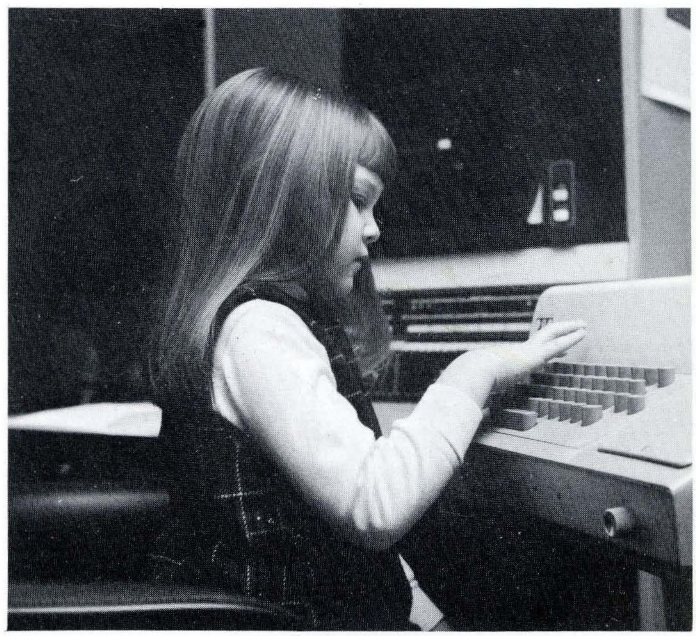
March, 1969

computers and automation

Computers and Education



Could you use Pat Branch? She can type an order, produce invoices, update a mailing list, prepare management reports, and help keep track of 82,000 things. All at once!

Of course, she gets a lot of help from her machine.

The 2201 FLEXOWRITER* automatic writing machine by Friden.

Pat works for Modern Talking Pictures Service, in one of their branch film libraries. Modern equipped their principal branches with 2201's to speed the flow of paperwork involved in distributing 82,000 movies to over 200,000 groups.

The 2201's ability to read and automatically type routine customer data (name, address, etc.) from either paper tape or edge-punched cards has meant that every order Pat types now takes 80% fewer keystrokes. And 60% less time.

While Pat is busy with the order, the 2201 is busy punching another tape for direct input to Modern's computer in New York. The computer processes these tapes to update mailing lists, produce invoices, and prepare detailed reports for management.

How efficient can you expect any girl—or any branch office—to be? Let us give you a demonstration. Call your nearest Friden office, or write Friden, Inc., San Leandro, California 94577. Sales and service throughout the world.

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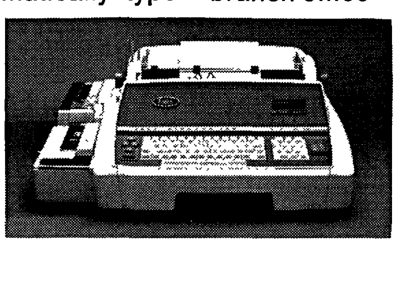

Friden

DIVISION OF SINGER

DIVERSIFIED·WORLDWIDE

*A TRADE MARK OF FRIDEN, INC.

Why select Sangamo Data Stations for keyboard applications?

Ask the operator who uses one.

"There's more work space. Plenty of leg room. Even a drawer for personal belongings."

"It speaks 'English.' No confusing codes to learn. Makes training a snap."

"It's almost silent and magnetic erasure provides instant error correction."

"It's the easiest to operate. Simple tape threading takes mere seconds."

It's human engineered! And that's only the beginning of the new Sangamo Data Station's major advantages. It produces computer compatible tape—eliminates cards—saves computer time—doubles as a verifier—its electronics are 400% faster than the other leading keyboard-to-magnetic tape machines. Alpha-numeric display—no Octal or EBCDIC codes to learn. Installation includes professional operator training by Keyboard Training, Inc. Resident customer engineering service. Delivery now starting in two series: DS-7000 and DS-9000. Interested? Let's communicate!

SANGAMO ELECTRIC COMPANY Springfield, Illinois 62705

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computers and automation

Vol. 18, No. 3 — March, 1969

Editorial Offices
BERKELEY ENTERPRISES, INC.
815 WASHINGTON STREET,
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AUDIT BUREAU OF CIRCULATIONS

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computers and automation

Vol. 18, No. 3, March, 1969 *The magazine of the design, applications, and implications of information processing systems.*

Special Feature: Computers and Education

The front cover *photographs were taken in the Computer-Assisted Instruction Center of* Computers and Automation *in Newtonville, Mass. Some of the potential for the use of computers in education is illustrated in the expressions of five-year-old Shelley Langdale (daughter of the Associate Editor of C&A), as she receives some instruction, tries her hand at it, discovers an error . . . and receives more instruction. The computer in the background is a Digital Equipment Corporation PDP-9, used for courses, instruction, and research at the Center. Courses deal with the fundamentals of computing, programming, and systems, with emphasis on hands-on operation of the computer in subjects of particular interest to students. For more information, see the announcement on page 67 of this issue, or inquire of C&A's Computer-Assisted Instruction Center.*

Regular Features

Departments

Computers and Education: Forecast

In a few years access to computers will be as common as access to copying machines.

The price of an interesting and powerful modern small computer nowadays is around $10,000. In a few more years, that price will be $5000. In a few more years after that, the price will be $3000. Amortize that $3000 over 60 months, and the cost becomes $50 a month for over 400 usable hours per month of computer time, or less than 15 cents an hour. This is not much of a cost for at least a third of American families and schools; so the computer can be actively in use for education and many other purposes; and it will become as much a part of home life as the family car, and as much a part of school life as the classroom projector.

Probably 90 percent or more of all computer programs do not require access to large central files of information. And in cases where a computer program on a local computer does require such access, a dialed connection via telephone line to a large computerized file for a minute, ought to be able to load the disc memory of the local computer with all the information the user needs for at least the next few hours.

Under these new and revolutionary conditions, what is likely to be the effect of the programmed, small and inexpensive computer on education and learning?

One of the primary effects will be that the learning environment of the student studying by himself will become active instead of passive. The learning environment with its programmed computer will respond to the student intelligently and in a friendly, skillful, cooperative way. The programmed computer will become a completely personal tutor. A good book, which is a "guide, philosopher and friend" in a passive sense, when closely interlinked with an appropriately programmed computer, will become a "guide, philosopher, and friend" in an active and even interactive sense. The learning environment and the programmed computer together should lastingly encourage the student to become interested, excited, and happy in life-long learning.

Some of these effects have been described in the reports of Dr. Richard Kobler and Responsive Environments Corporation. See Dr. Kobler's article in *Computers and Automation,* November 1967, entitled "The Talking Typewriter — and the Learning of Reading in a Disadvantaged Community."

A much earlier example of these effects is the airplane simulator, in which pilots and crew practice "flying" a new plane long before it is delivered. Then when the multi-million dollar plane is at last produced and arrives, the entire crew is ready to fly it and fly it well.

A second effect will be a considerable change in the work of school and college teachers. They will graduate from much of the ordinary teaching they now do, in arithmetic, algebra, calculus, grammar, spelling, physics, etc., and change over to dealing in a more skillful and personal way with other tasks, those that computers have trouble with. One such task is listening to a foreign language as spoken by a student, and correcting his individual mispronunciations. Other such tasks are helping students to express themselves well in writing and composition, providing psychological guidance to students who have troublesome personal problems, etc.

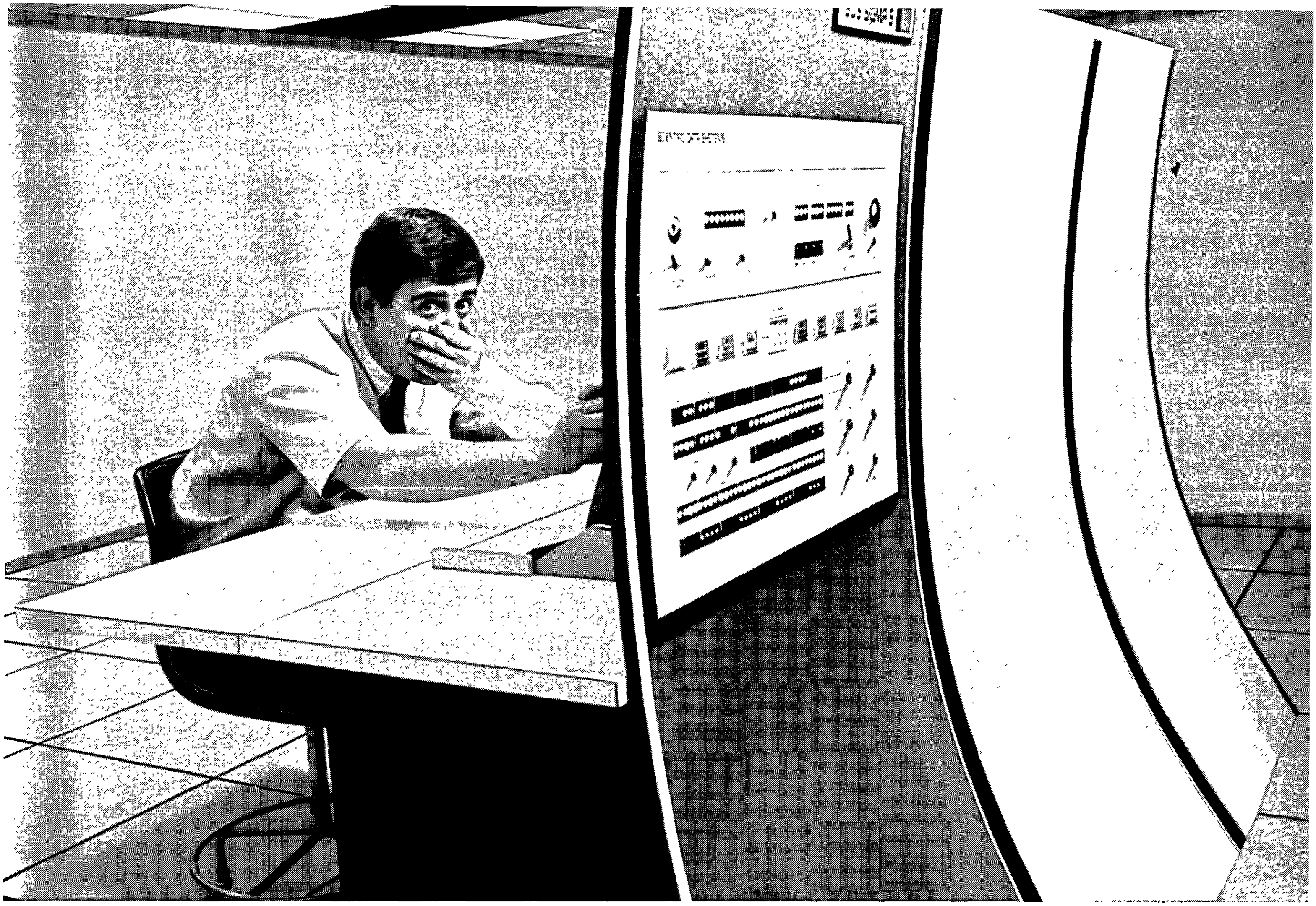
Perhaps the most profound effect of all will be the multiplying factor on the amount of education produced in the world. For the same amount of expense, perhaps 10 to 20 times as much education will be produced. This is like the effect of the invention of the printing press in the late 1400's, and the mass production of books. This is like the effect of the invention of the automobile in the early 1900's, and the mass production of automobiles. People did not choose to continue to travel four miles a day on the average — they chose instead to travel 40 miles a day on the average.

How should we measure amount of education, or amount of learning — if we refer to a ten times increase? This is not hard; people do it all the time and very quickly, in both business and social situations. The amount of education acquired by a person is measured by his knowledge, behavior, attitudes, and skills, and his answers to sample questions, and his responses to sample situations. For example, an educated man does not make unsupported sweeping statements; he continually tags most of what he says with something like "it seems to me"; and he is ready to change his mind on good evidence. For a second example, when you are sitting in the front seat of a car as a passenger, you can decide in three minutes whether the driver of the car is a good driver or a bad one, by watching his decisions about the driving situations that he encounters.

The multiplying factor on the amount of education produced could very well transform society and civilization. It might produce a world almost full of educated people instead of a world almost full of uneducated people.

For there are a great many things that all of us could do much better if we could only apply what the wisest of us knows.

Edmund C. Berkeley
Editor



If you can't afford an extra Sigma, fake it.

Get remote batch.

Most companies that need an extra Sigma, but can't afford it, get a Volkswagen.

The VW picks up stacks of punched cards at outstations, runs them back to your computer, then back to the boondocks. It's a big waste of time. A programmer away from headquarters gets only a few passes through your computer each day.

Our remote batch lets the boondocks transmit directly to your computer. Programs get queued immediately, instead of being held up by traffic jams.

The system is unique in the industry: it doesn't cost an arm or a leg. You can have the 7670 card reader/punch/line printer for $810 a month on a four year lease. Communications equipment for your center runs $196 per terminal each month, for the same length of time. But we'll toss in the program for free. Or if your comptroller prefers, buy the system.

The only other item needed to give small stations large computing ability is a telephone line for each station. You'll be able to transmit data as fast as a voice grade line will permit.

It's slightly slower than being there. But an awful lot faster than a Volkswagen.

SDS

Scientific Data Systems,
El Segundo, California

AS WE GO TO PRESS

PROGRAMMATICS INC. HAS BEEN AWARDED A SOFTWARE PATENT. The patent (No. 3422404) was awarded to David E. Ferguson, president of the company, for an "Apparatus and Method for Decoding Operation Codes in Digital Computers". It covers methods for using redundant command codes for computers or interpretive languages, and, according to the company, will increase the effective capacity of small word-size computers.

Patent Office guidelines state that computer programs cannot be patented. But reportedly because the courts have recently overruled the patent commissioner on this point, and because the Programmatics patent includes both hardware and software, the firm had little difficulty in obtaining the patent.

ADAPSO IS CONTINUING ITS FIGHT AGAINST BANKS OFFERING DATA PROCESSING SERVICES. The Board of Directors of ADAPSO voted unanimously on Feb. 14 to appeal to the Supreme Court a U.S. Court of Appeals ruling that upheld a lower court decision which would permit banks to perform data processing services.

ADAPSO brought its suit against the Comptroller of the Currency of the U.S. and the American National Bank & Trust Co. of St. Paul, Minn., charging that when the Comptroller authorized national banks to perform data processing services for bank customers, the National Banking Act was violated. ADAPSO claimed that this action would cause its members to lose a substantial part of the data processing service market.

ADAPSO spokesmen said they were confident that the Supreme Court would hear their case.

XEROX CORP. AND SCIENTIFIC DATA SYSTEMS HAVE REACHED A TENTATIVE AGREEMENT TO MERGE, according to announcements by the presidents of both companies. The terms of the proposed transaction call for the exchange of one share of Xerox common stock for each two shares of SDS common stock.

The merger is subject to approval by both companies' directors and shareholders, as well as a favorable tax ruling. The annual meeting for Xerox shareholders is scheduled for May 16; no date has been set for a vote by SDS shareholders.

WESTINGHOUSE ELECTRIC CORP. HAS BEGUN PRODUCTION OF WHAT IT CALLS ITS FOURTH GENERATION SERIES OF COMPUTERS, the Prodac 2000 series. Four plug-in circuit cards comprise all of the basic P-2000 — the input/output, memory, and arithmetic functions. A malfunction can be corrected by simply replacing one of the four integrated circuit cards. Spares of the cards will be available on a lease basis, and faulty cards can be returned to Westinghouse for repair.

Offering both modular hardware and software, the P-2000 is designed to cover the market area between the upper limits of wired logic capability — such as simple data logging — and the middle limits of large sophisticated computer systems. The computer can be expanded by simply adding additional circuit cards or portions of cards. The new computer costs less than $10,000 for basic hardware, but will also be marketed as a key component in systems that could cost more than $1 million.

THE SPECIAL INTEREST COMMITTEE ON THE SOCIAL IMPLICATIONS OF COMPUTING (SICSIC) OF THE ACM HAS BEEN DISSOLVED because of an apparent lack of interest on the part of its members to maintain the committee. The action was taken on the recommendation of the chairman of the ACM Committee on Special Interest Committees and Groups, Jean Sammet.

The official ACM procedure is for Special Interest Committees to become Special Interest Groups after one year. Thus SICSIC was dissolved when it showed no signs of activity and no complaints had been received about its inactivity.

TWO TOP LAWYERS ON IBM'S LEGAL STAFF WERE RECENTLY PROMOTED, possibly in preparation for IBM's defense in the anti-trust suit recently filed against it by the Justice Department.

Burke Marshall, IBM Vice President and General Counsel since 1965, has been elected a senior vice president, and will become part of IBM's Management Committee. (The Management Committee reviews the plans of the firm's operating divisions and examines new and revised corporate policies.) Nicholas deB. Katzenbach has been elected a vice president, and will succeed Marshall as General Counsel. Both men are former Justice Department employees.

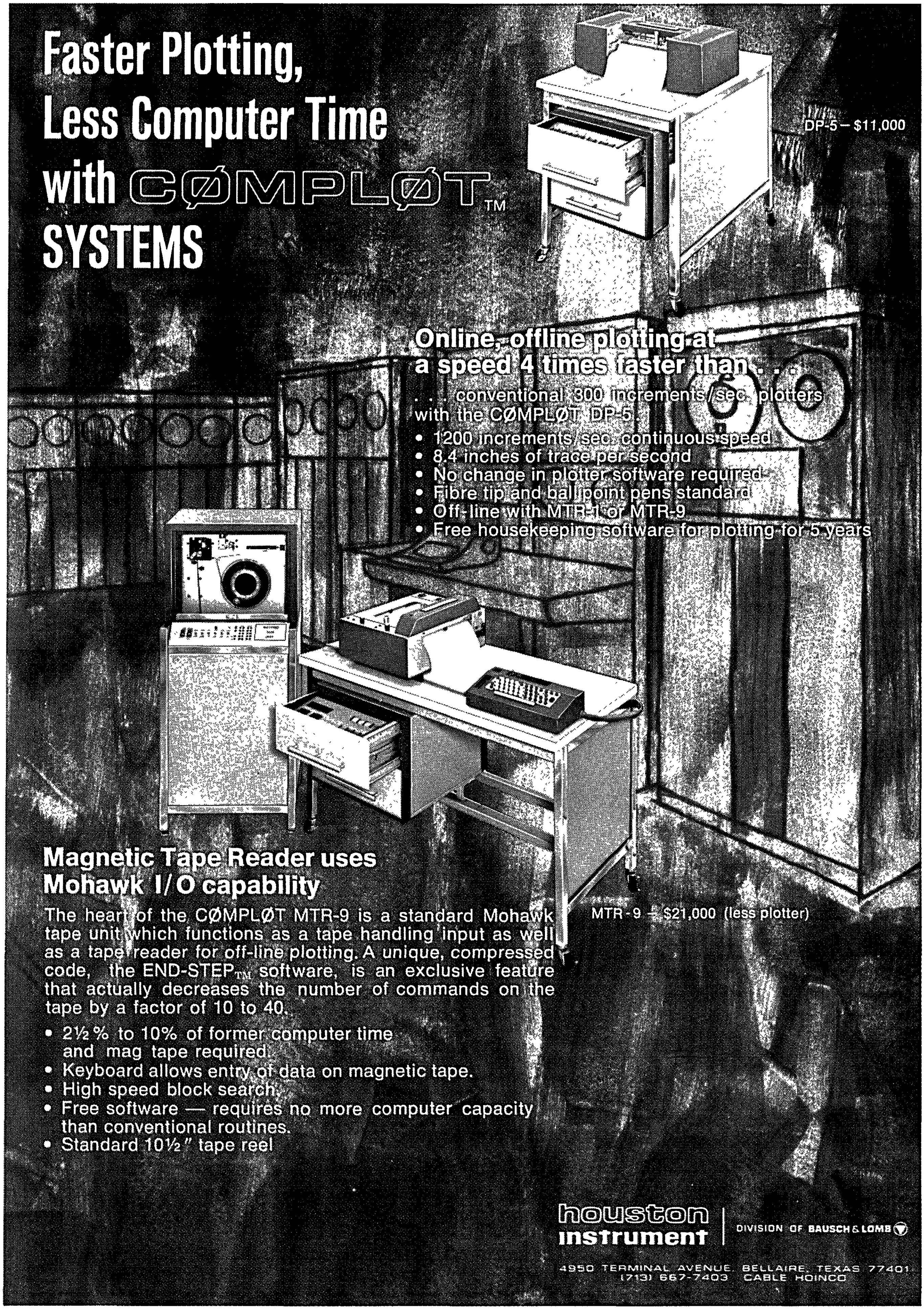
The editorial staff of Computers and Automation has received several queries on the possible effects of the several suits recently filed against IBM. Until the cases have been argued and the evidence weighed in court or before a judge, it is not very reasonable to draw any solid conclusions. In the long run, it seems likely that the suits will be settled by way of a consent decree some years from now, and that IBM will continue to be a very strong company, as it was after the last consent decree.

SHOULD YOUR ORGANIZATION BE IN "THE COMPUTER DIRECTORY AND BUYERS' GUIDE, 1969"?

The Fifteenth Annual Edition of the "Computer Directory and Buyers' Guide" (a special issue of C&A to be published additionally in June 1969) is now being prepared.

If your organization has recently entered the field of computers and data processing, or if you are not sure that we have your organization's name on our mailing list to receive entry forms in March for this Directory, please write us at once and ask us for your free entry forms:

Directory Editor
Computers and Automation
815 Washington Street
Newtonville, Mass. 02160



Designate No. 18 on Reader Service Card

Letters To The Editor

Candor

Somehow I didn't receive the August issue of C&A. Could you supply a copy please? I am most anxious to read your editorial of that month. A copy of your memorandum would be most appreciated too.

Your comments on pages 8-10 in the December issue ("How to Spoil One's Mind — As Well As One's Computer — Some Comments") were accurate. Loss of faith in our elected leaders has been the major cause of our nation's woes. Congratulations on your insight and candor.

R. W. ROSENBAUM
Systems & Industrial Relations Research
2618 Colonial Way
Bloomfield Hills, Mich. 48013

(Ed. Note — *Thank you. A copy of the August issue and the memorandum are being sent to you.*)

Retrieval of Legal Information

After reading the article "Automated Retrieval of Legal Information: State of the Art" in the December 1968 issue of *Computers and Automation,* I feel compelled to make this comment: It was a well-written summary of articles on legal indexing and information retrieval which have been listed in the ACM's *Computing Reviews.* Therefore it seems to me the subtitle, "State of the Art" is misleading.

May I respectfully recommend that you solicit an article from someone who is solving or has solved the problems which present themselves in the flow of information in, around, and through the legal process, rather than present summarized viewpoints of supersalesmen?

HUB S. RATLIFF
Data Processing Consultant
P.O. Box 22487
Houston, Tex. 77027

So Why Study?

I read the book *A Guide to Mathematics for the Intelligent Non-Mathematician* by Edmund C. Berkeley. I thought it was good. Do you know of any books which make analytic geometry and calculus a little bit easier to learn and understand? I haven't been in college for 6 years and I plan to go back soon. My hardest (worst) subject was calculus. I like it but I can't understand much of it.

Another thing I would like to know, if computers one day will duplicate the mind of a human being and be able to think much better and faster than we, then why should I invest 10 or 12 thousand dollars in a college education when it won't do me a bit of good? It (and I) will become obsolete and computers will have the answers to everything (and much quicker and more accurately than I). I want to major in Chemistry or Physics. What good would it do me to learn these things, if some machine can learn them better? What can I contribute to these sciences? Nothing, except just learning them for my own knowledge.

GERRY KASUGA
337 Louise Ave.
Bellevue, Ohio 44811

(Ed. Note — *There are a number of books on analytic geometry and calculus which make them easier to learn and understand. I suggest that you go to a large library nearby and look up 15 or 20 of them, and see which you might think most helpful, and then obtain those. I also suggest you talk with a professor of mathematics at a nearby college.*

The relations between computers and human beings are more complicated than what you suggest in your letter. Although computers will be able to do *some intellectual activities better and cheaper than human beings, it will be over a hundred years before they "duplicate the mind of a human being" if they ever do. In the meantime, a college education will be most useful.*

Proof Goofed — Again

Upon examining the January 1969 issue of *Computers and Automation,* I found an error in the table of contents (page 5): The words "Annual Index for Vol. 16 (1967)" listed there should have read "Annual Index for Vol. 17 (1968)". This is not the first time I have found errors on the Table of Contents page. I have come to the conclusion that the Table of Contents page should be used on the Proof Goofs page frequently.

CHARLES ARONOVICI
366 Cochran Ave.
Los Angeles, Calif. 90036

P.S. I have no other complaints about your magazine!

(Ed. Note — *We regret the inexcusable error, due to insufficient care, of listing on the January Table of Contents page the wrong year for the annual index actually published. The department "Proof Goofs" deliberately excludes all newspapers and magazines and includes books only — because newspapers and magazines are always published under the pressure of meeting rigorous deadlines.*)

Chess Playing Programs

If I remember correctly, your magazine has featured articles that have referred to man/computer chess playing programs. I don't recall any writer offering the reader a source from which a write-up of such a program might be obtained. I would also be interested in the record of any significant game involving a competent human player. I would appreciate information concerning the source of such documentation as may exist.

ROBERT J. HUNT
Chief, ADP Office
Dept. of the Army
P.O. Box 103, Downtown Sta.
Omaha, Nebr. 68101

(Ed. Note — *The most important chess-playing computer program that I know of is a program at Project MAC called the Greenblatt Program. I understand that it plays on a number of DEC PDP-6 computers besides the one at Project MAC. The address of Project MAC is c/o Mass. Inst. of Technology, 545 Technology Sq., Cambridge, Mass. 02139.*)

MULTI-ACCESS FORUM

MARTIN LUTHER KING MEMORIAL PRIZE CONTEST

Computers and Automation has received an anonymous gift and announces the annual Martin Luther King Memorial Prize, of $300, to be awarded each year for the best article on an important subject in the general field of:

> The application of information sciences and engineering to the problems of improvement in human society.

The judges in 1969 will be:

> Dr. Franz L. Alt of the American Institute of Physics; Prof. John W. Carr III of the Univ. of Pennsylvania; Dr. William H. Churchill of Howard Univ.; and Edmund C. Berkeley, Editor of *Computers and Automation.*

The closing date for the receipt of manuscripts this year is April 30, 1969, in the office of *Computers and Automation,* 815 Washington St., Newtonville, Mass. 02160.

The winning article, if any, will be published in the June issue of *Computers and Automation.* The decision of the judges will be conclusive. The prize will not be awarded if, in the opinion of the judges, no sufficiently good article is received.

Following are the details: The article should be approximately 2500 to 3500 words in length. The article should be factual, useful, and understandable. The subject chosen should be treated practically and realistically with examples and evidence — but also with imagination, and broad vision of possible future developments, not necessarily restricted to one nation or culture. The writings of Martin Luther King should be included among the references used by the author, but it is not necessary that any quotations be included in the article.

Articles should be typed with double line spacing and should meet reasonable standards for publication. Four copies should be submitted. All entries will become the property of *Computers and Automation*. The article should bear a title and a date, but not the name of the author. The author's name and address, and four or five sentences of biographical information about him, should be included in an accompanying letter — which also specifies the title of the article and the date.

TUNNEL VISION — COMMENTS

I. From William E. Blessing

Federal Highway Adm.
Bureau of Public Roads
1717 H St. N.W.
Washington, D.C. 20006

Your editorial ["Tunnel Vision"] in the January 1969 issue commented on the naivety of a remark attributed to Mel Seligsohn to the effect that computers don't think.

A computer, as any other piece of machinery, can do no more than it is designed to do, and it may have to do less depending on the constraints under which it must operate. In the case of a computer, it is a program, whether built into the hardware or read in, that causes the computer to act in a particular way. It is not the computer doing the thinking, but the program. You point this out in your editorial where you tell about the checker-playing program improving its strategy from experience. I notice you do not say the *computer* improved its strategy from experience. It should not be forgotten that the program was developed by a human being.

I don't believe it's so naive to say that computers do not think, but I'm probably suffering from tunnel vision.

II. From Christopher J. Shaw

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

In your January editorial, you deride as "a naive remark" exemplifying "tunnel vision," an assertion to the effect that computers don't actually think, as some people still believe — including, I suppose, the editor of *Computers and Automation.* You mention (as evidence to the contrary?) Samuels' checker-playing program, and you go on to discuss the fallacy of "the argument of the beard" without, evidently, realizing its applicability to your previous argument. Just because it is impossible to rigorously define a dichotomy (such as the difference between being bearded and being beardless, or between human thinking and mechanical computation), that is no evidence the difference isn't real. Is this, perhaps, an example of tunnel vision on your part?

III. From the Editor

There are three questions which should be asked, and discussed:

1. What is thinking?
2. Does a computer think?
3. Is it worthwhile to decide whether computers think or do not think?

First: The common word "think" received most of its meaning in the days before computers. In those days it was evident and accepted that most human beings did think, and that some clever animals (both domesticated such as dogs and elephants and wild such as foxes and chimpanzees) did think. In other words, human beings and other animals were able to take in problems, "mentally" work out sensible solutions to them, and apply those solutions in situations. Textbooks on the measurement of intelligence describe such problems and solutions. In those days if any non-human animal had been found which was able to learn checkers and gradually come up to playing a championship game of checkers, most certainly that animal would have been classified as thinking. Now clearly it is not scientifically honest to change the definition just because non-animal machines display abilities which if displayed by an animal would certainly be called thinking.

Second: Over and over again the word computer is used with the meaning programmed computer; a digital computer that could *not* be programmed in any way would never be made, and of course it would not think. So is it not scientifically honest to quibble that it is the programmed computer and not the computer unprogrammed that does whatever thinking may be done. For that matter, human beings also are programmed — they are programmed by their years of schooling and education and their contacts from birth onwards with human culture transmitted through hundreds of generations.

Third: It is important to decide that computers do think, because that rational decision made on the basis of reasonable evidence changes the attitudes and behavior of human beings who are investigators, scientists, engineers, or even ordinary people with ordinary capacities. In the same way it was important to decide that the internal plumbing of arteries, veins, and pump of one human being was like the internal plumbing of arteries, veins, and pump of other human beings, so that the way was open to consider transplanting a heart from one man to another. We recognize many varieties of thinking by human beings, from the thinking that is done by an ordinary elevator operator (when he operates an elevator), up to the thinking that is done by a composer of a symphony, or the winner of a Nobel Prize in physics. Just as many human beings think well in some ways and badly in other ways, so do computers. And just as it is a mistake to ask an ordinary elevator operator to conduct Beethoven's Ninth Symphony, so it is a mistake to ask a computer to drive a school bus, pick up the right children, and bring them to school.

To assert that a computer cannot think is to commit a serious scientific and logical error. It is like the error of asserting that the process of evolution did not create all living species — a denial of a principle established by overwhelming scientific and logical evidence. □

ACCESS TO A COMPUTER FOR EVERY PERSON — A PREDICTION

Leon Davidson
Technical Director
Metroprocessing Corp. of America
64 Prospect St.
White Plains, N.Y. 10606

The December 1968 editorial in *Computers and Automation* on "Access to a Computer for Every *Computer* Person — Are We There?" prompts me to suggest that a topic for a similar editorial not too many years hence could well be "Access to a Computer for *Every* Person — Are We There?".

I have found, in my business of extending the availability of Touch-Tone computer input systems to every telephone — whether Touch-Tone or rotary dial — that there is no economic barrier now to making computer services accessible to the general public for many types of applications. However, a sort of vicious circle has impeded the widespread use of these systems. Touch-Tone phone service is still limited or unavailable in many localities because of the production and equipment schedules of the telephone companies. Therefore, marketing of general Touch-Tone input services hasn't been undertaken on a large scale.

There has not yet been any provision, that I am aware of, for accepting Touch-Tone input on a public time-sharing system. Several such input systems are under development, and there are quite a number of in-house systems already in use, but none accessible to the public. Therefore, the average businessman has had no opportunity to witness the performance and judge the benefits of computer systems accessible over his regular telephones.

I think the recent advent of portable Touch-Tone terminals is going to break that vicious circle and make it feasible to set up large-volume applications in any geographical pattern required by a business. This should induce time-sharing systems to equip some of their input ports with Touch-Tone data sets, allowing pioneering public telephone-input systems to be established. These new portable terminals, such as the one you showed on p. 42 of your December issue, can be acoustically coupled to the ordinary telephone set without extra charge, under A.T.T.'s new tariffs.

Improvements based on experience may soon bring the cost of a portable Touch-Tone audio-response terminal down below $100 per unit. At those prices, every working person whose job justifies someone's investment in a box of tools, a typewriter, or a car, can also justify having one of these portable personal terminals with him at all times, for use on any telephone.

Of course the general public, including businessmen and business employees, is not going to want to do programming over these, or any other, terminals. Applications will be set up to provide uncomplicated, loosely-structured, input requirements, capable of use by the average Joe and Jane. Output will be chiefly by voice-response systems heard over the telephone earpiece, but printers are already on the market for use in situations that require hard copy output.

This whole area of public access to computers should be breaking wide open in the next couple of years, and may be the next big growth area in the computer field. I would suspect that you could schedule that editorial for your December 1970 issue, and not be far off. □

ECKMAN AWARD TO BE GIVEN AT 1969 JOINT AUTOMATIC CONTROL CONFERENCE

The Donald P. Eckman Award Comm. of AACC
c/o Systems Research Center
Case Western Reserve University
University Circle
Cleveland, Ohio 44106

A certificate and cash award of $300 will be granted for an outstanding contribution in the field of automatic control at the 1969 Joint Automatic Control Conference to be held Aug. 6-8, 1969, in Boulder, Colo.

Nominations are invited in support of outstanding individual young contributors to the field of automatic control, subject to the following qualifications:

(a) Contributions may take the form of technical or scientific publications, theses, patents, inventions, or combinations of the above in the field of automatic control.

(b) Applications will be accepted in support of candidates who are less than thirty years of age.

(c) The contribution for which the Award is sought must represent work performed prior to the age of 27 while resident in the U.S.A.

(d) Supporting evidence must include a full professional résumé and letter of recommendation by at least one responsible supervisor.

(e) All supporting documents shall be in the English language.

Nominations for the 1969 Award must be submitted before May 6, 1969, and should be sent to the address above. □

CALLS FOR PAPERS: ACM SYMPOSIUM ON PROGRAMMING LANGUAGES DEFINITION — CONFERENCE ON APPLICATIONS OF SIMULATION

The ACM Special Interest Group on Programming Languages (SIGPLAN) calls for papers to be presented at the Symposium on Programming Languages Definition to be held August 24-25, 1969, in San Francisco, California, immediately prior to the 1969 National ACM Conference.

The conference will be concerned with the definition of syntax and semantics of programming languages, self-defining languages or extendible languages, and with mathematical models of programming languages. Appropriate topics for the conference include, but are not limited to, models of language definition, correctness, termination or equivalence of algorithms, user-defined extensions to language skeletons, automatic program verification, automatic detection of program parallelism, etc. The deadline for papers is April 30, 1969. For further information contact: Dr. James A. Painter, IBM Corp. Research Lab., Dept. 978, Bldg. 025, Monterey and Cottle Rds., San Jose, Calif. 95114.

Papers are invited for presentation at the Third Conference on Applications of Simulation to be held Dec. 8-10, 1969, in Los Angeles, Calif. Only papers concerned with *discrete* simulation (using languages such as GPSS and SIMSCRIPT, but not limited to them) will be considered. Suggested topics include:

Statistical Considerations
Recent Language Developments
Corporate and Financial Models
Transportation and Distribution Models
Computer System Models and Languages for Modeling Computer Systems
Manufacturing Applications
Aerospace Applications
Social System Models
Gaming
Job Shop Scheduling
Urban System Applications
Simulations of Large-scale Systems

Only papers which have not been presented or published previously should be submitted. Complete papers will be published in the *Conference Proceedings*. Three copies of a 50-100 word abstract, together with a working title, should be submitted no later than March 31, 1969 to: Philip J. Kiviat, Program Comm. Chrmn., The Rand Corp., 1700 Main St., Santa Monica, Calif. 90406. □

FOUNDING COMMITTEE FORMED TO ESTABLISH SOCIETY FOR MANAGEMENT INFORMATION SYSTEMS

Robert V. Head, Chairman
SMIS Founding Committee
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A founding committee of leaders in the electronic data processing industry has been formed to establish a new professional society, the Society for Management Information Systems (SMIS). The objective of the new group is to provide an interdisciplinary forum for people concerned with all aspects of management information systems. It is not intended to duplicate or overlap the work of existing societies.

SMIS will serve management systems directors, top-level

C.a

PROOF GOOFS

Neil Macdonald
Assistant Editor

We print here actual proofreading errors in context as found in actual books; we print them concealed, as puzzles or problems. The correction that we think should have been made will be published in our next issue.

If you wish, send us a postcard stating what you think the correction should be.

We invite our readers to send in actual proofreading errors they find in books, *not* newspapers or magazines (for example, *Computers and Automation*), where the pressure of near-at-hand deadlines interferes with due care. Please send us: (1) the context for at least twenty lines before the error, then the error itself, then the context for at least twenty lines after the error; (2) the full citation of the book including edition and page of the error (for verification); and (3) on a separate sheet the correction that you propose.

We also invite discussion from our readers of how catching of proofreading errors could be practically programmed on a computer.

For more comment on this subject, see the editorial in the September 1968 issue of *Computers and Automation.*

Proof Goof 693

(Find one or more proofreading errors.)

The science-built world of engines and laboratories in which man lives has grown up apart from man himself. Science has not instructed man — it has only implemented him.

A very proper sense of confusion has thus fallen upon mankind. His elected representatives do not understand the gadgets and machines which have come into being, or their consequences, or their social implications, or even the reason for the existence of many of them. Soil erodes away. States become dust bowls. People are unemployed and famished. Prices rise. Bread grows scarce. The radio blats away all day and night without the dimmest notion of responsibility for the effect of what it says. Men and women harbor in their houses machinery the workings of which they do not have the intelligence quotient to learn to comprehend by any possible means of instruction. Men and women drive automobiles which are so much better and more dependable, as natural objects, than the minds of the drivers that the net result, aside from universal escapism, is a homicide total higher than that of all our war casualties put together.

But science continues irresponsibly to tender new tools — airplanes, for example — and it is not bright of science. There is nothing wrong with the tools. The trouble is with the people. I would declare no truce against discovery. But I do suggest new lines for scientific investigation. Men unequipped internally but overloaded by objects are sure to stumble and fall to fighting. Again — one should not hand loaded pistols to the youngsters in a day nursery; but that is the learned procedure of this century. The proliferation of goods mounts and mounts again. Avarice, imitation, the lust for money, power and glamour — all primitive and unrestrained impulses — control the consumer public. The demented dogma of classicism reimbues the scientists with the urge to continue the proceeding irrespective of all result. And so they burn late oil, to freedom's glory — or Hitler's.

Our boots are not merely seven league: they stride the globe. Our eyes see through light years. Our ears hear voices from every city on the planet. Our biceps tear down cliffs. In every material sense, we have reached the end of the legends, the finale of the fairy tales. All the physical imagining of man, when he was limited to the power of his own body, has been realized. But not any good whatever has come of it — only the greatest evil man has yet endured.

During the decade before the onslaught of the current war, society was very near to collapse, and one thing was certain: in that prewar society of ours, not one per cent of the population really understood the material advances of their time, and of that one per cent, scarcely a man in ten thousand was giving any large part of his effort to an *intelligent* study of the hysterical dilemma. I say intelligent, advisedly. There were myriad panacea-makers but almost none mentioned as the cause — individual man.

Science had convinced itself that *only* the field of matter, or energy, was worth exploring with its new instrument: truth. Not one physical scientist in a thousand made a suggestion for attacking the manifest shambles of the individual. Salvation was expected even by the savants from a loosely associated group of pseudo-scientific quacks who called themselves economists or sociologists. The plans of those persons, probably, will go into the formulation of the next peace — making that peace as unrealistic as its numberless precursors. For this is the era when man subscribes his whole body and soul, in so far as he can, to materialism, and farms out the remnant to somebody called an economist.

— From *Generation of Vipers* by Philip Wylie, pp. 12-14, published by Pocket Books, A Division of Simon & Schuster, Inc., 1 West 39th St., New York, N.Y. 10018, 312 pp., 10th printing 1968; first published, 1942.

Solution to Proof Goof 692:

Paragraph 4, line 5: Replace "changes" with "chances".
Paragraph 5, line 6: Replace "risk of doing so" with "risk in doing so". □

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executives working with Management Information Systems, educators in graduate schools of business, MIS resource people, and members of the general public who are interested in MIS.

Members of the Founding Committee include: Dr. James C. Emery, Associate Professor, Wharton School of Finance & Commerce; Robert B. Forest, Editor, *Datamation* magazine; Mel H. Grosz, Vice President, Esso Mathematics and Systems, Inc.; Dr. Alan J. Rowe, Chairman, Dept. of Management, School of Business Administration, University of Southern California; James G. Rude, Vice President, Information Systems, Pillsbury Company; Robert G. Stevens, Vice President, First National City Bank, New York; and Robert K. Wilmouth, Senior Vice President, First National Bank of Chicago. □

COMPUTERS AND EDUCATION

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The future of computers in education is assured. The open questions are: 'How soon?', 'How much?', . . . and 'How?'

It is difficult to report on "Computers and Education", because the topic is so new and what it includes is so fragmentary that it almost defies concise description. But there are, it seems to me, three major types of use of computers in education, where the computer is on-line and the student is included in the loop of interaction (see Chart 1). In this chart, the columns are arranged from left to right according to the degree of control that the computer system exerts upon the student's next response.

In the *Ad Lib* category, the student takes charge. He calls in computer programs to process data that he gives to it. When necessary he, himself, constructs new computer programs to serve his own purposes. As Professor Kemeny of Dartmouth has eloquently argued, the computer age has indeed arrived, and every well-trained college man needs to acquire facility in dealing with computers and to be provided with adequate on-line computer support. Some obvious advantages deriving from providing generous amounts of *ad lib* computer resources are listed in the chart. Some of those advocating the *ad lib* approach are also listed there. The roster could be extended. Often, in fact, each man listed in one column could also appear in another, because the men in the field have worked in more than one area.

Computerized Games and Simulations

The center column deals with the category of computerized games and simulations. Here the student learns by doing. He isn't lectured *to* or preached *at*. His explorations and manipulations of the pseudo-world provided by the computer allow him to experience the (often complex) interplay of forces that exist in the real world. Properly-designed environments allow him to assess the consequences of his own actions, to encounter rare or dangerous situations, and to devise and test new strategies. This type of self-assessment can be augmented by critique and guidance resulting from the computer's analysis of the student's activities. The amount of positive transfer from this type of training to the actual job should be high. Also, working in a pseudo-environment is a good way to help the student develop self-confidence after he has been taught the rudiments of the job.

Military and space training programs rely heavily upon elaborate simulators to provide training that is too expensive, too dangerous, or too hard-to-control in the real-world case. Up until recently, these have been designed mainly to *be* something, namely, realistic substitutes for the real operational equipment.

However, there is a growing awareness that *being* a safe and economical substitute isn't enough. Rather, greater attention needs to be directed at what the training system should *do* (namely, to guide and assist learning). This trend is stimulated by: (1) the increased use of digital computers in the big devices; (2) the amount of publicity given to computer-aided instructional concepts; and (3) a growing appreciation of the training potential of games and simulation.

Effective beginnings involving augmented games and simulation have been made at a number of locations. Bolt, Beranek, and Newman were among the earliest exponents of this arrangement. More recently, the Electronics Personnel Research Group at the University of Southern California has been conducting useful exploration of on-line computing for strict performance monitoring. In one case, they permit the student to designate how much help he wants while tuning and troubleshooting a complex transceiver. If he opts for "None" (as against "Some" or "Lots"), he will be free to proceed (without guidance or interference) to do as he pleases except when he wishes to do something that would produce catastrophic consequences. If he chooses "Lots", he will be told exactly what to do next at every point. As currently planned, the program can run against a functional simulation of the transceiver or with the actual equipment, free standing, alongside a computer terminal.

A related phase of this work is being carried out in conjunction with Project PLATO at the University of Illinois. However, in the PLATO case, the transceiver is tied into the CAI system in such a manner that the system senses certain states of the transceiver and controls still others.

Teaching Electronics Troubleshooting

An ingenious strategy for teaching electronics troubleshooting, devised by H. R. C. Dale, could easily be adapted to CAI simulations. Basically, it requires the learner to seek information ("make tests") about a schematic diagram in order to find the cause of the improper performance of the equipment represented. If the student made a critical check which would have revealed the difficulty immediately by using the "wrong" strategy, the problem was secretly switched to maximize the amount of work that he would have to do to solve the problem. Conversely, a beginner who employed the correct search strategy, but didn't act as if he fully appreciated the information he was acquiring, might have the problem secretly changed as he was working on it, in order to force success and thus reward the use of good strategy.

This ability to scale games and simulation to the characteristics of the student is most advantageous. A beginner can be given easy problems or have his performance evaluated according to tolerant standards. An expert can be given experience with rare and difficult problems seldom encountered in the real world.

Controlled Learning

In Chart 1, the final column is labelled Controlled Learning. In this category, almost everything, including the title

TWO-WAY CLASSIFICATION OF COMPUTER-ASSISTED INSTRUCTION ACTIVITIES

CATEGORY	TYPE OF ACTIVITY: 1. Ad Lib	2. Games and Simulation	3. Controlled Learning
1. Degree of Control Over Student's Next Response	None	Constrained by the rules of the game or by the logic of the simulation	Essentially predetermined, systems-approach process or process control
2. What the System Does:	It allows the student to: 1) manipulate data (e.g., perform calculations) 2) seek and find information (e.g., table "look-ups") 3) transform outputs (e.g., convert tabular display to graph)	Plays a game or simulates a dynamic process 1) without augmentation 2) with augmentation	1) Produces a fixed single path; 2) establishes level-of-mastery criteria for any path traveled; 3) senses deviation from ideal path and guides student back to that path; 4) provides multiple paths; with two types of branching (major, minor); with two types of model criteria (fixed, dynamic)
3. Some Advantages:	Student can do more: problems, exercises, and research. Student can tackle: complex problems, big problems, realistic problems, problems requiring extensive computation Student can concentrate on: the "big picture", larger issues, and conceptual (rather than computational) matters	Student learns by "doing" and gets "experience in a realistic context". The game or exercise can be chosen to emphasize specific aspects of a task, to exercise specific skills, or to be at a specific level of difficulty.	Sets specific goals. Control is exercised (in detail) with respect to those goals.
4. Workers in this Area:	Oettinger, Culler-Fried, Licklider, Swets, Kemeny	Weizenbaum, Perlis, Feurzeig	Bitzer, Adams, Suppes, Gerard
5. Subjective Grade at this Time:	B+	B- or C+	D+

Chart 1. Three types of computer operations with the "student-in-the-loop."

of the column, requires some explanation. The title is intended to convey the notion that learning can be regarded as a deterministic process, subject to control. These process-control procedures are ordinarily called teaching, training, or instructing. A person who advances this point of view must be prepared to take charge of the learning process and regulate its occurrence and flow in a definite way.

The first type of controlled learning manipulates the content of the curriculum as a means for control. Exponents of this point of view are greatly concerned about analyzing the subject-matter domain into logical units which must then be arranged to form a proper sequence. Customized curricula are used as means for dealing with the special needs of individual students or groups of students. Computer Managed Instruction (CMI) is achieving increased popularity as a means for automatically collecting information about the students and prescribing appropriate sequences for each student with minimum "turn-around time." While not strictly "on-line", this approach bears considerable resemblance to more closely coupled CAI systems.

Stepping Stones

In this category, we may think of planning a curriculum as the sort of planning that is involved in putting a string of stepping stones across a stream. The type of stone selected for use, the place chosen for the crossing, the distance between the stones, etc. will be determined by such factors as: the nature of the stream, how fast it is running, the characteristics of the people who will be crossing the stream, the loads they will be carrying, and so forth. Clearly, the kind of stepping stone "bridge" required to allow your best girl to cross a shallow stream without getting her feet wet would be quite different from that required to accommodate a battalion of heavily-laden foot soldiers.

Checkpoints

The second instance of controlled learning shown in Chart 1 adds the capability for establishing subgoals and checkpoints along a designated route. A system with this capability insures that the student achieves each subgoal before being permitted to proceed to the next.

If we switch from the stepping stone analogy to a railroad analogy, this new feature is similar to deciding that the railroad from A to X will go through B, C, and D. Further, since there is little value in sending empty trains along the route, each train will be given orders to pick up specific freight at each intermediate point. To this we add procedures for checking, to make sure that the designated freight has been picked up before each train is permitted to leave each station. We top this off with a computer to keep track of the status of each train and its load and to compile the orders for each station master, and then we have a system that resembles (in some ways) the Drill and Practice routines described by Suppes. Decisions regarding the particular intellectual baggage to be acquired at each stop, procedures for deciding when the requisite baggage has been picked up, and what to do if an inventory reveals deficiencies can be placed under the automatic control of a computer program with an alarm to solicit human assistance if certain unusual conditions are encountered.

In the first two analogies the learner was confined to a single path and was given no opportunity to stray from it. But some subject matters are of such a nature that the student has difficulty in staying exactly on any "ideal" path — if it exists. Consequently, in those cases a system is required to sense the student's location with respect to the "path" and to guide him back to it when he has strayed. Such a system is analogous to the aircraft auto-pilot. Unplanned, but inescapable, perturbations create conditions which cause the aircraft to deviate from its planned course. When such a deviation is sensed by the auto-pilot, a correction is fed in to steer the aircraft back to where it belongs. In the early days of programmed instruction, Dr. Norman Crowder developed the "Scrambled Book" as a device for determining whether a student was on the ideal path and for returning him to it if he had deviated. All systems which employ so-called "branching strategies" lean heavily upon this feature.

Multi-Path Logics

The next group of controlled-learning variations is called "multi-path logics." It is tempting to use the term "tree" in referring to the type of logic employed in these cases. However, the networks that are actually used are not true trees since every divergence must somehow be compensated for by a convergence somewhere down the line if every route does in fact reach the goal. In other words, the networks are like those shown in Figure 1 for interconnecting points A and X.

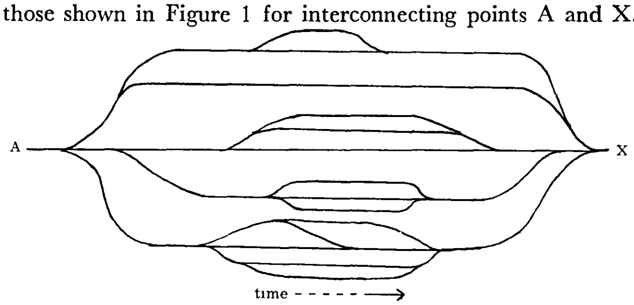

Figure 1. A multiple-path network connecting A to X.

A switch exists at every divergence or convergence. A time dimension is implied, running from left to right. Thus, movement through the network is always in that direction. The system consists of alternate routes (i.e., every route eventually leads to the goal). Important structural features such as clearances, contours, and load limitations aren't depicted but are known to exist.

Planning the route for any given train (returning to the railroad analogy) should take into account such factors as terrain, clearances, condition of the roadbed, and the weather. It should also consider factors associated with the train (its pulling power, etc.), the load (its size, weight, etc.), and management constraints (such as cost and efficiency). Working out an optimum route for each train and an optimum loading for the railway system is a sufficiently complicated problem to require a computer. The computer would also assist in the preparation of orders to be sent to the switchmen to notify them when and in which position the various switches should be set.

One would expect that a troop train would be sent along one route, a 200-inch telescope mirror along another. A heavy freight train and "Little Toot" would place different requirements upon the system. The network shown in Figure 1 clearly indicates a northern portion, a central position and a southern portion. The decision to commit a train to one of these major portions of the network is of a different magnitude from the decision that is made at some of the minor switch points. Furthermore, under some circumstances, it would not be necessary to worry about the exact setting of each and every minor switch so long as the major switches were properly set.

To leave the analogy for a moment, it is surprising that computer-based instruction hasn't paid more attention to major switching in terms of such factors as individual goals, learning styles, teaching strategies, and performance styles. To give a concrete (but hypothetical) example, suppose that you wanted to give sales training to all of the salesmen in a life insurance company. For the sake of simplicity, assume that there are exactly two types of salesmen in the company; call one the "backslappers" and the other the "brokers". The backslapper is open, affable, and interested in his clients as people. The broker is formal and reserved; he is an expert on devices for escaping taxes and taking advantage of inheritance laws. He delights in preparing official-looking portfolios which seek to tailor an insurance program to your particular resources, goals, and obligations. Most likely, each of these types could be given beneficial training. However, it seems unlikely that a standardized course could be developed that would suit both types of salesmen. It would seem more sensible to try to help the backslapper become a more productive backslapper and to help the broker become a more productive broker. Routing individual salesmen according to such stylistic considerations appears to be analogous to sending one train along the northern route and another along the southern route. It seems that these broader learning-related variables should have enjoyed more research attention than they actually have.

Micro-Route Logic

On the other hand, the micro-route logic has many adherents. The term micro-route refers to the fine-grained plan for selecting among alternative minor branches down to the last detail. There are three ways that such routing could (in principle) be accomplished: One: prior to departure, the entire route is specified before the train leaves Point A and then the planned route is adhered to throughout the trip. Two: at each switch, the train is tested with respect to some prescribed criteria when it arrives at a given switch and then the train is disposed of according to the outcome of the test. Three: as a result of the performance record accumulated up to any point in passing in the network, patterns of future planned switch settings are changed.

The first of these alternatives hardly seems in the spirit of switching. It is more like customized curriculum planning. The second is used extensively by CAI enthusiasts. Periodic testing sessions are introduced to assess the student's degree of mastery, which then determines whether the student is switched one way or another. Smallwood's work is one example of the point of view. Perhaps Suppes' arithmetic drill and practice may again be cited as an example, this time, of the third sort of switching strategy. In the third strategy, the student's regular performance (not a special test) is used as a basis for determining what happens to him next. Ideally, it takes into account the learner's performance while learning. Of course, Suppes' work isn't the only example of this approach, and he deals only with one aspect of the student's performance. Effective computer programs should be able to recognize persistent performance patterns which the learner exhibits while he is learning, and these patterns could serve as bases for readjusting significant numbers of switches in the balance of the network — not just the next one.

Super-Adaptive Network

The final entry in the column is the super-adaptive network. So far as I know, no one has gotten very far with this sort of thing in the specific area of controlled learning. Such a network would be one that alters itself and its own operating characteristics as a result of its success in interacting with past students (or with the current student on previous occasions). Clearly some of those interested in learning machines and artificial intelligence are looking forward to such possibilities.

Advantages of Controlled Learning

As for the advantages of controlled learning, its obvious strength so far seems to lie in the use of explicitly-set, objectively-measured goals and its thoroughgoing analysis of the tasks to be performed. As might be expected, this is also a source of considerable weakness. For it just might be that human learning isn't as deterministic as all that, and that some useful bodies of knowledge are not fully amenable to such analysis and goal setting. In any case, it is clear that we must find out a great deal more about learning processes before we can exercise effective direct control over them to the extent required by the applications in the third column.

Evaluation

At the very bottom of Chart 1, each column has been given a grade reflecting my assessment of where it stands in terms of its potential. The *ad lib* approach is well ahead of the others, probably because it overlaps the domain of non-educational computer applications to a great extent. This, of course, isn't to suggest that all of the problems have been solved or that work in this area need be pedestrian or unimaginative. However, enough is known about the *ad lib* approach to permit realistic estimates to be prepared and truthful proposals advanced to Boards of Trustees or other governing bodies who are confronted with the difficult task of allocating educational resources.

The second column is given B− or C+.

If this column were a student of mine, I would do my best to encourage it to discipline itself, in order to realize a greater proportion of its obvious potential.

The third column is hard to grade. It is clearly the most difficult area in which to work. Impressive efforts have been made, but progress has been slight. Many, many obstacles of all sorts (technical, economical, social, psychological, you name it) lie ahead. Dramatic demonstrations may be necessary in order to attract the support required to underwrite more aggressive research and development efforts in this area. My present grade is D+.

A few general comments: First, the field of computers and education, like all aspects of computers in America, has grown impressively. The future of computers in education is assured. The open questions are, "How soon?" "How much?" and simply "How?" At present, we seem to be in the stage that the auto industry was in during the early part of this century. At that time there were many prophets of doom; they were more than willing to call attention to the absurdity of building private automobiles to supply a non-existent market, for travelling on non-existent highways at unnecessarily high speeds. But the American public decided that it *wanted* automobiles. The early prophets have been replaced (or, should I say, have been driven out) by another kind of profits. Today, our very lives are structured (and sometimes threatened) by the horseless carriage.

The introduction of color TV was even more surprising and less predictable. After all, the early color sets were much more expensive than the black and white receivers. They were far more unreliable and more difficult to repair; the repairs themselves were costlier. The color sets showed (in ghastly color) the same poor programs that could be seen on the black and white sets. Yet, the buying public (many of whom already had a black and white set) stood in line to buy the color sets; they want to see a very limited number of "color specials". The public decreed that it wanted color TV, and it got it.

It is not my purpose to equate the use of computers in education with autos or TV. Rather, I just want to emphasize that the American public tends to get what it wants, and that it sometimes wants things that seem out of reach or absurd. I think that the public wants the things that computers can provide to education, such things as:

- remote access;
- around-the-clock availability;
- enduring patience;
- student anonymity;
- self-pacing; and
- some forms of individualized instruction.

The research efforts of those in this field at the present time have made important contributions. Difficult problems of many kinds still stand between the public and its desires for better educational facilities. I venture to predict that this society is capable of marshalling its resources to fulfill these public desires.

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A Guide to Some Workers in the Field

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COMPUTER SIMULATION OF A SCHOOL SYSTEM

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Last autumn, the school district of Philadelphia, Pennsylvania, through its Division of Administrative and Survey Research, began looking at some of its planning problems through the projections of a computer-simulation model. The model used was developed by the Management Science Center of the Wharton School of the University of Pennsylvania under a federal grant to the school district. It represents the administrative process, at the top district level, of allocating and spending money. The simulation of this process shows the financial consequences of various management policies carried out under a variety of assumed conditions.

Programmed in FORTRAN IV for an IBM System/360 Model 65, the model has no unusual state-of-the-art features. It consists of 833 instructions, and takes up, including data areas, some 51,264 bytes of core memory. Outputs are produced on a 1403 printer in both tabular and graphic form. A series of four ten-year simulations can be run in 1.10 minutes. The model is run in one of two batch partitions of the 360/65, which mixes batch and real-time service under the control of Operating System/360 — Multi-programming Fixed TASK (MFT).

Yet, despite the lack of technological glamour, the model is an important one. For one thing, it is the first to be designed to look at the problems of education management. For another, its application provides some idea of the potential benefits computer simulation holds for the education field, and a review of its development says much, to the computer scientist as well as the educator, about what has to be done to realize these benefits.

Roger L. Sisson is an Associate Professor of Operations Research at the Wharton School of the University of Pennsylvania. He has been a Senior Scientist at Auerbach Corp.; Manager of the Systems Dept., Aeronutronic Div., Ford Motor Co.; and a partner of Canning, Sisson and Associates. Professor Sisson received his B.S. (1948) and M.S. (1950) in Electrical Engineering from the Massachusetts Institute of Technology. He has published numerous papers and books. His latest book is *A Manager's Guide to Computer Processing* (co-authored with Richard G. Canning).

Simulating Resource Allocation

The model simulates the process of allocating the financial resources of a school district by breaking the process into four subsystems. These subsystems allocate and spend money for: staff; facilities; computer-assisted-instruction (CAI) equipment; and other, more general expenses according to the assumptions and policies selected for testing. (See Figure 1.)

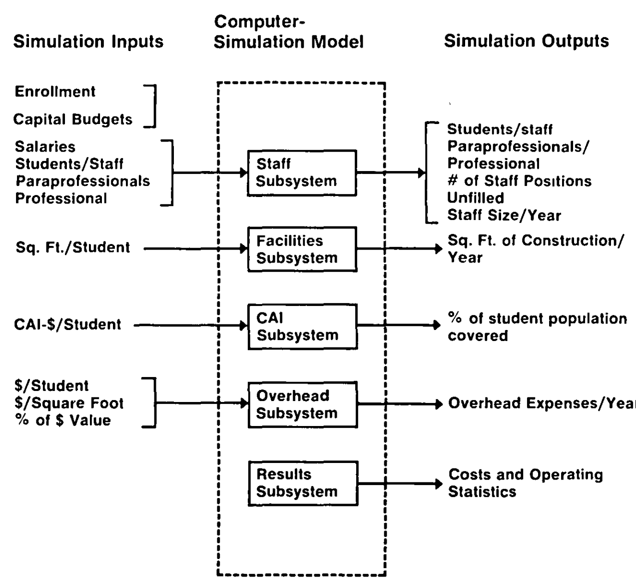


Figure 1.

The difference between assumptions and policies is one of control. Variables over which the school district has little or no direct control are considered assumptions. These consist of enrollment, the amount of money available for capital spending, staff salaries, maintenance costs, and debt service — all of which are determined by the community, economic conditions, and competitive market forces.

Since student population is a major factor in all spending, some assumption must be made about it in every run. This takes the form of estimates of future enrollment at five-year intervals. Based on census and demographic studies of Philadelphia, the estimates reflect birth rate, housing trends vis-a-vis city and suburbs, the mix of public and private school

"The people who understand the model analysis techniques that hold great promise for educational advancement must begin, or the promise will never be realized."

enrollment, and the rate at which pupils progress through the grades. Yearly enrollments are obtained by interpolation.

Assumptions about capital funds are optional. If the purpose of the simulation is to find out how much money will be required to bring the square-feet/student ratio up to a particular level, no capital budget is required. However, yearly capital budgets must be assumed in a run aimed at showing how long it will take to reach the required ratio, or determining the relative financial merits of various ways of allocating funds between improvements to existing schools and the construction of new ones.

All the other assumptions are, like enrollment, mandatory inputs. Salary assumptions take the form of average, annual salaries estimated separately for professional and paraprofessional staff members. The averages are based on the salaries and fringe benefits being paid during the current year. They are automatically increased each year (usually at a rate of 4%) to keep pace with inflation. Maintenance assumptions take the form of estimates of the dollars/square-foot cost of maintaining facilities and the percent-of-total-dollar-value that will be spent to maintain CAI equipment. An estimated percent-of-the-total-dollar-value of outstanding debt is also provided as a basis for simulating the cost of debt service.

Major Policies

Those variables that are manipulated by the school district to achieve an optimum allocation of resources are considered policies. Collectively, they prescribe for the model how both operating and captital funds should be spent. Individually, they consist of the following major policies:

- professional-staff/students ratio
- paraprofessional-staff/students ratio
- professional/paraprofessional ratio
- square-feet-of-space/student
- CAI-dollars/student

In addition, dollars/student policies are established for books and materials, health services, transportation, miscellaneous contracted services, and minor equipment purchases.

The procedure for simulating staff, facilities and CAI expenditures is the simple one of comparing the current situation with the policy goals, and then spending, according to established parameters, whatever is necessary or available to meet or move closer to the goal. Each of the subsystems consists of the instructions required to carry this out and the necessary spending parameters.

Spending Parameters

The staff subsystem has two sets of these parameters: one for professional staff and the other for paraprofessionals. Each set consists of an annual attrition rate and a hiring curve. The last, which is used to inject the recruiting difficulties found in the real world into the simulation, shows success in hiring as a function of requirements, with the percentage of success inverse to the level of requirements.

These parameters, the policy goals on staff size, the size of the staff at the end of the preceding year, and salary assumptions are used to determine the number of positions to be filled and the amount of money that will be spent in filling as many of them as possible. Professional-staff requirements are derived from two policy goals: professional/student ratio for teaching and administrative requirements, and professional/paraprofessional ratio for determining the number of professionals needed to supervise paraprofessional activities. Paraprofessional requirements are derived from the single paraprofessional/students policy.

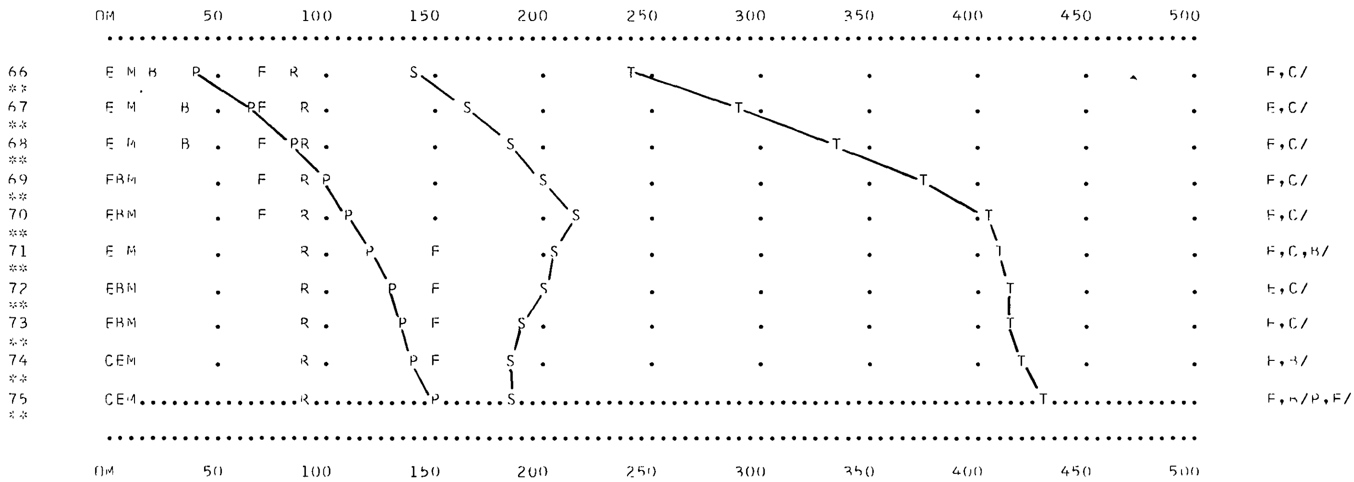
The spending parameters in the facilities subsystem are the annual rate at which existing schools require additions and renovations, and the rate at which new construction is financed. The first is used to determine the cost of improving existing facilities, a process for which the model provides a one-year lead time. The second is used to keep the value of outstanding debt, and the cost of debt service, accurate by having the model spread expenditures for new construction over a lead-time period of three years (five years for high schools). The allocation of funds to new construction projects, which is made in full at the beginning of the project, is computed from the square-feet/student policy and the amount of space available at the beginning of the year.

Both new-school construction and the improvement of existing facilities are subject to the restrictions of any capital budget that is assumed.

Expenditures for CAI Equipment

Expenditures for CAI equipment are simulated by comparing the policy goal of CAI-dollars/student to the existing ratio, and spending as much for CAI equipment as the capital budget permits. A one-year lead time is allowed before the expenditures are converted into operating equipment. The subsystem also simulates the impact CAI will have on staff requirements. It does this with a special adjusted staff/students ratio based on the use of CAI to supplement staff resources. This parameter is weighted according to the percent of student population covered by the CAI network and is then

Graph of Financial Statistics in Millions of Dollars



T - Operating Costs
S - Total Staff Salary
P - Total Paraprofessional Salary
E - Non-computer Equipment Cost
M - Cost of Books and Educ. Materials
C - Cost of Computer Equipment Added this Year
B - Total Construction Cost
R - Cost of Plant Replacement
F - Capital Budget for Construction

Figure 2.

combined with the staff/students ratio used in the staff subsystem. This produces a ratio that reflects the degree to which CAI equipment in operation has reduced staff requirements.

All other expenses are treated as overhead and simulated in the fourth subsystem of the model by applying the policies and assumptions provided for books and materials, health services, transportation, facilities maintenance, miscellaneous contracted services, CAI equipment maintenance, purchases of audio-visual and other minor equipment, and debt service.

A fifth subsystem of the model reports the simulation results, which consist of both financial and operational data. The financial results take the form of operating and, if appropriate, capital budgets. Operating budgets show sub-totals for professional and paraprofessional salaries, and each of the overhead items. Capital budgets itemize improvements to existing schools, new school construction, and CAI equipment purchases.

The operational data consists of statistics on the staffing levels achieved (students/professional staff, students/paraprofessional staff, paraprofessionals/professional, total number of professionals and paraprofessionals, and number of professional and paraprofessional positions unfilled), square feet/student, size of enrollment, square feet of construction/year, and the percent of student population covered by the CAI program. All of these statistics, plus the total operating and capital costs, can be produced in either tabular or graphic form.

Useful Role

The early exploratory use made of this model already clearly indicates that computer simulation can be a substantial, and maybe even unique, help in improving our school systems. For example, the model showed that the idea of supplementing professional staff with paraprofessional on a massive scale probably amounts, for Philadelphia at least, to an expensive impossibility. Because of the high attrition rate among paraprofessionals and the difficulty in recruiting them, the model was never able to drive the paraprofessional-student ratio below 1:15.

These simulation results are shown graphically in Figure 2. The curves show the probable financial implications of implementing the rather drastic policy of building up the paraprofessional staff to a 5:1 student-staff ratio and, after a period of three years, reducing the professional staff to change the students/professional staff ratio from 19:1 to 25:1. The computer-simulation model was run to show the results of this policy over a 10-year period, from 1966 through 1975. Time is indicated by the column of numbers on the far left, and is plotted downward rather than upward. P indicates paraprofessional-staff salary expense. S indicates professional-staff salary expense. T indicates total operating costs. The graph shows that the policy would raise total operating expenses almost 80% over the 10-year period. Other results from the simulation run show, also, that a combination of high turnover and difficulty in recruiting would make it impossible to build a large enough paraprofessional staff to achieve the desired 5:1 ratio. The increase in total operating costs reflects only a ratio of 14 students to each paraprofessional-staff member.

$30 Million Annually for CAI

The model also threw some light on the economics of CAI. It showed that for a school system the size of Philadelphia's, some $30-million a year would have to be spent for a period of 18 years before a full CAI program could be provided to the entire student population. It also showed that as long as staff is reduced only by attrition, the 26% savings in staff expense that is attributed to CAI cannot begin to be realized until the ninth year of the implementation program.

The model also produced some interesting insights into how the capital budget for construction interacts with the operating budget. For example, it showed that a 500% increase in facilities spending, distributed relatively evenly over a five-year period, would increase operating expenses by only 12½%, and that the full impact of this increase wouldn't be felt for seven years after the program was started. In the meantime, the square-feet/student ratio would be improved by 33-1/3%.

Despite the obvious usefulness of this first model, there still is considerable doubt about just how much of a role computer simulation will ever play in educational planning. The basic problem is obtaining data, and the present lack of it.

Problem: Lack of Data

While the data requirements for this model were not very demanding, filling them required an extensive, special effort. This was the case despite the fact that the model took an aggregate view of the system from the vantage point of the simplified operation of the top management level. What's more, since the model looked at the particular decision-making process from strictly an administrative viewpoint, no correlations between spending and educational performance were needed. Yet, without extraordinary cooperation from the Philadelphia school district, the model could never have been built.

Almost all of the data needed for the model had to be compiled by manually searching through thousands of records and making the necessary correlations between raw data.

For example, nowhere were maintenance costs related to either total square feet of facilities or student population to provide a reasonably accurate basis for estimating future maintenance costs. Even data on the size of the professional staff, the number of staff vacancies, and the number of staff positions filled during a given year were difficult to find, and what had been reported was done so in a different way from one year to the next.

There was some data on future estimates of enrollment, but it came from a study that was several years old and was of doubtful value at the time it was performed. Staff/student ratios and cost data also were available, but only as totals for the entire district. When it was decided to use the model to see what financial impact selected policies and assumptions would have at the elementary, middle, and high school levels of the eight subdistricts in the system, some 18 additional man-months were needed to develop the data required.

Essentially, reporting within most school systems begins and ends with showing expenditures against budget by organizational area. And even this is shown for only the district and subdistrict levels. There are no budgets for grade levels or individual schools. (Philadelphia has just introduced such budgets.)

In the personnel area, the only data available is payroll records. None of this data about individuals is summarized for administrative or management purposes. There is nothing showing staff attendance, turnover, length of service, or transfer patterns.

At the top policy-making level, there is little in the way of definitive documentation.

There is not even the most elementary data on teaching materials. Short of a special study, it is impossible to find out what types of materials are being used, how, where, in what quantities, and what they cost. Nor is it possible to find out what results are being achieved with given materials.

In fact, there is nothing to show what effect anything has on student achievement. There isn't even any data that relates resource use to educational programs. Though it is possible to find out how many teaching hours were expended at the elementary school level last year, it is not possible to tell how many of them were devoted to reading.

Initiative Required

As bad as all this may sound, the reporting performance of the school systems is really no worse than that of most business organizations. None of them has been able to apply computer simulation, or any other formal techniques for operational analysis, without going through a long period of manual data collection and development. In fact, few organizations have been able to implement even a relatively simple computer-based inventory-control system without first developing a new data base.

Yet, if the data in our school districts is not particularly poor when compared to most business organizations, improving the data will be a great deal more difficult. Business organizations have the staff personnel needed to provide the data inputs that are missing. School systems generally do not. This is partially the result of economics, and partially the result of tradition. Having little management orientation, school systems have tended to use their research staffs, the ones in the best position to develop the needed data, in a narrow educational role that precludes any management assistance. These staffs deal almost exclusively with the information inputs needed for teaching and the evaluation of curriculum; they do little, if anything, about the inputs needed for management.

Obviously, if the potential benefits of computer simulation are to be realized, a suitable data base is going to have to be built and maintained. This cannot, however, be done simply by re-orienting the research staffs, or even expanding them. Although the development of a sound administrative data base is the most visible requirement, it is not, in the long run, the most important one. Simulation models oriented toward administration of the type described here cannot alone produce the payoff that the school systems need most urgently. While it is very helpful to be able to predict the probable financial consequences of various policies, it would be much more to the point to be able to relate these consequences to educational performance.

Modeling the Educational Process Itself

This is difficult to do because it involves modeling the educational process itself. Not only is the process an extremely complex one, but it also is one for which there is no valid theory. Consequently it is impossible to say what data is needed for an effective model.

This situation brings up the old question: "Which comes first, the data or the model?" Social scientists tend to say "the data", holding to some myth that models can evolve out of some massive effort to gather information that has no theoretical guidelines. They do not understand the role that computer-simulation models can play in defining what data is useful, and in developing theory.

For this reason, the contribution of computer simulation to education depends on the model builders taking the initiative. The time has come for them to begin hypothesizing some models from the admittedly scant understanding we have of the educational process. Of course, the first attempts will not produce valid models and accurate predictions. But they will consolidate the little we already know about the educational process. They will lead to a definition of what data is important and what is not. And the process of going through the building-predicting-refining loop several times will help identify those parameters that may be universal enough to form the foundation for a useful general theory.

Unless the people who understand the model analysis techniques that hold so much promise for educational advancement are willing to begin, the promise will never be realized.

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COMPUTERS IN EDUCATION: THE COPERNICAN REVOLUTION IN EDUCATION SYSTEMS

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We stand at the brink of a vast revolution in teaching, learning, instruction, and education. The possibilities exist today for individualized instruction to a degree heretofore unimaginable. The development of the computer makes possible teaching and learning that is uniquely suited to the individual human being. The newfound potential for development of learning theory in the field of psychology will make possible the engineering of the unique fit between (a) the information to be learned and (b) the individual human being to be instructed.

Enormous horizons are being opened up. The possibilities now exist for the meaningful development of learning principles from the field of psychology and for direct application to the prescriptive field of instructional development. These two fields have the *possibility* now to be merged, to meld into instructional development and curriculum design.

But to view these fields of development from the traditional schoolhouse is *not* appropriate. Because of the technological potential from using the computer in instruction, the criteria for achievement of the student can change. The criteria for the utility of a school can change. The roles of teachers and faculty can change. But these changes literally cannot take place within an educational system bound by the constraints of the traditional classroom, the traditional school day, and the traditional administration of the traditional educational system.

Dr. Seidel is the director of an interdisciplinary development project in computer-administered instruction (CAI) at HumRRO. The end products of this project will be the development of prototype CAI systems for the Army, including software and computer hardware specifications for future CAI development.

Dr. Seidel is a member of the Society of Sigma Xi, Phi Beta Kappa, the American Psychological Association, Psychonomic Society, American Educational Research Assoc., and Eastern Psychological Assoc. He is also listed in *American Men of Science.*

A Gap in Conceptual Development

But as a background to the general topic of computers in education, let us first consider a larger issue of which this is a particular example. This is the subject of a gap in conceptual development. This gap refers to the fact that the elements of a technology exist long before human beings are able to evaluate the usefulness of that technology. In fact, we might call it a type of generation gap.

The problem is illustrated in a recent discussion by Dr. Robert M. Hutchins in *The New York Times.* Dr. Hutchins addressed his thesis to many facets of our society, such as ideas concerning public finance, federalism, international relations, and citizens' duties. His concern was that in the 1930's we were prisoners of our illusions. The question he raises for the 1960's is: Are we still prisoners of our illusions? In the 1930's "we didn't suspect that there could be anything wrong with our system or that it could ever end." That is what the new era meant. Delusions of the 1930's indicated by definitions of terms given by Dr. Hutchins included these examples: the budget "must be in balance by June 30 of every year, otherwise the country will collapse on July 1." Free enterprise is "a system that will in time provide a job for everybody willing to work." Inflation is "any increase in business activity produced by a cause other than free enterprise . . . . worse than socialism." Due process — "what makes it unconstitutional for a State to do anything." Gold standard — "untouchable." In the 1930's under Roosevelt's pragmatic leadership, according to Hutchins, we did not give up our ideas, we simply stopped acting in accordance with them, with the justification amply supplied by the term "emergency". So, as soon as the difficult depression was licked, we reverted to our true faith. Thus, Hutchins' thesis, the tried and true ideas, or "received" ideas, as he calls them, continued as buttresses against change even when catastrophe struck. The depression was looked upon as an exceptional emergency situation and the achievements that were made as a result of the changes in economic applications were viewed still within the old concepts of economic systems. Changes brought about by federal intervention, high and in-

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"We now have the potential to develop a new model of education, because we have tremendous new advantages of storage, retrieval, access, interaction, and complete attentiveness to the needs and desires of the individual student."

creased government spending — all of these were looked upon as necessities of the moment. No novel evaluative structure was available to enable us to see the quantum leap forward made possible by a change in the economic and political system in the country.

Today we have a similar difficulty when individuals in positions of influence talk about nuclear weapons as if they were appropriate to the context of World War II weapons. The very fact of existing nuclear weapons changes the nature of the international system of war and politics.

A New Model of Education

We are now able to develop a new model of education, because we have tremendous new advantages of storage, retrieval, access, interaction, and complete attentiveness to the needs and desires of the individual student. It is silly to ignore the potential that now exists.

In computer-assisted instruction, for example, supposedly we are limited by the principal response mechanism, the typewriter terminal. I do not think so. I like to think that soon we can have more "natural" kinds of responding such as writing or speaking. I believe we can increase the modes of interaction.

However, in a new model of education, it is conceivable that typing could become a very natural mode of response. It certainly is true that anyone can be taught typing, in the same way as anyone can be taught hand writing.

I do not assert that educational values can be subsumed under the rubric of worshiping a digital, transistorized god, much less a tin god. I am quite sympathetic to the problem of establishing values in the modern world. But science is loyal only to the possible.

New Jargon

I wish to discuss some of the implications of a computerized world in defining and developing an educational system.

In the broadest sense, this new era (of which CAI as we now know it is but a beginning) demands a revolution in the conceptual framework of education. Hutchins has spoken of the need to change the "received ideas" of an economy. In the same way we need to change the "received ideas" for education. Terms such as teacher, classroom attendance, blackboard, lecture, grades, and perhaps even textbook as we know it, may soon become obsolete. New jargon will become commonplace. The new jargon will include subject-matter experts instructional programs and programmers, decision models, instructional agents, course maintenance teams (proctors, monitors, etc.) and achievement units. Still other terms are yet to be invented. Today the new terms are by no means common; they are used by a few of those working in CAI, who are trying to fit together the beginnings of a different type of educational or training system.

A revolution has, as one of its basic meanings, the notion of a complete change in system.

The stage is set today for a revolution in education as it was for a revolution in astronomy in the days of Ptolemy, when the concept of the epicycles had been pushed to its ultimate extremes. In those days man's egocentricity blinded him to his much less significant position in the universe (as was pointed out clearly by Copernicus and those who followed him). In the same way, today man's egocentricity in education largely blinds him to the change which is at hand.

We have long labored under the concept of the schoolroom as the bench mark from which education has developed and progressed. We have recently had many innovations such as team teaching, the part concept, homogeneous grouping, heterogeneous grouping, the progressive curriculum, and so forth. But, even so, the advances in the educational system have left unquestioned the central position of the human teacher as the primary instructional agent and tutor.

But today, we find the electronically generated information explosion. Older "received ideas" are no longer adequate to the new challenge. We have seen quantum leaps in scientific and communications disciplines; we have seen the entire framework of our job structure change, based upon the advances in automation and related technologies. More and more those activities, which used to be thought to be always the province of man, have been taken over by the *inventive creations of man.*

The "Best" Teacher

I think we are now at another crossroad. We must question whether or not man *is* the *best* instructional agent to teach man. This question raises all kinds of sociological, political and other questions. It raises threats of what has been called the "dehumanization" of instruction. I suppose such wording is just a way of saying you're destroying the human teacher-student relationship.

Yes, this concept implies the destruction and metamorphosis of an entire set of accepted "received" ways of thinking about the instruction environment.

I am reminded of a recent chat with a colleague who is also concerned about this problem of dehumanization.

He said, "You know, I can remember just *one* of my teachers doing anything that was really helpful to me in a tutorial way. But for the most part, if I raised difficult questions or if I deviated from the pattern that the teacher thought the class should be following at the time, I was viewed with alarm — I was considered an uncooperative, unparticipating member of the class." I advocate that you think about that anecdote; it is far too representative far too often.

I do not say that human beings will not contribute to developing appropriate instruction. I do not say that creative roles by human beings in other frontier areas will be laid aside. I do assert that we will be able to eliminate, eventually, nearly all of the mediocre, human contributions in education. We shall do this by commending the instructional procedures to a much more reliable, a much more objective, a much faster operating, and a much more individually attentive, instructional agent.

Certainly the acceptance today of assistance or adjuncts to the human teacher through the use of a computer in communicating course materials to the student is becoming rather widespread (the usual view of CAI). We are, I think, at the threshold of developments in learning and instructional theory which can benefit mankind in a far greater way than ever have been imagined before. But, will CAI, computer-administered instruction (now called elsewhere, computer-assisted instruction) be able to go beyond a crawling step forward if the same human teachers, with their shortcomings in memory, attention, and the capacity to react to the student's capabilities and monitor his progress, remain the core of the instructional agent? Most assuredly not. We will end up by putting shiny new coats of paint on the same old, rusted ideas.

For an analogy, if we need one, we can go back to the turn of the century just prior to the development of the horseless carriage. Would we be able to develop this novelty, this great invention, if we simply observe in detail the best wheelwright at work and attempt to pattern innovations in his style? No.

Instructional Strategy

But if it is not the teacher who will develop the new course material, who will? Who will determine the instructional strategy? Who will develop the instructional agents which will in a relatively automated manner take over the education of our children or of our college students, or military personnel? To answer the question requires a rather careful delineation of what we mean; first, by the instructional situation. Secondly, it will require a consideration of advanced developments of learning and instructional theory potentially available within a meaningful and controlled environment, such as the CAI environment can provide.

To begin with, let's sketch out the instructional situation as seen in Figure 1. Note that on the left you have the flow of information to and from the student, on the right, the corresponding flow of information with respect to the instructional agent. Note also that the top set of arrows going from the instructional agent to the student, we call the Teach Channel because of the direction of the information flow. The bottom channel, where the flow is from the student to the instructional agent, we label the Test Channel. The dotted line down the center of the diagram indicates the area at which direct control stops for one processor and begins for the other. Thus, for example, the instructional agent has direct control over the information which it displays for the student. It also has direct control over the information which it is reading and ingesting. However, on the other side, the student side of the environment, any control by the instructional agent is, at best, indirect. In like manner, the student has direct control over the information which he reads, takes in, massages in some manner, and about which he makes his response. In other words, his direct control stops after the student display.

Turning once again to the instructional agent side of the schematic, we note that the process which the instructional agent goes through is that of assimilating the response materials made available by the student. The agent then evaluates, through a set of rules (intuitive or explicit), makes a decision, and then executes the next presentation of the material for the student. This total environmental situation can be looked upon as a lateral slice in time of the instructional process. Note that what we in education or training are intending to do, if you draw this process out in time, is to maximize at the end of the course the appropriate criterion performance. In order to do this, we must optimize the information flow through these series of instructional slices such as indicated in the schematic.

With all the description I have just given, I have not mentioned the term computer. What we have here is the basis for a cybernetic model of development, a set of control processes passing information back and forth between one another, the capacity to change and adapt over time, to improve the system, that which we call the instructional environment.

Psychology of Learning

Now let's turn for a moment to psychology, and particularly the psychology of learning. As part of the educational revolution, there are relevant events in the psychology of learning as well. For decades the developments in psychology have dealt with principles and laws pertinent to the learning of nonsense materials, isolated units, whose previous history and immediate presentation and consequences could be well ordered, controlled in an experimental environment, and predicted.

Psychologists for decades have by and large stayed within this environment because of the lack of predictability, and the difficulties in controlling, or in specifying, the history of conceptual materials and their interrelationships to which the student would be exposed in a meaningful instructional environment. Each student's history was different, represented a different, specific pattern relevant to any given meaningful material. What might be one level of information for one student would be another level for a second student, and so

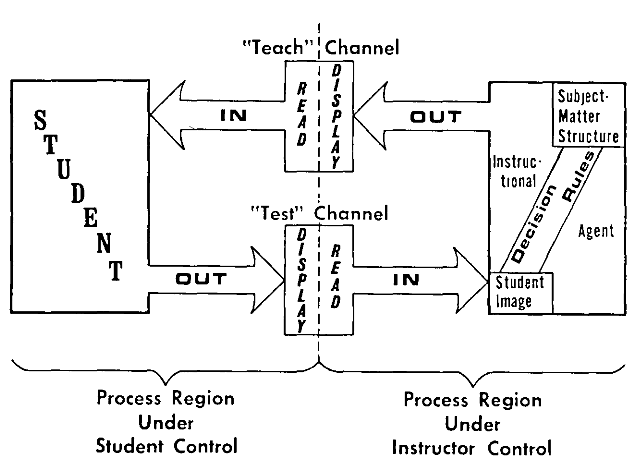

Figure 1.

on. Finally, one learning theorist, B. F. Skinner, saw the need and attempted to apply principles gleaned from the laboratory (1957, 1958). Perhaps the increasing demands of our technocratic society provided a receptive atmosphere. Perhaps education had simply been waiting patiently for any meaningful attempt by psychologists to aid in human development. For whatever the reasons, programed instruction (PI) has provided a stage-setting for both education and psychology to take huge leaps forward in laying open the complexities of human learning. But the stage has only been set; the players are still in the wings.

The appearance of the computer has produced potential for control over all facets of the instructional environment. So the psychologists can come out of the nonsense-syllable laboratory; they can now deal with more meaningful material: hierarchically ordered concepts; complex human learning; the learning of principles; and problem solving. The opportunity is here for those who are interested in studying the psychology of learning and instructional processes to bring together a basic science and an applied science into a single, unified, scientific discipline.

Programmed Instruction

The computer in the *appropriate* CAI environment provides the next step in a bridge to be built between theoretical and experimental psychology on the one hand, and meaningful development of instructional theory and curricula on the other. Some of the problems of individualization, controls, predictability, and specifiability of the histories of both students and material have been partially addressed in the arena of programmed instruction.

Unfortunately in programed instructional environments, however, the control is, by and large, indirect. Material to a great degree is presequenced (with a very limited adaptiveness). Direct control is lost after presequencing material. The student's path may be changed from time to time, but one is limited in the kind of adaptiveness that the PI representation of a controlled, meaningful environment can provide with respect to the instructional system described in Figure 1. With the arrival of the computer, however, the control can proceed from indirect to direct; the number of facets of the instructional system which can be dealt with capably and rapidly as required have been increased significantly with the "appropriate" CAI system. The use of the term "control" should be amplified. Behavior is not random, and if one desire is to shape behavior toward a specified goal, that behavior must be measured. "Control" can be introduced into the system both from the student-option side of the exchange as well as from the instructional-agent side. Thus, appropriate student-generated instructional options are highly desirable within a good CAI system.

Project IMPACT

Now let me describe one approach toward starting the conceptual metamorphisis of which I spoke earlier. The use of the computer which we feel is an appropriate CAI representation of the instructional system is described in Figure 2. The title of the project we are working on at HumRRO is called IMPACT. As you might imagine, the acronym has some meaning. Ours stands for *I*nstructional *M*odel *P*rototypes *A*ttainable in *C*omputerized *T*raining. And in this title you have the essence of our approach to CAI as a total, meaningful, instructional system. Figure 2 presents a flow diagram of the first cycle of the project with the interrelationships among the facets specified. As may be implicit in Figure 2, this effort requires an interdisciplinary team consisting of behavioral scientists, mathematicians, instructional programers, software experts, and engineering personnel.

The heart of our project is the development of appropriate classes of instructional decision models. With these we can optimize a student's path through an instructional informational exchange system as indicated in Figure 1. Secondly, extremely important to determining the dimensions and parameters of models of the instructional process is the particular type of content which we are studying. The subject matter for our development is the computer programming language COBOL. Third, we are developing appropriate software with which the student and instructional content designers can interact with the computer. Finally, we are developing the appropriate hardware for carrying on informa-

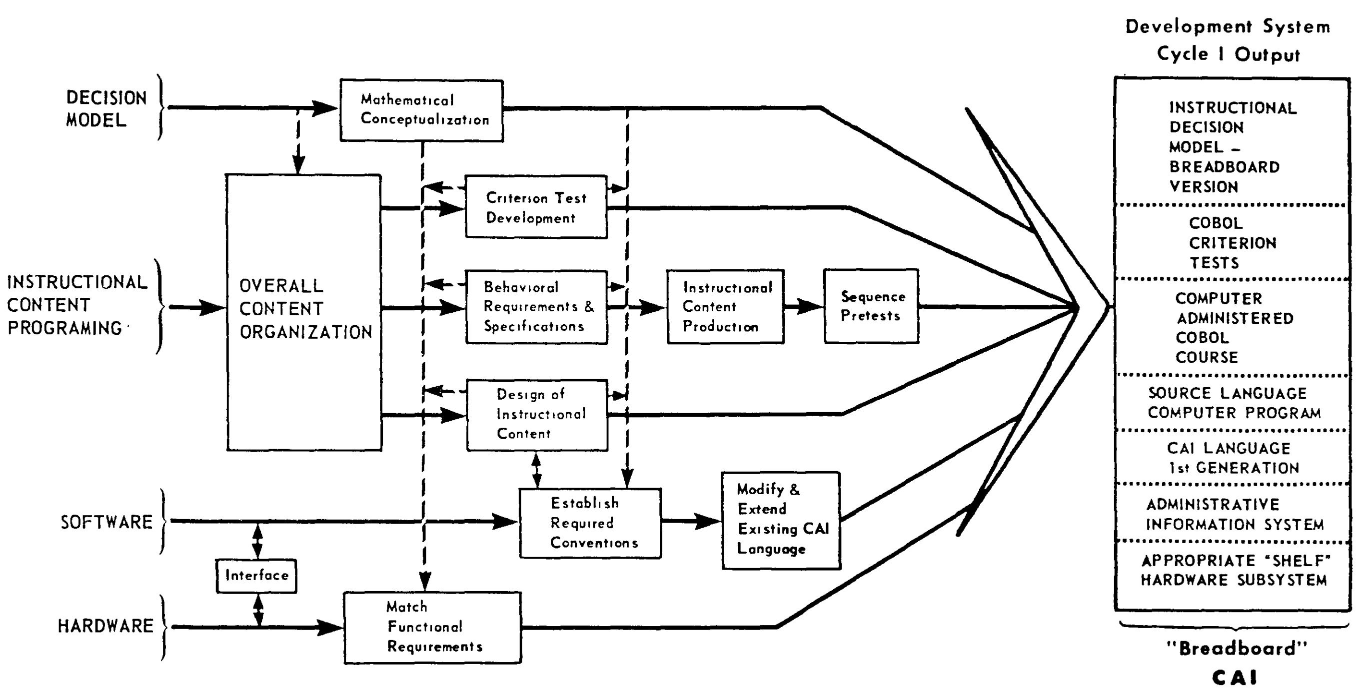

Figure 2.

tional exchange between agent and student. Observe that this is a total instructional system. Note also that the computer is used to provide a link between the instructional agent and the student. The computer is the tool which allows the information exchange to take place. But the rules by which the exchange is carried on are designed and developed via meaningful studies carried out within the CAI environment.

Summary

The exploitation of the computer as a tool remains to be accomplished. We are at the very beginning of establishing the new premises for instructional theory development and revolutionizing the horizons of education and training. In the past, research in psychology had been directed toward describing the learning process, and subsequent to this, attempts had been made to prescribe for the instructional process.

In conclusion, my thesis is that, with the computer and the environments it makes possible, we stand at the threshold of being able to coalesce the study of learning and the prescribing of instruction.

To accomplish this, however, man has to relinquish his egocentric role as usually understood in teaching. Instead, interdisciplinary teams will produce instructional materials. The interdisciplinary instructional team of the future will design the contents of courses, but not as it prevails in traditional instruction. The system for information exchange between learner and knowledge will become far more explicit, more efficient, and more reliable.

The use of computerized educational and training systems will produce astonishing successes.

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TIME–SHARING VS. INSTANT BATCH PROCESSING: AN EXPERIMENT IN PROGRAMMER TRAINING

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"Objective measures indicate no particular preference for either time-sharing or instant batch access, because of the overwhelming individual differences found in the eight students participating in the study. However, the students themselves preferred the instant batch system, and did not even attempt to use the time-sharing system for the remainder of the summer, even though it was available."

Since the early 1960's, there has been an increased interest in time-sharing computer applications in many areas. A notable example is in education, where a computer monitors drill practice in some subject and the student responds to the computer at a terminal. Applications of this type use a multi-processing time-shared computer which allocates attention to several jobs, so that each appears to be running simultaneously with the others. Many students may be using the same time-sharing computer at once, but at different terminals. Time-sharing not only demands a multi-processing computer, but also requires that the user interact with the computer on-line in a series of connected communications about the programming process.

The Value of Man-Computer Interaction

In the past several years, various studies have been conducted to evaluate whether or not man-computer interaction as provided by current time-sharing systems contributes to more effective programming techniques. For example, Sackman, extrapolating from data obtained in his study at Systems Development Corporation, reached the conclusion that "in the limit, as turnaround approaches zero in the off-line condition, the performance advantage of the on-line condition tends to disappear."[1] This would suggest that turnaround time is a very important factor. If a programmer may continue his problem solving with instant or rapid feedback, it is possible to keep the problem goals freshly in mind. We need to ask whether the advantage of the interactive mode is simply the quick turnaround that on-line time-sharing provides, or whether there is some other major advantage. A comparison of rapid-turnaround batch processing with time-sharing becomes an interesting experiment.

This paper presents a case study of rapid-turnaround batch processing versus time-sharing done in the field of the computing facility of our scientific research organization, the National Center for Atmospheric Research (NCAR). Our interests are mainly selfish: we want to know how new methods will work in our organization; since training is a continuing activity here, we are also interested in new applications that contribute to better training programs.[2]

Here are some of the questions considered in our case study:

1. Is a time-sharing computer or a batch processing computer more effective as a teaching device?
2. What are the impressions of the user-trainee in evaluating his experience on a computer under these two modes?
3. What would be the relative costs of the two modes?
4. What are suitable objective measures of programmer performance? Do these measures reflect the same quality of performance that a subjective evaluation of the same programmer might provide?
5. How does this research compare with results of other similar studies?
6. As a pilot project, do these preliminary inquiries suggest that further research in the use of time-sharing is important for us?

The Teaching Method: Responsive Environment

The use of a programming language, such as FORTRAN, is learned most easily in a laboratory situation. At NCAR the following technique[3] has been used for four years. The student is encouraged to explore and experiment while learning in a "responsive environment".[4] Regular seminars are conducted on various topics such as computer arithmetic, the memory of the computer, core dumps, and various input-output techniques. However, the main learning experience takes place when the student and the computer interact in an effort to get acceptable code on the computer. Many questions arise. Some of these the computer answers, but the computer output sometimes fails to provide enough feedback. It is also necessary for an instructor to be immediately available as an interpreter. He clarifies the computer response to a job and answers questions that emerge as the student continues to explore this learning environment. Individualized instruction is emphasized as much as possible. Whether the student was using the batch-processing computer or the time-sharing computer, this was the learning environment provided in our study.

Design of the Study

The number of students participating in the NCAR case study (only eight) might be considered too small a group from which to draw valid conclusions. But a statistical analysis of numbers of events was not the purpose of this study. What the study did emphasize was the personal evaluation by the students of their work, and the averages and the figures showing how the students spent their time on any given day. Some tables and totals of computer usage were analyzed to measure effective output objectively. But the impressions of the user-trainees (students) themselves, and excerpts from their personal logs and records during the experiment, were examined in order to discover what it is like subjectively to program under these different modes. Some of the results have suggested further research.

The eight student participants in NCAR's 1968 Summer Work-Study Program were selected from universities all over the country on the basis of grades in physics and mathematics and their need to continue work on a computer. In this program there were no grades or formal rewards for performance; the only rewards were those intrinsic to the learning situation. The students were given the option of not participating in the experiment; so we had no unwilling or uncooperative participants.

In addition to selecting the students from the relatively homogeneous set described above, we tried to select two matched groups of four students each with regard to previous experience in programming in order to make some comparisons by differences in group training. Each group included one experienced person, two with very little experience, and one with virtually no experience. The four programmer pairs were selected according to the number of programs they had previously written.

Programmer Pair	*No. of Programs Written Previously*
1	100-250
2	10-15
3	5-6
4	0

One group used only the time-sharing computer the first week; the other group used the batch-processing computer. During the second week the group that had been on time-sharing switched to batch, and the group that had used batch switched to time-sharing. They were told to use the assigned computer mode exclusively, i.e., not to switch back and forth from time-sharing to batch during the week. The only other activity for the two-week period was daily one-hour seminars attended by both groups.

The Computers Used

During the experiment, the two teletype terminals to the time-sharing computer were available to the students full-time; no other users were allowed at these terminals. The terminals were near, but not in, the students' office space. The time-sharing computer used was a General Electric 265 located in Dallas, Texas; the terminals used were one Model 33-ASR teletype and one Model 35-ASR teletype.

Batch processing on the Control Data 6600 computer at NCAR works in the following way: The user submits his deck at an "input" counter near the card reader in the computer room. An operator reads his deck into the computer. While waiting for output, the user may watch a CRT (cathode ray tube) display unit which shows his name and the status of his job. When his job comes off the scope, he walks to the "output" counter to pick up his output. For short jobs, this can take from a few seconds to 10 or 15 minutes. A program establishes a system of priorities within the computer based on time required to run and core size. Practice problems usually get high priorities; so the turnaround for these problems is quite fast.

The FORTRAN language was used exclusively by both groups of students. None of them had ever used NCAR's Computing Facility before the experiment; so the surroundings were new to everyone. The NCAR staff offered no greater assistance in either batch processing or time-sharing because there was an experiment running. We tried to avoid the so-called "Hawthorne Effect", where people who are being studied change their behavior as a result of being studied. The staff is accustomed to having graduate students and visitors use the computer at any time. The batch-processing computer went "down" at times, and the students had to wait for keypunches at peak periods. The time-sharing computer also went "down" at times, and at peak periods the terminal sent back a busy signal. In both modes the students suffered all the ordinary frustrations encountered at any computer facility.

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IDEAS: SPOTLIGHT

Computer Science vs. Computer Engineering

. . . Let me make an arbitrary distinction between science and engineering by saying that science is concerned with *what* is possible while engineering is concerned with *choosing,* from among the many possible ways, *one* that meets a number of often poorly stated economic and practical objectives. We call the field "computer science", but I believe that it would be more accurately labeled "computer engineering" were not this too likely to be misunderstood. So much of what we do is not a question of can it be done so much as it is a question of finding a practical way. It is not usually a question of can there exist a monitor system, algorithm, scheduler, or compiler; rather it is a question of finding a practical working one with a reasonable expenditure of time and effort. While I would not change the name from "computer science" to "computer engineering", I would like to see a far more practical flavor in what we teach than I usually find in course outlines. . .

At the heart of computer science lies a technological device, the computing machine. Without the machine almost all of what we do would become idle speculation, hardly different from that of the notorious Scholastics of the Middle Ages. The founders of the Association for Computing Machinery clearly recognized that most of what we did, or were going to do, rested on this technological device, and they deliberately included the word "machinery" in the title. There are those who would like to eliminate the word, in a sense to symbolically free the field from reality, but so far these efforts have failed. I do not regret the initial choice. I still believe that it is important for us to recognize that the computer, the information processing machine, is the foundation of our field. . .

— From "One Man's View of Computer Science" the 1968 ACM Turing Lecture, p. 5, by Dr. Richard W. Hamming, Bell Telephone Laboratories, Inc., Murray Hill, N.J., in the *Journal of the Association for Computing Machinery,* January, 1969, vol. 16, no. 1, pp 1-12. □

Switching Groups

We switched groups after one week in order to get comparative impressions. This change introduced a different computer in the second critical week of learning the FORTRAN language. In any future experiment, we would probably not switch computers mid-stream. Although the change did not seem critical for the experienced participants, it did seem to produce a certain amount of confusion for the rank beginners.

Each student kept a daily log of his programming activities, using two forms, one for batch and one for time-sharing. Categories were kept for design time, study time, debug time, and time for keypunching and terminal use, in order to analyze how the students spent their time. At the end of the first week both groups were given the same Markov chain problem to program using their assigned programming mode. A polynomial integration problem was given to both groups at the end of the second week. The problems are available on request from the author.

The daily logs were completed for the test days, as well as the practice days. Additional information was used to validate the student's logs: the accounting program on the 6600 and the bill from General Electric gave detailed information on computer usage and cost during this period for each student.

At the end of the two weeks each student completed a questionnaire about his impressions of batch versus time-sharing. We told them that they had their choice of computers during the rest of the summer program, and that they should use either batch, or time-sharing, or both in combination, to solve any of their programming problems. Four weeks later we held a group discussion about time-sharing versus batch to obtain some of the views of the students in retrospect.

The Study Summary

	Time-Sharing	Batch
	Group I	*Group II*
First Week:	Four days practice Fifth day Markov problem	Four days practice Fifth day Markov problem
	Group II	*Group I*
Second week:	Four days practice Fifth day integration problem	Four days practice Fifth day integration problem

Instructors' Evaluation of Performance

Although the batch-processed output looked better because of formatting and generally more flexibility in input-output, there was no significant difference in program quality between the two groups. At the end of the first week the general level or "feel" of the programs, as judged by the instructors, was only poor to fair. Even those students who completed the problem successfully wrote sloppy, inefficient, fairly special-purpose programs. One of the main problems was in approaching the problem properly: they had trouble thinking in computer terms. (This ineptness in writing in FORTRAN is probably similar to the uneasy way a foreigner expresses himself when he first starts speaking in English.)

At the end of the second week the programs of both groups showed marked improvement in performance and quality. The students no longer had trouble attacking the problem. Some failed because their ability or knowledge was not developed, but no student had as basic a problem as had been apparent the previous week. A little more familiarity with the language freed the students to look more closely at the overall program structure; and the programs started to be more efficient, more general, and just "felt" better.

Three experienced staff programmers did the two standard class problems as a check on the teachers' impressions of the difficulty and timing of the two programs. This group defined the difficulty of the problem in terms related to working in our organization. All three came up with approximately the same responses, doing the Markov problem in 2 to 2½ hours, and the integration problem in 1½ to 2 hours. They all thought the problems were of about the same degree of difficulty, though the Markov were perhaps a bit harder. They said the original estimates of six to eight hours for successful completion by the students were realistic, if not a little high. As expected, the control group wrote better, i.e., shorter, more efficient, more general programs than even the best student. These well-written programs are easy for other programmers to read and are easily recognized as good code.

Student Frustrations

The students who were not able to complete the assignments successfully were terribly frustrated. The problems, they felt, looked simple, and should have been easy to do. Part of their difficulty was their inexperience in approaching problems logically and carefully; part was their tendency to try to do too much or to be too fancy in approach and method of solution, thus making simple problems unnecessarily complicated. No student felt that the problems were beyond his level of ability, knowledge, or achievement.

Objective Measures of Performance

The objective measures of achievement used were simple averages of the group's performance and were based on the student's daily logs of how they spent their time. The experimental problems were given on Friday of each week; so on this day the student felt he was being tested.

An analysis of student activities is given in Table 1.

Problem 1

There was a marked decrease in study time from the non-test-day average to the test-day average for both groups. When they knew they were being tested, the students did not study, and there was an increase in design and debug time

Batch	Keypunch	Study	Design	Debug	Total
Group I:					
4 practice days (average)	1.3	1.2	1.6	1.2	5.3
Test day (Problem 1)	1.1	0.1	2.3	1.4	4.9
Group II:					
4 practice days (average)	1.0	3.0	1.4	1.6	7.0
Test day (Problem 2)	1.1	0.3	1.7	2.4	5.5

Time-Sharing	No. of Sessions	Study	Design	On-Line Debug	Off-Line Debug	Terminal	Total*
Group II:							
4 practice days (average)	3	2.1	1.1	1.5	0.9	2.1	6.2
Test day (Problem 1)	4	0.1	2.1	2.4	1.3	2.6	6.1
Group I:							
4 practice days (average)	5	1.6	2.0	1.2	1.3	1.3	6.2
Test day (Problem 2)	7	0.1	1.4	0.9	1.9	1.3	4.7

* Total includes Study, Design, Off-Line Debug, and Terminal time.

Table 1. Time Analysis of Student Activities (hours)

for both groups. Debug time was much higher (2:1) for time-sharing and increased to a 3:1 ratio on the test day. The number of terminal sessions for the time-sharing people was also higher on the test day. Total time spent on programming remained at about six hours for time-sharing and about five hours for batch-processing mode, with only a slight decrease for both groups on the test day.

Problem 2

Again a marked decrease in the amount of study time was apparent for both groups on the test day, with the same corresponding increase in debug time. Also, again, more sessions were spent at the terminal by time-sharing people on the test day. However, while there was an increase in design time for the students using batch, the time-sharing people spent less time on the design phase than on the previous four days when no test problem was given. Total time spent on programming decreased about 1¼ hours for each group, but the batch people spent more time (about 1½ hours) to complete the problem.

While Group I took less total time to complete both problems, the debug time was higher in both cases for time-sharing. The ratio of debug times for time-sharing versus batch was smaller when Group I used the time-sharing system.

Referring to Table 2, we see that the individual differences are quite large and would tend to mask any differences that might be credited to the two systems. Even though the groups

	Range	Ratio
Batch:		
Study	5.63 - 0.56	10:1
Design	2.25 - 0.06	37.5:1
Keypunch	1.44 - 0.27	5:1
Debug	2.95 - 0.10	29.5:1
No. of jobs submitted	65 - 7	9:1
Time-sharing:		
Study	4.44 - 0.50	9:1
Design	3.00 - 0.25	12.1
On-line debug	2.75 - 0.39	7:1
Off-line debug	2.56 - 0.00	---
Terminal time	2.77 - 0.60	4.5:1
No. of sessions	7 - 2	3:1

Table 2. Range of Individual Differences in Student Performance

were originally matched for previous programming experience, individual differences tended to bias performance in favor of Group I. (Those who performed best on the tests were not necessarily those with the most experience.)

The outcome of the students' programming efforts on the two test days is shown in Table 3. Both groups did equally well in solving the problem, though one group took longer than the other.

	Scores				
Problem 1:					
Batch	0	1	1	0	1 = correct
Time-sharing	1	½	½	½	
					½ = half correct
Problem 2:					
Batch	1	1	0	1	0 = incorrect
Time-sharing	1	0	1	1	

Table 3. Outcome of Tests

The students filled out a questionnaire at the end of the two-week period (See Table 4.). Their responses indicate an overwhelming and significant support of instant-turnaround batch over time-sharing. The tally is broken down into two columns plus the total. The column marked "Group I" includes students who started with time-sharing; the column marked "Group II" includes students who started with batch. Note that those who started with time-sharing all preferred batch. The one student who preferred time-sharing said that his initial confusion with the language prejudiced him against batch. By the end of the first week on batch, he was switched to time-sharing, was better at it by then, and so preferred the time-sharing. His was the only questionnaire consistently in favor of time-sharing. However, his response on question six indicated that for him it made no difference in understanding a computer which method was used.

Only one student thought that time-sharing was easier to learn. Five out of eight thought that time-sharing took more programmer time. Only one student thought program quality was better on time-sharing. Five thought batch presented a better understanding of the computer.

Only one student said he would use time-sharing assuming equal availability. This is corroborated by the fact that all eight students were given the opportunity to use either mode following the experiment. Only this student used time-sharing again. He put one program on the time-sharing computer, but did not go back to it again for the rest of the summer.

In answer to question seven, there were a number of suggestions to improve time-sharing. Four suggested that FORTRAN IV would be an improvement. Faster terminal response, faster teletypewriter speed, and fewer busy signals

Questions asked students and a tabulation of their responses:

	Group I	Group II	Total
1. Which did you like the best?			
Batch	4	3	7
Time-sharing	0	1	1
2. Which do you think was faster in terms of getting the job programmed?			
Batch	0	3	3
Time-sharing	2	1	3
Neither	2	0	2
3. Which method was easier to learn?			
Batch	3	1	4
Time-sharing	1	0	1
No difference	0	3	3
4. Which was most expensive in terms of programmer time?			
Batch	0	2	2
Time-sharing	4	1	5
No difference	0	1	1
5. By which method was the quality of the programs you produced better?			
Batch	2	2	4
Time-sharing	0	1	1
Neither	2	1	3
6. Which method gave you a better understanding of the computer?			
Batch	3	2	5
Time-sharing	1	0	1
No difference	0	2	2
7. If you were to suggest an improvement to facilitate time-sharing, what would it be? (answers explained elsewhere)			
8. If you were to suggest an improvement to facilitate batch processing, what would it be? (answers explained elsewhere)			
9. In your future research which would you use, assuming equal availability?			
Batch	4	2	6
Time-sharing	0	1	1
Both	0	1	1
10. When you put your first program on a computer, whether here or at your university, was it			
Batch	4	3	7
Time-sharing	0	1	1
11. Under which method did you think that you, the user, had the most control?			
Batch	2	1	3
Time-sharing	2	3	5

Table 4. Student Questionnaire

were suggested. There was only one suggestion in response to question eight to improve the batch system: this student said that there should be an easier way to punch and change cards.

Student Comments

A few weeks later during a seminar we asked the students to discuss time-sharing and batch processing informally. The secretary took notes during this session, and their conversation is summarized below.

Turnaround time was brought up quite frequently. The students said that time-sharing would probably be preferred if turnaround on the batch system were slow. They preferred batch because the 6600 system operates so fast. It was difficult to get on time-sharing during peak periods, and to wait on time-sharing was far more irritating than to wait for batch output.

One student liked time-sharing because on short programs he could debug immediately without waiting for output; on long programs, however, errors were more difficult to find on time-sharing. Some students preferred the diagnostics on batch; others said they could find errors as easily on time-sharing. A debate on errors and debugging was not resolved.

Some preferred the keypunch to the teletype. They said it was easier to sequence a deck of cards than to use the teletype, and they found it inconvenient to type out access numbers on the teletype.

When asked if performance was affected by getting answers back too fast on time-sharing, one student said he was nervous because he was on-line. This factor did not seem to bother the other students.

Communications

At one point the problem of communications came up. If one had to travel two miles to get to the computer, then time-sharing would be more convenient than batch. When asked if it made any difference that the time-sharing computer was in Dallas, most of them agreed it did not matter. But they said that time-sharing was like feeding a black box; one only saw what went in and what came out. Batch was more personal; it was nice to watch the scope (cathode ray tube) to see what was happening.

The students agreed that it took more tries to get correct answers on time-sharing. "You think [that] you think, but you don't think" at the terminal. One student said he could think better with the output sheet before him.

Conclusions

1. Based on the results of this pilot study, the time-sharing computer did not seem to offer any particular advantage over the batch-processing computer with rapid turnaround. Even though the students were told of a series of CAI (Computer-Assisted Instruction) drill lessons available in the time-sharing system and editing features of the time-sharing computer, they did not use them. The performance of the two groups was similar whether they were on batch or time-sharing. Both groups were better in the second week, as would be expected.

2. The students preferred rapid batch to time-sharing in all but one case. Emphasis seemed to be on rapid turnaround and computer availability. Students did not seem to find "conversational mode" a particular advantage. There was more emphasis on results being available quickly and in the most convenient form in order to get the job done. The students found that the Data Display dd80 on-line plotter for the 6600 was very easy to use and the output from it was available on the spot. When they were given certain tasks to explore and the opportunity to experiment in either mode, the students used the batch-processing computer.

3. To compare the costs of the two systems of operation, we looked at the bill from General Electric and the 6600 accounting program. The time-sharing bill was approximately $1,000, which represented about 75 hours of terminal time with about 115 minutes of computer time. During the two-week period of the experiment, the students submitted 402 jobs on the 6600, taking a total of 30 minutes of computer time. Considering 6600 time at $300 an hour, half an hour would cost $150 (some commercial companies charge as high as $1,000 an hour). Thus, for training purposes in this case, time-sharing was more expensive than batch.

4. The objective measures used in this study were the times it took the students to complete the various phases of the task and solve the two problems. These measures indicate that a good programmer is more important than the machine he uses or the modes in which it operates. A subjective evaluation of the two groups, by the instructors, confirmed the objective evaluation, that one group was consistently better whether it was using the time-sharing system or the batch-processing computer.

5. Most of the literature concerning on-line versus batch processing suggests that time-sharing requires fewer man-hours and less total elapsed time to prepare code and get results. The same results were suggested by the 1967 Smith study at Stanford University, which compared instant batch with several-hour turnaround: instant batch was superior to conventional batch.[5] All of these studies point out that individual differences are much more important than system differences. The superiority of time-sharing and the importance of individual differences are upheld by the Sackman study.

Our objective measures indicate no particular preference for either time-sharing or instant batch because of the overwhelming individual differences we found. However, the students themselves preferred the batch system and did not even attempt to use the time-sharing system for the remainder of the summer, even though it was available.

6. As a result of these preliminary findings, we have undertaken a second, more careful and controlled experiment with a class at the University of Colorado in "Introduction to FORTRAN Programming."

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[2]NCAR's Computing Facility provides training programs for new staff members; regular classes for in-house users, both beginning and advanced; intensive consulting sessions at all levels; and a summer work-study program for graduate students from various universities.

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[4]The authors have employed Moores' concept of the responsive environment to characterize the learning situation (see Moore, Omar K., "Autotelic Responsive Environments and Exceptional Children," *Experience, Structure, and Adaptability,* O. J. Harvey, Ed., Springer Publishing Company, New York (1966) pp. 169-216). Moore has subsequently expanded his concept of the "responsive environment" and now calls it the "clarifying environment" (see Moore, Omar K. and Alan Ross Anderson, "Some Principles for the Design of *Clarifying* Educational Environments," to be published in *Handbook of Socialization Theory and Research,* David Goslin, Ed., Rand McNally and Company, Chicago; in press, 1968).

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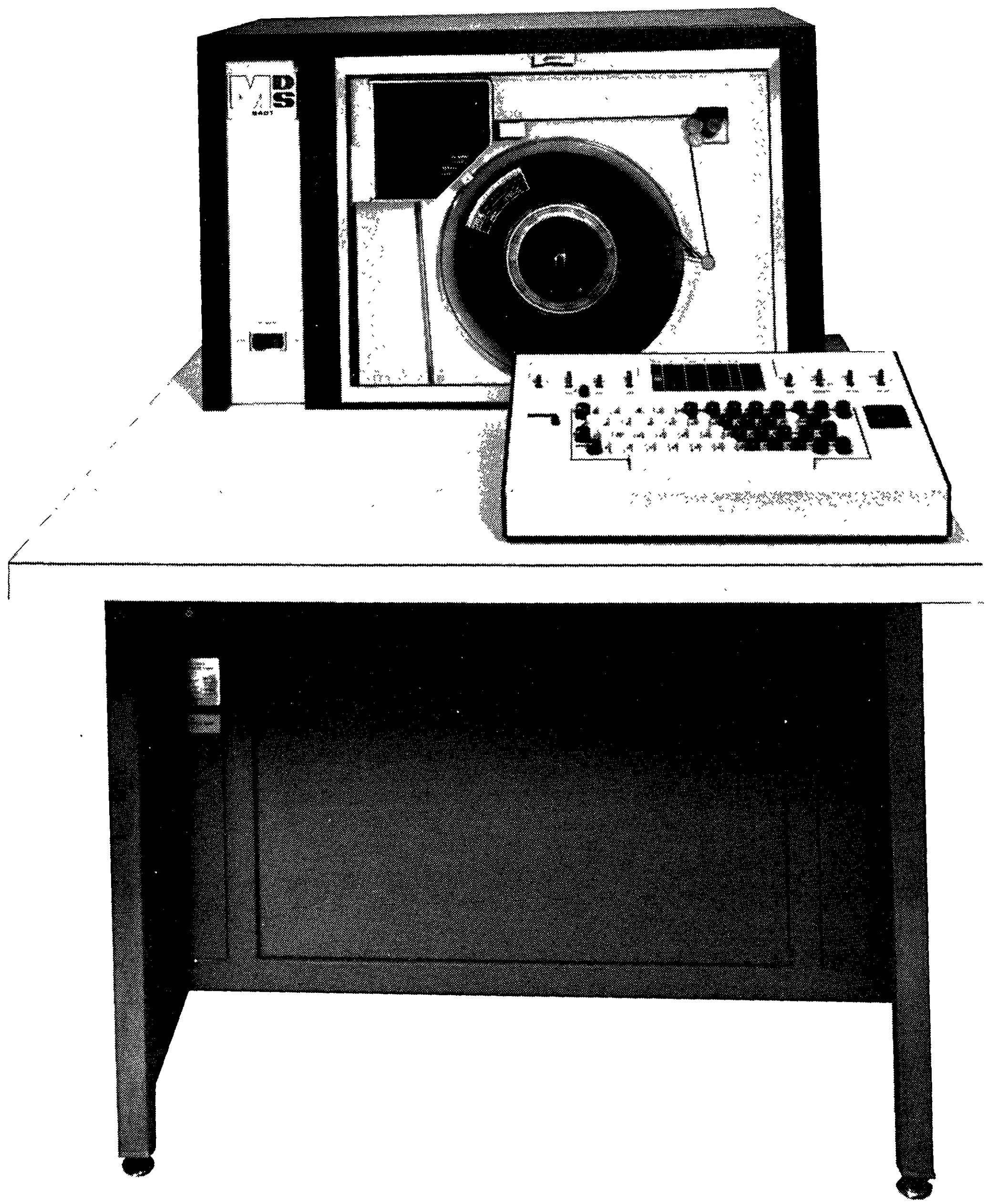

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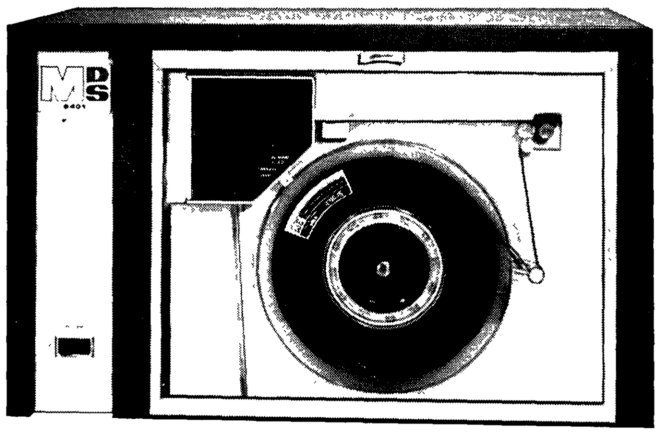

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WORLDWIDE

REPORT FROM GREAT BRITAIN

As I reported in January, there is a fast move into Britain from the United States by major and minor leasing groups all handling computers, but some also having interests in aircraft and general industrial equipment.

Granate Corp. to Compete with Leasco

Hard on the heels of Boothe and Leasco comes Granate Corp., which is seeking to buy outright from the Brooke Bond Food Company for $7m up its 89% interest in Management Dynamics. This is a group with four interests — a computer bureau, a data punch service which is doing very well, a software consultancy, and a personnel selection service.

For its $7m, Granate will be getting all this, plus an expert staff to a total of around 600 and their knowledge of the British market — which now has passed the 2,000 machine-per-year mark. It means that Granate will be able to offer the same measure of technical support on the UK market as Leasco through its Inbucon acquisition.

Virtually all equipment handled is IBM's. Negotiations between one leasing group and International Computers have taken place, but it is not known whether or when the UK market leader will play ball. All U.S. groups, on entry into Britain, have professed interest in taking up ICL machines. However, the only price rise recently noted for the latter was one of four percent following on devaluation. There is not the same incentive to go to a leasing group rather than ICL itself as there has been for IBM users since IBM's ten percent price hike.

Naturally all the leasing operators in Britain have been extremely worried at the indication that IBM Corp. in the U.S. was reviewing all price structures because of the impact of leasing operations there. Several have seen top brass at IBM (UK) and at least one group has been told that its fears of having supplies cut off are "not a valid interpretation of the text of the IBM statement."

Whether all this is still meaningful in the light of the anti-trust barrage aimed at IBM is hard to see at long range.

Inferior Software Packages "Dumped" on UK

Be that as it may, the remaining operators in Britain still independent of U.S. companies are extremely perturbed at the ingress of these powerful companies. Some — particularly those who specialize in software work — are unhappy at the way "inferior packages" are being unloaded on the UK market at "dumping prices." Now this is a commodity for which Parliament has not legislated. Nor do I think, has the Board of Trade any regulation which could drop a portcullis across their entry path. No doubt the professional association, COSBA, has already discussed the matter and will put pressure, where possible, to stop the rot. It is rather ironical that such a thing should be happening at a time when so many talent scouts from U.S. software houses and from major companies are seeking to employ expert British teams to crack the tougher time-sharing and other nuts.

British software has a good reputation, advisedly, because there is less money available and smaller installations have to be cajoled into doing jobs which would probably be run on systems twice the size in America.

British Airways Component Time System Control

A case in point is the complex spares control and maintenance scheduling operation which British European Airways — a big airline even by U.S. standards — has put on an ICL 1903, the equivalent of an IBM 30. Component Time System Control will monitor 500,000 parts and save $250,000 a year by extending the safe lives of many aircraft components.

The system relates reporting of parts for removal when due with scheduled servicing of aircraft. But it also automatically assembles an historical file from which component performance logging and, consequently design suggestions, are derived.

A component file holds details of unfitted spares and their locations. Its main purpose is to update the aircraft file, this being the statutory record.

More than 40 transaction types are recognized by this fundamentally simple system which was developed by the airline's management advisory service in conjunction with computer services at The Engineering Base.

Still More Power Needed for Unilever Group

Remote job entry for four laboratories belonging to the vast Unilever Group has proved too much for two successive configurations of IBM equipment installed at Port Sunlight Cheshire.

The system has been increased in size to a 50 with 265 kbytes (thousand bytes), three high-speed terminals and a multi-spindle disc drive unit. It began two years ago as a 40 with 64 kbytes, five disc drives and six terminals. The total cost of the new equipment is put at £300,000 and despite the fact that the decision to implement a multi-job system was taken in 1964, preliminary working was delayed till 1966. An interim increase in power nine months ago did not solve the operational problems that increasing work loads had brought about.

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C.a

COMPUTER MARKET REPORT

The Computer Leasing Industry — Some Statistics

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A Brief Profile

This presentation of a bird's eye view of the computer leasing industry is an initial step in understanding facts about this new industry, in order that an analysis of its past experience and an estimate of its future prospects can be made on a realistic basis.

This new sector of the data processing field has been in the limelight during the past two years. However, few accurate facts about this industry have been available to date. This article is an attempt to fill the need for factual information about this industry.

Background

The computer leasing industry is almost ten years old. The 1956 IBM consent decree was the starting point for some of the companies. During recent years other companies have been formed for the specific objective of leasing computers. Table 1 below shows the number of companies formed each year during the past five years which are currently still in business. These figures show a phenomenal growth.

Table 1
NUMBER OF COMPANIES FORMED AND STILL IN BUSINESS

1964	1965	1966	1967	1968
5	3	12	29	31

Business Activity

The amount of business generated by all firms, including those founded from 1957-1963, reached a peak in 1968. Table 2 shows the total estimated activity of all firms in the computer leasing industry in the United States during the past five years. Excluded are figures for leasing of unit record equipment by some firms in the industry.

Table 2
COMPUTER LEASING INDUSTRY ACTIVITY, 1964-1968

Year	Estimated Total Price of Equipment Purchased ($ in millions)	Percent Increase Over Prior Year
1964	22	
1965	27	23
1966	105	289
1967	360	243
1968	1,011	181

Equipment Classification

A classification of the total equipment purchased by leasing companies is shown in Table 3. While the amount of second generation equipment purchased has almost doubled over the five-year period from 1964-1968, the amount of third generation equipment has increased several hundred percent.

Table 3
TYPE OF EQUIPMENT PURCHASED
(Estimated price in millions of $)

Year	Second Generation Systems	Third Generation Systems	Total Paid in Each Year
1964	22	—	22
1965	25	2	27
1966	17	88	105
1967	31	329	360
1968	41	970	1,011

The percent of change over prior years is shown in Table 4.

Table 4
PERCENT CHANGE OVER PRIOR YEAR

Year	Second Generation Systems	Third Generation Systems
1965	14	Large
1966	(32)	Large
1967	82	274
1968	32	195

As can be seen, very little second generation computer equipment was purchased by leasing companies in contrast to the total amount of third generation equipment purchased. As can be expected, a very large percentage of the second and third generation equipment purchased was manufactured by IBM.

Breakdown by Type of Equipment

Almost every type of IBM computer system has been purchased by leasing companies. The main types of second generation equipment that have been purchased are the 1401, 1440 and 1460, 7074 and 7094 model I. However, as can be expected, the leasing companies purchased from IBM a comparatively larger percentage of the larger systems than they did of smaller systems. Most of the leasing companies have concentrated on large value equipment because this was the way they could substantially increase their business in the shortest possible time. Since their marketing coverage was limited and larger companies are easier to locate, they pursued large companies such as those listed in the "Fortune 500" list. These are also the companies who are most likely to experiment with new arrangements, such as leasing from computer leasing companies rather than continuing to deal directly with IBM or other computer manufacturers.

The most popular third generation system purchased by leasing companies, in terms of total number of systems, has been IBM's system 360, model 30 (3630). Next in popularity in terms of the number of systems have been IBM 360, model 40 (3640), model 20 (3620), and model 50 (3650). As in the case of second generation machines, the larger systems purchased account for a substantially larger percentage of all systems of that kind, compared with the smaller, less expensive systems.

The Major Companies

The ten leading companies and their total purchases of all data processing equipment, including IBM unit record machines, since 1957 is indicated in Table 5.

Table 5
TOP TEN LEASING COMPANIES

Rank	Company	Estimated Monthly Rental Value of Equipment (in millions of $)
1	Management Assistance Inc.	7.1
2	Greyhound Computer	3.1
3	Data Processing Financial & General	2.4
4	Levin Townsend	1.9
5	Randolph Computer	1.9
6	Leasco	1.4
7	Boothe Leasing	1.0
8	Bankers Leasing	0.8
9	Diebold Computer	0.8
10	D.P.A. Inc.	0.6

It is estimated that the data processing equipment installed and in actual use in the United States as of December, 1968, was worth almost $365 million in monthly rental value. The total monthly rental value of all data processing equipment owned by leasing companies as of December, 1968, is estimated at $48 million. Thus leasing companies owned almost 13 percent of the total equipment installed. This calculation, of course, ignores the possibility that some of the data processing equipment owned by leasing companies is not on rent to customers.

Relative Share of Market Held by Large Companies

Of almost 400 companies in this industry, 150 of them do approximately 95 percent of the total business. However, the top ten companies had purchased equipment worth almost $21 million of monthly rental value. This is about 44 percent of the industry total. The top twenty companies had about 78 percent of the industry's total equipment in terms of monthly rental value. Thus the remaining 380 companies are really very small.

Yearly Pattern of Equipment Purchased

The pattern of yearly purchases of computer equipment by each of the 150 companies shows that, with few exceptions, the value of equipment acquired did not increase from year to year. Total industry figures conceal the irregular annual profiles of equipment acquisition by company. The only exceptions to this general irregular pattern were a few of the top ten companies which have been in operation for over 3-4 years.

Obviously, the yearly equipment acquisition profiles for companies formed during 1966 and 1967 imply little. However, a monthly chart of their activity shows the absence of any regular pattern.

Size of Systems Acquired

For each of the top ten companies, a profile by type of systems acquired shows that while some concentrated only on the large systems, others stressed the medium-size computers. There is evidence that, over a period of time, each of these companies will attempt to obtain some computer systems of each size.

Based on this evidence it does not appear that any of these top ten firms actually had a prior plan of action in terms of what size equipment they would acquire. The acquisitions were made as opportunities in the marketplace presented themselves, with little consideration of the size of system acquired. This fact is contrary to public comments made by executives of these leading leasing companies when they express concern about the problems of selectivity in computer equipment acquisition, and imply that they have a plan to obtain a balanced portfolio of computer systems of all sizes.

Length of Lease

An examination of the mixture of length of lease commitments of the top ten firms discloses that the firms clearly accepted any available business without regard to the length of the lease period. Thus the longevity of the leases owned by a computer leasing firm was determined by chance and the forces in the marketplace, rather than by any prior plan of action. This fact is also contrary to the statements made by many of the top executives of these companies where they state that their companies were seeking only a certain type of customer who would lease a system for at least a certain minimum period. Starting with a one-year or two-year minimum term, it appears from fragmentary reports available that the lessee rather than the leasing company's views finally determined the question of the length of the initial lease commitment. In most of these cases, the leasing company accepted the wishes of the equipment users without regard to the desirability of establishing a portfolio of leases of varying lengths for the equipment purchased and leased to customers.

Table 6
GEOGRAPHIC LOCATION OF LEASING CUSTOMERS

State	No. of Companies	State	No. of Companies
Ark.	1	N.Y.	60
Calif.	16	Ohio	9
D.C.	3	Okla.	1
Fla.	1	Ore.	1
Ga.	1	Pa.	10
Ill.	14	R.I.	1
Ind.	2	S.C.	1
La.	1	Tenn.	2
Md.	3	Tex.	16
Mass.	7	Utah	1
Mich.	7	Va.	3
Minn.	1	Wash.	1
Mo.	4	Wisc.	2
N.J.	6		

(Please turn to page 69)

COMPUTER-ASSISTED PROGRAMMING for NUMERICAL-CONTROL PUNCH PRESSES

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"Generally, a computer program produced on the IMP (Improved Manufacturing Procedures) program processor for a single complex part has about one-sixth the program statements of a manually produced program . . . and IMP can be applied to most numerical control presses."

NUMERICAL-CONTROL MACHINES have provided efficient and accurate ways of fabricating hardware for complex electronic systems. In the Western Electric Company one application of numerical control (N/C) has been in sheet metal fabrication in which N/C punch presses, one of which is shown in Figure 1, have been installed and programmed to eliminate the drudgery and human errors inherent in the more conventional methods of machining. This application of N/C has improved product quality, reduced lead time, and improved ability to introduce product changes rapidly.

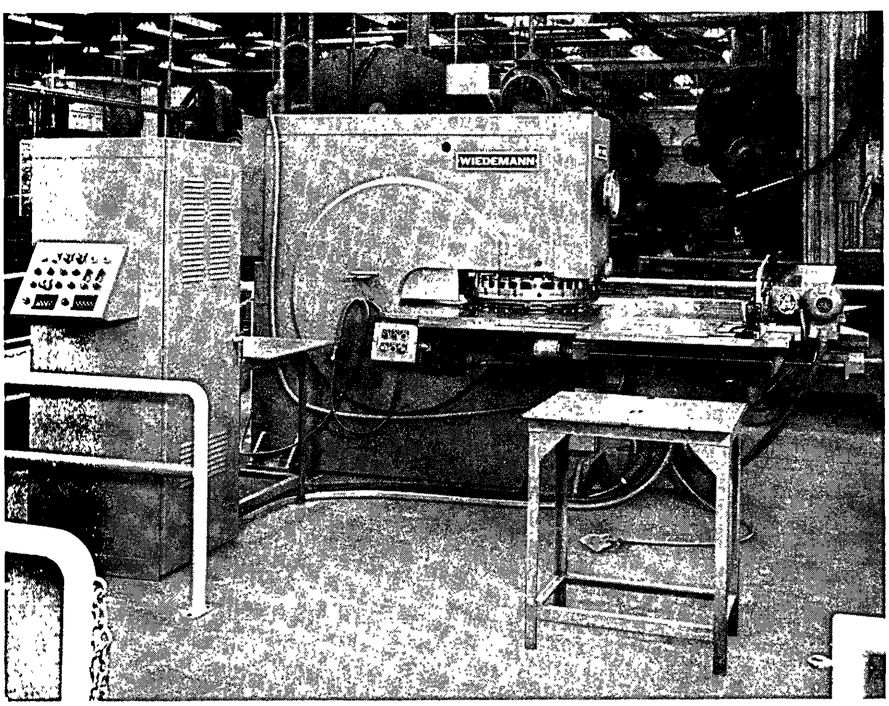

Figure 1. Numerical control punch press. IMP computer-assisted programming is adaptable to many makes of numerical-control punch presses.

As the use of N/C punch presses increased at the North Carolina Works, it was apparent that programming was a weak point in the N/C system. Part programming problems were responsible for a majority of nonproduction time on the presses. The manual programming method used was too slow. Since holes are punched in a development[1] of a part and the part then formed, X and Y dimensions for every hole location had to be computed for the development. The results of the computations were recorded manually on a manuscript in the exact format required for a particular machine and then punched onto a paper tape. The people available for part programming were not able to prepare programs fast enough to supply the required number of control tapes.

Considerable machine downtime occurred while waiting for first-part inspection to verify the accuracy of the part tape. (Manual computations for complex punchings provide many opportunities for error.) If an error

[1] A part development can be considered as the completed part unfolded into one plane.

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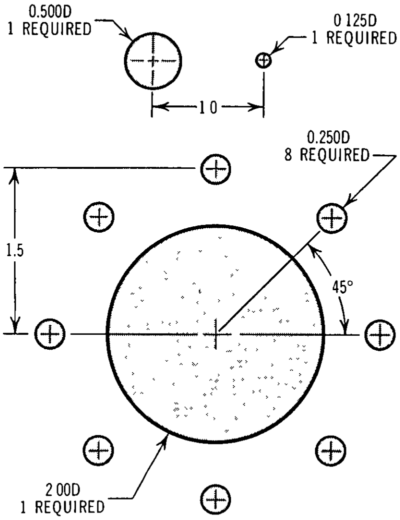


Figure 2. Typical of hole patterns required for mounting apparatus and hardware.

was found in the part, either the machine was torn down and a new setup made to run another part, or the press was idled while the errors were corrected and the control tape repunched accordingly. An analysis showed that a large portion of the errors resulted from incorrect computation of the developed location of the various holes in a part.

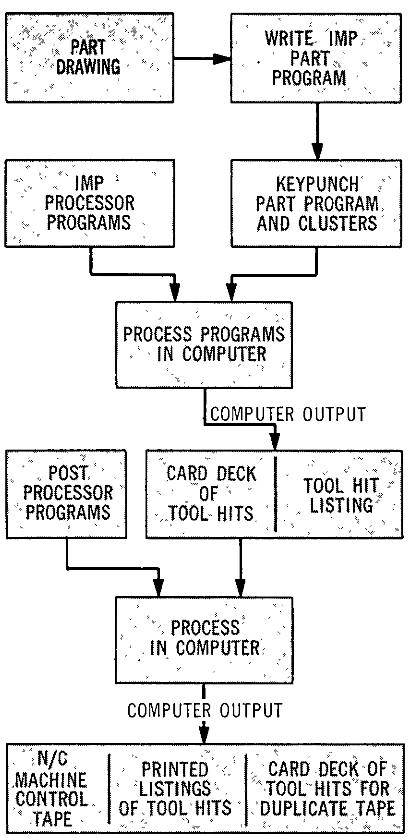


Figure 3. Programming flow diagram. The tool-hit listing, one of the computer outputs, is useful in checking the accuracy of a program.

There was a need for more sophisticated planning and programming than the manual method used in preparing for sheet-metal part manufacture. An engineering investigation into these problems indicated that use of a computer would provide the best means of reducing programming time and of eliminating human errors in the programming effort. As a result of the investigation the North Carolina Works Numerical Control Systems Development Organization was assigned the task of developing a computer oriented programming system.

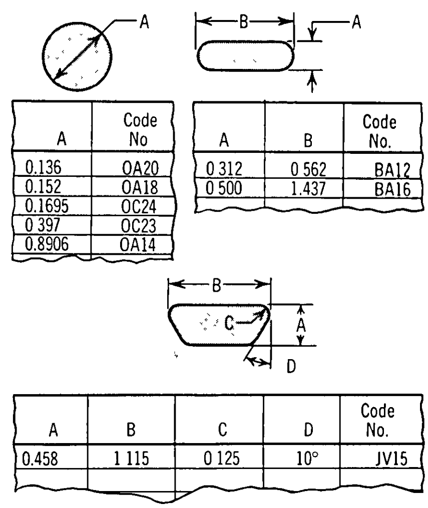
To handle the repetitive sequencing normally found in sheet metal part programming, the new system required a more sophisticated computer routine than was currently available. For example, in programming an apparatus mounting hole pattern, or cluster, (see Figure 2) each hole or shaped cutout was programmed individually regardless of how many times that particular pattern was repeated in a part design or used in a series of designs. With the new system it was intended that any pattern could be programmed one time, stored in a magnetic-tape file, and called out for use in as many part programs as required. In addition, capabilities would be provided for adjusting the pattern program for rotating the pattern through 360 degrees or for producing a right-to-left and top-to-bottom mirror image of the pattern.

IMP PROGRAMMING SYSTEM

Proposed improvements such as those discussed led to the development of a programming system for N/C punch presses called IMP, an acronym for *I*mproved *M*anufacturing *P*rocedures. The IMP system is a processor program; that is, the system generates a detailed sheet-metal punching program from relatively simple input instructions.

The flow of a part program from a drawing to a finished part tape is shown in Figure 3. A part program is written on the basis of information given on a conventional orthographic drawing of the formed part. The written information is then keypunched onto cards, and the punched program cards, or deck, is processed in a computer with the IMP system program. The computer output is both a card deck and a listing of all tool hits[2] to be made in a part. The tool-hit card deck and the appropriate postprocessor[3] program are computer processed to produce an N/C control tape for the punch press, a printed listing of all tool hits, and a punched card deck, which is used to make duplicate control tapes.

There are several features that make IMP a unique system. Hole locations on the development of a part are automatically calculated from dimensions taken from an orthographic drawing of the part. A fixed data file, or library, of frequently used cluster information is maintained on magnetic tape for repeated use. IMP determines an economical hole punching sequence. The system automatically adjusts X and Y co-ordinates of holes or clusters to reflect the difference between the programming and the punching orientations of a part. The system is designed to check for programming errors. Finally, the system will provide basic data for computation of wage incentive rates.



A	Code No
0.136	OA20
0.152	OA18
0.1695	OC24
0 397	OC23
0.8906	OA14

A	B	Code No.
0 312	0 562	BA12
0 500	1.437	BA16

A	B	C	D	Code No.
0.458	1 115	0 125	10°	JV15

Figure 4. Hole code directory. Holes that are listed are used in the bracket, Figure 5.

To use the IMP system, every basic hole size programmed is identified by a (four-character[4]) code. The code is a necessity when using the fixed data file feature and is also a convenience when specifying other than round holes that are made with a single

[2] Each stroke of a punch press is defined as a hit.

[3] In this instance a postprocessor is used to adapt a general IMP program to one suitable for a particular type of punch press.

[4] Coding length used at the North Carolina Works.

punch. Typical codes taken from the North Carolina Works' classified directory of holes are shown in Figure 4. A code would be unique to each using location.

In programming the bracket shown in Figure 5, a programmer first divides a development of the bracket into X and Y zones. A zone is bounded either by lines denoting right-angle bends[5] or by part edges, both of which are perpendicular to either the X or Y axis. In a development of the bracket shown in Figure 6, there are five X zones and three Y zones.

Next, the programmer describes the part to the IMP system by specifying the number of X and Y zones, dimensions of the zones, the number of material thicknesses included in the X and Y-zone dimensions, type of material, thickness of material, and radius of bends. He lists all hole codes used in the program and locations in the turret of a punch press for the tools (punches and dies) corresponding to the hole codes. The angle (if applicable) of the tool in the tool holder is also listed. Other information included is number of pieces to be made from a material blank and set-up instructions for a punch press operator.

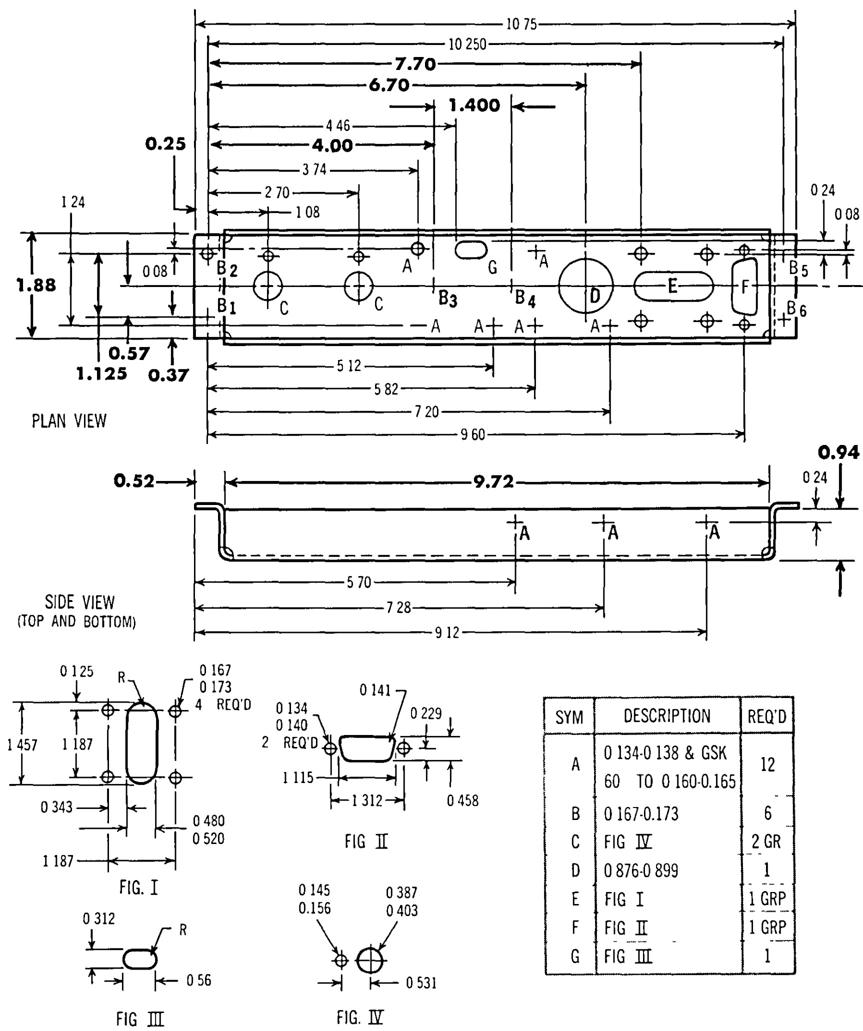
CALCULATION OF HOLE LOCATION

To determine the co-ordinates of a hole in a part, the programmer specifies the hole dimensions as they appear on the part drawing and the X and Y zones of the part development in which the hole appears. A representative programming entry for hole D in Figure 5 is shown on line one of Figure 7.

In calculating the X dimension of a hole, the IMP system computes a bend allowance for the material thickness and bend radius specified, and multiplies the allowance by the number of bends from the beginning of the first X zone, or X-zone reference point, to the hole(s) in question. For hole D there are two X bends.

To the bend allowance product, the system adds the dimension of the X-zones that are between the reference point and the zone containing the hole. The system then determines the dimension from the beginning of the X zone containing the hole to the centerline of the hole and adds this dimension to the previous total. With a bend allowance of 0.137 inch for one-sixteenth-inch material and one-sixteenth-inch radius of bends, the result for hole D is 7.790 inches. The Y co-ordinate is determined in the same manner, and for hole D, is 1.831 inches.

In situations in which there are two or more equally spaced holes in a line in the same zone, the programmer dimensions the first hole in the line and then adds the number of hits



SYM	DESCRIPTION	REQ'D
A	0 134-0 138 & GSK 60 TO 0 160-0.165	12
B	0 167-0.173	6
C	FIG IV	2 GR
D	0 876-0 899	1
E	FIG I	1 GRP
F	FIG II	1 GRP
G	FIG III	1

Figure 5. Orthographic drawing of typical part. Dimensions shown in color are used for programming example, Figures 6 and 7.

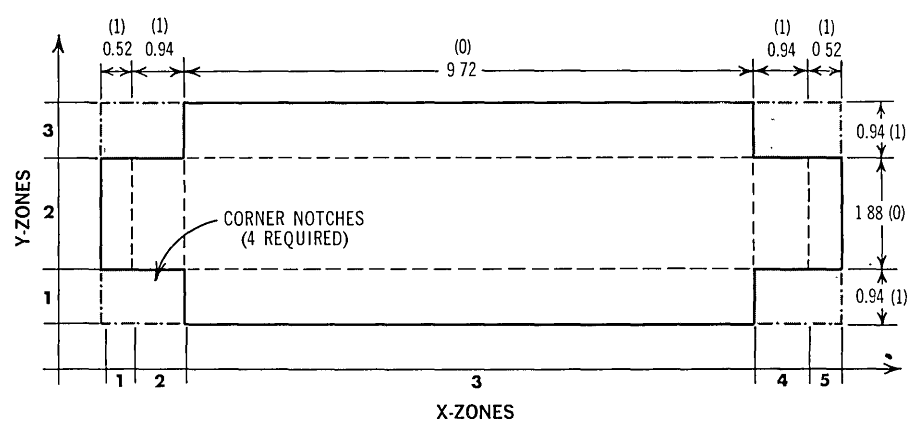


Figure 6. The development of a part is divided into X and Y zones. The number in parenthesis over the zone dimensions, which are in inches, indicate the number of bends included in the dimension.

[5] Thus far only right-angle bends are programmed into the IMP system. This limitation has been of little significance in that very few sheet metal parts require other than 90 degree bends.

Holes	X Dimension	Y Dimension	No of Hits in Line	Distance between Hits	Angle from Horizontal	X Zone No.	Y Zone No.	Distance from X Reference	Distance from Y Reference	Hole Code
D	6 70	0 57				3	2	0 25	0 37	OA14
B_1-B_2	0 25	0 37	2	1 125	0.90	1	2			OA18
B_3-B_4	4.00	0.57	2	1 4	—	3	2	0 25	0.37	OA18
E	8.294	0 57				3	2	0 25	0.37	KJ08

Figure 7. Basic information included on a programming sheet. The column headings have been simplified to cover the sample part, Figure 5, and for ease of explanation. On an actual programming sheet the column No. of Hits in Line is also called No. of Clusters in Row and No. of Hits in Circle. Thus each column serves many functions, which depend on an operation being described by the programming entry.

(holes) in line, spacing between hits, and angle of the line from the horizontal. The IMP system will calculate the punching centers for all the holes. Examples of in-line hole statements are shown in Figure 7 for holes B_1-B_2 and B_3-B_4. The IMP system can also be programmed to handle a matrix of equally spaced holes with just one statement.

FIXED DATA FILE

The fixed data file is a library of frequently used cluster program information that has been recorded by code on magnetic tape and in a directory of holes. The file also contains data on perforations required to make both corner notches and special holes by successive hits with a general use tool. A typical apparatus mounting hole pattern listing in the directory is shown in Figure 8. Line one of Figure 8 (cluster code KJ08) is a listing of pattern E on the part drawing, Figure 5.

To use the information stored in the data file, the programmer lists the cluster code and the dimensions to the cluster's datum point, which is shown in the directory (see Figure 8). The computer searches the data file for the listed code, extracts the cluster program, and inserts it into the part program. The programming statement for cluster E is shown on Figure 7.

If a programmer expects a new cluster to be used frequently, he programs it with respect to a datum point. This new information is coded, placed in the data file, and added to the directory.

DETERMINATION OF HOLE SEQUENCE

The order in which a particular tool is used is established by the programmer when he designates the tool location in the punch-press turret as part of operator setup instructions. For any one tool size the punching sequence can be determined by the programmer or automatically established by IMP. The IMP routine for automatic sequencing is as follows. A portion of computer memory is set aside for hit information for each tool. As IMP generates the co-ordinates of a tool hit, it stores the information in the appropriate section of memory. When all hits have been dimensioned and stored in memory, the computer searches memory of the first tool to be used for the closest hit to the set-up position. This hit is the first in the sequence. Subsequent hits are established by computing machine travel times from the last hole sequenced to all other holes of the same size. The tool hit location that has the shortest time to get into punching position is the next one in the sequence. Travel time computations and sequencing for all hole sizes continue until all tool hit locations in memory have been processed and tabulated in the printout.

ADJUSTMENT OF X AND Y CO-ORDINATES

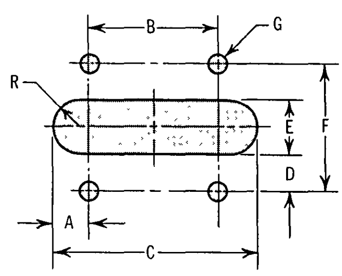
If a part is to be punched in a different orientation than that dimensioned on the part orthographic drawing, IMP will make the necessary calculations to adjust the X and Y co-ordinates of the tool hits from the programmed orientation to the punching orientation. For example, if a part must be rotated ninety degrees for clamping in a press, IMP will interchange the X and Y co-ordinates. If stock must be added to the part blank for clamping, IMP will add the width of the clamping stock to the appropriate dimensions and generate a cutoff punching sequence to remove the excess material provided for clamping.

If more than one part is to be punched from one blank of stock, IMP will generate the hit co-ordinate points for all parts in the blank. Calculations for hits in the second, third, etc. parts will include allowances for cutoff in blanking out the parts.

If a part is dimensioned from one side and the part is to be blanked from the opposite side, IMP will generate the required mirror-image co-ordinate points from the input information.

DETECTION OF PROGRAMMING ERRORS

The IMP system is designed to detect most programming errors and to facilitate their correction. The computer is programmed to examine part program data to identify mistakes, such as, failure to specify all tools to make a part, omission of the number of holes in a line statement, and programming X and Y co-ordinates that exceed the size of the raw material blank for the part.



A	B	C	D	E	F	G	CODE NO. OF "G" HOLE	CODE FOR "R"	CODE NO. FOR E&C	CLUSTER CODE
0 125	1.187	1.437	0.343	0.500	1.187	0.169	OA18		BA16	KJ08
0.380	2.125	2.875	0.720	0.750	2.188	0 266	OB14		BA27	KJ22
0 310	2.125	2.740	0.840	0.500	2.188	0 266	OB14		BA31	KJ23
0.500	2.440	3 440	1.340	0 750	3.440	0.266	OB14		BA27	KJ24
0.500	3 000	4.000	0 820	1.750	3.375	0 213	OB58	OB26	AN22	KJ25

Fig. 8. The cluster directory includes the hole codes for each of the basic configurations required to make a particular cluster. The cluster datum point is at the center of the elongated hole.

Additional error detection capabilities are provided by a program check, which is dependent upon a part being programmed simultaneously by two programmers. These programmers must follow the same order of tool usage but do not have to program tool hits in an identical manner. The co-ordinate points for each tool hit from one program are matched by the computer with the corresponding tool hit points in the second program. If the two sets of points are identical, only one set appears in the printout for the program. If there are any differences, the unmatched points appear side-by-side in the printout. This procedure allows any errors to be easily identified and corrected before the part data is processed with a postprocessor to produce a machine control tape.

The potential for savings with the dual programming procedure is tremendous for two reasons. First, no parts will have been made from a bad tape. Second, no machine downtime will have occurred while waiting for first part inspection to verify a tape, for a setup with a bad tape to be torn down and a new setup made, or for a bad tape to be corrected.

WAGE INCENTIVE DATA

The IMP system provides basic data used in computing wage incentive rates. IMP calculates the punched size of a single part, the raw material blank size (including allowances for clamping and for punching multiple parts from a single blank), total machine-table travel time and distance, turret indexing time and total number of hits.

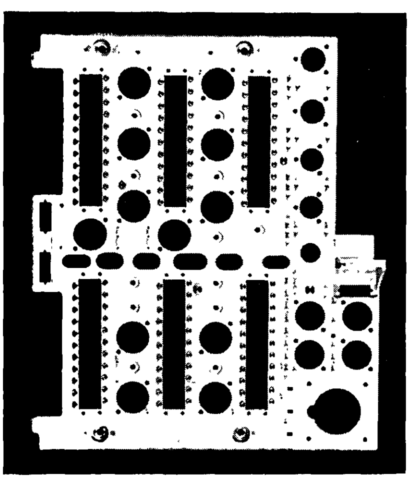


Figure 9. One of a series of similar panels required for one product.

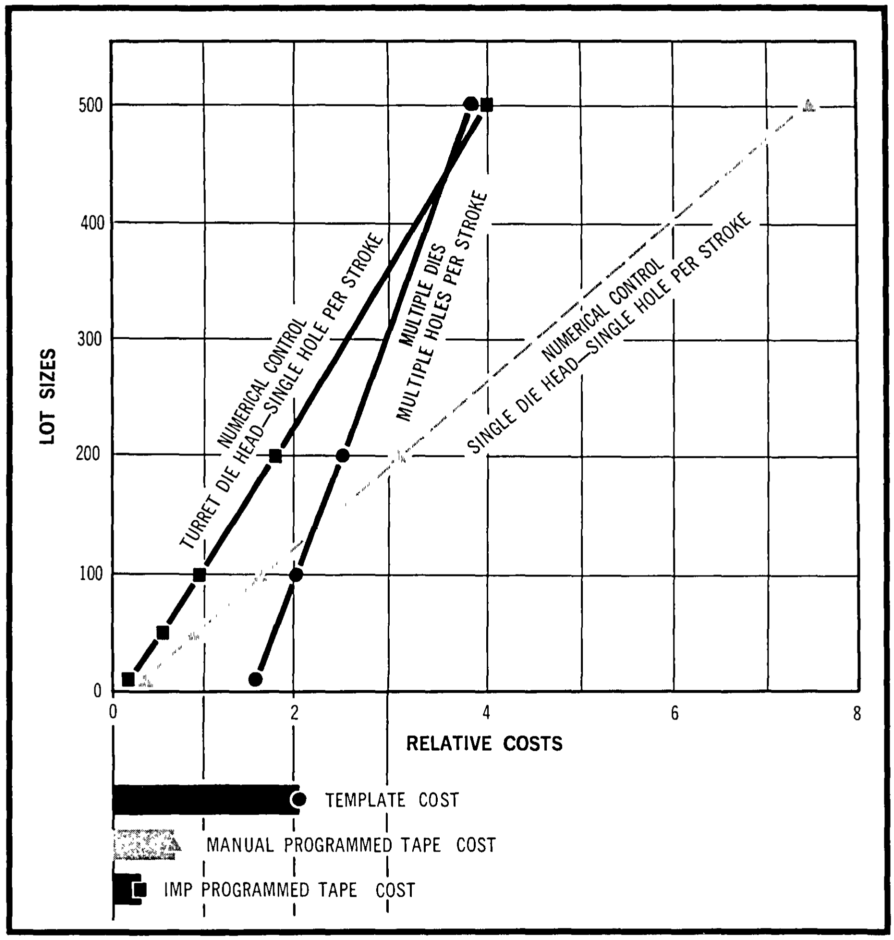


Figure 10. Cost Comparison. The production lot sizes for the panel ranged from 5 to 29 and averaged 15. The IMP programmed tape cost includes the double programming effort required to use the error checking feature of IMP. The tape and template costs are in addition to the part manufacturing cost.

COST STUDY

Figure 9 shows a complex panel that was recently run in the shop. A study was made to determine the cost of the panel if produced by the three methods available; multiple dies-multiple holes per stroke press (requires a template), a single head for dies-single hole per stroke N/C press, and a multiple head for dies-single hole per stroke N/C press. The results of the study are shown in Figure 10. The lead time for a template is twelve weeks; for a manually programmed tape, about three weeks; and for an IMP programmed tape, about two weeks (with double programming). The press setup time using a template and interchangeable punches and dies is 32.97 hours; a single head N/C press, 3.55 hours; and a multiple head N/C press, 2.50 hours. A tape program manually produced would require about 360 statements. The IMP program for this part required sixty statements.

CONCLUSION

At the North Carolina Works implementation of the IMP programming system has completely eliminated the backlog of parts to be programmed for N/C presses and has essentially eliminated press downtime resulting from part programming errors. With IMP the time required to program a part has been reduced fifty per cent when compared with the time required to manually program the same part.

The IMP system was designed for point-to-point positioning and punching of parts. Although it was oriented to one type of N/C machine, the system design is such that it may easily be converted for use on other point-to-point N/C machines with a minimum of cost and effort. This system, for example, is now being used at Western Electric's Kansas City Works and is presently being implemented at the Merrimack Valley Works. Both works' machines are of different manufacture than those at North Carolina Works.

What Kinds of Jobs? — Part 2

Business Equipment Manufacturers Assoc.
235 East 42 St.
New York, N.Y. 10017

Part 1 of this article, which appeared in this column last month, discussed job opportunities in the computer field in designing and manufacturing, marketing and sales, and customer or field engineering. Here we will describe the jobs that are related to putting computers to work.

The greatest current demand in the information processing field is for people to develop programming or software systems for computer applications. These are the "problem solving" activities which, first of all, require a thorough understanding of the problem to be solved, coupled with a good knowledge of the capabilities and limitations of computers. The need for such people is widespread throughout business, industry and government. Wherever there is a computer, there is an organization of people to make it function. Here are some of the positions involved in putting computers to work.

Systems Analysts

The work of the systems analyst involves the collection of facts regarding the information requirements of the computer user, and the analysis of those facts. Systems analysts formulate efficient patterns of information flow from its sources to the computer, define the computer process necessary to turn the raw data into useful information, and plan the distribution and use of the resulting information.

In smaller computer installations the functions of systems analysis and programming are frequently combined while in larger installations they usually separate. No matter what the title, the person performing the analysis has to understand the problem and interpret it correctly and, at the same time, know how to use the computer effectively. He must bring to every problem a deep insight that will enable him to reduce it to its fundamental information flow terms.

An engineering-scientific analyst may work on such problems as tracking a satellite or controlling a nuclear process. The analyst must consult with and understand top-level scientists and mathematicians, and develop mathematical equations that describe the problem and its solution. Such an analyst, of course, must have at least one degree in mathematics, physics or an appropriate engineering science.

On the other hand, while a formal educational background in business administration is helpful for systems analysts who specialize in business data processing, it is not always required. Business experience, plus the ability to reason logically, is important however. Typical of the projects that a business systems analyst may work on are the development of an integrated production, inventory control, and cost analysis system.

An area of increasing importance, as businesses grow bigger and more diversified, is operations research. This is an especially challenging specialty involving the analyst in the highest echelons of decision-making in any business or organization. The analyst must formulate a mathematical model of a management problem and use it to provide a quantitative basis for making decisions.

Many organizations require that systems analysts have two or more years of programming experience in addition to a college degree.

Programmers

After the analysts have laid out the solution for a problem or the design of an information processing system, it goes to the programmer. It is the programmer's job to devise a detailed plan for solving the problem on the computer. This plan is called the "program" and in final form it consists of a series of coded step-by-step instructions which make the computer perform the desired operations. In most instances, the analysts or the programmer will have prepared a "flow chart" which shows how information flows through the system and what actions are to be taken when a given condition is met or not met. The programmer generally employs one of several computer "languages" that use English words or phrases or common mathematical expressions to communicate with the machine. The programmer checks the program by preparing sample data and testing it on the computer. He also "debugs" his program (discovers and removes errors he has made in his instructions) by making several trial runs with actual data from the project.

To complete the entire programming process for a large project may take several months or a year or longer, and the program may take up several volumes of "flow charts" and listings of program steps.

Programmers often work as part of a team, with different levels of responsibility. Depending upon the size of the project there may be a programming manager or a senior programmer leading the team with a staff of programmers, junior programmers, coders and trainees. The expression "Coder" is sometimes used instead of junior programmer. The name derives from the fact that machine instructions

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Based on a booklet entitled "Computer Careers," published by the Business Equipment Manufacturers Association in cooperation with the American Federation of Information Processing Societies. The booklet provides detailed information about careers in the designing, production, marketing and application of computers. Single copies are available without charge; 2 to 99 copies are 40¢ each, etc.; orders, and requests for additional price information, should be sent to BEMA at the address above.

are often called machine codes. A coder takes detailed flow charts and produces "coded instructions".

In some organizations, coders and programmer trainees translate the programmers' instruction into the codes understood by the particular computer being used. The junior programmers write instructions from the detailed flow charts developed by the programmers and sometimes are given the opportunity to write specific parts of a broad program. In this way, they develop the skills and experience needed to develop programs on their own. Those who take a full range of computer courses leading to a computer science degree at a college or university can generally skip the initial training level positions in their first job and go right into full-fledged programming assignments.

The varieties of problems a programmer deals with, the different computers he may work with, and the various information processing languages he must know demand of him a high degree of ingenuity, experience, imagination — and above all, the ability to think logically.

Well-trained and experienced programmers can write programs for many different types of problems. However, programmers can specialize in one of three major areas: scientific applications programming, business applications programming, or systems programming.

Scientific Applications Programming

In order to use a computer to solve engineering and scientific problems, the programmer must have a sound knowledge of mathematics as well as of the basic principles of the particular discipline giving rise to the problem. An understanding of numerical techniques for solving mathematical problems is essential. A college degree is required and an advanced degree is desirable.

Business Applications Programming

A college degree is not always required but is very helpful. Experience adds earning power rapidly for the commercial application programmer. Supervisory jobs for this function usually go to men with college degrees, or considerable experience in diversified programming applications.

Systems Programming

An Operating System is a complex program which schedules and allocates the various components of the computer (input/output devices, memory, etc.), handles priorities, keeps track of what is going on and permits a large computer to be dealing with many tasks simultaneously. The development of operating system programs is usually done by the computer manufacturer or by consulting firms who develop this kind of "software" under contract. The people who do this work are usually called "software programmers" or "systems programmers" to distinguish them from the people who develop applications programs, which are intended to solve specific problems rather than those which make the computer easier to use. A college degree is usually required. An intimate knowledge of how the particular computer works is required.

Programmers in all three of these specialized areas have come from many walks of life. Some are former music students; others are former photographers, school teachers, accountants, or law students. Increasing numbers are coming from colleges where they have taken courses in programming and computer sciences. All have one quality in common: the ability to solve problems in an orderly, logical manner.

Most organizations employing programmers feel that a college degree is almost a must for admission to programming. However, some organizations will accept high school graduates as programmer trainees if they have had some training in a programming course and can pass a programming aptitude test.

Computer Operators

Another road to computer careers that is open to the bright high school graduate is through computer operations. Look into any busy information processing center and you will see several young men and women pushing buttons, changing magnetic tapes, flicking through punched cards and in other ways supervising the operations of the computer. The console operator — the man who pushes the buttons and watches the lights — actually does much more than that. He reviews computer programs and instruction sheets to determine the necessary equipment set-up for the job. When the control panel lights indicate that the machine has stopped for some reason, the console operator must investigate and correct the stoppage or, if the cause is equipment malfunction, call in a maintenance engineer. The console operator keeps a log of the work done by the computer and writes reports on its use.

In large installations, the console operator is assisted by tape librarians and handlers, and the operators of peripheral equipment such as sorters, collators, high speed printers, communications units, and so on.

Computer operators usually serve an apprenticeship during which their main duties are inserting punched cards in card readers and punches, inserting forms in printers, mounting reels of magnetic tape on tape drives and generally readying peripheral devices for operation. More experienced operators are usually given the responsibility for actually manipulating the controls which actuate the computer system. The console operator holds a position of considerable responsibility since mistakes can be time consuming and costly. Employers require a high school education and many of them prefer some college. A college degree is very helpful for those who aspire to progress into programming or systems analysis.

Many computer operators have successfully advanced to positions as supervisors of operations, programmers and managers of data processing centers.

Clerical and Keypunching

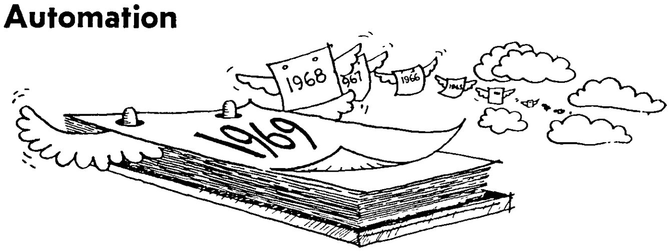
Clerical jobs vary, but usually include manual coding of data, verification of totals used for accounting controls, maintaining libraries of magnetic tape files, maintaining operating schedules, logs of operation and the like. These tasks provide good "on-the-job" training for high school graduates who wish to learn something about computing and they are sometimes "apprenticeship" jobs for computer operators.

Keypunching of data into punched cards or paper tape and operating other key-driven data recording devices requires an ability to type reasonably well (30-40 wpm) and an ability to work in a fairly noisy environment. After two or three weeks of intensive training, a high school graduate may start as a keypunch operator.

Manager of Information Processing or Manager of Data Processing

At the head of most computer installations or departments is an individual who coordinates and directs the overall efforts of systems analysts, programmers, computer operators and others involved with the use of the computer. This individual may have a title like Manager of Information Processing or Manager of Data Processing, Manager of Computer Services or Management Services. He generally reports to a top executive of the organization.

Management of the information processing activity requires considerable experience, good management skills and in most companies, a college degree. Salaries vary widely depending upon the size of the staff and the organizational level within the company. □



Towards More Automation in Petroleum Industries

Reprinted from Vol. 3, No. 3 — March 1954

Sibyl M. Rock
Consolidated Engineering Corporation
Pasadena, California

When we hear the term "automation," we are likely to picture in our minds a completely automatic refinery or petrochemical plant. The picture shows one or two lone service men replacing marginal tubes or watching a few critical meters, while perfect product pours out with almost no attention.

Such a plant does not now exist; there is in fact some doubt that it will within the next several decades if ever. However, many of the individual operations, which integrated form the refinery, are being observed and in some cases controlled either continuously or semi-automatically. In addition, engineers are aiming the refinery's instruments at obtaining better information and determining where controls should be placed so as to achieve optimum results.

Another recent advance has been centralizing and displaying controls in such a form that a human operator can quickly read and interpret them, and evaluate the needs of the system. Graphic display panels (see references 1 and 2) showing gages, temperature indicators, valve positions, etc., all arranged on a reduced scale, have been developed to a high degree of efficiency and are now used in most major refineries. These panels may display hundreds of automatic controllers, and the total number of items of information displayed may exceed 2000.

Most of the instruments now used in control cycles detect only one variable, quality, or characteristic. When the precise relation of this observed variable to the whole process is known, then it can be used as a direct control. But usually the variable measured is not the actual product but some related physical characteristic such as temperature or pressure. For example, temperatures at crucial points of fractionating towers are continuously measured, and the deviation from the best point is used to control the input of heat or steam. Acidity indicators have also been used as detectors in closed-servo-loop systems.

Regardless of how closely such secondary measurements are maintained or how compactly they may be displayed, both intermediate and end-point checks of actual composition of the product are also necessary. Here engineers aim to develop instruments for more accurate and frequent analysis of the more complex products, and for continuous measurement of components in the less complex products.

In the case of highly complex chemical mixtures, engineers are extending the use of mass spectrometers, infrared spectrometers, and similar instruments so as to analyze for more and more components. Analyses are being made not only of gases and liquids, but well into the range of waxes and solids. Because of the increased amount of analyses, the reading of records and the computations from them are becoming a serious bottleneck.

One development to overcome this difficulty applicable to analysis of the mixtures of lighter density is a new machine known as "Spectrosadic" which combines: (1) a programming unit to select the peaks to be read; (2) an analog-to-digital converter which converts the signal to relay contact closings; and (3) an analytical mass-spectrometer (see reference 3). The digits representing peak magnitudes are punched into IBM cards or into a perforated paper tape, or may be typed out directly by an electric typewriter. Thus, the work of reading graphical records is cut out, and data suitable for automatic computation is obtained immediately upon completion of the spectrometer run. The analysis is then computed by a card-programmed machine or a general-purpose digital computer, and the report is automatically typed in a suitable form.

The next development of instrumentation immediately needed is the corresponding machine applicable to analysis of mixtures of higher density. Then the labor of reduction of refinery data will be greatly lessened in the case of the analysis of batches of even the most complex mixtures. But variability of sampling, and the time it requires, as well as time for pumping out between samples will still limit any method of analyzing batches, even after all picking of records and computation by hand have been replaced by automatic analysis.

So engineers are approaching the problem of fuller automation from another angle. This angle is the continuous observing of streams with instruments that, while not so flexible nor wide-range in application as those now analyzing batches of mixtures of 15 to 30 components, are less expensive and hence can be tied to one particluar job. Pump-out time and defects in sampling are lessened since only one stream passes through the instrument and its flow is seldom interrupted. At present this kind of instrument is most frequently used to indicate one component in one stream. For example, an infrared analyzer (reference 4) is used as an accurate indicator of the content of carbon dioxide in certain gas from the catalyst in a butadiene plant. The output signal from the infrared spectrometer indicates concentration, is telemetered several thousand feet, and produces a continuous record which enables the controls to be adjusted to maintain the catalyst at a suitable level of activity. Infrared spectrometers are also continuously monitoring hydrocarbons in refinery streams where there is minor interference between the critical component and other components in the mixture (reference 5).

At least three companies (references 6, 7,) are now selling mass spectrometers for monitoring. These too start with recording of a single component. However, with suitable programming units they can, even at their present stage of development, be used to display two to six peaks. The next step will be to attach a computer to the output of peak measurements, so that actual composition of the stream is displayed. As long as only a few components are present, a small analog computer will probably be used. As the observing instruments measure more and more peaks, enabling them to analyze for more and more components, we may expect technology to develop to the point where a digital computer can be built which is sufficiently small and inexpensive to be incorporated in the control loop with a spectrometer. This computer should be able to analyze the mixture, compare it to a standard, make the decisions necessary to actuate the controls, and eventually drive the controllers as well.

One caution should again be emphasized at this point: it is extremely unlikely that the human being will be eliminated completely from the process of control. Machines can be programmed to do a large number of repetitive operations more quickly and more reliably than can a human being. But the intelligent operator will still be required when the unusual occurs: the phenomenon for which the new tool has not been programmed.

Before the fullest feasible automation can be achieved, we must learn from the wealth of data accumulated by batch analysis and by monitoring, just what relations exist between composition at various points and the desired end-product. Also, engineers must carefully determine the placing of controllers for the best operation. These studies will take considerable time, but progress is being made by the development of a new group of men, "system engineers." These men are forsaking narrow specialties and educating themselves in over-all aspects of refineries and chemical plants. The speed with which automation is achieved will depend considerably on how skilled they become in the correlation and interpretation of data now being accumulated.

To summarize: The problem of large-scale automation using both intermediate and endpoint analysis is being attacked from two sides. One is monitoring and display of one or perhaps more indicators of composition, such as a mass spectrum peak or an infrared absorption at a specified wave length. Here the sampling variables and time lag can be minimized. Second, mixtures of greater range and complexity are being analyzed, and the computations required for their solution are being mechanized. As the first approach is extended to more and more components, and as the instruments required for the second are simplified and their price decreased, the two types of instruments will converge on the ultimate objective: continuous analysis of complex streams of components, with automatic interpretation of the data and feedback to the controllers, eliminating much (but probably not all) of the human intervention now necessary.

References

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NUMBLES

Number Puzzles for Nimble Minds — and Computers

Neil Macdonald
Assistant Editor

A "numble" is an arithmetical problem in which: digits have been replaced by capital letters; and there are two messages, one which can be read right away and a second one in the digit cipher. The problem is to solve for the digits.

Each capital letter in the arithmetical problem stands for just one digit 0 to 9. A digit may be represented by more than one letter. The second message, which is expressed in numerical digits, is to be translated (using the same key) into letters so that it may be read; but the spelling uses puns or is otherwise irregular, to discourage cryptanalytic methods of deciphering.

We invite our readers to send us solutions, together with human programs or computer programs which will produce the solutions.

Numbles 693:

```
                N E G L E C T
            X     J U S T L Y
              C M S T B S E M
            S C B O M B M L
          E S M S L M T J
        T E N M B N L E
      L O L B M S J C              EGO = YKU = ECO
    O T J T M J C O
    N B B S L B J E C M J O M

    28376  04674  307714
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Solution to Numble 692

In Numble 692 in our February issue, the digits 0 through 9 are represented by letters as follows

S = 0	C, K = 5
B = 1	R = 6
L = 2	H = 7
V = 3	A = 8
D = 4	E = 9

The full message is: Care beheads bad luck.

Our thanks to the following individuals for submitting their solutions to recent Numbles we have published: T. P. Finn, Indianapolis, Ind.; James Monagle, Brooklyn, N.Y.; D. F. Stevens, Berkeley, Calif.; and Robert R. Weden, Edina, Minn. □

CALENDAR OF COMING EVENTS

March 20-21, 1969: Information Industry Association First National Meeting, Americana Hotel, New York City, N. Y.; contact Eugene Garfield, Institute for Scientific Information, 325 Chestnut St., Philadelphia, Pa. 19106

March 20-21, 1969: 7th Annual Atlantic Systems Conference, Americana Hotel, New York, N.Y.; contact Atlantic Systems Conference, P.O. Box 461, Pleasantville, N.Y. 10470

March 24-26, 1969: 10th VIM meeting, (users group of Control Data 6000 computer series), Florida State University Union, Tallahassee, Fla.; contact Carol J. Richardson, Control Data Corp., 8100 34th Ave. So., Minneapolis, Minn. 55440

March 24-27, 1969: IEEE International Convention & Exhibition, Coliseum and N.Y. Hilton Hotel, New York, N.Y.; contact IEEE Headquarters, 345 East 47th St., New York, N.Y. 10017

March 24-28, 1969: Univac Scientific Exchange Conference, Chase-Park Plaza Hotel, St. Louis, Missouri, contact: Harry Rayner, Sperry Rand Univac, P.O. Box 8100, Philadelphia, Pa. 19101

March 26-28, 1969: Seventh Annual Symposium on Biomathematics and Computer Science in the Life Sciences, Univ. of Texas Graduate School, Houston, Tex.; contact Office of the Dean, Univ. of Texas Graduate School of Biomedical Sciences, Div. of Continuing Education, P.O. Box 20367, Houston, Tex. 77025

March 26-29, 1969: 16th International Meeting of The Institute of Management Sciences, Hotel Commodore, New York, N.Y.; contact Granville R. Garguilo, Arthur Anderson & Co., 80 Pine St., New York, N.Y. 10005

March 28, 1969: Association for Systems Management 18th Annual Spring Conference, Fairmont Hotel, San Francisco, Calif.; contact A.S.M. Spring Conference Registrar, P.O. Box 26097, San Francisco, Calif. 94126

April 1-3, 1969: Numerical Control Society's Sixth Annual Meeting & Technical Conference, Stouffer's Cincinnati Inn, Cincinnati, Ohio; contact Peter Senkiw, Advanced Computer Systems, Inc., 2185 South Dixie Ave., Dayton, Ohio 45409

April 8-10, 1969: General Electric 400 Users Association, Voyager Beach Motel, Daytona Beach, Florida; contact Bruce H. Reinhold, Pittsburgh National Bank, Pittsburgh, Pa.

April 8-10, 1969: International Symposium on "Computer Processing in Communications," Waldorf Astoria Hotel, New York City; contact Polytechnic Institute of Brooklyn, M.R.I. Symposium Committee, 333 Jay St., Brooklyn, N. Y. 11201, Attn: Jerome Fox, Executive Secretary

April 15-18, 1969: The Institution of Electrical Engineers and the Institution of Electronic and Radio Engineers Computer Aided Design Conference, Southampton University, So 9, 5 NH., Hampshire, England; contact Conference Dept., IEE, Savoy Place, London, W.C.2

April 23-25, 1969: Honeywell "200" Users Association Spring 1969 Conference, Chatham Center, Pittsburgh, Pa.; contact W. Gretzler, Anderson and Gilbert Assoc., Inc., Box 2144 Downtown Station, Uniontown, Pa. 15201

April 23-25, 1969: 21st Annual Southwestern IEEE Conference and Exhibition, San Antonio Convention and Exhibition Center, San Antonio, Texas; contact William E. Cory, Southwest Research Institute, Box 2296, San Antonio, Texas 78206

April 28-30, 1969: Conference on Statistical Computation, Univ. of Wis., Madison; contact Dr. Roy C. Milton, Univ. of Wis. Computing Center, 1210 W. Dayton St., Madison, Wis. 53706

May 5-6, 1969: Association For Computing Machinery (ACM) Symposium on Theory of Computing, Marina del Rey Hotel, Marina del Rey, Calif.; contact Prof. Michael A. Harrison, Dept. of Computer Science, Univ. of California, Berkeley, Calif. 94720

May 6-9, 1969: The Association of Educational Data Systems (AEDS) Annual Convention, Portland Hilton Hotel, Portland, Ore.; contact Wayne J. Smith, Convention Contractor, 201 Massachusetts Ave., N.E., Washington, D.C. 20002

May 7-9, 1969: International Joint Conference on Artificial Intelligence, Statler-Hilton Hotel, Washington, D.C.; contact Dr. Donald E. Walker, IJCAI Program Chairman, The MITRE Corp., Bedford, Mass. 01730

May 13, 1969: Symposium on Extensible Languages sponsored by the ACM Special Interest Group on Programming Languages, Boston, Mass.; contact Carlos Christensen, Chairman, Massachusetts Computer Assoc., Inc., Lakeside Office Park, Wakefield, Mass. 01880

May 14-16, 1969: Spring Joint Computer Conference, War Memorial Auditorium, Boston, Mass.; contact American Federation for Information Processing (AFIPS), 210 Summit Ave., Montvale, N.J. 07645

May 14-28, 1969: International Exhibition, Automation-69 (Modern Equipment for Automation of Production), Moscow, USSR; contact Mikhail Nesterov, USSR Chamber of Commerce, Moscow, USSR.

May 18-21, 1969: Power Industry Computer Application Conference, Brown Palace Hotel, Denver, Colorado; contact W. D. Trudgen, General Electric Co., 2255 W. Desert Cove Rd., P.O. Box 2918, Phoenix, Ariz. 85002

May 19-21, 1969: National Automation Conference of the Automation Dept. of The American Bankers Assoc., Conrad Hilton Hotel, Chicago, Ill.; contact William P. Rust, American Bankers Assoc., 90 Park Ave., New York, N. Y. 10016

May 21-22, 1969: ACUTE (Accountants Computer Users Technical Exchange), Palmer House, Chicago, Ill.; contact ACUTE, 947 Old York Rd., Abington, Pa. 19001

May 21-23, 1969: Seventh Annual Workshop Conference of the Interagency Data Exchange Program (IDEP), Sheraton-Belvedere Hotel, Baltimore, Md.; contact E. T. Maguire, Avco/MSD IDEP Center, 201 Lowell St., Wilmington, Mass. 01887

June 8-12, 1969: Sixth Annual Design Automation Workshop, Hotel Carillon, Miami Beach, Fla.; contact Dr. H. Freitag, IBM Watson Research Ctre., P.O. Box 218, Yorktown Heights, N.Y. 10598

June 9-11, 1969: IEEE International Communications Conference, University of Colorado, Boulder, Colo.; Dr. Martin Nesenbergs, Environmental Science Services Administration, Institute for Telecommunication Sciences, R614, Boulder, Colo. 80302

June 16-19, 1969: Data Processing Management Association (DPMA) 1969 Internat'l Data Processing Conference and Business Exposition, Montreal, Quebec, Canada; contact Mrs. Margaret Rafferty, DPMA, 505 Busse Hwy., Park Ridge, Ill. 60068

June 16-21, 1969: Fourth Congress of the International Federation of Automatic Control (IFAC), Warsaw, Poland; contact Organizing Comm. of the 4th IFAC Congress, P.O. Box 903, Czackiego 3/5, Warsaw 1, Poland.

June 17-19, 1969: IEEE Computer Group Conference, Leamington Hotel, Minneapolis, Minn.; contact Scott Foster, The Sheffield Group, Inc., 1104 Currie Ave., Minneapolis, Minn. 55403

June 19-20, 1969: Assoc. of Data Processing Service Organizations Management Conference, Sheraton Ritz Hotel, Minneapolis, Minn.; contact Jerome L. Dreyer, Assoc. of Data Processing Service Organizations, Inc., 420 Lexington Ave., New York, N.Y. 10017.

June 19-20, 1969: Seventh Annual Conference of the Special Interest Group, Computer Personnel Research of the Association of Computing Machinery, Univ. of Chicago, Chicago, Ill.; contact Dr. Charles D. Lothridge, General Electric Co., 570 Lexington Ave., New York, N.Y. 10022

June 21-28, 1969: Second Conference on Management Science for Transportation, Transportation Center at Northwestern University, 1818 Hinman Ave., Evanston, Ill. 60204; contact Page Townsley, Asst. Dir., Management Programs, 1818 Hinman Ave., Evanston, Ill.

June 23-24, 1969: National Gaming Council Eighth Symposium, Sheraton-Elms Hotel, Excelsior Springs, Mo.; contact Dr. Richard L. Crawford, Booz, Allen Applied Research Inc., 911 Walnut St., Kansas City, Mo. 64114

June 30-July 1, 1969: ACM/IEEE/SHARE/SCi Conference on Applications of Continuous System Simulation Languages, Sheraton-Palace Hotel, San Francisco, Calif.; contact Robert Brennan, IBM Scientific Center, 2670 Hanover St., Palo Alto, Calif.

June 30-July 3, 1969: Institution of Electrical Engineers Conference on Computer Science and Technology, Univ. of Manchester Institute of Science and Technology, Manchester, England; contact Conference Secretariat, Institution of Electrical Engineers, Savoy Place, London, W.C.2, England.

Aug. 6-8, 1969: Joint Automatic Control Conference, Univ. of Colorado, Boulder, Colorado; contact unknown at this time.

Aug. 11-15, 1969: Australian Computer Society, Fourth Australian Computer Conference, Adelaide Univ., Adelaide, South Australia; contact Dr. G. W. Hill, Prog. Comm. Chrmn., A.C.C.69, C/-C.S.I.R.O., Computing Science Bldg., Univ. of Adelaide, Adelaide, S. Australia 5000.

Aug. 25-29, 1969: Datafair 69 Symposium, Manchester, England; contact the British Computer Society, 23 Dorset Sq., London, N.W. 1, England

Sept. 8-12, 1969: International Symposium on Man-Machine Systems, St. John's College, Cambridge, England; contact Robert C. McLane, G-MMS Meetings Chairman, Honeywell Inc., 2345 Walnut St., St. Paul, Minn. 55113

Sept. 28-Oct. 1, 1969: Association for Systems Management International (formerly Systems and Procedures Association) International Systems Meeting, New York Hilton Hotel, New York City, N.Y.; contact Richard L. Irwin, Association for Systems Management, 24587 Bagley Rd., Cleveland, Ohio 44138.

Oct. 1-5, 1969: American Society for Information Science, 32nd Annual Meeting, San Francisco Hilton Hotel, San Francisco, Calif.; contact Charles P. Bourne, Programming Services, Inc., 999 Commercial St., Palo Alto, Calif. 94303.

Oct. 6-10, 1969: Second International Congress on Project Planning by Network Analysis, INTERNET 1969, International Congress Centre RAI, Amsterdam, the Netherlands; contact Local Secretariat, c/o Holland Organizing Centre, 16 Lange Voorhout, The Hague, the Netherlands

Oct. 13-16, 1969: Association for Computing Machinery (ACM) Symposium on Data Communications, Calloway Gardens, Pine Mountain, Ga.; contact Edward Fuchs, Room 2C-518, Bell Telephone Laboratories, Inc., Holmdel, N. J. 07735; Walter J. Kosinski, Interactive Computing Corp., P.O. Box 447, Santa Ana, Calif. 92702

Oct. 15-17, 1969: IEEE Tenth Annual Symposium on Switching and Automata Theory, University of Waterloo, Waterloo, Ontario, Canada; contact Prof. J. A. Brzozowski, Dept. of Applied Analysis and Computer Science, University of Waterloo, Waterloo, Ontario, Canada

Oct. 22-24, 1969: IEEE 1969 Systems Science and Cybernetics Conference, Philadelphia, Pa.; contact C. Nelson Dorny, Moore School of Electrical Engineering, Univ. of Pa., Philadelphia, Pa. 19104.

Oct. 27-31, 1969: Business Equipment Manufacturers Assoc. (BEMA) Annual Business Equipment Exposition and Management Conference, New York Coliseum, Columbus Circle, New York, N.Y. 10023; contact Laurance C. Messick, Business Equipment Manufacturers Assoc., 235 East 42nd St., New York, N.Y. 10017

Oct. 30-31, 1969: Assoc. of Data Processing Service Organizations Management Conference, Regency Hyatt Hotel, Atlanta, Ga.; contact Jerome L. Dreyer, Assoc. of Data Processing Service Organizations, Inc., 420 Lexington Ave., New York, N.Y. 10017.

November 15-16, 1969: ACUTE (Accountants Computer Users Technical Exchange), Jack Tar, San Francisco, Calif.; contact ACUTE, 947 Old York Rd., Abington, Pa. 19001

Nov. 18-20, 1969: Fall Joint Computer Conference, Convention Hall, Las Vegas, Nev.; contact American Federation for Information Processing (AFIPS), 345 E. 47th St., New York, N.Y. 10017 □

PROBLEM CORNER

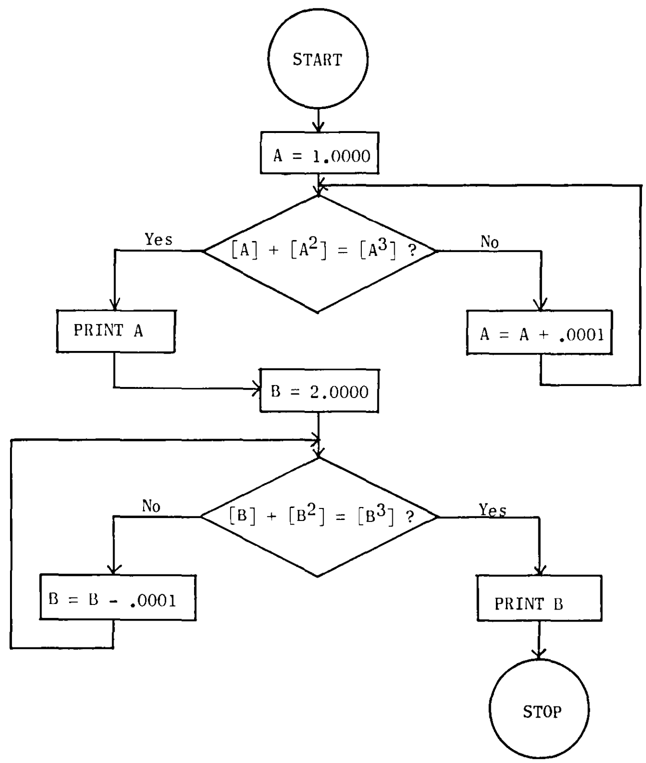
Walter Penney, CDP
Problem Editor
Computers and Automation

PROBLEM 693: HOMEWORK ON THE RANGE

"It's an interesting problem," said Al, straightening up from the flow chart he had been working on. "This may not be the best way to go about it, but it ought to get the answer — at least to four decimal places."

"What problem is this?", asked John.

"Well, it's part of the homework in our programming course. We have to find the range of N for which $[N] + [N^2] = [N^3]$, where [N] is the greatest integer in N. Here's how I'm going to go about solving it." He pointed to the flow chart.



"The required range of N will then be from A to B," Al went on.

John studied it a few moments. "It looks good, but I don't think it will do what you expect," he said.

"Why not? If I work up from 1, which is too small, I ought to hit the lower limit, and if I work down from 2, which is too large, I ought to hit the upper limit. Right?"

"Perhaps, but I think you're in for a disappointment."

What is wrong?

Solution to Problem 692: A Strain on the Brainware

The position of the item in I row, J column will be given by $N\ (I-1) + J - \frac{I\ (I-1)}{2}$. □

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

ACROSS THE EDITOR'S DESK

Computing and Data Processing Newsletter

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APPLICATIONS

WINTER'S DAMAGE TO ROADS IS UNDER COMPUTER STUDY BY ENGINEERS AT UNIV. OF ALASKA

Damage to roads, and other structures, caused by winter's repeated freezing and thawing of unstable soils is being investigated by engineers at the University of Alaska (College, Alaska). The transfer of heat in soils is a particular problem to Alaskan highways, airport runways, and underground utilities. The studies are aimed at reducing seasonal damage to highways and other structures in cold climates.

Engineers are using a special test apparatus to monitor soil samples. Every 12 seconds data about the effects of temperature, moisture content, and other factors, is automatically punched into IBM cards. This information is being used by the university's IBM System/360 Model 40 to create a mathematical model of the earth's crust to a depth of 75 feet. Using the computer in this way, engineers can simulate differing soil conditions and determine how they are affected by freezing and thawing.

Computer-assisted analysis to date indicates that a judicious use of styrofoam added to permanently frozen soils prior to paving would help stabilize road beds and prevent seasonal buckling and other damage. The studies may also lead to the agricultural development of areas where sub-surface soils remain permanently frozen throughout the year.

UTAH "JOB BANK" USES COMPUTER TO MATCH UNEMPLOYED PERSONS WITH WORK OPENINGS

A system of finding jobs for Utah workers through a computerized job bank recently was disclosed in a joint announcement by U.S. Secretary of Labor George P. Shultz and Governor Calvin L. Rampton. The automated job matching operation employs an RCA Spectra 70/45 computer-communications system. Utah was selected by the Federal Government for the job matching pilot project in 1966. Project costs are borne entirely by the Bureau of Employment Security in Washington.

Job matching works in the following manner. An employer with an opening phones an Employment Security Office. His specifications are transmitted from a Video Data Terminal over telephone lines to the central computer. Details on the Department's annual total of some 80,000 job-seekers are stored for match-ups in mass random access files, along with complete information on 50,000 nonfarm openings. The computer searches its files, in seconds, for persons whose job skills match the opening.

The same process occurs when a job-seeker registers. The file is searched to see if his qualifications can be matched to a vacancy. If not, they are stored electronically for later matches. If he secures the job, his name is removed from the rolls of the unemployed.

Information on job matches is transmitted over telephone circuits to high-speed terminal printers, located at the Salt Lake City and Ogden offices. The copy is then delivered to the Employment Security office and his client. Overall time to furnish a matching is only a few minutes.

ARCHITECTURAL FIRM IS USING A COMPUTER TO "TOUR" BUILDING STILL ON THE DRAWING BOARD.

Bradley and Bradley, Architects, Inc., Fort Wayne, Ind., a firm specializing in the design of commercial and industrial structures, is using an IBM 1130 computer linked to a plotter to take electronic "tours" of buildings still on the drawing boards. Design data fed into the computer yields a set of perspective drawings showing interior or exterior views of the proposed structure from virtually any angle.

To use the desk-sized 1130, a designer transfers sketch data onto punched cards for computer entry. The computer analyzes the data to determine dimensions and elevations and how the surfaces relate to form the building. To produce a drawing showing a proposed building from a particular angle, the designer enters a punched card into the system containing information on the viewing distance, angle of elevation and perspective desired in the graphic print-out. The plotter, activated by the computer, produces the drawing in one to ten minutes depending on the number of surfaces involved. If another view from a different angle is desired, the designer enters another card with the new specifications.

With their new method of evaluating tentative design plans, Bradley and Bradley architects are able to study substantially more design variations than would be possible using manual drafting methods. Carl Bradley, company president, said, "We can keep asking questions about what would happen if we change this dimension or that elevation and literally see the impact such changes would have on space relationships, structural stability and physical appearance. The cost of examining all of these possibilities through hand-drawn designs would be prohibitive."

COMPUTER-GUIDED RADIO TELESCOPE MAY PREDICT HARMFUL PROTON SHOWERS IN SPACE

Until the advent of travel beyond the earth's atmosphere, man had not traveled far enough into space to be seriously affected by proton showers — a form of high-intensity solar radiation. These showers sometimes follow large solar flares and present some of the same radiation hazards as found in a 100 megaton nuclear explosion. To reduce the chances of exposure to such showers, Dr. Edward Altshuler, chief of the Millimeter Wave Branch of the Air Force Cambridge Research Laboratories (AFCRL) in Waltham, Mass., is attempting to develop a technique for predicting when they will occur.

The technique employs a computer-directed antenna that scans the sun's surface. Using an IBM 1800, the radio antenna maps the temperature of the sun's surface at approximately 250 separate points each day. By measuring the intensity of the millimeter wave radiation emitted from the sun, regions from which solar flares may originate are identified. These areas of intense millimeter activity are then monitored. When their temperatures reach a critical point, there is then a high probability that proton showers will follow.

Ultimately, these data may be used to alert travelers in space of an impending proton shower. "If we have enough warning, say a minimum of six hours," Dr. Altshuler says, "we could bring a spacecraft down or take precautionary measures such as facing the ship's rocket engines toward the sun so they could act as a shield."

The system being used was developed for the Air Force by Logicon, Inc., a Los Angeles firm specializing in computerized control systems.

CONNECTICUT WELFARE WORKERS RECEIVE AID FROM COMPUTER

The Connecticut State Welfare Department (Hartford) has begun to use a computer to assist its case workers in meeting the needs of some 35,000 Public Assistance cases.

Typewriter-like terminals have been installed in field offices in the New Haven and Norwich Districts, linking them by communications lines to an IBM System/360 Model 50 at the state's data processing center in Hartford. When the system is fully implemented, the computer will maintain individual case records, receive and acknowledge recommendations from case workers, and answer specific queries for them. Gradually, all of the District Offices in the state will be included in the network.

The system's first main job is to speed the exchange of thousands of messages affecting individual welfare cases. These messages include address changes, changes in marital status or the number of children in a family, and other vital social data. Until now, the exchange of information between headquarters and the field was done by mail and telephone. With the computer system, case workers will spend less time on paperwork and concentrate on providing individual professional service to clients. Before visiting a client, the case worker may review the current data on the case by calling for a print-out of the record on the terminal.

To use the system, a terminal operator types a coded message on the keyboard of an IBM 2740 communications terminal. The computer automatically prints out its response on the terminal. Safeguards have been built into the system to insure that only authorized Welfare Department personnel have access to the confidential information stored in the computer.

As part of future planning, the department's computer may exchange data with computers in hospitals and insurance companies to aid in the handling of medical assistance claims. Persons receiving aid under the Connecticut welfare program include the aged, the blind, the disabled, dependent children, residents of boarding homes, and those who are eligible for medical aid only.

EDUCATION NEWS

TRAVELING FELLOWSHIPS ESTABLISHED BY THE THOMAS J. WATSON FOUNDATION

The Thomas J. Watson Foundation (Providence, R.I.) has announced establishment of a traveling fellowship program providing a year of independent study and travel abroad for 50 college graduates of outstanding promise. The Foundation was established in 1961 as a charitable trust by the late Mrs. Thomas J. Watson, Sr., in memory of her husband, the founder of IBM Corporation. The Watsons' daughters and sons decided to establish this traveling fellowship in view of their parents' long-standing interest in world affairs. Fellows will be chosen from among candidates nominated by 25 moderate-sized U.S. colleges and universities participating in the program. The grants will be awarded annually.

All students in their initial graduate year, regardless of their career plans, may take part in the program. Although over-all academic records and extracurricular activities will be taken into account, the principal selection criteria will be the individual's potential for leadership and excellence in his chosen field. The graduates selected will be able to devise their own programs of travel and study, and pursue them with considerable independence. They may choose to develop further their knowledge in previous fields of study or to explore new areas of interest. Fellowships will carry stipends of $6,000 for single students and $8,000 for those who are married.

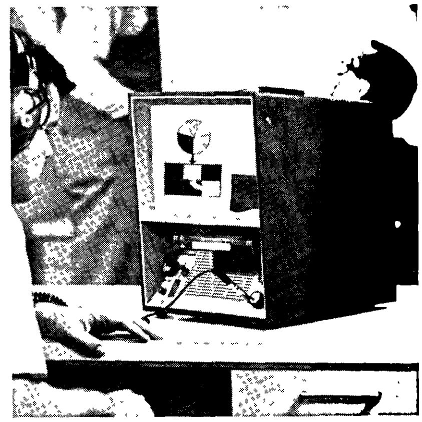
From approximately 100 nominees — four from each of the 25 participating colleges and universities — 50 winning Fellows will be announced this March. Colleges and universities participating in the program are: Amherst, Antioch, Bates, Bowdoin, Brandeis, Carleton, Colgate, Davidson, Dickinson, Grinnell, Hamilton, Johns Hopkins, Kenyon, Lawrence, Middlebury, Occidental, Oberlin, Pomona, Reed, Swarthmore, Trinity (Conn.), Tufts, Union, Wesleyan, and Williams.

ANIMATED COMPUTER EDUCATION OFFERED BY EDUTRONICS OF CALIF.

A filmed sequence on File Organization, Design and Processing is available from Edutronics of California, Inc., Costa Mesa, Calif. The sequence employs Animated Computer Education (ACE) and is the first of a planned series covering all positions and job functions in an EDP department.

ACE uses animation to depict computer system functions in proper time relationship, even when they happen simultaneously. Relationships are quickly grasped, concepts are fully understood. The addition of color and sound to animation reinforces its teaching power.

The system includes subject matter in film cartridges, daylight rear-projection viewer, hi-fi earphones, workbook materials, and Guidelines for Professional Development. Although designed primarily for programmer trainees and junior programmers, the sequence is also pertinent to management, systems analysis, and computer operators.



— Edutronics Education System

File Organization, Design and Processing, together with viewer, headset, and supplemental materials, is available on a lease basis. (For more information, designate #41 on the Reader Service Card.)

NAVAL ACADEMY MIDSHIPMEN NOW TAKING FOUR CREDIT COURSES FROM COMPUTER AT U.S. NAVAL ACADEMY

Working at a terminal, a U.S. Naval Academy midshipman studies one of four credit courses being taught at the U.S. Naval Academy (Annapolis, Md.) for the first time by computer. At the beginning of

the 1968 fall semester, an experimental IBM 1500 Instructional System, began teaching Russian, Thermodynamics, Physics and Fluid Dynamics to some 150 midshipmen. At the same time, hundreds of other midshipmen were receiving traditional classroom instruction in the same four subjects. The new system is serving as the basic research tool in the Academy's approach to computer-assisted instruction.

The central computer of the new system, an IBM 1800, automatically flashes information, study directions and questions on the TV-like terminal screens. It also operates slide projection units (center), presenting study material related to screen displays. Midshipmen respond to terminal instruction and questions by typing answers on the keyboard or by using a light pen (shown in student's hand).

The central computer keeps a running log of each student's terminal responses and use of media. Computer-generated reports of this information, immediately available at the end of each class session, allow USNA researchers to improve and refine the computer system's curriculum materials. "Our research objectives," said USNA Superintendent Rear Admiral James Calvert, "are to statistically prove howmuch CAI accelerates the learning process, and exactly where in the curriculum the technique is most effective."

The same four subjects now are being taught to a different and larger group of midshipmen during the 1969 spring semester. By 1972 Academy officials expect some form of CAI to be part of the normal curriculum for nearly 4,000 midshipmen.

SPECIAL COURSES FOR HOSPITALS DEVELOPED BY COMPUTER EDUCATION FIRM

Computer Environments Corporation, Hanover, N.H., has announced the availability to hospitals and other health care organizations of a special computer training course entitled "Hospital Business Systems". The course prepares graduates for lower and middle management positions in hospital business operations.

The "Hospital Business Systems" course balances background lectures with live problems in forms design, system flowcharting, computer programming and actual "hands-on" computer operation. The modular 200-plus hours of instruction makes it easy to adjust the program to specific needs of students who may have had some prior experience either in computer operations or hospital procedures.
(For more information, designate #42 on the Reader Service Card.)

COMPUTER COURSE USES PRE-RECORDED CASSETTES

Dynaphonics, Inc., Dayton, Ohio, is offering a tape-recorded course in the fundamentals of electronic data processing, designed for the businessman who wishes to learn computer basics and keep up with the data processing field. The course is designed to make businessmen conversant with more than 800 EDP terms ranging from common words like "software" to technical ones like "piezoelectric".

The course comes on pre-recorded tape cassettes which can be played on any standard cassette recorder. It is available in a bookshelf binder, and runs nine hours.
(For more information, designate #43 on the Reader Service Card.)

NEW PRODUCTS

Digital

HONEYWELL SERIES 16 LOW-COST TIME-SHARING SYSTEM / Honeywell Computer Control Division

Series 16 time-sharing system (H1648) from Honeywell Computer Control Division, Framingham, Mass., handles up to 48 simultaneous users for $12 per terminal per day, according to T. Paul Bothwell, division vice president and general manager. He said many users are paying a typical price of $100 per terminal per day in subscription charges for a similar functional capability.

Three processors are used in the Honeywell Series 16 time-sharing system: a communications processor (a DDP-416 computer with 4,096 words of core memory and full cycle time of .96 microseconds); a control processor (a DDP-516 computer with 32,768 words of memory): and a job processor (a DDP-516 computer with 32,768 words of memory).

The communications processor acts as a line handler; it receives information from the user's terminal and formats it for input to the other processors. Conversely, it transmits responses from these processors to the user's terminal. The control processor monitors all activity within the system. It controls the sequence in which requests are serviced, monitors the flow of input and output data and logs information on services provided for each user. The job processor performs job requests. It compiles programs and executes jobs under the direction of the control processor.

Total main memory provided by the three processors is 136,000 eight-bit bytes. Memory is allocated to users in a maximum unit of 16,000 words or 32,000 eight-bit bytes. Average response time at a user's terminal is three to five seconds. Two disk units are standard with the minimum configuration.

One is used for system storage; the other for up to 7.2 million eight-bit bytes of user storage. Two magnetic tape units for user file backup are provided with the minimum system.

A variety of computer languages are available, some that do not require that users be computer specialists. Applications packages are available covering business and statistical routines and engineering and scientific uses.
(For more information, designate #44 on the Reader Service Card.)

Digital-Analog

DIGITAL HYBRID EXPANSION PACKAGE / Honeywell Computer Control Division

A hybrid expansion package designed for TR-48 analog computer users has been announced by Honeywell's Computer Control Division in Framingham, Mass. The DDP-516/TR-48 hybrid system is designed for bio-medical analysis, teaching analog and digital computing techniques, process modeling, control system analysis and design and simulation of physical phenomena.

The new system provides a Honeywell DDP-516 computer, analog linkage and a hybrid software package. Honeywell will provide its standard DDP-516 training course to hybrid system customers together with a special hybrid course at no charge.
(For more information, designate #45 on the Reader Service Card.)

Special Purpose Systems

DIAGNOSTIC COMPUTER FOR MANUFACTURERS AND USERS / Digital Systems Corp.

A low-cost diagnostic computer, capable of determining in one to two seconds whether a logic card is functioning properly, has been announced by the Digital Systems Corp., Cleveland, Ohio. Suitable for both manufacturers and users, the new computer performs operations that previously have required machines costing up to 10 or 15 times more. The new Model III will test individual logic modules, individual IC's, logic cards containing either IC's or discrete components, cable assemblies, and complete rack systems. It also is useful in initial design of logic circuits, in debugging prototypes, and in production testing.

In operation, the Model III tests a logic circuit card against a punched tape that has been programmed to specify the input and output voltages of all the significant signals on the card. Tape is read at 450 characters per second, with an average of six characters being required per area being tested. Since about 75 tests are thus conducted per second, and an average logic card requires from 100 to 150 tests, a complete card is tested in 1 to 2 seconds. Optional features permit the Model III to be programmed directly by a small general purpose computer, without use of punched tape; the computer will aid in preparing the test program and also in isolating errors detected by checking.

Standard models of the device are primarily intended for testing TTL and DTL logic circuits with 64 pins or less. An optional interface package, which converts the computer to voltage levels other than zero and plus 5 volts, also permits testing of MOS and discrete logic cards.
(For more information, designate #46 on the Reader Service Card.)

"CREDITMASTER", A SYSTEM FOR AUTHORIZING CREDIT-CARDS / Digital Data Systems Corp.

Digital Data Systems Corp., Pennsauken, N.J., has announced a new credit-card authorizing system to help department stores eliminate losses from fraud and bad debt. The system meets credit verifying needs of retailers as small as those with just ten sales counters, up to big national chains with as many as 10,000 sales counters across a continent. The "Creditmaster" System consists of a sales-counter card reader about the size of a desk telephone, and a computerlike central processor and credit-office console.

Kenrick Stephenson, engineering vice president of the firm and developer of "Creditmaster" is shown examining the system's circuit board,

which contains 20 of the latest Texas Instruments micro-circuits. These devices take just a few millionths of a second to translate a 12-digit credit card number into an electronic signal. The signal initiates a search of numbers, stored in the memory, to determine whether the past record of the customer is regular enough to justify authorization of credit.

In operation, the clerk places a customer's credit card in her card reader, presses a series of buttons, and within one second the processor flashes signals (tiny lights on the card reader which are hidden from the customer's view) back to the clerk, indicating what the central processor has found.

With Digital Data System's equipment, the central processor can be programmed to permit customers with accounts in good standing to make purchases up to a much higher floor level than usual — perhaps $150 or more. (The floor limit is the arbitrary dollar figure set by the store for credit-card purchases without need for back-office approval, usually between $25 and $50.) For special purchases — for example, prescription drugs — the central processor can be programmed to authorize automatically even over-limit purchases for marginal accounts.

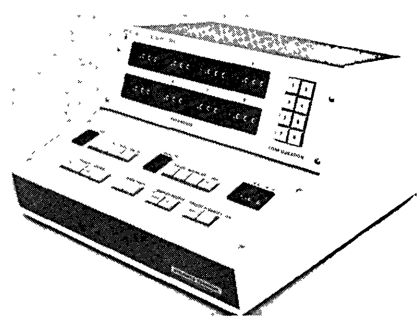
Cost for leasing Digital Data's "Creditmaster" system depends on the size of the store, the number of branches and sales counters to be covered, and the number of credit card accounts it has. The lease price includes training of sales personnel and all maintenance.
(For more information, designate #47 on the Reader Service Card.)

Teaching Devices

REMOTE TERMINAL FOR TIME-SHARING OF ANALOG/HYBRID COMPUTER / Applied Dynamics

The DYNAMICS TERMINAL, a compact, desk-top computer device, now makes possible the time-shared use of analog/hybrid computers. Developed by Applied Dynamics Inc. (Ann Arbor, Mich.), the DYNAMICS TERMINAL is said to obsolete the need for the numerous small analog computers previously required in teaching and training applications.

By equipping each student's desk with a DYNAMICS TERMINAL device, multiple station access is provided to a large central research computer, enabling a single instructor to present, monitor and demonstrate various problem solutions to groups of up to 64 students simultaneously. No formal training in analog, digital or hybrid programming is required for either student or instructor in order to utilize the TERMINAL concept.



While the individual TERMINALS "share" the large central computer on a sequential basis, their nearly instantaneous response time — up to 1000 time-shared solutions per second — is considerably faster than that of existing time-shared general purpose digital computers.
(For more information, designate #48 on the Reader Service Card.)

Memories

370 CORE MEMORY SYSTEM / Fabri-Tek Inc.

A new 370 Core Memory System, developed by Fabri-Tek Inc., Minneapolis, Minn., is the first in a family of modular, compact and expandable Fabri-Tek memory systems. The 370 Memory basic module sizes are 1K to 4K by 40 bits, with expansion capacities of up to 655,360 bits.

A basic 370 System offers three full-cycle memory speeds of 750 nanoseconds, 1 microsecond and 1.5 microsecond. Access times are 325 nanoseconds, 350 nanoseconds and 400 nanoseconds, respectively. The following modes are standard: full cycle, half cycle, and split cycle. All sub-assemblies, including stacks, are pluggable. Inter-face circuits are compatible with a wide range of interface logic levels. A wide range of options are available for the 370 Memory.
(For more information, designate #49 on the Reader Service Card.)

TWO FASTER VERSIONS OF IBM 2314 / IBM Corporation

IBM Corporation, White Plains, N.Y., has announced two new versions of the IBM 2314 direct access storage facility — each with an average access time 20% faster than the one model previously available. One of the new disk storage models, with five independent disk units, has a storage capacity of 145.8-million bytes; the larger new disk storage model, with eight disk units, has a capacity of 233.4-million bytes.

The new 2314 versions include their own control units and are designed for use with System/360 Models 30, 40, 50, 65, 67, 75 and 85. Average access time is 60 milliseconds; minimum access time is 25 milliseconds. Existing programming and data formatting for the 2314 (first announced in November 1966) can be used with the new versions. First customer shipments for both new versions are scheduled for the third quarter of this year.
(For more information, designate #50 on the Reader Service Card.)

Software

ACCOUNTS PAYABLE SYSTEM / Delta Data Systems Inc., College Park, Md. / Designed for use by a single or multi-divisional company, the system produces seven accounts payable reports and prints the required checks. The system has been developed for use on an IBM System/360 system; the eleven programs comprising the system have been written in COBOL.
(For more information, designate #51 on the Reader Service Card.)

AUTOMATED SAVINGS AND LOAN SYSTEM / The Dikewood Corp., Albuquerque, N.M. / The system provides extensive and complete analytical reports and meets all savings and loan requirements of the Federal Reserve Board. It is divided into two parts, Part I: Savings Accounts, and Part II: Loan Accounts, which are availalbe as separate units. Based on daily updating of individual accounts, the system can be tailored to run on most medium-scale computers. Complete documentation and training programs are available.
(For more information, designate #52 on the Reader Service Card.)

BOSS (Business Oriented Software System) / Information Control Systems, Inc., Ann Arbor, Mich. / A two pass assembler designed for use by the business community with any of the DEC PDP family of 8 computers. BOSS was developed for ease in programming business oriented applications such as: payroll, general ledger, accounts receivable and payable, etc. A basic knowledge of everyday arithmetic is all the user needs to program this language.
(For more information, designate #53 on the Reader Service Card.)

CADIC (Computer-Aided Design of Integrated Circuits) / Norden division of United Aircraft, Norwalk, Conn. / Offered to the electronics industry, CADIC has been successfully applied to the design of complex microcircuitry. Circuit layout is performed by automatic computer programs, subject to the human review and modification. It produces automatic preparation of initial layout, and, after revisions by the designer, generates final plots of mask patterns. Norden said it can provide CADIC program tapes and associated instructions, for installations at customer facilities, or will operate the system for a customer at its own computer laboratory.
(For more information, designate #54 on the Reader Service Card.)

CURFIT / Optimization Associates, Inc., Pittsburg, Pa. / A general purpose non-linear curve fitting program (CURFIT) which broadens the choice of functions to which data can be fitted. The program will fit sets of data points with non-linear combinations of elementary or higher functions. The method utilizes the General Orthonormal Optimization Procedure (GOOP) and the fit can be computed according to any even L^p norm. A version of the program capable of handling functions of several variables also is available. CURFIT is available as an object program ready for installation on the user's computer at $2500 plus an installation charge, or as a source program in FORTRAN or ALGOL at $8500. Mathematical descriptions of the program as well as usage manuals are provided.
(For more information, designate #55 on the Reader Service Card.)

DISPLAYALL / Informatics Inc., Sherman Oaks, Calif. / A proprietary software package designed to reduce the time required to develop on-line application programs for IBM 2250/2260 display terminals. The package consists of a display generation and checking program; a multi-console executive routine; higher order display programming statements; and application interfacing utilities. DISPLAYALL operates under OS/360 and may be used with Assembler Language and FORTRAN IV. The price is $9500 installed.
(For more information, designate #56 on the Reader Service Card.)

EASYTRIEVE/300 / Management Science Systems, Rockville, Md. / A proprietary information retrieval and reporting program available for the IBM System/360, RCA Spectra 70, and IBM 1401 computers. Information is extracted from magnetic tape files and reports are generated in standard or user-defined formats. The program has special capabilities for accounting and statistical reporting, mailing label generation, and data file editing. Queries are written in a free-form English-like control language that is designed expressly for use by personnel with little or no computer background. EASYTRIEVE will be leased for $4800, which includes installation, indoctrination seminar, users manual, and maintenance warranty.
(For more information, designate #57 on the Reader Service Card.)

QUICK-DRAW / The National Cash Register Co., Dayton, Ohio / A documentation system which automatically produces computer-prepared flowcharts and related cross-reference listings. The program source language statements just as originally prepared for the compiler are used as input. Quick-Draw generates documents for AUTOCODER, BAL, PL/I, COBOL, FORTRAN, and other languages, and is available for most manufacturers' hardware.
(For more information, designate #58 on the Reader Service Card.)

REAL TIME COBOL / Martenson Associates, Park Forest, Ill. / System provides for the administration of remote terminal devices such as the IBM 2260 and the IBM 2740. Any existing file organization can be used; records and data may be retrieved, displayed, updated, or otherwise controlled using COBOL. The program requires an IBM System/360 Model 40 with 128K

using DOS. Remote terminals can be simulated.
(For more information, designate #59 on the Reader Service Card.)

SCORE / Atlantic Software Inc., Philadelphia, Pa. / An information management system which can be used as: an information retrieval system; an automatic report generator; an automatic COBOL generator; a conversion tool; a file creation utility; and a debugging aid. Input to SCORE is in the form of elementary English statement parameter cards. SCORE is available for IBM System/360, Honeywell 200, RCA Spectra 70, or any other system with a COBOL compiler.
(For more information, designate #60 on the Reader Service Card.)

Peripheral Equipment

ACOUSTIC/MAGNETIC COUPLERS / Direct Access Computing Corp.

A new line of acoustic/magnetic couplers, designated Telemate "300," has been announced by the Communications Equipment Group of Direct Access Computing Corp., Southfield, Mich. The coupler connects a conventional telephone to a remote input/output terminal device.

Telemate "300" measures 3½ x 10 x 10½ inches and weighs 5½ pounds. Other specifications include: a 300 Baud data rate; carrier and power on/off signal indicator lights; half & full duplex switch; acoustic isolation — minimum of 20 db; and teletype on EIA interface. Options include a carrying case, originate/answer capability, a loudspeaker, and several different cable interface connections.
(For more information, designate #61 on the Reader Service Card.)

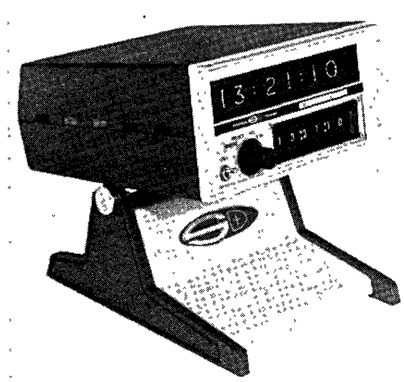
DATA ENTRY STATION / Datanetics Corp.

A new keyboard device for transmitting highly formatted information has been developed by DataNetics Corp., Redondo Beach, Calif. Called the Model 33 DataNetics "Secretarial Terminal," it operates into a Bell System Data Set 402C. The keyboard will transmit data up to 75 characters per second, which is the top capability of the 402C Data Set.

DataNetics Model 33 has a fully buffered keyboard with an 8-bit ASCII code output. Another eleven special function codes are available. A special key converts the terminal into a KEYPUNCH numeric format.
(For more information, designate #64 on the Reader Service Card.)

DIGITAL CLOCK / Systron-Donner Corporation

Systron-Donner Corp., Concord, Calif., has announced a 24-hour Digital Clock, the Model 8210, especially useful in Data Acquisition Systems, where time of day must be recorded along with the measurement of other physical variables.



The 6-digit, in-line readout presents time to 23 hours, 59 minutes and 59 seconds. The time base is optional with power line frequency or built in crystal references. An in-line preset system allows a variable starting time and as an option can be used to provide a preset alarm signal out-put. All time information is provided as parallel BCD outputs for use with printers or data processing equipment.

The device may be mounted in racks, on benches, desk tops, or tilt-mounted high above the bench area.
(For more information, designate #63 on the Reader Service Card.)

OPTICAL SCANNER WITH COMPUTER INTERFACE / General Atronics Corporation

Through the use of a new ACCU-SORT optical scanner with computer interface, the volume manufacturer can have instant inventory plus product counting, sorting and diverting. The system, developed and manufactured by the Industrial Division of General Atronics Corp., Philadelphia, Pa., consists of an ACCU-SORT scanning head and electronic code reader plus a special data processing interface device.

On-line data collected by the system can be stored on paper or magnetic tape, punched into cards, or fed directly into a computer. ACCU-SORT with data processing interface can transmit product data to a computer in a central control room, another plant, or to a time-shared facility many miles away. The system is applicable to any high volume multi-plant or multi-product manufacturer handling a product mix or a variety of types, sizes, colors, flavors, etc.
(For more information, designate #62 on the Reader Service Card.)

ACOUSTIC DATA SET / ComData Corporation

ComData Corporation (Niles, Ill.) has announced a new Series 301 acoustic data set. The new coupler, usually associated with computer time-sharing, satisfies the requirements of "Acoustical Coupling for Data Transmission" issued in November, 1968 by AT&T.

Flexibility of options provides operation with practically any terminal device including all of Teletype Corporation's Model 28, 33, 35 and 37's, IBM 1050, 2740, 2741 and 2260, Datel, Friden 7100 and 7102, and Kleinschmidt. Optional arrangements provide: half/full duplex; originate/answer; and teletypewriter/EAI RS-232 interface.

The Series 301 Data Sets may be used with the Bell System Series 101 and 103 or equivalent Data Sets, or they may be used to transmit data from one unit to another via the dial-up telephone network.
(For more information, designate #66 on the Reader Service Card.)

ANALOG I/O SYSTEM / General Automation, Inc.

A modular analog I/O system has been announced by General Automation, Inc., Orange, Calif. The system, which ties into General Automation's SPC-12 and -8 computers, accepts up to 512 input channels of analog data from analytical instruments and sensors. After the computer has processed the data, it is outputted through up to 256 analog channels for driving displays, recorders, etc. The system operates at a 3.3 microseconds per bit conversion rate and provides 12 bits of resolution.

The analog system interface devices — ASIU's — include an analog input/output unit, a 16-channel per card multiplexers, an 8-channel per card differential multiplexers, and an 8-channel per card output analog storage unit.
(For more information, designate #68 on the Reader Service Card.)

KEYBOARD DISPLAY TERMINAL / Digital Equipment Corp.

A keyboard display terminal, the VT03, has been added to the PDP-10 product line by Digital Equipment Corp., Maynard, Mass. The terminal, designed for the interactive time-sharing environment, provides quicker response than is possible with teletypewriter devices.

The VT03 display console operates similarly to a conventional teleprinter and incorporates "carriage return" and "line feed" characters for position control. It accepts data at the rate of 1200 baud as compared to a teleprinter rate of 110 baud. The terminal displays up to 960 characters arranged in 12 rows of 80 characters each.

The display terminal has an alphanumeric keyboard, editing capability from the keyboard or computer, audible end-of-line and incoming message tones and plug-in boards for easy maintenance. An interface option is available which allows the user to generate hard copy remotely via standard teletype devices.
(For more information, designate #67 on the Reader Service Card.)

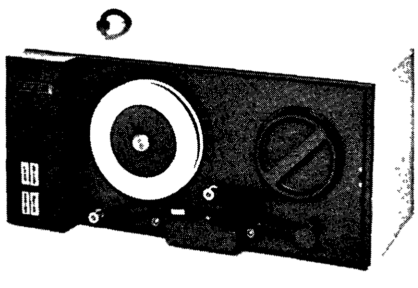
PORTABLE DATA COUPLER / Data Communications Systems, Inc.

DAC Model 327 Portable Data Coupler from Data Communications Systems, Inc. (Minneapolis, Minn.) is designed for the time-sharing industry and specifically for the OEM and quantity user market. The Coupler can connect a data terminal via any convenient telephone handset to a time-sharing computer. Various models of Teletypes, and terminals with an EAI communications interface, are compatible with the coupler.

The Model 327 is available for Originate only mode of operation. Standard features are half and full duplex operation, and a "Carrier-On" Indicating Light. An optional Circuit Monitor Speaker is also available.
(For more information, designate #69 on the Reader Service Card.)

MAGNETIC TAPE TRANSPORT FOR SMALL COMPUTERS / Peripheral Equipment Corp.

Peripheral Equipment Corporation of Chatsworth, Calif., has announced a low-cost, digital magnetic tape transport especially designed for small digital computer and data communication terminal applications.



The PEC Model 7820 is an IBM compatible, 9 track, 12.5 ips, 800 bpi write/read tape transport, to provide data transfer rates of 10KHz. Available options include a 7 track operation and an erase head.

The PEC Model 7820 employs a single capstan velocity servo system which eliminates the pinch roller. The 7820 requires only 8-3/4 inches of standard 19" rack height. It uses 7-inch reels, capable of storing 600 feet of magnetic tape.
(For more information, designate #65 on the Reader Service Card.)

Data Processing Accessories

ELECTRONIC SYSTEM FOR DRYING OF COMPUTER CARDS / Radio Frequency Co., Inc.

Radio Frequency Co., Inc., of Medfield, Mass., manufacturers of MACROWAVE heaters, have developed an electronic system for rapid drying of computer cards. The system is already in use at utility companies where meter cards collected are damp or wet due to weather and must be dried before being fed into computers. The need for hand transferring meter information to dry cards, or the slow process of spreading cards to dry at room temperature, is eliminated with the RFC system.

The RFC Model 3000-ECD heating cycles average 1/10th second for each computer card when fed in 500 lots. A high frequency tuner provides exact control of dryer power. The press section is complete with air controls, exhaust and safety switches. The electronic drying system is completely automatic and requires floor space of only 20" x 30".
(For more information, designate #70 on the Reader Service Card.)

BULK ERASER FOR MAGNETIC TAPE / Ferranti Electric Inc.

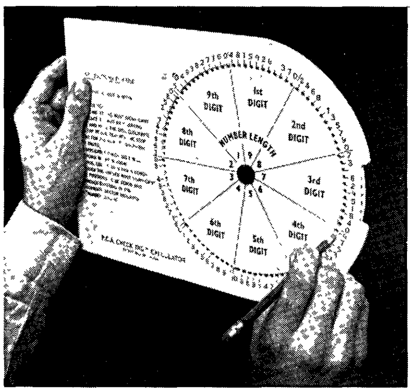
The Ferranti Weircliffe Bulk Eraser Model #9 is designed to accommodate fully loaded magnetic tape reels with dimensions up to 1-3/8" x 16". The new Model #9, introduced by Ferranti Electric, Inc., Plainview, N.Y., can erase tapes used in recording studios, radio stations, data processing fields and research laboratories.

The Model #9, a static instrument without electrical moving parts, and free from the need for adjustment or service, is capable of erasing saturated tapes at the rate of up to 100 reels per hour. All recorded data, audio pulses, or any

kind of signal from DC to video is efficiently erased to better than 80 decibels below saturation recording level.
(For more information, designate #71 on the Reader Service Card.)

PATENT CHECK-DIGIT CALCULATOR / Punched Card Accessories, Ltd.

The PCA Patent Check Digit Calculator provides the computer programmer with a rapid and inexpensive means of determining check digits for numbers up to nine digits in length. Made like a large circular slide-rule, the Check Digit Calculator is large (12" x 9"), and has large, easily-read figures. When each digit within a number is selected by pencil point, and advanced to the next "stop" position, the resulting Check Digit appears in a window.



Standard Moduli are available as follows for numbers up to nine digits in length: Modulus 11, weights 3, 6, 8, 5, 7, 10, 2, 4, 9; Modulus 12 S/W, weights 10, 9, 8, 7, 6, 5, 4, 3, 2; and Modulus 10, weights 1, 3, 7, 1, 3, 7, 1, 3, 7. Calculators with other moduli or weight arrangements may be obtained on special order. They are made in England by Punched Card Accessories, Ltd., and distributed in the United States by Jay Smith, Inc. of Westport, Conn.
(For more information, designate #72 on the Reader Service Card.)

COMPUTING/TIME-SHARING CENTERS

HONEYWELL OPENING SEVEN COMPUTER TIME-SHARING CENTERS IN 1969

Honeywell Inc. (Minneapolis, Minn.) has announced plans to offer computer time-sharing service in seven major U.S. cities by the end of 1969. The service will be aimed initially at scientific and engineering problem-solving organizations within industry, government and education. Later, service will be expanded to include small businesses that wish to computerize their operations.

Each regional center will be equipped with a Honeywell 1648 time-sharing system (see New Products). The first of the new time-sharing centers opened in Minneapolis in January. The six other Honeywell time-sharing centers will be located in: Boston and Chicago (February), New York and Cleveland (April), Los Angeles (July), and San Francisco (November).

PROJECT ACCESS — A REGIONAL COMPUTING SERVICE FOR NINE SCHOOL DISTRICTS IN IOWA

ACCESS (Area Cooperative Computer Educational Systems Services) in Des Moines, Iowa, utilizes an IBM System/360 Model 30 to process data for 58 elementary and secondary school districts in nine Iowa counties — with a total public school enrollment of more than 115,000 and a private and parochial school enrollment of nearly 10,000. Project Director K. W. Miller said the service puts electronic data processing within the reach of any school in the state.

As many as five services — class scheduling, grade and attendance reporting, test scoring, payroll accounting and student census — are available to the schools. Each participating school compiles basic information and delivers it to the computer center where it is processed and returned to the school within a few hours.

In Polk County, the Model 30 also is used as an educational tool. Students from the five Des Moines high schools have joined computer clubs — where they learn FORTRAN programming, and then on Saturday have scheduled time to run those programs on the computer. At Des Moines Tech, students enrolled in courses to train programmers have the added advantage of the availability of a 1050 typewriter terminal and accompanying card reader for transmitting, compiling and testing their own programs over the telephone lines to the computer at ACCESS.

Project ACCESS is helping serve the schools in Iowa more efficiently and economically than would otherwise be possible. Mr. Miller said, "We believe that a regional computer center such as ours is the best solution. Project ACCESS makes data processing facilities available to schools as needed and at a price they can afford."

PROGRAMS & ANALYSIS INC. PUTS TIME-SHARING IN REACH OF SMALLER BUSINESSES

Programs & Analysis, Inc., Waltham, Mass., is now providing small and medium-sized companies with all basic "hardware" services covering accounting, management and financial procedures; full programming specifically tailored to the individual company's needs; and all related personnel training.

A teletypewriter in a firm's office is connected over standard telephone lines to a GE-420 computer system at Programs & Analysis. After first "calling the computer" over the standard telephone equipment, the operator teletypes requests for data. (Current data of interest to the company have been previously collected and stored in the computer system for later processing.) Within seconds, data is printed on the teletype sheet. Each company runs its own operation.

MISCELLANY

COMPUTER HEAT WARMS EDP FIRM

Although readily controllable through cooling units, heat, generated by a computer's densely-packed wires and speeding electric circuits, has been considered an unwanted side effect of computer operations. One computer user, however, has turned this 'liability' into an asset expected to save from $2,500 to $4,000 a year in heating bills.

Computer Management Consultants Inc. has made heat generated by its Honeywell Model 200 computer an integral part of the heating system of the corporation's new 6,500-square-foot building in the Chicago, Illinois suburb of Skokie. In the CMC system, heat is pulled off the computer and pumped into the rest of the building by fans through overhead ducts. The installation is controlled by Honeywell thermostats.

CMC's resident engineers designed the system which augments the computer's heat with that put out by the building's lights, by the bodies of the corporation's 70 employees and by four electric coils placed strategically throughout the building. The Honeywell controls keep the temperature at 72 degrees during the working day.

The $2,500 to $4,000 heat bill savings was predicted by the contractor for the one-story building on the basis of the corporation's present 12-hour-a-day, 6-day week computer operation. He said the savings would go up when CMC's computer goes to a round-the-clock, 7-day week next year.

CMC offers a variety of technical services to clients including a computer service bureau, systems design and programming, new product development and operations research.

ORGANIZATION NEWS

HONEYWELL LEASE PLAN FOR PATIENT-MONITORING UNITS WILL AID HOSPITALS

A leasing plan designed to help hospitals eliminate large capital outlays for electronic patient monitoring systems for coronary and intensive care facilities, has been announced by Honeywell's Test Instruments Division, Denver, Colo. These systems include monitoring and alarm circuitry intended for use at the patient's bedside for detection and remote display of critical condition changes. The new plan is patterned after the successful buy-or-lease program initiated by the computer industry several years ago. An important option of the Honeywell "lease-on-life" plan, permits the hospital to apply a "considerable portion" of the lease payments toward later purchase of a system.

A typical four-bed Honeywell system includes four bedside units and a central station; cost is approximately $16,000. Under the "lease-on-life" plan, a typical system would lease for about $5.50 per bed per day under average use conditions according to Alan B. Dallas, division marketing vice president. Basic monthly charges and hourly rates would vary depending on the size and use of the system involved. Higher system usage would result in proportionately lower hourly rates. In all cases, the basic rental fee includes connection of the patient monitoring system to the "in-the-wall" wiring, start-up, on-site instruction of nursing and other personnel, quarterly preventive maintenance and emergency servicing.

The American Hospital Association said recently that more than 50,000 heart fatalities could be prevented each year if more hospitals had coronary care units. Such facilities, Honeywell said, would be equipped with patient monitoring equipment. Only an estimated 15% of U.S. hospitals now have such coronary care units.

COM-SHARE, INC. TO EXTEND TIME-SHARING SERVICES INTO CANADA UNDER AGREEMENT WITH COMPUTER SHARING OF CANADA

Com-Share, Inc., of Ann Arbor, Mich., a national time-sharing computer service firm, has announced that it will extend its time-sharing services into Canada under a technical service agreement with Computer Sharing of Canada (CSC). The agreement extends Com-Share services throughout North America.

Under the terms of the agreement, the Toronto-based firm will be considered the sole distributor of Com-Share's standard commercial services in Canada. CSC customers will have access to the Com-Share system through communications equipment and transmission lines maintained by Com-Share. CSC will install and maintain standard remote-terminal equipment approved by Com-Share.

Under terms of the agreement, Com-Share holds an equity position in CSC and receives appropriate reimbursement for its services to the firm. CSC presently has offices in Toronto and plans to open offices in Montreal and Ottawa.

COMPUTICKET SELLS RIGHTS TO INTERNATIONAL PUBL'G CORP. FOR ITS TICKET SALES SYSTEM IN UNITED KINGDOM AND EUROPE

Computicket Corp., Los Angeles, Calif., has concluded an agreement with International Publishing Corporation, Ltd., for the sale of rights to its computerized ticket sales system for the United Kingdom and Europe. The London based company, one of the world's largest publishing enterprises, has also purchased Computicket's remote electronic ticket printing terminals for its overseas network. A subsidiary of IPC, International Data Highways, will operate the system. Computicket will provide continuing technical support.

The arrangement between Computicket (a subsidiary of Computer Sciences Corporation) and IPC provides for a special trans-atlantic cable connection which will permit international ticket purchases via computers. A person in the United States will be able to purchase seats to European sports and entertainment events through the Computicket system prior to leaving the country, with the reverse being true for those in Europe.

Computicket began operations in Los Angeles in September 1968 and now sells tickets to a variety of local sports and theatrical events as well as tickets to fifteen Broadway shows. The company begins service in New York in early spring.

NEW COMPANIES

COMPUTER CONVERSIONS, INC., Jenkintown, Pa. / Specialize in services covering all phases of computer conversions.

CYBERCOM CORP., Sunnyvale, Calif. / Produce and market computer terminal and peripheral systems.

DATA MEMORY, INC., Mountain View, Calif. / Produce and market full line of magnetic disc recording systems.

MICRO SYSTEMS, Inc., Santa Ana, Calif. / Produce series of high-speed general purpose computers in $5000-$10,000 price range.

TEMPO COMPUTERS, INC., Orange, Calif. / Produce data processing equipment and application solutions for commercial and industrial markets; first product, an integrated circuit, general purpose computer system with a 4,096 word memory.

ACQUISITIONS

COMPUTER AGE INDUSTRIES, INC., Fairfax, Va., specializing in computer education, has acquired BELL EDUCATIONAL SERVICES, INC., Washington D.C., which provides professional assistance in program planning and development to educational institutions as well as educational subsidiaries of business and industry.

COMPUTER COUNSELING, INC., Baltimore, Md., a firm offering computerized college-selection, has acquired SCHOOL AND COLLEGE ADVISORY CENTER, New York, N.Y., a professional guidance organization.

COMPUTING AND SOFTWARE, INC., Panorama City, Calif., engaged in software development, computing centers and technical training, has acquired RETAIL MERCHANTS CREDIT ASSOCIATION OF LOS ANGELES, a credit reporting company.

MODERN DATA TECHNIQUES, INC., Madison, N.J., a computer software company and franchisor of computer systems, has acquired CENTRAL JERSEY DATA PROCESSING, INC., a privately held, Jamesburg, N.J. computer service company.

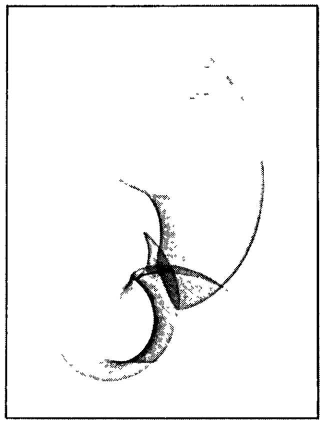
FINANCIAL AND BUSINESS NEWS

Box Score of Sales & Income for Computer Field Firms

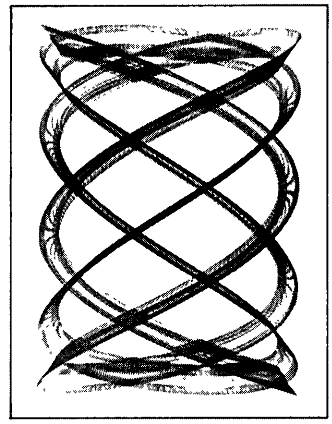
C&A presents below comparative operating results
for firms of interest to computer people, as distilled from the latest group of news releases.

COMPANY	PERIOD	SALES Current Period Previous Period	(%)	NET INCOME Current Period Previous Period	(%)	NOTES
Burroughs Corp., Detroit, Mich.	Year ended December 1968	$655,560,000 $553,886,000	(+18%)	$43,301,000 $34,830,000	(+24%)	Figures are for worldwide operations. Estimated U.S. and foreign '68 taxes, $45,690,000; compares with '67 taxes of $29,310,000
Canoga Electronics Corp., Los Angeles, Calif.	Year ended October 31, 1968	$14,500,000 $10,300,000	(+40.8%)	$410,000 $737,000	(-44.8%)	Heavy product development investments, a factor in lower '68 earnings
Cognitronics Corp., Mt. Kisco, N.Y.	Year ended December 31, 1968	$1,827,746 $505,569	(+63.7%)	$66,893 (Loss) $270,597 (Loss)		
Computer Applications Inc., New York, N.Y.	Year ended September 30, 1968	$42,831,000 $36,281,000	(+18.1%)	$578,000 $856,000	(-32.5%)	Expansion, reorganization of company's software segment contributed to lower '68 income
Computer Environments Corp., Hanover, N.H.	Year ended October 31, 1968	$1,045,119 $715,157	(+46.4%)	$74,950 $42,197	(+77.6%)	CEC planning national expansion through its Franchise Division
Computer Industries, Inc., Dallas, Texas	Year ended December 1968	$11,227,000		$930,000		Firm, a subsidiary of University Computing Company, was formed late '67
Computer Usage Company, Inc., Mt. Kisco, N.Y.	Year ended September 30, 1968	$13,608,996 $13,257,898	(+2.6%)	$485,041 (Loss) $603,335		Operating losses of subsidiaries, a factor in income loss
Computing and Software, Inc., Panorama City, Calif.	Year ended October 31, 1968	$33,651,000 $27,946,000	(+20.4%)	$1,877,000 $1,313,000	(+43%)	
Continental Computer Associates, Inc., Wyncote, Pa.	Year ended September 30, 1968	$3,301,060 $2,186,231	(+51%)	$272,620 $158,800	(+72%)	
Honeywell Inc., Minneapolis, Minn.	Year ended December 31, 1968	$1,281,000,000 $1,045,000,000	(+22.6%)	$50,500,000 $42,300,000	(+19.6%)	
IBM Corporation, Armonk, N.Y.	Year ended December 31, 1968	$6,888,549,209 $5,345,290,993	(+28.9%)	$871,497,991 $651,499,588	(+33%)	High level of outright sales of dp equipment to independent computer leasing companies is a factor in income growth rate
International Computing Service, Inc. Miami, Fla.	Year ended October 31, 1968	$531,249 $290,542	(+82.8%)	$78,526 $49,212 (Loss)		
Leasco Data Processing Equipment Corp. Great Neck, N.Y.	Year ended September 30, 1968	$47,083,000 $29,285,000	(+60.8%)	$26,861,000 $22,058,000	(+21.8%)	
Management Assistance Inc. (MAI), New York, N.Y.	Year ended September 30, 1968	$66,885,000 $63,985,000	(+4.5%)	$19,995,000 (Loss) $1,589,000 (Loss)		Extraordinary charge — provision for data processing equipment off rent ($17,000,000) is included in '68 income figure
Maxon Electronics Corp., Great River, L.I., N.Y.	Year ended September 30, 1968	$52,256,011 $66,584,097	(-21.5%)	$1,687,411 $1,516,357	(+11.3%)	
Memorex Corporation, Santa Clara, Calif.	Year ended December 1968	$58,300,000 $34,200,000	(+70.5%)	$4,900,000 $3,600,000	(+27%)	
Moore Business Forms, Inc., Niagara Falls, N.Y.	Year ended December 1968	$341,300,000 $306,700,000	(+11.3%)	$30,900,000 $29,400,000	(+5.2%)	
Randolph Computer Corp., New York, N.Y.	Year ended December 1968	$30,976,000 $15,584,000	(+99%)	$3,950,000 $1,820,000	(+117%)	
Recognition Equipment Inc., Dallas, Texas	Year ended October 31, 1968	$13,500,000 $4,000,000	(+235%)	$2,100,000 (Loss) $3,600,000 (Loss)		Fiscal '69 expected to be first year of profitable operation as per financial plan announced in '65
Scientific Data Systems, Inc., Los Angeles, Calif.	Year ended December 31, 1968	$100,600,000 $71,796,000	(+40%)	$10,050,000 $6,929,000	(+45%)	
URS Systems Corp., San Mateo, Calif.	Year ended October 31, 1968	$12,300,000 $7,700,000	(+62%)	$729,913 $297,883	(+115%)	
Xerox Corporation, Rochester, N.Y.	Year ended December 31, 1968	$896,357,472 $738,853,063	(+21.3%)	$116,194,187 $99,951,769	(+16.3%)	

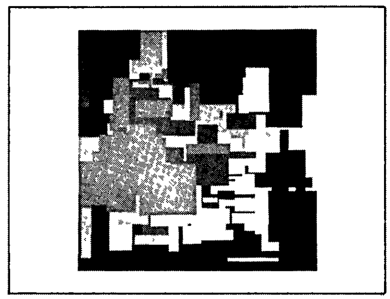
HUMMINGBIRD



INSPIRALATION



PLEXUS



IDEALIZED BRUSH STROKES

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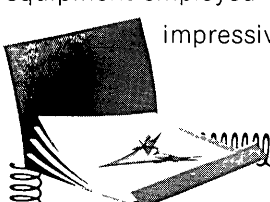

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NEW CONTRACTS

TO	FROM	FOR	AMOUNT
Scientific Data Systems, El Segundo, Calif.	Leasco Systems and Research Corp. (a subsidiary of Leasco Data Processing Equipment Corp.), Bethesda, Md.	SDS computers for use in a world-wide time-sharing newtork offering a wide variety of time-sharing services; first system delivery scheduled for April '69	$40 million
Computer Sciences Corp., Los Angeles, Calif.	U.S. Navy Naval Undersea Warfare Center (NUWC), Pasadena, Calif.	Analysis and programming of scientific and business applications, and operation of NUWC Pasadena computer facility	$4.8 million (3-year period)
Burroughs Corp., Paoli, Pa.	U.S. Post Office Dept., Washington, D.C.	Purchase of 39 letter sorting machines, including allied training equipment, for use in 36 cities; installation during 1970	$3.9 million
Technical Operations, Inc., Burlington, Mass.	U.S. Army Combat Developments Command	Extended performance through December 31, 1969; continues scientific studies and operations research in areas such as war gaming, weapons evaluation, cost effectiveness	$3.5 million
General Dynamics, Electronics Div., Rochester, N.Y.	NASA's Goddard Space Flight Center	Four multifunction receivers (MFRs) for NASA's global Space Tracking and Data Acquisition Network known as STADAN	$2 million (approximate)
Bryant Computer Products, Walled Lake, Mich.	Com-Share Inc., Ann Arbor, Mich.	Four Disc File systems with interfacing controllers; Com-Share will interface them with their SDS-940 computer systems for program storage, in N.J. and in Mich.	$1.4 million
Lear Siegler, In-., Santa Monica, Calif.	Lockheed-California Co.	Initial production of advanced automatic flight control systems for the P-3C anti-submarine patrol aircraft	$1.3 million
Computer Industries, Inc., Dallas, Texas	Lockheed Missiles and Space Co., a division of Lockheed Aircraft Corp.	COPE .45 (Communications Oriented Processing Equipment) terminal systems	$1+ million
Data Products Corp., Culver City, Calif.	Digital Logic Corp., Anaheim, Calif.	Model 400 LINE/PRINTERS and SR-400 punched card readers	$1+ million
Dynamics Research Corp., Components Div., Stoneham, Mass.	Perkin-Elmer Corporation	Fabrication and testing of optical shaft encoders	$1+ million
Scientific Control Corp., Dallas, Texas	Recognition Equipment Inc.	SCC's Model 655R computers to be used in Recognition Equipment's optical character recognition system	$1 million
	Universal Systems, Inc., Washington, D.C.	Ten SCC Model 4700 computers, five data communications terminals and software; equipment will be used for communications processing, feeding even larger computers	$850,000+
Astrodata, Inc., Anaheim, Calif.	Douglas Aircraft Co., Long Beach, Calif.	A large-scale hybrid computing system for general simulation purposes on DC-10 program	$800,000
Planning Research Corp., Los Angeles, Calif.	Navy Space Systems Activity (NAVSPASYSACT)	Additional technical support in investigation of Navy's use of satellite systems	$800,000
Conrac Corp., New York, N.Y.	Digital Equipment Corp., Maynard, Mass.	"Private-label" on-line computer data display terminals which DEC will market in own colors and house marks to complement PDP-10 computer product line	$750,000
Digital Equipment Corp., Maynard, Mass.	Strategic Time-Sharing, Inc.	Time-Share 8 Systems to be used by Strategic Time-Sharing, a subsidiary of Strategic Systems Inc.	$700,000+
Addo-X, Inc., New York, N.Y.	IBM Corporation, New York, N.Y.	Modified models of an Addo-X Data Recorder for use with IBM 1907 Batch Recording System	$500,000 (approximate)
Ampex Corp., Redwood City, Calif.	Western Electric Co., Inc., New York, N.Y.	Model TM-7 digital tape transports; will use to update information for stored-program controllers in two of Western's systems	$300,000+
	General Automation, Inc., Orange, Calif.	Core memory stacks for incorporation into firm's line of small, general purpose and automation computers	$200,000
Lockheed Electronics Co. (a div. of Lockheed Aircraft Corp.), Plainfield, N.J.	Massachusetts General Hospital, Boston, Mass.	A two-bed instrumentation system; device will provide an analog data acquisition system to monitor and record physiological data from cardiac patients	$165,940
Fisher-Stevens, Inc., Clifton, N.J.	Practicing Law Institute	List management and sale of P.L.I.'s national list of attorneys; under contract, firm will computerize, maintain and update list, and will be only authorized source for the P.L.I. list	—
Precision Instrument Co., Palo Alto, Calif.	Pan American Petroleum Corp., Tulsa, Okla.	UNICON Laser Mass Memory System; system to be supplied has a computer on-line storage capacity of one-trillion bits and will be used in conjunction with IBM-360/65 or 360/75 computers	—
Univac Division of Sperry Rand Corp., St. Paul, Minn.	General Dynamics Corp., Pomona, Calif.	Subcontract for development work on the Advanced Surface Missile System (ASMS) for the U.S. Navy's new class of DXG destroyers	—
Advanced Computer Techniques Corp., New York, N.Y.	Dominion Bureau of Statistics, Government of Canada, Ottawa	An electronic data processing training program; 3 courses in EDP Project Management will be given by ACT personnel to Bureau's senior staff members of the statistical and data processing staffs	—

NEW INSTALLATIONS

OF	AT	FOR
Burroughs B340 system	Capital National Bank of Miami, Florida	Savings, installment loan, demand deposit accounting, as well as proof and transit applications
Burroughs B3500 system	Bank of Las Vegas, Las Vegas, Nev.	Upgrading services of B300 currently in use; bank's external applications include work with four other banks, and gaming analysis
Burroughs B6500 system	Midland Bank Ltd.,of Great Britain (2 systems)	A nationwide automated on-line banking system; systems will be in Liverpool and London and linkage to branches throughout England and Wales will be via 1,850 Burroughs TC-500 terminal computers
Control Data 3150 system	Applied Industrial Dynamics, Inc. (A-I-D), Seattle, Wash.	Providing more efficent service to its customers in Pacific Northwest; plans future time-sharing
	Hamburger Flugzeugbau GMBH, Hamburg, West Germany	General scientific programs for aircraft industry, as well as performing aerodynamic programs and wing tip vibration calculations of its own
Control Data 7600 system	Lawrence Radiation Laboratory, Livermore, Calif.	Increasing capabilities of what is currently world's largest computer complex and includes 4 Control Data 6600s; the 7600 has a high degree of machine compatibility with CDC 6000 series
Digital Equipment PDP-8/S	French Atomic Energy Commissariat	Neutron diffraction studies; computer controls angles through which specimen under investigation is mounted, and aids in data acquisition
	Technological University of Delft, The Netherlands	Educational uses, and occasional research projects
GE-225 DAES (Direct Access Education System)	Kendall College, Evanston, Ill.	A variety of instructional and administrative purposes, including use by other nearby colleges and high schools
GE-635 system	International Telecomputer Network Corp. (ITN), Bethesda, Md.	Use in exploring specific program developments for the academic, scientific and business communities, as well as government agencies
Honeywell Model 200 system	Ideal Cement Co., Denver, Colo.	General accounting jobs and other business applications; also is figuring traverse closure, which involves computation to determine acreage of a given piece of land and the accuracy of the land survey
Honeywell Model 1250 system	Society for Savings, Hartford, Conn.	Loan and savings accounting on-line with 15 branch offices (system valued at $1.5 million)
IBM System/360 Model 25	Hastings Manufacturing, Hastings, Mich.	Processing payrolls, production control, status reports of sales and inventory
	Hitchcock Publishing Co., Wheaton, Ill.	Handling present data processing work (now being processed on 1440 system) and adding new publishing field applications
	United Steel and Wire, Battle Creek, Mich.	Payroll processing, production control, sales and inventory reports
IBM System/360 Model 50	Applied Data Research, Inc., Princeton, N.J.	Developing proprietary software programs, and on a service bureau basis for outside business accounts
IBM System/360 Model 65	University of Miami, Coral Gables, Fla.	Expanding capabilities of University's academic, administrative, and scientific communities
RCA Spectra 70/45 system	Marriott Corp., Washington, D.C.	Processing information to guide flow of food to nearly 300 operating units
	Shippensburg State College, Shippensburg, Pa.	Instructional and administrative purposes
SDS Sigma 7	Com-Share Inc., Ann Arbor, Mich.	Expanding present capabilities within a framework familiar to company's customers who currently use 6 SDS Model 940s; Sigma 7 is capable of serving 140 users simultaneously in addition to providing a remote batch processing service (system valued at over $2 million)
UNIVAC 494	Scandinavian Airlines System, Copenhagen, Denmark	Processing administrative work; this is third such system installed by SAS (system valued at $2.5 million)
UNIVAC 1108 system	University of Wisconsin	Time sharing and teaching of computer technology (system valued at over $2.75 million)
UNIVAC 9200 system	Danbury, City of, Danbury, Conn.	Applications embracing all departments of the city government including police and schools
	Hansen Order Inc., Cleveland, Ohio	Payroll inventory, sales analysis, accounts receivable and payable, and production scheduling
	Lenox Furniture Corp., Bladensburg, Md.	Inventory control, payroll processing and general accounting
	Newbury Industries, Newbury, Ohio	Inventory and production control, cost accounting, payroll, and other applications
	Sloan Paper Co., Atlanta, Ga.	Inventory control, invoicing, accounts payable and receivable, and general ledger work
	Timber Structures Inc., Portland, Ore.	Lumber inventory control, production control, estimating, job costing and payroll processing
UNIVAC 9300 system	Denver Water Board, Denver, Colo.	Preparation of bills, inventory control, purchasing, payroll, budgeting and general accounting
	Erie County Comptroller's Dept., Buffalo, N.Y.	A wide variety of applications dealing with public assistance, medical assistance, payroll, and budgetary accounting

COMPUTER CENSUS

I. and U. Prakash
DP Data Corp.
61 Helen Drive
Marlboro, Mass. 01752

Introduction:

DP DATA CORPORATION collects information through year-round continuing market surveys. Its market research program includes world-wide files on computer, unit record, and other data processing equipment and software. These files identify by each user, installation sites and information regarding digital computers, other data processing equipment, and software.

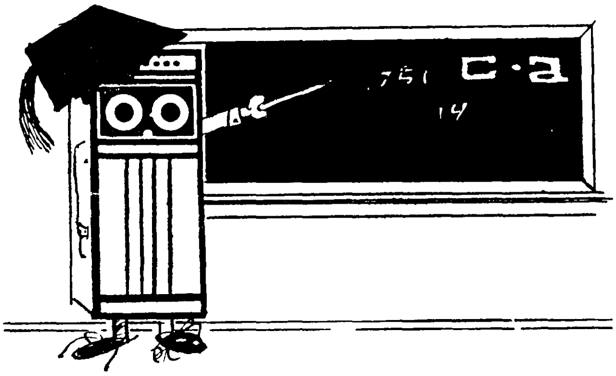
Part 1, information on the ten largest manufacturers in the U.S. market, was published last month. Part 2, information on other manufacturers in the U.S. market is presented here. Part 3, information on all manufacturers in the non-U.S. market will be presented next month. Any company whose data is not included in our census below is invited to send us the applicable figures for us to publish. Also, we invite any corrections or additions from informed readers.

COMPUTERS AND AUTOMATION has published a monthly Computer Census for several years. Starting with the February issue, an improved Computer Census is being published. Essentially, it is based on more accurate information and is presented in a new format. We have made an arrangement with DP DATA CORPORATION, a leading market research firm specializing in the information processing industry, to provide data from its data base and to supplement the information provided to us by other sources.

PART 2 - OTHER U. S. MANUFACTURERS
Data as of December 30, 1968 (except as noted)
* Data not available at press time
** For sale only

MANUFACTURER	COMPUTER TYPE	DATE OF INITIAL CUSTOMER INSTALLATION	AVERAGE MONTHLY RENTAL $ (000)	NUMBER OF COMPUTERS INSTALLED IN U. S. LEASED & PURCHASED
Datacraft	6024	-	1.3	None
Digital Electronics	DIGIAC 3080	12/64	**	11
	DIGIAC 3080C	10/67	**	4
Electronic Associates	640	4/67	1.2	42
	8400	7/65	12.0	21
EMR Computer Div.	ASI 210	4/62	3.9	*
	ASI 2100	12/63	4.2	*
	ADV 6020	4/65	4.4	*
	ADV 6040	7/65	5.6	*
	ADV 6050	2/66	9.0	*
	ADV 6070	10/66	15.0	*
	ADV 6130	8/67	1.6	*
Hewlett Packard	2116A	11/66	0.6	106
	2116B	5/68	0.7	110
	2000A	-	2.5	None
Honeywell #	DDP-24	5/63	2.8	*
	DDP-116	4/65	1.0	*
	DDP-124	3/66	2.3	*
	DDP-224	3/65	3.8	*
	DDP-516	9/66	0.8	*
	632	-	3.7	None
Pacific Data	1020	2/64	0.8	145
Raytheon	250	12/60	1.2	175
	440	3/64	3.6	20
	520	10/65	3.2	27
	703	10/67	**	102
Scientific Control	650	5/66	0.5	23
	655	10/66	1.9	65
	660	10/65	2.0	11
	670	5/66	2.7	1
	4700	-	0.6	None
	6700	-	30.0	None
Standard Computer	IC 4000	-	10.0	*
	IC 6000	5/67	18.0	*
Systems Engr. Labs	810	9/65	1.1	24
	810A	8/66	0.9	100
	810B	9/68	1.2	6
	840	11/65	1.5	4
	840A	8/66	1.5	33
	840MP	1/68	2.0	8

Computer Control Division



Using a powerful, modern, small, general-purpose computer (a Digital Equipment Corp. PDP-9 which can perform 500,000 additions per second, etc.) which we have recently acquired -- and our experience since 1939 in many parts of the computer field, we have started to teach:

Course C12:

COMPUTING, PROGRAMMING, AND SYSTEMS FUNDAMENTALS FOR SUPERVISORY MANAGEMENT— WITH 'HANDS-ON-THE-COMPUTER' ORIENTATION AND EXPERIENCE

This course will be offered: April 16-18 (Wed. through Fri.) and May 21-23 (Wed. through Fri.) at the Computers and Automation Computer-Assisted Instruction Center, 815 Washington St., Newtonville, Mass. 02160. Computer time for course enrollees will be available, without additional charge, Wednesday through Sunday. The fee is $235; the enrollment is limited to 12.

After the lectures beginning at 9 a.m. each day, the course will center around study groups of three or four persons who will have access together to the computer for three hours at a time; while one person runs his program, the others will work out or correct their programs. The instructor will, of course, be regularly available for guidance.

WHO SHOULD TAKE COURSE C12?

In a recent article in Computers and Automation, Swen Larsen, now president of Computer Age Industries Inc., said:

> "In many companies, the top operating executive --the one who makes the key decisions -- came into his position of responsibility before the computer revolution. Of all the men in an organization, he is probably the one in the greatest need of knowledge of the computer. Two computer experts describe the manager's plight in this way:
>
> > 'The executive is likely to be baffled, or confused, or snowed. He has confidence in his firm's EDP manager, but he doesn't understand the jargon that he hears, nor does he comprehend what can be effected from the tools he controls.'"

Course C12 is directed squarely towards these people and this problem.

WHAT TOPICS ARE INCLUDED IN COURSE C12 ?

- Fundamentals of Computing, and Orientation in Computers and Programming, with "hands-on-the-computer" experience in: how to compute; how to program; how to edit a program; how to assemble a program; how to debug a program
- Some Powerful Concepts in Programming
- Introduction to Programming Languages
- Basic Principles of Systems in Computer Applications
- Applications and Nonapplications of Computers
- Some Natural History of Mistakes, and How to Avoid Them

WHO IS THE INSTRUCTOR?

The instructor for this course is Edmund C. Berkeley, editor and publisher of Computers and Automation since 1951, and president of Berkeley Enterprises, Inc., since 1954. He has been in the computer field since 1939. He took part in building and operating the first automatic computers, the Mark I and II, at Harvard University in 1944-45; he is now implementing the programming language LISP for the DEC PDP-7 and PDP-9 computers.

Mr. Berkeley is: a founder of the Association for Computing Machinery, and its secretary from 1947-53; the author of eleven books on computers and related subjects; a Fellow of the Society of Actuaries; and an invited lecturer on computers in the United States, Canada, England, Japan, the Soviet Union, and Australia. He graduated from Harvard College in 1930, A. B. summa cum laude, having concentrated in mathematics.

WE BELIEVE

that the experience of:

- sitting at a computer;
- having the entire machine at your command;
- being able to look into any register you choose, to see just what information is there;
- experimenting first with simple programs, then with more complicated programs; and
- having someone at your elbow to answer questions when you are perplexed;

is one of the most exciting, interesting, and instructive experiences of the computer age.

This experience is, we think, part of the essential background of supervisory management. With such experience, supervisors of data processing departments and divisions are better able to:

- make reality-based appraisals of computing and data processing;
- form sensible judgments that are relatively independent of what the computer professionals in their groups may tell them;
- avoid commitment to unworkable proposals and costly errors.

If you are interested, or have questions, or are considering enrolling, write, wire, or telephone:

computers and automation

COMPUTER-ASSISTED INSTRUCTION CENTER,
815 Washington St., Newtonville, Mass. 02160
(617) 332-5453

NEW PATENTS

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

The following is a compilation of patents pertaining to computers and associated equipment from the "Official Gazette of the U. S. Patent Office," dates of issue as indicated. Each entry consists of: patent number / inventor(s) / assignee / invention. Printed copies of patents may be obtained from the U.S. Commissioner of Patents, Washington, D.C. 20231, at a cost of 50 cents each.

December 3, 1968

3,414,886 / Frank W. Wells, Pasadena, Calif. / Burroughs Corporation, Detroit, Mich., a corporation of Michigan / Information transfer into a word-addressed memory.

3,414,887 / John R. Scantlin, Los Angeles, Calif. / Scantlin Electronics, Inc., Los Angeles, Calif., a corporation of Delaware / Memory transfer between magnetic tape and delay line.

3,414,888 / Horst Gehrmann, Munich, Winifried Graf, Munich-Solin, and Karl Schneider, Munich, Germany / Siemens Aktiengesellschaft, a corporation of Germany / Method and apparatus for the recording and transmitting of messages on and from a storer.

3,414,889 / Edward R. Higgins, North Linthicum, and John L. Patrick, Laurel, Md. / Westinghouse Electric Corporation, Pittsburgh, Pa., a corporation of Pennsylvania / Electronically multiplexed dynamic serial storage register.

3,414,890 / Sidney J. Schwartz, Dayton, Ohio / The National Cash Register Co., Dayton, Ohio, a corporation of Maryland / Magnetic memory including delay lines in both access and sense windings.

3,414,891 / Gehard Kohn, Thalwil, Zurich, Switzerland / International Business Machines Corporation, Armonk, N. Y., a corporation of New York / Nondestructive readout thin film memory.

December 10, 1968

3,416,006 / Max Bruno Peltier, Courbevoie, Hauts-de-Seine, France / Societe d'Electronique et d'Automatisme, Courbevoie, Hauts-de-Seine, France / Digital data processing system.

3,416,083 / William E. Ray, Sykesville, Md. / The United States of America as represented by the Secretary of the Navy / Phase comparator utilizing logic circuitry.

3,416,138 / Robert L. Brass, Colts Neck, N. J. / Bell Telephone Laboratories, Inc., New York, N. Y., a corporation of New York / Data processor and method for operation thereof.

3,416,141 / Edson D. de Castro, Newton Highlands, Mass. / Digital Equipment Corp., Maynard, Mass. / Data handling system.

3,416,142 / Brian E. Sear, Baltimore, Md. / Sperry Rand Corporation, New York, N. Y., a corporation of Delaware / Storage diode memory device utilizing tunnel diode drive means.

3,416,143 / Jan Van Goethem and René De Smedt, Antwerp, and André Ernest Antoon Lauwers, Muizen, Belgium / International Standard Electric Corporation, New York, N. Y., a corporation of Delaware / Read-only memory system.

3,416,144 / Joseph Abruzzo, Severna Park, Andrew Paul Cox, Jr., Lutherville, and Robert H. Sapp, Baltimore, Md. / by mesne assignments, to the United States of America as represented by the Secretary of the Navy / Efficient buffer storage.

3,416,145 / William A. Edson, Los Altos Hills, Calif. / General Electric Company, a corporation of New York / Read-out system for recirculating memory.

3,416,147 / Jöns Kurt Alvar Olsson, Sundbyberg, and Sven Arne Olsson, Hagersten, Sweden / Telefonaktiebolaget L M Ericsson, Stockholm, Sweden, a Swedish corporation / Register for recording and non-destructive reading of binary information.

December 17, 1968

3,417,261 / James L. Walsh, Hyde Park, N. Y., / International Business Machines Corp., Armonk, N. Y., a corporation of New York / Logic circuit.

3,417,265 / Edwin S. Lee III, Altadena, Calif. / Burroughs Corporation, Detroit, Mich., a corporation of Michigan / Memory system.

3,417,375 / Roger E. Packard, Glendora, Calif. / Burroughs Corporation, Detroit, Michigan, a corporation of Michigan / Circuitry for rotating fields of data in a digital computer.

3,417,377 / Charles A. Vietor, Westminster, and Norman S. Blessum, Covina, Calif. / Burroughs Corporation, Detroit, Mich., a corporation of Michigan / Shift and buffer circuitry.

3,417,378 / Richard C. Simonsen, South Pasadena, Norman S. Blessum, Covina, and John A. Hibner, Sierra Madre, Calif. / Burroughs Corporation, Detroit, Mich., a corporation of Michigan / Multiple frequency data handling system.

3,417,379 / Roderick S. Heard and Louis M. Hornung, Lexington, Ky. / International Business Machines Corporation, Armonk, N. Y., a corporation of New York / Clocking circuit for memory accessing and control of data processing apparatus.

3,417,384 / Donald E. Blahut, Irvington, N. J. / Bell Telephone Laboratories, Inc., New York, N. Y., a corporation of New York / Magnetic memory.

3,417,385 / Irving William Wolf, Palo Alto, Calif. / Ampex Corporation, Redwood City, Calif., a corporation of California / Thin film shift register.

December 24, 1968

3,418,492 / Hung Chang Lin, Silver Spring, Md. / Westinghouse Electric Corp., Pittsburgh, Pa., a corporation of Pennsylvania / Logic gates.

3,418,640 / Thomas J. Werner, North St. Paul, Minn. / Minnesota Mining and Manufacturing Co., St. Paul, Minn., a corporation of Delaware / Method for storing and retrieving information onto and from an electroplatable recording medium.

3,418,642 / Paul M. Davies, Manhattan Beach, Calif. / by mesne assignments, to TRW Inc., a corporation of Ohio / Dual control memory modules for self-searching memory.

3,418,643 / Frank R. Bradley, Jr., 9 Dash Place, Riverdale, N. Y. 10471 / ________ / Memory device in conjunction with a magnetically variable electric signal generator.

3,418,644 / Paul Higashi, Gardena, and Robert O. Gunderson, Torrance, Calif. / The National Cash Register Co., Dayton, Ohio, a corporation of Maryland / Thin film memory.

3,418,645 / Richard L. Fussell, Chester Springs, Pa. / Burroughs Corporation, Detroit, Mich., a corporation of Delaware / Magnetic data store with radio-frequency nondestructive readout.

3,418,646 / Ira R. Marcus, Wheaton, Md. / The United States of America as represented by the Secretary of the Army / Transistor bistable devices with non-volatile memory.

3,418,647 / William Joseph Taren, Poughkeepsie, N. Y. / International Business Machines Corporation, Armonk, N. Y., a corporation of New York / Memory sense gating system.

December 31, 1968

3,419,678 / Carmi Ariel, Hollywood, Calif. / Clary Corporation, San Gabriel, Calif., a corporation of California / Data printing system.

3,419,851 / Joseph R. Burns, Trenton, N. J. / Radio Corporation of America, a corporation of Delaware / Content addressed memories.

BOOK REVIEWS

Neil Macdonald
Assistant Editor
Computers and Automation

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

Bellman, Richard / Some Vistas of Modern Mathematics / University of Kentucky Press, Lexington, Kentucky 40506 / 1968, hardcover, 141 pp., $7.00

This book is meant as a description of some ways the problems of the modern world provide mathematical questions and open up new domains of mathematics and computer applications.

The three sections are: "Dynamic Programming and Modern Control Theory;" "Invariant Imbedding and Mathematical Physics;" "The Challenge of Mathematical Biosciences." There is an index.

Richard Bellman is professor of mathematics, electrical engineering, and medicine at the University of Southern California. He is the author of more than twenty books and of numerous articles on theoretical and applied mathematics.

Hellerman, Herbert / Digital Computer System Principles / McGraw-Hill Book Co., 330 West 42nd St., New York, N. Y. 10036 / 1967, hardcover, 424 pp., $13.50

The purpose of this book is to give a college-level treatment of important principles of digital computer systems. The viewpoint of this book is primarily tutorial rather than encyclopedic in that it is intended to impart important insights and skills and to encourage an analytic and critical spirit. The ten chapters are: "Automatic Computers," "Programming," "Storage Organization and Searching," "Logic and Logic Circuits," "Data-Flow Circuits and Magnetic-Core Storage," "Sequential Circuits," "Number Representations, Conversions, and Elementary Arithmetic Operations," "Addressing and Instruction Sequencing," "The IBM System/360," "Some Principles of Reliability Theory." There are three appendices and an index. The author is a senior systems consultant with IBM Corporation and adjunct professor of electrical engineering at New York University. The reader is assumed to be comfortable with mathematics through college algebra.

Knuth, Donald E. / The Art of Computer Programming: Volume I. Fundamental Algorithms / Addison-Wesley Publishing Co., Inc., South St., Reading, Mass. 01867 / 1968, hardbound, 634 pp., $19.50

This book is the first in a projected series of seven encyclopedic volumes. This book contains the first two chapters of the work, "Basic Concepts", pp 1 to 225, and "Information Structures", pp 228 to 464. The appendices are: Answers to Exercises; Index to Notations; Tables of Numerical Quantities; Index and Glossary. The last section of each chapter is entitled "History and Bibliography". The book assumes considerable mathematics, much patience, and learning of the hypothetical machine language "MIX", an invention of the author.

Donald E. Knuth is Associate Professor of Mathematics at the Calif. Institute of Technology; he is a member of the

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COMPUTER MARKET REPORT

(Continued from page 40)

Geographic Location of Leasing Customers

The geographic location of the top 175 computer leasing company customers is shown in Table 6 (see page 40). In general, the geographic distribution of computer leasing company customers parallels closely the geographic location of the companies themselves. Except for the large companies, most of these leasing companies are local or regional in character.

Entry into World Markets

Some of the larger firms have publicly stated an intention of entering Canadian and European markets, and other firms have actually obtained financing and appointed personnel in one or more foreign locations. But the international volume of computer leasing activity as of the end of 1968 was an insignificant part of the total business conducted by this industry on a worldwide basis. U.S. activity amounted to over 98% of total industry activity, based on preliminary estimates.

Breakdown by Industry of Computer Leasing Customer

A preliminary tabulation of the industry classification of computer leasing company customers has been made. This tabulation shows that the computer leasing activity in each user industry is not proportional to the total installed points (excluding unit record equipment) in each of these industries. This is evidence that the computer leasing companies have tried to "skim" the market and obtain customers wherever they were available. They have apparently not gone after those computer users in specific industries who are less likely to change and/or replace their equipment as quickly as others in certain highly technological fields. Studies have shown that the latter are usually the leaders in obtaining new and improved equipment as soon as it becomes available.

Total Industry Financial Resources

The years 1967 and 1968 saw a large amount of public and privately placed debt and equity financing by firms in the industry. In addition, the banks have provided lines of credit to many firms. The extension of new lines of credit has tended to fluctuate as the loan markets have experienced relative ease and tightness. Interest rate changes have supplied a further dimension. Since these rates have increased during the past two years, an increasing amount of financing of computer leasing company purchases has been thrust on the shoulders of the equipment manufacturers, primarily IBM. It is estimated that IBM alone has seen an increase of over 100% in the amount of installment credit extended to computer leasing companies in 1968.

Based on information from some leasing company executives, Greyhound Computer, Data Processing Financial and General, Dearborn Computer, Leasco, Boothe Leasing, Levin-Townsend, and Randolph are likely to be the largest users of manufacturer-extended credit. With the large volume of funds available to companies in this industry, it is not likely that the availability of capital will be the main deterrent to growth in the near term future.

Funds estimated to be available to all companies in this industry during 1968 was a figure over $1.4 billion. Based on current money and equity market conditions, the range of funds available during 1969 is estimated to be about $2.0 - 2.4 billion.

Association for Computing Machinery, the Mathematical Association of America, the American Mathematical Society, and various honorary societies.

Schumaker, B. G. / Computer Dynamics in Public Administration / Spartan Books, 1250 Connecticut Ave., Washington, D.C. 20036 / 1967, hardbound, 195 pp, $?

This book deals with the relationship of computers and public administration as part of the history of public administration and "particularly as a part of the scientific management phase".

Among the eleven chapter titles are: Public Administration — Technical Transition and Software; Automation and Organization; Automation in Public — National — State and Local Administration. The book has bibliography and index.

Levy, Joseph / Punched Card Equipment: Principles and Applications / McGraw-Hill Book Co., 330 West 42nd St., New York, N.Y. 10036 / 1967, hardbound, 161 pp., $8.95

This book explains how to wire and operate six IBM punch card machines: The model 26 Keypunch, the 82 Sorter, the 548 Interpreter, the 514 Reproducing Punch, the 85 Collator, and the 402/403 Accounting Machine. IBM illustrations are included, such as machine schematics, simple electro-mechanical drawings, control and panel wiring diagrams.

The author is an account representative, Data Processing Division, for IBM Corp.

The only machines dealt with are IBM punch card machines — not even IBM computers. Also, no punch card machines of other companies are apparently discussed or mentioned.

Shapiro, George, and Milton Rogers (editors) and 39 authors / Prospects for Simulation and Simulators of Dynamic Systems / Spartan Books, 432 Park Ave. S, New York, N.Y. 10016 / 1967, hardbound, 301 pp., $12.50

This is a report of a symposium in September, 1966 in Baltimore, Md. The focus of the symposium was on the "universal, interdisciplinary, and symbiotic aspects of simulation". The purpose of the symposium was to speed up "the interchange of ideas, concepts, and needs between researchers with problems that can only be solved by simulation and specialists in the conception of simulation and novel organizations which may be useful in the solution of such problems".

There are 18 papers reported, some titles being: Man-Machine Simulation; Visual Information Processing Systems; Interactive Dynamic Modeling; and A New Simulation Technique for Extra-Vehicular Activities.

There is no glossary, or bibliography, although some papers include a few references. Very sparse index of 2 pages. The papers are of uneven quality, interest, and level.

Brown, George W., James G. Miller, and Thomas A. Keenan / Edunet: Report of the Summer Study on Information Networks conducted by The Interuniversity Communications Council (Educom) / John Wiley and Sons, Inc., 605 Third Ave., New York, N.Y. 10016 / 1967, hardbound, 440 pp., $?

This book seeks to convey the content of the "Summer Study" held July 1966 in Boulder, Colo., by the Educom Task Force (180 persons) on Information Networks. The aim of the book is to present a coherent analytical presentation of the ideas expressed in, and to provide a basis for the preparation of, an inter-university information network. The chapters are: 1, Background and History of the Study; 2, Current Configurations and Resources; 3, Identification of Needs; 4, Applications; 5, Organizational Considerations; 6, Network Design; 7, Edunet. There are seven appendices, a glossary, and an index.

The gist of the book is in the first section of chapter 7, "The Need for a Coast to Coast Interuniversity Information Network", a "pilot network" with "multiple-media information processing capabilities", "to enable us to take a hard look at how such networks can assist education" . . . (because) "networks make possible sharing of informational resources, equalize access to information, facilitate long-distance interpersonal relations, provide better bibliographic services, make life-saving information instantaneously available, and decrease production of unused copies of a wide range of informational materials".

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.