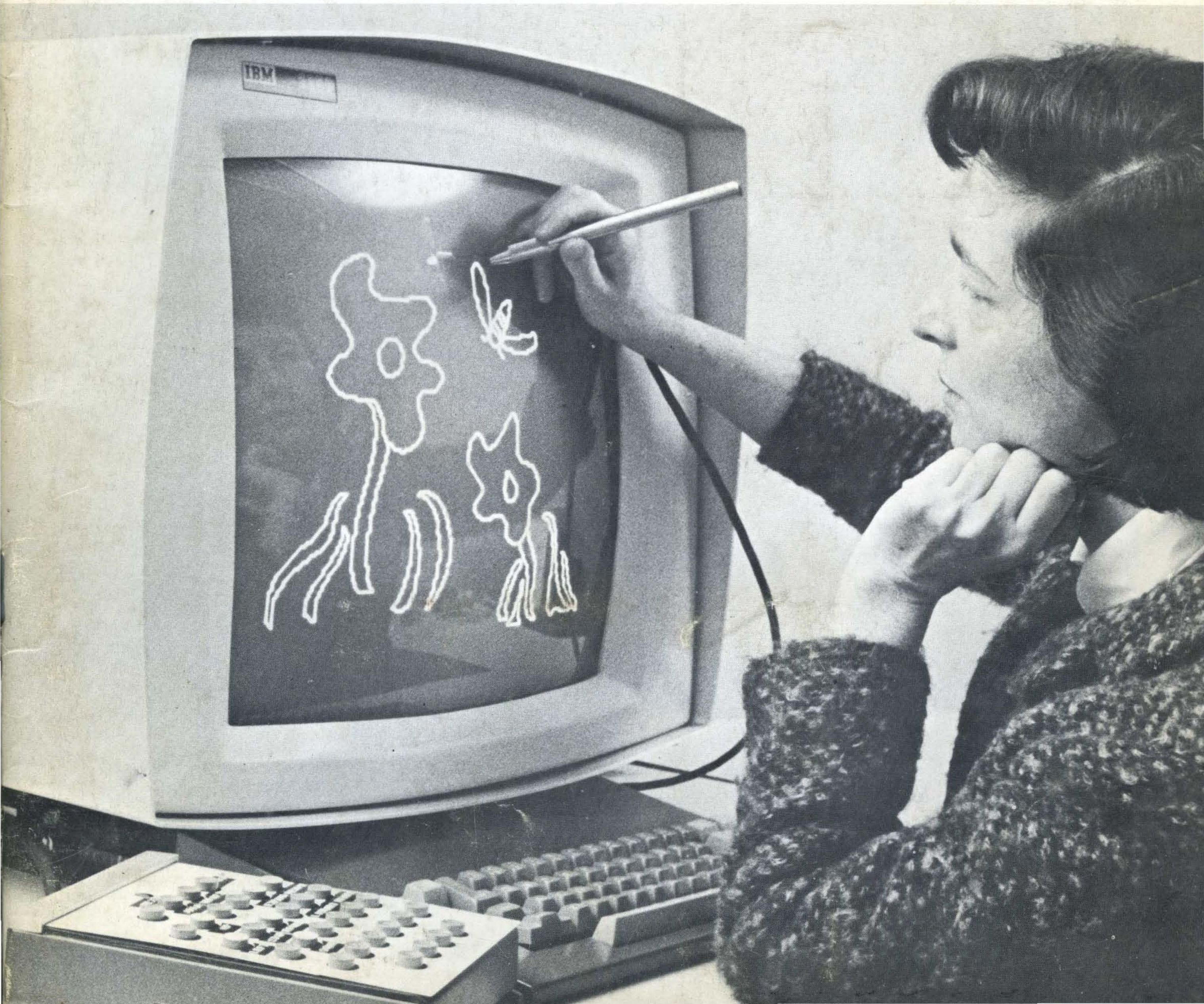
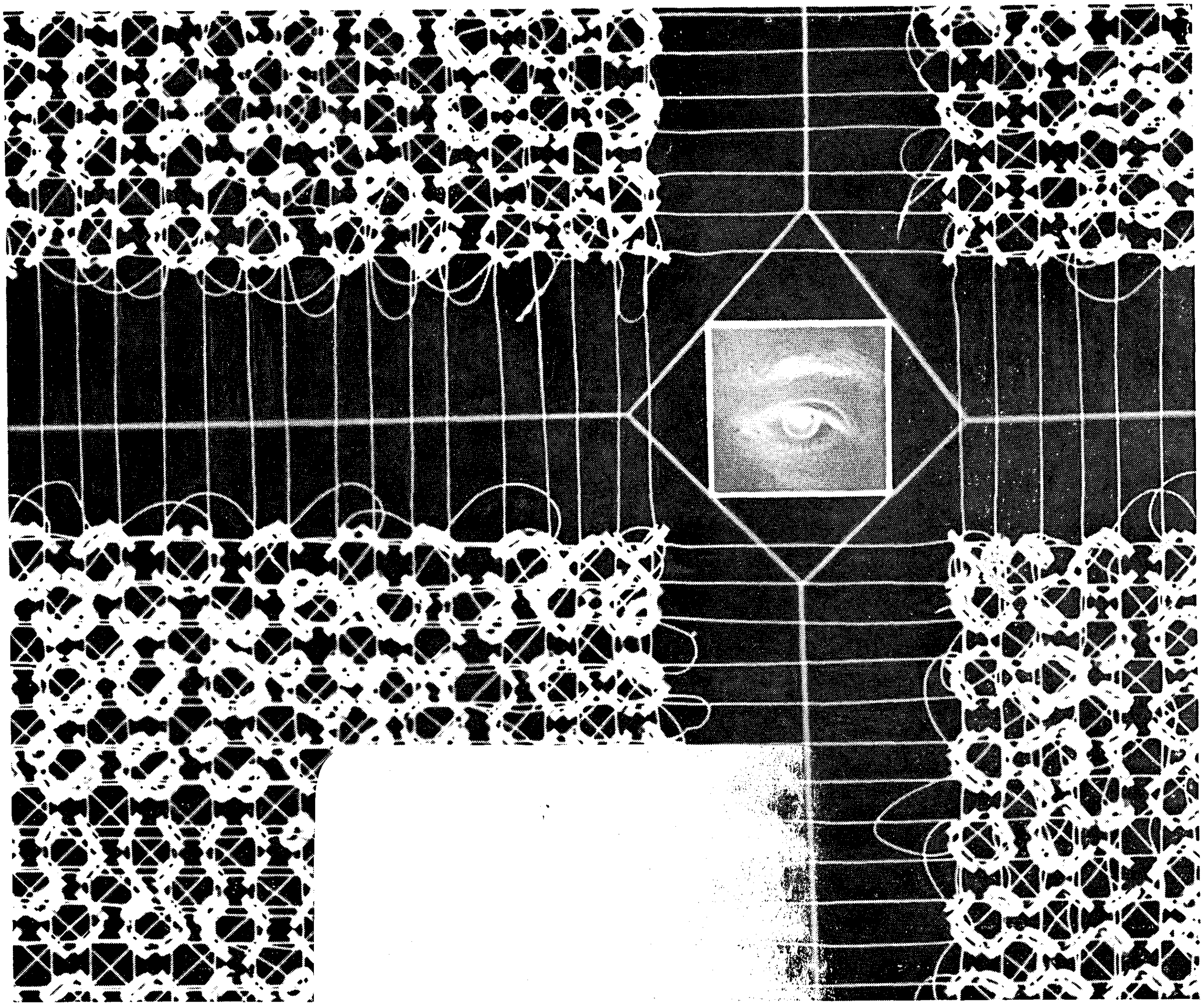
January, 1967

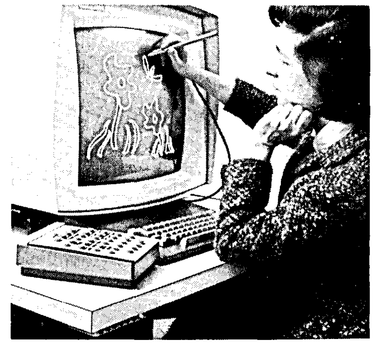
computers and automation

Electronic Paint Brush for Textile Design





The textile designer of the future may be able to discard her paint brush. The front cover shows a "textile graphics" technique being demonstrated at IBM's New York Scientific Center by Mrs. J. R. Lourie, an amateur weaver herself. For more information see page 58.



computers and automation

JANUARY, 1967 Vol. 16, No. 1

Special Feature: Prospects in the Computer Field — 1967

In This Issue

In Every Issue

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LIES (Lying Invalidates Excellent Systems)

"Economic forecasters in the United States are having a bad year, a *New York Times* business columnist notes. They have had to make almost constant revisions in their projections during the last five months. . . .

"Now the economic experts have become so confused by rapid changes in business outlook that few of them can agree on what to expect next. . . .

"What has gone wrong? In this age of sophisticated economic planning, of electronic brains, and impressive educated prognosticators, how can experts err so often?

"Perhaps the answer lies in the sophistication itself, in the growing reliance of businessmen and business observers alike on machines and punch-cards, data processors and pat answers.

"In their infatuation with computers, have not the experts forgotten the human element? . . . Like fingerprints, no two human minds are alike, and this happy fact may be stumping the machines and the experts who rely on them."

— From "Stumping the Wonderful Machines", editorial in "The Province", Vancouver, B.C., May 30, 1966

"There are other factors in our analyses which sometimes surprise our friends", General Nguyen van Vinh, assistant chief of staff, continued. "For example, despite the tremendous weight of material and technical power, which impresses so many western correspondents, we do not consider the American military machine very efficient. The French were better. We do not consider very competent either the generals in the field, the Saigon command, or the overall direction from the Pentagon. We think they are especially weak in their overall evaluations of specific situations — particularly in relation to Vietnam."

"Despite the computers?" I asked. "They are supposed to be infallible in their evaluations."

"Despite the computers," he replied, and smiled. "I suppose that computers can only turn up the right answers if scientific, objective facts are supplied them."

— From Chapter 10, "Hanoi Computers", in "Vietnam North" by Wilfred G. Burchett, International Publishers, New York, 1966

People who are in the computer field know well that the great majority of the applications of computers, where they are earning their keep, are in problems where the input and the program are correct. Examples are payroll, order processing, inventory control, engineering analyses, data reduction, etc. In these cases the right information to put in is quite obvious, and the right sequence of processing steps is also quite clear.

In borderline cases, computers are being used to assist experts in making decisions, and in choosing between alternatives. In making economic forecasts, evaluating military situations, and similar applications, the answers produced are no better than the data put in, the program used, and the expert interpreting the answers. In some cases, wrong answers are undoubtedly being produced.

It may seem that the purpose of computers and information processing is to produce right answers. But wrong answers have their uses too. They can be useful to people who want to deceive, who want to alter the truth; and they can be useful to people who want a more comfortable kind of truth than bitter reality.

Statistics can be prepared to support almost any cause, if the selection of data is limited to data favorable to the cause. Computers also can turn out calculations and tables by the hundreds from a biased selection of facts and figures about a situation. To the layman, these impressive-looking results can frequently seem irrefutable. Here is the special danger of the computer in the hands of those who want or need biased answers, and who are able to put the computer's image of infallibility behind their cause.

Abraham Lincoln is reported to have said, "You can fool some of the people all of the time, and all of the people some of the time; but you cannot fool all of the people all of the time." But how long is "all of the time?" For more than 15 years, Hitler fooled the people of Germany with wrong data and wrong answers, until over 7 million Germans were dead and most of the cities of Germany were bombed ruins. For more than a thousand years, certain wrong data and wrong answers have fooled human beings, such as the data that dead human bodies were unclean and the proposition that they were not to be studied and dissected but buried or cremated religiously.

And the wrong answers seem to sparkle with magic when labeled "the computers say"!

It is very hard to get right answers. It is true that no two human beings are alike; and when putting data about human beings into computers, we run the risk of error. It is true that scientific, objective, factual data may not be put into computers; and when we fail to put in such data, we run the risk of error. It is also true that a correct program of correct computer instructions is necessary for right answers. And there are more requirements besides, for obtaining reliable, correct answers, *with* or *without* computers. For some time I have been putting together a short guide to getting right answers. If any reader would like a copy of this, please designate 1 on the Readers Service card.

There is no substitute for honest, thorough, scientific effort to get correct data (no matter how much it clashes with preconceived ideas). There is no substitute for actually reaching a correct chain of reasoning. Poor data and good reasoning give poor results. Good data and poor reasoning give poor results. Poor data and poor reasoning give rotten results. As computer people often say, "Garbage in, garbage out."

Edmund C. Berkeley

EDITOR

MULTI-ACCESS FORUM

"LANGUAGE AND MACHINES"

Neil Macdonald
Assistant Editor
Computers and Automation

One of the most interesting and important reports to appear recently affecting the computer field is the report "Language and Machines: Computers in Translation and Linguistics" by the Automatic Language Processing Advisory Committee of the National Research Council. It has just been published as publication 1416 of the National Academy of Sciences and the National Research Council, and is available for $4 from Printing and Publishing Office, NAS-NRC, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

The committee that made this report consists of John R. Pierce, Bell Telephone Laboratories, Chairman; John B. Carroll, Harvard University; Eric B. Hamp, University of Chicago; David G. Hays, Rand Corporation; Anthony G. Oettinger, Harvard University; and Alan Perlis, Carnegie Inst. of Technology. The report is in the form of 15 short chapters covering 34 pages, and 20 appendices filling up the rest of the 124 pages of the report. The chapters are conspicuous for their directness, and calling spades spades. The chapter headings include such topics as: Is There a Shortage of Translators or Translation? (the answer is no); English as the Language of Science (which remarks that):

> It is generally true that the English-speaking scientist has less need to read in a foreign language or to have translations made than does a scientist of any other native tongue.

and The Present Stage of Machine Translation:

> There has been no machine translation of general scientific text, and none is in immediate prospect.

although some projects have continued as long as 8 years.

A very illuminating remark is:

> The development of the electronic digital computer quickly suggested that machine translation might be possible. The idea captured the imagination of scholars and administrators. . . . Early machine translations of simple or selected text . . . were as deceptively encouraging as "machine translations" of general scientific text have been uniformly discouraging.

The report is like an advancing weather front of cool Canadian air after many days of atmospheric pollution and smog along the Eastern coast of North America.

We hope we can say more about this report in an early issue of "Computers and Automation."

ANALYTICAL PEACE GAME

L. Mezei
Associate Professor of Computer Science
University of Toronto
Toronto, Canada

A large portion of Thomas A. Throop's general review of learning aspects of computer programs in the November issue of "Computers and Automation" is devoted to war games. I would like to draw your readers' attention to a more important and newer, potential application of these techniques — the "peace game."

As an example, I should like to mention the simulation of the Vietnam situation developed by the Canadian Peace Research Institute, Clarkson, Ontario. It is a peace-game played by human participants, using a computer. The computer simulates real-life restraints and evaluates the effects of the decisions made by the participants.

BOOK

Stephen R. Yarnall, M.D.
School of Medicine
University of Washington
Seattle, Wash. 98105

I am enclosing a copy of something entitled "Learn with BOOK," which I think you will enjoy, and possibly consider for republication in "Computers and Automation":

Learn with BOOK

A new aid to rapid — almost magical learning — has made its appearance. Indications are that if it catches on, all the electronic gadgets will be so much junk.

The new device is known as "Built-in Orderly Organized Knowledge." The makers generally call it by its initials, BOOK.

Many advantages are claimed over the old-style learning and teaching aids on which most people are brought up nowadays. It has no wires, no electric circuit to break down. No connection is needed to an electricity power plant. It is made entirely without mechanical parts to go wrong or need replacement.

Anyone can use BOOK, even children, and it fits comfortably into the hands. It can be conveniently used sitting in an armchair by the fire.

How does this revolutionary, unbelievably easy invention work? Basically, BOOK consists only of a large number of paper sheets. These may run to hundreds where BOOK covers a lengthy program of information. Each sheet bears a number in sequence, so that the sheets cannot be used in the wrong order.

To make it even easier for the user to keep the sheets in the proper order, they are held firmly in proper place by a special locking device called a binding.

Each sheet presents the user with an information sequence in the form of symbols, which he absorbs optically for automatic registration on the brain. When one sheet has been assimilated, a flick of the finger turns it over, and further information is found on the other side.

By using both sides of each sheet in this way a great economy is effected, thus reducing both the size and cost of BOOK. No buttons need to be pressed to move from one sheet to another, to open or close BOOK, or to start it working.

BOOK may be taken up at any time and used by merely opening it. Instantly it is ready for use. Nothing has to be connected up or switched on. The user may turn it at will to any sheet, going backwards or forwards as he pleases. A sheet is provided near the beginning as a location finder for any required information sequence. . . .

The initial cost varies with the size and subject matter. Already a vast range of BOOKs is available, covering every conceivable subject and adjusted to different levels of aptitude. One BOOK, small enough to be held in the hands, may contain an entire learning schedule.

Once purchased, BOOK requires no further upkeep cost; no batteries or wires are needed, since the motive power, thanks to an ingenious device patented by the makers, is supplied by the brain of the user.

BOOKs may be stored on handy shelves and for ease of reference the program schedule is normally indicated on the back of the binding.

Altogether, the Built-in Orderly Organized Knowledge seems to have great advantages with no drawbacks. We predict a big future for it.

(This article by R. J. Heathorn, originally appeared in *Punch,* May 9, 1962)

INSTRUMENTATION AND INFORMATION

Arthur L. Kenney
Advisory Committee on the "Guide to Scientific Instruments"
Science, November 22, 1966,
(vol. 154A, no. 3751A) p.7

Scientists are coupling advanced instrumentation to computers to produce quantitative and qualitative analyses undreamed of a few years ago. . . .

Today optical scanning devices view slides through a microscope and process the images into digital language, which a properly prepared computer can restructure to provide accurate measurements of the DNA content of chromosomes. Computers can also start with measurements in analog or digital form and present pictorial reconstructions, such as three dimensional models of protein molecules, on display devices. New instrumentation applications appear limitless and are opening research frontiers in all disciplines. Today's psychology departments use more electronic equipment than most physics departments used a decade or two ago. . . .

The new instruments, the new companies, and the pace of events in an increasingly complex world present an information problem. Weighing these events with the fact that scientific information is expanding at an exponential rate, it seems natural that men should attempt to use machines to organize and control the data generated. The computational speed of computers, along with expanding technological capabilities, makes it possible to handle all kinds of information on a correspondingly larger scale, and to consider the structuring of automated libraries on subjects such as scientific instrumentation. Computer information utilities are likely to play an increasingly large part in scientific affairs. . . .

INTERNATIONAL EXHIBITION OF COMPUTER ART FORMS

Jasia Reichardt
Institute of Contemporary Arts
17 Dover St.
London, W.I.
England

The Institute of Contemporary Arts in London, England, is organising, under the title Cybernetic Serendipity, a vast international exhibition exploring creative forms engendered by technology.

The exhibition will be held in Carlton House Terrace in January 1968.

Apart from robots, automata, and various cybernetic devices, the ICA is anxious to collect as much material as possible in the fields of computer-generated art, music and poetry. Or more specifically — computer graphics, films utilising computer animation, music composed or played on computers, and any experiments involving literature and poetry.

The purpose of the exhibition is to present an area of creative activity which manifests artists' involvement with science, and the scientists' involvement with the arts; and to show the links between the random systems employed by artists, composers and poets, and those involved in the use of computers and other cybernetic devices.

The ICA would be happy and grateful to receive results of any experiments relevant to this general theme.

COLLECTION OF MATERIAL IN THE FIELD OF LAW AND DATA PROCESSING

John F. Banzhaf, III, Pres.
Computer Program Library
509 Fifth Ave.
New York, N.Y. 10017

I am writing this letter in the hope that your readers will be kind enough to help me help them and the data processing community.

I am now engaged in a survey study and collection of material in the broad field of law and data processing. The results of the study and the accompanying bibliography are expected to have a wide circulation. Unfortunately, published works in this field are scattered among many journals in different fields and even incomplete bibliographies are difficult to come by. Many works appear to exist in unpublished form. Information about court decisions and actual experience in this field are not readily available.

I would greatly appreciate hearing from any reader who has information about unpublished works or publications not widely known, bibliographies in the field, court decisions, personal experiences with legal problems concerning data processing, or any information which might be useful to the study. Any assistance will be gratefully acknowledged in the study. I would also like to learn of any legal problems in this area which your readers feel have not been treated in the available literature and which are nevertheless important to them.

If their firm's lawyers are not regular readers of COMPUTERS AND AUTOMATION, I hope your readers will bring my request to their attention also,

FOURTH ANNUAL COMPUTER PROGRAMMING CONTEST FOR GRADES 7 TO 12

A contest designed to stimulate inventive interest among students in the computer programming field is being sponsored for the fourth year by the Association for Educational Data Systems (AEDS). March 15, 1967, is the deadline for entries. Students in grades 7 to 12 are eligible. Financial support for the contest is being provided by the Control Data Institute, an accredited vocational school which has training centers in Washington, D. C., Minneapolis, and Los Angeles.

Entries in the Computer Programming Contest may be submitted at any time during the school year prior to the deadline. They will be judged by a panel of nationally known authorities in the computer sciences as they are received for originality, scope, usefulness, completeness of solution, and quality of documentation.

The grand prize winner will receive a $150 cash award plus an all-expense-paid trip for the student and his teacher to the 1967 AEDS Convention to be held in Detroit next April 30-May 3. In addition, the winning student's school will receive for its library a collection of educational data processing publications donated by various publishing firms. A project may be submitted by an individual student or by a team of two or more students. In the event the project winning the grand prize is submitted by a team, the team must select one of its winners to make the trip to Detroit.

Six second prize awards of $50 each will be given; all students who submit projects that receive honorable mention are eligible to receive a one-year subscription to a professional publication.

Students wishing more contest details and an application blank should write to AEDS Programming Contest, Iowa Educational Information Center, East Hall Annex, Iowa City, Iowa 52240.

The 1966 winner was William J. Elliott, a 12th grade pupil at West High School in Minneapolis. His project, ELTRAN, is an algorithmic language compiler system for the UNIVAC 422 Computer. Until the development of ELTRAN, no compiler existed for the computer.

"A SYNTAX-ORIENTED TRANSLATOR" BY P. Z. INGERMAN — COMMENTS

I. From H. C. Kerpelman
Manager, New Language Systems Design
RCA Electronic Data Processing
Camden, N.J. 08101

As manager of a group of programmers currently implementing the translator described in "A Syntax-Oriented Translator," by P. Z. Ingerman, I feel qualified to take exception to the review of this book which appeared in the October, 1966 issue of *"Computers and Automation."*

First, your reviewer conjectures that the techniques described . . . "may be hard to apply." As a counter-example (the best method known for squelching conjectures) I offer the fact that my group has now implemented most of the translator described, using Ingerman's book as our primary design reference, and what remains to be done is well in hand. None of the implementation, although mostly non-trivial, was as difficult as the reviewer would imply.

The reviewer next complains that, "There is no glossary to guide the reader to what the author means by the terms he uses." Did the reviewer not read pages ix and x of the book? Perhaps they were missing from his copy, but in mine, page ix is entitled "Glossary of Definitions" and there follows a list for quick reference of the less common words, phrases, and symbols used in the book, each followed by the number of the page on which it is defined. Incidentally, an entry for this Glossary itself appears in the Table of Contents on page vii. Furthermore, the Subject Index appearing at the end of of the book contains (as described at the beginning of that Index) similar information for *all* words, phrases, and symbols defined in the text. For almost all other words and phrases used in the book, may I suggest emphatically that an author *not* be critiziced for having a good command of English; such criticism reflects, rather, on the reviewer.

The final complaint of your reviewer is simply unfathomable. He says, "The 'syntax-oriented translator' . . . is not described as if it had actually worked on a computer." I contend that not only is such a remark completely irrelevant, but it has no apparent basis in fact based upon my own (may I say careful) reading of the book. By his remark, I assume the reviewer means that implementation techniques for a specific computer are not described in the book. I would say that not only is this true, but it is in fact a virtue. Indeed the utility of the book (and this is certainly borne out by our experience) is in the fact that the description it contains is a machine-independent one. To have done otherwise would have been to perform a disservice to the person interested in implementing this translator on any other computer. This is not to say, however, that no thought is given in the book to implementation. On the contrary, rather careful consideration seems to have been given to both implementation techniques and implementation problems.

To conclude, it is my studied opinion, having now been through almost all of the most difficult implementation problems involved, that the author admirably fulfills the purpose of the book as stated in his Preface; namely, to present sufficient detail to enable the "*patient* reader" (my emphasis), to "construct a copy for himself." In addition, the book helps to fill a previously noticeable gap in the literature (outside of numerous widely scattered articles in the professional journals) in an area of current and active investigation.

II. From Neil Macdonald
Assistant Editor,
Computers and Automation

Thank you for your letter. I am glad that you challenge the remarks that I made in the review of P. Z. Ingerman's book "A Syntax-Oriented Translator."

Let me repeat the review here since it is only four sentences long:

> The first chapter is interesting and understandable. The later chapters seem hard to understand and may be difficult to apply. There is no glossary to guide the reader to what the author means by the terms be uses. The "syntax-oriented translator" which the author talks about is not described as if it had actually worked on a computer.

The reason for my remarks "may be difficult to apply" and "is not described as if it had worked on a computer" is that in our reviews of books we try to indicate clearly whether or not any particular computer, or programming language, or software device, etc., (a) has actually been used or applied, or (b) is only a scheme or plan which has not yet met the acid test of actual application. From the book and from your letter, it is clear that in February 1966 when Mr. Ingerman dated the preface, his syntax-oriented translator had not been applied in any instance. In your letter you say you have now "implemented *most* of the translator," implying that you have not yet implemented *all* of the translator. Furthermore, I note that you are in the most advantageous of all positions: your address and Mr. Ingerman's address are the same, and this makes it seem very likely that you had not only the book to use as a guide but also Mr. Ingerman to answer questions as a consultant.

Second, as to the "glossary." It is perfectly true that there is something entitled a "glossary" printed in the book on pages ix and x. But it is only a list of terms giving pages where the terms are defined. So what is actually on those pages ix and x is an index. Looking up some of the pages where terms are defined one sees that the definitions are embodied in text, and can only be really grasped by reading and rereading the text. In other words, pages ix and x are not a glossary of definitions, but simply an index to presentation of definitions in the book.

Programmers: You know these leaders in your field.

Left: Kenneth Iverson (*A Programming Language:* Wiley, 1962; *Automatic Data Processing:* Wiley, 1963, co-author F. P. Brooks, Jr.; *Elementary Functions:* Science Research Associates, Inc., in press) has used his language in a formal description of IBM System/360. It is now being used to write a formal description of advanced software.

Center: David Sayre, left, and Robert Nelson (members of the original FORTRAN team) use a remote console of a time-sharing computer now in operation at IBM. The machine was designed specifically for programming research, with a wide variety of timing and measuring features to permit evaluation of programming performance.

Right: William S. Dorn (*Numerical Methods and FORTRAN Programming:* Wiley, 1964; *Mathematics and Computing:* Wiley, 1966) oversees the IBM Research Computing Center, which will install a System/360 Model 67 this fall.

c & a MARKET REPORT

COMPUTERS FIND GROWING MARKET IN TYPESETTING; NUMBER OF SYSTEMS QUADRUPLE IN TWO YEARS

The number of computers used in typesetting applications has increased over four times in the last two years, from 70 to 292, according to a recent survey released by Composition Information Services (CIS), Inc.

CIS reports that computerized typesetting installations are now found in 42 U. S. states and in 18 countries throughout the world. Newspapers represent the largest user group, with 63% of the installations. Printers and specialized typesetting houses follow with 23% and 5% respectively. Applications range from the routine processing of unjustified tape to the creation of fully formatted control tapes to drive sophisticated photocomposition machines making up full pages.

Although special-purpose computers launched the commercial development of computer typesetting applications in the early part of this decade, general-purpose systems have been capturing a growing share of the market due to their decreased cost and the compatibility they can offer with the user's administrative data processing equipment. In the U. S. and Canada, general-purpose computers account for 53% of the systems in use, and 57% of the systems on order. In contrast, only 30% of the typesetting computers used in other countries are general-purpose.

All major American digital computer manufacturers are now active in the typesetting market. As indicated in Table 1, IBM leads the field with 73 installations, and 19 1130's and one 360 on order. In second place is Digital Equipment, with 21 of its PDP-8 systems in use and 5 on order. RCA has ten 301 systems and two Newscom 30 systems in use for typesetting. Control Data has six installations of its 8050 typesetting unit, which is built around a CDC 160 computer.

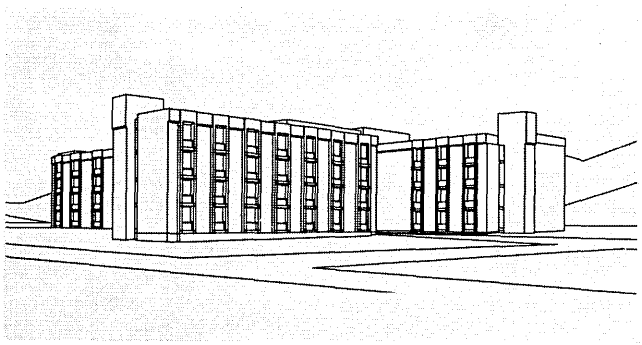
A summary of the results of the survey is presented in Table 1. The complete survey results include a listing of the names and locations of users of each specific model of equipment, a geographical breakdown of all graphic arts organizations using computers for typesetting, and a description of the particular typesetting or photocomposition equipment associated with each installation. Persons interested in the full results of the survey and/or in the activities of CIS should write to Composition Information Services, 1605 N. Cahuenga Blvd., Los Angeles, Calif. 90028

CIS SURVEY OF COMPUTERIZED TYPESETTING

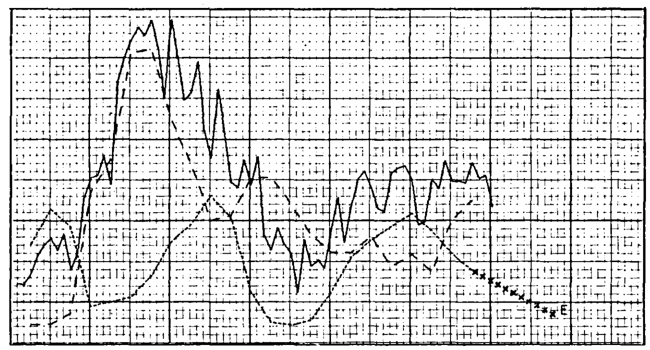
Computer Systems	U.S. & CANADA		INTERNATIONAL		TOTAL		CLASSIFICATIONS OF USERS*						
	Users	Orders	Users	Orders	Users	Orders	Newspapers	Printers	Typesetters	Publishers	Centers	Government	Educational
BULL-GENERAL ELECTRIC				1		1	1						
BURROUGHS 220 SYSTEMS	1				1							1	
COMPUGRAPHIC DTP	13				13			13					
CONTROL DATA SYSTEMS	5		1		6		5		1				
DELCO JUSTIFIER	1				1		1						
DIGITAL EQUIPMENT PDP-8	20	5	1		21	5	22	2			2		
ELLIOTT-AUTOMATION LTD.			1	2	1	2	2	1					
FAIRCHILD COMP/SET	6		1	1	7	1	6	1	1				
GENERAL ELECTRIC	1				1			1					
GUTTINGER GSA/MONOTRON		1	13	3	13	4	2	13	2				
HELLCOM SYSTEMS			2	3	2	3	2	3					
HONEYWELL H-200 SYSTEMS	10	5			10	5	5	6		3		1	
HONEYWELL SYSTEMS	4	1	1		5	1	4	1				1	
IBM 1620 SYSTEMS	28				28		18	7	2				1
IBM 1130 SYSTEMS	22	19			22	19	35	3	2	1			
IBM 1400 SERIES	8		6		14		5	3		1	2	3	
IBM 709/7090 SYSTEMS	4				4					1		1	2
IBM SYSTEM/360	3	1	2		5	1	3	2				1	
ICT SYSTEMS			2	3	2	3		3			2		
INTERTYPE COMPUTERS	15		2		17		11	3	3				
MERGENTHALER LINASEC	41	1	24	1	65	2	48	15	4				
MERGENTHALER JUSTAPE	34	27		1	34	28	54	5	2	1			
NCR 315 SYSTEMS	1				1		1						
RCA 301 SYSTEMS	10				10		4	2		2	2		
RCA 30 NEWSCOM	2				2		2						
RCA SPECTRA 70		5				5	1	1	1	2			
RCA SYSTEMS (MISC.)	1	1			1	1		1		1			
SCIENTIFIC DATA SYSTEMS	1				1		1						
SIEMENS/HELL 3003			1	1	1	1	1	1					
STAR PARTS AUTOCOMP	1				1		1						
UNIVAC SYSTEMS	2		1		3						1	2	
Totals	234	66	58	16	**292**	**82**	235	87	18	12	9	10	3
							63%	23%	5%	3.2%	2.4%	2.6%	0.8%

*Systems installed and on order, including U.S., Canada and International

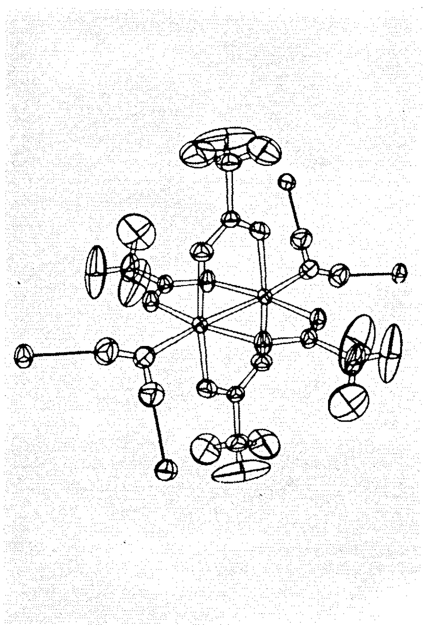
Would you believe a CalComp plotter and any computer can draw pictures like these in seconds?



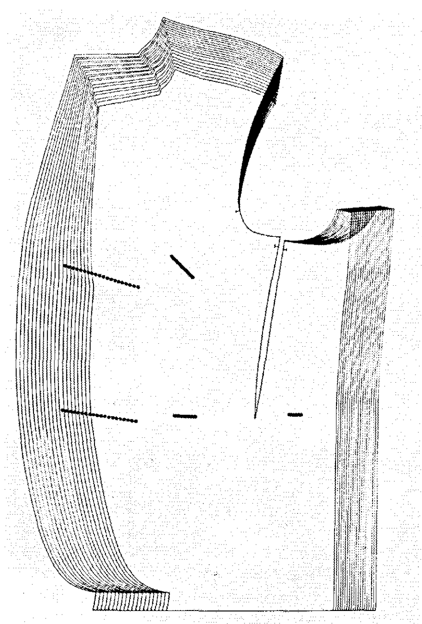
a perspective sketch of your new plant



statistical trend charts



molecular structure diagrams



apparel patterns, graded for sizes

and even the Mona Lisa

it can

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THE COMPUTER FIELD AND THE IBM 360

— A 1966 PROGRESS REPORT

Patrick J. McGovern
Associate Publisher
Computers and Automation

"By the 1970's . . . we may expect that equipment development will follow the pattern established in the automobile business. Computer systems of various manufacturers will probably be selected by potential users on the grounds of style, cost, and reputation, rather than on considerations of hardware reliability, compatibility, and other technical factors."

By the end of 1966 over 44,000 electronic computers were in operation in the world. These machines are now assisting science, engineering, business, industry and government with an automatic calculating power of nearly 1 billion operations per second. In contrast, ten years ago less than 800 computers were installed and they had a total calculating power of under 5 million operations per second.

Production

The so-called "computer revolution" — the rapidly expanding impact of the computer in almost all phases of human endeavor — has given rise to one of the fastest growing industrial activities in the world. Manufacturers of analog and digital computer systems around the world shipped in 1966 approximately $5.4 billion worth of equipment. This was an increase of some 25% over the $4.3 billion worth shipped in 1965. Annual production levels of this size are even more startling when we consider that just eleven years ago, in 1955, less than $200 million worth of computers were manufactured in the world.

Installations

The United States had 28,500 computers installed by the end of 1966, 63% of the world total. West Germany was in second place in the computer power derby, with 2750 computers installed by year end. Japan, Great Britain, and France followed with 2100, 1700, and 1550 computers respectively. Table 1 provides a country-by-country census of computer installations as of the end of 1966. These figures were compiled by the International Data Corporation, Newton, Mass.

The high installation rate of new computer systems during 1966 is due to quantity shipments of "third generation" computer systems. These computers incorporate some of the most recent advances in computer technology, including:

(1) micro-electronic circuits
(2) faster main-memory speeds,
(3) expanded main-memory sizes,
(4) more flexible mass random-access memories,
(5) extensive equipment to handle data communications,
(6) various remote terminal devices, and
(7) improved programming languages.

IBM System/360

As anticipated, System/360 of International Business Machines Corp. accounted for the largest share of the value of computer systems shipped during 1966. Over $2.5 billion in new 360 systems were shipped during the year. In a true sense, the fortunes of 1966 for the computer field were shaped by the System/360, its successes, and its limitations. It provided the criteria with reference to which the vast majority of computer users measured the feasibility of their computing and data processing plans. The 360 delivery schedule provided the time standards by which computer users set their expectations.

TABLE 1
World Computer Census
As of December, 1966

Location	Number of Digital Computer Systems Installed
North America	
United States	28, 500
Canada	1, 000
Mexico	200
Central America	150
South America	400
Western Europe	
Austria	175
Belgium	300
Denmark	175
Finland	90
France	1, 550
Great Britain	1, 700
Greece	85
Ireland	65
Italy	1, 150
Netherlands	410
Norway	150
Portugal	50
Spain	70
Sweden	350
Switzerland	380
West Germany	2, 750
Eastern Europe and Siberia	
U. S. S. R.	1, 000
Elsewhere	300
Asia	
Japan	2, 100
India	140
Hong Kong	50
Elsewhere	270
Africa	
South Africa	175
Elsewhere	200
Oceania	
Australia	450
New Zealand	50
Elsewhere	20
TOTAL	44, 455

The Computer Industry's Cycles

To fully understand the significance and implications of the System/360, let's take a brief look at the historical background of the computer industry. In early 1964 the "second generation" computer cycle was coming to an end and signs indicating the start of the "third generation" appeared in a few, unrelated computer systems. According to the cycle theory of the computer industry, significant economic and technological transitions occur in the industry approximately every five years, resulting in the appearance of a "new generation" of computer systems, and the beginning of a new cycle.

This theory has a certain amount of historical justification since such a turning point appeared previously in the industry in 1959-1960. This was when the transition from the "first generation" systems to the "second generation" systems occurred. According to this theory, new product development in the computer industry is regulated by the fact that over 75% of computers are leased rather than purchased. It takes approximately 60 months or five years before the manufacturer recovers his costs for research and development, manufacturing, sales, service, and interest, and attains a satisfactory profit.

The Reason for the Cycles

The major reason why this fact creates a stable, regular pattern in the computer industry is that one manufacturer, IBM, controls 70-75% of the computer market, and has 80% of its equipment on a rental basis. Technical differences between generations of computers, although present, have represented more of an evolution than a revolution.

The First Generation

Broadly, the computers of the first generation were built with vacuum tubes operating at slow speeds and had limited memory capacity (2-4 thousand words) consisting of magnetic drums and slow cores. The computer lines of different manufacturers were isolated, unrelated machines and were applied primarily to scientific applications.

The Second Generation

The second generation of systems (1959-1964) saw the introduction of solid-state components on a large scale, increasing the speed of the computers to the microsecond range and extending memory capacities to 32 thousand words. The computers of various manufacturers tended to be separated between business and scientific machines. This period saw a rapid increase in business data processing, accounting and payroll applications, due primarily to the moderate cost and widespread popularity of the IBM 1401 system. Costs of computer systems came steadily down and were brought within the reach of medium-size business establishments. The size of the market increased rapidly. By the end of 1963, just prior to the announcement of the IBM System/360, the cumulative value of American-made computers installed in the world market reached close to $5 billion. This market was shared by various manufacturers as shown in Table 2.

The status of the EDP industry toward the end of the second generation computer industry cycle was as follows. During the ten year period 1954-1964 IBM rose from a second position in the industry behind UNIVAC in 1954 to a position of overwhelming dominance. IBM managed to steadily increase its share of the market during the entire 1954-1964 period. UNIVAC's lead in the early '50's, although supported by technical skills second to none at that time, was quickly overtaken by IBM's superior marketing approach and shrewd understanding of the potential of computers in the business field. Late decisions, management hesitations, and other non-technical factors contributed to UNIVAC's steadily declining share of the market.

TABLE 2

SHARES OF THE U. S. COMPUTER MARKET BY MANUFACTURER-- AS OF JANUARY 1964

Manufacturer	Total Value of Installed Systems	Percent Of Market
Burroughs	$ 120-130 million	2.5 - 2.7 %
Control Data Corp.	240-260 "	5.0 - 5.4 %
General Electric	100-120 "	2.1 - 2.5 %
Honeywell	100-120 "	2.1 - 2.5 %
IBM	3,400-3,600 "	71.0 - 75.0 %
NCR	110-120 "	2.3 - 2.5 %
RCA	180-200 "	3.7 - 4.1 %
UNIVAC	420-440 "	8.7 - 9.2 %
TOTAL	$4,670-5,090 "	100 %

Source: Computers and Automation, Jan. 1964

Announcement of the Third Generation

On April 7, 1964, IBM made the long-awaited, widely-anticipated announcement of its new, third-generation computer product line, the System/360. What were IBM's objectives in developing a line of computers like the System/360?

IBM's Objectives: Competitive Equipment with Orderly Transition

IBM had installed at customer sites computer equipment valued at approximately $3.5 billion. Of this, about $2.8 billion was on a monthly rental basis, producing an annual income of approximately $700 million. The largest part of this equipment had already been fully depreciated, and was a highly profitable, revenue-producing asset. With its traditional concern for steady growth in sales and profits, IBM realized that a prime objective for its new computer product line was to promote an orderly transition by customers between the use of their current product line and the new series. The introduction of equipment vastly superior to the current product line on a price/performance basis and directly program-compatible with it would have an unfavorable effect on gross earnings and profits. On the other hand, competitors such as Honeywell, Control Data and others were introducing equipment with price/performance ratios four to eight times superior to IBM's 1400 and 7000 series. Clearly, the new product line had to make a passable showing against the mounting competition. This objective was met in the System/360 by making the new computer line attractively superior to second generation equipment on a price/performance basis, but sufficiently different in programming and system structure from the 1400 and 7000 series to make the transition of customers from old to new equipment a process that required considerable planning and expense. This helped to insure, for a period of two to four more years, continuance in the flow of revenues from 1400 and 7000 series machines.

Related Compatible Equipment

Second, the new product line was to cover a broad range of equipment capability and to provide for considerable flexibility in upgrading a customer's computer capacity and range of peripheral equipment. IBM well recognized the fact that over 70% of its annual gross in sales was due to upgrading of the value of equipment installed at current customer locations. Only a relatively small part came from new business accounts. During the first and second generations, computers supplied by the various manufacturers including IBM were often unrelated, isolated units, with only limited provisions for program compatibility even with higher-level programming languages such as FORTRAN and ÇOBOL. This condition made it more difficult to upgrade the capacity of a customer's computer system when desired. The new System/360 was to offer a series of related processors, modular, expansible, and program compatible. Indeed, this capacity for rather continuous growth in computer capacity provided one of the most attractive features of the System/360.

Broad Range of Equipment

The third major IBM objective was to cover with various models of the same family the needs of a broad, comprehensive market. The intention was to provide a computer capable of efficient business data processing, scientific computation, and industrial process control in a family of computer processors. This objective was widely publicized as the "full circle" capacity of the System/360. Although admirable, this objective was somewhat overambitious as later developments revealed.

System/360 Characteristics

The impact of IBM's System/360 announcement on the EDP community was profound. To be sure, System/360 did not introduce completely new, revolutionary features to the computer industry that had not been discussed, experimented with, and available in some form or other previously. However, IBM succeeded in integrating various, scattered advanced concepts for machines and systems into a single, broad family of computers. And herein lies the most significant characteristic of System/360. The full impact of the System/360 can be assessed by investigating these concepts from three points of view: system, hardware, and software.

System Concepts: On-Line Processing instead of Batch Processing

During the first ten years of the computer era, computers were generally organized to perform specific, discrete and independent tasks (frequently called "batch processing"). This type of organization was challenged by the System/360. In place of providing a system organization primarily suited for clerical, accounting and bookkeeping type of applications, the 360 offered a system organization that is designed to do information processing on a more systematic and integrated basis. The System/360 system organization permits the user to set up a real-time system for business information and management control with on-line data communication terminals for input, output, and display. This is achieved in the 360 by a variety of data channel capacities, message storage and switching facilities, mass storage devices, and a sophisticated executive control and operating system.

Compatible Interlinking

Compatibility among various members of a computer family is essential for doing integrated data processing tasks by interconnecting several systems or system components. The System/360 introduced and implemented this system concept by providing six systems differing only in speed, memory capacity, and cost. In all other respects the members of the family are both hardware-compatible and software-compatible, thus allowing the interlinking of central processors and peripheral equipment with a minimum of effort.

Multiprogramming and Multiprocessing

The System/360 has opened up new opportunities in the basic mode of computer operation by providing efficient facilities for multiprogramming and multiprocessing. Multiprogramming is the execution of several programs in parallel in one computer system; multiprocessing is a processing mode by which several central processors are interconnected with an array of peripheral equipment to handle a given processing job. These forms of operations allow more versatile and efficient execution of data processing tasks.

Hardware Concepts: Microelectronics

These system concepts were implemented in the System/360 by using technically superior and economically feasible hardware components. System/360 machines are built by using micro-electronics on a large scale. Micro-electronic circuits provide for smaller-size circuits in the logic and arithmetic units, are substantially faster than conventional circuits, produce greater reliability, and if manufactured in great quantities, they offer substantially lower manufacturing costs.

In the area of peripheral equipment, the most substantial improvements occurred with the introduction of extensive communications terminals and a hierarchy of mass-storage devices — both essential ingredients of management information systems. The System/360 did not emphasize improvement of standard peripheral devices, such as card readers, tape drives, printers, and paper-tape equipment. IBM's philosophy in this area calls for evolutionary improvement of performance characteristics over the years.

Software Concepts: Operating System

Major conceptual changes in software technology were introduced with the System/360 to complement the changes in system and hardware developments. IBM realized that the complexity of the system operation of the 360 required that the programmer be freed from learning the detailed complexities of the system operation, and instead rely on the operating system provided by the manufacturer to schedule and control the execution of this program. The use of an operating system to perform the administrative and scheduling functions in the operations of the 360 is an extremely important concept. However, as yet the practicality of its application in all levels of 360 performance is yet to be demonstrated.

New Programming Language, PL/I

IBM also promoted the definition of a new programming language, PL/I, designed to replace existing higher level languages and permit utilization of the advanced features of the 360. The feasibility and wisdom of this decision has been widely questioned. As yet, PL/I has not been fully implemented. Its success and widespread acceptance are speculative at the moment.

The software support to be given the 360 included the development of program packages designed for specific industries, such as distribution, civil engineering, financial analysis, etc. Although the organization of the 360 was not an important influence on these application packages, their existence was widely extended with the change to third generation computers.

Critical Evaluation of System/360

From the foregoing it is clear that IBM with System/360 has set *de facto* standards in the computer industry. These standards are not basically challenged by any of IBM's competitors. To summarize, these concepts are: (1) an integrated, one-family, computer line covering a range of applications instead of a specific task; (2) an integrated compatible set of systems, program, and equipment; (3) increased use of communications and mass storage devices; (4) extensive use of software packages for specific application areas; and (5) increased reliance on powerful operating systems.

In several areas, however, limitations of the System/360 have caused it to fall short of expectations. The system is extremely complex. The general input/output channel philosophy is inflexible. The objective of providing upward and downward program-compatibility among the members of the computer family leads to failure to optimize in any one area.

The latter is probably the cause of an important market weakness of the System/360. Because the 360 tried to have equal appeal to both small and large computer users, and equal appeal to people with business applications and people with scientific applications, the 360's price/performance ratio was weak in many areas. The competition recognized this and moved in quickly to exploit the situation. IBM soon recognized this weakness, and introduced a number of additional System/360 processors designed to cover specific application areas or specific classes of users. These new processors have had only a token relationship to other members of the 360 line. Thus, the model 20, model 44, model 67, and model 90 series are all directed to cover areas which were not covered competitively by the original members of the 360 family.

Also, the market success of the upper end of the original 360 family was affected unfavorably by the announcement of advanced large computer systems by Control Data, UNIVAC, and General Electric. IBM moved to counter this situation by upgrading the price/performance of the original models 60, 62, and 70 and offering in that size class two new processors called the model 65 and model 75.

Table 3 indicates IBM's market share within specific industry classes in the United States. Its share is compared with that of its seven leading competitors. The figures in the table are based upon a statistical analysis of a Computer Installation Census File compiled and maintained by the International Data Corporation. This file identifies currently the users of nearly 85% of the computer installations in the United States. The figures generated in the study have been extrapolated to cover the entire domestic market.

Sales of the System/360

IBM's success in sales of the 360 is undeniable. A recent prospectus accompanying the May 1966 offering to IBM stockholders of 1.3 million shares of IBM common stock when analyzed indicates that as of March 31 IBM had on hand orders for the lease or purchase of data processing machines and systems having a net monthly rental value or equivalent of approximately $78 million. This figure is computed after deducting estimated replacements of installed rented equipment and estimated cancelled orders. This $78 million figure represents a net increase in the total monthly rental value of installed IBM data processing equipment when the backlog has been worked off. This net monthly

TABLE 3

SHARES OF THE U. S. COMPUTER MARKET BY MANUFACTURER AS OF DECEMBER 30, 1965

Manufacturer	Total Value of Installed Systems	Percent Of Market
Burroughs	$ 259.0 million	3.14 %
Control Data Corp.	372.8 "	4.53 %
General Electric	182.2 "	2.21 %
Honeywell	253.2 "	3.07 %
IBM	6,063.2 "	73.67 %
NCR	190.1 "	2.31 %
RCA	235.4 "	2.86 %
UNIVAC	540.4 "	6.57 %
Others	135.0 "	1.64 %
TOTAL	$8,231.1 "	100 %

Covers installed general purpose digital computers; Source, Computer Installation File of International Data Corp., Newton, Mass., Copyright 1966 by International Data Corporation

rental increase is estimated to represent 37% of the gross rental backlog. Therefore, IBM was estimated to have on order as of March 31, 1966, orders for $10.5 billion worth of equipment. Of this, the System 360 is calculated to account for $5.3 billion.

The Implications for Management

In the computer industry during the coming years, it is clear that the system concepts and mode of operation of the System/360 will continue to be *de facto* standards. This statement is tacitly admitted by most people in the industry; and competitors are eager to adopt System/360 features and concepts and incorporate them in their line. This situation causes increasing standardization in the industry, and can be expected to have beneficial results for management. What implications does this kind of computer standardization have for management?

First, since the systems design and software of products of different manufacturers will be compatible, management can select more objectively the computer equipment best suited to its need. The competitive equipment supplied by various manufacturers can be evaluated more on facts and figures than on subjective impressions.

Second, there is less danger of rapid obsolescence, which was characteristic of first and second generation systems. The commitment IBM has made to System/360 is enormous; it is very likely that it will be *the* equipment in use for more than the usual five-year cycle. Moreover, since higher level programming languages will be more used, the transition from the third generation of equipment to the fourth generation will be less costly and less painful.

Third, available computer manpower can be used better. Knowledgeable computer personnel are very hard to find. Standardization along IBM System/360 lines will enable training periods for computer specialists working with new equipment to be reduced, and will increase their usefulness on different installations.

Also, computers will increasingly become tools for everyday management activity. This will be helped by the steadily decreasing costs of remote terminal devices, display devices, and other equipment that can be used on the desks of middle and top management. The decrease in cost of communication lines, sophistication of central processors and software, and the conceptual changes in processing modes will lead to acceptance of the concept of the "total management information system." The full implications of this concept in furthering business objectives and improving business practices can hardly be estimated today.

The Future

From the platform of 1966 from which to make an evaluation of major trends in the EDP industry, it is possible to speculate reasonably on the environment of the early 1970's.

IBM will still unquestionably dominate the EDP market. However, it is very likely that its share of the market will decrease somewhat, to around 65-70%. The main reasons will be: increasing standardization, permitting potential users to select non-IBM equipment with confidence; superior equipment offered by the competition in selected areas; and the use of higher-level programming languages.

This "decrease" in IBM's share of the market will hardly cause any hardships at IBM, for it is expected that the market will expand during the next 5 years at least at an annual expansion rate of 15-18%. Thus by 1970 approximately $20 billion worth of EDP equipment will be installed, and IBM's expected share of around $12 to 14 billion is certainly formidable. However, there will be increasing room for able competitors. General Electric, Honeywell, Control Data Corporation, RCA and UNIVAC should each have a sizeable chunk of the market, although it is not predicted that any one of them will command more than 10% of the total.

The Approaching Maturity of the Computer Field

By the 1970's the industry will be more mature, and the pace of technical advances will probably slow to a more leisurely pace. Financial and market considerations will dominate in the design of new equipment, along with the restrictions created by widespread standardization.

In fact, we may expect that equipment development will follow the pattern established in the automobile business. New computers offered by major manufacturers will be more or less similar in characteristics, and will offer about the same performance/cost characteristics. Characteristically, manufacturers will woo customers by attractive financial arrangements, superior support and servicing of equipment, and applications-oriented software. As in the automobile industry, computer systems of various manufacturers will probably be selected by potential users on the grounds of style, cost, and reputation, rather than on considerations of hardware reliability, compatibility, and other technical factors.

WORLD REPORT—GREAT BRITAIN

The steady march of the British computer makers into Eastern Europe continues. After Bulgaria, which has bought a $400,000 1904 machine from International Computers and Tabulators as the first of 20, Poland has been negotiating with the same company for a whole range of equipment worth altogether just over $2m.

Metronex, the Polish State enterprise for foreign trade, has been the prime mover in the discussions which involve a machine for the coal mining authority in Katowice, one for a large electrical equipment manufacturer, a big system for ship design and research work and a still larger one for the Central Statistical Office in Warsaw.

If or when placed, these orders would raise the value of business concluded in Eastern Europe by ICT over the past few months to $6m with at least the same figure just around the corner.

Particularly significant is the way in which the Central Statistical Agencies of several of the countries involved have ordered the same type of machine, implying that there is an intention to standardise and speed up the provision of important economic data for such organisations as COMECON.

This steady advance, shared by the other major manufacturer English Electric-Leo-Marconi, must be a matter of some concern to International Business Machines which has wooed Eastern Europe through an envoy in the person of A.K. Watson, but with little result so far as can be discovered.

The reason is not hard to find. There is no lack of systems and programming talent in the area and potential clients are well aware of all developments in the west. They are not prepared to accept obsolete machines unless there is a particularly good software package to go with them. But IBM still is not near selling System 360 in the East, however many rumors of sales there may be.

This is hampering English Electric which would soon like to begin offering System-4, if it has not already done so. But if strategic reasons hold back IBM, they must prevail even more strongly with English Electric since System-4 with its microcircuitry is one technological step ahead of the 360 and is based on RCA designs for Spectra-70.

At home in Britain an important announcement on multi-access time-shared computer experiments by the Ministry of Technology's National Computing Centre has been followed very closely by an equally important announcement that C-E-I-R in London — once an offshoot of America's C-E-I-R but now wholly owned by British Petroleum Company, in which the Government has a majority shareholding — that it too was going for system sharing.

The National Computing Centre trials will start about the middle of next year when the big KDF-9 has been bedded down. They will involve connecting this machine to one of equal power over a high-speed link, adding a number of access consoles to each, and writing software which is capable of shuttling work between the two machines as and when either is loaded to capacity, so that consoles connected to one could well be working to the other machine at any moment.

The idea behind this is to prove that the suggestion of a nation-wide "computer grid" is feasible in the not too distant future. Said Professor Gordon Black, the ebullient head of the project, as matters now stand it should be possible to set up a form of grid by 1972. "Of course, we shall have to push the Post Office into providing adequate data transmission facilities and bringing down the cost of using coaxial cable", he declared.

Just a few days after this came the disclosure that C-E-I-R had opted for an IBM 67 equipped to serve as many as 400 users with simultaneity on 150 consoles. Delivery is for some time in 1968, hopefully, and while a British manufacturer was slugging it out right up to the last round, it is understood that delivery promises carried the day. There was nothing to choose on price.

A C-E-I-R spokesman hinted that bargaining for the 67, which will be rented, was tough. It included the ploy on the side of the C-E-I-R team of refusing to meet any more salesmen or listen to any more sales talk and demanding to hold discussions with the systems teams on the 67 and senior management on the manufacturing side. It was stated without ambiguity during the press conference that C-E-I-R was "resigned to making a major software effort to support this machine which would involve doubling its expert teams to a total of 250 systems men and programmers". The company has a CDC 3600, IBM 1401, and uses IBM Data Centre time.

On the military minicomputer front, the manufacturers seem to be winning the day. It looks now as if the Ministry of Defence's computer experts will need to do not a little redrafting of their IBM 4-Pi type specifications. What has saved the day is in all probability the decision that the remains of the Ministry of Aviation shall be taken over by the Ministry of Technology. This would give the latter a far greater say-so in military computers, and Technology has been committed since it was formed to "saving the British computer industry".

What this industry is going to look like in a few years' time in the context of the Common Market is still anybody's guess. Officialdom for the time being has passed on the buck to the companies, commenting that "Government-to-Government negotiations are too cumbersome and understandings between companies are far more advisable at present".

ICT this year will sell several million dollars worth of peripherals into the U.S. — to RCA and GE among others — and is seeking tie-ups on such ancillaries with a number of European firms. English Electric is talking about a "big base" in one of the Common Market countries. Elliott-Automation, with a massive $3m contract for a fully automated control system for a zinc smelter under its waistcoat, continues to sell through Continental subsidiaries.

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ARTIFICIAL INTELLIGENCE RESEARCH

RETROSPECT AND PROSPECTS

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> *"An answer to the question 'Can machines think?' that would be acceptable to all reasonable men would have as profound an influence on science, theology, and philosophy as did the demonstration of the chemical basis for life."*

Speculation concerning the potential existence of artificially constructed devices exhibiting intelligent behavior is probably as old as man's invention of magic. The golem of Jewish legend, Mary Shelley's Frankenstein, and Karel Capek's robots are well-known examples that predate electronic computation. It was the physical realization of automatic digital computers that brought such speculative impulses, at least in part, out of the domain of fantasy and into the laboratory.

A. M. Turing's "Can machines think?"

In 1950, when less than a handful of these machines actually existed, A. M. Turing analyzed the question "Can machines think?" in a thought-provoking essay. Turing's paper is, perhaps, the earliest instance of a scientific and philosophically meaningful effort to deal with the central problem of artificial intelligence. Much subsequent work in the area is an elaboration and extension of his ideas.

Turing's answer to the question he posed was "yes," largely on three grounds: he could refute the then-extant objections to the possibility; he was able to outline a procedure whose implementation *might* result in success; and he had developed an objective criterion for measuring claims of success. In general, if not in particular, these refutations, procedures, and criteria remain valid today.

The Current State of Research

As this article is concerned primarily with the current state of affairs in artificial intelligence research, there is little to be gained from detailed examination of most arguments against the possibility of such research leading to successful accomplishment. If one is not able to accept Turing's test, which is discussed below, or some philosophically equivalent variant of it, the argument becomes metaphysical and beyond the scope of this discussion. Stipulation of the validity of Turing's test in no way prejudges the possibility of satisfying the criterion; it merely ensures that further discussion will follow scientific rather than theological ground-rules.

Turing's Test

Turing's test was quite simple. An interrogator was to be provided with a teletype having two channels, one communicating with a human operator and the other with a suitably programmed digital computer. The interrogator would not know which channel was coupled to the machine and would be given the task of determining that fact by asking questions and interpreting the answers. If the machine could not be identified with statistically significant frequency, then it would pass the test.

Current workers in the field are not so demanding, however. Rather than insisting on a demonstration of the full panoply of human intellectual capability and the consequent indistinguishability between man and computer, students of the subject are now generally willing to accept success in an explicit, circumscribed field, such as problem solving.

There are four essentially different approaches to this problem of creating an intelligent device artificially.

Biochemical Synthesis of Artificial Intelligence

In the first approach, a potential end product of current research in molecular biochemistry and life synthesis is the android. Whether or not an automaton of manlike form composed of biological materials is a machine is moot; whether creation of an android is possible will not be answerable for a long time. For these reasons, further consideration of this approach is irrelevant in this article.

Artificial Neural Systems

In the second approach, an attempt is made to produce artificial nervous systems electronically, either by direct construction from basic electronic devices or by simulation on a digital computer. The relevance of this work to artificial intelligence is questionable today because of the limited understanding available concerning the neurophysiology of higher animals, including man. As a result, most work in artificial neural networks has concentrated on the simulation of such creatures as the jellyfish and the construction of abstract nervous systems of no greater complexity. Creation of an artificially intelligent device by these techniques seems as remote as the first android. It may happen, but hardly soon.

Simulation by Digital Computer

In the third approach, advocated by almost everyone who claims to be doing research in this area, and which will accordingly be discussed here at greater length than were the first two approaches, a digital computer is used to simulate some psychological model of human intellectual behavior. Superficially this appears sound. There is a plethora of models to choose among. Limiting the area of human behavior whose simulation is required allows the use of simpler models than those necessary to explain fully all rational human behavior. Indeed, through the use of one particular model of human problem-solving behavior, certain limited, yet in some ways remarkable, successes have been achieved.

Programs have been written that prove theorems in elementary logic and plane geometry, solve algebraic "word problems," perform indefinite integration symbolically, play checkers well and chess badly, solve simple puzzles and generalize the solution to more complex ones, balance assembly lines, compose music, and answer natural language questions about a limited subject. This list is by no means exhaustive; many other similar tasks could be performed. Furthermore, it would be neither a hopeless programming task, nor beyond the capacity of existing hardware, to package all these programs into a single, self-consistent system. Admittedly, such a system would be expensive, and it would fall far short of being able to pass Turing's test; nevertheless, the charitable critic might then admit that something approaching an intelligent device had been demonstrated.

Programming Strategies for Problem Solving

The common thread running through all these programs is the viewpoint each program assumes of the structure of its assigned task. These tasks are looked upon as problems to be solved, and the problems are structured as if they were formal games, having rules, legal moves, and, by derivation, strategies. Successful strategies, of course, are those whose result is the solution of the problem.

The naive might assume that the procedure to follow is that of programming the systematic analysis of every possible strategy to determine its consequences, and then selecting the best strategy. A moment's reflection shows how futile this tactic is. Even in the simpler problems the number of strategies can be enormous. The estimated number in chess exceeds the number of particles in the observable universe. In some cases, such as theorem proving, the number of strategies is literally infinite.

Copying People's Strategies

Since people are known to prove theorems, it is clear that some procedure other than exhaustive search is involved. Attempts have been made to isolate this alternative problem-solving technique, by studying human behavior in such alternative problem-solving technique, by studying human behavior in such situations. The method of study is to present a human subject with a specific problem, ask him to solve it and simultaneously to verbalize (and record) his thinking as he proceeds. When a sufficient number of recordings, called "protocols," are accumulated, the investigator attempts to find general, characteristic principles that are involved.

Rules of Thumb

The main principle that has been identified is that people employ a variety of approximate rules of thumb. These rules of thumb, called "heuristics" in the artificial intelligence community, are of variable utility and do not always yield useful results, but they drastically reduce the number of possibilities that are considered. An example of a heuristic is the technique known as "means-ends analysis." Here an attempt is made to transform an initial state, such as the axioms of logic, into a final state, such as a candidate for a theorem, by successive application of operators, such as the rules of inference, where each application reduces the difference between the existing state and the final one. In some problems the notion of difference may be objective and measurable; in others a further heuristic must be applied to estimate whether a reduction has occurred.

Without demeaning the efficacy of the resultant heuristic techniques, it should be noted that the procedure by which they were isolated is questionable, self-limiting, and unnecessary. By forcing an individual to verbalize at the same time that he is solving a problem, the investigator is really calling for the solution to a different, dual problem, and there is no guarantee that the original problem would be solved in the same way in the absence of verbalization. The limiting factor is obvious; not all intellectual activity is readily verbalizable, and, if simultaneity is required, the difficult things to verbalize will either be omitted or distorted. Finally, the heuristics that have been obtained could have been identified, probably with less trouble, by inviting some veteran problem solvers to introspect.

Using Any Available Computer Techniques

Finally, there is a fourth approach to the problem of creating artificially intelligent devices it has been used by surprisingly few investigators, excepting only those dealing with natural language. Here the investigator simply employs any computer techniques at hand that contribute toward the goals of the program, without regard to whether *people* employ related techniques or not. Such expanding of the range of permissible techniques should improve the probability of success. The only hypothesis that seems to explain the general failure to try this approach is that it is often felt to be cheating: if a task can be accomplished by computer in some way that is different from the way a person would do it, it is argued that performing this task does not really demonstrate intelligent behavior after all.

One cause for this feeling is that the problems of creating artificial intelligence and of studying human behavior by computational models — in reality quite separable endeavors — are frequently confused in the same investigation.

Suppose sufficient effort were devoted to designing an artificially intelligent device using any available computer techniques — like for example building the analogue of an airplane rather than the analogue of a mechanical bird. Then it seems to me it would be possible to develop a device that would pass Turing's test with fair success, unless the test were applied over a lengthy period and with some astuteness. To actually do this however would be expensive and time consuming, of course — and rather pointless, because Turing's test, as he posed it, has two flaws.

Communication of Patterns

One of these flaws, easily removed with current hardware, is the lack of provision for the communication of patterns other than those present in strings of symbols chosen from a limited alphabet. Adding graphic input-output devices to the computer repairs this flaw — and presents enormous difficulties for the designer of a system that would pass Turing's test. Men are superb at the task of recognizing two-dimensional patterns; at present machines are so bad at it that any comparison is ludicrous. This remains true despite large efforts to automate pattern recognition because of its practical importance in such problems as the automatic analysis of weather satellite photographs.

Learning New Methods of Problem Solving

The second flaw in Turing's test is not fatal, for it can be overcome by a diligent interrogator. That flaw is that it is difficult to determine whether a program can learn at any level above the trivial, and also difficult to determine whether it can generalize significantly. It is relatively easy to program the ability to file presented facts and retrieve them subsequently upon presentation of suitable cues. It is even possible in certain areas, such as game playing, to program the ability to learn from mistakes. But there is little to suggest that present techniques will produce the ability to learn new methods of problem solving; indeed, there is the negative evidence provided by the many investigators who have tried and failed. Precisely the same remarks can be made about programs that generalize.

Plateau

Devices that cannot recognize patterns and that cannot learn and generalize at about the level at which people can do these things will fail to satisfy even the friends of artificial intelligence. Today's techniques appear unable to contribute significantly to the attainment of these abilities; also, with the possible exception of pattern recognition, there seem to be few ideas to explore. At present, research in artificial intelligence has reached a plateau. Heuristic techniques can obviously be extended to more problem areas, and further study will undoubtedly somewhat improve their applicability and generality. The extent of early accomplishments, however, is unlikely to be repeated at the next higher level, however, until some fresh ideas have been found.

Fortunately, recognition of this situation has begun to percolate into the community studying the problems of artificial intelligence. The public is no longer subjected to such patently silly claims as that of the world chess title going to a machine in 1967. Enthusiasm for one's own project is commendable, but extravagant claims result in the real accomplishments being drowned in a sea of charges and countercharges. With respect to this problem the artificial intelligence community seems to be growing up.

Two Groups of Investigators

With some exceptions, the artificial intelligence students are dividing into two groups: one maintains the original objective of the eventual creation of a device that will be regarded as intelligent by all reasonable people; the other maintains the original purpose for which artificial intelligence was supported by practical men — to do jobs cheaper or better than people could do them. The first group is settling down for a long pull, mainly in university laboratories. The second group, recognizing that at present optimum performance will come from a division of labor between men and machines, is turning to investigations of on-line systems. It is evident that the near-term payoff is much higher when the human being is left in the loop. As intellectual functions now performed by men become programmable and attain a higher cost-effectiveness, they can be turned over to the machine.

One might well question the sense of continuing study on the pure artificial intelligence problem. Why not simply wait and see if the man eventually gets automated out of the on-line systems? The answer is that the on-line route might never go all the way without continuing research on the pure problem, and, furthermore, might be a dead end without demonstrating the infeasibility of some other route.

The Value of an Answer

An answer to the question "Can machines think?" that would be acceptable to all reasonable men would have as profound an influence on science, theology, and philosophy as did the demonstration of the chemical basis for life. It is one of life's important questions; the answer should be pursued until it is either found, or shown to be unfindable.

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Designate No. 11 on Readers Service Card

CREDIT CARDS — STEPPING STONES TO THE CHECKLESS SOCIETY?

Dale L. Reistad
Director of Automation
Department of Automation
American Bankers Association
New York, N. Y. 10016

"We have an existing network of bank interrelationships, holding companies, branches, correspondent relationships, etc., that could form the base for a data transmission system that would permit all banks to communicate electronically with each other in seconds."

Credit cards are going to be our keys to a future checkless-cashless banking system. This is very much a matter of concern to the Department of Automation at the American Banking Association. Let us consider the subject of credit cards from the standpoint of automation. What will be their probable impact on an automated credit card system, on consumer banking, and on a checkless, cashless economy?

Bank Credit Cards

Including the franchises signed by small banks with their big city correspondents, probably close to 1,000 banks are now committed to a program of credit cards. That means that 1,000 banks have already taken, or plan to take in the near future, a giant step forward into the automated future when a plastic bank identification card will serve to activate a series of electronic pulses that will slowly but surely lessen the need for cash and cause fewer and fewer checks to be written. What this will lead to eventually we can only guess — but most certainly the technologies will be available to make a checkless, cashless society a possibility in some form and size.

There are of course expenses involved when a bank enters a credit card program: promoting the cards, absorbing the initial credit losses, advertising massively, providing the budgets required by entirely new departments set up to implement this program. Also there is the danger of what might occur if credit cards lead to excesses in consumer purchases as a result of consumer-buying binges. These are critical problems worthy of careful consideration, but what I am concerned with here is the changes taking place in the banking industry as a result of credit cards.

What is the effect that they, when combined with the other new technologies, will have on the future mechanism of commercial banking?

What effect will the proliferation of credit cards and the increased use of charge account purchasing plans have on the present habits of consumers in paying cash or in writing checks?

(Based on a talk to the Illinois Bank Management Conference, November 3, 1966, Urbana, Ill.)

Are we going to move from one huge paperwork jungle — namely, check processing — to another — the processing of charge account receipts?

Is this the giant step forward now being taken by the industry? Or are we going to use the collective talents of the banking industry (such as we did with the MICR program) to develop new processing techniques which take full advantage of the new tools now at our disposal?

Adoption of Bank Credit Cards

Robert K. Wilmouth, vice president of The First National Bank of Chicago, has predicted that credit cards will be adopted by banks of all sizes, and has stated that in Illinois over 200 banks have already signed up for one of the plans now being offered. Eventually a bank will have several approaches from which to choose, such as banks today have several alternatives in automation. Wilmouth also pointed out that there is bound to be a decline of small installment loans as we know them today, and that automatic individual lines of credit and merchant check cashing guarantees will become routine services for banks to offer.

The Future Financial Interchange

What is happening therefore is not that an isolated new service is being added to full service banks. The credit card is more than this. It is a stepping-stone to an entire new era of banking — the checkless, cashless society. For some banks, credit cards are the first stepping-stone, for others computers came first and credit cards second, but whatever the sequence a bank takes, it must eventually take a number of steps along an entire new path of banking — the financial interchange of the future.

What is a financial interchange? It starts with the decision by a consumer to make a purchase — either cash or charge — which initiates the credit inquiry process. It continues on through the use of credit cards as the method both of identification and input to an automated record-keeping and advisory service and concludes with the loaning function. These processes are not separate; where they interface with each other, entire new industries are starting to develop. For example, if you interface the credit inquiry process with credit cards you develop the computerized credit bureau which, when tied in to the credit card, or better yet, the bank identification card, revolutionizes the credit checking phase of the charge transaction. The same bank ID card could also be used in the future for cash transfer purposes.

Housewife's Use

Let us consider the use of the credit card or bank identification card in the checkless economy of tomorrow. A housewife, let's call her Mrs. Bates, will be able to charge a purchase at any store in her area by simply presenting her card to the store clerk. The card will be inserted in a slot and the housewife will push two buttons — her confidential code — in a small inexpensive input terminal which in turn is connected through the merchant's telephone to a computer system located miles away. In seconds the housewife's record on the computer is interrogated, her credit rating is mathematically computed, a rating determined, and the merchant informed as to the results. The store clerk might be informed by a voice answerback system, or perhaps a light will flash on the input terminal or on a signal device behind the counter. This may sound complicated, but it really isn't. It may seem reasonable to expect a long time delay — but it requires only a few seconds. When the clerk pushes the "sale approved" button on the input terminal, the sale has been completed, records have been updated at the credit bureau and the accounting data spun off on an auxiliary magnetic tape unit for later processing.

But what happens if there is a cash purchase? Let's follow the housewife into the supermarket. At the cash register Mrs. Bates presents the same ID card to the check-out girl, where it is inserted into an input device connected to the cash register and then in turn to the telephone link to the computer at the bank. This time a simple accounting transaction takes place in the bank's computer. Our housewife, Mrs. Bates, has her cash transfer account debited and the supermarket — also a customer of the bank — has its account credited. No paper need change hand, and the benefits to both parties as well as to the bank are considerable.

Upon returning home, Mrs. Bates finds that the mailman has delivered several bills. She decides to pay them since she is in a cash transferring mood. This time she uses her home telephone, first to contact the bank's computer and next to transfer funds from her account to those of her creditors. If she wishes, she can supply the bank with a future date for each bill that she wants the bank to delay payment on. Meanwhile, back at the bank, cash transfers are keeping the computer busy 24 hours a day from merchants, housewives, small businesses.

Bankers' Expectations

Recently we conducted a survey to determine what bankers thought about some of these new concepts of electronic banking. We first described the concept and then asked, "How does your bank regard the following developments in banking automation?" The bank was asked to check: (a) an accepted fact, (b) for the "Giant" banks only, (c) just a matter of time, (d) at least ten years away or, (e) not likely to happen. Here are the results from three concept areas.

1. *Bank Credit Cards:* Base — 1,845 banks
   a. An accepted fact — 14%
   b. For Giant banks only — 14%
   c. Just a matter of time — 32%
   d. At least ten years away — 21%
   e. Not likely to happen — 19%

At the time this survey was conducted less than 100 banks had announced their plans. Today the figure, as mentioned earlier, is closer to 1,000.

2. *Elimination of Check Writing:* Base — 1,844 banks
   a. An accepted fact — 1%
   b. For Giant banks only — 4%
   c. Just a matter of time — 11%
   d. At least ten years away — 32%
   e. Not likely to happen — 52%

Perhaps the wording for this inquiry was too strong. Certainly it's inconceivable that *all* checks will be eliminated in the future. The question should have read, "great reduction of check writing over the next 10-15-year period due to electronic cash transfer systems." Bankers are not nearly so pessimistic about this concept as can be seen from the next question.

3. *Bill Paying Via Telephone:* Base — 1,818 banks
   a. An accepted fact — 2%
   b. For Giant banks only — 8%
   c. Just a matter of time — 26%
   d. At least ten years away — 39%
   e. Not likely to happen — 25%

Businessman's Use

Let's not forget the breadwinner, Mr. Bates, as we design our future banking system. His transaction volume may not be as high as it was before his wife took over the accounting — but he still merits our concern and appreciation. Mr. Bates, a local businessman, used to conduct his banking at one of the local branches near his office — or on occasion — at the main office when the transaction was complex or when he was in that area. With the development of the "On-Line Banking Station" (introduced for the first time in San Francisco by Diebold, Inc.), all this will change. In the future, Mr. Bates will be able to do his banking from his office lobby, or at the train station, or in his customary department store. Through the simple process of inserting his bank ID card in a slot on the station he will be on-line immediately to his bank. With the "banking station" approach the bank ID card will determine the bank main office at the other end of the telephone line, so the busy consumer won't have to wander around looking for the station with the First National emblem (say) if he wants to contact his bank. Once again we see the importance of having a bank ID card — or bank credit card in any future system.

Bank Capabilities

A recent survey of capabilities of banks currently indicates that approximately 3,000 banks are now involved in some form of computer processing. Banks are installing third-generation computers and training our second-generation bankers how to use them.

How can a bank possibly handle all those cash transfers we spoke of earlier — especially during the peak periods? One answer is that power makes it all possible, that is, the power of the third generation equipment, some of which is capable of processing in billionths of seconds. We know too that the total installment credit needs of banks is going up, and that the per unit processing cost on computers continues to go down. In fact, each new generation of equipment seems to be getting smaller, faster, and although slightly more expensive to acquire, is in fact less costly in terms of throughput, the amount of data that can be processed from start to finish during a given period of time. As technology keeps going up, credit use keeps going up, and processing costs continue to go down.

(Please turn to page 46)

c & a CAPITAL REPORT

The possibility of government regulation of electronic data processing services involving interstate communications appeared a few days ago, when the Federal Communications Commission issued a notice of inquiry to computer users, common carriers, manufacturers, and the public. The FCC set December 12 as the deadline for submission of views and recommendations dealing with how and whether EDP services falling under the Communications Act should be regulated.

Early response to the inquiry notice has been generally favorable, according to the Commission. The realization that proliferation of time-sharing networks, cross-country data transmission, and remote computing facilities is a public matter, seems to be shared by many in the industry.

One of the critical questions to be answered is how to draw lines between organizations providing purely data processing services, and those who also own and/or lease long-distance communications lines as a part of their data processing activity.

Another question pertinent to the Commission's inquiry is the quality of service which common carriers now offer to long-distance communications/computer users. The Commission will investigate the possibility that inferior or inadequate service between remote units and their central processors might slow the development of this segment of the industry. With the prospects of a no-money society, remote consoles in every kitchen, and vest-pocket access devices in every scientist's coat, some regulation is probably inevitable.

Even now, in some cases beyond a 50-75 mile radius of the central computer, the cost of lines exceeds the cost of the computation itself.

The Commission is charged with the responsibility of making sure that the public is served with technically adequate, reasonably priced lines necessary to the continued development of the industry. Projections for the future of remotely accessed systems resemble those made in the early days of the telephone.

The Commission does not state that regulation is needed or mandatory at this time, but seeks to gather as much information as it can about the important questions surrounding communications/computer public policy.

Aside from these questions, there is another area of concern. What is the policy to be with regard to the large common carriers themselves providing dual computing/communicating services, where regulation of competition could become an important factor?

At this early date, the Commission feels that it is too early to predict the outcome of the inquiry. They will attempt to move rapidly in assessing the views and recommendations submitted by interested groups, and follow up later with the complex task of gathering factual and pertinent information related to specific questions which need answering.

The computer industry is in a headlong drive to develop computer utilities and network-linked service bureaus. It could generate a major regulatory action by a Federal agency concerned with assuring the computer-using public that their services are provided at reasonable cost, equitably available to all, and not monopolized.

Biomedical applications are frequently overlooked in the current controversy centering around Big Brother and the invasion of privacy. Scores of little-publicized systems are being improved and perfected in the capital by dedicated public servants who often labor for years without sharing the limelight of their counterparts in the glamour agencies.

The Veterans Administration Research Center for Cardiovascular Data Processing in Washington has worked for nine years on a system to produce accurate and timely statistical diagnoses for heart patients, and they are within sight of a real-time system which may save many lives in the future. It's not quite real-time yet, but the hardware exists, and the analytical programs are almost perfected.

A Control Data Corporation 3200 is being used at the D.C. VA Hospital to analyze electrocardiographic data from patient electrodes which record heart cycle impulses on analog tape. The analog records are converted to digital, and calibration records from the analog equipment are also recorded to standardize the input. The digital tapes are then processed through the CDC 3200 programs for cycle analysis. More than 300 different measurements are printed out, including several complex vector analysis measurements of the major wave forms which are used to distinguish normal and abnormal heart cycles.

Dr. Hubert V. Pipberger, head of the Research Center, has been working on automatic analysis of heart data since 1957, and has progressed through the problems of using straight analog data, several different kinds of patient lead systems, and the difficulties of writing programs to analyze 24-dimensional vectorcardiographic digital input.

He now has a data bank with 40,000 digitized patient records in it. From this bank, and verified cases of abnormalities, he is able to automatically recognize, with 90% accuracy, several different abnormalities or transient conditions. With an EDP-experienced viewpoint, he says that his automatic diagnostic real-time system is still sometime away, but that the equipment is available, and the necessary mathematical techniques for the complex programs are in sight.

The result of the many years of ADP research which the VA staff and the Georgetown Medical School have done, should be a system which can be used with heart patients to automatically diagnose their condition within three or four minutes. It will tell the attending MD what the patient's condition is, what he probably has wrong with his heart, and what the indicated emergency treatment should be.

Central processors accessed by remote analog/digital recorders at the patient's bedside will operate over voice-grade telephone lines. A portable data-cart will record, convert, and transmit the data, and receive the results of a probabilistic computer diagnosis and the indicated emergency treatment.

Senter W. Stuart

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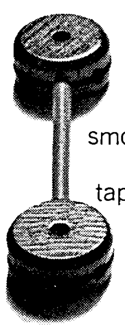

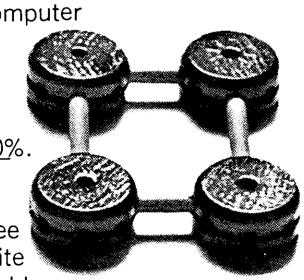

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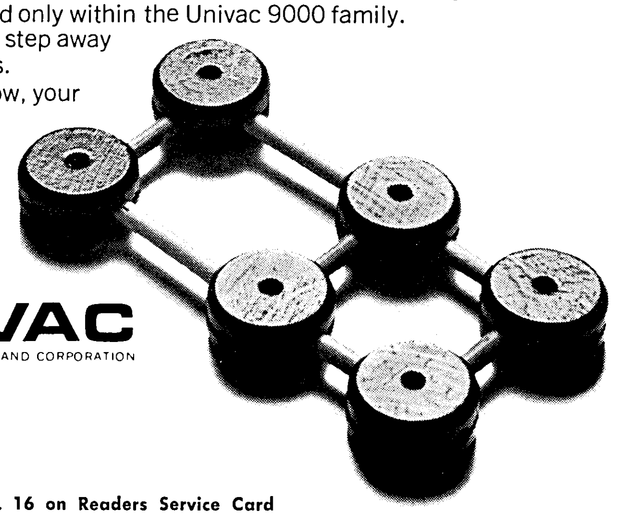

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THE ART OF LEASING COMPUTERS

George H. Heilborn, President
Information Processing Systems, Inc.
200 West 57 St.
New York, N. Y. 10019

"Corporations with large or multiple computer systems should seriously consider the various forms of computer leasing as a method of decreasing their costs for electronic data processing."

One of the more curious tribal customs in the computer field has been the habit of renting equipment from the manufacturer. Capital equipment — machine tools, aircraft, ships — is usually purchased outright. In very few cases does industry rent equipment from the manufacturer at a level monthly payment which includes maintenance. In other fields, when equipment is leased from the manufacturer, it is as a rule merely a case of the manufacturer obtaining the bank financing and holding title. The leasing is done merely as a convenience to the customer. The manufacturer's leasing subsidiary has a separate set of books, and is expected to make a profit, or at least break even, on the financing alone, while the manufacturer himself treats delivery of such a leased piece of equipment as a sale. In some cases, equipment may be leased from a leasing company, bank, or other financing source, rather than from a captive leasing company of the manufacturer.

The purpose of this article is to examine in detail some of the methods of obtaining capital equipment, with particular reference to electronic data processing systems, through leasing, that is, by means other than rental from the manufacturer, or outright purchase.

Definitions

To minimize confusion, let us differentiate between "rental" and "leasing." In this article, we will define "rental" of equipment as rental from the manufacturer at a fixed monthly rate basically independent of the time over which the rental occurs, and during which the user can cancel the rental contract on relatively short notice. The equipment would then be returned to the manufacturer without obligation and without the renter having achieved any ownership rights in the equipment. Rental also includes maintenance, personal property taxes, and insurance.

A "lease" will be a contract under which the user pays someone other than the manufacturer a monthly sum, where the lessor has purchased the equipment outright from the manufacturer or previous user, and where at the end of the lease the equipment belongs either to the lessor or the lessee, but not to the manufacturer. These definitions are not perfect, but they clearly distinguish between what are ordinarily called "rental" and "leasing" by the computer and financial fraternities, respectively. As we shall see later, certain forms of leasing begin to shade into virtually rental contracts.

Background

Historically, of course, rental of computer equipment has come about through IBM's insistence, for many years, on only renting equipment to users. The consent decree of 1956 required IBM to change this policy, but as much of this equipment, particularly punched card equipment, once installed on rental, tends to remain installed, rental, which IBM has continued to stress, has been a highly profitable area for them. Computer users tended to continue to rent equipment for several reasons;

(1) out of sheer habit,
(2) because, in the "computer revolution," they did not, for the most part, know how successful their computer operations would turn out, and wanted to remain flexible in changing to different or newer equipment,
(3) the peripheral nature of data processing to most companies.

Point (3) should perhaps be explained further. Consider the shipping or metal-working industry. In a real sense, such an industry revolves around its particular capital equipment. With the exception of service bureaus, which are almost all small firms, this is not true in the EDP field. Thus, a metal-working firm would be inclined to place its capital primarily into machine tools, and a shipping line, into ships. But EDP systems, while useful and often necessary, are not central to the operation of most businesses in this sense, and thus tend to get less emphasis from the point of view of capital investment. This is particularly true of small firms, where the problem of capital allocation is most critical. Here one finds the far majority of EDP systems rented. Large firms, on the other hand, are much more likely to have purchased or leased their computer equipment.

In view of the fact that the technology is changing more slowly than previously, and there is a "new generation" of computer equipment coming onto the market, it is of interest

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Author's note: This article discusses various facets of computer leasing. In doing so, it is necessary to go briefly into such areas as depreciation, investment credits, contractual status of leases, etc. The discussion here is one of principles, not details; no claim is made that these highly complex subjects are treated exhaustively. Qualified legal counsel and/or accountants should be consulted on the problems of specified leases.

to investigate alternatives to the traditional rental to see if there may be advantages to purchase or lease of equipment.

Technical Considerations

From a technical point of view, one of the main advantages to rental has been the ease of upgrading equipment or changing systems. One piece of equipment is moved out, another is moved in, and the only thing that changes (in theory) is the rental bill, usually upward, and the through-put, hopefully also upward. When relatively small changes are made, often this is an important advantage. Small changes might be addition of core storage or replacement of low speed tape units by faster ones. As changes become more complex, however, the advantages become more illusory. Reprogramming becomes necessary. A change from tape to disc may mean completely new systems analyses as well. Operator techniques change, and retraining is necessary. Much of this occurs even if moving to a "program-compatible" system, if one wishes to utilize the extra capacity and capability of the newer equipment. Thus, once a system is installed, the programs written, the system analysis done, and the operators trained, it tends to stay installed in relatively the same configuration. Major changes are not made unless absolutely necessary.

If equipment is purchased, however, *no* changes are made lightly, as they will involve either selling or trading-in the old equipment, and buying new components. Trade-in values tend to be low, and are generally well below book value during the early years (2-3 years) after purchase. Until the last two or three years, no secondary (used equipment) market existed for EDP equipment, and hence there was effectively no open market price which would allow a realistic estimate to be made of net cost in changing equipment. (In the used car market, even the average man, with the aid of the classified ads, can make a reasonably close guess as to what he will be allowed on his four-year-old Model X on a new Model Y, because there is a stable market). As leasing is, from this point of view, the same as purchasing, since the manufacturer no longer owns the equipment, this objection on changing systems also applies to the leasing field. There are now various types of leases, with different advantages and disadvantages, which attempt to take account of this problem, as we shall see below.

Leasing—Financial Considerations

There are several types of leases used in the leasing of capital equipment. Before going into them in detail, however, we should investigate several areas which have a direct bearing on the merits of each type in a particular situation. These are depreciation of equipment, the investment credit for purchase of new or used capital equipment, and the residual values of equipment at the end of the lease term.

Depreciation

In the purchase of capital equipment, a company is allowed to write off the cost of the equipment against income over a more-or-less specified number of years. This "depreciation allowance" is theoretically to recoup the cost of equipment used up in productive work during its lifetime.

Depreciation guidelines are set by the Internal Revenue Service for certain classes of equipment, although the guidelines can be modified for particular cases if it is shown the equipment wears out more rapidly than the guidelines indicate, or that replacement on a more frequent schedule is actually made.

It is important to note that depreciation is allowed only to the *owner* of equipment, not to the lessee. Thus, depreciation for equipment rented from the manufacturer is taken by the computer manufacturer. Depreciation on leased equipment is taken by the lessor.

Purchased equipment must be depreciated by the purchaser, in other words, according to the guidelines, while lease payments are considered a business expense, and can be directly written off against income.

Depending on company policy, use of the machine, anticipated replacement schedule, and other factors, industrial corporations which purchase computer equipment generally depreciate it over periods of four to ten years. (The IRS guideline for office equipment is ten years.) Computer manufacturers usually use shorter periods, often as little as four years, probably justified because of the risks necessarily taken in renting equipment on a month-to-month basis to their customers, where the equipment may be removed at any time.

Depreciation Policies

Depreciation policies vary in type as well as in length. For example, over a given period, capital equipment can be depreciated on a straight-line, sum of the years-digits, declining balance, and other bases. A straight-line basis, as the name implies, means that the same amount is written off every year; on a five-year schedule, 20% of the cost is charged to income each year. A double-declining balance method, over a five-year period, means writing off 40% the first year, 24% the second, 14.4% the third, and so on. A "fast write-off" usually means that equipment cost is more heavily charged off to income in the early years of use, as in the double-declining balance method.

The undepreciated (remaining) cost of the equipment at any time is its "book value" at that time. Therefore, even two companies writing off the same equipment over the *same* number of years may, at any time before the end of the depreciation period, have quite *different* book values for their equipment.

It should be stated generally that to many managers, there is a certain mystique about "book value," which they feel must be obtained at all costs if equipment is sold before being completely depreciated. The author has seen a number of companies take severe and unnecessary losses by insisting on selling equipment only at or above "book value," only to find this impossible, while the equipment sat gradually becoming completely worthless. Very few managers realize how arbitrary (but consistent by standards of company policy) such "book value" is, depending as it does on the depreciation period chosen, the way investment credit is handled, the salvage value assumed, and the type of depreciation chosen. For example, suppose two companies each buy a computer system for $1,000,000. One company depreciates it over five years by a double-declining balance method; the other, over ten years by a straight-line method. Both assume negligible salvage value. (All other effects, being relatively minor, are ignored.) At the end of the fourth year, the first company's system will have a book value of $129,600; the second company's, a book value of $600,000. In this admittedly extreme example, the open market value of both systems would clearly be the same (but not necessarily either of these values); so book value obviously does not reflect the "real value" of equipment.

Discounted Price

It is also important to distinguish between "depreciation" and "discounted price." Until recently, IBM, particularly, has had a price schedule whereby the equipment could be purchased by a renter of the equipment at the original cost minus 5% or 10% per year of age, down to a certain minimum. This is a *discounted price,* and has no relationship to the status of *depreciation* of the equipment. Much if not all the equipment sold at these higher prices has undoubtedly been *depreciated* on IBM's books (as the owner) to zero or to a much lower value than the discounted price. As pointed out before, there is no relationship between book value and open market price, and the discounted price is nothing more than an artificially stabilized "market price."

For used property, some of the faster write-off methods of depreciating capital equipment cannot be used. This is not serious, however, as there seems to be more disagreement among companies as to the length of time over which equipment is written off than on the method to be used (almost always a straight-line write-off).

Investment Credit

A purchaser of new capital equipment having a useful life of at least four years (i.e., depreciated over four years or longer) has an investment credit which can be directly subtracted from his tax liability (not from pre-tax income, but from the federal tax liability itself). This credit is 2-1/3% of its purchase price for equipment with a life of 4 or 5 years, 4⅔% for equipment with a life of 6 or 7 years, and 7% for a useful life of 8 years or longer. The investment credit may offset up to approximately one-fourth of the tax liability for a corporation with tax liability much greater than $25,000; for smaller companies, the situation is somewhat more favorable.

On new equipment, a lessor can elect to pass through the investment credit to the lessee, or retain it himself. Companies whose expenses are largely made up of depreciation charges for capital equipment (e.g., airlines, whose biggest expense is the depreciation charge for jet airliners), sometimes lease equipment because the lessor can then take the investment credit for amounts exceeding the legal amount that the user himself can take (approximately one-quarter of his tax liability). In such cases, the tax savings now taken by the lessor are reflected in the lower lease cost to the lessee. Generally, of course, the situation works the other way around — the lessee is interested in obtaining the investment credit for his own use.

Used equipment is eligible for the investment credit only up to the value of $50,000. Also, for used equipment, the lessor cannot pass on the credit to the lessee.

Residual Value

The residual value of equipment is the value at the end of the lease or depreciation period. Generally, on a net or financial lease (see below), the lessor will depreciate the equipment over the term of the lease, on the basis that there is no way to tell in advance whether or not there will be a market for the equipment at the end of the lease term, particularly because the equipment has been ordered to the specifications of a specific user. Residual values may be obtained either by outright sale of the used equipment or by re-leasing it to another firm.

With these various considerations in mind, we will examine the different types of leases.

Net Leases

First, let us look at net leases, which might be considered the "classical" type of lease. In a net lease, the leasing company (lessor) buys a computer according to the specifications of the lessee. The lessee signs a contract for lease of the equipment for a given number of years. During the term of the lease, the lessee will pay the lessor for the cost of the equipment, plus a service charge which covers the lessor's cost of money, administrative costs, and a small profit. The lessee usually is responsible for insurance, maintenance, and other such costs. At the end of the lease term, the equipment will have been paid for, in essence, by the lessee. He may at that time renew the lease, usually at a purely nominal charge, or then or later, abandon the equipment to the lessor. The lessor then obtains the residual values (if any) by selling or re-leasing the used equipment to another company. The lessor often counts on a certain residual value to make up the total profit expected from the lease.

The leasing service charge usually depends to some extent on the cost of the lessor's money, and the credit rating of the lessee.

Financial Leases

A financial lease is again a lease whereby the lessor buys equipment to the specification of the lessee, and the lessee signs a contract guaranteeing payment for the entire cost of the equipment over the term of the lease, plus interest and service charges. In the financial lease, however, the lessee in effect *retains the residual values* of the equipment. At the end of the lease, the lessee can either, as in the net lease, continue to lease the equipment at a nominal charge, or have the lessor sell the equipment for the lessee's account. (He may also abandon the equipment to the lessor, in cases where the equipment has little or no residual value.) Obviously, the concept of retaining residual values can also be extended to equipment sold *before* the end of the original lease term, where upgrading or replacement may be desirable. For example, a financial lease may be written for five years, and at the end of the third year, the lessee decides to install faster tape units. The old tapes can be sold on the open market, new ones purchased, the amount obtained for the old ones credited to the cost of the new ones by the leasing company, and the remainder of the increased cost is added to the lease. Of course, if the equipment is sold during the lease term and fetches less on the market than the undepreciated (unpaid for) value on the books of the lessor, the lessee is also responsible for making up the difference between the two.

What we have called a net lease, above, is sometimes called a financial lease by some banks and leasing companies, who often do not differentiate between the two types. One should therefore be careful to define the type being discussed.

In a financial lease, the lessor is thus a service organization, obtaining financing, holding title to the equipment, advising on sales and purchases, and possibly acting as sales agent for the lessee in selling older EDP equipment. His profit comes not from taking the residual values, but from service charges on the lease and possibly on the sale of equipment. Since the residual values of newer computer systems now being placed under lease can be expected to be appreciable, the lessee can anticipate a reasonable return on his used equipment when it is finally replaced.

Residual values given to the lessee, and losses on the sale of equipment replaced during the lease, if applicable, are usually passed on in the form of rental adjustments.

Because of the relatively small unit profit on financial leases, they are usually written only for larger amounts than net or non-payout leases.

The financial lease has not been generally used in the computer field, probably because of the lack of a used equipment market until quite recently. It has been extensively used in such fields as auto fleet and truck leasing by major corporations.

In a financial lease, the investment credit is passed on to the lessee in some form, while in a net lease this may or may not be the case. In any event, in net leases, the lessor is concerned mostly with the lease rate he must charge overall, and the investment credit is part of the "package" and not negotiated separately.

"Short-Term" and "Non-Payout" Leases

In "short-term" or "non-payout" leases, the lessor may or may not buy the equipment to the specifications of the lessee. In some cases (and this is occasionally true of net leases or financial leases as well), the equipment to be leased is presently rented by the lessee from the manufacturer. The lessee then buys the equipment from the manufacturer, generally at a discounted price, and simultaneously resells it to the lessor. The lessor then leases the equipment back to the lessee at a lower price than he was previously paying.

A non-payout lease differs from a net or financial lease in a number of ways, as we shall point out later. The most important difference, however, is that the lessee signs a contract agreeing to lease the machine for a period *less* than that required to pay out the entire cost of the equipment purchased by the lessor. Thus, the lessor must be able to re-lease or sell the equipment at the end of the original lease term for enough to recover the remainder of the equipment cost, plus interest, expenses, and a profit.

In common usage, the term "non-payout" refers to leases which are long enough to recover most, but not all, of the lessor's equipment cost. A "short-term" lease is a non-payout lease in which only a small portion of the lessor's cost is covered by a signed lease; in some cases, the contract may be cancellable on 30 days' notice. Leases this short, however, are generally restricted to popular types of punched card equipment and a few computers.

Non-payout leases involve the lessor taking over completely the rights and responsibilities of ownership. The lessor takes the investment credit, depreciation, and residual values. Usually, whether the equipment is bought new, for a particular customer, or used, on a lease-back, the equipment is depreciated over a period long enough (eight years or more) to allow the lessor to obtain the full investment credit. Also included in these lease charges are maintenance, personal property taxes, insurance, etc. Thus, these factors, together with short-term cancellation clauses, give certain leases characteristics which make them almost indistinguishable from rental to a user. However, advisory services, instruction, and programming assistance of the type expected from manufacturers is not currently available from any leasing company.

Non-payout leases are not, on the other hand, without risk for lessor and lessee. Many of the publicly-owned companies now engaged in leasing EAM (electric accounting machine) and EDP equipment (generally through lease-backs of installed equipment) depreciate the machines over ten years on a straight-line basis. By the very nature of lease-backs, much of this equipment is already several years old when this depreciation period starts. It is therefore a point of dispute whether or not a few of these companies may not be in serious difficulty if any appreciable amount of this equipment can no longer be leased for sufficient income to cover depreciation and other costs before the ten-year period is up. The longer the depreciation period, of course, the better earnings look in the short run.

Some corporations, on the other hand, have made lease-back arrangements on the theory that they would obtain a good price for the equipment while it still had appreciable value, meanwhile shifting the risk of decreases in market price to the buyer. Unfortunately, this procedure became expensive when IBM announced major delivery delays on its new 360 series, and the lessees found themselves committed for several months additional rental to the new owners.

Leases of Computers used on Government Contracts

An apparent anomaly occurs because of the government's stipulation that interest is not an expense allowable under government contracts. Thus, an aerospace company might find itself forced to lease equipment on a non-payout basis, where the leasing company charges a flat monthly fee and does not break out interest costs, rather than under a net or financial lease where interest charges are stated or computable, even though the former method might be more expensive to the government over the long run.

IBM 360 Delivery Delays

As of this writing, IBM has slipped delivery dates for some of its 360 systems as much as six months. Clearly, this is proving to be a wind-fall for leasing companies, whose systems remain installed in the interim. By the same token, these delivery delays are keeping up the prices of older systems, at the same time decreasing the amount of used computer equipment coming onto the market in the short term. There seem to be indications of sales picked up by IBM's competitors as a result of the delays, but it remains to be seen if this failure of IBM's can be turned to good account by other manufacturers, or whether IBM's sales organization will allow them to recoup the losses of customers.

Effect of October 1, 1965 Announcement

On Oct. 1, 1965, IBM announced that henceforth there would be no further decrease in the discounted prices at which rented equipment could be bought by the current renter. Thus, except for a credit of rental to purchase price available for rentals paid during the first year of use, amounting perhaps to 10%-12% of the purchase price, used IBM equipment would now cost just as much as new equipment. Probably the major factor in IBM's making this move was the heavy increase in business on EAM equipment being done by lease-back companies, and the prospect that this would spread, as it had slowly started to do, into the computer field. Such lease-backs not only cut into IBM's profits from rentals of equipment heavily or completely depreciated on its books, but also cut IBM salesmen's access to customers in whose offices IBM equipment was installed. It is perhaps far-fetched, but not impossible, that IBM also began to realize that incipient delivery delays on 360 would not only increase the sales activities of lease-back companies, but that, as the discounted prices continued to drop, corporations themselves might start buying older computer equipment if few or no new 360's were forthcoming.

What about the monopoly and anti-trust aspects of this action? The consensus appeared to be that what IBM had done was making pricing changes, and indeed raised certain prices rather than lowered them. This served to inhibit future growth of the leasing companies, but did not immediately hurt them; the effect on other computer manufacturers was negligible. Thus, while there was much talk about complaining to the Justice Dept., it was clear that *legally* there was not even remotely a possible violation of anti-trust laws.

At worst, then, this move might be taken in conjunction with other possible future moves, if they occurred, in showing that IBM had acted "unfairly," but in itself was not grounds for any criminal or civil action by the Justice Dept. or competitors.

Another interesting result of IBM's Oct. 1st, 1965 announcement is that it is now theoretically possible for a company to pay *more* for used equipment than for identical new equipment. This is because of the $50,000 limitation on value of *used* equipment eligible for the 7% investment credit, plus whatever value might be assigned by the purchaser to the use of money denied him by his ineligibility to use faster depreciation methods on used equipment.

Contractual Status of a Lease

Leases generally are not shown on balance sheets as liabilities. In this sense, they are different from *debt* (such as a bank loan to pay for a computer), which is a direct obligation of the corporation for the full amount of the debt. Thus, they may be considered "junior" to debt obligations. In case of default, the lessor can, of course, take back his equipment (according to terms of the lease), but would probably have to show actual damages in order to collect the rest of the lease moneys due. The credit rating of the lessee is therefore an important factor in the type and cost of lease which will be offered him by a potential lessor in net or financial leases.

Summary

Leasing, then, is a technique whereby computer equipment can be obtained other than by rental from the manufacturer, or outright purchase. Advantages to the lessee vary, of course, with the lessee's situation and the type and size of lease considered. One or more of the following advantages may accrue to the lessee:

(1) Financing for capital equipment is obtained without adding to the company's debt;
(2) Leased capital equipment may often be paid for in less time than would be indicated if depreciated according to IRS guidelines ;
(3) In financial leases, the lessee effectively obtains the residual values;
(4) In either net or financial leases, the cost of the lease is basically limited to the equipment cost, plus interest charges, etc. Unlike rental, the monthly rate does not remain the same forever. The economic advantages of such a lease usually increase directly with the length of time the user expects to utilize the system;
(5) Management sometimes feels less "locked-in" to the existing system when leased than when purchased, and is more willing to consider modernization during, or at the end of, the lease term;
(6) In short-term leasing, the equipment can be cancelled on short notice. This is sometimes a good way to obtain interim capacity while awaiting new equipment, although, like rental, may be expensive if continued over a long period of time.
(7) Through short-term leasing, it may be possible for small companies to obtain usable, if not new, EAM or EDP equipment for lower rates than they would have to pay computer manufacturers. Larger corporations may benefit by reducing their rental costs for similar equipment.
(8) Leases can usually be worked out which avoid the payment of extra-shift charges common to the EDP equipment rentals.

The main disadvantages of leasing, like purchase, is that it does not have the flexibility of rental in equipment changes. The seriousness of this depends on whether any change in equipment configuration is contemplated, and the ease with which older equipment can be sold on the open market. With the development of the latter, and brokers capable of evaluating and selling this equipment, it can be expected that the preponderant advantage of flexibility through rental will diminish.

At any rate, corporations with large and/or multiple computer systems should seriously consider the various forms of computer leasing as a method of decreasing their EDP costs. Such possibilities should be discussed in detail with a firm knowledgeable in the areas of EDP systems leasing and marketing.

CREDIT CARDS – Reistad

(Continued from page 27)

What other capabilities do we have? We have an existing network of bank interrelationships — holding companies, branches, correspondent relationships, etc., that could form the base for a data transmission system that would permit all banks to communicate electronically with each other in seconds. Think of the potential of a fund transfer system and a national clearinghouse for corporate accounts built on this type of instant communication system.

The advent of third-generation computers and the need for even the smallest bank to have computer capabilities has caused some banks to form computer satellites designed to serve wide areas in the form of a computer utility company. This may be the answer for over 10,000 banks that are still not automated — but must become automated in order to survive in the future.

Computer Personnel

The more progressive banks realize that computers and allied technologies are worthless if people are not developed to take advantage of them. These banks are developing new operations capabilities — hiring staff, determining the management services needs, and digging in to try to solve some of the myriad problems facing their bank today. With the computer program there has also been an increased need for market research — especially in those banks where new automated services have been developed, or where credit card plans have been under consideration.

The results of the combined efforts of the new technicians are finally receiving the treatment they deserve in bank management circles. With new bank buildings come new techniques of informing management of the changing world we live in. A few banks are building their management information systems around their strategy, or chart, or "war" room. They hold their senior management meetings in such a room; there at the touch of a button, management can have graphic displays of the most current information on the bank's status.

Some banks are already installing sub-systems of the checkless society. At the installation of the Bank of Delaware, the telephone is used to charge department store purchases directly to the customer's account at the bank. A very possible next step for them could be the housewife bill paying system described earlier.

The banking industry needs its pioneers but not all pioneering is individualized nor aimed at the improvement of a single bank's market or profitability. We are fortunate indeed to have collective action on the part of our member banks in preparing for what's ahead in the checkless and cashless society of tomorrow. The A.B.A. is interested through its various banker committees in a number of automation planning and technology projects. One is the Personal Identification Project — or PIP; the purpose of this project is to determine if a single discrete identification number for individuals is practical, and if so to assist in its selection and implementation.

A Sleeping Giant

In summary, the announcements by banks of their credit card arrangements is snowballing, and with each day's releases the swath gets wider, the banks involved smaller, the implications for the industry more complex and uncertain. Bank Credit Card Plans, although in their infancy today, could take on giant proportions in the very near future. The consumer credit information field has all the potential for similar quick growth. This sleeping giant, when inevitably engaged with its credit card counterpart, is certain to create extraordinary new developments for the banking industry — and for all our society as well.

ACROSS THE EDITOR'S DESK

Computing and Data Processing Newsletter

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APPLICATIONS

TRAMP SHIP OPERATOR PLANS COMPUTER-AIDED BIDDING

An IBM computer is keeping tabs on the tramp ship operations of Transeastern Associates, Inc. of New York in order to give its managers more accurate and timely information upon which they can base bids for new business. The management information system is believed to be the only one of its kind in the tramp ship charter field.

Although this project is not yet in full operation, a great deal of preparatory work has been done which has been found immediately valuable. For more than a year an IBM 1440 computer has been processing and storing data on the worldwide voyages of the company's fleet of more than thiry tankers and dry cargo vessels (an IBM System/360 Model 30 is installed now). A computer library has been built containing detailed information as to the costs, itineraries, and other aspects of several hundred voyages of the Transeastern fleet.

Traditionally, the operators of tramp ships have used a kind of sixth sense based on years of experience to bid successfully for business that returns a profit. Hard facts on costs and competitive behavior have been scarce. The managers must evaluate a variety of conditions — from the costs of loading and discharging in obscure foreign ports to the distribution of competitive fleets over the face of the globe. Every day there are hundreds of charter offerings, contracts to carry oil, wheat, or some other commodity between ports anywhere in the world. Costs and conditions change continually. The bidding however must be done in a short period of time.

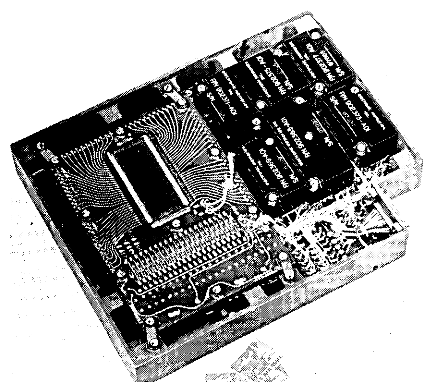
"Our ultimate goal," said Sydney P. Levine, director of research, "is to describe a piece of business in computer terms and have the system evaluate its profit potential against a general, predictive model of costs and market behavior....We feel that the speed with which the computer can answer questions for our chartering staff can make the difference between good bidding and exceptional bidding."

TINY MEMORY STARTS LUNAR ORBITER CAMERAS

The command to start the cameras photographing the moon as Lunar Orbiter B swung into orbit was given by a memory hardly larger than five packs of cigarettes. The memory, built by Electronic Memories, Hawthorne, Calif., is part of the flight programmer aboard the vehicle.

The accurate functioning of this tiny memory is responsible for these critical functions: controlling the propulsion and attitude control systems which maneuver the spacecraft in midcourse; inserting the spacecraft into lunar orbit; positioning the vehicle for photography; activating the cameras; and beginning the scientific experiments. The memory's commands also deploy the four solar panels and two antennas of Lunar B into extended position after departure from Earth.

To provide the reliability required for the mission, memory functions such as drive current selection and routing are performed by magnetic techniques rather than by the usual semi-conductors. The use of semi-conductors would require more components and result in a higher failure rate. Weight of the tiny memory is one and a half pounds and it measure 1" high, 7-3/4" long and 6-1/4 inches wide.



It uses only 1.25 watts of power — less than the amount used to turn on a flashlight — to transfer data at a rate of 5000 pieces of information a second. All information is stored in 128 memory words which are randomly accessed. Each word is 21 bits long and is read out a bit at a time.

During spacecraft acceleration, the memory acts as a speedometer. It also provides continuous information on the attitude of the vehicle by counting the units of the angle traversed by the spacecraft as it pitches or yaws. During the periods the spacecraft is out of the line of sight of Earth where no command can reach it, the programmer memory will control it. The memory can control the craft for periods up to 16 hours without command from Earth.

COMPUTER PRODUCES FINISHED ENGINEERING DRAWINGS FOR SANYMETAL PRODUCTS CO.

Finished engineering drawings are being produced in minutes on its new computer at The Sanymetal Products Co., Inc. (Cleveland, O.) slashing weeks off the time required to get an order into production. William Daugherty, president of the Cleveland manufacturer of industrial lavatory compartments, said Sanymetal achieved this application of electronic technology by linking its new IBM 1130 computer with a 1627 graphic plotter. "In the three months the system has been in operation we have reduced from six to two weeks the minimum time required to begin manufacture of an order," Mr. Daugherty said.

"In addition, we have: reduced by more than 50 per cent our cost per engineering drawing; achieved a built-in capacity to handle even our heaviest peak loads; released our draftsmen from routine jobs to handle more creative design work; and cut production waste by assuring that each order is completely and accurately made up."

When an order is received, its specifications are converted into punched cards and fed into the 1130. The computer, drawing on product design information already stored in its disk files, then constructs a mathematical model of the order. When this is completed, the computer, through advanced programming techniques, directs the pllotter as it makes an exact engineering drawing of the order. At the same time, it punches a deck of cards, later to be run on a printer, listing the order's complete bill of materials. The whole job takes less than 14 minutes. The speed of the system now makes it possible for Sanymetal to send a drawing to the customer for approval in the same letter as the order acknowledgement.

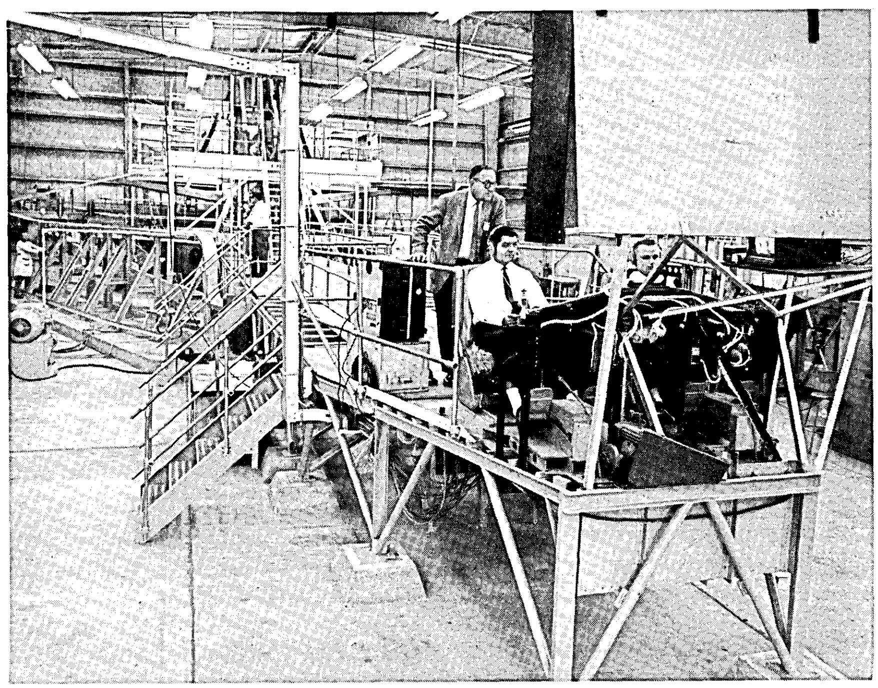
"IRON BIRD" WILL HELP THE BOEING 737 FLY

Early this year the test pilots of the new Boeing 737 will lift the twinjet from the runway for the first time, but the feel of the controls will be "old hat" to them, because of a device called the "Iron Bird". Technically the Iron Bird is a flight controls systems test rig. It is 94 feet in length and stands 31 feet high in its own building at The Boeing Company's Renton, Washington, plant.

The Iron Bird was designed to perfect and prove flight control systems — the complex of wires and devices which move the elevators, ailerons, spoilers and rudder — to a point which is highly reliable for flight. At the same time the hydraulic power systems which drive the controls also are evaluated along with the automatic pilot.

The cockpit looks more like an airplane than any other part of the simulator. The pilot's compartment contains most of the normal cockpit equipment except for the engine instruments and controls. In addition, there are a television screen and large rear-view mirror so test engineers can view the action of the control surfaces.

A pilot will feel as though he were flying the real 737 when he handles the controls of the Iron Bird. "He is literally flying the plane on the ground," Downing explained. "He will experience control systems loads which duplicate actual flight." As the pilot "flies" the Iron Bird, stresses are applied on the various control surfaces by mechanical means to simulate the loads encountered in flight. A bank of computers simulates the airplane's reaction. "We know exactly how the aircraft will feel to the pilot," Downing said, "because the 'feel' the pilot experiences in the control system during actual flight is an artificial one. We have to build it in right here on the ground."



— Boeing Company engineers "fly" the firm's 737 Iron Bird, first used in the development of the Boeing 727 trijet and completely redesigned and rebuilt for the 737. Technicians in the background check the action of the ailerons.

The Iron Bird is only a skeleton of the 737. "Basically, it is a steel support structure," says Robert Downing, Boeing 737 controls group engineer, who is responsible for the design, assembly and operation of the simulator. "We simply hang all of our pumps, motors and control surfaces on it and run the control cables through it. The simulator duplicates the control systems on the real airplane, but these systems will never get off the ground."

The Iron Bird also is used to evaluate how well the various control systems interact with each other. The systems are designed to operate in harmony because more than one of the systems comes into play when the aircraft is maneuvered in flight. The Iron Bird helps improve — and prove out — this relationship.

ELECTION RETURNS PROCESSED BY UNIVAC-COLEMAN ELECTRONIC VOTE COUNTING SYSTEM

Electronic ballot reading equipment and general purpose computers were teamed up for the first time to successfully tabulate the Multnomah County (Portland, Oregon) returns in the general election last November 8. A Sperry Rand UNIVAC 418 computer and electronic ballot readers (manufactured by Coleman Engineering Company) combined to count more than 209,000 ballots from 1,018 precincts in the county. A special computer program for use in the vote counting system was written by UNIVAC Portland systems analysts. In addition to the primary program, special program segments accomodated the 193 different ballots used in the various county precincts. The ballot reader and computer concept enabled the county to retain the long-favored traditional paper ballot for the voters.

The system employs a photoelectric sensing system which "reads" a fluorescent blue dot marked by voters to designate their choices on the ballot. Special marking pens replaced pencils and pens in the voting booth. After the polls closed, election workers opened the ballots and stacked them on spindled trays and sealed them in boxes. The sealed ballot boxes were delivered to the county election headquarters where three large ballot readers were located.

At election headquarters they were opened, registered, and placed on conveyor belts for feeding into the ballot readers. The ballot readers, each capable of reading 600 ballots a minute, scanned each sheet. The readers, linked by broadband communication data lines, transmitted the data to the county 418, a few miles away. The 418 computed the data instantaneously. Hard copy printouts of the returns were produced by an on-line UNIVAC 1004 and were distributed to the press every 15 minutes. Final returns were compiled by 8 a.m., although 99% of the total vote had been counted by 6 a.m.

In addition to speeding the vote counting, Multnomah County officials reported that the system greatly reduced manpower expenses in an election. More than 4000 fewer election workers were required during the election.

LOCKHEED'S TECHNICAL LIBRARY AIDED BY COMPUTERS

A library indexing arrangement offering approximately 1½ million references to identify its literature resources has been installed in the technical library of Lockheed Missiles & Space Co., Sunnyvale, Calif. Developed by Lockheed, this new system discards the traditional card file system used for almost 100 years in libraries throughout the world. Instead, the identical information is arranged and cross-referenced on computer-produced microfilm rolls.

Using standard library techniques, each document or book is identified in six sections: title, author, subject, source, contract number and report or call number. Thus, the researcher has a variety of avenues available to find specific information contained in the library. Each entry is processed through a computer system which arranges the data in desired sequence and produces the library inventory in its various sections on separate 16 millimeter microfilm rolls.

Stored in automatic, no rewind cartridges, microfilmed information can be magnified and examined on reading equipment located in the library. Three sets of microfilm and four reading machines are available in the library itself, while the library staff has its own microfilm sets and readers for internal use. The microfilm roll, enclosed in its special cartridge, is easily slipped into the reading machine. The speed and direction of the microfilm is controlled by a single switch. The system can be operated by anyone without difficulty after reading three sentences of instructions. The library catalog is kep current by completely replacing the microfilm sets every three months.

— Betty Woodall uses a microfilm reading machine in Lockheed's technical library to scan a microfilm roll of authors. Information encased in 720 card files like those in background have been processed by a computer system and compressed into 40 microfilm cartridges.

Dr. William A. Kozumplik, manager of Lockheed's Technical Information Center, estimates that the new computer-produced microfilm cataloging system saves the library approximately $10,000 annually in processing costs. In addition, more free space is provided by eliminating bulky card cabinets. Information formerly contained in 720 card files has been compressed into 40 microfilm cartridges. From the user standpoint, reference time has been cut in half. Dr. Kozumplik said the significant by-product of the library microfilm catalog is the opportunity to make the library inventory more accessible outside the library itself. "By installing microfilm and readers sets in buildings heavily populated by scientists and engineers, the library's resources can be reviewed with little if any work interruption," he said.

NEW CONTRACTS

FROM	TO	FOR	AMOUNT
U. S. Army	The National Cash Register Company, Dayton, Ohio	18 mobile computer systems using Series 500 computers designed to travel with military units and improve the maintenance of Army equipment — contract calls for NCR to install the systems in standard six-ton Army shop trailers	over $2 million
U. S. Air Force	ITT Data Services	Development of computer programs and test routines relating to Strategic Air Command Communications and Control System (SACCS) operations at Offutt Air Force Base, Nebr.; March Air Force Base, Calif.; and Barksdale Air Force Base, La.	$779,000
British Ministry of Social Security for the General Post Office	ITT's Creed & Company Ltd.	Teleprinter transmission equipment to be used in first stage of projected nationwide network which will link Social Security offices with a number of computer centers; system will be used for processing of National Insurance benefit claims	$700,000
Sylvania Electric Products Inc.	Sperry Rand Corp., UNIVAC Div.	Two 1218 computers, four 1532 programming consoles; two 1394 motor generator sets, a 1540 magnetic tape unit, a 1469 high-speed printer, and a 1299 switchboard — for new U.S. Air Force detection and warning system (Prime contract is with Electronics Division of Avco Corp.)	$500,000
General Electric, Special Information Products Dept., Syracuse, N.Y.	Data Products Corp., Culver City, Calif.	Additional Discfile random access memory systems for use in time sharing applications	over $400,000
California State Water Resources	Sperry Rand Corporation's UNIVAC Division	Installation of a computer system (418) that ultimately will control operation of the California Aqueduct of the State Water Project	$325,000
U. S. Army	URS Corporation, Burlingame, Calif.	Study and field test of an automated combat logistics system at Ft. Hood, Texas	$215,000
U. S. Air Force Electronic Systems Command (ESKK)	Informatics Inc., Sherman Oaks, Calif.	Developing a methodology for the evaluation of data management systems	$47,400
University of Saskatchewan, Saskatoon, Saskatchewan, Canada	Lockheed Missiles & Space Co., Information Systems	Supervising an evaluation study that may lead to a system for computer processing of many of the clinical and administrative data at the university hospital	$21,400
The People's Savings Bank, Bridgeport, Conn.	The Bunker-Ramo Corp., Stamford, Conn.	An on-line electronic system which will allow every teller at the main office and 13 branches to use a central computer to process all savings and mortgage transactions instantaneously	—
General Dynamics/Electronics Division, Rochester, N.Y.	Control Data Corp., Morristown, Pa.	Delivery of an additional quantity of Control Data low-speed card punches to be used in the AUTODIN System (Automatic Digital Network) — final delivery by 1968 - over 1250 units totaling over $5.5 million	—
Kalamazoo Ltd., Northfield, England	Auerbach Corporation, Philadelphia, Pa.	System design and programming in connection with implementation of a service bureau offering computerized accounting services for automobile dealers	—
U. S. Army	Bolt Beranek and Newman Inc., Data Equipment Div., Van Nuys, Calif.	An automatic graphic data processing system	—
Fairchild Semiconductor Div., Mountain View, Calif.	Burroughs Corporation, Detroit, Mich.	Twenty million silicon integrated circuits, transistors and diodes over the next two years to be used in the B2500, B3500, B6500 and B8500 computers	—
United States Steel Corp.	Sylvania Electric Products, Inc.	Installation of a KarTrak® electronic scanning system to identify and record the weights of railroad cars transporting crude ore at firm's taconite plant in Mountain Iron, Minn.	—
Argonne National Laboratory, Argonne, Ill.	IBM Corporation	Two IBM System/360's (Model 50 and Model 75) to be installed next June. The computers will be used to facilitate research on peaceful uses of atomic energy	$4.5 million
Lindsay Rie Olive Company, Lindsay, Calif.	The National Cash Register Co., Dayton, Ohio	A National Cash Register 315 computer system, scheduled for installation next spring, which will control inventories of its products in 70 brokers' warehouses throughout the U.S.	—

NEW INSTALLATIONS

AT	OF	FOR
University of Denver, Research Institute, Denver, Colo.	PDP-5 computer — donated by Digital Equipment Corporation	Systems development, engineering design, and mathematical analysis
Pensick & Gordon Inc. (toy wholesaler), Commerce, Calif.	Honeywell 200 computer system	Order processing for over 3000 retail stores; inventory control
AAI Corporation, Cockeysville, Md.	General Electric 415 valued at $300,000	Routine business data processing and highly complex scientific and engineering calculations
South African Iron and Steel Corp. (ISCOR), Vanderbijlpark, Union of South Africa	Control Data 3300 Time Sharing Computer System valued at about $2 million	Use as part of a total integrated industrial data processing system
The Bank and Trust Company, Willow Grove, Pa.	NCR 315 computer system	Savings, Christmas Club and consumer credit applications in addition to demand deposit accounting
Kondor Plas Limited, Dublin, Ireland	Honeywell Series 200 computer	Use in first independent electronic datacenter in Ireland; will provide comprehensive data processing services for the Irish business community
The Manila Electric Co., Manila, Philippines	NCR 315 computer system	Processing its half-million customer accounts as well as a variety of other accounting duties
The Drackett Co. (household products), Cincinnati, Ohio	IBM System/360 Model 30	Inventory maintenance on more than a million cases of products in a coast-to-coast network of warehouses
Peat, Marwick, Mitchell and Co. (accountants and consultants), New York and Chicago	Two GE-115 computer	Use in training auditors, for client service, and internal accounting at both offices
Fluor Products Co., Inc., Santa Rosa, Calif.	IBM 1130 computer	Providing faster, more selective solutions to water cooling problems (firm designs and builds cooling towers for refineries, petro-chemical processing plants and power plants)
Prince George's County, Md.	RCA Spectra 70/45 system	Nucleus of a new data processing center that will handle official record-keeping in the county ranging from tax assessment to library book withdrawals
The Travelers Insurance Companies, Hartford, Conn.	Six Burroughs B300 systems, leased; valued at over $2 million	Handling data processing job which involves nearly half a billion punched cards, 2300 computer programs and 4000 monthly reports
Rich's Inc. (department store), Atlanta, Ga.	NCR 315 RMC (Rod Memory Computer) System	On-line system that will help solve inventory control problems; linked to main store, five branches and central warehouse by means of 25 remote-inquiry Teletype units
University of California, Berkeley Campus, Berkeley, Calif.	Control Data Dual 6400 Computer System costing $2,420,000	Examining larger and more extensive scientific problems, extending present processing services, providing interactive computing, and enlarging potential usage to experimenters at remote stations located away from the Computing Center
City National Bank of Miami, Miami, Fla.	NCR 315 computer system	Producing a total of 14 management reports, plus daily trial balances and posting journals, for the City National Bank of Coral Gables, the City National Bank of Miami Beach and the City National Bank of Miami. Seven teletypes distributed throughout the three banks can inquire into the NCR 315
The University of Iowa, Computer Center, Iowa City, Iowa	IBM 360/40 system valued at $547,000	Use extensively by the Department of Physics and Astronomy for space research, by faculty and staff for individual research, and by students for thesis work
Rank Xerox Ltd., Denham, England	Four Honeywell Series 200 computers valued at over $1 million	First stage in an international program to integrate its data processing and management control; systems will allow Rank Xerox to adopt a uniform approach to programming throughout its international subsidiaries
Auditor's Office, Montgomery County, Dayton, Ohio	NCR Series 500 computer system	Appropriation accounting, general ledger, payroll distribution, credit union reports and accounting in connection with the Public Employees Retirement System; later will include tax work and welfare
Dartmouth College, Hanover, N.H.	GE-625 time-sharing system valued at $2.5 million and comprised of some 30 pieces of equipment (replacing GE-265 system installed in 1964)	Serving some 200 people simultaneously at widely scattered locations — on the Dartmouth campus, selected customers of G.E.'s Information Processing Center in the New York City and Boston areas, and other New England colleges, universities and secondary schools
Clark-O'Neill, Inc. (medical mailing and marketing service), Fairview, N.J.	Spectra 70/45 and 70/35 computers	Electronically pinpointing markets for new and improved pharmaceutical products; computerized file will contain profiles of nation's 380,000 physicians, osteopaths and dentists, as well as detailed data on every major medical facility in the U.S.
Hoeganaes Corp. (producer of iron and alloy powders), Riverton, N.J.	RCA 301 computer	Preparation of monthly sales reports for distribution directly to key management personnel; also routine accounting and administrative procedures

ORGANIZATION NEWS

CONTROL DATA RECEIVES EXPORT LICENSE TO SHIP 6600 SYSTEM TO FRANCE

William C. Norris, president of Control Data Corp., Minneapolis, Minn., has announced that his company has received an export license to ship a super-scale Control Data 6600 Computer System to the French Power Bureau of Paris, France. Norris said that this export license was granted to Control Data under terms of the agreement recently reached by the United States and French Governments on computer exports to France.

He said that the French Power Bureau (Electricite de France) will use the 6600 computer system for a wide range of applications that will include electrical network power distribution studies, power plant engineering, economic studies, as well as scientific computation.

It is anticipated that the recent clarification of computer exports to France "will be most significant to Control Data, as we have several other 6600 orders with firms and organizations located in that country", Norris added.

UNIVERSITY COMPUTING COMPANY ACQUIRES MORTGAGE SYSTEMS CO.

Sam Wyly, president of University Computing Company has announced the acquisition of Mortgage Systems Company of Houston and Dallas which will be operated as a wholly-owned subsidiary within UCC's newly-formed Data-Link Division. Mortgage Systems, which was acquired for an undisclosed amount of cash and notes, will be operated with the same management and personnel as at present.

Mortgage Systems is a computer service firm which specializes in mortgage loan accounting systems for mortgage loan servicing companies. It uses data processing equipment to provide a wide range of reports to mortgage investors and borrowers for its customer companies. "It has been operating profitably at its practical capacity offering one of the best such systems in the country," Mr. Wyly noted.

UCC plans to upgrade the Mortgage Systems computer programs so that they may be used on large-scale communications-oriented computers. This will be completed by next May or June at which time the service will be offered nation-wide to mortgage loan service companies as a part of the operations of University Computing's new Data-Link Division.

C-E-I-R ACQUIRES ASSOCIATED AERO SCIENCE LABORATORIES

C-E-I-R, Inc., Washington, D.C., has acquired Associated Aero Science Laboratories, Inc., a Torrance, Calif., engineering and data processing company, in exchange for 35,000 shares of C-E-I-R Class A Voting Stock. The acquisition was announced jointly by Dr. Herbert W. Robinson, C-E-I-R president, and John E. Leadbetter, president of AASL.

AASL, which currently employs about 200 people at facilities in Torrance and China Lake, Calif., and in five field offices located at military installations in California and Alabama, is wholly owned by its officers and key employees. Under the agreement, Dr. Robinson said, AASL will be operated as a subsidiary of C-E-I-R, and will continue and even expand its services for its clients. AASL specializes in rocket flight data reduction and analysis, a wide range of engineering and computer services, and technical training.

ZEHNTEL, INC. FORMED TO SERVE ELECTRONIC MEASUREMENT SYSTEMS MARKET

Zehntel, Inc.,Emeryville, Calif., is a newcomer to a field which to date has had very little penetration — the area of modest-sized instrumentation systems for measurement and control of manufacturing processes and for data logging. Zehntel's systems will be of the company's own design and manufacture, and will provide digital data handling capability for measurement and control. Compatability with computers and computer interface media is incorporated.

Zehntel operating executives include William L. Martin, president; Clarence C. Wright, administrative manager; David N. Lytle, applications manager; Ronald N. Borrelli, project manager; and Thomas E. Castanera, project manager. The Zehntel management are former Beckman Instruments and SCM personnel, with many years experience in data processing and instrumentation.

Since most Zehntel installations will be of a specialized nature, organization is on a project manager basis to provide direct client liason from problem solution through equipment installation. The company's initial marketing will be confined largely to the Pacific Coast. Sales contacts will be made directly and through associated representatives. The privately financed firm has begun marketing of its products.

COMPUTING CENTERS

COMPUTERIZED BOOKKEEPING FOR THE SMALL MERCHANT

A new service — computerized bookkeeping for the small merchant who has previously found computer services far beyond his means — now is available through Automated Bookkeeping Service, Inc., Van Nuys, Calif. The firm takes bookkeeping, accounting, sales tax returns, federal tax returns, payroll (including quarterly federal tax reports), annual W-2s and sales analysis off the hands of the small businessman so that his full time can be devoted to business.

Automated Bookkeeping Service, Inc. (ABSI) offers electronic data processing for all types of businesses. The firm is designed to give computer services to people operating beauty salons and barber shops, bar and restaurants, service and repair shops, all types of general merchants. ABSI also can be used as a bookkeeping service for professional offices and other specialized businesses, supplementing or replacing a bookkeeper.

Full profit and loss statements are available on monthly, quarterly or any other schedule specified with full comparisons to past business with each statement. P&L statements are available soon after the books close. ABSI, through its computer memory files, stores each client's full financial statements and these can be made available in a matter of minutes when needed. (For more information, designate #41 on the Readers Service Card.)

NEW PRODUCTS

Digital

LC 1000, LOW COST COMPUTER

Logic Corporation, Palmyra, N.J., has announced a model LC 1000 digital computer — a powerful, general purpose, low cost machine for the businessman, educator and scientist. The computer has 29 instructions. The instruction word is 16 bits and the data word is 32 bits.

Add time, including access to memory, is 5 milliseconds. There are 11 registers displayed and each register may be individually set or cleared by the operator. Special features of the machine are: single-command mode — allowing the operator to step through a single instruction; built-in D/A converters — for displaying data on an oscilloscope; audible and visual alarm — can be set under program control; and Bootstrap hardware — a single button loads the Bootstrap routine.

Effective addressing and indirect addressing are provided. Multiply and divide hardware is included in the basic machine. Software comprises a Symbolic Assembler and I/O, Math., and Utility Programs. The computer is available with paper tape, punched cards, magnetic disk file, and line printer.

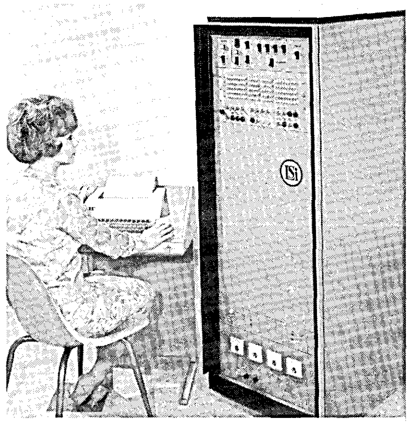
For Payroll and Billing applications, the company provides all necessary forms imprinted with the customer's company name. Complete software and instructional texts are provided. For Educational applications, the company provides lesson plans, programming examples with explanatory text and an illustrated Instruction Manual.

Prices start at $8990 ($222 per month) including ASR 33 Teletype and 512 word memory. Delivery is 90 - 120 days A.R.O.
(For more information, designate #42 on the Readers Service Card.)

LSI 8816 COMPUTER

Lear Siegler, Inc., Data and Controls Division, Melville, N.Y., has announced the second low cost processor in the Computer System 8000 family. The LSI 8816 is a small, real time, high speed computer for scientific, engineering and process control uses. It is a 16 bit machine complementing the I/O and byte oriented LSI 8800. The standard system features hardware multiply and divide of 4.0 µsec and 5.0 µsec respectively with multi-programming and multi-processing capability.

The minimum LSI 8816 includes 4096 x 16 bit core memory, three hardware index registers, six priority interrupts with I/O rate of 666K words per second. Memory is expandable from 4096 to 32,768 words directly addressable. Its modular construction permits a wide variety of custom configurations including the addition of a high speed programmable data channel allowing connection of up to 254 I/O devices. ASR-33 is standard.



— LSI 8816 Computer

Software includes FORTRAN, Real Time Monitor and Subroutine Library. Options for the machine include one memory protect bit per word and one parity bit per word. When these options are exercised, the machine is fully IBM 1800 compatible.
(For more information, designate #43 on the Readers Service Card.)

u-COMP DDP-416 COMPUTER

A new integrated circuit computer, the second to be announced in less than a 30 day period, was displayed by Honeywell, Computer Control Division, Framingham, Mass., at the Fall Joint Computer Conference in San Francisco. Only two weeks earlier the Division had announced the µ-COMPT DDP-516, a 16-bit on-line real-time computer.

The DDP-416 also is a 16-bit on-line real-time computer. Memory capacity is 4096 words expandable to 16,384 words; cycle time is 960 nanoseconds. MTBF (Mean Time Between Failure) is 4000 hours or two years under normal 40-hour week operation. The software package for the 416 will contain 50 programs, including a DESECTORIZING technique which was field proven with the DDP-116. DDP-416 software is directly compatible with the μ-COMPT DDP-516 and DDP-116.

The DDP-416 now is being manufactured and first deliveries with software are scheduled for the second quarter of 1967.
(For more information, designate #44 on the Readers Service Card.)

PDP-10 COMPUTER SYSTEM

PDP-10, a new, expandable computer system, was introduced by Digital Equipment Corporation (Maynard, Mass.) at the opening session of the 1966 Fall Joint Computer Conference in San Francisco. The company is offering its new PDP-10 in five configurations.

The new computer is designed for on-line and real-time scientific, engineering and process control applications. It has a 1 microsecond cycle time, a 2.1 microsecond add time, I/O bus transfer rates up to 7,200,000 bits per second and a modular, proven software package that expands to take full advantage of all hardware configurations. Memory can be expanded in 8192 word increments to the maximum directly addressable 262,144 words.

The PDP-10 system is the third new computer system to be introduced by the Maynard, Mass., company within a five month period. Digital recently introduced the PDP-8/S (Computers and Automation, August, 1966, p. 38), the first full-scale general purpose core memory digital computer selling for under $10,000; and the PDP-9 (Computers and Automation, October, 1966, p. 47), the largest general purpose system in the low cost field. Now with the PDP-10, Digital is prepared to service all levels of computing requirements.
(For more information, designate #45 on the Readers Service Card.)

ELLIOTT 920M MICROMINIATURE COMPUTER

Elliott-Automation Ltd.'s (London, England) latest model in the Elliott 900 Series, the Elliott 920M Microminiature Computer is fully program-compatible with the other machines in this Series. The 920M will be used not only in space and aviation (both on the ground and in the air) but also in scientific and industrial fields.

The computer is constructed as a 3/4 short ATR package of 0.42 cu. ft. volume. The device contains three hinged layers: two layers comprising logic circuitry and the other holding the 8192 words of core store with its associated circuitry. The 920M, designed for quantity production and easy servicing, is constructed from inexpensive "throw-away" modules and welded or wire-wrapped joints are used throughout. There are two basic forms of non-repairable "throw-away" 920M modules: one is used in the logic layers and the other in the store layer. Altogether the computer holds 447 of these modules of which there are only 38 different types so that the spares complement is kept to a minimum. The logic modules are constructed with a built-in heat sink and are encapsulated to form a solid block which is not susceptible to damage by vibration. Both types of module terminate in a small number of wire-wrap pins for easy removal and insertion.

Cycle time is 5 microseconds. The order structure is single address and modifiable, there being four levels of priority programming for operation in real-time programs. Add time is 18 microseconds, subtraction 20 microseconds, multiplication 37 microseconds, and division 38 microseconds. Inter operating temperature of the computer is between $0^{o}C$ and $70^{o}C$ and non-derangement temperature is between $-40^{o}C$ and $+100^{o}C$. It withstands vibration up to 10 g and shock of 25 g without breaking loose from its mounting.

Memories

PHOTO-DIGITAL MASS STORAGE SYSTEM

A direct access computer memory with a capacity of a trillion bits or more was described by IBM Corporation at the 1966 Fall Joint Computer Conference, San Francisco. The mass storage system, which can contain up to seven modules of one-third of a trillion bits each, uses a new combination of technologies, including: electron beam recording of digital data on photographic film chips; housing of chips in small plastic cartridges; pneumatic transport of cartridges to recording and reading stations; and optical reading of data at a rate of two-and-a-half million bits per second.

In their paper, entitled "A Photo-Digital Mass Storage System", authors Jack D. Kuehler and H. Ray Kerby describe the basic storage medium as 35mm x 70mm silver halide photographic film chips. Data is recorded on the film in the form of light or dark spots "painted" by an electron beam at the rate of a half-million bits per second. The film chips are housed in small plastic cartridges, or cells, containing 32 chips — 150-million data bits (information equivalent to that in three typical encyclopedia volumes). Cells are retrieved from trays resembling egg crates by a pneumatic system which delivers them to recording or reading stations.

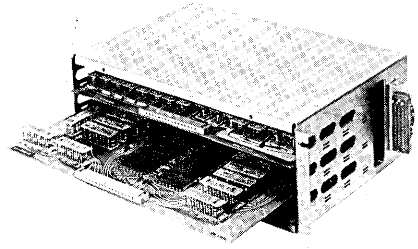
The data recording mechanism of the IBM-developed system includes an electron beam recorder and film chip developer. It receives unexposed chips, records data on the chips and automatically develops them. The finished chip then is placed in a cell for delivery to the reading station or file. The recording and development process takes about three minutes.

When data is to be read, the selected chip is positioned before a cathode-ray tube flying spot scanner. Data is read by the scanner at a rate of approximately 2.5-million bits per second. Electronic control units built into the photo-digital system link it to a computer and regulate operation.

The photo-digital system, developed at IBM's San Jose, Calif., facilities, has potential applications where masses of computer data must be stored in a randomly accessible file, and where information is too voluminous for storage in presently available devices.
(For more information, designate #47 on the Readers Service Card.)

4-uSECOND MEMORY SYSTEM AVAILABLE AT 8-uSECOND PRICES

A new 4-μsecond version of its low-cost, 10-μsecond, FX-12 coincident-current core memory system has been announced by Ferroxcube Corporation, Saugerties, N.Y. The new system, called the FX-22, features full cycle times of less than 4 μseconds, capacities up to 512 eight-bit words, a full complement of input-output facilities including data registers and timing and control circuitry in a compact package 5 inches high, 15 inches wide, and 9 inches deep and weighing less than ten pounds.



The new system, according to Mr. Edwin Podsiadlo, Product Manager of the Memory System Division of Ferroxcube, is expected to extend the firm's small memory capabilities into the higher speed areas. The FX-22 is expected to open up markets which have been inaccessible to the slower speed systems such as display refresh, data acquisition, small computer and calculator memory and certain types of communications buffers.
(For more information, designate #46 on the Readers Service Card.)

Software

CSC BANK PAYROLL SYSTEM

Computer Sciences Corp., El Segundo, Calif., has developed a computer payroll system applicable to more industries than any other payroll system available, according to William R. Hoover, president of CSC's Computer Sciences Division. The new system is designed for use by banks as part of their payroll processing services for customers, Hoover said.

The Bank Payroll System, developed for use on the new "third generation" computers, accommodates the various payroll periods and tax requirements which may apply in a multi-department company operating in several locations in separate states. Multiple wage rates for each employee and additional compensation such as tips, meals, and room and board also are provided for.

The Bank Payroll System is written in COBOL, a computer language commonly used in business applications. The system is made up of several independent groups of related programs which can be operated separately or together to suit the bank's convenience in scheduling its computer operations.
(For more information, designate #50 on the Readers Service Card.)

PROGRAM CONVERSION PACKAGE FOR "THIRD GENERATION" IBM COMPUTERS

ITT Data Services, a division of International Telephone and Telegraph Corporation, Paramus, N.J., recently announced the development of a simple, low-cost method of reconstructing most currently-used scientific computer programs for processing on the new "third generation" IBM System/360 computers. Called STAFF, the ITT computer program conversion service makes possible the economical conversion of all existing programs written in FORTRAN IV, the most commonly used scientific computer language in the nation, to FORTRAN-H, the version of this programming language required for the solution of scientific problems on IBM's new System/360 series computer.

A computer program in itself, STAFF analyzes programs currently being used with "second generation" scientific computers and screens out those instructions or statements which are incompatible or incomprehensible to System/360 computers. It also indicates the changes required to convert these statements to a form which is acceptable to these new computers.

Robert A. Leonard, executive vice-president and general manager of the ITT division said that although IBM provides instructions for the writing of original programs in FORTRAN-H, no economical method of converting existing programs for use on the new "third generation" IBM computers had been available to the nation's data processing users until the development of STAFF.
(For more information, designate #52 on the Readers Service Card.)

THE 40X PACKAGE

Computer Usage Development Corporation, Mt. Kisco, N.Y., has announced the availability of a program called 40X for 360/40 users who are emulating 1401/1460 programs. The 40X package, which utilizes disk spooling and multi-programming techniques, speeds up emulator operation by 20 to 75 percent.

Additional features of the 40X package include: ability to run some programs that cannot be run under regular emulation, due to critical timing problems; ability to reprint a complete page or part of a page without reprocessing the page; and ability to print the last page of a report first to check controls for accuracy.

The 40X package requires a 360/40 with at least 65K bytes of memory, one 2311 disk, and the 1052 typewriter. It is available under a lease arrangement as well as for purchase.
(For more information, designate #51 on the Readers Service Card.)

COMPUTER PROGRAM TO SPEED PROBLEM SOLVING IN CHEMICAL PLANTS

A simple yet powerful useroreinted computer language that eliminates tedious computations in chemical and petroleum plant operations is a key feature of a new Chemical Engineering Information Processing System designed by The Service Bureau Corporation (SBC), New York, N.Y. The system is designed to simulate on a computer the operations of all or parts of chemical or petroleum plants to find operating conditions that lead to desired ends.

The system, called CHIPS, contains a library of programs for most of the important unit operations of chemical engineering as well as a simple but comprehensive language for describing chemical processes and designing solution procedures. The program performs logical operations and is designed to conveniently accept an almost unlimited number of unit operations.

CHIPS can be used in the study of anticipated plant designs, for equipment alteration, for process control and optimization studies through simulation, and for performance evaluation of equipment in use compared to new or clean equipment.
(For more information, designate #49 on the Readers Service Card.)

Data Transmitters and A/D Converters

MICROMATION® TECHNOLOGY BY STROMBERG-CARLSON

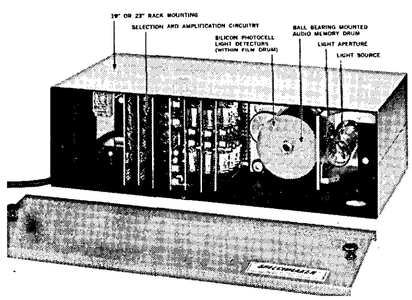
A high-speed system of converting computer data into readable form, MICROMATION® Technology, has been developed by Data Products Division of Stromberg-Carlson, San Diego, Calif. The system consists of an entire family of compatible equipment (18 different pieces) that operates at computer speeds to record output in alphanumeric or in graphic form, coupled with necessary ancillary equipment to provide effective use of the recorded output.

Key elements in the family of equipment are four new MICROMATION Recorders from Stromberg-Carlson. Each recorder, a system-within-a-system, takes digital codes from a computer or magnetic tape and translates the codes into ordinary language or graphic form at tape speeds. The information is presented on a special cathode ray tube where cameras automatically record it. Data may be recorded on special computerized microfilm for 16mm roll cartridges or 35mm aperture cards. An optional microfiche camera will be available in the system to automatically produce titled microfiche records with 72 images on a tab card size, or in other sizes and formats.
(For more information, designate #53 on the Readers Service Card.)

COGNITRONICS SPEECHMAKERS

A new audio response system capable of generating a variety of words from its 31-word film vocabulary has been announced by Cognitronics Corp., Briarcliff Manor, N.Y. The new device differs from most other speech generation equipment in that its vocabulary is stored on longer life photographic memory drums rather than magnetic drums with their inherent points of wear. The Speechmakers, models 631 and 632, have direct application for banking, credit, manufacturing, telephone, inventory control and any other computer-controlled systems requiring an audio response.

The Model 631 vocabulary selection is by individual switch closures for each of the 31 words while the model 632 contains a binary decoding matrix which performs the vocabulary selection from a standard five-bit binary code. The heart of both models is a 3" photographic film audio memory drum with 32 tracks (one track for each word and one for a timing pulse or silent word time).



A light source or aperture provides a narrow light beam that is directed through the rotating memory drum. This light beam is modulated by the pre-recorded audio on each track and in turn detected by silicon photocells located within the memory drum (one cell for each track). The output of the photocells is then amplified to a level compatible with the associated equipment's audio amplifiers or fed directly to telephone lines. Units are available with optional self-contained power supplies, cabinets and multiplexing electronics. They are designed for standard 19" relay rack mounting.
(For more information, designate #54 on the Readers Service Card.)

Information Retrieval

NCR ENTERING MICROFORM INFORMATION SYSTEMS FIELD

The National Cash Register Co., Dayton, Ohio, has announced it is entering a major new market — microform information storage and retrieval systems. The system is being marketed initially for applications which require frequent updating of a large volume of information for quantity distribution. Catalog systems, service manuals, and reference libraries are examples. NCR president R. Stanley Laing said that orders for PCMI® microform transparency readers already total 26,000 units. (The PCMI trademark refers to the use of a special NCR-developed coating used in the recording process.)

A file of PCMI transparencies that would fit in the corner of a desk drawer can store the equivalent of 10,000 books. Each transparency (4 x 6 inches) holds the images of up to 3200 typical business documents, which are reduced about 150 times. Any desired page of information can be accessed in seconds. The transparencies can cost as little as approximately $1 each (or about 1 cent for each 30 images) depending upon the quantity used.

In a typical installation, a user has a catalog or manual which needs frequent updating. This usually contains a large volume of information and illustrations and is generally sent on a regular basis to hundreds or even thousands of local points. With the PCMI system, each local station — a repair center, retail store, library, or an individual subscriber — installs only an NCR microform reader and a file of transparencies. For updating, replacement transparencies are simply mailed to the user from an NCR processing center, where they are produced, and the old transparencies destroyed. At the processing center, new pages or other revisions are periodically added to a master file. A completely new "edition" can be produced as often as required.

The PCMI system initially offers two models of microform transparency readers which provide magnifications of either 115 or 150 times. The readers will be rented for an average of $10 per month.
(For more information, designate #55 on the Readers Service Card.)

Input-Output

SOLID-STATE CRT COMPUTER DISPLAY

A real-time computer X-Y CRT display unit to sell for about $500 in production quantities has been developed by the Conrac Division of Giannini Controls Corp., Duarte, Calif. The new device, Model CDF Alphanumeric Display, presents a CRT display of computer or other digital outputs when driven by a character generator. In addition to alphanumerics, the display can handle a number of computer graphics functions.

In describing the device, GCC Vice President and Conrac General Manager W. J. Moreland said that plug-in modular construction is used to permit the use of a common chassis for the greatest possible number of computer interface requirements. The electronics are all solid state with the exception of a single high voltage rectifier tube and integrated circuits are used in the Z axis amplifier.
(For more information, designate #58 on the Readers Service Card.)

RECOGNITION EQUIPMENT REVEALS MACHINE THAT READS HAND PRINTING

A machine that reads numbers and the complete alphabet printed by hand was demonstrated recently by Recognition Equipment Inc., Dallas, Texas, to 52 financial analysts. Herman L. Philipson, Jr., president of Recognition Equipment, said that the Electronic Retina® Computing Reader has had this capability for some time although it never had been announced publicly. The disclosure was prompted, he said, primarily by the recent announcement of another machine scheduled for delivery in 1968 that reads hand-printed numbers and 5 specific alphabetic characters (see Computers and Automation, November, 1966, p. 46).

Mr. Philipson said that he felt that the ability to read hand-printed information would be useful to Recognition Equipment's customers only for limited "add on" applications. He said that clerical employees using conventional adding machines and other office equipment can prepare data for computer input by optical character reading about 10 times faster than they can print it by hand.

The optical character recognition system reads hand-printed characters intermixed with typed or printed characters in a variety of different, standard type styles at a rate of 2000 characters per second and processes documents containing this information at rates up to 1200 per minute. This capability is available immediately, at a nominal charge, for installation on the company's Electronic Retina® Computing Readers presently operating at data processing installations. It also can be supplied on all readers scheduled for future delivery, including those currently on order.
(For more information, designate #59 on the Readers Service Card.)

TALLY ANNOUNCES NEW PERFORATOR

A new high speed paper tape perforator featuring integral tape handling on a space saving rack mounted panel has been announced by Tally Corp., Seattle, Wash. The new model, designated the P-150A, operates asynchronously up to 150 characters per second. Standard units have unidirectional tape advance with remote tape backup at a modest extra cost. The new perforator has quick and easy front panel tape loading.

The P-150A will perforate five through eight levels of paper, plastic, or foil tape. Tape supply and take-up capacity is 1000 feet.

Error control options are available. Adding error control allows the motion of each punch pin to be mechanically sensed as the character is being punched. Odd or even parity can be checked. If an error has occurred, the tape advance pulse can be inhibited and the erroneous character overpunched with a delete code.
(For more information, designate #57 on the Readers Service Card.)

DIGITAL MAGNETIC TAPE RECORDING SYSTEM FROM POTTER

A new digital magnetic tape recording system designed for geophysical, mobile, and shipboard field recording applications has been announced by Potter Instrument Co., Plainview, N.Y. The new system, identified as Model FT-152, operates directly from a 12-volt battery, with very conservative power consumption.

The basic FT-152 is equipped with 10½" reels. The standard transport provides three selectable tape speeds with any combination from 15 ips to 120 ips. It is fully IBM-compatible for 7- and 9-channel (IBM 360, ASCII) tape formats. Start time is 50 ms, maximum; stop time is 100 ms, maximum.

Servo amplifiers and other electronic circuitry are solid state throughout and are packaged on printed circuit cards mounted in the back of the transport. A separate power supply provides all voltages required to operate the transport from an input voltage of 12 volts.
(For more information, designate #56 on the Readers Service Card.)

Components

BRIDGE-TYPE MAGNETIC MODULATOR HEAD

Ferroxcube Corp., Saugerties, N.Y., has announced development of a new flux-responsive, magnetic recording head capable of resolving up to 20,000 bits per inch. The new device, called a bridge-type magnetic modulator head, operates on the principle of flux-gating or magnetic modulation. It is capable of reading while stationary and is sensitive enough to resolve displacement increments as small as 50 microinches.

The basic head package consists of a glass-bonded ferrite pole-piece with a 60 microinch gap mounted in a ceramic or non-magnetic ferrite case. Its construction is similar to standard digital magnetic recording heads except that an excitation winding has been added to permit variation of reluctance around the magnetic path through the core structure. The variation in reluctance modulates the flux passing through the core. Thus the voltage induced in the output windings is proportional to the amount of flux rather than rate of change of flux as in most standard magnetic recording heads.

The head is extremely stable with temperature and in multi-track form can be used as a displacement transducer of the stored calibration, absolute coding type for making force, acceleration, temperature, or pressure measurements where readout of displacement increments to extremely high levels of accuracy are required or for general storage applications where the high packing density would contribute to small size and the flux-responsive readout would allow input power to be zero except during reading time. Simpler versions with as few as one or two tracks can be adapted for applications where incremental coding is possible.

According to Ferroxcube the ability to encode displacement increments directly permits drastic simplifications of sensing systems. Most of this type of measurement is done by transducers with analog electrical outputs so that complex analog-to-digital conversion systems with a time sharing switch or multiplexer to handle large numbers of transducers are required. With "absolute" or "true" encoding techniques each transducer becomes its own A to D converter and the necessity for the additional electronics is eliminated.
(For more information, designate #62 on the Readers Service Card.)

PERIPHERAL EQUIPMENT TESTER

Scientific Data Systems, Los Angeles, Calif., has developed an on-line peripheral equipment tester that allows peripheral devices to be checked out while the computer is operating. The Peripheral Equipment Tester (PET) is the first peripheral maintenance device ever offered that can independently exercise and diagnose operations of peripheral devices. The tester can detect and isolate interface problems between a Sigma computer and its peripheral devices even while the computer is performing on-line, real-time problems.

PET also permits Sigma peripheral devices to be exercised, tested, and simulated off-line so that possible malfunctions can be detected and repaired. Operations such as parity generation, code conversion, and error detection can be checked. Tests are designed so that each portion of a peripheral device's operating cycle is under control of a separate PET test sequence.

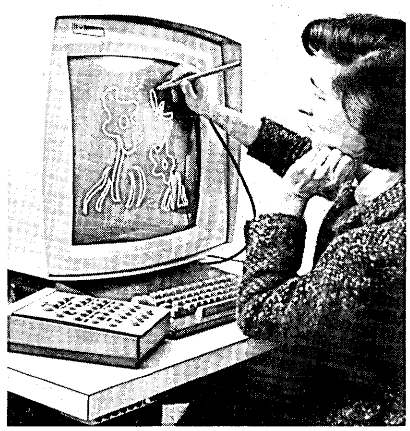
The portable PET device is housed in an 11 x 19 x 17-inch cabinet that contains all cables, controls, instructions, and electronics needed for testing Sibma peripheral devices. The machine operates on standard 115v ac power. Model 7901 Peripheral Equipment Tester will be available in the first quarter of 1967.
(For more information, designate #63 on the Readers Service Card.)

RESEARCH FRONTIER

ELECTRONIC "PAINT BRUSH AND DRAWING BOARD" FOR THE TEXTILE DESIGNER OF FUTURE?

The textile designer of the future may be able to discard his traditional paint brush and graph paper in favor of a pen that "writes" with light on an "electronic drawing board" linked to a computer. The new technique, called "textile graphics", has been developed by IBM Corporation. Substantial time savings are possible using this technique because the designer is able to select a weave from a library stored in the computer and have it inserted in all appropriate areas of the design simultaneously rather than painting it into each individual thread intersection.

IBM's 2250 display unit has function keys that permit the designer to communicate with the computer and manipulate the design in any way desired, enlarging or reducing it, moving it horizontally or vertically, rotating it. The



2250 shown in the picture is being demonstrated by Mrs. Janice R. Lourie, a member of IBM's New York Scientific Center, developer of the textile graphics technique, and an accomplished amateur weaver herself.

Fabric designed with the aid of the new technique recently was shown by IBM in New York City as part of a textile graphics demonstration for the industry. While IBM is demonstrating the feasibility of textile graphics, it has not developed full-scale programming support for this application. Manufacturers who wish to develop their own textile graphics programming can call upon IBM for technical assistance and guidance, based on IBM's experience in development of this prototype technique.

GE DEVELOPS AUDREY — A TALKING COMPUTER

Computer Engineers at the General Electric Company's Missile and Space Division, Valley Forge, Pa., have accomplished another developmental achievement with a talking computer called AUDREY (for AUDio REplY). The new device already supplements existing capability for desk-side teletypewriters and cathode ray tube (CRT) data display terminal units as part of the Time-Sharing computer systems located at GE's Space Technology Center. The new device utilizes a Touch-Tone® telephone as a terminal, remotely located from the computer center and capable of performing many of the functions of other time-sharing terminal units.

Louis F. Cimino, manager of GE's Information Systems and Computer Center in Philadelphia, says AUDREY achieves her unique voice answerback talent through the use of photographic memory tape on which her vocabulary is stored. "Because of the photographic memory tape approach," he said, "voice output is totally nonmechanical and responses are always natural and pleasant sounding." After the initial connection is made with the computer the user hears — "This is AUDREY" — and he can then present his problem, or request previously stored information. All computer answers are in the form of a human voice.

Low cost, accessibility, and the potential of multiple applications are AUDREY's distinctive qualities. The cost of a Touch-Tone telephone is the only terminal cost and the operating procedure is simple. AUDREY may someday be a significant traveling aid to scientists, engineers and management personnel while on business trips, since it conceivably will be feasible for them to use AUDREY to obtain information or perform complex calculations during an airport wait, from motel rooms, or any location where Touch-Tone telephones are in service.

BUSINESS NEWS

AMPEX SALES UP 37% AT MID-YEAR

Ampex Corp. reports sales for the six months ended October 29, 1966, totaled a record $101,265,000, up 37% from the same period last year. Record net earnings were $4,453,000, up 30% from last year.

Incoming product orders in the first half increased 18% over the same period last year and backlog of unfilled product orders rose to a total of $49,400,000, up 17% from the backlog at the end of the first half of last year.

President W. E. Roberts said Ampex's results represented particular progress in sales of broadcast and closed circuit video recording equipment, domestically and in international markets, consumer stereo tape recorders and all types of magnetic tape.

INFORMATICS DOUBLES EARNINGS

Informatics Inc. reports net income of $136,772 on sales of $3,105,700 for the first six months of fiscal year 1967, ended September 24, 1966, compared with earnings of $61,805 on sales of $1,892,512 for the same period last year.

Dr. Walter F. Bauer, president, reported "substantial new contracts" with Jet Propulsion Laboratory for computer programming related to the Surveyor and Mariner space programs, and with The Army Operations Center in Washington, D.C. for display systems programming.

COMPUTER USAGE HAS RECORD SALES, EARNINGS

Computer Usage Co. reports record revenues of $8,897,174 for the fiscal year ended September 30, up 47% from the previous year. Net income was $449,378, up 30% from the previous year.

Elmer C. Kubie, President, said the financial growth was especially gratifying considering the staff expansion CUC experienced during the year — the number of employees rose from 397 to 667 at year end.

UNIVERSITY COMPUTING NINE-MONTH NET UP 225%

University Computing Co. reports net income was up 225% in the first nine months of the year on a 110% gain in revenues.

For the period ended September 30 the Dallas-based computer service firm had net income of $608,294 compared with $186,532, in the like 1965 period.

Revenues totaled $3,118,808, compared with $1,483,843 in the first nine months of 1965. Operations of D. R. McCord and Associates, Inc., which University Computing acquired effective June 30, 1966, are included on a pooling-of-interest basis for both years.

President Sam Wyly noted that University Computing now had a capital base of nearly $10,000,000, "the largest of any publicly-owned computer service company." He added that with this base the company is in position to take advantage of many new opportunities to expand services to customers by acquiring and developing new computer programs, by developing new computer centers, and through acquisition of computer equipment.

During the third quarter University Computing's wholly-owned subsidiary which was formed in the spring, Computer Leasing Company, booked its first business and installed computer equipment for a customer under a long-term lease.

COMPUTER SCIENCES SALES DOUBLE FOR HALF YEAR

Computer Sciences Corporation reports revenues for the six months ended September 30, 1966, rose 100% over the year earlier period to $17,372,000. After provision for federal income taxes, net operating income for the 26-week period was $587,000. An additional non-recurring gain of $83,000 was also realized.

The decline in earnings from the first quarter, ended July 1, 1966, was termed temporary by Computer Sciences and said to be the result of start-up expenses on several large contracts and costs of consolidation of the recently acquired Politz Division, which experienced operating losses.

SANDERS UNDER MAJOR EXPANSION PROGRAM

Sanders Associates, Inc., reports sales for the fiscal year ending July 31, 1967, are expected to reach over $125,000,000. This sales estimate is almost double fiscal 1966 sales of $66 million, and is an upward revision from the company's previous estimates of $110 million for the current fiscal year.

The company's accelerated expansion program in plants and personnel plus new contracts and the expansion of present contracts provides this sales base, declared president Royden C. Sanders, Jr.

In its stepped up expansion program, over $6 million was expended during fiscal 1966 for new plant and equipment, and a minimum of $5 million more has been budgeted for fiscal 1967, said Mr. Sanders. Employment has also risen on an accelerated schedule, with current employment rolls standing at 5900 compared with about 3100 at the beginning of the year.

The increased business expectations for this year include all of the major areas in which the company is active, including electronic warfare, ocean systems, communications, electro-optics radar, and aerospace systems, and data handling and displays.

WORLD REPORT – AUSTRALIA

Australia maintained its rapid rate of investment in computer equipment with an increase of 26 per cent to $A105 million in the 12 months ended June 30. Over the year the number of installations rose from 356 to 486, consisting of 410 digital machines and 76 analogue machines. There are also 192 computers at present on order. When delivered, they will add about $A50 million to the value of installed equipment. With nearly 500 installations, Australia now rates on a per capita basis as a major user-country, ranking among the highly industrialised nations of Western Europe.

The latest statistics on Australia's computer population were issued by the Commonwealth Department of Labour and National Service which estimates the average cost of a digital installation at about $A250,000. Among the large-scale installations, 18 are valued at more than $A1 million. More than three-quarters of the computers in operation are in New South Wales and Victoria, with Sydney and Melbourne together accounting for 342 installations and 136 orders. The report of the department says there are 278 computers in use in manufacturing and commercial enterprises, including government business undertakings and public utilities. Governments accounted for 86, including 70 for the Commonwealth, education for 74, and data processing bureaus for 48. Metal manufacturing is the largest single industry user of computers, with 44 installed and 28 on order. It is followed by the finance, commercial, and transport groups, in that order.

* * * * *

What is described as the first fully automated betting system in the world is scheduled to go into operation in Melbourne, Victoria, early in 1967. It has been designed for the Victorian Totalisator Agency Board, a government-controlled betting organisation, which allows off-course bets to be placed at scores of different betting shops located in Melbourne.

The central computer complex is a twin Control Data 3100 system which, together with peripheral units, is worth more than $1 million. Other equipment consists of a special telephonic exchange and 270 key sets to be used in agency offices.

When it goes into operation the system will remove the need to close betting 40 minutes before the beginning of a race. This time will be reduced to 20 minutes. Agency operators will key betting information into the computer via the telephonic exchange which will control the number of input lines to the computer. When all the information for a particular race has been received, the computer totals up the investments, and these details are then sent to the totalisator at the racecourse.

After the race has been run, the computer sends information on placings, dividends, and total payout to each agency. The system design provides for the handling of one million messages per race day and for bursts of 3000 messages a minute.

The computer, a communications module, and a magnetic drum in the operating system are all duplicated to provide back-up facilities in the event of a breakdown. Each computer has a core store of 32,000 words and can perform 300,000 simple operations in a second. Each magnetic drum can store more than four million characters and spins at 1800 r.p.m.

* * * * *

A Control Data 6400, the most powerful computer yet imported into Australia, has been installed at the University of Adelaide in South Australia. Valued at about $A1.5 million, the machine is believed to be the most powerful installation outside North America and Europe. It is being used mainly to support the university's expanding research and educational activities, but its spare time is being offered to outside organisations with large or complex problems.

Some large companies which at present send complex computing tasks to overseas installations are expected to buy time on the 6400. The university also believes some organisations in South-East Asian countries will wish to make use of the machine.

International Business Machines Australia Ltd., a wholly owned subsidiary of IBM World Trade Corporation, raised $A3 million in a public debenture issue in Australia in October. It was the first public borrowing to be made by a computer company in this country. Strong confidence in the future of the computer business was reflected by the fact that the issue opened and closed within a couple of hours.

W. R. Cooper

W. R. COOPER

MONTHLY COMPUTER CENSUS

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

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

In general, manufacturers in the computer field do not officially release installation and on order figures. The figures in this census are developed through a continuing market survey conducted by associates of our magazine. This market research program develops and maintains a data bank describing current computer installations in the United States. A similar program is conducted for overseas installations.

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

AS OF DECEMBER 10, 1966

NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS
ASI Computer	ASI 210	Y	$3850	4/62	25	0
	ASI 2100	Y	$4200	12/63	7	0
	ADVANCE 6020	Y	$4400	4/65	13	5
	ADVANCE 6040	Y	$5600	7/65	7	6
	ADVANCE 6050	Y	$9000	2/66	6	6
	ADVANCE 6070	Y	$15,000	10/65	5	6
	ADVANCE 6130	Y	$1000	11/66	2	18
Autonetics	RECOMP II	Y	$2495	11/58	36	X
	RECOMP III	Y	$1495	6/61	7	X
Bunker-Ramo Corp.	BR-130	Y	$2000	10/61	160	2
	BR-133	Y	$2400	5/64	27	42
	BR-230	Y	$2680	8/63	15	X
	BR-300	Y	$3000	3/59	35	X
	BR-330	Y	$4000	12/60	30	X
	BR-340	Y	$7000	12/63	20	X
Burroughs	205	N	$4600	1/54	42	X
	220	N	$14,000	10/58	34	X
	E101-103	N	$875	1/56	125	X
	B100	Y	$2800	8/64	168	14
	B250	Y	$4200	11/61	84	1
	B260	Y	$3750	11/62	232	2
	B270	Y	$7000	7/62	164	4
	B280	Y	$6500	7/62	128	5
	B300	Y	$10,000	7/65	130	81
	B2500	Y	$5000	1/67	0	42
	B3500	Y	$14,000	5/67	0	30
	B5500	Y	$22,000	3/63	60	12
	B6500	Y	$33,000	2/68	0	10
	B8500	Y	$200,000	2/67	0	1
Control Data Corporation	G-15	N	$1600	7/55	310	X
	G-20	Y	$15,500	4/61	23	X
	LGP-21	Y	$725	12/62	118	X
	LGP-30	semi	$1300	9/56	122	X
	RPC-4000	Y	$1875	1/61	55	X
	160*/160A/160G	Y	$2100/$5000/$12,000	5/60;7/61;3/64	460	3
	924/924A	Y	$11,000	8/61	26	X
	1604/1604A	Y	$45,000	1/60	58	X
	1700	Y	$4000	5/66	35	125
	3100	Y	$11,000	12/64	105	38
	3200	Y	$14,000	5/64	86	X
	3300	Y	$15,000	9/65	60	50
	3400	Y	$25,000	11/64	19	X
	3500	Y	$30,000	9/67	0	6
	3600	Y	$58,000	6/63	50	X
	3800	Y	$60,000	2/66	16	14
	6400	Y	$50,000	5/66	12	18
	6600	Y	$85,000	8/64	21	16
	6800	Y	$130,000	4/67	0	4
Data Machines, Inc.	620	Y	$900	11/65	35	25
Digital Equipment Corp.	PDP-1	Y	$3400	11/60	60	X
	PDP-4	Y	$1700	8/62	57	X
	PDP-5	Y	$900	9/63	115	1
	PDP-6	Y	$10,000	10/64	23	2
	PDP-7	Y	$1300	11/64	105	35
	PDP-8; 8/S	Y	$525; $300	4/65	550	560
	PDP-9	Y	$1000	12/66	0	60
	PDP-10	Y	$9000	7/67	0	2
El-tronics, Inc.	ALWAC IIIE	N	$1820	2/54	15	X
Electronic Associates, Inc.	8400	Y	$12,000	6/65	12	8
General Electric	115	Y	$1800	12/65	240	560
	205	Y	$2900	6/64	44	X
	210	Y	$16,000	7/59	49	X
	215	Y	$6000	9/63	54	X
	225	Y	$8000	4/61	205	X
	235	Y	$10,900	4/64	69	2
	415	Y	$9600	5/64	200	55
	425	Y	$18,000	6/64	84	44
	435	Y	$25,000	9/65	30	18
	625	Y	$50,000	4/65	22	18
	635	Y	$56,000	5/65	19	22
	645	Y	$90,000	7/66	2	10
Honeywell	DDP-24	Y	$2500	5/63	85	3
	DDP-116	Y	$900	4/65	138	35
	DDP-124	Y	$2050	3/66	24	36
	DDP-224	Y	$3300	3/65	46	10
	DDP-516	Y	$700	2/67	0	40
	H-120	Y	$3900	1/66	330	290
	H-200	Y	$8400	3/64	960	140

NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS
Honeywell (cont'd)	H-400	Y	$8500	12/61	115	X
	H-800	Y	$28,000	12/60	90	2
	H-1200	Y	$8000	2/66	50	95
	H-1400	Y	$14,000	1/64	12	1
	H-1800	Y	$42,000	1/64	20	1
	H-2200	Y	$12,000	1/66	18	58
	H-4200	Y	$20,500	3/67	0	6
	H-8200	Y	$35,000	3/68	0	2
	DATAmatic 1000	N	$40,000	12/57	2	X
IBM	305	N	$3600	12/57	140	X
	360/20	Y	$2000	12/65	1200	6400
	360/30	Y	$7500	5/65	2500	4400
	360/40	Y	$15,000	4/65	1350	1500
	360/44	Y	$10,000	7/66	20	150
	360/50	Y	$26,000	8/65	140	600
	360/62	Y	$55,000	11/65	1	X
	360/65	Y	$50,000	11/65	28	215
	360/67	Y	$75,000	10/66	6	66
	360/75	Y	$78,000	2/66	16	32
	360/90 Series	Y	$140,000	6/67	0	10
	650	N	$4800	11/54	170	X
	1130	Y	$1200	11/65	700	3800
	1401	Y	$6600	9/60	7680	X
	1401-G	Y	$2300	5/64	1620	X
	1410	Y	$14,200	11/61	805	65
	1440	Y	$4800	4/63	3350	120
	1460	Y	$11,500	10/63	1780	X
	1620 I, II	Y	$4000	9/60	1670	20
	1800	Y	$7600	1/66	100	320
	701	N	$5000	4/53	1	X
	7010	Y	$22,600	10/63	214	6
	702	N	$6900	2/55	6	X
	7030	Y	$160,000	5/61	6	X
	704	N	$32,000	12/55	32	X
	7040	Y	$22,000	6/63	120	4
	7044	Y	$32,000	6/63	125	5
	705	N	$38,000	11/55	52	X
	7070, 2, 4	Y	$27,000	3/60	322	X
	7080	Y	$55,000	8/61	85	X
	709	N	$40,000	8/58	9	X
	7090	Y	$63,500	11/59	45	X
	7094	Y	$72,500	9/62	117	2
	7094 II	Y	$78,500	4/64	128	4
National Cash Register Co	NCR - 304	Y	$14,000	1/60	25	X
	NCR - 310	Y	$2500	5/61	10	X
	NCR - 315	Y	$8500	5/62	380	150
	NCR - 315-RMC	Y	$12,000	9/65	26	45
	NCR - 390	Y	$1850	5/61	720	30
	NCR - 500	Y	$1500	10/65	810	810
Philco	1000	Y	$7010	6/63	16	X
	2000-210, 211	Y	$40,000	10/58	16	X
	2000-212	Y	$52,000	1/63	12	X
Radio Corporation of America	RCA 301	Y	$7000	2/61	644	2
	RCA 3301	Y	$17,000	7/64	68	6
	RCA 501	Y	$14,000	6/59	96	X
	RCA 601	Y	$35,000	11/62	5	X
	Spectra 70/15	Y	$4100	9/65	75	110
	Spectra 70/25	Y	$6700	9/65	43	60
	Spectra 70/35	Y	$10,400	7/66	14	94
	Spectra 70/45	Y	$17,400	11/65	22	98
	Spectra 70/55	Y	$40,500	12/66	0	12
Raytheon	250	Y	$1200	12/60	175	X
	440	Y	$3500	3/64	16	3
	520	Y	$3200	10/65	20	6
Scientific Control Corporation	650	Y	$500	5/66	3	7
	655	Y	$1800	10/66	0	2
	660	Y	$2000	10/65	5	3
	670	Y	$2600	5/66	1	2
Scientific Data Systems Inc.	SDS-92	Y	$1500	4/65	70	28
	SDS-910	Y	$2000	8/62	188	6
	SDS-920	Y	$2900	9/62	138	10
	SDS-925	Y	$3000	12/64	30	10
	SDS-930	Y	$3400	6/64	135	15
	SDS-940	Y	$10,000	4/66	8	10
	SDS-9300	Y	$7000	11/64	33	7
	Sigma 2	Y	$1000	12/66	0	180
	Sigma 7	Y	$12,000	12/66	0	25
Systems Engineering Labs	SEL-810/810A	Y	$1000	9/65	28	8
	SEL-840/840A	Y	$1400	11/65	3	6
UNIVAC	I & II	N	$25,000	3/51 & 11/57	25	X
	III	Y	$20,000	8/62	76	X
	File Computers	N	$15,000	8/56	16	X
	Solid-State 80 I, II, 90 I, II & Step	Y	$8000	8/58	240	X
	418	Y	$11,000	6/63	98	38
	490 Series	Y	$35,000	12/61	112	54
	1004	Y	$1900	2/63	3200	50
	1005	Y	$2400	4/66	460	240
	1050	Y	$8000	9/63	295	35
	1100 Series (except 1107)	N	$35,000	12/50	10	X
	1107	Y	$55,000	10/62	29	X
	1108	Y	$65,000	9/65	29	60
	9200	Y	$1500	6/67	0	600
	9300	Y	$3400	6/67	0	200
	LARC	Y	$135,000	5/60	2	X
				TOTALS	39,983	23,443

X = no longer in production.

* To avoid double counting, note that the Control Data 160 serves as the central processor of the NCR 310. Also, customers ordering a new computer model intended to replace a computer model in the same product line may continue to use their current peripheral equipment, which can account for 30-70% of the value of the total computer system.

NEW PATENTS

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

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

October 4, 1966

3,277,443 / Ben A. Harris and John D. Frey, Jr., Rochester, N.Y. / assignors by mesne assignments to Friden, Inc., San Leandro, Calif. / Data Receiver.

3,277,444 / David W. Masters, Palo Alto, Calif. / assignor to General Electric Co. / Data Transfer System.

3,277,447 / Edward Arthur Newman, Oxshott, Surrey, and Michael Arthur Wright, Cheam, Surrey, England / assignors by mesne assignments to International Business Machines Corp., N.Y. / Electronic Digital Computers.

3,277,448 / Ronald N. Borrelli, San Leandro, Harold T. Madden, Pleasant Hill, and Stanley R. Olson, Oakland, Calif. / assignors to SCM Corp. / Data Processing Mechanisms.

3,277,449 / William Shooman, Culver City, Calif. / no assignee listed / Orthogonal Computer.

3,277,450 / William A. Edson Los Altos Hills, Calif. / assignor to General Electric Co. / High Speed Information Storage System.

October 11, 1966

3,278,733 / Lucian E. Kowalski, Detroit, Mich. / assignor to Burroughs Corp. / Adding And Subtracting Unit For A Digital Computer.

3,278,758 / Jan Vroman, Borgerhout-Antwerp, Belgium / assignor to International Standard Electric Corp. / Anti-Coincidence Logic Circuits.

3,278,898 / Dale H. Rumble, Carmel, N.Y. / assignor to International Business Machines Corp. / Data Transmission System For Distinctively Modulating Given Datum Bits For Parity Checking.

3,278,904 / Carl M. Lekven, Burbank, Calif. / assignor to General Precision, Inc. / High Speed Serial Arithmetic Unit.

3,278,905 / Joseph E. McAteer, Anaheim, Calif. / assignor to Hughes Aircraft Co., Culver City, Calif. / Associative Memory.

3,278,906 / Robert J. Gountanis, Mendota Heights, and Herman Osofsky, Roseville, Minn. / assignors to Sperry Rand Corp. / Dual Channel Mode.

3,278,909 / Jean Borne, Clichy, and Michel Audebert, Paris, France / assignors to North American Philips Co., Inc. / Reading And Writing Device For Use In Magnetic Core Storages.

3,278,910 / Andrew H. Bobeck, Chatham, N.J. / assignor to Bell Telephone Laboratories, Inc. / Magnetic Memory Circuits.

3,278,911 / Richard L. Snyder, Malibu, Calif. / assignor to Hughes Aircraft Co., Culver City, Calif. / Word Organized Magnetic Memory Selection And Driving System.

3,278,913 / Jack I. Raffel, Groton, Mass. / assignor to Massachusetts Institute of Technology / High Capacity Memory.

3,278,914 / John L. Rashleigh and John S. McMurtrie, Poughkeepsie, and William C. Barehan, Wappingers Falls, N.Y. / assignors to International Business Machines Corp. / Magnetic Film Storage Device.

3,278,915 / David F. Joseph, Norwood, Mass. / assignor to Radio Corporation of America / Two Core Per Bit Memory Matrix.

3,278,916 / James R. Kiseda, Yorktown Heights, and Harold E. Petersen, Chappaqua, N.Y., Walter C. Seelbach, Scottsdale, Ariz., and Michael Teig, Yonkers, N.Y. / assignors to International Business Machines Corp. / High Speed Magnetic Core Switching System.

October 18, 1966

3,280,316 / Terry A. Jeeves, Penn Hills Township, Allegheny County, Pa. / assignor to Westinghouse Electric Corp. / High-Speed Tunnel Diode Adder.

3,280,344 / Jules R. Ville, Mountain View, Calif. / assignor to Sylvania Electric Products Inc. / Stored Charge Information Transfer Circuits.

October 25, 1966

3,281,788 / George W. Hernan, Haddonfield, and Stanley H. Hunkins, Merchantville, N.J. / assignors to Ultronic Systems Corp. / Data Retrieval And Coupling System.

3,281,792 / Francois Henri Raymond, Saint-Germain-en-Laye, Seine et Oise, France / assignor to Societe d'Electronique et d'Automatisme, Courbevoie, Seine, France / Electrical Digital Computers.

3,281,798 / William E. Glenn, Jr., Scotia, N.Y. / assignor to General Electric Co. / Thermoplastic Information Storage System.

3,281,802 / Robert E. McMahon, Dunstable, Mass. / assignor to Massachusetts Institute of Technology / Magnetic Memory Core.

November 1, 1966

3,282,503 / Marvin Jacoby, Fort Washington, Pa. / assignor to Sperry Rand Corp. / Fluid Memory Device.

3,283,175 / James E. Webb, Administrator of the NASA, with respect to an invention of Ted Winkler / A.C. Logic Flip-Flop Circuits.

3,283,180 / Abraham I. Pressman, Elkins Park, Pa. / assignor to RCA / Logic Circuits Utilizing Transistor As Level Shift Means.

3,283,308 / Walter Klein, Santa Ana, and Robert J. Grady, Garden Grove, Calif. / assignors to Beckman Instruments, Inc. / Data Processing System With Autonomous Input-Output Control.

3,283,312 / Ira R. Marcus, Silver Spring, and Osvaldo T. Dellasanta, Rockville, Md. / assignors to the United States of America as represented by the Secretary of the Army / Read-Out Circuit For Static Magnetic Core Devices.

3,283,313 / James C. Hathaway, Corona del Mar, Calif. / assignor to Collins Radio Co. / Thin Film Magnetic Register.

November 8, 1966

3,284,640 / Edward Lindell, Los Angeles, Calif. / assignor to Ampex Corp. / Memory Addressing Register Comprising Bistable Circuit With Current Steering Means Having Disabling Means.

CALENDAR OF COMING EVENTS

Jan. 19, 1967: Symposium on Computers and Communications and their System Interaction, Institute of Electrical and Electronics Engineers, Inc., Miramar Hotel, Santa Monica, Calif.; contact Irving Cohen, Symposium General Chairman, Informatics, Inc., 5430 Van Nuys Blvd., Sherman Oaks, Calif. 91401

Feb. 1, 1967: University of California Extension in cooperation with American Statistical Assoc. (Southern Calif. Chapter) and the Assoc. for Computing Machinery (Los Angeles Chapter) Computer Science and Statistics Symposium; contact Business Administration Extension Conferences, 2381 GBA, University of California, Los Angeles, Calif. 90024

Feb. 16-17, 1967: The Association of Data Processing Service Organizations (ADAPSO), Sheraton Hotel, Chicago, Ill.; contact James Powell, United Data Processing, Inc., 1001 S.W. Tenth Ave., Portland, Oregon

Mar. 7-9, 1967: 8th Annual AFETR Range User Data Symposium, Air Force Eastern Test Range, Orlando Air Force Base, Fla.; attendance by invitation only; a SECRET clearance is required; contact Col. Asa P. Whitmire, Chief of Data Processing Div., Patrick Air Force Base, Fla. 32925

April 12-14, 1967: Electronic Information Handling Conference, Pittsburgh, Pa.; contact Jack Belzer, University of Pittsburgh, Pittsburgh, Pa. 15213

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

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

Mar., 1967: Fifth Annual Symposium on Biomathematics and Computer Science in the Life Sciences, Shamrock Hilton Hotel, Houston, Texas; contact Office of the Dean, Division of Continuing Education, the University of Texas Graduate School of Biomedical Sciences, 102 Jesse Jones Library Bldg., Texas Medical Center, Houston, Texas 77025

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

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

May 9-11, 1967: Spring Joint Computer Conference, Convention Center, Philadelphia, Pa.; contact AFIPS Headquarters, 211 E. 43rd St., New York, N.Y. 10017

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

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

Aug. 28-Sept. 2, 1967: AICA (International Association for Analogue Computation) Fifth Congress, Lausanne, Switzerland; contact secretary of the Swiss Federation of Automatic Control, Wasserwerkstrasse 53, CH 8006 Zurich, Switzerland

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

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

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

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

ADVERTISING INDEX

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

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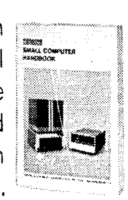

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