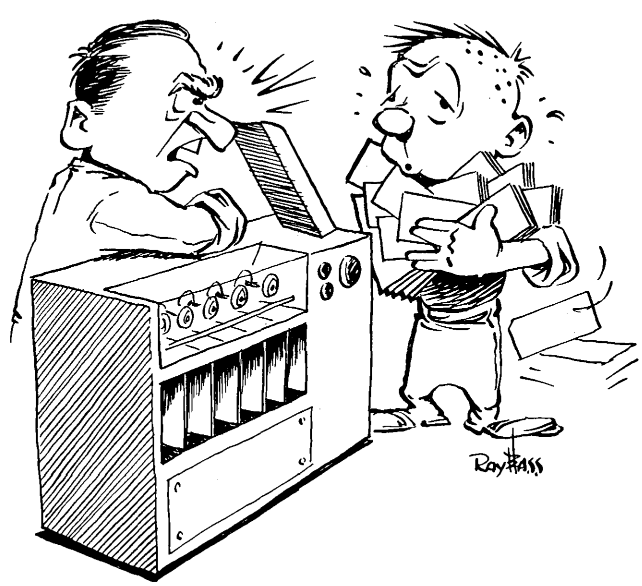
(Continued from page 24)

enormous leverage over our present day economy. Nor would Walter Reuther go today to the River Rouge to organize a power base. Instead, the astute labor leader of our time would seek to organize the programmers. The possibility of a disciplined, national-scale programming work stoppage is a deeply disturbing one. For without programmers — whatever their grievances real or imagined might be — the wheels of industry, commerce, government, indeed of the entire national economy, would grind inexorably to a halt. The computer has made such inroads into our productive and administrative machinery that the disappearance of its custodians would be a far more serious matter than a walkout of teamsters or mineworkers ever was. The very idea of such an eventuality is frightening. In the real-time era we are now entering, the implications will be almost unimaginable.

Footnotes

1. R. V. Head, "The Programming Gap in Real-Time Systems," *Datamation,* February 1963, pp. 39-41.
2. C. W. Bachman and S. B. Williams, "A General Purpose Programming System for Random Access Memories," *Proceedings of the 1964 Western Joint Computer Conference,* Spartan Books, Baltimore, 1964, pp. 411-422.
3. *IBM Operating System/360. Storage Estimates,* International Business Machines Corp., Form No. C28-6551-0, 1965, 73 pages.
4. K. A. Randall, Address before the Utah Bankers Association, *Banking,* August 1965, p. 110.

COORDINATED OPERATIONS



"You two really complement each other — one spills and one sorts."

"ACROSS THE EDITOR'S DESK"

Computing and Data Processing Newsletter

TABLE OF CONTENTS

APPLICATIONS

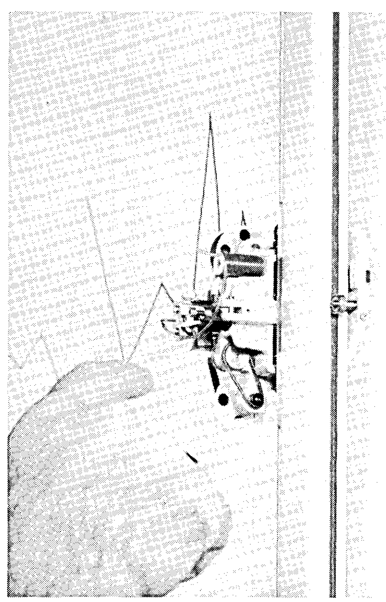
MARINER IV DATA DISPLAYED ON 24-HOUR BASIS FOR THE FULL 7½ MONTH MISSION

Four digital plotting boards continuously plotted a vast amount of real-time data received from the Mariner IV spacecraft during its 350 million mile trip to Mars. The plotters were supplied by Milgo Electronic Corporation, Miami, Fla., to Jet Propulsion Laboratory, National Aeronautics and Space Administration, Pasadena, Calif.

Well over 200 million bits of information have been transmitted to Earth from Mariner IV, providing over 10 million measurements of temperatures, voltages, etc., and over 12 million measurements of scientific data.

The plotters were in operation for a total of 5,483 hours, operating on a 24-hour basis, from launch to completion of the mission.

Since its Cape Kennedy launching last November 28, three types of data were transmitted from the spacecraft to the three Deep Space Instrumentation Facilities (located at Goldstone, Calif.; Johannesburg, South Africa; and Woomera, Australia) and then transmitted via teletype to the Space Flight Operations Facility at Jet Propulsion Laboratory, Pasadena, Calif. The data was then processed by the JPL computer complex and delivered to the plotting boards for display. The data included spacecraft performance, space science experiments and tracking data.



— Vertical plotting boards displayed real-time data from Mariner IV round-the-clock from launch to Mars flyby. Close-up photo shows plotting arm with pen and 50-character symbol printer.

The Milgo Model 4021D plotters used at JPL for displaying the real-time data are vertical, single-arm recorders with 50-character symbol printers and pens, designed for both on-line and off-line operation from a digital input source.

Two of the plotters were located in the Mariner Mission Support Area: one plotting twelve multiplex functions of spacecraft subsystem performance and another plotting twelve scientific experiment functions. Each of these functions was plotted at approximately one per second at the maximum received data rate. Another plotter, located in the Space Science Area, also plotted up to twelve functions of scientific experiments.

The information received on real-time spacecraft subsystem performance included the measurement of: Power Switching and Logic Output; Cumulative Solar Panel Current; Battery; Remaining Attitude Control Nitrogen Supply; Canopus Sensor Intensity; Magnetometer Temperature; Trapped Radiation Detector Temperature; Battery Temperature; Canopus Sensor Temperature; Television Subsystem Temperature; Solar Panel Temperature (Sunward); and Telemetry Margin.

During critical maneuvers such as mid-course correction, a plotter in the Spacecraft Performance Area was used to observe the performance and results of controls sent to the spacecraft. This plotter provides the primary information source for assessment of performance in real-time. During these critical periods a standby plotter was available for immediate use.

AIRPLANE MAINTENANCE RECORDING AND ANALYZING

A fully automatic data analysis system for the aviation industry has been announced by Lockheed Aircraft Service Company and Trans World Airlines, after two years of joint pioneering development in the field of airborne maintenance recording. TWA will equip its entire fleet of new DC-9 jet transports with the system, which will be manufactured by LAS Special Devices Division, Ontario, Calif.

The DC-9 installation monitors 50 separate parameters of engine information. It is the first fleetwide application of automatic airborne data collection to provide a daily "health report" on aircraft engines and systems.

Automatic Data Analysis System (ADAS) will greatly reduce paper work in the DC-9 cockpits by automatically recording data which reports on punched paper tape the state of performance of all monitored components. The data is then transmitted by teletype to TWA's overhaul base at Kansas City, Mo.; there, rapid computer analysis and printout produce quick and accurate diagnosis of maintenance requirements.

The $350,000 initial order to LAS for the DC-9 fleet, is based on an estimate that the system will result in a saving to TWA of approximately $200,000 annually.

SHAKE, RATTLE, ROLL AND VIBRATE — UNDER COMPUTER DIRECTION

A shake, rattle, and roll program at the Lockheed Missiles & Space Company, Sunnyvale, Calif., has been updated to produce a net cost saving of more than $1.4 millions of dollars annually.

Called centralized automatic random vibration test control, the system remotely controls, by means of computers and telephone lines, vibration testers or shakers at several dispersed testing locations, distant up to 40 miles.

Vibration testing of missile and space components is essential to verify how these units will stand up under the variety of stresses they must meet during actual operation. This testing consists of applying a wide variety of vibration frequencies, at specific time intervals, to the part under test.

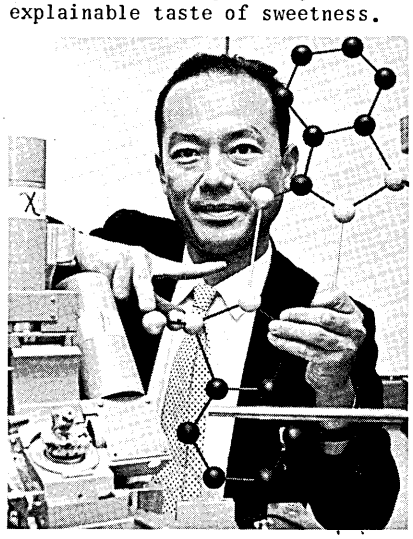
A particular test series, for example, could call for a broad range of frequencies to be applied for a short period; then a specific frequency for a short period; then another vibration frequency, at greater intensity, for a certain number of minutes.

In the past, a specific vibration test pattern was fed into the shakers (which are located at more than a dozen separate laboratories) using a separate control station for each shaker, along with test engineers and controlling equipment.

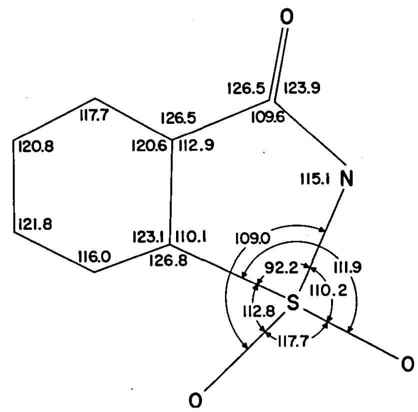
Under the new system, all remote shakers are connected by 2-way telephone lines to a computerized control center. The test pattern is relayed to the computer which then directs the vibration, frequency and intensity, continuously monitoring the results. The computer also senses an over-limit condition and turns off the shaker before serious damage can occur to the test specimen.

SCIENTIST DETERMINES EXACT SHAPE OF SACCHARIN MOLECULE

Dr. Y. Okaya of the IBM Research Center, Yorktown, N.Y., has determined the exact shape of the molecule of saccharin, artificial sweetener. Dr. Okaya believes that a comparison of the structure of saccharin with its many-flavored derivatives may reveal what accounts for the pleasing but unexplainable taste of sweetness.



In the experiment, a tiny crystal of saccharin was placed in the apparatus in the foreground. Under control of an IBM 1620 computer, a beam of x-rays was directed at different planes of atoms in the crystal and the intensity of the reflected x-rays was measured. From this information, Dr. Okaya deduced how atoms are arranged in the crystal. By using the experimental computer-controlled system, the overall time of the analysis was reduced from about four months to one month.



The diagram shows the bond angles in the saccharin molecule, analyzed by Dr. Y. Okaya. Unmarked locations are occupied by carbon atoms. All atoms lie in the same plane, except for the oxygen atoms in the SO_2 group, which lie in an almost perpendicular plane.

Three unusual molecular features were uncovered by Dr. Okaya's analysis: (1) the five-sided heterocyclic ring is flat, due to the sharp bond angle formed at the sulphur atom; (2) the next-nearest neighbor distance from the nitrogen to the oxygen atoms in the SO_2 group is 25 percent greater than observed for any molecule; and (3) the benzene ring exists in a compressed, slightly unstable state.

$2 WORTH OF MAGNETIC TAPE RECORDED 120 MILLION DOLLAR PHOTOS OF MARS

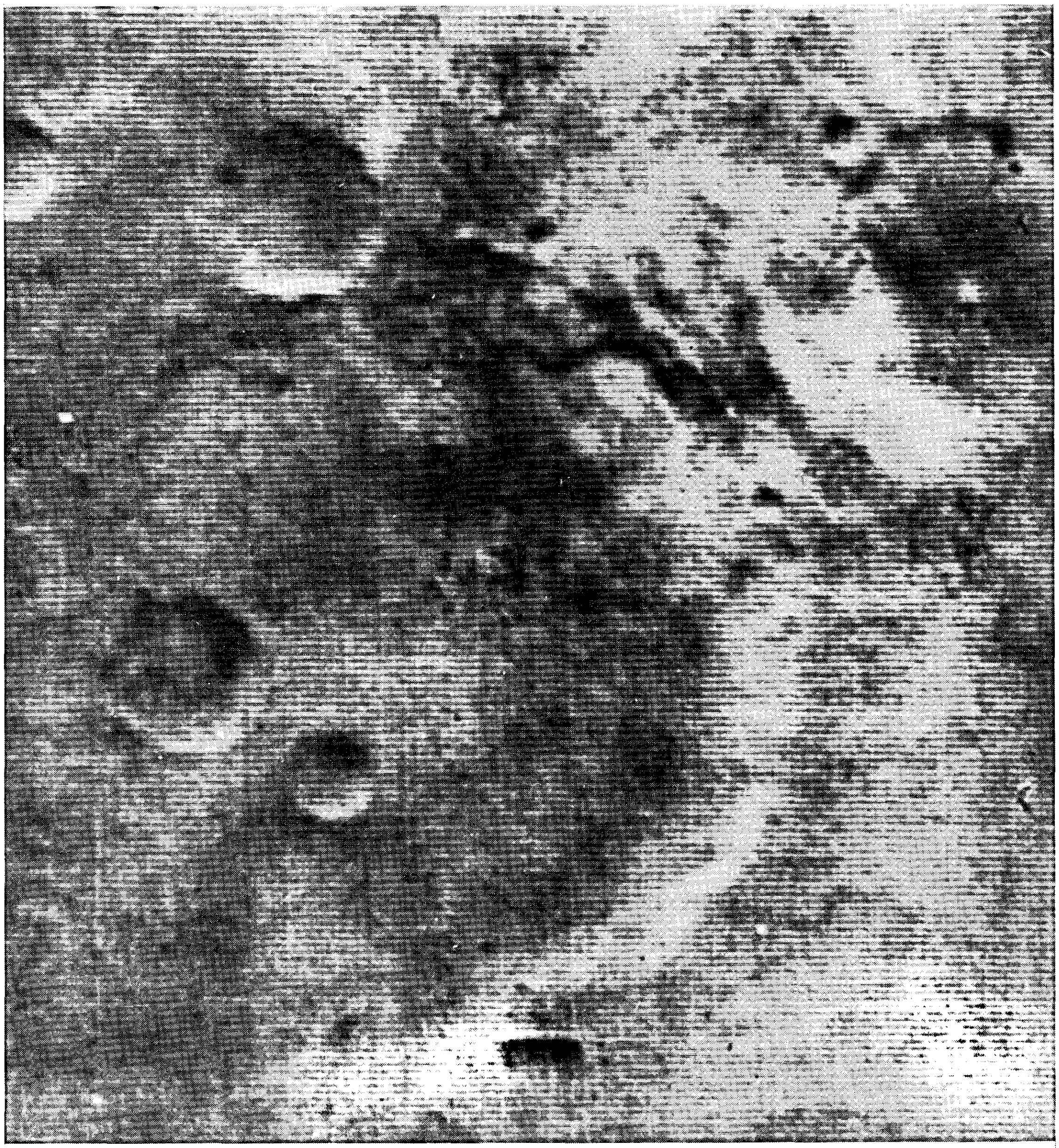
Mariner Four, the spacecraft that flew by the red planet July 14, was launched from Cape Kennedy November 28, 1964. During its 228-day flight, Mariner Four's 138,000 components functioned admirably to place the spacecraft on a path that took it past Mars at a closest dis- of 6,118 miles.

More than 60 of Mariner's subcontractors provided 21 million dollars worth of hardware and instruments. More than 1,000 other firms provided another 19 million dollars worth of procurements. Officials of the National Aeronautics and Space Administration estimate the entire cost of the Mariner Four flight at 120 million dollars.

But Mariner Four's photographic success depended on, among other elements, the ability of one strip of magnetic tape — thinner than a razor blade, not quite as wide as a pencil, and about as long as a 15-cent spool of thread — to record and faithfully reproduce photographs of Mars. The tape was Scotch instrumentation tape, made by 3M Co., St. Paul, Minn.

As Mariner Four passed Mars, a single television camera took 21 black-and-white pictures describes as "near perfect". The pictures were stored on the tape in digital form for later playback. This was necessary because, while picture data was recorded at 10,700 binary digits per second, the radio transmission rate from Mars was an extremely slow 8.33 bits per second. The slow transmission was needed to achieve reasonable picture quality over the 144 million miles of communications distance.

Tape length was held to 330 feet by the recorder's ability to operate at the extremely slow speed of 1/100 of one inch per second.



A photo of Mars — The photographic success of the $120 million Mariner IV program depended on a small, thin strip of magnetic instrumentation tape, on which pictures were recorded in binary digits. This photo of Mars was recorded from 7,800 miles away. The area covers 170 miles from east to west, 150 miles from north to south.

TIME-SHARING A COMPUTER AT A STOCK EXCHANGE

The New York Stock Exchange is among the first business organizations to put time-sharing into actual operation. Without disturbing almost instant stock quotations for 1600 listed stocks to subscribing brokers, the Exchange is operating an automated teaching program under actual market conditions at Post 17 on the trading floor.

Today, all sales and quotations involving the 119 stocks traded at the post are reported by duplicate teams of "Reporters" — one employing the traditional paper, pad and pencil, the other the new optical scanning method.

Under the old method, as each transaction occurs, a Reporter notes the stock by its abbreviated ticker symbol, along with price and volume, on a small slip of paper and hands it to a page. He, in turn, places it in a pneumatic tube for transmission to the ticker room, five stories above the trading floor. Normally, the information is flashed over a ticker network within two to three minutes.

In the automated system, a Reporter, by marking the specially-coded boxes on a pre-printed card, records up to three trades and one bit-asked quotation. The card is handed to a page who places it in the scanner which transmits the data to the computer. Within seconds, the data will appear on the ticker tape.

In the present teaching phase, however, this information does not enter the ticker tape. Instead, the computer converts it to a running account of trading activity at Post 17, recorded on a special teletypewriter printer nearby. The printer is monitored by a supervisor who sees what the computer pinpoints and identifies — in intelligible English — any card error that might occur during reporting. A mix-up in the issue traded, for example, is labeled "IDENTIFICATION," while "SPREAD" indicates that the difference in price between the latest trade and the previous one appears too large. Errors in pencilling the card's boxes are identified as "MARKING."

Guided by the computer's print-out, a Supervisor compares the original card against the transaction as reported on the ticker tape, pinpointing an error in seconds. The error is brought to the attention of a Reporter immediately, and as part of his training he marks a new card correctly.

Before the remaining trading posts are equipped with optical scanners and the automated reporting system becomes fully operational, more than 160 Exchange Reporters will be instructed by the "teaching machine" at Post 17. After being "graduated," every Reporter will be assigned to another post and given the responsibility for recording trading data for a specific "book" of stocks assigned him — usually about 17 issues.

TWO SDS 930 COMPUTERS WILL MONITOR APOLLO FLIGHT

In order to process high-priority performance data that requires immediate evaluation by flight controllers during the launch of the forthcoming Apollo spacecraft, two SDS 930 computers have been installed at Cape Kennedy, Florida.

The Apollo program is scheduled to begin test flights late this year, and is aimed at landing a man safely on the moon in five years.

The SDS 930 computers, made by Scientific Data Systems, Santa Monica, Calif., will process a multiplexed stream of information from the rocket boosters and the Apollo vehicle during the first ten minutes of flight at a rate of 250,000 words per second.

Later, during the orbit, the computer will handle telemetry from the orbiting spacecraft and booster. Data is telemetered from the Saturn boosters and Instrumentation Unit, the Command and Service Module, and from the Lunar Excursion Module (LEM). The separate telemetry links are multiplexed into a single, high-speed telemetry stream and fed into the SDS 930s which sample the data at a speed of three million binary digits per second. The SDS 930s then extract the operational parameters required for real-time decision and relay them to the Manned Spacecraft Center in Houston, Texas.

The $624,000 SDS computer system includes 16,384 words of core memory, two time-multiplexed communication channels, two tape transports, 32 levels of priority interrupt, a 300-line-per-minute printer, and a 200 card-per-minute reader.

OWENS-ILLINOIS SAVES NEARLY $50,000 THIS YEAR WITH RCA COMPUTER-ORIENTED MESSAGE SYSTEM

Owens-Illinois, Inc., Toledo, Ohio, will save nearly $50,000 this year as a result of an RCA electronic system that switches and processes more than 500,000 transactions a month in a fraction of the time previously required.

The new system has been in operation for nine months and utilizes an RCA 301 computer. It has reduced the order cycle time for goods and services by 90 per cent.

The computer-oriented message switching system installed in Toledo serves 103 widely scattered plants and offices through a teletype network. The system has reduced order float time from 14 days to 30 hours. It also analyzes one day's message traffic in about 15 to 20 minutes as a by-product of its operation, compared with three men working full time for a month.

Incoming information consists of administrative messages, orders, change orders, credit memos, shipping data, production information, and inventory.

To enter the network, a teletype operator punches out 48 characters which constitute all of the pertinent data about an order for finished goods. This order is received in Toledo by the message switching computer, is validated, and a paper tape of the order is created.

A second RCA 301 computer in the data processing center codes the message with an address to the plant or warehouse involved, prints the invoice, and computes and stores all particulars for later follow-up and analysis.

Associated with an RCA 501, the system also computes payrolls for more than 35,000 employees, calculates incentive pay, keeps stock records of 60,000 different items of finished goods, amasses order entries, invoice data, and property records, performs shareholder accounting, and operates a mathematical model used for scientific inventory management.

NEW CONTRACTS

FROM	TO	FOR	AMOUNT
U. S. Army	Telecomputing Services, Inc. Panorama City, Calif.	Data reduction and computing services for three years at White Sands Missile Range, N.M.	$7.5 million
Bankers Life and Casualty Co. Chicago, Ill.	Radio Corp. of America New York, N.Y.	Five RCA Spectra 70 electronic data processing systems	-
U. S. National Bank of Oregon Portland, Ore.	IBM Corporation White Plains, N.Y.	Three System/360's (one Model 30 and two Model 40's), due to arrive in 1966	-
Sylvania Electric Products, Inc. New York, N.Y.	Potter Instrument Co., Inc. Plainview, N.Y.	Digital magnetic tape transports for Army Electronics Command, Fort Monmouth, N.J.	$2.3 million
Continental Copper and Steel Industries, Inc. New York, N.Y.	General Electric Co. Computer Dept. Phoenix, Ariz.	GE-415 and GE-115 computers, etc., to be linked together for management information systems and communications over telephone lines	$500,000
U. S. Atomic Energy Commission, Lawrence Radiation Laboratories Berkeley and Livermore California	Control Data Corp. Minneapolis, Minn.	Control Data 6600 computer system for Berkeley; 6600 and 6800 computer systems for Livermore	Over $14 million
U. S. Air Force Systems Command Hanscom Field, Mass.	Librascope Group, General Precision, Inc. Glendale, Calif.	Data processing and programming services to diagnose potential electronic failures in the computer-based USAF 473L command-and-control system in the Pentagon, including the 27-unit AN/FYQ-11 data processing system	$1,270,000
Rome Air Devt. Center Griffis Air Force Base New York	Decision Systems Inc. Teaneck, N.J.	Diagnostic programs for RADC experimental multi-purpose computer system	Over $85,000
City of Los Angeles California	Systems Devt. Corp. Santa Monica, Calif.	First phase of a computer based information system for the Los Angeles Police Dept.	$50,000
Laclede Steel Co. Alton, Ill.	Westinghouse Elec. Corp. Pittsburgh, Pa.	Prodac 50 computing control system for arc furnaces	-
TRW Systems TRW Inc. Redondo Beach, Calif.	General Electric Co. Phoenix, Ariz.	Two GE series 635 computers and peripheral equipment, including core memory of 130,000 words and disk memory of 200 million characters	-
U. S. Army Materiel Command, Harry Diamond Laboratories Aberdeen Prvg. Grnd., Md.	Electro-Mechanical Research, Inc. Sarasota, Fla.	Fabrication, installation, and checkout of an automated magnetic data acquisition system, AMDAS	$130,000
NASA Washington, D.C.	Documentation Inc. Bethesda, Md.	Operation of NASA's Scientific and Technical Information Facility	About $5 million
U. S. Naval Air Development Center Johnsville, Pa.	Stromberg-Carlson San Diego, Calif.	Special airborne computer display equipment for anti-submarine warfare	Over $500,000
Rome Air Devt. Center Rome, N.Y.	Auerbach Corporation Philadelphia, Pa.	Design and evaluation of computing systems, composed of a content-addressable (associative) memory and a general-purpose computer for handling intelligence data-processing problems. Also, design of a storage-and-retrieval system for RADC computer	$136,000
NASA, and National Science Foundation	Texas A & M University College Station, Tex.	Space Research Center and Data Processing Center on Texas A & M campus	$1.9 million (Grants from NASA and NSF total $1,170,000 with Texas A & M providing the balance)

NEW INSTALLATIONS

AT	OF	FOR	FROM	AMOUNT
State Farm Mutual Insurance Co. Bloomington, Ill.	42 IBM System 360's	A national information network to maintain 10 million policy records	IBM Corporation White Plains, N.Y.	Over $30 million
Mass. Institute of Technology Computation Center Cambridge, Mass.	IBM System/360 Time-Sharing Computer Complex	To serve M.I.T. and 51 other cooperating colleges and universities in New England	IBM Corporation White Plains, N.Y.	$6 million
NASA, Marshall Space Flight Center Huntsville, Ala.	EAI hybrid system, comprised of EAI 8400 (digital) and 8800 (analog/hybrid)	Design studies in Saturn booster program, etc.	Electronic Associates, Inc. W. Long Branch, N.J.	$875,000
Iowa-Illinois Telephone Co., subsidiary of Continental Telephone Corp. New London, Iowa	IBM System/360	Processing toll call ratings and preparing subscribers' bills in a nine-state area; payroll preparation and financial records	IBM Corporation White Plains, N.Y.	-
National City Bank Marion, Ohio	NCR-315-100, including check sorter, printer, paper tape reader, and 5 magnetic tape units	Processing checks and deposits, payrolls, sales analyses, inventory control, accounts receivable	National Cash Register Company Dayton, Ohio	-
First National Bank of Dona Ana County Las Cruces, N.M.	NCR 315-100, with extra 10,000 digits of memory in processor and an additional tape handler	Processing demand deposit accounts, loans, and savings	National Cash Register Company Dayton, Ohio	-
USAF Pacific Air Command, (PACAF) Hickam Field Honolulu, Hawaii	H-800 and H-200 — which are among ten similar pairs of systems being installed by USAF in USA and in Europe	Greater management control over 70,000 men at 20 bases, covering a third of the earth's surface	Honeywell EDP Wellesley Hills, Mass.	-
Credit Bureau of Hawaii Honolulu, Hawaii	IBM System/360, Model 30: data cell drives, IBM 2260 visual display terminals, output printer	Mechanize credit information files; billing and accounting	IBM Corporation White Plains, N.Y.	-
Bank of America San Francisco, Calif.	Two IBM 360-65's consisting of central processor, direct access file facilities, etc.	Deposit accounting system in Los Angeles and San Francisco	IBM Corporation White Plains, N.Y.	$10 million
First National Bank Highland Park, Ill.	NCR 315 system: 20,000 digits of processor memory, four magnetic tape files, printer, paper tape reader, and magnetic document sorter	Magnetic sorting and processing of checks and related items. Data processing services to business accounts.	National Cash Register Co. Dayton, Ohio	-
Westinghouse Electric Corp. Underseas Div.	HYDAC-2000	Development of undersea warfare and oceanographic devices	Electronic Associates, Inc. W. Long Branch, N.J.	Over $500,000
Univ. of Rochester Rochester, N.Y.	On-line time sharing computer system, consisting of PDP-6 and PDP-8 computers and a new intercommunication subsystem	Time-shared computation and on-line data acquisition for nuclear experiments at university's Nuclear Structure Research Laboratory	Digital Equipment Corp. Maynard, Mass.	-
Univ. of So. Calif. School of Engineering Communications Systems Laboratory Los Angeles, Calif.	Model 420 digital computer	Development of more efficient television system, to transmit pictures from as far as Mars or the Moon	Beckman Instruments, Inc. Fullerton, Calif.	$80,000
Sunset International Petroleum Corp. Beverly Hills, Calif.	H-200: 12,288 characters of memory, 4 magnetic tape drives, card reader/punch, and printer	General accounting, payroll, oil production reporting, inventory analysis, etc.	Honeywell EDP Wellesley Hills, Mass.	-

ORGANIZATION NEWS

NAME OF OMNITRONICS, INC. IS CHANGED TO OMNI-DATA

The name of the Borg-Warner subsidiary, Omnitronics, Inc., of Philadelphia, has been changed to Omni-Data Division. The division manufactures paper tape readers and reelers, communications terminals, and electrostatic out-put printers serving the fields of computers, numerical control machine tools, graphic arts, and communications.

NEW COMPANY FORMED FOR TAX RETURN PROCESSING

Commerce Clearing House, Inc., and Computer Sciences Corporation have organized a new company, COMPUTAX Corporation, which will offer computerized income tax return processing. The service will be made available to all professional preparers of tax returns, principally accountants and attorneys.

COMPUTAX Corporation has taken over and will expand the system which Computer Sciences has had under development since 1963 and in operation since 1964.

COMPUTAX will offer computer service for the calculation and printing of income tax returns and schedules. Technical staff and facilities developed by CSC during the past two years for processing returns will be combined with CCH's nation-wide marketing organization to offer this special service.

Headquarters for COMPUTAX will be located in Los Angeles, with additional processing centers in several other cities, including New York and Chicago. For the 1966 tax season, the service will be available in approximately one-half of the states, those from which the most returns are filed. Expansion to other states is planned for the future.
(For more information, designate #41 on the Readers Service Card.)

NCR DATA CENTER IN HONG KONG

The National Cash Register Company opened in September the first data center to be established in Hong Kong.

The EDP system is an NCR 315 with two CRAM (Card Random Access Memory) units, and paper tape and punched card input and output. The center is providing inventory control, market research, statistical analysis, off-line savings account processing, and other management control services. It will also be used for local EDP training and as a backup for other installations in Hong Kong.

Another NCR 315 system in Hong Kong, at the China Light & Power Company, has been in operation for over a year and is currently billing some 260,000 customers a month.

NINE COMPUTER SYSTEMS COMPRISE NEW RCA DATA PROCESSING FACILITY

The Radio Corporation of America is installing a multi-million dollar data processing center to support sales and programming activities for its new Spectra 70 line.

Located at Cherry Hill, N.J., the data processing headquarters, will hold nine RCA Spectra 70 systems, serving both as a demonstration and a testing area where customers can develop programs and train personnel prior to installing their own equipment.

Two RCA Spectra 70/15's already have been installed. Another 70/15 and a pair of Spectra 70/25's will be installed this fall. A third-generation Spectra 70/45 system, using monolithic integrated circuitry, is scheduled to go on-line in November. Two additional 70/45's will be installed February 1966 and a fourth in May.

BURROUGHS GRANTS INDICATOR TUBE LICENSE TO AMPEREX

Burroughs Corporation, Electronic Components Division, Plainfield, N.J., has settled its infringement suit against Amperex Electronic Corp., Hicksville, Long Island, N.Y. The suit was filed two years ago in Federal Court and was settled by the signing of a royalty-bearing licensing agreement between the two companies.

Under the terms of the settlement, Amperex may market and sell its Biquinary numerical indicator tube type ZM 1030 and other indicator tubes covered by certain Burroughs patents.

The biquinary tube was first developed by Burroughs in 1958. Amperex introduced its version, a side-viewing type called the "Bi-Qui", in 1962.

CODE BAR SWITCH DIVISION SOLD BY COMPUTER CONTROL COMPANY

C & K Components Inc., Newton, Mass., have acquired the code bar switch product line from Computer Control Company of Framingham, Mass., for an undisclosed sum.

C & K Components Inc. produce magnetic timers, code converters, logic elements, and subminiature toggle switches.

BRANDON APPLIED SYSTEMS, INC. ACQUIRES MULTI-METHODS CORPORATION

Stockholders of Brandon Applied Systems, Inc. and Multi-Methods Corporation have approved the acquisition of Multi-Methods Corporation by Brandon Applied Systems, Inc. The acquisition was made for an undisclosed amount of cash.

Brandon Applied Systems, Inc. is a technical consulting firm specializing in data processing. Multi-Methods Corporation is a service firm, specializing in systems and programming services, located in Queens, N.Y.

Brandon Applied Systems, Inc., offers a range of services in the data processing field, and is the joint publisher of Moody's Computer Industry Survey, a new financial-technical service devoted to evaluating developments in the data processing industry.

GE COMPUTER SERVICE CENTER IN SAN FRANCISCO

A General Electric computer information processing service center began operation in San Francisco, Calif., in August.

This center is ninth in a growing chain of nationwide G-E computer service centers. They provide data processing services for organizations which require professional programming and computer application services, including banks, savings and loan associations, construction firms, manufacturers, high schools, scientific and engineering concerns, wholesale distributors and general businesses.

Facilities at the center include a GE-225 general-purpose computer system equipped with a 16,000-word memory, a 1,200-check-per-minute sorter and reader, 8 magnetic tape units, card reader and punch, and a high-speed printer.

COMPUTER APPLICATIONS INC. ACQUIRES SAN FRANCISCO FIRM

Computer Applications Inc. has acquired all the capital stock of Peninsula Tabulating Service, Inc. of Burlingame, Calif., a large independent data processing firm in the San Francisco area.

The transaction involved 35,000 shares of CAI common stock worth approximately $700,000.

This new joint operation will be CAI's third in California — the others are in San Diego and Los Angeles — in addition to its facilities in New York, New Jersey, and Washington, D.C.

Peninsula Tabulating will be operated as a wholly-owned subsidiary of CAI. Kenneth Patchett, president of Peninsula, will remain chief executive officer and will also assume responsibility for CAI's service bureau activities on the West Coast.

REMOTE ON-LINE COMPUTING SERVICE IN BOSTON AREA

Bolt Beranek and Newman Inc., Cambridge, Mass., who have pioneered in on-line time-sharing of a computer, have begun to provide a remote on-line computer service in the Boston area. The language used is TELCOMP, an expanded version of Rand Corporation JOSS (Johnniac Open-Shop System). TELCOMP, which is easily learned by non-programmers, is an interpretive system for doing arithmetic computation.

Teleprinters used as remote consoles are connected to the central computer by means of either the teletype network or private telephone lines.
(For more information, designate #42 on the Readers Service Card.)

EDUCATION NEWS

UNIVERSITY OF IOWA ADOPTS DEGREE PROGRAM IN COMPUTER SCIENCE

A graduate program in computer science has been approved for The University of Iowa, Des Moines, Iowa, by the State Board of Regents.

The University will offer the master of science degree and the doctor of philosophy degree in conjunction with the recent establishment of a Department of Computer Science within a new Division of Mathematical Sciences.

Requirements for admission to the advanced degree programs in computer science will be generally those of the Graduate College. The programs will include courses in mathematics, computer science, statistics, and electrical engineering.

The master of science program is designed to equip students for advanced study in the mathematical, physical, and social sciences, and to prepare them for careers in industry, education, or government. The doctoral degree program in computer science will prepare students for careers in teaching and research, as designers of computer systems, or as consultants in industry.

EDUCATIONAL COMPUTER CENTER IN SACRAMENTO, CALIF.

The Sacramento Regional Educational Data Processing Center, located in the offices of the County Superintendent of Schools, Sacramento, opened in July. It is the first one of 12 such centers that ultimately will operate in California, providing computer services to hundreds of school districts.

Through the Sacramento regional center, complete pupil personnel services will be offered in the fall to 44 school districts in 16 Northern California counties. The services "package" will cost participating schools $2.50 a year per pupil, and will include student scheduling, attendance reports, grade reporting, and test scoring.

A Honeywell 200 computer system has been installed and will be used until December when a Honeywell 2200 computer will start operating.

The Sacramento Center's H-200 system includes a central processor with 65,536 characters of memory, a console, 6 magnetic tape drives, two 650-line-per-minute printers, a card reader/punch, and random-access drum storage that can hold up to 2.6 million characters.

A master processing schedule has been prepared for the coming year, with computer time scheduled for all participating districts.

Junior college students enrolled in a special advanced computer class will work at the Sacramento center on programming, use of machine languages and actual operation of the H-200.

STUDENT ESSAY CONTEST ON "COMMUNICATING WITH COMPUTERS"

"Communicating With Computers" is the theme of an International Student Essay Contest sponsored by SIGPLAN, the Special Interest Group on Programming Languages of the Los Angeles Chapter of the Association for Computing Machinery. The Group is offering a $100 first prize, a $50 second prize, and a $25 third prize. The contest rules are:

Any full-time college or university student, graduate or undergraduate, may enter.

Entries should deal with the technical, philosophical, or social aspects of communicating with digital computers, with emphasis on the languages that may be used to direct or control the computer's operation.

Entries will be judged on interest, originality, and clarity of thought and style, and must be received by the contest chairman no later than January 3, 1966. Awards will be made in February 1966 and will be publicly announced soon after.

For more information, write to:
Chairman, SIGPALN Essay Contest
Los Angeles Chapter, ACM
P. O. Box 892
Pacific Palisades, Calif. 90272

RENSSELAER POLYTECHNIC MAKES NEW COMPUTER LABORATORY

A new digital computer systems laboratory has been constructed and furnished by the electrical engineering department at Rensselaer Polytechnic Institute, Troy, N.Y.

The laboratory contains more than $250,000 worth of equipment ranging from a magnetic core memory system to a complete digital computer.

Grants from the National Science Foundation helped establish the laboratory; and provide the equipment.

Students are taught the design of digital systems by means of a series of experiments: first, the design of basic circuits; second, the use of basic circuits as building blocks to construct digital subsystems; and third, the assembly of subsystems to form a complete digital computer system.

In all the experiments, students are given wide flexibility to pursue the subject of the experiment beyond the prescribed goal. In this way they may be motivated toward additional experiments involving NOR Circuit Design, Pulse Circuits, Micrologic, Arithmetic Units, Magnetic Core Logic, Magnetic Tape Storage, etc.

UNIVERSITY OF CHICAGO ESTABLISHES DEGREE IN INFORMATION SCIENCES

The University of Chicago, Chicago, Ill., has formed a Committee on Information Sciences, which will sponsor a graduate program leading to the S.M. and PhD. degrees.

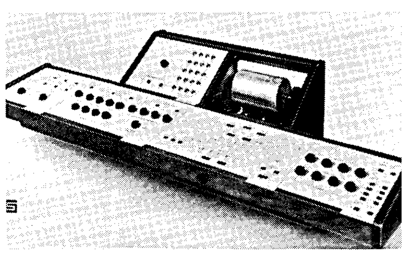
The Committee is based in the Division of the Physical Sciences, but has ties with other academic units within the University through joint appointments. The Committee provides the instructional focus to computer-related activities within the University, already represented in their research aspect by the Institute for Computer Research and in their service aspect by the Computation Center. A faculty committee of eight has been named, with R. H. Miller, Director of the Institute for Computer Research, as Acting Chairman of the Committee.

NEW PRODUCTS

Digital

MOTORIZED COMPUTER TRAINER

A new, motorized Model 601 Computer-Trainer for teaching Computer Basics, Programming, Boolean Algebra, Number Theory and Binary Logic is available from Arkay International, Inc., Brooklyn, N.Y. The Model 601 is designed to enable industrial training courses and programs to better meet the requirement for trained personnel in deisgn, programming and servicing of computers.



The device contains a decimal-to-binary encoder section for converting numbers into the binary system, and a five-address/four-digit scratch pad memory storage for containing and retaining binary-coded data or instructions, a binary add/subtract module for actual computation including multiplication and division by binary 2, a motorized one-step-at-a-time drum program section which brings each computer direction into a control panel read-out for manual operation, and an output section which converts the binary answer into a decimal number once more.

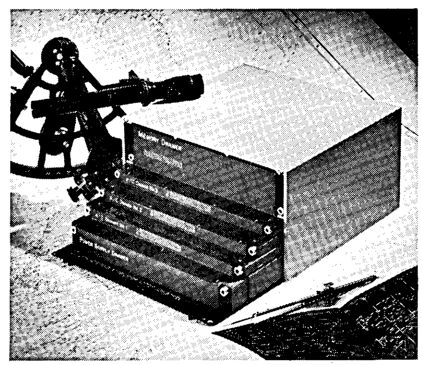
The student may operate the Computer-Trainer from the Control Panel while following his steps on the back-of-panel wiring. Each section is a complete, separate sub-unit and may be taught as a separate operation section in any given lesson.

Since Model 601 operates as a "slow motion", semi-automatic digital computer, any of the computer or mathematical sciences including the flow of number-traffic through a computer can be demonstrated. (For more information, designate #43 on the Readers Service Card.)

LITTON'S L-304

The smallest and lightest computer to offer militarized real time data processing with multiple program and multiple computer capability has been developed by Litton Industries' Data Systems division. It can be used for ground or airborne command and control of jet military aircraft and missiles, or any other large-scale military computing problem.

The first of the company's L-300 series computers weighs only 34 pounds, including the power supply, and is contained in a case measuring .3 cubic ft. — about the size of two cigar boxes. Designated the L-304, the computer contains 4096 thirty-two-bit words of memory. The package provides a selection of plug-in drawers including memory, arithmetic and control, input-output, and power supply.



— Litton's L-304

The L-304's memory is expandable to 32,000 32-bit words. With the addition of memory extension logic, it can be increased to 262,000 32-bit words. Computational capability also is expandable through a multiple computer configuration. Each computer can communicate with up to 16 memory modules at 8192 words each, and each module can communicate with up to four computers or computer-like devices.

Read-write cycle time is 1.6 micro-seconds for a memory composed of 4096-word modules, or 1.8 microseconds for a memory composed of 8192-word modules.

The computer's compactness is made possible by maximum use of monolithic silicon integrated and hybrid circuits, interconnected by multi-layer boards, and by use of a series of miniaturized power supplies developed by Litton's Data Systems division.

While organized as a general purpose computer, special features of the L-304 that make it effective in real time command and control and intelligence data processing include special instructions, multiple program capability with automatic priority control, and an extensive and flexible input/output system — allowing for communication with up to 64 input/output devices.
(For more information, designate #44 on the Readers Service Card.)

MODEL 44 ADDED TO IBM SYSTEM/360

A new computer with a combination of speed, programming and low cost that make it especially suited for scientific problem solving has been added to IBM's System/360. The System/360 Model 44, announced by IBM Corporation, is expected to see widest uses in fields such as aerospace, medicine, manufacturing, and with universities and government agencies.

Information stored in the Model 44's memory can be "accessed" — reached by the computer — in a millionth of a second. The internal cycle of the Model 44 is four times faster — a machine cycle can be completed in 250 nanoseconds (billionths of a second). When the computer is working with large numbers the precision — the number of digits which are rounded off — can be varied in order to gain problem-solving speed.

To speed data flow between the computer and peripheral equipment and for program storage, a 272,000-word, direct access disk storage unit is built into the Model 44.

The new computer can be linked to the IBM graphic system, the IBM 1800 data acquisition and control system, other System/360 models and to auxiliary equipment specifically chosen for the scientific user. This can include data storage devices and visual display units.

A series of comprehensive scientific support programs is provided by IBM for the Model 44. These programs enable it to utilize FORTRAN and to perform basic computer routines.

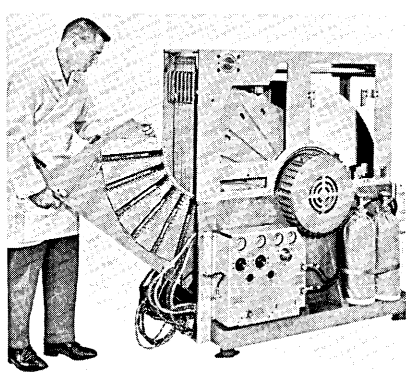
Model 44 is the ninth System/360 model now available and ranks fourth in scientific computing power. First deliveries are scheduled to begin in the third quarter of 1966.
(For more information, designate #45 on the Readers Service Card.)

Memories

GIANT DISC MEMORIES BY GENERAL PRECISION/LIBRASCOPE

A series of large disc memories with storage capacity up to 6.4 billion bits on a single trunk line and a data-transfer rate of a billion bits per second has been developed by Librascope Group of General Precision, Inc., Glendale, Calif. The memory capacity and transfer speed make the disc memories among the fastest and largest ever developed.

R. W. Lee, Librascope president, said the memories, designated LIBRAFILE 4800 mass memories, are designed for use as computer mass memories in large scientific computing centers, in message-switching centers, in military command-and-control installations, and in intelligence data-processing systems.



— Technician retracts mounting plates of new LIBRAFILE 4800 mass memory. The retractable plates permit easy maintenance.

The new LIBRAFILE 4800 mass memories are available in a basic 6-disc configuration with a storage capacity of 400 million bits, a data transfer rate up to 150 million bits per second, and an average access time of 35 milliseconds.

By combining 16 files on a single trunk line, an on-line storage capacity of 6.4 billion bits can be achieved. With special electronics, a data transfer rate of a billion bits per second is available.

The new memories also feature a fixed-head per track, two methods of search and retrieval, and retractable head plates.
(For more information, designate #46 on the Readers Service Card.)

Software

AUTOMATIC TRANSLATION OF PROGRAMS FROM ONE COMPUTER TO ANOTHER

After five years of development and over twenty man years of effort, Celestron Associates, Inc., Valhalla, N.Y., has developed a system which performs fully automatic program translation.

The system, called X-ACT (automatic code translation for any (X) computer), is capable of accepting machine language computer programs written for any computer and automatically translating these programs into machine language programs for any other desired computer. The system is designed to be 100% automatic and produces a target program for all possible varieties and sequences of instructions in the original program.

Two implementations of the X-ACT system have been developed. The first concerned two medium-scale computers. The second concerned two larg-scale computers, and takes into account the full range of programming capability including fixed and floating point arithmetic, index registers and independent simultaneous input/output.

The X-ACT system is capable of translating a program of 10,000 instructions in 5 hours. This time includes up to four passes of the program on a CDC 1604, but no editing or programmer intervention is required. The generated program will be an exact equivalent of the original.

The X-ACT system requires, as input, only the binary source program with its loader and a description of the external data to be processed by the program; it produces a binary target program and a flowchart of the original program as output.
(For more information, designate #47 on the Readers Service Card.)

A BUSINESS PROGRAMMING PACKAGE FROM SDS

A new Business Programming Package for all SDS 900 Series computers and the SDS 9300 has been developed by Scientific Data Systems, Santa Monica, Calif.

It consists of: a file maintenance system known as MANAGE; the SDS Business Language; and a generalized SORT/MERGE program.

MANAGE is expressly designed for implementing corporate decision-making. Management personnel outside of the data processing department, through it, are able to obtain direct access to information processed by the computer. MANAGE provides a highly simplified method of using an SDS computer to establish and maintain company records on magnetic tape and to selectively retrieve data and generate printed reports.

One feature of MANAGE is a data file "dictionary" which describes the format and characteristics of all records in a magnetic tape file and eliminates the need to specify formatting and control parameters each time a job is run.

The new business programs supplement an extensive library of programming systems available to SDS computer users. These include MONITOR and MONARCH systems for total operational and supervisory control, FORTRAN II and IV compilers, ALGOL compilers, and META-SYMBOL and SYMBOL assemblers.
(For more information, designate #48 on the Readers Service Card.)

FLOW CHART PRODUCER

A new programming software system called AUTOFLOW which produces flow charts from assembly or higher level languages has been developed by Applied Data Research, Inc., Princeton, N.J. A patent application for it has been filed. It has been implemented so far for nine computers (three manufacturers).

AUTOFLOW produces flow charts on a high speed printer that are comparable in quality and clarity to flow charts produced manually by the programmer. For assembly language input, the key to AUTOFLOW is a special chart code placed in the comments field. The placing of chart codes is the only special effort required on the part of the programmer to obtain a flow chart. AUTOFLOW edits all information to be contained within a flow chart symbol, allocates columns and pages and draws connecting lines on a page. It rearranges the input language to provide a graphic representation of the true program interaction. The programmer is never required to specify any graphic or flow chart layout information to the program. AUTOFLOW also produces special listings which, together with the flow chart, aid the programmer during debugging.

As a documentation tool AUTOFLOW has proved invaluable for controlling the accuracy and quality of flow chart documentation and has been in operation at ADR customer installations since 1965.
(For more information, designate #49 on the Readers Service Card.)

PREPROCESSOR FOR CONVERTING DECISION TABLE LANGUAGE

Decision tables are being used by more and more people for problem specification, system analysis, and programming. To encourage increased use of decision tables in business data processing, a preprocessor has been built to convert a decision-table language — DETAB/65 — into COBOL.

The preprocessor was developed by Working Group 2 on Decision Tables of the Special Interest Group on Programming Languages (SIGPLAN) of the Los Angeles Chapter of the Association for Computing Machiners.

The preprocessor is written in required COBOL'61. It converts limited-entry decision tables, incorporated by the user into his COBOL program, into required COBOL '61. The preprocessor was designed to be used with any computer that has a COBOL'61 compiler. So far, it has been successfully compiled and executed on seven computers (two manufacturers).
(For more information, designate #50 on the Readers Service Card.)

Data Transmitters and A/D Converters

HIGH SPEED DATA SET MODIFIED FOR UNATTENDED TRANSMISSION

Bell System Data-Phone service now enables business machines transmitting at speeds up to 2,000 bits per second (about 2,700 words per minute) to converse with one another without any human intermediary. Operating in conjunction with Bell System 801-type Automatic Calling Units, the 201A Data-Phone data set now is compatible with computer-to-computer transmission as well as with machines that transmit punched paper tape, magnetic tape and card media.

With this new feature of the 201A Data-Phone data set, companies with several branch offices will be able to poll these offices automatically over the regular telephone switched network for sales, production and other information. By making such polls in off-hours, companies will be able to take advantage of lower evening telephone rates and also reduce the transmission traffic which their telephone service must handle during regular hours.
(For more information, designate #51 on the Readers Service Card.)

Input-Output

HIGH SPEED SERIAL ENTRY PRINTER

The Data-Master Division of The Bristol Company, Waterbury, Conn., has announced the development of a new high-speed, alphanumeric data printer. This printer, the Model 750 combines the speed and reliability of a line printer with the ease of operation, flexibility and low cost of a serial entry printer. Uses include on- or off-line operation with tab card, punched tape, and magnetic tape devices.

The Data-Master® Model 750 prints data at the same rate at which data is received up to a maximum of 75 characters per second. It will accommodate roll paper as wide as 50 inches and all standard sizes of fan-fold paper. Versatility of this printer is indicated by the fact that the input code and print-out characters can be selected by the user to meet his specific needs.
(For more information, designate #52 on the Readers Service Card.)

MICRO PUNCH 461 — PORTABLE KEY PUNCH DEVICE

The Micro Punch 461 weighs only eight pounds and punches fully interpreted numeric data into standard tabulating cards.

This device, developed by the Paul G. Wagner Co., Los Angeles, Calif., uses standard 80-column cards for source input. Data is set up on a slide-type keyboard which displays selected numbers in visible windows for full verification. A single stroke of the platen punches and interprets eight columns of data. Application-tailored program bars make it possible to cover full-card capacity in a series of sequenced operations.
(For more information, designate #53 on the Readers Service Card.)

Components

KYREAD TAPE DEVELOPER

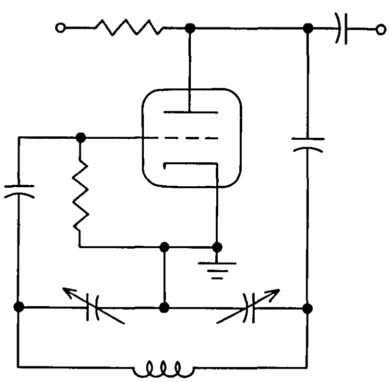
KYREAD®, a new tool for the computer industry, is a high precision visual tape developer. It is available from Kyros Corporation, Madison, Wisc.

Accurate to better than 10^{-3} inches, Kyread can be used to determine recorder head alignment, track placement, dropouts, and interblock spacing. The product is easy to remove after use and yields zero readback error. It is non-flammable and non-toxic.

Kyread is now available from stock in bulk, eyedropper bottles, dip jars, and aerosol bottles (both metered and continuous spray).
(For more information, designate #53 on the Readers Service Card.)

ELECTRONIC TYPING ELEMENT

The Electronic Typing Element developed by Camwil Inc., Los Angeles, Calif., for use with IBM Selectric typewriter mechanisms enables production of schematics by simple keyboard operation.



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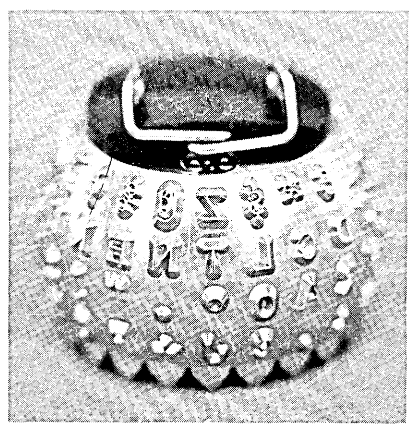


with this —

The special characters on the electronic element will create all components needed for electrical and electronic diagrams and schematics. The use of an electronic element with a tape or card punch machine will provide a library of pre-punched standard schematics ready for incorporation into new designs, reports and articles. The library also permits rapid construction of modified diagrams.

The electronic element assures neatness and legibility in an exacting medium. Accuracy and uniformity are achieved through standardization of symbols and letters.
(For more information, designate #55 on the Readers Service Card.)

AUTOMATION

AUTOMATIC MEASURING DEVICES AID FLOOD-CONTROL SPECIALISTS

In Everett, Wash., automatic measuring devices "talk" to government flood-control specialists over conventional telephone lines to assure that residents are evacuated promptly from flood-threatened areas.

The devices, installed by the state of Washington, measure the depth of the many normally placid rivers that feed into Puget Sound. When melting snow from the Cascade Mountains creates a flood threat, this information is transmitted in code to the flood-control specialists when they telephone the individual measuring stations. West Coast Telephone Company, a subsidiary of GT&E, provides telephone relays that link such flood-warning installations on the Snohomish River nearby to conventional telephone facilities.

The measuring device, known as Stevens Telemark, is housed in a specially-designed well attached to a bridge at each of the Snohomish River locations. The water in each well reflects the depth of the river at that particular point, and a float mechanism positions recording drums within the Telemark equipment to indicate the water level.

When the unlisted telephone number of the Telemark station is called, a motor is energized and sweeps a contact arm across the face of each recording drum. This action produces the code signals, which are directed into the telephone tranmitter by a nearby "buzzer". The buzzer tone transmits a series of dots and dashes at six-second intervals, with a dot representing "one" and a dash "zero". A government caller hearing two dots, one dash, and three dots would be provided with a water-level reading of 20.3 feet.

Similar devices are used in rivers throughout Washington by the weather bureau, water conservation district, Army engineers, and other state and federal agencies. It is anticipated that supplemental equipment will be added in the future to transmit the data in a form suitable for direct input into computer systems.

MEETING NEWS

FOUR DAY PROGRAM TO EXPLORE COMPUTER REVOLUTION ON LAW

The impact of the computer revolution on law and the administration of justice will be explored during a four-day institute, Nov. 30 - Dec. 3, sponsored by American University's Center for Technology and Administration, Washington D.C. It will be held at Washington's Twin Bridges Marriott Motor Hotel.

The four-day session will cover the storage and automatic retrieval of statuatory and case law; recently developed aids to decision making; computer uses in federal judicial and regulatory administration, and applications at the state and local levels.

Additional information can be obtained by writing Paul W. Howerton, director of the Center for Technology and Administration, The American University, 2000 G St. NW, Washington, D.C.

RECORD NUMBER OF PAPERS SUBMITTED FOR FJCC

An unprecedented total of more than 300 technical paper drafts are being reviewed for the 1965 Fall Joint Computer Conference (FJCC), it was disclosed by S. Nissim and T. B. Steel, Jr., co-chairmen of the technical program committee.

Drafts of complete papers were submitted by authors from every section of the United States and several foreign countries. They said that topics included aspects of information sciences ranging from exotic programming theory to data system management and practical applications. A total of approximately 20 papers will be selected for presentation at the conference, which will be held from November 30 through December 2 at the Convention Center in Las Vegas, Nev.

BUSINESS NEWS

AMPEX ACHIEVES RECORD ORDER LEVEL

Ampex Corporation sales for the first quarter of fiscal 1966, ended July 31, 1965, totaled $35,273,000, up from $32,457,000 in the first quarter of fiscal 1965. Net earnings after taxes were $1,408,000 compared with $1,290,000 for the corresponding period last year.

William E. Roberts, president and chief executive officer, said both sales and earnings for the first quarter were as planned. "Orders received in the quarter were the highest in any quarter in the company's history, and we continue to expect gains in both sales and earnings during the rest of fiscal year 1966," he said.

Among the new products introduced by Ampex in the quarter were the HVR home videotape recorder, new home audio recorders, speakers, accessories and prerecorded tapes. In addition, the company placed on the market a new family of instrumentation tape recorders, a high-quality, low-cost computer core memory, a core memory stack for small scale data systems, an off-line card-to-tape conversion system, two audio teaching devices, and a solid state professional audio recorder/reproducer for radio station and recording company use.

CONTROL DATA'S SALES RISE 22%

Sales, rental and service income of Control Data Corporation and its subsidiaries amounted to $160 million for the year ended June 30, 1965, as compared with $131 million in the same period last year. Net earnings after provision for income taxes were $7,912,961 as compared with $6,018,121 last year.

The figures for the fiscal year 1964 have been adjusted retroactively to reflect acquisitions subsequent to that fiscal year recorded as poolings of interests and for the 3 for 2 stock split in September 1964. Amounts shown for the fiscal year ended June 30, 1965 include the effect of two basic accounting changes:

One change, effective January 1, 1965, was a switch from an accelerated to a straight line depreciation of leased computer systems — the term in each case being three years. Without this change earnings for fiscal 1965 would have been reduced by $0.16 per share

The second change was made to give recognition to the fact that an increasingly substantial portion of the Company's development, programming and marketing expenses are spent in obtaining orders for leases, the income from which will be spread over several years. Accordingly, the Company now defers that portion of such expenses directly related to lease contracts and amortizes them over the periods during which the rental income is received but not to exceed three years. Without this revision the earnings for fiscal 1965 would have been reduced by $0.30 per share.

The Company's incoming orders for fiscal year 1965 are reported increased approximately 40% and the backlog as of June 30 are reported increased approximately 60% over the previous year, again with a much larger portion in leases. This means, a company spokesman said, that this improved performance for the past year would not have been reflected in the profit and loss statement without the recognition that certain current development, application and support costs apply to the Company's firm lease contracts and should therefore be charged against future lease income.

CALCOMP REPORTS SALES, EARNINGS

California Computer Products, Inc., Anaheim, Calif., have announced net income of $446,751 on sales of $5,089,000 for the fiscal year ended June 30, 1965. This compares with earnings of $459,391 on sales of $5,157,000 for the previous year.

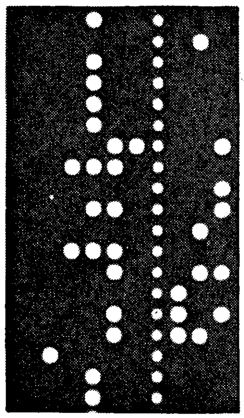
Research and development expenditures amounted to more than double those of last year.

Lester L. Kilpatrick, president, said that the company's product line was upgraded and a variety of new products were added "to keep pace with the expanding computer industry." Proprietary product sales rose 23% to a record 84% of total sales, while non-proprietary government sales decreased to 16% from 46% the previous year.

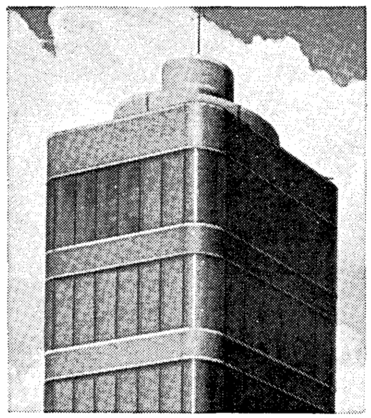
What can NCR Total System do for You?

Gives you a COMPLETE chain of control over sales, production, inventory and distribution! The same thing it's doing for JOHNSON'S WAX!

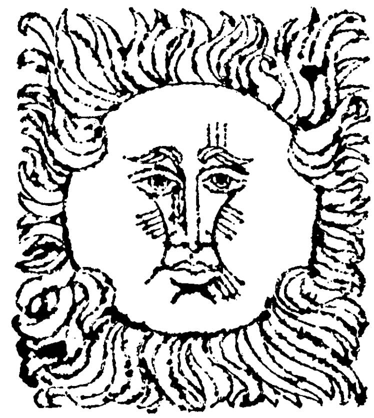
It starts very simply. With a sale. A Johnson Wax product is sold . . . anywhere.



When re-orders are issued to Johnson salesmen in the field, they are immediately entered on an NCR 160 Adding Machine equipped with a paper tape recorder.

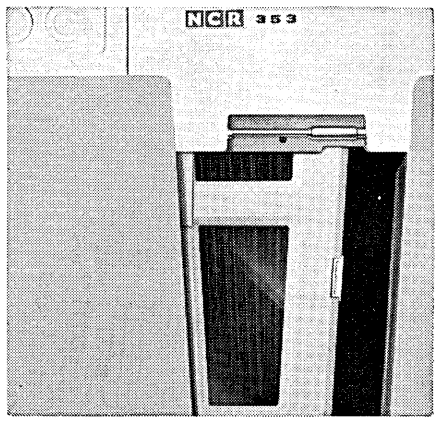


These orders are then transmitted to Johnson headquarters in Racine, Wisconsin, via AT&T lines. In Racine, the tapes are removed from the Teleprinters and forwarded to the NCR computer.



Incoming orders and inquiries are processed by early the next morning. Changes in demand (and, naturally, inventory) can be decided by this system within 24-48 hours. Thus revisions in production and distribution can be implemented, immediately. This uniquely flexible NCR Total System gives Johnson Wax a completely closed loop of control—from the sale of the product—all the way through to the next sale . . . ad infinitum.

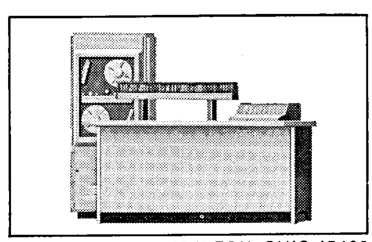
(Among other benefits: they've reduced their inventory by about 7-10 days supply.) Quite an investment.



In addition, the NCR 315 computer is used in all phases of Johnson's marketing operation: special marketing campaigns, marketing forecasts, production control, manpower assignment, ordering of raw materials, and many others.

That's why Johnson Wax knows... when NCR says Total Systems... they mean *total!* To learn how Total Systems can work for you, see your local NCR man. Or write to NCR, Dayton, Ohio.

NCR



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MONTHLY COMPUTER CENSUS

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

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

In general, manufacturers in the computer field do not officially release installation and on order figures. The figures in this census are developed through a continuing market survey conducted by associates of our magazine. This market research program develops a documented data file which now covers over 85% of the computer installations in the United States. A similar program is conducted for overseas installations.

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

AS OF SEPTEMBER 10, 1965

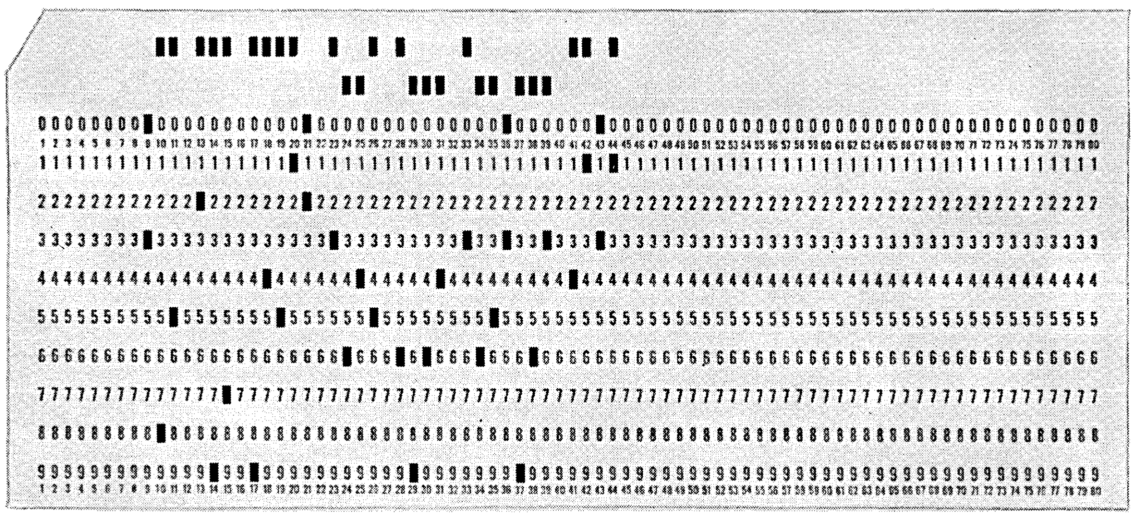
NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTALS	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS
Addressograph-Multigraph Corporation	EDP 900 system	Y	$7500	2/61	11	1
Advanced Scientific Instruments	ASI 210	Y	$2850	4/62	23	2
	ASI 2100	Y	$3000	12/63	6	0
	ASI 6020	Y	$2200	4/65	3	4
	ASI 6040	Y	$2800	7/65	1	4
	ASI 6050	Y	$3000	10/65	0	1
	ASI 6070	Y	$3500	10/65	0	7
	ASI 6080	Y	$4000	1/66	0	0
Autonetics	RECOMP II	Y	$2495	11/58	52	X
	RECOMP III	Y	$1495	6/61	13	X
Bunker-Ramo Corp.	BR-130	Y	$2000	10/61	160	6
	BR-133	Y	$2400	5/65	8	7
	BR-230	Y	$2680	8/63	14	1
	BR-300	Y	$3000	3/59	40	X
	BR-330	Y	$4000	12/60	35	X
	BR-340	Y	$7000	12/63	19	1
	BR-530	Y	$6000	8/61	15	X
Burroughs	205	N	$4600	1/54	55	X
	220	N	$14,000	10/58	44	X
	E101-103	N	$875	1/56	162	X
	B100	Y	$2800	8/64	70	33
	B250	Y	$4200	11/61	105	5
	B260	Y	$3750	11/62	215	55
	B270	Y	$7000	7/62	150	20
	B280	Y	$6500	7/62	88	22
	B300	Y	$8400	7/65	4	50
	B5000/B5500	Y	$20,000	3/63	40	10
Clary	DE-60/DE-60M	Y	$525	7/60	330	3
Computer Control Co.	DDP-19	Y	$2800	6/61	3	X
	DDP-24	Y	$2500	5/63	66	5
	DDP-116	Y	$900	4/65	12	45
	DDP-124	Y	$2050	2/65	0	2
	DDP-224	Y	$3300	3/65	8	22
Control Data Corporation	G-15	N	$1000	7/55	328	X
	G-20	Y	$15,500	4/61	26	X
	160*/160A/160G	Y	$1750/$3400/$12,000	5/60;7/61;3/64	428	3
	924/924A	Y	$11,000	8/61	28	1
	1604/1604A	Y	$38,000	1/60	60	X
	3100	Y	$7350	12/64	29	36
	3200	Y	$12,000	5/64	80	32
	3300	Y	$15,000	9/65	0	35
	3400	Y	$25,000	11/64	14	20
	3600	Y	$58,000	6/63	43	10
	3800	Y	$60,000	11/65	0	23
	6400	Y	$40,000	1/66	0	7
	6600	Y	$110,000	8/64	5	10
	6800	Y	$140,000	4/67	0	3
Digital Equipment Corp.	PDP-1	Y	$3400	11/60	60	2
	PDP-4	Y	$1700	8/62	55	2
	PDP-5	Y	$900	9/63	113	3
	PDP-6	Y	$10,000	10/64	11	10
	PDP-7	Y	$1300	11/64	24	50
	PDP-8	Y	$525	4/65	50	202
El-tronics, Inc.	ALWAC IIIE	N	$1820	2/54	23	X
Electronic Associates, Inc.	8400	Y	$7000	6/65	2	6
Friden	6010	Y	$600	6/63	200	188
General Electric	115	Y	$1375	12/65	0	100
	205	Y	$2900	6/64	31	14
	210	Y	$16,000	7/59	55	X
	215	Y	$6000	9/63	50	4
	225	Y	$8000	4/61	142	2
	235	Y	$10,900	4/64	54	5
	415	Y	$7300	5/64	65	72
	425	Y	$9600	6/64	36	52
	435	Y	$14,000	10/64	12	20
	625	Y	$41,000	12/64	6	24
	635	Y	$45,000	12/64	7	28
General Precision	LGP-21	Y	$725	12/62	110	X
	LGP-30	semi	$1300	9/56	340	X
	RPC-4000	Y	$1875	1/61	70	X
Honeywell Electronic Data Processing	H-120	Y	$2600	12/65	0	170
	H-200	Y	$5700	3/64	595	280
	H-400	Y	$8500	12/61	124	6
	H-800	Y	$22,000	12/60	85	6
	H-1200	Y	$6500	2/66	0	35

NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTALS	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS
Honeywell (cont'd)	H-1400	Y	$14,000	1/64	12	2
	H-1800	Y	30,000	1/64	12	8
	H-2200	Y	11,000	10/65	0	44
	H-4200	Y	16,800	2/66	0	6
	H-8200	Y	35,000	3/67	0	1
	DATAmatic 1000	N	40,000	12/57	4	X
IBM	305	N	$3600	12/57	180	X
	360/20	Y	$1800	12/65	0	2800
	360/30	Y	$7500	5/65	120	2400
	360/40	Y	$16,000	4/65	130	650
	360/44	Y	$12,000	9/66	0	45
	360/50	Y	$30,000	8/65	3	310
	360/60	Y	$48,000	9/65	0	14
	360/62	Y	$55,000	9/65	0	5
	360/65	Y	$49,000	1/66	0	100
	360/67	Y	$49,000	9/66	0	8
	360/75	Y	$78,000	11/65	0	90
	650	N	$4800	11/54	265	X
	1130	Y	$850	11/65	0	1150
	1401	Y	$4500	9/60	7000	260
	1401-G	Y	$2000	5/64	1050	100
	1410	Y	$14,200	11/61	755	45
	1440	Y	$3500	4/63	2200	400
	1460	Y	$9000	10/63	2000	300
	1620 I, II	Y	$2500	9/60	1740	25
	1800	Y	$3700	12/65	0	90
	701	N	$5000	4/53	1	X
	7010	Y	$22,600	10/63	145	55
	702	N	$6900	2/55	8	X
	7030	Y	$160,000	5/61	7	X
	704	N	$32,000	12/55	42	X
	7040	Y	$18,000	6/63	110	15
	7044	Y	$35,200	6/63	60	12
	705	N	$30,000	11/55	61	X
	7070, 2, 4	Y	$27,000	3/60	350	8
	7080	Y	$55,000	8/61	75	X
	709	N	$40,000	8/58	11	X
	7090	Y	$63,500	11/59	52	2
	7094	Y	$72,500	9/62	136	12
	7094 II	Y	$78,500	4/64	81	30
ITT	7300 ADX	Y	$18,000	9/61	9	6
Monroe Calculating Machine Co.	Monrobot IX	N	Sold only - $5800	3/58	150	X
	Monrobot XI	Y	$700	12/60	570	120
National Cash Register Co.	NCR - 304	Y	$14,000	1/60	26	X
	NCR - 310	Y	$2000	5/61	46	1
	NCR - 315	Y	$8500	5/62	350	55
	NCR - 315-RMC	Y	$12,000	9/65	0	50
	NCR - 390	Y	$1850	5/61	990	45
	NCR - 500	Y	$1500	9/65	0	220
Philco	1000	Y	$7010	6/63	20	0
	2000-210,211	Y	$40,000	10/58	19	0
	2000-212	Y	$52,000	1/63	9	0
	2000-213	Y	$68,000	9/66	0	1
Radio Corporation of America	Bizmac	N	$100,000	-/56	3	X
	RCA 301	Y	$6000	2/61	620	8
	RCA 3301	Y	$11,500	7/64	36	22
	RCA 501	Y	$14,000	6/59	99	2
	RCA 601	Y	$35,000	11/62	5	X
	Spectra 70/15	Y	$2600	11/65	0	66
	Spectra 70/25	Y	$5000	11/65	0	60
	Spectra 70/35	Y	$7000	4/66	0	5
	Spectra 70/45	Y	$9000	3/66	0	65
	Spectra 70/55	Y	$14,000	5/66	0	14
Raytheon	250	Y	$1200	12/60	170	10
	440	Y	$3500	3/64	12	5
	520	Y	$3200	10/65	0	10
Scientific Data Systems Inc.	SDS-92	Y	$900	4/65	18	42
	SDS-910	Y	$2000	8/62	142	20
	SDS-920	Y	$2700	9/62	92	14
	SDS-925	Y	$2500	12/64	7	25
	SDS-930	Y	$4000	6/64	55	27
	SDS-9300	Y	$7000	11/64	12	8
Systems Engineering Labs	SEL-810	Y	$750	9/65	1	8
	SEL-840	Y	$4000	10/65	0	3
UNIVAC	I & II	N	$25,000	3/51 & 11/57	29	X
	III	Y	$20,000	8/62	87	4
	File Computers	N	$15,000	8/56	19	X
	Solid-State 80 I, II, 90 I, II & Step	Y	$8000	8/58	305	X
	418	Y	$11,000	6/63	33	15
	490 Series	Y	$26,000	12/61	60	34
	1004	Y	$1900	2/63	3000	220
	1050	Y	$8000	9/63	200	145
	1100 Series (except 1107)	N	$35,000	12/50	12	X
	1107	Y	$45,000	10/62	28	1
	1108	Y	$50,000	9/65	1	15
	LARC	Y	$135,000	5/60	2	X
				TOTALS	28,960	12,100

X = no longer in production.

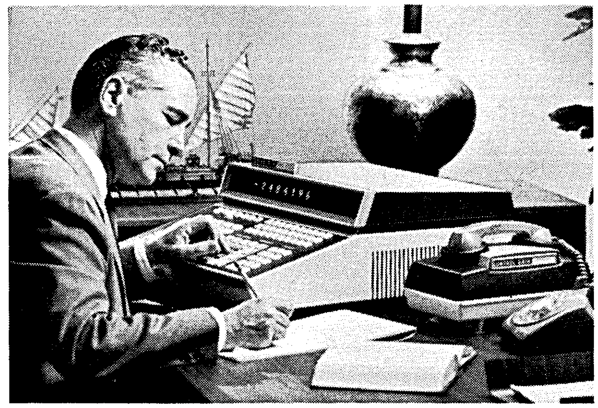
* To avoid double counting, note that the Control Data 160 serves as the central processor of the NCR 310. Also, many of the orders for the IBM 7044, 7074, and 7094 I and II's are not for new machines but for conversions from existing 7040, 7070 and 7090 computers respectively.

save your punched cards...



they may become collectors' items!

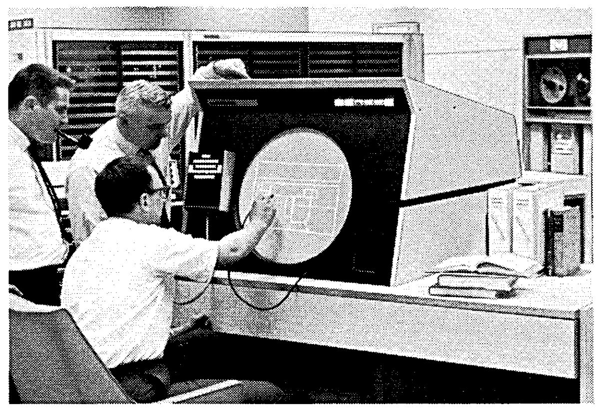
CONTROL DATA 210 Visual Display Unit . . . lets you query the central computer remotely; read out answers instantly on video screen. Up to 63 such units can share a single computer.



CONTROL DATA Remote Calculator . . . ties mathematicians, via remote, into any CONTROL DATA Series-6000 computer. So, many individuals can simultaneously share these powerful systems.

CONTROL DATA 915 Optical Reader . . . "sees" your printed and typewritten material. Inputs data directly, without need for converting it to punched cards, tape, or other intermediate formats.

CONTROL DATA Digigraphics . . . a light pen and keyboard, far more versatile than ever before. Lets you sketch your ideas and type in data, while computer generates precise details.



CONTROL DATA® today provides these new ways to keep punched cards and punched tape from coming between you and your computer

Could it be that the mighty data card will go the way of the abacus? Take a look at what's happening! The new ways even non-computer people now can talk directly to a Control Data computer — in ordinary language. And numbers of people can time-share the same central computer simultaneously.

Big computer systems can most efficiently offer this instantaneous, direct accessibility — and this plain-talk way of getting at a computer, at lower cost per task than ever before. Bigness lets you tie divisions, departments, and projects together in real time as things happen, without the delay of waiting to get on the computer. The punched card may always have a role in things. But it will be overshadowed by these new ways of working with computers.

Experience shows it pays to plan with a total system in mind . . . even when your primary objectives seem more limited. To learn exactly how bigness figures in your own future, talk to your Control Data Representative; or write for further information, to Dept. P-95.

The biggest computers for the biggest installations come from

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CALENDAR OF COMING EVENTS

Oct. 10-15, 1965: 1965 Congress of the International Federation of Documentation (FID), Sheraton Park Hotel, Washington, D. C.; contact Secretariat, 1965 FID Congress, 9650 Wisconsin Ave., Washingon, D. C. 20014

Oct. 13-19, 1965: INTERKAMA (International Congress and Exhibition of Measuring Instruments and Automation); contact Nordwestdeutsche Ausstellungs- und Messe-Gesellschaft mbH - NOWEA -, Düsseldorf, Messegelände

Oct. 14-15, 1965: Association of Data Processing Service Organizations, Inc. Washington Conference, Statler Hilton, Washington, D. C.; contact ADAPSO, 947 Old York Rd., Abington, Pa.

Oct. 19-22, 1965: Symposium on Economics of Automatic Data Processing, Rome, Italy; contact International Computation Centre, Viale della Civilta del Lavoro, 23, P.O.B. 10053, Rome, Italy

Oct. 20-22, 1965: Fall Conference of the H-800 Users Association, Jung Hotel, New Orleans, La.; contact John D. Kearney, Conference Chairman, NASA Michoud Operations, P. O. Box 29300, New Orleans, La. 70129

Oct. 20-22, 1965: Fall Meeting of CUBE (Cooperating Users of Burroughs Equipment), Sahara Hotel, Las Vegas, Nev.; contact William S. Macomber, CUBE Secretary, Boston Insurance Group, 87 Kilby St., Boston, Mass.

Oct. 21-23, 1965: IFAC/IFIP Symposium on Microminiaturization in Automatic Control Equipment and in Digital Computers, Munich, Germany; contact Verein Deutscher Ingenieure — Abt O, P.O. Box 10 250, Düsseldorf, Germany

Oct. 25-27, 1965: National Electronics Conference, McCormick Place, Chicago, Ill.; contact NEC Office, 228 La Salle St., N., Chicago, Ill. 60601

Oct. 26-28, 1965: CO-OP Users Group, Maison Internationale Des Chemins de Fer, 14 Rue Gene Rey, Paris, France; contact Gordon V. Wise, Mgr., Public Relations, Control Data Corp., 8100 34th Ave., So., Minneapolis, Minn. 55440

Oct. 27-29, 1965: Second National Conference on EDP Systems for State and Local Governments, N. Y. University Graduate School of Public Administration, New York, N. Y.; contact Prof. Herman G. Berkman, Graduate School of Public Administration, N. Y. Univ., 4 Washington Sq., No., New York, N. Y. 10003

Oct. 29, 1965: 5th Annual Symposium of the San Francisco Bay Area Chapter of the ACM, Jack Tar Hotel, San Francisco, Calif.; contact Harry E. Brandon, Control Data Corp., 3260 Hillview Ave., Palo Alto, Calif.

Nov. 1-3, 1965: International Systems Meeting, Palmer House, Chicago, Ill.; contact Richard L. Irwin, Exec. Dir., Systems and Procedures Association, 7890 Brookside Dr., Cleveland 38, Ohio

Nov. 2-5, 1965: GUIDE International (User Organization for Large Scale IBM EDP Machines) Meeting, Jung Hotel, New Orleans, La.; contact Lois E. Mecham, Secretary, GUIDE International, c/o United Services Automobile Assoc., 4119 Broadway, San Antonio, Tex. 78215

Nov. 3-5, 1965: Data Processing Management Association Fall International Conference, Adolphus Hotel, Dallas, Tex.; contact R. Calvin Elliott, Exec. Dir., DPMA, 524 Busse Highway, Park Ridge, Ill. 60068

Nov. 29, 1965: Annual Fall Symposium of the Digital Equipment Computer Users Society (DECUS) Stanford University, Tresidder Union Hall, Stanford, Calif.; contact Ken Gold, Digital Equipment Corp., Maynard, Mass.

Nov. 30-Dec. 2, 1965: Fall Joint Computer Conference, Convention Center, Las Vegas, Nev.; contact W. D. Orr, S.F. Assoc., Thousand Oaks, Calif.

Nov. 30-Dec. 3, 1965: Four-Day Institute on the Impact of the Computer Revolution on Law and the Administration of Justice, sponsored by American University's Center for Technology and Administration, Twin Bridges Marriott Motor Hotel, Washington, D. C.; contact Paul W. Howerton, Director, Center for Technology and Administration, The American University, 2000 G St., N. W., Washington, D. C.

Dec. 3-4, 1965: 6th International SDS Users Group Meeting, Dunes Hotel and Country Club, Las Vegas, Nev.; contact Dr. Robert J. Stewart, Jr., Cyclone Computer Center, Iowa State University, Cedar Falls, Iowa

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

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

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

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

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

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

May 30-June 1, 1966: National Conference of the Computing and Data Processing Society of Canada, Banff Springs Hotel, Banff, Alberta, Canada; contact Mr. K. R. Marble, Mgr., Systems and Computer Services Dept., Western Region, Imperial Oil Ltd., Calgary

June 20-26, 1966: 3rd Congress of the International Federation of Automatic Control, London, England; contact American Automatic Control Council, c/o Dr. Gerald Weiss, Electrical Engineering Dept., Brooklyn Polytechnic Institute, 333 Jay St., Brooklyn 1, N. Y., or IFAC Secretary, Postfach 10250, Düsseldorf, Germany

June 21-24, 1966: Data Processing Management Association June International Conference, Hilton Hotel, Chicago, Ill.; contact R. Calvin Elliott, Exec. Dir., DPMA, 524 Busse Highway, Park Ridge, Ill. 60068

Oct. 25-28, 1966: Data Processing Management Association Fall International Conference, Los Angeles Biltmore Hotel, Los Angeles, Calif.; contact R. Calvin Elliott, Exec. Dir., DPMA, 524 Busse Highway, Park Ridge, Ill. 60068

SUPERVISORY SYSTEMS FOR THE DARTMOUTH TIME-SHARING SYSTEM

(Continued from page 27)

ning for background control cards. When a control card is encountered that calls for a task that cannot be run in parallel and for which the background supervisor is needed, a signal is sent to the master supervisor.

When the foreground supervisor receives a command to run background from the master, the background supervisor replaces the foreground supervisor. The background supervisor uses 1.5K of memory, but provides the background job with routines for tape, disk, and printer operations. In addition, the supervisor will place on the background output tape the output destined for the high-speed printer or the card punch. After completion of the job or jobs, the output will be transferred to the printer or punch by the foreground supervisor, thus significantly decreasing the slave computer time required. In effect, the foreground supervisor is acting as an off-line peripheral to peripheral computer. When the master supervisor sends a dump background message or when the program is roadblocked, the background supervisor dumps 15K of memory and then reads in the foreground supervisor which then takes control.

Conclusions and Observations

While the decision to have two supervisors was dictated by the available hardware, the division of labor chosen has worked out surprisingly well. The master computer handles almost all of the supervisory tasks while the slave computer concentrates on what it can do best — floating point calculations. The two-computer situation probably contributed substantially to the rapid development of the Dartmouth Time Sharing System by providing a trivial solution to the memory allocation and protect problems.

On the technical side, the Dartmouth System has shown that time sharing can be done with less than large-scale equipment, and quite well at that. Not only that, but the resulting system can be quite efficient, provide good service for foreground users, and also provide for the less frequent large job in background. The efficiency of use of the slave computer, which performs the floating point calculations, is about the same as in a conventional system using batch-processing if the tape and peripheral overhead is properly measured.

On the man-machine interface side, the Dartmouth System has shown that computing can be made simple, that the communication with the system and the programming languages can be made natural and easy to use. Computing no longer need be the private realm of the expert. The student and the faculty member can now make use of this powerful tool. It is now possible to consider teaching computing on a wide basis in colleges, secondary schools, and even primary schools. The research worker now has available a computing power that he can call up almost at a moment's notice and can use efficiently and at reasonable cost for running small problems as well as large ones.

Judging from the overwhelming success at Dartmouth and elsewhere, there can be no doubt that time-sharing and simplified man-machine interfaces will play an extremely important role, not only in educational institutions but also in private industry and government as well.

References

1. Lochner, Kenneth M., Jr., "The Evolving Time-Sharing System at Dartmouth College," in *Computers and Automation,* September 1965, pp. 10-11.
2. "A Manual for BASIC," Dartmouth College, 1965. (For copies, please write to the Dartmouth Bookstore, Hanover, New Hampshire, 80 cents per copy, postpaid.)

NEW PATENTS

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

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

May 11, 1965 (Continued)

3,183,485/ John F. Cubbage, Phoenix, Arizona/ General Electric Co./ Logic Circuit Employing Capacitor Switching Elements.
3,183,488/ Richard M. Bloch, West Newton, Alan J. Deerfield, Franklin and Lynn W. Marsh, Jr., Marblehead, Mass./ Honeywell Inc./ Data Processing Apparatus.
3,183,489/ George J. Laurer, Johnson City and Carl D. Southard, Endwell, NY/ IBM Corp.,/ Data Transfer Device.
3,183,490/ John F. Cubbage, Phoenix, Arizona/ General Electric Co. of NY/ Capacitive Fixed Memory System.
3,183,495/ Albert Blain, Phila., Pa./ Sperry Rand Corp./ Random Access Magnetic Tape Memory Systems.

May 18, 1965

3,183,579/ George R. Briggs, Princeton and Rabah Shahbender, Berlin, NJ/ Radio Corp. of America/ Magnetic Memory.
3,184,712/ Arthur W. Holt, Silver Spring, Md./ by mesme assignments to Control Data Corp./ Core Correlation Matrix Reader.
3,184,717/ Floyd A. Behuke, Ruby, NY/ IBM Corp./ Associative Memory Low Temperature Fast Read Circuit.
3,184,718/ Jacques Albin, Chaville, Alice Maria Recoque, Sartrouville and Andre Michel Richard, Paris, France/ Societe d'Electronique et d'Automatisme, Courbevoie, France./ Information Handling Systems.
3,184,723/ Frank M. Goetz, Franklin Square, NY/ Bell Tele. Labs. Inc.,/ Logic Detector Circuit.
3,184,724/ Eugene H. Irasek, Los Angeles, Calif./ The National Cash Register Co., Dayton, Ohio/ Random-Access Information Storage Device Utilizing Flexible Rectangular Magnetic Strips.

May 25, 1965

3,185.965/ Chi-Yuan Lee, Chatham, NJ/ Bell Tele. Labs. Inc./ Information Storage System.
3,185,969/ William E. Burns, Los Gatos, Calif./ IBM Corp./ Core-Transistor Logical Device.

June 1, 1965

3,186.634/ Alan Foster, Addiscombe and Raymond Owen Parmenter, Mitcham, England/ International Computers and Tabulators, Ltd./ Data Recording Apparatus.
3,187,308/ Stanley P. Frankel, Los Angeles, Calif./ General Electric Company/ Information Storage System for Microwave Computer.
3,187,309/ Paul David Dodd, San Jose and George L. Owens, Los Gatos, Calif./ IBM Corp./ Computer Memory.
3,187,310/ James E. Drummond, Bellevue, Roy R. Johnson, Vashon and Betsy Ancker-Johnson, Seattle, Wash./ The Boeing Company, Seattle, Wash./ Solid State Data Storage and Switching Devices.
3,187,311/ Arthur E. Wemstrom, Los Angeles, Calif./ Hughes Aircraft Co./ Memory Core Device.
3,187,312/ Friedrich Ulrich, Neustadt, near Waiblingen, Germany/International Standard Electric Corp./ Circuit Arrangement for Binary Storage Elements.

June 8, 1965

3,188,480/ Robert Betts, Vestal, NY/ IBM Corp./ Multiaperture-Core Logic Circuit.
3,188,613/ George A. Fedde, Norristown, Pa./ Sperry Rand Corp./ Thin Film Search Memory.
3,188,614/ Petrus Ludovicus Maria van Berkel, Voorburg, Netherlands/ de Staat der Nederlanden, ten deze Vertegenwoordigi door de Directeur-General der Posterijen, Telegrafie en Telefonie, The Hague, Netherlands/ Apparatus for Compensating For Skewed Digital Information Upon a Magnetic Tape.

June 15, 1965

3,189,754/ Harold D. Ausfresser, Baltimore and Richard D. French, Arnold, Md./ Westinghouse Electric Corp./ Computer Logic Circuit.
3,189,757/ Albert Feller, Riverton, NJ/ Radio Corp. of America/ Logic Circuit.
3,189,872/ William F. Beausoleil, Poughkeepsie and Dominick J. Galage, Newburgh, NY/ International Business Machines Corp./ Data Handling Mechanism.
3,189,877/ Wilbur David Pricer, Wappingers Falls and Hermann P. Wolff, Poughkeepsie, NY/ IBM Corp./ Electronic Memory Without Compensated Read Signal.
3,189,879/ Robert M. MacIntyre, Newport Beach and Cravens L. Wanlass, Santa Ana, Calif./ by mesme assignments to Raytheon Co./ Orthogonal Write System for Magnetic Memories.
3,189,889/ Argyle W. Bridgett, Newton, Mass./ Image Instruments Inc., Newton, Mass./ System for Modifying Stored Data.

June 22, 1965

3,191.006/ Emik A. Avakian, 92 Juana St., Tuckahoe 7, NY/ -o-/ Information Storage, Retrieval and Handling Apparatus.
3,191,007/ Harold P. Mixer, Boca Raton, Fla./ Sperry Rand Corp./ Information Sensing Device with Electromechanical Storage.
3,191,009/ Per Lennart Anderson, Berwyn and Olver G. Aberth, Swarthmore, Pa./ Sperry Rand Corp./ Check Digit Verifiers.
3,191,012/ Harold Fleisher, Poughkeepsie and Robert I. Roth, Briarcliff Manor, NY/ IBM Corp./ Memory Readout and Summing System.
3,191,054/ Walter Ghisler, Upplands Vasby, Sweden and Simon Middelhoek, Kilchberg, Zurich, Switzerland./ IBM Corp./ Coplanar Thin Magnetic Film Shift Register.
3,191.057/ Shao C. Feng, Huntington, NY/ Sperry Rand Corp./ Current Adder Type Logic Circuit.
3,191,064/ Charles C. Ih, Phila., Pa./ Sperry Rand Corp./ High Speed Switching Circuit.
3,191,067/ Herbert Zimmerman, Phila., Pa./ USA as represented by the Secretary of the Air Force/ Logical Gating and Routing Circuit.
3,191.151/ John E. Price, San Francisco, Calif./ Fairchild Camera & Instrument Corp./ Programmable Circuit.
3,191,155/ Robert R. Seeber, Jr., Poughkeepsie and Arthur J. Sciver, Jr., Wappingers Falls, NY/ IBM Corp./ Logical Circuits and Memory.
3,191,158/ Charles A. Sherman, Tacoma, Wash./ Weyerhaeuser Co., Tacoma, Wash./ Capacitor Memory Device.
3,191,161/ Robert W. Clark, Centerville, Ohio/ The National Cash Register Co./ Means for Driving Magnetic Storage Elements.
3,191,162/ William W. Davis, Minneapolis, Minn./ Sperry Rand Corp./ Magnetic Thin Film Memory Cell.
3,191,163/ David J. Crawford, Poughkeepsie, NY/ IBM Corp./ Magnetic Memory Noise Reduction System.
3,191,164/ John P. Lekas, Hollywood, Calif./ by mesme assignments to Litton Systems, Inc./ Moving Head Memory Device.

June 29, 1965

3,191,860/ Walter G. Wadey, Bethesda, Md./ Sperry Rand Corp./ Fluid Logic Control.
3,192,366/ Leslie L. Cochran, Minneapolis, William Weigler, St. Paul, James C. Nelson, Rosemount and Harold L. Ridout, Minneapolis, Minn./ Sperry Rand Corp./ Fast Multiply System.
3,192,368/ Abraham Franck and George F. Marette, Richfield and Berc I. Parsegyan, St. Paul, Minn./ Sperry Rand Corp./ Arithmetic System Utilizing Ferromagnetic Elements Having Single Domain Properties.
3,192,369/ William Francis Schmitt, Wayne, Pa./ Sperry Rand Corp./ Parallel Adder with Fast Carry Network.
3,192,370/ Thomas J. Matcovich, Willow Grove, Pa. and Joseph J. Chang, West Lafayette, Ind./ Sperry Rand Corp./ Adding Circuit Using Thin Magnetic Films.
3,192,396/ Lawrence Hasdorff, Madison, NJ/ Bell Telephone Labs. Inc./ Logic System.
3,192,410/ Woo F. Chow, Horsham Township, Pa./ Sperry Rand Corp./ Logic Circuit with NRZ Operation.

BOOKS AND OTHER PUBLICATIONS

— Reviews

Moses M. Berlin
Allston, Mass.

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.**

Harrison, Howard L. and John G. Bollinger / Introduction to Automatic Controls / International Textbook Co., Scranton 15, Penna. / 1963, printed, 349 pp, cost ?

This book, intended for the mechanical engineer, introduces the fundamentals of automatic control. In addition to theoretical information, a number of applications are reviewed. The first five of fourteen chapters deal with the time domain in which the underlying principles of dynamic system response are most easily understood. The sixth chapter, "Laplace Transformation", serves as the basis for the ensuing discussion of control system analysis and synthesis. Both analog and digital computers are covered. Five appendices, including "Digital Computing for Control System Analysis" and "Transfer-Function Simulation on the Analog Computer", a bibliography, and an index are included.

Rademacher, Hans, and Otto Toeplitz, / The Enjoyment of Mathematics / Princeton University Press, Princeton, N. J. / 1957, printed, 204 pp, $4.50

This is a beautifully written book, with many interesting and vivid examples, which deals with interesting and significant mathematical topics which may be understood with only the mathematical background obtained in high school plus a capacity to apply one's self.

For many persons approaching work in the computer field and thereby coming into contact with mathematics, this book would be useful and worthwhile to give the flavor of intriguing mathematical problems which may be enjoyed.

Topics include the prime numbers, the four-color problem, the regular polyhedrons, relations of irrational and rational numbers, etc.

Digital Equipment Corporation, staff of / Analog-Digital Conversion Handbook / Digital Equipment Corp., 146 Main St., Maynard, Mass. / 1964, printed, 73 pp, free on request

Using simplified diagrams to introduce the beginner to various conversion methods, this publication presents a comprehensive discussion of analog-to-digital conversion circuitry and logic. Seven chapters include: "Basic Elements of Conversion", "Typical Converter Logic", "Interconnection and Calibration", and "Testing an Analog-to-Digital Converter". Four appendices, including "Table of Voltages" and "Digital Symbols and Standards", thirty-five illustrations and nine tables are included.

Lorens, Charles S. / Flowgraphs for the Modeling and Analysis of Linear Systems / McGraw-Hill Book Co., Inc., 330 West 42 St., New York 36, N. Y. / 1964, printed, 178 pp, $3.50

Flowgraph techniques, i.e., graphic representation of systems of equations, and their application in analyzing linear equations, are here discussed. Examples are given of applications to linear equations of electrical, mechanical, statistical and electronic systems. Fifteen chapters include: "Introduction", in which a brief history and some general rules are given, "Derivations of the Loop Rule", "Formulation by Conventional Network Analysis", "Statistical Properties", and "Continuous Generating Functions". Problems, references, and an index are included.

— Notices

Burnett-Hall, D. G., L. A. G. Dresel and P. A. Samet / Computer Programming and Autocodes / D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J. / 1964, printed, 106 pp, $4.50

Silvern, Leonard C. / Fundamentals of Teaching Machine and Programmed Learning Systems: Course One, Programmer's Kit / Education and Training Consultants, 979 Teakwood Road, Los Angeles, Calif. 90049 / 1964, offset, 103 pp, $27.50 for two volume set

Lytel, Allan / Calculus for the Electronics Technician / Howard W. Sams & Co., Inc., Indianapolis 6, Ind. / 1964, printed, 160 pp, $3.95

Middleton, Robert G. / Pulse Circuit Technology / Howard W. Sams & Co., Inc., Indianapolis 6, Ind. / 1964, printed, 192 pp, $3.95

Data Processing, vol. VI, Proceedings of the 1963 International Data Processing Conference / Data Processing Management Assn., 524 Busse Highway, Park Ridge, Ill. / 1963, printed, 498 pp, $3.75

Martino, R. L. / Project Management and Control: vol. I, Finding the Critical Path / American Management Assn., 135 West 50 St., New York, N. Y. 10020 / 1964, printed, 144 pp, $15.00

Jacker, Corinne / Man, Memory, and Machines: An Introduction to Cybernetics / MacMillan Co., 60 Fifth Ave., New York, N. Y. 10011 / 1964, printed, 126 pp, $3.95

Schuster, Donald H. / Logical Electronic Troubleshooting: A Programmed Book / McGraw-Hill Book Co., Inc., 330 West 42 St., New York 36, N. Y. / 1964, printed, 303 pp, $5.95

Levine, Leon / Methods for Solving Engineering Problems Using Analog Computers / McGraw-Hill Book Co., Inc., 330 West 42 St., New York, N. Y. 10036 / 1964, printed, 485 pp, $14.50

Renwick, W. / Digital Storage Systems / John Wiley & Sons, Inc., 605 Third Ave., New York 16, N. Y. / 1964, printed, 212 pp, $8.50

Winograd, S., and J. D. Cowan / Reliable Computation in the Presence of Noise / M. I. T. Press, Cambridge 42, Mass. / 1963, printed, 96 pp, $5.00

Llewellyn, Robert W. / Linear Programming / Holt, Rinehart and Winston, Inc., 383 Madison Ave., New York 17, N. Y. / 1963, printed, 371 pp, $9.00

Wilkinson, J. H. / Rounding Errors in Algebraic Processes / Prentice-Hall, Inc., Englewood Cliffs, N. J. 07632 / 1964, printed, 161 pp, $6.00

Chang, Kern K. N. / Parametric and Tunnel Diodes / Prentice-Hall, Inc., Englewood Cliffs, N. J. 07632 / 1964, printed, 256 pp, $10.95

Gass, Saul I. / Linear Programming, 2nd edition / McGraw-Hill Book Co., Inc., 330 West 42 St., New York 36, N. Y. / 1964, printed, 280 pp, $8.95

Beckenbach, Edwin F., and Richard Bellman / Inequalities, 2nd revised printing / Springer- Verlag New York, Inc., 175 Fifth Ave., New York, N. Y. 10010 / 1965, printed, 198 pp, cost ?

MacMillan, R. H., T. J. Higgins, and P. Naslin, editors / Progress in Control Engineering, volume 2 / Academic Press, Inc., 111 Fifth Ave., New York, N. Y. 10003 / 1965, printed, 292 pp, $13.50

Weber, Samuel, editor / Modern Digital Circuits / McGraw-Hill Book Co., Inc., 330 West 42 St., New York 36, N. Y. / 1964, printed, 358 pp, $9.50

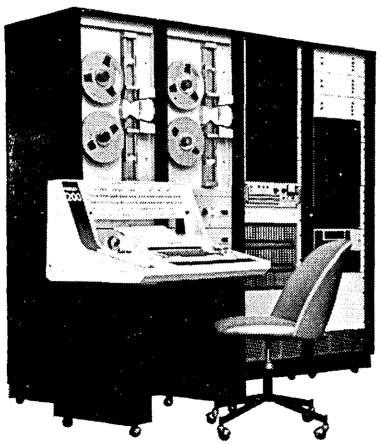
Fowler, L., R. D. Eanes, and T. J. Kehoe, editors / Analysis Instrumentation 1963: Proceedings of Ninth National Instruments Society of America Analysis Instrumentation Symposium / Plenum Press, Inc., 227 West 17 St., New York 11, N. Y. / 1963, offset, 261 pp, $12.50

Lytel, Allan / Fundamentals of Data Processing / Howard W. Sams & Co., Inc., Indianapolis, Ind. / 1964, printed, 320 pp, $6.95
Lytel, Allan / Handbook of Algebraic and Trigonometric Functions / Howard W. Sams & Co., Inc., Indianapolis, Ind. / 1964, offset, 160 pp, $2.95
Crowhurst, Norman H. / Mathematics for Electronics Engineers & Technicians (A Programmed Text) / Howard W. Sams & Co., Inc., Indianapolis, Ind. / 1964, printed, 256 pp, $6.95
Hart, B. L. J. / Dynamic Systems Design / Mercury House, 103 Waterloo Road, London, S. E. 1, Eng. / 1964, printed, 233 pp, $5.30
Fenves, S. J., R. D. Logcher, S. P. Mauch, and K. P. Reinschmidt / STRESS: A User's Manual—A Problem-Oriented Computer Language for Structural Engineering / M. I. T. Press, Cambridge, Mass. 02142 / 1964, offset, 51 pp, $2.00
Manning, Eric G. / A Performance Measure for Game-Playing Programs, AD 601621 / Supt. of Documents, U. S. Govt. Printing Office, Washington, D. C. 20402 / 1964, offset, 39 pp, $1.25
Hendershot, Carl H. / Programmed Learning: A Bibliography of Programs and Presentation Devices, third edition / C. H. Hendershot, 4114 Ridgewood Drive, Bay City, Mich. / 1964, offset, 190 pp, $8.00 ($5.00 in paperback)
Westwater, F. L. / Electronic Computers / Dover Publications, Inc., 180 Varick St., New York, N. Y. 10014 / 1964, printed, 151 pp, $2.00
Goshay, Robert C. / Information Technology in the Insurance Industry / Richard D. Irwin, Inc., Homewood, Ill. / 1964, printed, 160 pp, $6.65
Toombs, H. D., and L. A. Delhom / Development of an Intermediate Capacity High-Speed Magnetic Film Memory System, AD 600271 / Supt. of Documents, U. S. Govt. Printing Office, Washington, D. C. 20402 / 1963, offset, 48 pp, $3.00
Centner, R. M. / Development of Adaptive Control Techniques for numerically-Controlled Milling Machines, AD 600330 / Supt. of Documents, U. S. Govt. Printing Office, Washington, D. C. 20402 / 1964, offset, 48 pp, $3.00
Entwisle, Doris R. / Auto-Primer in Computer Programming / Blaisdell Pub. Co., 135 West 50 St., New York, N. Y. 10020 / 1963, printed, 345 pp, $6.50
Harris, D. J. / Analogue and Digital Computer Methods / Gordon and Breach Science Publishers, 150 Fifth Ave., New York 11, N. Y. / 1964, printed, 106 pp, $5.95
Adelfio, Salvatore A., and Christine F. Nolan / Principles and Applications of Boolean Algebra / Hayden Book Co., New York, N. Y. / 1964, printed, 325 pp, cost ?
Stein, Edward S., and Associates / Factors Influencing the Design of Original-Document Scanners for Input to Computers, NBS Technical Note 245 / Supt. of Documents, U. S. Govt. Printing Office, Washington, D. C. 20402 / 1964, offset, 50 pp, 35 cents
Buffa, Elwood S. / Models for Production and Operations Management / John Wiley & Sons, Inc., 605 Third Ave., New York 16, N. Y. / 1963, printed, 632 pp, $9.25
Larsson, Robert D. / Equalities and Approximations: With Fortran Programming / John Wiley & Sons, Inc., 605 Third Ave., New York 16, N. Y. / 1963, printed, 158 pp, $5.50
Camp, Ruth D. / Bureau of Ships Technical Library Thesaurus of Descriptive Terms and Code Book / Bureau of Ships, Dept. of the Navy, Washington 25, D. C. / 1964, offset, 835 pp approx., cost ?
Raisbeck, Gordon / Information Theory: An Introduction for Scientists and Engineers / M. I. T. Press, Cambridge, Mass. 02142 / 1964, printed, 105 pp, $4.00

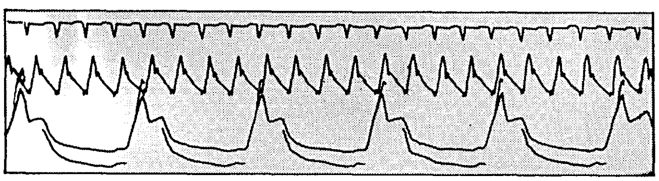
ADVERTISING INDEX

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.

AMBILOG 200 the only computer designed especially for signal processing



Using the best of both analog and digital techniques, the AMBILOG™ 200 Stored Program Signal Processor is designed from the ground up to handle the "floods of data" generated in test and research programs. Although such programs cover many fields — biomedical monitoring, geophysical research, test stand instrumentation, automatic weapons checkout, speech analysis — all require complex *signal processing:* multiple input acquisition and output distribution, monitoring, editing, arithmetic, analysis, recording and display. Because of its high processing speed and extensive input/output for both analog *and* digital data, AMBILOG 200 is ideally suited for such tasks. Here are some examples.



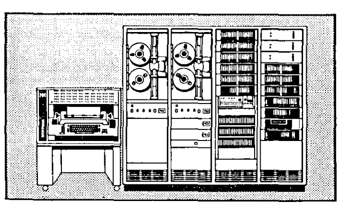
Real Time Waveform Measurement

Peak values, axis crossings, ratios of successive differences, and other characteristics of analog signals are measured in real time. Incoming signals are monitored for events of interest, using complex programmed detection criteria. In a typical biomedical application, the result is a 100-to-1 reduction in the bulk of magnetic tape output records.

$$A(n,w)=\int_0^T W(t)F(n,t)\cos(wt)dt$$
$$B(n,w)=\int_0^T W(t)F(n,t)\sin(wt)dt$$

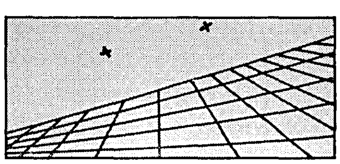
Spectrum Analysis

Parallel hybrid multiplication and summing, 2 microsecond 30-bit digital storage, and a flexible instruction format providing efficient list processing combine to make the AMBILOG 200 powerful in statistical signal analysis techniques such as Fourier transformation, auto and cross correlation, power spectrum density analysis, and generation of histograms of amplitude spectra.



Digitizing and Recording

Multiple inputs, from up to several hundred sources, are routed through a multiplexer switch array under stored program control. At no penalty in sampling rates over conventional systems, the AMBILOG 200 converts incoming data to engineering units for recording or monitoring. An analog-to-digital converter performs a complete 15-bit conversion in 4 microseconds for digital storage, recording or outputing.



Display Generation

Multiple analog outputs facilitate close man-machine relationships in systems involving visual displays. Points of an image stored in memory are rotated through three space angles and projected on a CRT at a 50 Kc rate. Co-ordinate transformation is accomplished simultaneously with digital-to-analog conversion.

For technical reports describing in detail these and similar AMBILOG 200 applications, write I. R. Schwartz, Vice President.

Adage INC
1079 Commonwealth Avenue, Boston, Massachusetts 02215

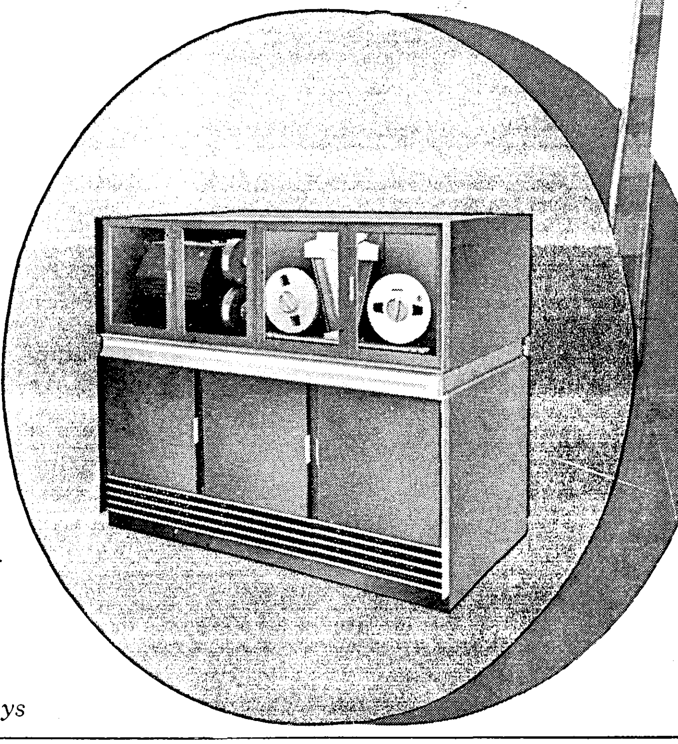
Designate No. 18 on Readers Service Card

B-L 120 Microfilm Printer/Plotter

FIRST
SECOND GENERATION CRT MICROFILM PRINTER/PLOTTER ON THE MARKET TODAY

The B-L 120 is a truly expandable, modular system, completely **solid-state** and features the latest in high reliability silicon logic circuits.

- Truly off line—does not require expensive computer tape transport
- Through-put—120 frames per minute for both 556 and 800 bpi tapes
- 64 character selection with 128 character option
- Vector line drawing and axes line drawing
- Handles either 16mm or 35mm monocromatic film
- Tape transport compatible with all 7-track, ½-inch magnetic tapes or 9-track, ½-inch magnetic tape
- Optional "Quick-Look" hard copy-exposure simultaneous with film



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Demonstrations Now Being Conducted at Van Nuys