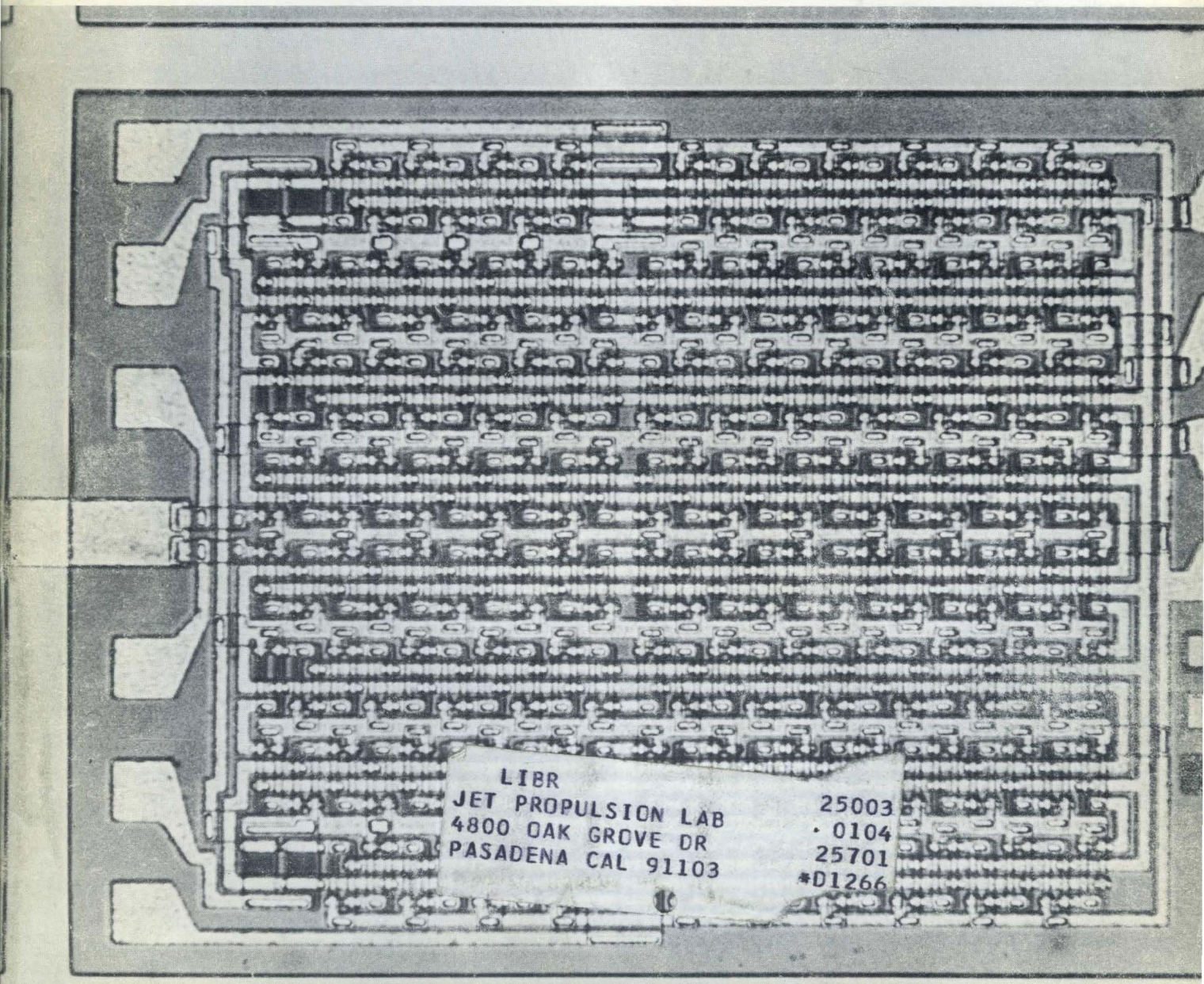
March, 1966

computers and automation

Shift register of 90 bits, size less than 1/200 square inch



Banks can render this type of bill and these types of statements for all types of businesses!

JOHN A. JONES D.D.S.
MEDICAL CENTER
310 MAIN STREET
PITTSBURGH, PA. 15250

RETURN TO

MR. BERNARD ANDERSON
344 MADISON AVENUE
PITTSBURGH, PA.

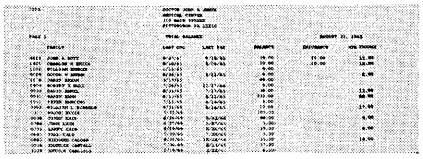
JOHN A. JONES D.D.S.
P. O. BOX 333
PITTSBURGH, PA.

STATEMENT DATE 9/30/65 PHONE 333-8800 AMOUNT ENCLOSED $
PLEASE DETACH AND RETURN THIS PORTION WITH YOUR PAYMENT IN THE ENCLOSED SELF-ADDRESSED ENVELOPE

DATE		DESCRIPTION	CHARGES & CREDITS (CR)	BALANCE
8/31/65		PREVIOUS BALANCE		62.00
9/07/65	KAREN	X-RAY	5.00	67.00
9/14/65		MAIL REMITTANCE	50.00CR	17.00
9/21/65	TED	SCALING	3.00	20.00
9/30/65		BALANCE DUE		20.00

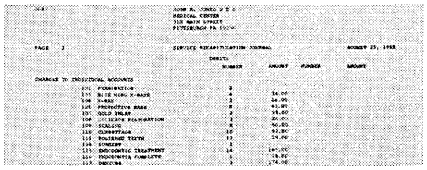
CHARGES OR CREDITS PROCESSED AFTER THE STATEMENT DATE SHOWN ABOVE WILL APPEAR ON THE NEXT STATEMENT

What started out to give doctors relief from bookkeeping chores has turned into a remedy for many another small business in Pittsburgh.



For now the Mellon National Bank & Trust Company of Pittsburgh is doing it for restaurants, auto parts stores, florists, drugstores, country clubs and others, as well as for dentists and doctors.

Prepunched account cards are inserted into a card reader connected to a Data-Phone* data set. And the information is transmitted over regular telephone lines. At the bank, the cards are automatically duplicated

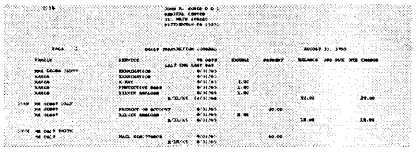


and then processed to provide the bills and forms shown here.

Businesses using the service need no longer be concerned with accounting equipment, maintenance agreements, printed forms, envelopes and stamps.

Overtime and billing-time confusion are eliminated. Remittances come in regularly, because statements are mailed on time regardless of personnel turnover, vacations, peak loads and emergencies.

The bank's data system provides businesses with these daily reports and forms: Transaction Journal; Trial Balance Journal; summary of all daily charges, payments, adjustments, month-to-date and year-to-date receipts; deposit tickets for all money



automatically deposited in the business's account; prepunched cards for new accounts.

Monthly reports include: Statements for all due accounts; Aged Accounts Receivable Report; Service Recapitulation Journal; New Account Report; Closed Account Report.

Now even small businesses get big-business billing service.

Our Communications Consultant can give you more details. Call your Bell Telephone Business Office and ask to have him contact you.

NCR 500 Series Computers are on their way . . .

. . . Out of the factory. Out to Florida and Washington and California and Maine.

To commerce, industry, finance and government.

The NCR 500 Series offers a solution to data processing and reporting for firms of varying size and with widely divergent needs. Within a given industry it can handle a tremendous range of assignments. A modest sampling would be accounts receivable, billing, disbursements, government reports, costs, accounts payable, sales reports, scheduling, and inventory. There are literally scores of applications that your NCR representative would be happy to fill you in on.

First announced in January '65, NCR 500 systems are setting records for enthusiastic acceptance.

Why? Very simple.

NCR 500's give more input, output and processing capabilities than any other low-priced computer system on the market today.

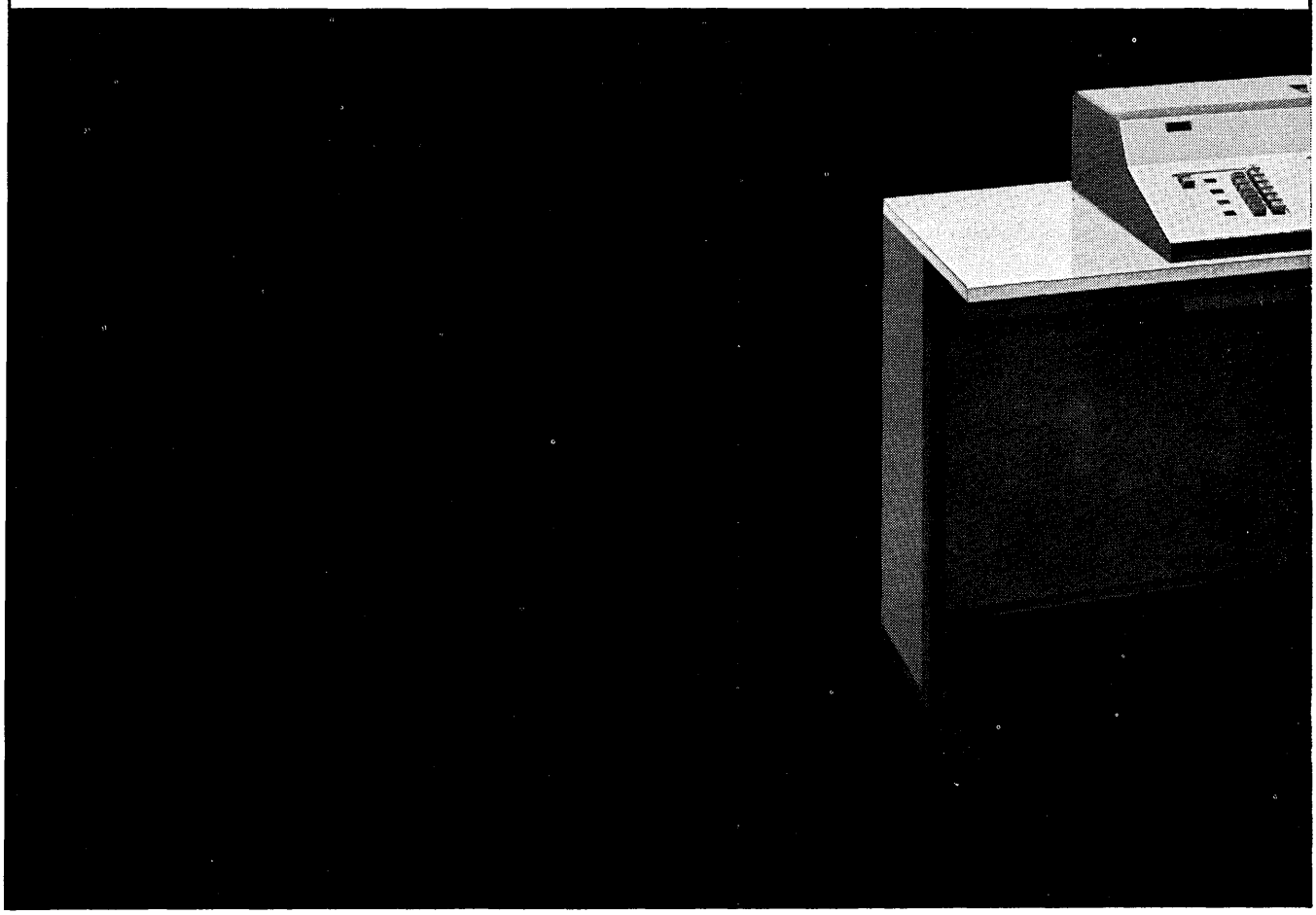
Buyers get NCR's unique "total system" advantage . . . everything from one manufacturer, from data input through processing to output. No costly translating operations.

They get NCR's unique "all languages" capacity, too. (Input and output on punch card, punch paper tape, magnetic ledger card, and optical print.)

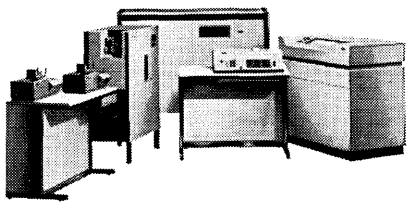
And they get a system of unequalled flexibility. It works alone or as a satellite to any other computer systems. Even within the system itself there's expandable flexibility.

So, in organizing the data required for efficient business operation, users of the NCR 500 Series Computer get more than they can get anywhere else for their money.

No wonder that for businesses of every kind, NCR 500's are on their way . . . all across the country.



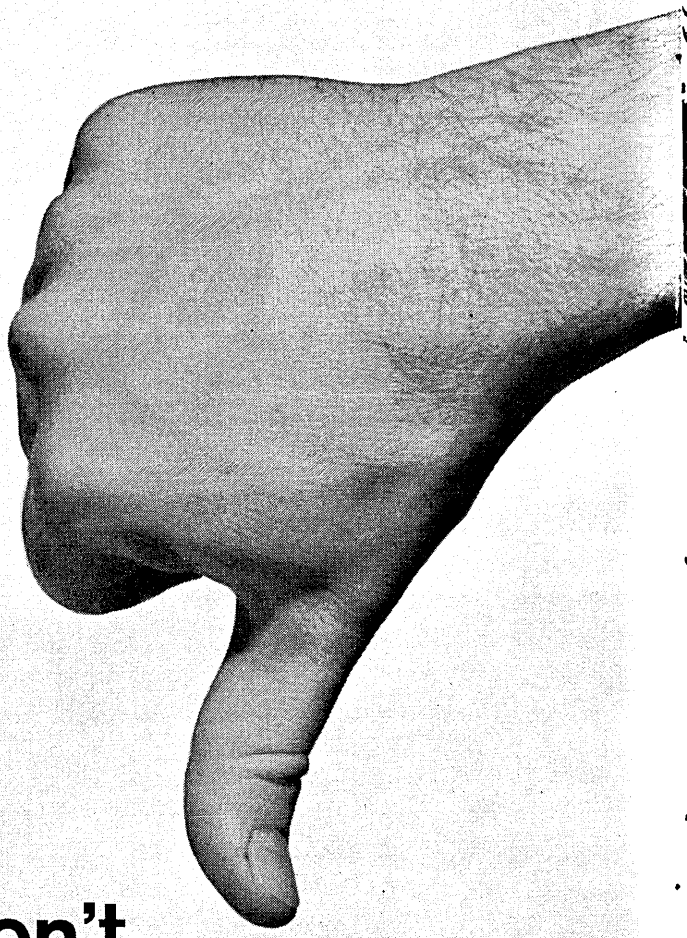
NCR



THE NATIONAL CASH REGISTER COMPANY ®

DAYTON, OHIO 45409

Designate No. 3 on Readers Service Card



Most people like Computape

A few don't

The way repeat sales are going lately, there are an awful lot of people out there who like Computape.

But occasionally we run into someone who doesn't.

Bound to happen, of course. Once in a long while it turns out to be someone who has a legitimate gripe. Like the little car ad says, nobody's perfect.

Much more often, interestingly enough, it's someone who has never even tried Computape. Maybe he's found another brand that seems adequate and would rather fight than switch. Or maybe he has a feeling that the company that does the most and the loudest advertising just naturally makes the best precision tape.

We will respect his opinion without subscribing to its validity.

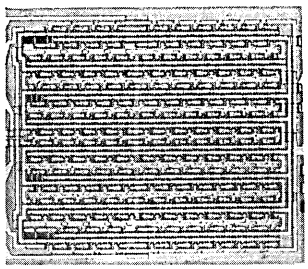
Nevertheless, we would like the chance to prove to him that Computape is the finest, most dependable tape that money can buy. Tape is our only business, so it jolly well better be.

Maybe you're missing out on something good, too, just because you've never tried it. Why not investigate? After all, most people like Computape.

A PRODUCT OF COMPUTRON INC.
MEMBER OF THE BASF GROUP
122 CALVARY ST., WALTHAM, MASS. 02154

Designate No. 4 on Readers Service Card

The front cover shows a shift register with a capacity of 90 bits and containing 542 transistors. The entire register is on a chip of silicon, size 58 by 80 in thousandths of an inch. For more information see page 38.



computers and automation

MARCH, 1966 Vol. 15, No. 3

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

In This Issue

Special Feature: Computers and Education

In Every Issue

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

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Workable Solutions to the Technological Revolution

— II

In the January 1966 issue of "Computers and Automation" appeared an editorial entitled "Workable Solutions to the Technological Revolution."

An important additional contribution to solving this problem has now appeared. This is the report of the National Commission on Technology, Automation, and Economic Progress, completed and given to President Johnson after thirteen months of study. The commission members include among others:

Patrick E. Haggerty, chairman, Texas Instruments, Inc.
Philip Sporn, chairman, systems development committee, American Electric Power Co.
Thomas J. Watson, president, International Business Machines Corp.
Howard R. Bowen, president, University of Iowa
Whitney M. Young, Jr., executive secretary, Urban League
Walter Reuther, president, United Automobile Workers
Joseph A. Beirne, president, Communications Workers

The report has been signed by all the members, although some of them have included footnotes in the report stating their own varying views.

It is exciting to see that a solid attack on some of the real problems of technological unemployment is contained in the recommendations of the commission. These recommendations include:

1. A "negative income tax," to provide federal assistance to families below adequate income levels.
2. Compensation of low-income families for loss of income which would occur if their children remained in school or college when they might otherwise work.
3. Fourteen years of free education for everybody.
4. Expansion of retraining programs to cover 750,000 persons a year.
5. Creation of 500,000 public-service jobs, to be supported by the government for the "hard-core unemployed," at a budget of $2 billion a year.

In addition, the recommendation is made that the unemployment service of the states and the Federal government be "nationalized," establishing a nation-wide job information service, making use of the powers of computers. In this way, jobs looking for workers could be more rapidly matched up with workers looking for jobs.

As our January editorial pointed out, a scientific solution to the problem of technological unemployment implies "figuring out and doing the right thing." We talked about long-term balancing and managing of input and output. This report takes some positive steps in that direction. For example the "negative income tax" and the 14 years of education are a step in the direction of:

> "All the other people in society (the young, the old, the students, the housewives, the sick, the underprivileged and the underdeveloped) should be given a decent minimum standard of living, and also incentives for making a better life for themselves."

Of course, there is a wide gulf between the presentation of a report by a national commission, and actual legislation by the government. But a beginning has been made. It is necessary now to persuade, push, and pull the members of Congress to take steps in the direction of an economic society that functions better in regard to technological unemployment.

Such persuasion is one of the social responsibilities of computer people — since they are intimately associated with one of the prime factors of technological development — the incorporating of decisions, control, guidance, and logical thinking in programmed computers.

Since there are now well over 200,000 computer people, an immense force for good could be called into being, if all these computer people:

—studied the recommendations of the National Commission;
—thought about them and discussed them;
—persuaded members of Congress and other members of the government to take steps rapidly in the direction of solving technological unemployment.

Edmund C. Berkeley

EDITOR

THE COMPUTER AND THE ARTS — COMMENTS

Leo S. Packer
Manager, Government Programs
Xerox Corporation
Rochester, N. Y.

I am writing in response to the inquiry of Mr. L. Mezei on "The Computer and the Arts" which appeared in the January, 1966 issue of *Computers and Automation*. No doubt Mr. Mezei will be familiar with most of the items mentioned below, but I hope they will be helpful.

1. IBM and a series of universities have conducted at least six two-day seminars on computers as applied to the humanities and the arts. The most recent one was held in Boston several months ago and featured talks on computer applications in theology, literary research, social studies, history, archaeology, music and so on. Mr. Edmund Bowles of IBM was the organizer and guiding spirit for the entire series of seminars.

2. New York University has established a new Center for Computer Applications in the Humanities and the Arts. Professor Jan LaRue is the Acting Director, I believe, and he has described their very interesting projects in linguistics, musicology, literature, and other humanistic disciplines. They enjoy the use of excellent computer facilities as well as the services of some fine computer specialists in support of their work.

3. During 1965, there was a very interesting conference on the use of computers for literary research. The proceedings have been published and are available. IBM was sponsor of the conference. The specific reference can be supplied on request.

4. I presented a paper last December on "The Impact of Technology on Musical Scholarship" at the Annual Meeting of the American Musicological Society at Ann Arbor. A copy of the paper is available on request.

5. Professor Harry Lincoln of the Music Department of Harpur College is doing some interesting work using computers for data processing in connection with musicological studies. Also Professor Barry S. Brook of Queens College, Flushing, New York, is quite an authority on computer uses in musical research.

6. I have compiled a rough bibliography on technology and music, which is available on request.

I am sure that many people are beginning to become interested in computer aids for their specialized research needs. A conference on "The Computer and the Arts" would indeed be of interest to a growing circle of scholars; but there should be an understanding of what has already been done before such a conference is planned in detail.

1966 FALL JOINT COMPUTER CONFERENCE — CALL FOR PAPERS

Dr. William H. Davidow
Technical Program Committee Chairman
1966 Fall Joint Computer Conference
P. O. Box 2208
Menlo Park, California 94025

The 1966 Fall Joint Computer Conference will be held in San Francisco, California, on November 8, 9, and 10, at the San Francisco Civic Center.

The scope of the conference will be the entire information processing field. Papers are invited that report on significant trends, achievements, concepts, and techniques. Survey and tutorial papers are welcome. The conference committee is currently planning several sessions on on-line hardware, software, and applications, and desires papers that discuss in detail all aspects of these systems and their use. Some examples of appropriate topics are listed below; authors are encouraged to submit papers in other areas as well.

- Analog and Hybrid Computers
- Communication Devices and Systems
- Components and Circuits
- Impact of Computers on Education
- Impact of Computers on Management
- Machine Organization
- Management of Data Processing Centers
- New Areas of Application
- Numerical Analysis
- On-Line Systems
- Peripheral Equipment
- Programming Languages
- Storage Devices

A $500 prize will be awarded by AFIPS for the best paper presented at the Conference.

Only new papers which have not been published are eligible. Five draft copies of the entire paper should be submitted by May 2, 1966. The draft should include a 100-150 word abstract and a text which should not exceed 10,000 words. Each contributor should arrange for the necessary company or security clearances before submission of his draft.

The preliminary draft should be typewritten, double-spaced on one side of the sheet with the author's name, address, and telephone number on the first page, and the author's name on each subsequent page. Each page should be sequentially numbered. A full set of rough illustrations properly keyed to the text should be included with each copy. Final versions of the papers chosen for presentation will be required by August 8, 1966. The final version of the text will be published in the AFIPS Conference Proceedings.

The Conference Committee would appreciate early notice of intention to contribute a paper. Authors who intend to submit a paper should as soon as possible inform the Technical Program Committee at the address above.

AUTOMATIC DATA PROCESSING MANAGEMENT TRAINING CENTER

Joseph W. Lowell, Jr.
Director, ADP Management Training Center
U. S. Civil Service Commission
Washington, D. C. 20415

To prepare thousands of Federal managers to make the most of the computer's promise and potential for more efficient and economical Government operations, the Civil Service Commission has established a new ADP Management Training Center.

The new training operation is designed to help managers and key officials to use more effectively automatic data processing in solving management problems. It will operate under the Civil Service Commission's Office of Career Development.

Initially, the Center will offer 30 different training programs concerned with management application of ADP as well as career skills in the field. Course listings and schedules are included in a brochure CSC is distributing.

In the last fiscal year, the prior arrangements for such training had reached over 40 training programs. Well over 50 agencies sent a total of 2000 employees to these programs, with about 200 coming from outlying installations in 22 different states.

For more information on the instruction offered by the ADP Management Training Center, interested persons should write to the Office of Career Development, U. S. Civil Service Commission, 1900 E Street N.W., Washington, D. C. 20415.

DECEMBER PICTORIAL ISSUE — USE FOR A SUMMER CONFERENCE

I. From Karl G. Bartscht

Hospital Systems Research Group
Institute of Science and Technology
University of Michigan
Ann Arbor, Mich. 48104

I have just read and thoroughly enjoyed your December issue of "Computers and Automation."

I noticed with particular interest the "Annual Pictorial Report." We at the University of Michigan, give a summer conference each year on the application of computers in hospital management and have been looking for such a pictorial collection to aid our teaching program.

Would it be possible for us to obtain the original pictures of these individual machines? We would like to make slides of them for instruction purposes. If we did so, of course we would credit your magazine and the individual manufacturers. These pictures would be a great help to our program.

Keep your fine magazine coming! We enjoy it.

II. From the Editor

Thank you for your nice letter. We are sending you the pictures we used for the December issue. After you have finished with these pictures, would you please return them to us? We shall appreciate such credit as you can give us.

DECEMBER PICTORIAL ISSUE — COMMENTS

Josiah M. Lynch, Jr.
Assistant Actuary
Ostheimer, Peat, Marwick, & Co.
Philadelphia, Pa. 19102

Orchids to you for your December issue! As subscribers of three months standing, we would like you to know that we have been thrice-impressed by your magazine.

THIRD ANNUAL NATIONAL COLLOQUIUM ON INFORMATION RETRIEVAL

Dr. Morris Rubinoff
Univ. of Pennsylvania
Philadelphia, Pa.

The third annual National Colloquium on Information Retrieval will take place at the Univ. of Pennsylvania, Philadelphia, Pa., May 12, and 13, 1966. It is sponsored by six organizations including the ACM Special Interest Group in Information Retrieval. The theme is "Information Retrieval — A Critical View." The main topics are:

1. Presently Operating Information Retrieval Systems and how they compare with other ways of solving the problem. Comparisons may be based on time, cost, hardware-software trade-offs, techniques, etc. For example, how do mass storage systems compare with tape systems while accounting for load time, back-up storage for error recovery, storage, space, etc.?
2. Informative Retrieval Systems being planned and justification for the new techniques.

BENCHMARK PROBLEMS — SOME COMMENTS

Dr. E. A. Racicot
Manager, Information Systems
Litton Systems (Canada) Ltd.
Rexdale, Ontario
Canada

The articles in the January issue of "Computers & Automation" were of interest to us since we are involved in the problem "How Does The $10,000-a-Month User Decide Among The Several Machines Available?" We have been giving some thought to another view of benchmark problems.

The smaller user with rapid system growth sometimes cannot define his processing in detail due to close implementation dates and staff shortages which prohibit feasibility studies, etc. Yet he can often define the file structures with reasonable accuracy or sufficient accuracy to demonstrate throughput time assuming items to be I/O limited, i.e. benchmark program timing.

However, with present-day ubiquitous software and executive systems, which consume both space and time, the user is led to the question "How much core time and space is left to do my processing after the hardware and software are finished passing the files and looking after each other?" The same hardware with two different software implementations could leave the user markedly different residual time and space in which to process the data that the system feeds him before he becomes computer limited.

Perhaps how this residual time can be meaningfully measured would be an interesting subject for the FORUM.

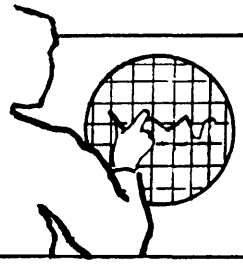
THE JOURNAL: COMPUTERS AND BIOMEDICAL RESEARCH

Academic Press
New York, N. Y.

We should like to inform your readers that we will soon be publishing a new journal "Computers and Biomedical Research," devoted to the applications of computers to life sciences research.

The results of research in this diversified area are currently being presented at special conferences throughout the world and being published in a variety of journals. The common feature of computer-oriented techniques, offers a great po-

(Please turn to page 41)



c & a MARKET REPORT

COMPUTER SHIPMENTS IN '65 REACH $2.3 BILLION; '66 EXPECTED TO TOP $3 BILLION

The gross sales value of computers and related peripheral equipment shipped by American manufacturers during 1965 reached $2.3 billion, according to year-end figures compiled by the International Data Corporation (IDC). Although this is a record high, it represents a relatively modest 4.5% increase over the $2.2 billion shipped during 1964. The percentage breakdown by manufacturer of these '65 computer shipments is:

MANUFACTURER	GROSS VALUE OF SHIPMENTS IN $ MILLIONS (Estimate)	PERCENTAGE OF TOTAL (Estimate)
IBM	$1,472 - $1,495	64-65%
UNIVAC	173 - 185	7.5-8.0%
Honeywell	173 - 185	7.5-8.0%
Control Data	150 - 161	6.5-7.0%
General Electric	81 - 92	3.5-4.0%
NCR	74 - 78	3.2-3.4%
Burroughs	60 - 64	2.6-2.8%
RCA	41 - 46	1.8-2.0%
Others	29 - 39	1.3-1.7%
TOTAL		100%

The above figures are IDC's estimates of the gross sales value for general-purpose digital computers shipped by the listed manufacturers and their subsidiaries to all countries during 1965. They include peripheral equipment and memory units shipped during the year to expand existing installations.

'65 proved an excellent year for Honeywell EDP shipments, with the company finishing neck-and-neck with UNIVAC for the "Number Two" spot in industry by the measure of annual shipments. IBM's share of annual shipments was 10-12% below its current market share. The drop was due to reduced production levels on 1400 and 7000 series equipment as IBM tooled up for volume production on 360 units. '65 deliveries of 360 units were 200 less than the 1000 level predicted by IBM at its last annual meeting. Control Data's shipment level equalled its annual sales for its last fiscal year...but since just over half of the systems were shipped on leases, the firm is currently burdened with a heavy share of postponed and, to some extent, uncertain income.

'66 we've christened the "Year of the Rolling Circle." It's the year when volume deliveries of IBM's "circle system," the 360, get underway. This, coupled with heavy shipments of other third-generation computer series such as RCA's Spectra 70 and Honeywell's 200 series, should push the value of computer shipments during '66 to $3.0 billion, a 30% increase over '65.

This is the season when industry observers become infected with "predictionitis." We find we are not immune to this malady. It leads us to offer the forecast that the "Year of the Rolling Circle" will prove to be:

(1) The year that confirms that a firm doesn't have to have the most advanced computers in order to capture a profitable share of the EDP market. The highly unsaturated nature of the market for small- and medium-scale computers, as well as the conservative approach to EDP taken by many managements in small- and medium-sized firms, will provide a strong demand for second-generation computer systems with proven software. Burroughs, Honeywell, IBM, NCR, and UNIVAC should benefit particularly from this situation.

(2) The year in which strategic delays in shipping dates for 360 systems enable IBM to maintain its profit margin while undergoing the heaviest production, marketing, and support expenses in its history.

(3) The year in which the performance and payoff obtained from the super-scale computer demonstrates that the industry hasn't matured much beyond the STRETCH stage. Machines such as Control Data's 6000 series, larger members of GE's 600 series, and IBM's 360/90 series can be expected to continue to experience performance headaches due to the complexity of their logic organization and to the shortage of sophisticated system analysis and programming talent needed to realize the full potential of such equipment.

Our expectations of activity involving the leading EDP manufacturers during '66 include:

Burroughs will introduce a new series of computer systems (internally called the B-2000 series) in April. It will be the firm's third-generation offering in the small- and medium-class computer area. We expect it will feature integrated circuitry and offer program compatibility with the B200 series.

Control Data will find that IBM can be paternalistic. We expect White Plains to lessen considerably the competitive pressure in the super-scale computer market to permit Control Data to improve its current financial condition. IBM is sensitive to the anti-trust investigation that might follow

(Please turn to page 42)

COMPUTER ASSISTED INSTRUCTION

E. N. Adams
Director, Computer Assisted Instruction
IBM Watson Research Center
Yorktown Heights, N. Y.

Society is conscious today, as never before, of the importance of education, both in its qualitative and its quantitative aspects. As a consequence, the educational profession finds itself under unprecedented pressure to broaden its responsibility and increase its productivity.

The profession is being asked to train the mass of our young people to higher standards than ever before. It is being pressed to bring an end to conditions which presently permit a great many underachievers to drop out of the process of conventional education. It is being called on to devise and develop institutions and techniques for the re-education of adults whose education is either inadequate or obsolete.

The potential benefit to society of these educational reforms, now being actively formulated, has led to a rapid increase of the funds available to accomplish them. However, non-financial factors may limit progress towards the desired goals; these factors include the limited supply of trained teachers, a shortage of facilities, lack of adequate techniques, and lack of institutions for training those persons who have not received a satisfactory education by normal progress through the conventional educational system.

A New Educational Tool

The existence of such problems enhances the potential importance of the new instructional tool, *computer-assisted instruction* (CAI), which we wish to discuss. This is a tool which can substantially increase the output of a teacher. Also, it is a tool of unique value for purposes of observing, evaluating, and improving the efficacy of instructional technique.

The instrument for effecting CAI is an electronic communication station controlled by a stored program computer. For practical reasons a number of communication stations will ordinarily be controlled by a single computer. So we will refer to the tool as a *computer assisted instruction system.*

Powers of a Computer-Assisted Instruction System

When suitably programmed a CAI system can, to a useful extent, do all the following things for a student at one of its terminal stations:

1. Engage in two-way communication with a student by means of natural language messages.
2. Guide the student through a program of tasks, helping him where he has difficulty, and accelerating his progress where he finds little challenge.
3. Observe and record significant details of the student's behavior, including steps undertaken in performing tasks, time taken for particular steps, and values of varying physiological or environmental quantities.
4. Simulate the operation of a physical, mathematical, or social process responding to variations in parameters.
5. Analyse and summarize performance records and other behavioral records of individual students and also groups of students.

Limitations

As we have described a CAI system, it has among its characteristics many of the capabilities of a human teacher's assistant. However for the near future a CAI system will have substantial limitations of technical ability in comparison to a trained human assistant. A fundamental limitation is that it can act only along the lines of a very specific predetermined program. Unlike a human, it cannot devise on-the-spot solutions to problems which have not come up before.

Moreover, its capability for natural language communication is quite limited compared with a human. In "speaking" it is ordinarily limited to the use of pre-recorded messages, or, in the case of written messages, to messages pre-recorded or synthesized according to very simple patterns. In "listening" it can accept only symbolic messages, and with respect to them is largely incapable of dealing with any subtleties of meaning; when "confused", it has very limited ability to "think things through" and understand a "partial meaning."

Help from a CAI System

Despite these limitations a CAI system might be quite valuable in instructing where conventional methods are unable to approach ideal conditions for learning.

Let us characterize an ideal learning situation as one in which every student has:

the experience of working on tasks that are meaningful and challenging;
is involved in work adjusted to his individual capability so that he can be encouraged with suitable successes; and
is continually getting appropriate help for overcoming his own shortcomings.

Comparison with Classroom Instruction

In relation to this ideal, classroom instruction is characteristically inefficient in dealing with such subjects as mathematics or a foreign language. In these subjects, a high level of skill is ultimately possible, student ability varies greatly, and students may need considerable individual recitation and drill on partly learned material before they achieve mastery. We may further characterize these subjects as requiring of the student a composite skill, a facility to deal with a hierarchically structured subject, or the ability to bring together disparate elements to solve a problem.

If, in dealing with such a subject, the teacher uses a classroom procedure in which the individual student recites before the class, then because of the spread of ability in the class, what is done at any given time will ordinarily not interest or help every student or even most of the students in the class. On the other hand, if the teacher uses a classroom procedure in which all of the students simultaneously work on problems during class time, the students get little personal attention; and in particular the students who are having the most difficulty do not usually get adequate tutorial aid.

Individualization of Instruction

The *desideratum* lacking in such classroom instruction is often referred to as "individualization of instruction." It has two main components. One is the proper selection of student tasks to provide a suitable level of challenge and to respond to specific deficiencies in student performance. The other is the capability for "individualization of remediation" — a term meaning "providing individual remedies for individual deficiencies".

Both these components are inherent in the structure of a CAI system. Even in a routine recitation each student works directly with his own communication station and recites individually in direct relation to the system. The repertoire of exercises in a single computer can span a great range of difficulty. Thus every student can work on material appropriate to his ability. The logical power of the computer permits complex processing of the student response to reveal individual deficiencies, and to determine what assignment should be given next. Thus each student as he works receives immediate individualized feedback whenever he runs into difficulty.

Even though the range of remedial "tutoring" available on a particular problem will often be narrower when provided by a machine than that which could be provided by a good teacher, such machine tutoring can be valuable and effective. It seems clear that by proper choice of drill and by appropriate design of tasks, the greatest part of routine drill in many courses might be effectively administered by computer.

The ability of the computer to take over a major part of recitation and drill makes the computer an instructional tool of the greatest promise. It offers the hope that a skilled teacher could concentrate his activities in relation to his special students, his very poor learners, and perhaps his very good learners, for whom non-routine assignments may be most important, and he could spread his effective teaching over a larger number of students. So used, the CAI system would be cast in a "task upgrading" role, and the human teacher could devote his effort exclusively to the less routine parts.

Simulation of Complex Processes

Another potentially important way to use a computer as an aid to instruction is to exploit its ability to simulate a relatively complex process. Clearly, for any process which the computer can conveniently simulate, one could construct a computer program which allows the student to manipulate the process parameters and thus to "experiment" with a model of the process. We may refer to this instructional mode as "ersatz laboratory" instruction. Because the ersatz laboratory permits access to many processes otherwise not accessible to laboratory manipulation, its use would seem to have the potential for contributing unique instructional values in some areas of human knowledge.

Data Analysis

One of the special potentials of CAI is in exploiting the capability of the machine for high-speed monitoring, recording, and analysis of data. Many provocative ideas present themselves, both in regard to instruction itself and in regard to research on student behavior. In principle the broadest spectrum of variables may be monitored and correlated, ranging from performance variables of academic tasks to physiological variables, such as body temperature, and environmental variables such as ambient light level. Given powerful statistical analysis programs, one may consider many possible uses for such data:

continuous student testing and placement;
new dimensions in testing;
continuous self-adaptive course improvement;
identification of psychologically crucial steps in learning through physiological measurements;
manipulation of environmental parameters as an aid to learning, etc.

Thus, CAI systems seem uniquely suited for carrying out a broad range of research related to instruction.

How Reach the Potential?

These then are some of the important potentials of CAI. What are some of the developments needed to accelerate realization of that potential? There are several. To be broadly useful, CAI systems must satisfy stringent cost criteria and at the same time moderately demanding technical requirements in high-speed logical processing.

The only promising approach to this dual goal is to multiplex a fairly large number of student stations to a single central processor. Since very fast response is essential for "conversational mode" operation, time-sharing programming systems written for suitable processors and designed to deal with the special character of CAI programs must be developed. While general purpose central processors seem adequate for the job, new terminal stations of moderate cost need to be developed.

Special Programming Languages

Much of the application of CAI must be made in areas where the professional workers are unfamiliar with computer science or are non-mathematically oriented. Therefore special

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TEACHING MATHEMATICS USING A TIME-SHARED COMPUTER SYSTEM

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Tools for Teaching Mathematics

One of the major problems in the field of mathematics education is the development of new teaching tools.

Historically, the usual teaching aids employed by the mathematics teacher in classroom instruction have been simple instruments, such as the ruler, the compass, the protractor, the slide rule, and the blackboard. These devices, as well as the textbook or reference materials in use, are all extensions of the human brain. Properly employed, they can increase clarity of understanding, extend memory, and make possible more effective use of available facts. As teaching aids become more efficient, they can provide for a higher degree of student participation and consequent enrichment of the instructional program.

In contrast to subjects such as physics, chemistry, or biology, where a wide array of laboratory devices and instruments are available to the teacher and the student, the mathematics teacher has relied largely on his own ingenuity in developing new ways of using conventional materials to improve classroom instruction. One approach which is showing much promise is the development of the mathematics "laboratory." This is a classroom which has been equipped with special teaching aids such as demonstration slide rules, coordinate-ruled blackboards and desks, overhead transparency projectors, film and slide projectors, mathematical models, calculators, and extensive reference materials. Here a student can utilize these devices to extend his learning beyond the scope of his textbook, to a degree limited only by their effectiveness in stimulating his thinking, and coordinating his learning.

Applications of Computing Facilities in Classrooms

To experiment further with the applications of modern technology to the classroom, the Massachusetts Department of Education during the past three years has been exploring the use of the electronic digital computer as an extremely effective teaching aid for the classroom and laboratory. It has worked closely with the New England School Science Advisory Council (NESSAC), an independent agency representing more than sixty professional, scientific, and technical societies. It has also worked closely with the Association for Computing Machinery and the computer industry, in providing the use of data processing and computing facilities for selected school systems in the Commonwealth.

Generally, the interest expressed by a local school system in establishing a pilot program in computer-oriented instruction has been stimulated by a teacher who attended National Science Foundation (NSF) institutes or programs, and had been introduced to the effectiveness of the computer as a powerful tool for solving problems. Many of these problems are far too complex to include in the usual science and mathematics curriculum because of the excessive length of time required for solution.

Also, some teachers have had the opportunity to work closely with industrial and scientific organizations where computer facilities were in use, have developed skills in the use of the equipment, and have in turn made use of this knowledge to complement and improve their own classroom teaching techniques. This has been particularly true of teachers in the vicinity of the larger metropolitan areas or in locales where concentrations of scientific, research, and development activities exist.

Pilot Programs

In general, the pilot programs in computer-oriented mathematics instruction have, with the assistance of instructors from the computer industry, taught students some basic concepts of computer operation, capabilities, and programming. When actual experience with a computer was needed, students were taken on a field trip to a computer facility, usually on a Saturday, so as to prevent interference with the daily school program. This has provided, at best, only limited access to the computer itself.

The results of these pilot instructional programs have been most satisfactory, proving to be both feasible and rewarding to the student, but they did not give him the actual "hands-on" experience with the machines necessary to provide intimate familiarity with new methods of computation. It was concluded, therefore, that if it were possible for a mathematics teacher to have a large-scale computer at his disposition in the classroom at times appropriate to his class schedule, he and his students could experiment readily with sophisticated mathematical concepts as an extension of

the usual classroom and laboratory instruction. However, such a facility is far beyond the reach of the usual public school system's budget.

Research Proposal and Project

With the firm conviction that experimentation in depth with the use of an electronic computer in the improvement of the mathematics curriculum would provide results of benefit to the entire educational community, the Department of Education filed a research proposal with the Cooperative Research Branch, United States Office of Education. A major grant of $176,000 was received from this agency in June, 1965, to carry out this research as Project H-212. It is entitled "A Laboratory Approach to the Teaching of Mathematics through the Use of a Time-Shared Digital Computer."

This project has as its basic goal the development of a mathematical laboratory, based on a time-shared digital computer, for the purpose of improving instruction in the mathematics curriculum. In working towards this goal we are focusing on solving the following tasks:

1. How a time-shared computer can be programmed to act as a useful tool for teaching mathematics;
2. How classroom teachers can be taught the necessary techniques to enable them to use this new teaching tool successfully;
3. How multiple-user computer facilities can be developed in line with economic constraints; and
4. How the mathematics curriculum can best be augmented to make effective use of the computer as a tool for classroom instruction.

We feel that the use of computers in the mathematics class is best carried out by day-in-day-out interaction between the student and the computer, not by occasional exposure of the student to an industrial computation center. While such interaction would be extremely expensive under ordinary conditions, time-sharing techniques can significantly reduce these costs. These techniques make it possible for many independent, remotely located users to share simultaneously the facilities of a large-scale digital computer and associated peripheral equipment.

Economic Feasibility of a Time-Shared Computer System

The time-shared system used in Project H-212 provides a real-time capability in computation and instruction for mathematics and science classes at a cost per terminal that is less than the yearly salary of a classroom teacher. This capability is available to the participating schools for the entire school week on a full-time basis. Based on projections made by representatives of the computer industry who are members of the advisory board for the project, it is entirely feasible to anticipate that the cost to a user school for a time-shared computer terminal will, within two or three years, be in the range of two dollars an hour.

Advantages

In addition to demonstrating the economic feasibility of this new approach, we are testing hypotheses that:

1. A terminal teletypewriter connected to a large computer operated in the time-shared mode gives the mathematics student the feeling of working on his own computer;
2. Having the computer on an "always ready" basis encourages students to engage extensively in voluntary extracurricular use of the computer terminals;
3. The presence of a continuously available real-time computer in the classroom leads students to acquire a more thorough grasp of mathematics.

Project Testing Schedule

The project is being carried out at grades 6, 9, and 11 in five school systems in eastern Massachusetts. These communities are Belmont, Brookline, Lexington, Westwood, and Phillips Academy, Andover. In each participating school these classroom procedures will be established: A student of mathematics, sitting in a classroom or a laboratory works directly with a Teletypewriter that is connected, through private telephone lines, to a digital computer located miles away. Simultaneously, other students in other schools are using Teletypewriters connected to the same central computer. The students type numerals, letters, and symbols found on the keyboard, and solve a mathematical problem, or test a theorem, or practice solving equations, or experiment with number bases, or discover the power of the Monte Carlo Method.

The computer serves as a "mathematics laboratory," permitting the student to write logical and computational procedures in a suitable algorithmic language, and to demonstrate their operation. In such a learning process, the student does not need to know anything about the internal workings of the computer; all that is needed is the algorithmic language. In this way, the computer gives the student a more intimate feeling for mathematics and will influence his approach to problem solving in general. It also provides the teacher with a means for demonstrating the more difficult mathematical concepts, so that the student may grasp them more easily.

Limits and Convergence

For example, at the Westwood High School, which served as the pilot school in the experimentation prior to the project grant, sophomore students gained fuller appreciation for the mathematical concepts of limits and convergence by operating computer programs that performed these functions. In a matter of a few minutes, students were able to test the convergence properties of a large number of examples and to compare the results with the theory they had learned in class. Without the use of a computer, the computations alone for this work would have taken an entire week of class time.

Creating New Programs

In each of the participating schools, students and teachers are able to call on and to operate programs which fill the needs of each school's own curriculum. They will also be allowed to create their own programs for the purpose of working out specific mathematical problems of their own choosing. The same teletypewriter terminal can be used as the input to a wide spectrum of simulated computers — from simple machines with a limited instruction repertoire to sophisticated computers with a greater language and problem-solving capability. The student starts with the simpler type of machine. As his knowledge and ability increases, he is allowed to work with the more advanced types of computer.

Sharing Programs

With the central time-shared computer, it is possible for participating schools, regardless of geographical separation, to share programs. A program illustrating a particular mathematical concept, developed in one school is available immediately to all the other schools. In fact, the sharing of programs is quite simple since all of the programs are maintained in a central computer file and all of the schools

have an identical computer facility. In the past, this type of direct program sharing was not possible because even neighboring schools did not necessarily use the same type of computer equipment.

Phases of the Project

This project is being conducted in three phases:

1. An in-school preliminary phase was conducted during the spring of 1965. Its purposes were to install and test equipment, to familiarize instructors with the use of the equipment, to carry out limited teaching experiments, to establish tentative instructional format, and to experiment with evaluation procedures.
2. During the summer, a workshop-institute involved educators and members of the advisory board, reported on the results of the preliminary phase, provided training for 30 teachers involved in the program, and reviewed and improved the curriculum materials for the third phase.
3. The main experimental phase of the project is being conducted for a full school year at the three grade levels described earlier.

The workshop-institute was conducted for a group of 30 mathematics teachers from the schools participating in the research project. The workshop program of 6 weeks accomplished the following:

1. Taught the mathematics teachers the fundamentals of computer use and the potentials of a real-time computer in the mathematics and science classroom;
2. Reviewed and improved the preliminary curriculum materials developed for the classes using the computer;
3. Appraised the results of the preliminary phase of the experiment conducted during the spring;
4. Established a teacher's user-group to write and share programs;
5. Tested the computer programs developed during the initial phase of the experiment.
6. Developed new computer programs to be used during the school year 1965-66.
7. Started a monthly newsletter which is distributed to all of the participating schools. This newsletter includes descriptions of new programs that have been added to the library by teachers, programmers, and in some cases by students. It also contains suggestions to teachers.

Computer Facilities

The computer facilities which are being used in the research project are provided by Bolt, Beranek, and Newman, Inc., of Cambridge, Massachusetts, a leader in the development of time-shared computer systems and techniques. The hardware consists of a Digital Equipment Corporation PDP-1 computer, a dual FASTRAND drum, and UNIVAC peripheral equipment. The remote terminals used in the mathematics classrooms are Model 33 Teletype units.

Plans have been made to experiment with graphical input-output devices and visual displays as an adjunct to the teletypewriter. This should lead to greater flexibility in the adaptation of the system to the mathematics curriculum, and more applications.

Conclusions

One of the most significant aspects of the project is that it places the mathematics student in a one-to-one relationship with a time-shared computer. The student and the computer can work together as students and teachers now work together at the blackboard or over a textbook.

The close interaction between students and computers requires a new approach to the problem of communications. There must be no appreciable delay in the interchange of information between the student and the machine. The student and the computer need to be able to converse with each other in conventional language and symbols.

The TELCOMP Language

In order to accomplish this, the method of communication must employ a language which is easily understood by an inexperienced user. Several languages have been developed recently for this purpose. The one used in our project is TELCOMP, adapted from JOSS by Bolt, Beranek, and Newman, Inc., by agreement with the RAND Corporation. Experience has shown that a new user can familiarize himself with TELCOMP in less than an hour's time, and there is the added value that this period of familiarization is on a live teletype terminal.

The mathematics student, then, finds himself working in partnership with a powerful, large-scale computer. He is able to turn his mathematical ideas into mathematical actions almost as rapidly as he can formulate the idea. He can obtain almost immediate answers to questions he has asked of the computer. He can get detailed and accurate information, often as rapidly as the teletypewriter can print it out. In a matter of seconds he can see the results of what would be long and complicated computations if manual procedures had been used.

It is our conviction that the electronic digital computer will prove to be a device of great importance in assisting the teacher. It will help create the most effective learning situation that is possible. The instructional techniques associated with a computer in the classroom will have a lasting effect on methods and materials of instruction in many mathematical areas.

Appendix 1

Applications of Computers in Educational Areas Which Were Described in the Summer Workshop-Institute:

a) Lewis Clapp of Computer Research Corporation, a consultant to the Project, and James Pender, Head of the Mathematics Department at Westwood High School, reported on computer programming courses they have given at Westwood for the past two years.
b) Dr. Daniel Bobrow, a computer scientist at Bolt, Beranek, and Newman (BBN), described his work on "Natural Language Input for Computer Problem-Solving Systems," for which he obtained a Ph.D. at Massachusetts Institute of Technology.
c) Mrs. Sylvia Charp, Assistant Director of Data Processing for the School District of Philadelphia, reported on computer classes sponsored by the Delaware Valley Computer Education Committee.
d) Dr. David A. Page, Director of the University of Illinois Arithmetic Project at Educational Services Inc., Watertown, Mass., showed a film made as part of the Arithmetic Project to illustrate new methods for teaching mathematics to children.
e) Dr. Lauren Woodby, the H-212 Project Monitor, described other research projects in educational technology being supported by the U. S. Office of Education.
f) The Summer Institute members made a trip to Dartmouth College as guests of Professors John Kemeny and Dr. Thomas Kurtz of the Mathematics Department. The purpose of the trip was to learn about Dartmouth's time-shared computer system and its computer language, BASIC.

g) Dr. Warren Brody, research psychologist, spoke to the group about various aspects of interaction between children and learning devices.

h) Richard Kahan, a social psychologist of the BBN staff, discussed processes of group interaction as they relate to an experimental project such as this.

i) Wallace Feurzeig described BBN's Socratic Computer System for tutorial problem-solving and the MENTOR language in which teachers describe problems for use with the System.

j) Professor Robert Fano, Director of Project MAC at Massachusetts Institute of Technology, arranged a presentation for the group. Project MAC is a large program directed toward developing a time-shared computer system for application to research and teaching. Several demonstrations of the teaching capabilities of the system were given, including one by Professor Anthony Oettinger of Harvard University.

Appendix 2

Summary of the TELCOMP Language

Procedures:

TURN ON	1. Depress break key Wait for "CALL" 2. Type "TELCOMP" *ALTMODE* Wait for "NAME" 3. Type name *ALTMODE* Wait for "←"
TURN OFF	1. Type "HALT" ALTMODE

Designators:

STEP, PART	five significant decimal digits jointly

Functions:

LN(A)	natural log
EXP(A)	e to the power of
LOG(A)	log base 10
SQRT(A)	square root
SIN(A)	sine (radians)
COS(A)	cosine (radians)
ARG(A,B)	arc-tangent (A/B)
IP(A)	integer part
FP(A)	fraction part
DP(A)	digit part
XP(A)	exponent part
SGN(A)	sign (1,0.-1)
MAX(A,B, . . .)	max of list
MIN(A,B, . . .)	min of list
RAN(A)	random no. between zero and A

Boolean Operators:

=	equal
<	less
>	greater
<> or ><	not equal
<= or =<	less or equal
>= or =>	greater or equal

Algebraic Operators:

+	add	8 digits carried
−	subtract	
*	multiply	
/	divide	
↑	exponentiation	
|A|	absolute value	

Modifiers:

IF	expression to left is interpreted if Boolean to right is true
FOR	expression to left is fully interpreted for each value

Commands:

TYPE	types values
GO	continues from interrupt or STOP
STOP	interrupts program
DELETE	deletes all parts
TO	jumps to the step or part named
DEMAND	program waits for type-in
DO	executes the step or part named
SET	set variable to a value
LINE	feeds paper one line
PAGE	feeds to next page head
DONE	ends program
TYPE ALL PARTS	types program
SAY	types the subsequent message

Variables:

A-ZZZ	nonsubscript
A(J)-ZZZ(J)	single subscript
A(J,K)-ZZZ(J,K)	double subscript

Control Symbols:

←	your turn to type
.	decimal point in numbers
\	deletes last valid char.
,	separates members of a list
(A)	step size in FOR clause, or argument for functions or operators, or single subscript variable tag
(A,B)	double subscript variable tag
ALTMODE	enter typed line
RUBOUT	deletes entire line

Special Value Symbols:

TYPE $L	present line number
TYPE $P	present page number
TYPE $S	amount of storage left

Precedence Rules:

1. Modifying clauses interpreted right to left
2. Boolean and algebraic expressions are evaluated left to right except:
   a. inner (. . . . .) 1st
   b. unary operators 2nd
   c. exponentiation 3rd
   d. multiply or divide 4th
   e. add or subtract 5th

Warnings:

DELETE A — deletes all parts

Type-out "STORAGE FULL" halts program. Program is thus disabled from further operation. When file capabilities are available the "STORAGE FULL" condition will put user into FILE MODE (operating instructions will be forthcoming).

COMPUTERS AND EDUCATION: THE IBM APPROACH A REPORT AND AN EVALUATION

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Education and computers are closely allied subjects. They are closely allied because of the crying need for education about computers, and the ray of hope which computers offer to education. In this article, we will consider primarily the need for education about computers, what education is currently being supplied by a major manufacturer of computers, International Business Machines Corp., and how such education should spread.

The Need for Education about Computers

Our estimates, insofar as education is concerned, cover education for management, systems analysts, programmers, and operators. An estimate of the number of people by category, in today's data processing installations and in projected installations of the future, is as follows:

	1966	1970
Top management	40,000	75,000
Data processing managers	30,000	55,000
Systems analysts	50,000	190,000
Programmers	120,000	200,000
Operators	60,000	130,000
Totals	300,000	650,000

Assuming full strength in these categories, it is evident that at least 350,000 people will have to be trained in data processing within the next four years. Where are these people going to come from? How are these people going to be trained? What forms of education are currently offered to help solve the problem? To what extent can we rely for education upon various sources?

Sources of People

Where are these people going to come from? In the first two categories are management personnel who are to learn data processing: they will come, to the extent of over 90 percent, from the ranks of industry. They will have to be people who thoroughly understand the business or industry situation in which data processing will be applied, and who have a keen understanding of the businesses in which they are involved. The age of these people is not very relevant, but, in general, industry is looking for young and dynamic men to fill these roles.

Systems analysis trainees are, generally speaking, college graduates who have attacked and can attack business problems in a methodical and logical way, and who have had, if possible, several years of experience in business, including the particular business in which they function as systems analysts.

Programmers can come from a great variety of backgrounds: high school graduates, secretaries, electricians, and even plumbers have become good programmers.

Operating personnel have often come from punch card installations. Most of them have been electric accounting machine operators. Even elementary school graduates and high school dropouts have become operators of both computers and peripheral equipment.

In general, in the period 1966 to 1970, we do not expect public and private educational institutions to supply more than a few of the necessary people in the above categories. High school, college, and university graduates trained in computer sciences will be completely insufficient to meet the need.

Training of These People

How are these people going to be trained?

It is clear from the diverse backgrounds and requirements of these people, that many different kinds of training will be needed. Some of the training will be short, in the form of several hours or half days of training (e.g., for the operation of a tape drive, a card reader, or high speed printer). Some of the training will be relatively long, in the form of several formal courses from time to time, each lasting for periods of a week to several months.

The sources of this training basically are:

- Manufacturers' courses in the use, operation, and applications of their equipment,
- Courses given by consultants and other service organizations,

- Courses given by government departments and large corporations to their own people; these courses are organized and given by methods departments and electronic data processing groups,
- Courses given by colleges, schools, and universities, sometimes under special arrangements with corporations.

The forms of the training may be:

- Lectures, workshops, and discussions, with examinations in the usual school style,
- Programmed learning courses prepared by manufacturers or other special groups,
- Training from teaching machines, visual education, computer-assisted education, and other special training devices.

The Training Program of IBM

The largest training effort so far made in the computer field is the training program of International Business Machines Corporation. It has been estimated that their training program, in all its phases, currently uses some 1800 people full time, costs 90 to 100 million dollars annually, and gives training to over 100,000 people a year.

Courses for Customers

IBM offers three different types of courses to the management personnel of customers. The first type of course is called Executive Computer Concepts. The two courses offered under this heading are designed for top level management, vice presidents and above (in large companies), presidents (in smaller companies), and for flag rank and their civilian equivalent in the federal government. Two courses known as ECC1 and ECC2 are currently being proffered. They are comprehensive and effective educational tools devised by a manufacturer for the education of senior executives. The curricula, the implications, and the manner of conduct of these classes is excellent. They represent something like a 30 percent penetration in the field of top management education, but they do not convey an all-inclusive message. They also are somewhat market-designed, from the viewpoint of the manufacturer. Nonetheless, they represent sincere educational efforts.

The second type of course offered under this heading is conducted by IBM for executives immediately below the flag rank of the federal government. It is entitled "Computer Techniques for Management." This course offers essentially the same type of education as ECC1, but it lasts a shorter duration of time and teaches in a somewhat less extensive manner. Both of these courses are rigorous in their schedule — class hours range up to fourteen hours a day.

In addition, courses of varying types are offered for data processing managers. These are classified under the category of "Customer-Executive" classes. They are conducted at plant sites and in Washington, D.C. For the most part, they are introductory in nature and are designed for executives with no experience in the field of data processing. They are conducted by former salesmen and systems engineers and, aside from providing knowledge, they also represent a very fine sales tool. Some of these classes are general and are conducted for executives from any type of organization, while other classes are specifically oriented toward specific industries. Approximately one-third of the classes conducted are oriented toward federal government agencies, with the military being predominantly involved.

Courses which IBM offers to systems analysts vary to a wide extent. IBM has developed and conducted an extensive two-week course for experienced systems people; this course has been well-received and well-conducted. But such a course cannot be taught by the ordinary instructor. It requires an individual, or group of individuals, possessing a great deal of specialized knowledge in areas such as documentation techniques, data processing standards, computer operations, model building, simulation, and systems study and design techniques. Few courses of this type are offered by any manufacturer and those which are offered are heavily over-subscribed.

In programming, IBM offers courses in the various languages employed in their systems. Some courses are given in the form of programmed instruction; some employ the conventional classroom techniques; and, lately, because of demand, a "theatre party" approach including 100 students or more has been used. In general, these are introductory courses; one may not expect a graduate of these courses to be an entirely qualified programmer. But these courses are reasonably well organized and convey a fundamental knowledge about the subject.

In operator training, IBM courses give reasonably satisfactory training for those who are to operate computer systems.

No standards have yet been applied towards any of this instruction, nor are standards built in as part of the curriculum for these courses.

It seems clear that the largest educational gap in IBM's training involves the courses offered for systems analysts. There is a great need for additional educational effort in this area. Furthermore, all IBM courses are offered only to people from organizations which have installed or ordered IBM computer systems. Therefore, people who are not employed by IBM or an IBM customer, cannot make use of the courses.

Courses for Staff

IBM has a very extensive education program for its own personnel. The program includes training in marketing, systems engineering, and maintenance. The company mounted a massive effort during 1965 to train personnel for the System 360. The Systems Research Institute (New York City), an IBM subsidiary, provides the company's more talented systems engineers with an opportunity to obtain a good graduate course in data processing.

In the training program of IBM, the best efforts may be found in the education of IBM Customer Engineers. These people are responsible for the installation of equipment, its maintenance, *and* the maintenance of programs supplied by the company. A "broad-brush" training program is not used here. An experienced Customer Engineer may have to spend well over a year in learning a specific system. When IBM announced its 360, the best programmed instruction material which the company had to offer was furnished to their managers of customer engineering. Perhaps most significant here is that Computer-Assisted Instruction has been advanced by this group. Many field personnel are communicating with a computer, through a distant terminal, to learn how to install and maintain IBM equipment.

Advantages and Accomplishments

One of the great accomplishments of IBM's program of education for computers and data processing is that it provides a great spectrum of necessary information and training to its own customers and its own staff. This means that about three-fourths of the computer and data processing field, measured in terms of equipment sold or leased in a year, is provided with a substantial degree of required training and education.

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PROGRAMMED INSTRUCTION MATERIALS FOR COMPUTER PROGRAMMING – SURVEY, 1966

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This is the third of a series of surveys in which programmed instructional materials for computer programmer training are examined. Six of the earliest programmed courses were reported in the March 1963 issue of *Computers and Automation*.[1] In the March 1965 issue, twenty-five were reported.[2] In this article, ten are described which have not been previously listed and one is a revised edition of a listing in the last survey,[2] while new Evidence Rating information is given for several others.

The courses included in this survey are specifically in computing and data processing, and are designed to develop specific *programming* skills. All of them are currently available either by direct purchase or through the product support or marketing function of a computer manufacturer. Courses which have been developed for internal company use, and which are not circulated outside the organization, will not be found among those listed in this survey. Also not included are courses in computer mathematics, numerical analysis, networks, computer logic, keypunch and computer operation, etc.; although computer-related, these do not teach computer *programming*.

This survey is not a critical, comprehensive review. No attempt has been made to *analyze* the contents of each course for completeness and effectiveness. Rather, it is designed to acquaint the reader with available materials by identifying and describing them, with added comment where appropriate. It is hoped that users who have experience with a course will report, in actual *reviews,* the effectiveness and utilization in business, industry, education and government.

One of the requirements for inclusion in the survey is that the materials be examined personally by the authors. Also, information dealing with tryout and validation must be provided by the publisher or author in order to be included in the "Evidence Rating." This should appear preferably in the materials or in an accompanying guide as documented evidence of tryout and validation. The requirement of "examination" may have acted to restrict the listing to those programs which have been published in the U.S. It is known that one programmed text, "Basic Principles of Digital Computing," and three teaching machine programs, "Beginners' Guide to Digital Computers," "Introduction to Digital Computing," and "Introduction to Computer Programming," have been produced in England. They are not in the present listing since they have not been made available for examination.

Those readers who may not be completely familiar with programmed instruction are urged to read the short Part 1, "What is Programmed Instruction," appearing in the 1965 survey article (2).

Programmed Materials Currently Available for Computer Programming in Addition to Those Described in 1963 and 1965 Surveys:

26. Title: "FORTRAN IV FOR IBM SYSTEM/360: Programmed Instruction Course"
Author: IBM Staff
Publisher: International Business Machines Corporation
Date Published: 1965
Physical Form: Text, soft-covered, saddle-stitched, 8½" x 11", series of booklets: Chapter 1 (60 pages + ix, 208 steps), Chapter 2 (44 pages, 141 steps), Chapter 3 (96 pages, 319 steps), Chapter 4 (80 pages, 261 steps), Illustrations (plastic-bound, 44 pages), Problem Book (52 pages), Advisor Guide, Final Examination.
Type or Mode: Written-completion using constructed responses, mainly single-word and problem solution, with some multiple-choice and simple branching. If the student has any difficulty with any problem, he is asked to talk with the Advisor. Chapter 1 starts with a seven-page introduction to data processing which is in narrative form and which the student is given the option of skipping if already familiar with data processing.
Expendability: Problem Book constitutes the only expendable portion. Since, where written responses are required, the trainee is directed by the text to use the Problem Book or scratch paper, all other materials are reusable.
Criterion Test: Problem Book contains periodic exercises and end-of-chapter examinations. Trainee is directed to contact Advisor for Post-test.
Criteria Rating: Satisfies criteria as a written-completion program.
Content/Behavioral Objectives: The preface states that "the objective of the course is to provide the knowledge of some of the skills required to *write* computer programs using the FORTRAN system; . . ." According to the Foreword, "No previous experience with any kind of programming systems is assumed." The ADVISOR GUIDE states in the Course Description that the student will be able to:
"1. Express algebraic formulas involving addition, subtraction, multiplication, division and expo-

nentiation by means of FORTRAN arithmetic statements.
2. Express problem logic in terms of FORTRAN logical statements.
3. Specify problem input and output in the FORTRAN language.
4. Write FORTRAN subprograms once and use them as often as required in the solution of a problem.
5. Express several typical computational problems in the FORTRAN language."

Evidence Rating: There is evidence that the course has been tried out extensively and revised.

Mean Completion Times	
Chapter 1	3.5 hrs
Chapter 2	3.25
Chapter 3	7.0
Chapter 4	5.75
Final Exam	2.0
Total	21.5
Range of Time	15 to 30 hrs

Remarks: There is a trainee-Advisor relationship throughout the course. The trainee receives the Problem Book and Chapter 1 from his Advisor and must complete it satisfactorily before receiving the next Chapter. The Advisor provides supplemental assistance, personal follow-up, supervision and evaluation. This course is the FORTRAN IV version of "FORTRAN: Programmed Instruction Course" published by IBM in 1963 (Reference 2, Item 4). Based upon the 1963 course, it includes additional topics such as E, D, and A notation, COMMON, EQUIVALENCE, and the new form of the READ/WRITE statements.

27. Title: "COBOL Compiler D, Series 200/Operating System - MOD 1, Volume 1"
Author: American Institutes for Research, Inc., Staff
Publisher: Honeywell Inc., Electronic Data Processing Division
Date Published: October 1965
Price: $3.00
Physical Form: Text, soft-covered, bound, 8½" X 11", 124 + v pages; about 319 steps. "COBOL Compiler D Reference Handbook" is required for use in Section III; obtain separately.

Type or Mode: Written-completion using constructed single- and multiple-word and graphic flow chart responses. The text is divided into seven sections.
Expendability: Written responses are made directly into the text; it is expendable.
Criterion Test: There are no quizzes, selftests or post-test at the end of the course.
Criteria Rating: Satisfies criteria for a written-completion program.
Content/Behavioral Objectives: Authors state in the Introduction that this "is designed to provide such training in the business oriented language called COBOL."
Evidence Rating: Introductory section states that program performance data are available on request to the publisher. Publisher advises:

	Tryout #1	Tryout #2	Tryout #3
Number students	16	15	13
Mean Completion Time (hours)	4.66	—	7.0
Range of Time (hrs)	3.1 to 7.75	—	—
Mean Pre-test Score	57.1%	—	57.2% (N = 8)
Range Pre-test Score	32.5 to 79%	—	—
Mean Post-test Score	95.8%	91.4%	93.8%
Range Post-test Score	81.8 to 100%	—	—

Students in Tryout #1 were Honeywell employees having various amounts of experience in programming other computer languages. Students in Tryout #2 were civilian and military Air Force personnel. Students in Tryout #3 were employees of a Honeywell customer having various amounts of experience in programming other computer languages. Identical external Pre- and Post-test (71 points) were administered in Tryout #1. Post-test (71 points) administered in Tryout #2 was "end-of-volume" test. Pre- and Post-test (91 points) administered in Tryout #3 was revision of "end-of-volume" test.

Remarks: There are 3 volumes in the set. Volume 1 is an overview which provides a foundation for Volumes 2 and 3. Only Volume 1 was received for examination in this survey.

28. Title: "Programming With EASYCODER"
Author: John E. Harrah and Nancy G. Willford
Publisher: Honeywell Inc., Electronic Data Processing Division
Date Published: April 1965
Price: $4.50
Physical Form: Text, soft-covered, bound, 8½" X 11" 235 + vi pages, about 598 steps.
Type or Mode: The text is divided into six lessons. Most employ the written-completion mode using constructed single- and multiple-word responses, graphic flow chart responses and problem solution. The text is linear. Most of the lessons begin with a page of text material. Lesson IV ends with an optional section on "Bootstrapping and Loading" consisting of six pages of text material containing charts and diagrams with statements requiring written-completion in which the reader is instructed to refer to the charts and diagrams to obtain the information; there is no feedback in the optional section to inform the trainee of the correctness of his response.
Expendability: Written responses are made directly into the text; it is expendable.
Criterion Test: Five of the six lessons each end with a selftest. The selftest in Lesson VI constitutes the post-test. However, the answers are not given; instead, the student is advised to run the program on the H-200, have a qualified programmer check the program or check it himself using the illustrations given in previous lessons.
Criterion Rating: Satisfies criteria as a written-completion program.
Content/Behavioral Objectives: The authors state in the Foreword that it "is intended for the student whose prior experience included completion of the programmed textbook *Introduction to the Honeywell 200* or equivalent training. . . . . .preliminary attention is directed toward general concepts regarding data organization and conventions followed in programming. Subsequent information is designed to familiarize the student with procedures related to a basic system configuration utilizing a card reader/punch. . . .Lessons III, V and VI produce student coded programs suitable for key punching, assembly, and test data execution."
Evidence Rating: Publisher advises that it was tried out on Honeywell employees (N=32). Trainees had various experience ranging from none to previously having written programs in other computer languages.

Mean Completion Time (hours) = 20
Range of Time (hours) = 9 to 34

An external 80-question post-test yielded Mean Post-test Score = 85%; Range of Scores = 68 to 99%.

29. Title: "1440/1311 DPS-REPORT PROGRAM GENERATOR: Programmed Instruction Course"
Author: IBM Staff
Publisher: International Business Machines Corporation
Date Published: 1964
Physical Form: Text, loose-leaf, 8½" X 11"; *Student Materials:* Text (192 pages, 1216 steps); Notebook (202 pages); Illustrations: Panel A (162 pages), Panel B (194 pages), Panel C (200 pages); *Advisor Guide* (368 pages).
Type or Mode: Written-completion using constructed responses, mainly single-word and problem solution, with some multiple-choice and simple branching. If the student has any difficulty with any problem, he is asked to talk with the Advisor.
Expendability: Notebook constitutes the only expendable portion. Since, where written responses are required, the trainee is directed by the text to use the Notebook or scratch paper, all other materials are reusable.
Criterion Test: The Advisor Guide contains 4 problems identified as examinations, one or more to be administered as test problems. When administering these tests, a Master Work Deck of punched cards is required. These tests constitute the Post-test. There is no "written" examination. The Notebook may be used for Pre-test purposes. Text problems in Sections 12 and 13 require an IBM 1441 with 8,000 positions of core storage. Other problems require a 1441 with at least 4,000 positions.
Criteria Rating: Satisfies criteria for a written-completion program.
Content/Behavioral Objectives: The Advisor Guide states in the Course Description that
"Upon successful completion of the course, the student is able to:
1. Design a spacing chart for any report to be printed.
2. Write the specifications to produce printed reports from data on either cards or disks.
3. Write the specifications to produce disk output records.
4. Write the specifications to produce punched card output records, using consecutive disk records as input.
5. Write the control card information to generate one of the types of programs in steps 2-4 above."
Evidence Rating: There is evidence that the course has been tried out extensively and revised.

Mean Completion Time (hours) 23.5
Range of Time (hours) (excludes machine operation and keypunching time) 18 to 40

30. Title: "NCR 390 Computer Programming Course"
Author: NCR Staff
Publisher: The National Cash Register Company, Marketing Services Department
Date Published: 1965
Price: Training Manual $4.00, Answer Book $3.00, Set of Magnetic Tapes $50.00
Physical Form: Training Manual: text, loose-leaf, 8½" X 11", 154 pages + 64 page Appendix + packet of 6 sheets of labels. Answer Book: plastic-bound, 7" X 9", 68 pages; with 2 sliding "answer" tabs to identify coded solutions. Magnetic Tape: eleven 7" reels, ¼" prerecorded two-track tape, speed 3¾ ips. Tape playback device required but not provided.
Type or Mode: Audiovisual with many covert responses. Problems call for written-completion using constructed single- and multiple-word and graphic flow chart responses. Linear. Nearly all stimuli material is aural, being prerecorded. When directed, student responds by writing in Training Manual or thinking the response. The time allowed for response is controlled, but student may stop the tape when necessary to have more response time. Occasionally a chime signals a manual tape stop so the student can read text or do a problem. The voice directs the student to set "answer" tab in Answer Book and compare printed answer with his own written response in Training Manual. There are 24 Lessons.
Expendability: Written responses are made directly into the Training Manual which is actually a text-workbook and is expendable. Answer Book and Magnetic Tapes are reusable provided tapes are not accidentally erased.
Criterion Test: Contains periodic exercises, but no quizzes, selftests, pre- or post-tests are specified.
Criterion Rating: While there are many covert responses, the problems all require extensive overt responses in written-completion form with feedback verification both audibly and in the Answer Book. Satisfies criteria as a written-completion program. Self-pacing under student control requires manually stopping the tape if too rapid but does not allow speeding up.
Content/Behavioral Objectives: The Introduction states that it is a ". . .method of learning to program the NCR 390 Computer. . . a relaxed student, using this pleasant new method, can learn to program the computer in a matter of days." The publisher advises that "no prerequisites are required to take the course."
Evidence Rating: Tryouts and Conditions of Validation are not included in the Training Manual. Publisher advises that "the initial versions were tested on individuals four times and group tested twice with 5 in each group."

31. Title: "Programming the RCA 301 — a self-instructional programmed manual"
Author: James A. Saxon
Publisher: Prentice-Hall, Inc.
Date Published: 1965
Price: $6.95
Physical Form: Text, soft-covered, bound, 8½" X 11", 274 + xx pages.
Type or Mode: Text-workbook in which a series of short lessons is presented. Most lessons contain less than a page of text material and examples, followed by a set of problems. Some lessons contain slightly more information or longer examples. The problem sets are essentially "selftests," *not* responses to programmed steps. The correct answers, together with reinforcing explanatory information, are provided after each complete problem set. There are 72 lessons, grouped into 18 units.
Expendability: Written responses are made directly into the text; it is expendable.
Criterion Test: Of the 18 units, 8 end with a short quiz which is a unit selftest. In addition, there is a course selftest at the midpoint. A final problem to be programmed constitutes the post-test.
Criteria Rating: Does not satisfy the criteria for programmed instruction, particularly the criterion that instruction be presented in small incremental steps requiring frequent responses by the student. It is, however, an excellent example of a text-workbook.
Content/Behavioral Objectives: The author states that this text is designed "to teach the beginner the fundamentals of programming for the RCA 301 computer . . . .completion of this manual will not qualify the student as an expert programmer. It will teach him the fundamentals of programming for the RCA 301. He will have the basic tools of programming at his fingertips. . ."
Evidence Rating: No evidence is given in the introductory section nor in an appendix to describe how it was

tried out and debugged and the conditions of validation.

32. Title: "Programming the CP-667: A Self-Instruction Manual"
Author: James A. Saxon and Marnette Moles
Publisher: U.S. Navy Electronics Laboratory (San Diego, California 92152)
Price: Available at no cost to any government agency through Defense Documentation Center, Washington, D.C.
Physical Form: Text, loose-leaf, 8½" X 11", 316 + viii pages + 3 page errata (1 June 1965) + 2 plastic-encased instruction repertoire reference cards, 3½" X 5".
Type or Mode: Text-workbook in which a series of short, complete lessons is presented. Each lesson contains about two pages of text material and examples followed by a set of problems. The problem sets are essentially "selftests" and are *not* responses to programmed steps. The correct answers, together with remarks, are provided after each complete problem set. There are 94 lessons grouped into 20 units.
Expendability: Written responses are made directly into the text; it is expendable.
Criterion Test: Quizzes which are also selftests constitute criterion tests for 16 units. In addition, 9 units have problems which call for complete solutions. A final problem to be programmed and run on the CP-667 constitutes the post-test.
Criterion Rating: Does not satisfy the criteria for programmed instruction, particularly the criterion that instruction be presented in small incremental steps requiring frequent responses by the learner. It is, however, an excellent example of a text-workbook.
Content/Behavioral Objectives: The authors state in the Preface that "This self-instruction manual has been developed to teach beginners the fundamentals of programming for the CP-667 computer. . .completion of this manual will not qualify the student as an expert programmer. He will have learned the fundamentals of programming for the CP-667 and will have the basic tools of programming at his fingertips."
Evidence Rating: The senior author advises that it was tried out during development with 53 individuals of whom 35 were professional programmers and 18 were programmer trainees. Mean Completion Time for trainees = 30 hours.
Remarks: The senior author advises the CP-667, built by UNIVAC, is a large-scale scientific computer, more complicated to program than "most average computers. . . .It is recommended that an instructor be available to answer questions and to iron out problems. I would categorize this as semi self-instructional. . ."

33. Title: "INTRODUCTION TO ELECTRONIC DATA PROCESSING"
Author: Basic Systems Inc., Staff
Publisher: Basic Systems Inc. (Copyright, Sperry Rand Corporation)
Date Published: 1964
Price: $9.50
Physical Form: Text, soft-covered, bound, 8½" X 11", 242 + iv pages + 3 foldouts. 502 steps.
Type or Mode: Written-completion using single- and multiple-word constructed responses, matching and multiple-choice responses. There is some branching to permit skipping over short sections which are first "tested." The "test" step is identified as the "Express Stop." About 10 to 30 steps can be skipped.
Expendability: Written responses are made directly into the text; it is expendable.
Criterion Test: There are no tests in the program. A final examination constitutes the post-test.
Criterion Rating: Satisfies criteria as a combined written-completion and multiple-choice program.
Content/Behavioral Objectives: Author states in Instructions to Student that it is "designed to introduce you to electronic data processing and the UNIVAC 1050 systems."
Evidence Rating: No evidence was given in the introductory section nor in an appendix to describe how it was tried out and debugged and the conditions of validation. Publisher advises that Mean Completion Time = 6.0 hours.
Remarks: Except for the cover, title page and Introduction page, this is the same as "Orientation to Electronic Data Processing and The UNIVAC 1050 Systems" (Item 34).

34. Title: "Orientation to Electronic Data Processing and The UNIVAC 1050 Systems"
Author: Basic Systems Inc.
Publisher: UNIVAC Education Department, Sperry Rand Corporation.
Date Published: 1964
Physical Form: Text, soft-covered, bound, 8½" X 11", 242 + iv pages + 3 foldouts. 502 steps.
Type or Mode: Written-completion using single- and multiple-word constructed responses, matching and multiple-choice responses. There is some branching to permit skipping over short sections which are first "tested." The "test" step is identified as the "Express Stop." About 10 to 30 steps can be skipped.
Expendability: Written responses are made directly into the text; it is expendable.
Criterion Test: There are no tests in the program. A final examination constitutes the post-test.
Criterion Rating: Satisfies criteria as a combined written-completion and multiple-choice program.
Content/Behavioral Objectives: Author states in Instructions to Student that it is "designed to introduce you to electronic data processing and the UNIVAC 1050 systems." The Introduction states that "This is a self-instructional text on how to program the UNIVAC 1050 Systems."
Evidence Rating: No evidence was given in the introductory section nor in an appendix to describe how it was tried out and debugged and the conditions of validation.
Remarks: Except for the cover, title page and Introduction page, this is the same as "Introduction to Electronic Data Processing" published by Basic Systems Inc. (Item 33). This "Orientation to Electronic Data Processing and The UNIVAC 1050 Systems" is a prerequisite to "Programming The UNIVAC 1050 Card System" published by the UNIVAC Education Department (Item 35).

35. Title: "Programming The UNIVAC 1050 Card System"
Author: Basic Systems Inc.
Publisher: UNIVAC Education Department, Sperry Rand Corporation
Date Published: 1964
Physical Form: Text, soft-covered, saddle-stitched, 8½" X 11", series of booklets: Book 1 (92 pages +, 224 steps), Panel Book 1 (47 pages +), Book 2 (114 pages +, 268 steps), Book 3 (113 pages +, 250 steps), Book 4 (96 pages +, 218 steps), Book 5 (101 pages +, 265 steps), Panel Book 2 (54 pages +), Book 6 (94 pages +, 238 steps), Book 7 (88 pages +, 212 steps), Book 8 (95 pages +, 215 steps), Book 9 (66 pages +, 177 steps), Book 10 (71 pages +, 165 steps).
Type or Mode: Written-completion using single- and multiple-word constructed responses and problem solutions including flow charting. There is some branching in several books to permit skipping over short sections which are first "tested." The "test" step is identified as the "Express Stop." About 10 to 40 steps can be skipped.
Expendability: Written responses are made directly into the Books; they are expendable. Panel Books are reusable.
Criterion Test: Each Book has a "final examination" which

is a selftest. Answers are found at the beginning of the following Book. In Book 10, the "final examination" answers follow the selftest. A "thesis problem" constitutes the post-test; answers accompany the problem.

Criterion Rating: Satisfies criteria as a combined written-completion and multiple-choice program.

Content/Behavioral Objectives: The author states in the "Preview Frame" that ". . . .Books 1 through 10 will teach you the complete Program Assembly Language of this computer and how to use it."

Evidence Rating: No evidence was given in the introductory section nor in an appendix to describe how it was tried out and debugged and the conditions of validation.

Remarks: "Orientation to Electronic Data Processing and The UNIVAC 1050 Systems" (Item 34) is considered to be the "introductory book of this course."

Revised Edition of Course Previously Listed (Reference 2):

36. Title: "FUNDAMENTALS OF ELECTRONIC DATA PROCESSING: A Programmed Text"
Author: Kenneth L. Inman
Publisher: Prentice-Hall, Inc.
Date Published: Revised Edition 1965
Price: $6.50
Physical Form: Text, soft-covered, bound, 8½" X 11", 147 + vi pages, about 554 steps.
Type or Mode: Written-completion using constructed single- and multiple-word and graphic flow chart responses. Linear. The original edition was in 'page segment sequential,' i.e. the stimulus was on the right hand page, the student responded on that page, and the feedback was in a segment on the following left hand page. In the revised edition, 'page segment vertical' is utilized; i.e., the stimulus is on the right hand page, the student responds on that page, and the feedback is in the segment directly below, thereby allowing a 1-to-1 comparison of response-feedback. A cardboard mask conceals the feedback.
Expendability: Written responses are made directly into the text; it is expendable.
Criterion Test: Only the first three of the seven lessons are followed by quizzes which are selftests. There are no other tests and there is no post-test.
Criteria Rating: Satisfies criteria for a written-completion program.
Content/Behavioral Objectives: The Foreword states that "this book is a basic introduction to electronic data processing intended for the reader with little or no previous training in the field. . . . the purpose is to explain general principles. . ."
Evidence Rating: No evidence is given in the introductory section nor in an appendix to describe how it was tried out and debugged and the conditions of validation. However, see Evidence Rating for the Honeywell version of "FUNDAMENTALS OF ELECTRONIC DATA PROCESSING" in a later section of this article for Honeywell-furnished information.
Remarks: Except for Lesson V, this text is essentially the same as "FUNDAMENTALS OF ELECTRONIC DATA PROCESSING" published by Honeywell, with some specific Honeywell references deleted. In this revised edition, Lessons VI and VII have now been revised to be consistent with the newer flow chart conventions which the previous Prentice-Hall edition had already incorporated in Lesson V, Flow Charting.

Up-Dated Information on Courses Previously Listed (Reference 2):

(The item numbers refer to those used in the March 1965 survey article in which the original description appears.)

8. Title: "COBOL: A Self-Instructional Manual"
Author: James A. Saxon
Publisher: Prentice-Hall, Inc.
Date Published: 1963
Price: $6.50
Physical Form: Text, soft-covered, bound, 8½" X 11", 190 + xi pages
Type or Mode: Text-workbook in which a series of short, complete lessons is presented. Each lesson contains about two pages of text material and examples, followed by a set of problems. The problem sets are essentially "self-tests," *not* responses to programmed steps. The correct answers, together with remarks, are provided after each complete problem set. There are 34 lessons, grouped into 13 units.
Expendability: Written responses are made directly into the text; it is expendable.
Criterion Test: Quizzes which are also self-tests constitute criterion tests for each unit. A final quiz and a final problem to be programmed together constitute the post-test.
Criteria Rating: Does not satisfy the criteria for programmed instruction, particularly the criterion that instruction be presented in small incremental steps requiring frequent responses by the learner. It is, however, a very good example of a text-workbook.
Content/Behavioral Objectives: The author states that this text was "developed to teach the beginner the fundamentals of COBOL programming. . . . this book will not develop *expert* COBOL programmers. . . . It will teach the basic rules of COBOL. . . . Previous knowledge of computers, data processing or programming is not required. . ." This text is machine-independent, and refers the learner to manuals for each computer when machine characteristics are involved.
Evidence Rating: Author advises it was "formally field tested on 8 high school students and 21 college students. Based on these tests and on expert technical evaluations, it was revised several times prior to publication."

11. Title: "PROGRAMMING THE IBM 1401: A Self-Instructional Programmed Manual"
Author: James A. Saxon and William S. Plette
Publisher: Prentice-Hall, Inc.
Date Published: 1962
Price: $9.25
Physical Form: Text, hard-covered, stitch-bound, 6" X 9", 208 + xv pages
Type or Mode: Text-workbook in which a series of short, complete lessons is presented. Each lesson contains about two pages of text material and examples, followed by a set of problems. The problem sets are essentially "self-tests," *not* responses to programmed steps. Correct answers and reinforcing explanatory information are provided after each complete problem set. There are 42 lessons, grouped into ten units.
Expendability: Written responses are made directly into the text; it is expendable.
Criterion Test: Quizzes which are also self-tests constitute criterion tests for each unit. The final lesson consists of a final problem which, together with the final quiz, represent the post-test.
Criteria Rating: Does not satisfy the criteria for programmed instruction, particularly the criterion that instruction be presented in small incremental steps requiring frequent responses by the learner. It is, however, a very good example of a text-workbook.
Content/Behavioral Objectives: The introduction states that this "workbook has been developed to teach the beginner to *program* for the IBM 1401 computer. . . . this workbook will not qualify the student as an *expert* programmer. It will teach him the fundamentals of programming for the IBM 1401."
Evidence Rating: Author advises it was formally field tested in 1960 at Lockheed Missiles and Space Co.,

(Please turn to page 40)

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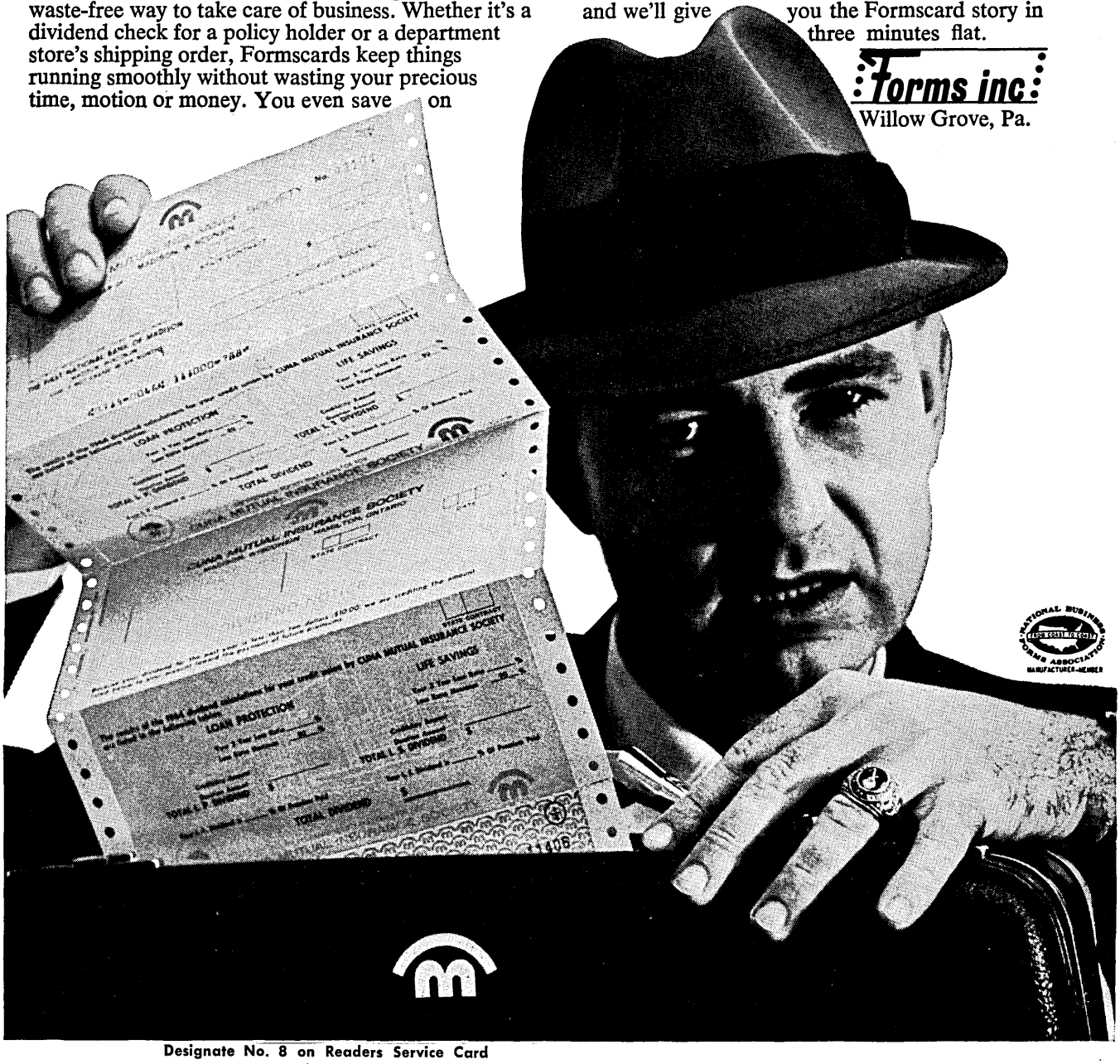

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CAPITAL REPORT

A Special Report from C&A's Washington Correspondent

A Post Office automation plan calling for $100 million worth of equipment was unveiled in January by the new Postmaster General, Lawrence F. O'Brien. In addition to EDP equipment to be outlined below, the plan involves installation of machines that face all letters the same way, then cancel them; huge automatic sack-sorters; parcel post systems that sort packages at high speeds; machines capable of removing odd-shaped items from the mail stream, such as hotel keys; and closed-circuit television systems that will help postal employees pinpoint problem areas in mail-handling systems.

By the end of March, industry will be invited to bid on all this equipment, plus optical scanners, data collection equipment, and computers. As previously announced, there are seven IBM 1401s in six post offices and Washington headquarters that will be replaced by new computers. Then, eight optical scanners will be installed in Boston, Houston, Minneapolis, San Francisco, Seattle, and Portland, Ore., to sort incoming and outgoing mail by reading machine-printed ZIP Codes. Philco Corp., under a $1,800,000 contract awarded in June 1965, is currently installing six scanners in Detroit and Buffalo.

A big contract — $33.5 million — is waiting for the firm that wins the competition for data collection equipment, which will be installed in multiple units in 75 post offices. They will gather information on mail volume, workloads, manpower fluctuations, and attendance records, then transmit this information through a nationwide telecommunications network to central computers for recordkeeping and analysis. Control Data may have an edge on this contract since the system will be based on experiments with its Transactor data collectors in Milwaukee and Minneapolis.

Postmaster O'Brien also announced a new Office of Planning that will chart service improvements for the immediate future and lay down blueprints for new programs. Dr. John Haldi, a consultant to the Bureau of the Budget, will head the new office, and the Postmaster said his planners will have a wide open field to explore many problems concerning the mails. Many in Washington are wondering aloud if they will be able to chart postal improvements to arrive at the envious record of many European countries — one day mail deliveries throughout the country.

The production of computing machines is expected to reach $2.4 billion in 1966, an 8.2 percent rise over 1965. Exports should increase 11.3 percent to a total of $445 million.

These are the main conclusions in the "U.S. Industrial Outlook for 1966," published by the Commerce Department, and available for $1.00 from the Government Printing Office in Washington.

According to Commerce, this favorable outlook for the industry reflects the following: A desire of business for more effective procedures in accounting, inventory control, production and planning, process control, and business forecasting; higher outlays for research and development in science and aerospace areas; advances in computers resulting from R&D performed under defense contracts; and expansion of foreign markets as U. S. automation is imitated.

Since 1958, Commerce said, the dollar value of factory shipments of computers has increased at an average rate of 12 percent per year. Based on Labor statistics, 66,000 production workers were in the industry in 1964, the most recent figure available. This is a 16 percent rise over 1958's figure of 57,000, but only a small percentage increase is expected in 1966.

The report also talks about the trend toward an international industry as a result of U. S. computer firms combining with foreign firms to seek a larger share of the fast-growing market.

"The trend toward internationalization of the industry could be dampened by the U. S. balance-of-payments picture," it said, "but the use of reserve funds from foreign subsidiaries or borrowings from foreign money markets could help in financing expanded overseas operations."

The report concludes with statement of some problems facing the industry, including the growing demand for Western computers by Eastern European countries; this market is not served by U. S. firms because of the Export Control Act, which forbids shipment of certain goods "to protect the national security." It also pointed to the trend toward "protectionism" by some foreign nations through such methods as subsidies to its own industry to hold down imports.

James Titus

JAMES TITUS

"ACROSS THE EDITOR'S DESK"

Computing and Data Processing Newsletter

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APPLICATIONS

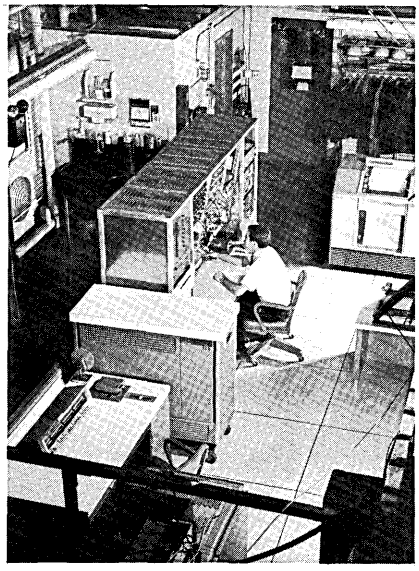
COMPUTER APPLICATIONS AT ARGONNE NATIONAL LABORATORY

Today at Argonne National Laboratory, southwest of Chicago, Ill., you will find computers at work in every scientific division. They perform "housekeeping" chores such as monitoring the controls of a nuclear reactor and recording innumerable measurements of reactor operating conditions. With millionth of a second precision, they control components of Argonne's 12.5 billion electron volt particle accelerator, the Zero Gradient Synchrotron. They analyze the results of a physics experiment while the experiment is in progress and help a scientist determine whether or not he needs further data. They scan pictures of high-energy particle tracks and pick out "interesting" tracks for further analysis.

Argonne's largest computer, housed in the Laboratory's Applied Mathematics building, is a Control Data 3600. This instrument is the center of a network of computer facilities which analyze most of the experimental data assembled at the Laboratory. The 3600 also performs complicated theoretical calculations, such as constructing models of the structure of an atom, showing the locations of its electron shells. With peripheral equipment (much of which was designed at Argonne) this computer also is used for mathematic research.

Also important to Argonne's experimental programs are smaller computers which simplify the job of data collection and analysis. These computers may be used with data handling facilities connected to a number of experiments. A typical system is the one installed in Argonne's Biology building. This system consists of a master data collection station connected to remote stations in several laboratories. Experimental data from the laboratories are fed into the central system, coded automatically on tape or punched cards for later processing by a computer. With this system scientists are calculating the theoretical effects of radiation on living organisms and comparing these predictions with experimental data; working out mathematically the products of involved chemical separation processes as a means of predicting and checking experimental results; classifying blood cells from irradiated animals according to size; and even maintaining up-to-the minute records of the health and breeding performance of thousands of rats and mice used in biological research.

In a few cases, as in the automated Van de Graaff laboratory, they perform entire experiments folowing prescribed routines. Two small electronic computers, located in a room adjoining a Van de Graaff Accelerator, share a common auxiliary memory unit and control the accelerator and experimental equipment for obtaining data vital to the construction of tomorrow's atomic power reactors. In the photo at the upper right, Reactor Physicist James F. Whalen, one of the designers of this equipment, is shown seated at a computer console. At his left is the memory unit, and at the left of the memory unit is the other computer.



Though it still is unusual for computers to run an entire experiment, this scene at Argonne may be typical of laboratories of the future where large amounts of precise data are required. Already electronic equipment has proved its superior ability to perform calculations, adjust apparatus, and even perform complicated analytical procedures without the intervention of a human hand.

Yet Argonne, where 1300 scientists and engineers are engaged in research on peaceful uses of atomic energy, foresees no shortage of work for trained specialists. "On

the contrary." states Reactor Physicist Alan B. Smith, who heads the automated Van de Graaff laboratory, "We already have a hard time keeping up with our equipment. Someone must decide what data the computers turn out are important, and how to use these data. Only an expert can do this, and we have too few experts."

COMPUTERIZED HEALTH PROGRAM

For the first time in the United States, computers have been "built-into" a community health program to help run a new comprehensive health center and to measure its effectiveness in providing medical care to a total population. The pioneering step in expanded health care began last December after the dedication of Boston's Columbia Health Center, the northern urban division of a community health action program which the Department of Preventive Medicine of Tufts University School of Medicine has established under a $1,168,000 grant from the U.S. Office of Economic Opportunity.

The computer system was planned for every stage of the Columbia Point Health Center's work from the moment the patient enters the door. Already in the computer's memory was all pertinent information on each one of the more than 6000 residents of this community being served by the new poverty program health center. Also the computer had assigned each resident a unique number, and a plastic "Health Center card" bearing the name and number was ready for each resident when the Center opened.

This card accompanies the patient through the Health Center on every visit — and is used to stamp special slips noting his contacts with nurses, doctors and other staff members, the amount of time spent with each, lab tests, diagnoses, drugs ordered, and similar information, all of which subsequently is fed to the computer. At the end of a week, a month, or any other interval, the computer is able to tell the Health Center staff which patients and families have used their service and which have not, and note the differences between the users and non-users. It is able to list all the illnesses in the population — and report how much medical care, in the form of doctor time, nurse time, specialists consultations, home visits, lab tests and drugs, was required for treatment. It can instantly identify all the individuals with diabetes, heart disease, or any other ailment, or check off all the households in which such illness occurs. But neither patients nor doctors will be affected by the computer in the Health Centers' daily work. The center also keeps its own regular set of traditional medical records on every patient and every family for day-to-day use.

By checking on the diagnoses made, the tests ordered, and the prescriptions written by each physician, the computer also can conduct a "medical audit" to assure high quality performance by the doctors. The computer also will run inventory control of the pharmacy and laboratory and will do automatic billing of welfare and other supporting agencies for services rendered to their clients at Columbia Point.

This breadth of approach to data processing of patient care was the idea of the Project's Directors, Tufts-New England Medical Center faculty and staff members, Dr. Count D. Gibson, Jr., Professor and Chairman of the Department of Preventive Medicine and Dr. H. Jack Geiger, Associate Professor of Preventive Medicine and Director of the Departments' Division of Community Health. "The computer data will be important," the doctors explain, "because for the first time it will give us a running record of the illness, the health needs and the medical care usage of a total population whose characteristics are known. It also will give us accurate information on the real costs of providing comprehensive health care. It should help us identify and correct any deficiencies of our own and help measure our progress from year to year."

These tasks are important since the new Health Center is a research and demonstration project which may serve as a prototype for other low-income urban areas in the country as part of the government's War on Poverty.

PENNSYLVANIA STATE POLICE USE COMPUTER-CONTROLLED TELETYPE NETWORK

In Pennsylvania, the time advantage usually enjoyed by criminals between misdeeds and statewide police alerts is shrinking rapidly, via the use of a computer-controlled Teletype network. The automated communications system, developed jointly by the Pennsylvania State Police and General Electric Company's Computer Department, is said to be the nation's fastest and most accurate in police work. As a sideline, the computer has memorized automatically the statistics on some 2500 vehicles and any car theft query is answered by the computer within minutes.

Key to the system is a General Electric Datanet-30 communications processor at the State Police Communications Center in Harrisburg. Every Teletype message originating anywhere in the network must first pass through the Datanet-30, where it is scanned for priority, destination and accuracy. The computer then checks line or circuit availability. If the message is directed to a single station and the line is busy, it is held in memory until the line is clear.

If confidential investigations are needed, such as security checks, this system (unlike others now in widespread use) relays the information only to the police station involved. Priority messages (car thefts, bank robberies, murder, hit-and-run accidents, etc.) are relayed immediately to all stations as general alarms. Every station in the network is checked automatically, to assure the message is received.

Messages follow a prescribed format. Everyday English is used in the body. Simplified code is used in address and signature lines. Thus, if an error occurs in format or code, the computer spots it immediately and notifies the sender that corrections are needed. Troopers originating a message can be sure it's on the way when the computer acknowledges receipt and disconnects the sending machine.

The computer-controlled network was conceived over an eight-year period by Captain Robert L. Bomboy, communications officer for the 2300-man Pennsylvania State Police. Last year, working with General Electric computer engineers, ideas were exchanged, code and format devised, and computer programs developed that could be understood easily by the State Police. The code and message format they developed are so good that messages are acceptable by Pennsylvania Courts as legal documents.

NEW CONTRACTS

FROM	TO	FOR	AMOUNT
Bell Telephone Laboratories, Inc., Whippany, N.J.	Sperry Rand Corporation, Univac Division, New York, N.Y.	Continuation of design, development, and delivery of computers and high-speed thin-film memory modules for use in the Army's Nike-X missile defense system	$24 million
Bache & Co. Inc., New York, N.Y.	Sperry Rand Corporation, Univac Division, New York, N.Y.	Communications computer network; nucleus of system, two UNIVAC 490 Real-Time computers (purchased outright); system is to provide control of private world-wide wire network and associated computing machinery	$3 million
Eastern Airlines, Eastern's Reservations Data Center, Miami International Airport, Miami, Fla.	IBM Corporation	Expanding present computer facilities to include electronic reservations system controlled by dual IBM System/360 Model 65s	$13 million
Southern Railway System	Radiation Inc., Melbourne, Fla.	A large quantity of Locotrol® systems which are used to provide synchronous, remote control of locomotive units in freight trains	$1.3 million
City of Los Angeles, Calif.	System Development Corp., Santa Monica, Calif.	Technical assistance in developing information system to serve city planning and operations requirements	—
U. S. Army Engineer Geodesy, Intelligence and Mapping, Research and Development Agency (GIMRADA), Ft. Belvoir, Va.	Bunker-Ramo Corporation, Canoga Park, Calif.	Third Universal Automatic Map Compilation Equipment System	$960,000
City of Portland, Oregon	Planning Research Corp., Los Angeles, Calif.	A study of city's traffic control system and recommendations for improving its effectiveness	—
General Instrument Corp.	Decision Systems, Inc., Teaneck, N.J.	Writing the program for a computer system to be used in checking out the Grumman Lunar Excursion Model (LEM) command control section	—
Anelex Corporation	Lear Siegler, Inc., Long Island City, N.Y.	Manufacture of power conditioning equipment for high-speed printers used in Defense Department's Automatic Digital Network (AUTODIN) communications system	over $600,000
Public Service Company of New Hampshire, Manchester, N.H.	The Foxboro Company, Foxboro, Mass.	Instrumentation and a digital computer system for a once-through steam electric generating unit; system will serve a new 350,000 KW generating unit at Merrimack Station, Bow, N.H.	—
Rome Air Development Center, Griffiss Air Force Base, N.Y.	Sylvania Electronics Systems, a division of Sylvania Electric Products Inc.	Programming a company-developed electronic reader to analyze foreign journals and to distinguish text from graphic material	$92,000
Air Forces' Oklahoma City Air Materiel Area for the Air Defense Command	Philco Corporation, Philadelphia, Pa.	Operating and maintaining the NORAD Combat bat Operations Center in the Cheyenne Mountain Complex	$286,000
NASA Electronics Research Center, Cambridge, Mass.	Wolf Research and Development Corp., West Concord, Mass.	One-year contract for mathematical and computational services for all laboratories at the Center in areas of trajectory analysis and guidance and control theory	$137,233
National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Texas	Philco Corporation, Philadelphia, Pa.	Designing, developing and manufacturing two speech compression devices	about $100,000

NEW INSTALLATIONS

AT	OF	FOR	FROM	AMOUNT
Rensselaer Polytechnic Institute, Troy, N.Y.	IBM System/360 Model 50	Wide range of applications from classroom research work to administrative and accounting tasks	IBM Corporation	$1 million, approximate
Sandia Corporation, Albuquerque, N.M.	SDS 92, 930 computers	Working in tandem to control a nation-wide network of 60 communications terminals	Scientific Data Systems, Santa Monica, Calif.	—
Continental National Bank, Phoenix, Ariz.	IBM System/360 Model 30	New computer center to service bank's own operations and numerous other Arizona business firms	IBM Corporation	—
Eastern Electricity Board, Ipswich, England	Honeywell 1800-III	Performing all consumer accounting functions for the company's two million electric customers	Honeywell EDP, Wellesley Hills, Mass.	$2.5 million

AT	OF	FOR	FROM	AMOUNT
Disneyland, WED Enterprises Inc., Anaheim, Calif.	PDP 1020	Wide range including design and engineering of new Disneyland projects; surveying and layout of new recreational areas; etc.	Pacific Data Systems, Inc., Santa Ana, Calif.	—
University of Essex, Wivenhoe Park, Colchester, Essex, England	I.C.T. 1909 computer	Use by 10 of 12 university departments with academic emphasis on the physical, social and engineering sciences	International Computers and Tabulators Limited	£120,000
Los Angeles Retail Merchants Credit Association, Calif.	RCA 3301 computer system	Providing retailers with immediate information on the credit status of about 5 million residents of Los Angeles and Orange Counties, Calif.	Radio Corporation of America, New York, N.Y.	—
Hemingway Transport, Inc., New Bedford, Mass.	IBM System/360 Model 30	Billing operations of firm's 28 trucking terminals in 17 eastern states; also such applications as terminal profit and loss calculations, and traffic lane analysis	IBM Corporation	over $300,000
Crawford and Company, Atlanta, Ga.	IBM System/360 Model 30	Speeding information processing from firm's hundreds of insurance adjusters across the nation	IBM Corporation	—
National Life and Accident Insurance Co., Nashville, Tenn.	IBM System/360	Faster, more thorough service to firm's 8 million policyholders	IBM Corporation	—
Lockheed Aircraft Corp. Research & Engineering Center, Huntsville, Ala.	EAI 8900 Hybrid Computing system	Applications primarily to support Army Missile Command and NASA Marshall Space Flight Center programs at Huntsville	Electronic Associates, Inc., West Long Branch, N.J.	$842,110
E. Gottschalk and Company, Fresno, Calif.	NCR 315-100 computer system	Accounts receivable and payable; sales audit, payroll and merchandise control to be included later	National Cash Register Company, Dayton, Ohio	—
A. B. Murray Co., Elizabeth, N.J.	Honeywell 120 computer	Inventory control, stock purchasing, sales analysis, and integration of data requirements of its three branches	Honeywell EDP, Wellesley Hills, Mass.	—
Yapi ve Kredi Bank, Istanbul, Turkey	NCR 315 system	Greater efficiencies in bank's operations, faster customer service; possible future "on-line" operation	National Cash Register Company, Dayton, Ohio	$500,000
State of Indiana, office of Auditor of State	NCR 315 RMC system	Obtaining up-to-the-minute data on state's financial resources; also will handle payroll for all state employees. Replaces NCR computer	National Cash Register	—
Greenfield Tap & Die, a division of United-Greenfield Corp., Greenfield, Mass.	UNIVAC 1050 System	Use in conjunction with UNIVAC 1004-11 Card Processing System; expanded system will accommodate inventory management, manufacturing scheduling and production control	Sperry Rand Corp., UNIVAC Division,	—
Tymshare Associates, Palo Alto, Calif.	SDS 940 time sharing computer	Full scale computer services for both business and scientific applications; individual subscribers will be connected to SDS 940 via telephone and telegraph lines	Scientific Data Systems, Santa Monica, Calif.	over $800,000
Merchants Bank of Miami, Miami, Fla.	NCR 315-100 system	General accounting, check posting and installment loan accounting by three Miami banks: Merchants Bank of Miami, the Commercial Bank of Miami, and the Bank of Kendall	National Cash Register Company, Dayton, Ohio	—
Computer Sciences Corp., El Segundo, Calif.	IBM System/360 Model 65 and Model 75	Expansion of remote access service bureau operations	IBM Corporation	—
Boeing Company, Aerospace Group, Seattle, Wash.	SDS 9300 computer	Use with analog computer in a hybrid installation to help in the development of several aerospace vehicles now under study	Scientific Data Systems, Santa Monica, Calif.	$628,000
Computer Graphics, Gardena, Calif.	PDP-8 computer system	Developing display-centered systems for processing commercial, educational, engineering and scientific data	Digital Equipment Corporation, Maynard, Mass.	—
G. C. Electronics, Rockford, Ill.	System/360 Model 30	A variety of data processing operations, ranging from inventory control to sales analysis	IBM Corporation	—
Los Angeles Times, Los Angeles, Calif.	Two IBM System/360 Model 30s	Setting type for editorial and advertising departments; also variety of newspapers' office work from accounting and payroll to market research	IBM Corporation	—
University of Minnesota, Biomedical Data Processing Center, Minneapolis, Minn.	Control Data 3100 computer system	Biomedical research and for training students and staff members	Control Data Corp., Minneapolis, Minn.	—
Airborne Instruments Laboratory Division of Cutler-Hammer Inc., Deer Park, N.Y.	Ten PDP-8 computers	Use in the control portion of a new automatic drafting system	Digital Equipment Corp., Maynard, Mass.	—

ORGANIZATION NEWS

RANDOM HOUSE TO BE MERGED WITH RCA

David Sarnoff, Chairman of the Board of the Radio Corporation of America, and Bennett Cerf, Chairman of the Board of Random House, Inc., have announced an agreement in principle for the acquisition of Random House by RCA. The agreement is subject to approval by the Boards of Directors of the two companies and by the shareholders of Random House.

If the agreement is approved, the publishing company will become a wholly owned subsidiary of RCA. It is contemplated that Random House will continue to function as a separate entity with complete editorial autonomy in the hands of its own Board of Directors and no changes in its present personnel and management.

GENERAL PRECISION EXPANDS LICENSE AGREEMENT WITH TOKO, INC.

General Precision, Inc., Tarrytown, N.Y., has expanded its licensing agreement with Toko, Inc., Tokyo, Japan, to include the manufacture and sale of Toko's high-speed, plated-wire computer memory for commercial applications in the United States. The commercial licensing augments General Precision's rights to manufacture and sell the memory for military and aerospace applications.

Toko, Inc., is one of the largest manufacturers of electronic components in Japan, with an international reputation in the development of plated wires for woven-memory matrices.

MONSANTO ENTERS FIELD OF DATA ACQUISITION SYSTEMS

Monsanto Company, St. Louis, Mo., is now offering a series of multiple input data acquisition systems to meet a wide range of laboratory and commercial data gathering requirements, Myron C. Pogue, manager of electronic development for the company's Inorganic Chemicals Division, has announced.

Mr. Pogue said that Monsanto's entrance into the data acquisition system field is a natural outgrowth of the technological experience the company has acquired from its years of successful pioneering in electronic computer use and in systems engineering applications.
(For more information, designate #41 on the Readers Service Card.)

ITEK TO ACQUIRE PENNSYLVANIA OPTICAL CO.

Franklin A. Lindsay, president of Itek Corporation, Lexington, Mass., and Charles A. Baratelli, president of Pennsylvania Optical Company, Reading, Pa., recently announced that agreement had been reached on a plan for Itek to acquire Pennsylvania Optical. Terms of the plan call for the acquisition by Itek of Pennsylvania Optical for a total consideration of 195,000 shares of Itek common stock. The Plan is to be submitted to the stockholders of Itek for their approval.

Pennsylvania Optical is an 80-year-old firm specializing in the mass production of precision optics, opthalmic-quality reading and sun glasses, industrial safety lenses and frames, and welding glass face-plates. Itek announced that the firm will continue to operate autonomously and that its personnel and operating procedures will not be affected by the proposed acquisition.

Itek's four major areas of operation are: optical systems and reconnaissance, commercial reproduction equipment and supplies, photo-optical storage and computing, and graphic data processing.

LEEDS & NORTHRUP FORM AUSTRALIAN SUBSIDIARY

Leeds & Northrup Company, Philadelphia, Pa., has formed a new subsidiary company in Australia to manufacture, sell, and service electronic instruments and automatic controls. The new company, known as Leeds & Northrup Australia Pty. Limited, has offices and manufacturing facilities at Mascot, near Sydney, New South Wales.

In addition to the new Australian concern, Leeds & Northrup has subsidiary companies in Canada, England, Italy and Mexico.

XEROX SETS UP NEW DIVISIONS

A major realignment of Xerox Corporation's existing organizational structure into six divisions has been announced by Joseph C. Wilson, president and chief executive officer.

Three new operating divisions, Business Products and Systems, Information Systems, and Education, each will have development, production and marketing responsibilities for product lines.

A fourth division will continue to serve as the corporate center for research and engineering activities. It will be strengthened by the addition of advanced engineering laboratories and a project analysis staff.

The overseas, patents and legal affairs of the company continue as a division. Another new division, the Corporate Administration Division, will provide the corporation with administrative and staff services.

PYLE-NATIONAL HAS SOLD SUBSIDIARY TO PHILCO

The Pyle-National Company has sold General Micro-electronics, Inc., its subsidiary in Santa Clara, Calif., to Philco Corporation for about $4,350,000. Of this amount, about $1,650,000 will be paid to the minority stockholders of General Micro-electronics, Inc. In addition to the sale price, Philco will provide GM-e with funds to enable GM-e to repay loans of about $4,800,000 from Pyle-National.

GM-e manufactures integrated circuits, including single-diffused metal oxide silicon circuits which complement the micro and hybrid circuits which Philco is making for defense applications. These will continue to be manufactured by the Lansdale (Pa.) Division of Philco. Philco plans to operate GM-e as a subsidiary in Santa Clara.

Micro-electronics are not related to Pyle-National's other business operations.

COMPUTING CENTERS

CARS

A specialized information service bureau dedicated to automobile dealerships has been announced. A spokesman for Computerized Automotive Reporting Service, Inc. (CARS), Jacksonville, Fla., said this will be a nationwide network of processing centers with offices in Jacksonville, Los Angeles, Dallas, Chicago, and New York and will provide auto dealers with all accounting services and detailed management reports.

By linking dealerships directly to its GE-415 computer center via Bell System communication equipment, CARS has eliminated the use of the mails to obtain client's source data. This also permits CARS to transmit a Daily Operating Control statement directly to dealers. Ten-day and monthly reports, however, are mailed to subscribers.

Dealership clerical personnel use special "question loop" programs to transpose data from daily invoices, orders, and vouchers into punched paper tape. The programs, when inserted in the teletypewriter, provide fixed information on the "answer tape", while variables from documents are entered by the clerk. From the data, which is transmitted by Bell System Data-speed service to CARS GE-415 computer center, a Daily Operating Control statement (DOC) is prepared. The same night the DOC is relayed back to and printed by the teletypewriter at the dealership.

Before a dealership actually starts to use the service, the business manager attends a one week course to familiarize himself with the CARS system. During the course, CARS personnel help him prepare a manual of source documents designed for the dealership's specific operations. Once the system is installed, a CARS senior automobile accountant goes to the dealership to help train the staff and oversee initial operation.

HARRIS EPOCH SERVICE

The Harris Trust and Savings Bank, Chicago, Ill, has developed the EPOCH savings and mortgage loan accounting service for savings and loan associations in Illinois, Wisconsin, Indiana and Michigan.

The Harris service will use a Univac 418 computer in the bank's quarters in downtown Chicago, connected to Bunker-Ramo teller window machines in savings and loan firms throughout the midwest. All transactions will be processed instantly, and each savings and loan association teller will, in effect, be hooked to her own computer storing as much information as needed by the savings and loan institution.

The EPOCH service will provide general management and specific account information, supplying each savings and loan association with as many as 19 different savings and 18 different mortgage loan reports. All such information from the computer will move over telephone wires to be printed in the savings and loan's office.

Several Chicago area savings and loan associations are in the final phases of contracting for the Harris EPOCH service, which will be operational later this year. Harris is the only banking institution in the Chicago area presently offering an on-line service to other financial institutions.

IBM ESTABLISHES CENTER TO AID SYSTEM/360 MODEL 20 CUSTOMERS

IBM Corporation, New York, N.Y., has added another dimension to its package of customer services by opening an installation center that provides technical help to customers who have ordered the System/360 Model 20. The new facility, located at IBM's Time/Life Datacenter, is the first one of at least 17 such centers that are scheduled for opening this year.

The center houses the first Model 20 for use by customers in testing and debugging programs. It is manned by four to five systems engineers who are Model 20 experts. Their job is to counsel and help customers write, test and debug programs. Customers also will have immediate access to the computer.

There is no charge to customers for use of the center of for the technical help offered. The Model 20 machine time is charged against the normal testing allotment stipulated in the sales contract.

EDUCATION NEWS

ADP MANAGEMENT TRAINING CENTER

To prepare thousands of Federal managers to make the most of the computer's promise and potential for more efficient and economical Government operations, the Civil Service Commission is establishing a new ADP Management Training Center, CSC Chairman John W. Macy, Jr., recently announced.

The new training operation designed to help managers and key officials to better understand and more effectively use automatic data processing in solving management problems and as an aid to decision making will operate under the Commission's Office of Career Development. It will be directed by Joseph W. Lowell, Jr., who has been directing interagency management science training programs.

Initially, the Center will offer 30 different training programs concerned with management application of ADP as well as career skills in the field. Course listings and schedules are included in a brochure CSC is distributing to agencies.

CUE TO PRESENT FOUR ADVANCED SEMINARS

Computer Usage Education, Inc. (CUE) will present four advanced seminars for the computing profession in March. While notice was not received in time for inclusion in the February issue, it still will be of interest to some of our readers.

The CUE seminar, "IBM System/360 Software: Plans and Prospects," will be presented at the International Hotel in Los Angeles on March 1-3. The meeting will provide an overview and a critique of the programming systems that IBM is supplying for the System/360.

"Data Communications" will be held in San Francisco on March 8-10 at the Jack Tar Hotel. This seminar is designed to cover the field of data communications in terms of currently available equipment and applications.

On March 14-16 in New York, the CUE seminar, "Information Retrieval: Today and Tomorrow," will be given at the Barbizon-Plaza Hotel. It will review current retrieval techniques and examine new areas of research effort.

A CUE seminar on "Time-Sharing" will be given in New York on March 22-24 at the Barbizon-Plaza Hotel. Intended for managers and key technical people, it will review time-sharing concepts and survey current and planned time-sharing systems.

Each of the CUE seminars includes a visit to an installation currently operating in the area covered. The registration fee for each three-day meeting, including luncheons, is $195. The cost of registrant hotel rooms is not included.

For more information, contact Charles E. Brunn, 51 Madison Ave., New York, N.Y. 10010

RCA INSTITUTES SCHEDULES FIVE-DAY SEMINAR ON DIGITAL ELECTRONICS

A five-day seminar on digital electronics will be held in New York by RCA Institutes, Inc., March 28 through April 1, 1966.

Bradford Daggett, Director, RCA Institutes' School of Custom Educational Programs, said the seminar is designed for engineers faced with challenging new areas of solid-state digital circuits. He explained that participants will be given practical, up-to-date procedures for designing standard logic packages, plus methods utilizing available circuits.

Mr. Daggett pointed out that the minimum registration requirements are a Bachelor of Science degree, or the equivalent, in electrical (electronics) engineering or in physics.

NEW PRODUCTS

Digital

SCM OFFERS NEW SYSTEM

A new solid state system, designated Typetronic 7816/330, has been developed by SCM Corporation, New York, N.Y. The new device combines Source Data Automation equipment plus a general purpose computer in one system. Source Data Automation is simply the automatic production of an original business document at the time the transaction is initiated.

The new Typetronic 7816/330 system has a simple plug-in component that increases the capacity and flexibility of the system. This component, Typetronic 330, is a solid-state magnetic tape memory device with the ability to store, read, write and update alpha-numeric data as well as program and control codes. The 330 component also offers the character-by-character punching and reading advantages of paper tape plus the simplicity and speed of magnetic tape. It derives its designation from the fact that it has a search capacity of better than 330 characters per second on a continuous magnetic loop.

This economical, small scale data processing system has been designed primarily for the small businesses which have been unable to avail themselves of the large scale computer automation attainable by big business. Typetronic 7816/330 sells for $19,500. (For more information, designate #42 on the Readers Service Card.)

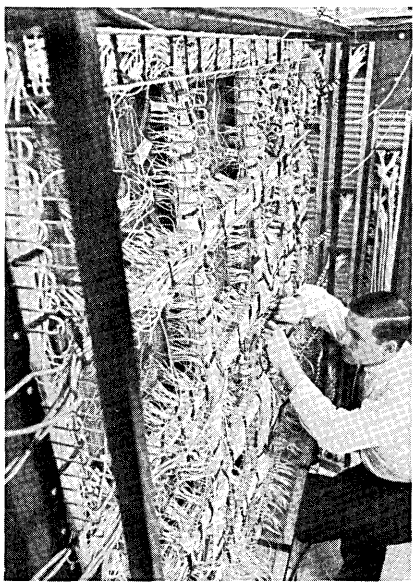
IBM SYSTEM/360 'SUPER COMPUTERS'

IBM Corporation, White Plains, N.Y., has announced plans to install six "super computers" in 1967 and one a month beginning in January, 1968. In their particular areas of application, the ultra-high performance computers — known as the IBM System/360 Model 90 series — have internal processing speeds up to 12 times faster than the next most powerful System/360 model and up to 100 times faster than the IBM 7090. The immense computing power of the Model 90 series — operating at a rate of up to eight million addition or five million multiplications in one second — is designed to solve problems in such highly sophisticated areas as space exploration, subatomic physics, theoretical astronomy and global weather forecasting.

Key technological advances in the Model 90 series include:

— Faster Memory Operations: Improved techniques for overlapping memory-access operations permit the computer to read at an effective rate of one character of information or two decimal digits in as little as eight nanoseconds (billionths of a second) — a rate up to three times faster than the next most powerful System/360 model.

— Ultra-High-Speed Circuits: Circuits more than twice as fast as those in current System/360 models



— This electronic arithmetic unit is part of a "super computer" now being built at IBM's Poughkeepsie (N.Y.) plant.

will enable the computer to add two 16-digit numbers in as little as 210 nanoseconds — a rate of more than eight million additions a second.

— Simultaneous Operations: Parallel operating techniques will allow the computer to execute many instructions simultaneously, improving significantly the system's ability to process complex problems involving millions of individual steps. For example, with parallel operations, the computer will execute up to twice as many additions — at rate of 16 million a second.

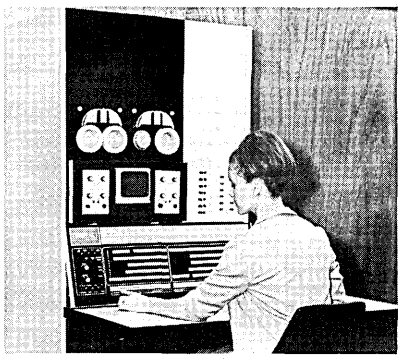
The Model 90 series systems are being proposed by IBM when the customer's particular applications require the system's extremely high internal computing performance. A typical system, including peripheral equipment, will cost about $6 million.
(For more information, designate #43 on the Readers Service Card.)

TWO-IN-ONE LABORATORY COMPUTING SYSTEM OFFERED BY DIGITAL

A two-in-one laboratory computing system combining the basic system concepts and operating simplicity of the LINC with the speed and memory advantages and the variety of peripheral devices available with the PDP-8 has been announced by Digital Equipment Corporation, Maynard, Mass. Digital's new system is the LINC-EIGHT, designed to control experiments and collect and analyze data in biomedical and enviornment science research. LINC-EIGHT combines the best equipment features of the two earlier computers and lets the user choose between the two programming systems available.

The LINC-EIGHT uses the field-proven LINC software, designed to let the researcher write his own operating programs after a minimum of instruction. It also uses the PDP-8 programming system, which includes a sophisticated FORTRAN as well as aids written for the beginning user. Because so many of the earlier computers are in use (43 LINCs, 125 PDP-8s) large libraries of operating programs have been built up and are available to LINC-EIGHT users through DECUS (Digital Equipment Corporation Users Society).

The new system includes the multiplexed analog-to-digital inputs and relay register output provisions of the LINC, plus its dual digital LINCtape transports and integral alphanumeric oscilloscope display. The LINC-EIGHT in-



— Digital's new LINC-EIGHT

corporates the PDP-8's 1.5-microsecond memory ranging in capacity from the basic 4096 words to a maximum of 32,768. LINC-EIGHT also utilizes the PDP-8's bus concept for additional input/output convenience.

To familiarize purchases with the new system, Digital offers four courses in programming and maintaining the LINC-EIGHT and the PDP-8.
(For more information, designate #44 on the Readers Service Card.)

Memories

NEW STORAGE MEMORY FOR FOUR MODELS OF IBM SYSTEM/360

IBM Corporation, White Plains, N.Y., has announced a new magnetic-drum storage device, the IBM 2303, for System/360. The device stores nearly five times as much data and delivers it at twice the rate of the earlier IBM 7320 drum used with the system.

The new drum storage unit replaces the IBM 7320 in Models 40, 50, 65 and 75 of the System/360 — at a cost increase of only 16 per cent, including attachment to the system. The 2303 also replaces the IBM 2301 drum in Model 50 of System/360.

The new memory can store almost four-million bytes (a byte is one character or two digits) of information, find any of this data in 8.6 thousandths of a second and transfer it to the computer's main memory at a rate of 312,000 bytes a second.

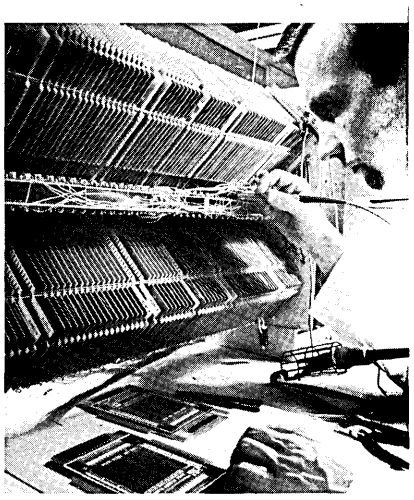
A major use of the 2303 will be to store IBM-developed programs which control and operate System/360. The new drum also will provide rapid access to indexes, tables and other frequently used programs and data.
(For more information, designate #45 on the Readers Service Card.)

TOKO'S HIGH-SPEED PLATED-WIRE MEMORY

General Precision's Librascope Group, Glendale, Calif., will manufacture and market Toko, Inc.'s (Tokyo, Japan) high-speed, plated-wire computer memory, under a new licensing agreement (see Organization News). Initial applications of the memory are expected to be in aerospace and military systems that require light weight, high speed, low-power consumption, and high reliability.

D. W. Smith, General Precision president, said, "Because of these characteristics and because the device can be machine-produced at a low cost, the plated-wire memory has an excellent chance of becoming the main memory of the next generation of commercial computers now on manufacturers drawing boards."

The plated-wire memory consists of an array of copper wires plated with a thin film of magnetic material and interwoven with insu-



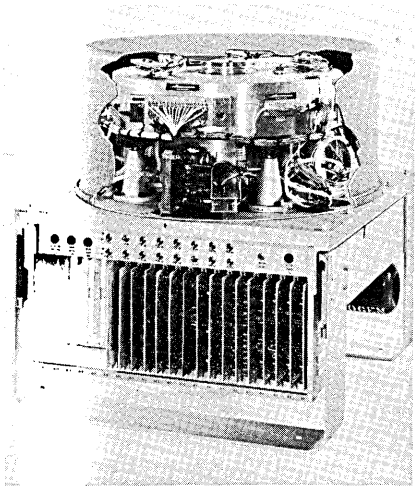
lated selection wires into a high-density mesh. The intersections of the wires form bits that store large amounts of information in extremely small areas.
(For more information, designate #46 on the Readers Service Card.)

DISC-DRUM MEMORIES, SERIES 7300

Digital Development Corp., San Diego, Calif., has announced a new series of disc-drum memories designed to improve the efficiency of mass storage and random-access computer applications. The new design, designated Series 7300, combines the high storage capacity of magnetic discs with the speed and reliability of magnetic drums. Volumetric efficiency of the unit's discs, for example, allows maximum data density in a package less than 25% of conventional drum size and weight.

Capacity of first memories in the DDC 7300 line are rated at up to 10.24 million bits with an average access time of 8.5 milliseconds. Higher capacity units will be announced in the near future.

Modular design of the compact devices facilitates selection according to individual system requirements. The self-contained package of the 7300 includes all-



silicon electronic circuitry for reading, writing, track selection and generation of timing signals. The multiple discs and heads of all units are interchangeable and system capacity may be expanded as needed.
(For more information, designate #47 on the Readers Service Card.)

Software

NEW CONCEPT FOR CALCULATING STATE AND FEDERAL WITHHOLDING TAXES

One of the most complicated and expensive aspects of a computerized payroll operation is the calculation of federal and state withholding taxes. There are 70 different state and federal payroll withholding tax formulas. The Federal Government, Puerto Rico, District of Columbia, and 32 states have two different formulas each: one formula for regular wages, and one formula for supplemental wages. (Eighteen states do not require employers to withhold taxes as of this time.)

Management Information Service, of Stony Point, N.Y., has developed a new concept for calculating state and federal withholding taxes. The requirements for calculating all state and federal withholding taxes have been incorporated into one standard computer formula which can be used in virtually any computer. It is readily adjustable to accommodate all withholding formula changes. The company reports that use of the one standard formula will substantially reduce both programming costs and computer running time. (For more information, designate #48 on the Readers Service Card.)

IBM SYSTEM/360 SCIENTIFIC SUBROUTINE PACKAGE (SSP/360)

Techniques for solving thousands of complex mathematical problems that occur repetitively in science and industry are now available in a new computer program from IBM Corporation, White Plains, N.Y. The program, written for System/360, is a single package of 122 different problem solving segments, the largest of its kind ever assembled for use on a computer.

Called the IBM System/360 Scientific Subroutine Package (SSP/360), the program is a ready-made library of problem-solving techniques — or subroutines — that frees engineers and scientists from having to program computers to handle each individual problem. Essentially, the program provides the computer in advance with the means to solve a wide range of problems. The computer needs only data to provide answers.

With SSP/360, problem solving becomes a simplified four-step operation: The user — through his program — 1) selects one or more subroutines from storage in tape, disk or cards; 2) provides numerical values for the problem; 3) establishes limitations; and 4) instructs the computer what to do with the answer. The answer can be a numerical value for the next problem or can be printed out in matrix, graph or other form.

The Scientific Subroutine Program is available to IBM customers without charge. It is distributed and maintained by IBM's computer program library at Hawthorne, New York.
(For more information, designate #49 on the Readers Service Card.)

Data Transmitters and A/D Converters

THE KROME SYSTEM

A new off-line magnetic entry system for the low-cost, high-speed conversion of punch tags to magnetic tape has been developed by Litton Industries' Kimball Systems division, Belleville, N.J. The new system, called KROME, eliminates punch cards, speeds computer input to 18,000 tags per minute, and has a reel capacity which accommodates up to 120,000 punch-marked tags.

KROME consists of a Kimball off-line incremental tape transport connected to the Kimball KRC tag reader. The system will convert tags to magnetic tape at the rate of 200 per minute. Automatic tape positioning when loading, automatic playback, and automatic tape rewind provide operating safeguards. Additional features include a manual entry device and an automatic machine stop at end of tape.

The system provides for tape density of 200 characters per inch, while a higher tape density of 556 characters per inch is available at additional cost.
(For more information, designate #50 on the Readers Service Card.)

ADF 5 TAPE FORMATTING SYSTEM

Pastoriza Electronics, Inc. (Newton Upper Falls, Mass.) has added a new product to their line of Analog-to-Digital Data Systems. The ADF 5 Tape Formatting system is a general purpose digital tape formatter which has both Binary and BCD coding formats. The device may be switched from one mode to the other by a front panel control. ADF 5 is used for formatting analog measurements into IBM compatible magnetic tape for use in computers using either Binary or BCD formats.

In addition to both Binary and BCD coding formats, ADF 5 includes: manual data insertion; variable sample rates (1, 2, 5, 10, 20, 50, 100, 200, samples per second); variable record lengths (up to 16384 words are available); preset record counter (record counts of up to 256 are available); display of Binary and BCD outputs; and IBM compatible format. The ADF 5, generally used with a multiplexer input, drives an incremental tape recorder. Multiplexer, Formatter and Recorder are generally sold as a system.

Used to collect bulk data for computer reduction and analysis, typical applications are in fields such as Medicine, Geophysics, Meteorology, Structural Dynamics, and Oceanography.
(For more information, designate #51 on the Readers Service Card.)

NEW DATA LINE TERMINAL FOR 1004

A new high speed data communications device has been announced by Sperry Rand Corporation's UNIVAC Division. The UNIVAC Data Line Terminal (Type 1B), which is available as an optional addition to the UNIVAC 1004 or 1005 Processors, enables 1004s to communicate via American Telephone and Telegraph's Type 301B Data Sets and Telpak facilities at a rate of 40,800 bits per second. Similar data transmission speeds also can be achieved between the 1004 and any other compatible equipment equipped for this type of data communication.

The device also can be modified for operation of two data sets. This feature permits programmed selection of one modem (301B) for high speed transmission or another modem (201A or 201B) for medium speed transmission.

The DLT-1B can be field installed on existing 1004s and deliveries of the first systems have begun.
(For more information, designate #52 on the Readers Service Card.)

Numerical Control

MCG — MAN-COMPUTER GRAPHICS

Dr. J. F. Sutton, director of research, Lockheed-Georgia Company, has announced that for the first time in the aerospace industry, Lockheed-Georgia (Marietta, Ga.) is manufacturing airplane parts through the use of a new technology called MCG — Man-Computer Graphics. This is a new concept which ties together more closely the designer, the computer and the machine that produces the part.

The man sits at a computer console and communicates directly with the computer through a "display scope". The man draws the part itself, and guides the path which the machine tool-cutter should take, directly on the display. Precise dimensions are input numerically. The computer automatically prepares a tape. This tape is used to control the machine that cuts out the part. If an error should occur while the drawing is being made, the man at the computer console can make immediate corrections.

This new Lockheed-Georgia system completely bypasses the cumbersome APT (Automatically Programmed Tools) or other symbolic computer languages which have been used. Thus, the time needed to derive the tape is reduced by a factor of ten, and the probability of error in the tape is greatly reduced. This advance in technology will be employed in the Georgia aerospace firm's work on the Air Force's giant C-5A transport.

RE-DESIGNED BUNKER-RAMO 3000 USES INTEGRATED CIRCUITS

Extensive improvements in the 3000 model numerical contouring control — including the first use of integrated circuits in a standard production-line N/C system by a major supplier — is announced by Bunker-Ramo Corporation, Canoga Park, Calif. Use of integrated circuits in the new design has substantially reduced the number of modules required — in a typical 3-axis system, for example, the reduction is from 96 modules to 55.

Other design improvements in the new 3000 control include: a touchtone type keyboard to increase the speed and convenience of manual data input; a revised word address panel and a revised character counter for easier operation; an automatic test light to indicate that the unit is back to zero electronically with satisfactory completion of each part; automatic acceleration and deceleration for rapid traverse moves; improvements in the servo system; and a number of mechanical changes, including an integral air conditioner.

All the standard features of the previous 3000 system are retained in the new model. This includes the data display lights and manual data input, the functional circuit design which centralizes all the circuits involved with one function on a single module board, buffer storage, sequence number readout, full floating zero, zero reset, manual feedrate override, slidehold, and the photoelectric reader.

The interpolator of the new design operates in 8-4-2-1 coding, which the data lights display to operator and maintenance man at all times. Programming for the new system as well as its operation are completley compatible with the previous Bunker-Ramo designs and all existing tapes for these units are usable without alteration on the new system.
(For more information, designate #53 on the Readers Service Card.)

Input-Output

MACHINE FOR MANUFACTURE OF DATA CARDS

A new machine for the manufacture of tabulating cards and card sets, with or without stubs, now is available from Bobst Champlain, Inc., Roseland, N.J. In a single pass, this machine (designated as the Model CNP-66) performs the basic operations of counting, numbering, and punching tabulating cards or card sets used in IBM and other processing systems.

Production speed varies according to size of card and the type and number of operations performed, up to a maximum speed of 350 cards per minute, or 700 cards per minute with optionally available accessories. Among the operations that can be performed in the CNP-66 are pre-punching and numbering of tabulating cards, repetitively or consecutively, up to nine digits. Other operations include diagonal and round corner cutting, cross-perforating, cut- and die-scoring, MICR-encoding, imprinting, fold creasing, and the delivery of cards or card sets in stacks of predetermined quantities.

The machine consists of a card-infeed unit, a card-transfer chain feed, six fabricating stations, and a dual-delivery unit. All components are easily accessible for adjustment and change-over. Operations are entirely automatic: the operator only has to load the infeed hopper, remove and inspect finished cards, and make periodic operational adjustments. Operating speed is controlled from either end of the machine.
(For more information, designate #54 on the Readers Service Card.)

PERFORATED TAPE HANDLER, MODEL 6011

A new, low-cost unidirectional perforated tape handler has been developed by Digitronics Corporation, Albertson, N.Y. The new device, Model 6011, handles 5, 6, 7 and 8-level paper tape, paper mylar laminated or mylar tape of 11/16ths, 7/8ths or 1-inch widths, interchangeably. No adjustments are required when changing from one tape width to another.

The tape handler, with 4-inch reels, spools up to 300 feet of 2.5 mil tape or 175 feet of 4.5 mil tape at speeds up to 300 characters (30 inches) per second. Speed of rewind is 400 characters (40 inches) per second. Model 6011 is designed to function with Digitronics Model 2500 photoelectric perforated tape reader.
(For more information, designate #56 on the Readers Service Card.)

DIGITAL STRIP PRINTER

A low-cost digital strip printer has been developed by Franklin Electronics, Inc., Division of Anelex Corp., Bridgeport, Pa.

The Franklin Model 120, operating at 20 characters per second, provides a full compliment of 63 characters including the alphabet, the numerals 0 through 9, punctuation marks, and various signs and symbols. Printout is produced in a single line (much like a ticker-tape printout) on 1/2 inch wide paper tape.

Operation is for 105-125 V ac. Character printing requires a 26 V pulse of 1.3 milliseconds duration and a peak power of 3.5 A. Character pulses are provided by a reluctance pickup. The absence of a pulse, signals the beginning of the character train. Overall dimensions are 3" x 6-1/4" x 8-5/8".
(For more information, designate #55 on the Readers Service Card.)

REMEX MODEL TAPE SPOOLER FOR UNIVAC® 1004 PROCESSOR

A new model high speed tape spooler to operate in combination with the UNIVAC® 1004 Processor has been announced by Dr. William C. Leone, vice president and general manager of Ex-Cell-O division, REMEX/Rheem Electronics, Hawthorne, Calif. The model RCS-502 was designed and built specifically for high speed tape operation under computer control.

These devices include self-adjusting electromagnetic brakes, electronic noise suppression, soft-take-up that ensures against breaking even the most fragile paper tapes, sensing of broken tape and no-tape, and bidirectional high speed (200 inches/second) rewind.

The REMEX Model RCS-502 spooler system is completely self-contained and is easily adaptable to most digital computer systems.
(For more information, designate #57 on the Readers Service Card.)

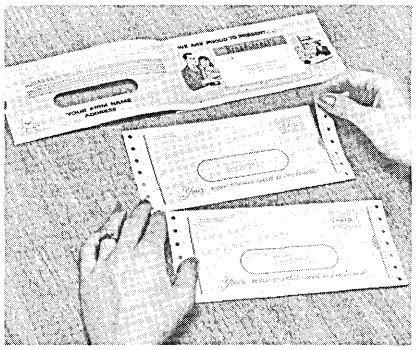
PUNCHED TAPE READERS BY CHALCO ENGINEERING

The new 5100-series photoelectric line or block punched tape readers, developed by Chalco Engineering Corp., Gardena, Calif., are available for immediate delivery. They have an operating speed up to 150 characters per second, asynchronously and 500 cps, synchronously. Reader includes an electronic lamp-output servo to eliminate amplifier adjustments. Panel height is 3½". They are used in data processing machines, numerical control systems and automatic test equipment.
(For more information, designate #58 on the Readers Service Card.)

2B SYSTEM PERMITS PLASTIC CARD ADDRESSING BY COMPUTER-PRINTER

A new technique has been developed which permits wallet-size plastic cards to be addressed by a computer-printer. The technique, introduced by 2B System Corporation, Madison Heights, Mich., and manufactured to their specifications by IBM Corporation, incorporates the economies of high speed computer addressing with the elimination of all the hand work previously involved in plastic card distribution. The new system was especially designed for those firms whose mail lists are computer stored.

Plastic cards are delivered already machine-applied to a two-leaf continuous form which also serves as a combination self-mailer and lithographed presentation piece. Machinery was developed by which the plastic cards could be mounted on continuous-form stock at high speed. A special adhesive was compounded that would function at the required speed, hold the card firmly, yet not tear the presentation piece when the card is removed.

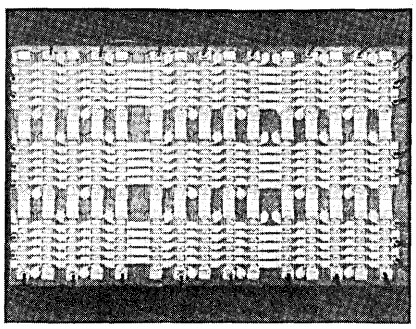


Preparation of the plastic cards and artwork for the combination self-mailer presentation piece is done at 2B's Madison Heights plant. From there the cards and the art are shipped to an IBM Corporation plant where the finished pieces are manufactured, packed 2500 units to a box, and sent directly to the customer, ready for the computer-imprinting of the names and addresses. When addressing is complete, the continuous forms are burst apart into individual units and placed in the mail.
(For more information, designate #70 on the Readers Service Card.)

Components

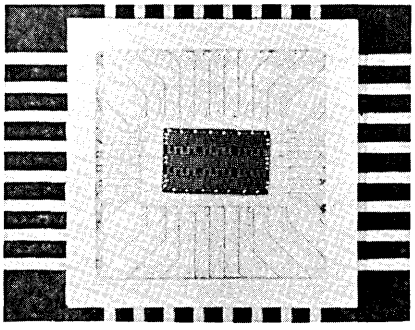
NEW 15 x 15 DIODE MATRIX

In a new 15 x 15 diode matrix developed by Radiation Inc., Melbourne, Fla., 225 passivated silicon diodes, fabricated using dielectrically isolated moats, are arranged in rows and columns (photo A).



(A)

The new product, packaged in a specially designed 32-lead flat pack (photo B), can be customized using novel interconnect "blow-out" process. The Model RM-50, suited for applications in coding, decoding, addressing and steering, can be employed in lieu of discrete components without adding to system costs.



(B)

Typical performance characterstics are: Forward Current, 100mA; Reverse Leakage 4nA @ 25V; Reverse Recovery Time 10 nsec; and Reverse Breakdown 60V.
(For more information, designate #59 on the Readers Service Card.)

FERRANTI MICRONOR II

Ferranti Ltd. of Britain has announced a new series of silicon integrated circuits — Micronor II. Since 1960 when work on these semiconductor networks commenced, the firm has introduced over 100 different Micronor I and Microlin circuits. The Micronor range is intended for high speed logic circuitry such as high speed computers, and the Microlin range is intended for linear applications.

The new Micronor II are monolithic DTL (Diode Transistor Logic) circuits which offer very high noise immunity, ultra high switching speed, large fan out and wide application. A typical circuit may contain up to 60 discrete components and is available in 8 Lead TO-5 and the standard 14 Lead flat pack encapsulations.
(For more information, designate #60 on the Readers Service Card.)

EXPERIMENTAL MNS TRANSISTORS

Scientists at Sperry Rand Research Center, Sudbury, Mass., working on improvements in semiconductor technology have successfully applied a new insulating material to silicon, which they say promises a greater production yield of more electrically stable diodes, transistors and integrated circuits.

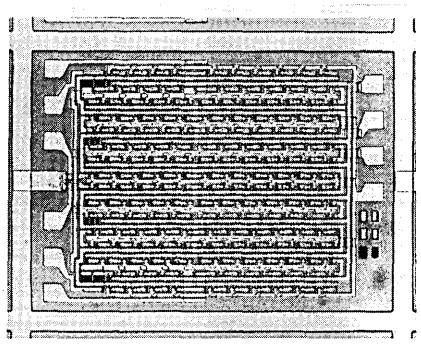
The use of silicon nitride in place of silicon oxide as a mask against diffusion, as a passivating layer over p-n junctions and as the insulating dielectric in silicon semiconductor devices and integrated circuits could be the most important advance in the industry since the planar-epitaxial breakthroughs of 1960-61, according to company officials.

Experimental metal nitride semiconductor (MNS) insulated-gate field-effect transistors fabricated and tested at the Sperry Rand Research Center have shown marked improvements in device stability, lower threshold voltage and higher voltage-handling capability over metal oxide semiconductor (MOS) devices, Dr. Roger Newman, manager of solids state sciences at the Center, said. Sperry Vice Pres. Richard S. Mandelkorn, general manager of the Sperry Semiconductor Div., Norwalk, Conn., whose engineers are working closely with the research scientists, said that the silicon nitride devices will be in the Division's product line within a year.

NEWEST MOS MICROCIRCUITS

A new group of 15 MOS (metal-oxide silicon) microelectronic circuits became available for off-the-shelf delivery last January from the Microelectronics Division of General Instrument Corporation. This new group of microcircuits, developed and produced by the Microelectronics Division, marks the second major expansion in four months of General Instrument's MOS microelectronic product "family", which now includes more than 35 standard devices.

The new microcircuits sharply reduce both the number of devices needed in any given system and the work of interconnecting all the circuits, which must be done by the equipment manufacturer. In a typical small computer system, only 23 of the MOS microcircuits replace 560 conventional microelectronic circuits, and interconnections are reduced more than 10-fold, according to the announcement.



— New 90-Bit shift register (MEM-4090) contains 542 MOS transistors on silicon chip only 58 mils by 80 mils.

New General Instrument production techniques, the announcement continued, "have increased the complexity and number of 'components' that can be included in an MOS microcircuit from 10,000 per square inch of silicon a year ago to 120,000 today."
(For more information, designate #61 on the Readers Service Card.)

AUTOMATION

HAWKER SIDDELEY TRIDENT COMPLETES OVER 1000 AUTOMATIC TOUCHDOWNS

More than 1000 automatic touchdowns now have been completed by the Hawker Siddeley Trident autoland development aircraft operating from the company's Hatfield, England, plant with Smiths Industries Limited Aviation Division equipment. Nearly half of these have been "autolands" — the term applied

when all aspects of the approach and landing are controlled automatically. The remainder have been "autoflares", in which the touchdown is automatic, though the pilot aligns the aircraft with the runway.

An important step towards the ultimate goal of blind landing was taken on November 18 when the development Trident carried out its first fully triplexed automatic landing with all three autopilots in parallel controlling the tailplane and ailerons, in conjunction with automatic control of rudder and throttles. This arrangement provides continued automatic control in the event of any equipment malfunction. Safe operation in conditions when the pilot cannot see the runway clearly enough to take over can only be achieved in this way.

When the aircraft operates at duplex level the pilot effectively takes the place of the third autopilot. If there is a malfunction in either of the two systems both cut out simultaneously, leaving the aircraft controls in trim ready for the pilot to complete the landing. This means that a landing using the duplex system can be made only as long as the pilot can see at least one-quarter mile ahead. Permissible landing limits are unlikely to be reduced much below this when reliance has to be placed on the pilot to take action in the event of a malfunction.

With the triplex system, if a failure occurs in one of the three autopilots, the remaining two autopilots outvote and disengage the defective system. Operating at duplex level, the system will land the aircraft without action being required of the pilot. The complete control and guidance system is destined to produce a reliability rate many times greater than that achieved by a human pilot in these conditions and will eventually allow landings to be made in fog when the pilot can see only to taxi. Automatic landings will make a considerable contribution to the safety of air travel as it will make landings and approaches consistently accurate, according to Hawker Siddeley.

The first fare-paying passengers touched down automatically at London Airport in a BEA Trident on June 10, 1965, and British European Airways is now operating twelve Tridents fitted with duplex equipment.

BUSINESS NEWS

CONTROL DATA EARNINGS DECLINE

Control Data reports that for the six months period ended Dec. 31, 1965, sales, rental, and service income amounted to $73,704,858 as compared with $78,006,402 for the same period of the previous year. Operations for the six months ended Dec. 31, 1965 resulted in net earnings of $106,241, compared with earnings of $4,198,653 for the same period last year, 1964.

Control Data's President W. C. Norris said that performance for the first six months was below that indicated at the Stockholders Meeting in September, 1965. He said that first six months performance reflected a continuation of effects of competition and a number of technical problems, and the shift of incoming business toward leases rather than outright sales.

Norris said that "it is taking longer and has been more costly than expected to solve the problems, or to make necessary adjustments where the entire solutions are not fully under our control." He added, however, that there has been substantial progress and that the Company is expecting the second half will show improvement over the first half, and a small profit for the total year.

Although revenues for the latest six months period were down, Norris said that orders continued at a good rate. The backlog, he said, increased 30% over December 31, 1964. He added that the major increase in the amount of backlog was in lease contracts which at this time comprise approximately 65% of the backlog.

IBM SALES REACH RECORD HIGH

Records for both gross income and earnings for 1965 were set by IBM, the company announced.

IBM's worldwide consolidated gross income for calendar 1965 was $3,572,824,719, an increase of $333,465,138 or 10.3 percent over 1964. This includes gross income from foreign operations of $1,085,505,571. Worldwide consolidated net earnings after taxes for 1965 amounted to $476,902,490. This compares with net earnings after taxes for 1964 of $431,159,766. Earnings from foreign operations, included in the consolidated results, were $144,026,330 in 1965 an increase of $20,027,432 over 1964.

HONEYWELL SHIPS COMPUTERS WORTH OVER $175 MILLION IN '65

Honeywell Inc. reports record sales for 1965 and the second highest earnings in the company's history.

Worldwide sales for the year increased about 5 per cent to $700,357,000, as against $667,193,000 in 1964. Indicated earnings for the year ended Dec. 31 were $37,500,000, down approximately 9 per cent from the previous year.

Indicated fourth quarter earnings were $11,752,000, compared to $14,871,000 in the comparable period last year. Fourth quarter sales increased to $204,291,000, as against $188,041,000 in the same quarter in 1964.

James H. Binger, board chairman of the automation systems company, said sales increased in most areas of the business. He cited, in particular, continuing growth in his firm's EDP Division, and disclosed that shipments of Honeywell EDP equipment exceeded $175 million in sales value during '65. Rental revenues increased 90 per cent from the year before.

Binger added that earnings were unfavorably affected by "the effect of a high percentage of data processing equipment installations on a rental basis as opposed to outright sales" among other factors.

FABRI-TEK SALES UP, EARNINGS DOWN

Fabri-Tek, Inc. reached sales of $16,976,267 for the nine month period ending Dec. 31, 1965, compared to $10,724,269 for the same 1964 period. Net income after taxes was $1,236,072, down from $1, 243,502 earned for the same period last year.

(Continued from page 19)

Also, IBM has pioneered in the development of computer-based instruction (or Computer-Assisted Instruction), where active use of the computer by the trainee enables the trainee to learn from the computer's responses. This computer is in Poughkeepsie and terminal sets (interactive consoles) are located at some 50 locations throughout the United States.

All in all, the IBM educational program is a remarkably fine example of a manufacturer taking a broad and forward-looking viewpoint and accepting a broad responsibility for education in the field of computers and data processing.

Disadvantages and Shortcomings

Perhaps the most conspicuous shortcoming of the IBM education program is that it is offered only to IBM staff and IBM customers. These courses are not offered to the general public on any basis, but exceptions occur in the IBM World Trade Corporation. In Spain and Sweden, IBM offers data processing training to the public on a fee-paid basis. Why the citizens of Spain and Sweden should be so treated and the citizens of the United States not so treated is an unanswered question.

Another fundamental shortcoming of the IBM education program is that it is centered on IBM equipment and IBM software, so that a general and unbiased view of equipment and software from all manufacturers and suppliers is difficult to obtain. For example, many important developments in computer programming languages, such as ALGOL, JOVIAL, and LISP, have originated outside IBM and are not covered in IBM training.

In addition, education in the subject of systems analysis and systems engineering, with a view to the optimal use of data processing, is relatively lacking. The courses which IBM offers in this area are not sufficiently penetrating nor are they offered often enough, considering the immense demand for this knowledge, to make really good use of computers and data processing. Of course, this subject is rather new; also it is a very hard one to teach unless the instructor possesses specialized knowledge based on considerable practical experience. This drawback, in fact, is not specific to IBM's training, but exists all through the field of computer education, no matter who is the supplier of the training.

Recommendations for Progress

Based on this brief and incomplete survey of the largest program for computer education now in existence, it seems reasonable to make some recommendations for more rapid progress in the field of computer education:

First, courses which are developed by one manufacturer should be made available to all manufacturers, and to all interested people in the general public, on a reasonable basis (e.g., for a fee). A great labor saving will result because instructors will not have to design and develop the same course over again.

Second, colleges, schools, and universities should make a prodigious effort at this time to expand computer and data processing instruction. If hundreds of thousands of people are to be trained, the regular educational institutions should join in meeting the need for education in the computer field.

Finally, the federal government should provide instruction for all the computer systems which it uses, and this instruction should be available to the public at a reasonable cost. Just as patents produced under government contracts go into the public domain, so should instruction and education for computers, paid for with public money, be in the public domain.

(Continued from page 24)

Sunnvale, Calif. (N=75). The control group (N=39) received classroom instruction only, of 40 hours duration; Post-test Mean = 84.5%. The experimental group (N=36) received instruction solely from the self-instructional materials; Mean Completion Time = 30 hours, Mean Post-test = 91.3%. Both groups were given the identical Post-test.

22. Title: "FUNDAMENTALS OF ELECTRONIC DATA PROCESSING: A Programmed Text"
Author: Kenneth L. Inman
Publisher: Minneapolis-Honeywell Regulator Company, Electronic Data Processing Division
Date Published: 1963
Price: $4.50
Physical Form: Text; soft-covered, bound, 8½" X 11", 282 + vi pages, about 575 frames
Type or Mode: Written-completion using constructed single- and multiple-word and graphic flow chart responses. Linear.
Expendability: Written responses are made directly into the text; it is expendable.
Criterion Test: Only the first two of the seven lessons are followed by quizzes which are self-tests. There are no other tests and no post-test.
Criteria Rating: Satisfies criteria for a written-completion program.
Content/Behavioral Objectives: The Foreword states that "this manual is a basic introduction to electronic data processing intended for the reader with little or no previous training in the field. The focus throughout is on general concepts . . . the purpose is to illustrate general principles. . . ."
Evidence Rating: Publisher advises it was tried out on government employees (N=21). Trainees had no previous EDP experience; all were college graduates. It was administered in 5 sessions of 3 hours each. Work in excess of 15 hours was completed as homework. Mean Completion Time = 11 hours. Range of Time = 7 to 16 hours. An external 80-question post-test yielded a Mean Post-test Score = 91%.

Computer-Assisted Instruction (CAI)

The use of a digital computer as a teaching machine to instruct students in computer programming, in the same sense that the foregoing programmed materials do this, has been reported recently. Despite several efforts by Brown (ILLIAC). Braunfield, O'Neill, Uretsky (FORTRAN), and Valley (System/360), a CAI program for computer programmer training has not reached the level of availability required for inclusion in this year's survey (3). Little has been done on developing CAI computer programming courses since much of the early work was centered about research in human learning rather than in course development. In 1966, with the expansion of on-line, time-sharing systems, there will be greater interest in programmer training by CAI methods by computer manufacturers and those engaged in course development at universities. Perhaps, in the 1967 survey, there will be a listing of one or more CAI courses in computer programming. To be so included, a course must be available to anyone inclined to procure it.

Readers are invited to submit to the authors the names and sources of any programmed materials which are currently available and not listed in the 1965 and 1966 surveys.

REFERENCES

(1) G. M. Silvern, "Programmed Instruction for Computer Programming," *Computers and Automation,* March, 1963.

(2) G. M. Silvern, "Programmed Instruction Materials for Computer Programming — A Survey," *Computers and Automation,* March, 1965.

(3) K. L. Zinn, "Survey of Materials Prepared for Instruction or Instruction Research Via On-Line Computer Systems," *Automation Education Handbook,* November, 1965.

(Continued from page 13)

programming languages and procedures, and system program packages consisting of the requisite compilers, analysis programs, etc., need to be developed. These will facilitate the use of the system by students, teachers, course authors, researchers, and administrators for various purposes. Much, too, needs to be done to improve the language processing capabilities of CAI systems, so as to ease the communication problems and simplify the tasks of course programming.

Pedagogical Questions

Fundamental pedagogical questions need to be answered in each of the important areas of instruction:

what parts of a subject can be efficiently taught?
what instructional techniques would be effective and economic?
what administrative restructuring of traditional coursework is necessary?

Thus, an art of CAI course programming needs to be developed. This will help experts in subject disciplines who want to adapt material from traditional formats into formats appropriate to CAI.

In recent years a number of research groups have investigated the usefulness of CAI in a variety of subject areas. Some of the subject areas in which computer assistance of some kind has been explored are: computing, mathematics, physics, chemistry, foreign languages, several vocational subjects, audiology, reading, business gaming, economics, medical diagnosis, behavioral gaming, optical system design, and architectural design. In spite of the number of subjects on this list, the state of development of the field is still exploratory and preliminary.

Systems Software

The development of subject programs and of systems software are closely related. The work at IBM has been oriented towards mathematical and physical science and language skills. The machine capabilities stressed accordingly have been intended to facilitate recitation of these subjects using natural language for communication. Compilers developed for research purposes and the ready preparation of programs in these areas have contained specialized macros which:

- Recognize any of a set of fixed-form answers to a given question and respond appropriately to each.
- Evaluate moderately complex free-form responses to questions which have essentially simply answers.
- Construct specific hints based on the nature of a student's error (the author of the course does not have to anticipate the exact form of the response).
- Recognize responses involving minor errors of spelling or punctuation (the errors did not have to be anticipated).
- Vary the program tasks on the basis of statistical as well as detailed historical criteria according to general algorithms.

In the course of work at IBM and a few other research locations, a number of different CAI specialized operating systems for time sharing of particular central computers have been developed. In addition, several prototype programming languages and compiling or assembling programs for course preparation have been developed. A general understanding of both the systems engineering problems and the applications problems is beginning to emerge, although it has not yet been fully articulated.

The Present and the Future

Obviously, much development remains to be done before CAI systems will be able to take over a major part of the routine, pedestrian work of the teaching profession. On the other hand, CAI should not be regarded as a technique of the far future: we stand today at the threshold of practicability with regard to the technique. At IBM, systems performing a broad range of cost-justified instructional tasks have been postulated within the frame of reference of present technology. Features of the systems considered include audio and visual message capability, cathode ray tube displays, touch plate and light pen input, and various systems packages to facilitate use of the CAI system by student, author, and researcher.

Our work has convinced us that practical means of working with CAI could soon be made available to a much larger community than hitherto. In our opinion the broad adoption of CAI need not await hypothetical future major breakthroughs in technology. Instead, the rate of adoption will be primarily determined by the rate at which resources are applied to develop the necessary system methodologies and pedagogical techniques.

READERS' AND EDITOR'S FORUM

(Continued from page 10)

tential for a unifying thread, bringing together contributions in one journal.

It is the intent of the Editors and the Publishers to provide the biomedical research community with: a medium for publication of the results of original research involving computer techniques; a forum for interchange and criticisms of these techniques; and a central source of information in order to facilitate exchange of ideas.

Some of the areas in which papers will be published are:

Pattern Recognition
Mathematical Models
Hospital Automation
Computer-Aided Diagnosis
Instrumentation
Problem-Oriented Software

The editor-in-chief of "Computers and Biomedical Research" is Dr. Homer R. Warner, Department of Biophysics and Bioengineering, L.D.S. Hospital, Salt Lake City, Utah. The members of the editorial board are: G. Octo Barnett, Massachusetts General Hospital; Jerome R. Cox, Jr., Washington University School of Medicine; George Dantzig, University of California, Berkeley; W. J. Dixon, U.C.L.A. Medical Center; Alston Householder, Oak Ridge Laboratories, A.E.C.; Josiah Macy, Jr., Yeshiva University; Paul Meier, University of Chicago College of Medicine; Hubert Pipberger, V.A. Hospital, Washington, D.C.; Arnold W. Pratt, National Institutes of Health; Antoine G. Remond, La Sal de Priere; Otto Schmitt, University of Minnesota; Ralph Stacy, University of North Carolina Hospital; A. Tybjaerg-Hansen, University of Copenhagen; Max A. Woodbury, New York University School of Medicine; William S. Yamamato, University of Pennsylvania.

MARKET REPORT

(Continued from page 11)

if Control Data were to lose an appreciable part of its current share of the computer market. Control Data, realizing this, is expected to intensify its current howl about how its "major competitor in the very large computer part of the market is making a highly concentrated effort to hinder our progress..." (Quote from statement by President W. C. Norris in CDC's 1965 Annual Report).

General Electric will introduce smaller members of the 600 series (the 605? and 615?) and will step up its drive to obtain centralized management information system orders for multi-computer installations from prestige accounts.

Honeywell will realign its computer marketing effort along industry lines, emphasizing sales to manufacturing, financial, insurance and distribution firms, and local government. This will allow its software support investment to be concentrated in specific application packages for these fields.

IBM will introduce a baby brother to the Model 360/20 aimed at replacing, in measured steps, punched card tabulators and calculators. Possibly called the Model 10, the system would have a restricted memory capacity, use a Multi-Function Card Machine similar to that offered with the 360/20, and rent in the $700-$1,000 a month range.

NCR will find that its 500 series continues its popularity with banks and with businesses with $5 to $25 million in annual sales.

RCA EDP Division will continue its slow and measured growth under a corporate restriction of "no loss" operations.

Scientific Data Systems will introduce a new series of computers designed for the small- and medium-scale computer market. The new systems will offer software for both business and scientific applications. '66 is also the year that SDS becomes a factor to consider in the general-purpose computer business, upgrading the "Big 8" reference to the "Big 9."

UNIVAC introduces the first three models of a new product line of small- and medium-scale computer systems. The firm should also continue to capitalize on its lead in the real-time systems market, yielding substantial order levels for the 490 series, the 418, and the 1108.

Associate Publisher

CALENDAR OF COMING EVENTS

March 18, 1966: One-Day Symposium on the Application of Computers to the Problems of a Metropolitan Society, four New York Area chapters of the Association for Computing Machinery, Statler Hilton Hotel, New York, N. Y.; contact Noel Zakin, UNIVAC division, Sperry Rand Corporation, 1290 Avenue of the Americas, New York, N. Y. 10019

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

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

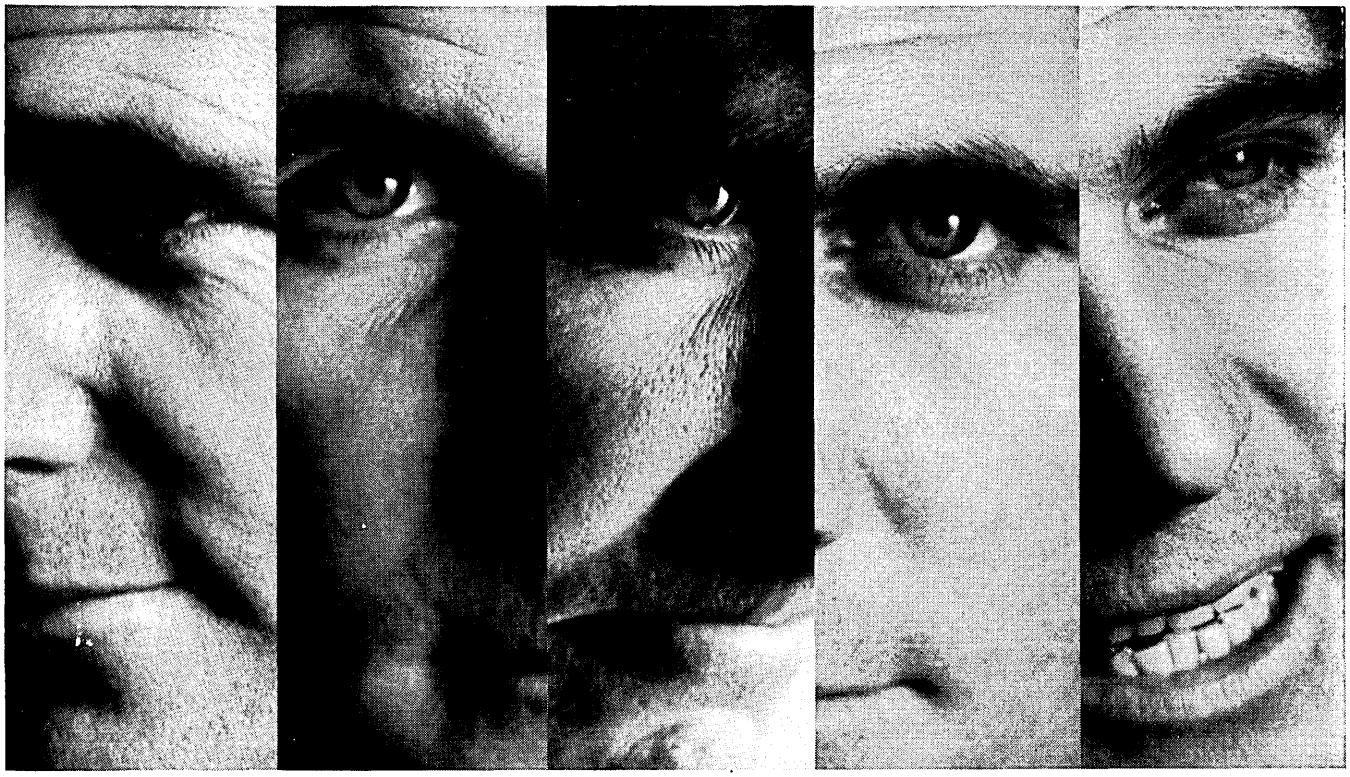
Mar. 29-31, 1966: ACM Symposium on Symbolic and Algebraic Manipulation, Sheraton-Park Hotel, Washington, D. C.; contact Miss Jean E. Sammet, IBM Corp., 545 Technology Sq. Cambridge, Mass. 02139

March 29-31, 1966: Honeywell 800/1800 Users Association, Jack Tar Harrison Hotel, Clearwater, Fla.; contact Norman P. Teich, Honeywell EDP, 60 Walnut St., Wellesley Hills, Mass. 02181

April 1-2, 1966: Conference on the Problems and Prospects of the Large-scale Public Electronic Data Processing System, Hotel Barbizon Plaza, New York, N.Y.; contact Dr. Doris Martin, Office of Special Projects and Conferences, New York University, 12 West 4th St., New York, N.Y. 10003

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

(Please turn to page 50)



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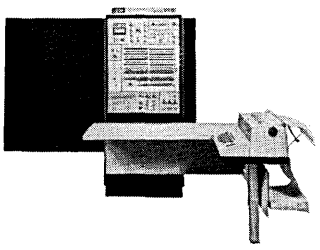

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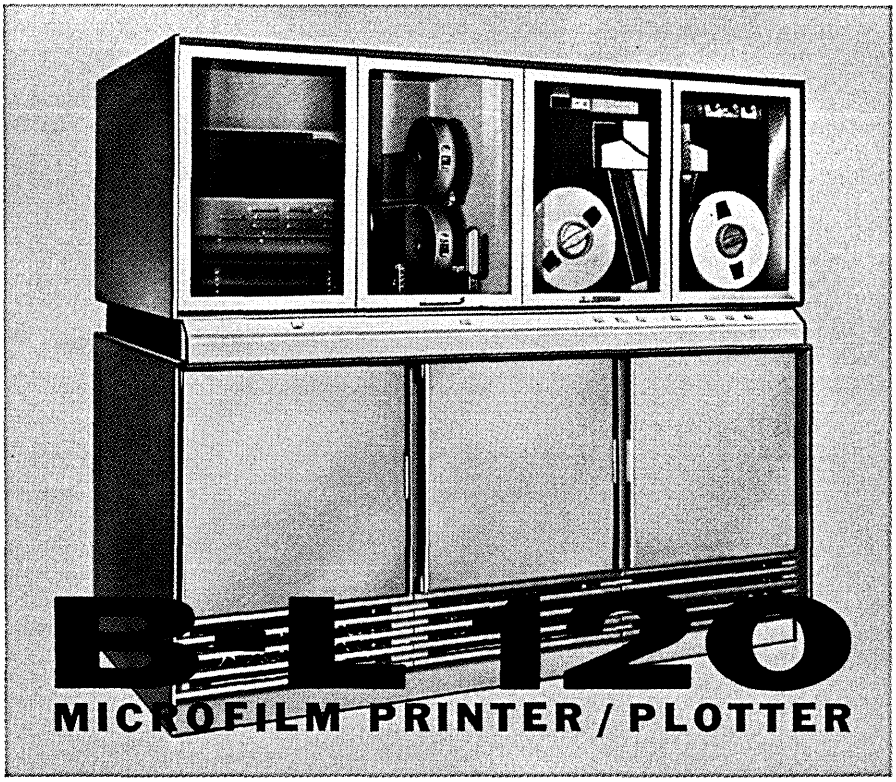

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MONTHLY COMPUTER CENSUS

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

To aid our readers in keeping up with this mushrooming activity, the editors of COMPUTERS AND AUTOMATION present this monthly report on the number of general purpose electronic computers of American-based companies which are installed or on order as of the preceding month. These figures included installations and orders outside the United States. We update this computer census monthly, so that it 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 though a continuing market survey conducted by associates of our magazine. This market research program develops a documented data file which now covers over 85% of the computer installations in the United States. A similar program is conducted for overseas installations.

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

AS OF FEBRUARY 10, 1966

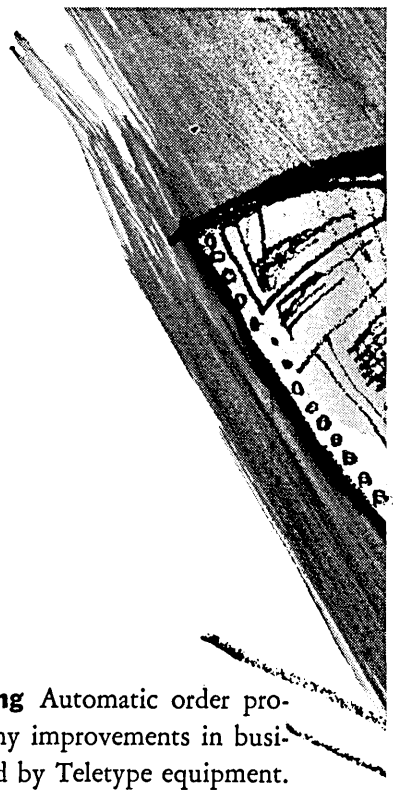
NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS
Advanced Scientific Instruments	ASI 210	Y	$2850	4/62	24	0
	ASI 2100	Y	$3000	12/63	6	1
	ADVANCE 6020	Y	$2200	4/65	5	5
	ADVANCE 6040	Y	$2800	7/65	3	6
	ADVANCE 6050	Y	$5000	10/65	0	4
	ADVANCE 6070	Y	$10,500	10/65	1	6
	ADVANCE 6080	Y	$7000	1/66	0	0
Autonetics	RECOMP II	Y	$2495	11/58	46	X
	RECOMP III	Y	$1495	6/61	10	X
Bunker-Ramo Corp.	BR-130	Y	$2000	10/61	158	5
	BR-133	Y	$2400	5/64	13	4
	BR-230	Y	$2680	8/63	15	X
	BR-300	Y	$3000	3/59	38	X
	BR-330	Y	$4000	12/60	34	X
	BR-340	Y	$7000	12/63	20	X
Burroughs	205	N	$4600	1/54	51	X
	220	N	$14,000	10/58	42	X
	E101-103	N	$875	1/56	148	X
	B100	Y	$2800	8/64	120	20
	B250	Y	$4200	11/61	95	4
	B260	Y	$3750	11/62	220	14
	B270	Y	$7000	7/62	145	13
	B280	Y	$6500	7/62	118	17
	B300	Y	$8400	7/65	64	105
	B5000/B5500	Y	$20,000	3/63	49	10
	B8500	Y	$200,000	2/67	0	1
Clary	DE-60/DE-60M	Y	$525	7/60	347	4
Computer Control Co.	DDP-24	Y	$2500	5/63	70	8
	DDP-116	Y	$900	4/65	40	45
	DDP-124	Y	$2050	2/66	0	9
	DDP-224	Y	$3300	3/65	18	15
Control Data Corporation	G-15	N	$1000	7/55	311	X
	G-20	Y	$15,500	4/61	23	X
	LGP-21	Y	$725	12/62	100	X
	LGP-30	semi	$1300	9/56	300	X
	RPC-4000	Y	$1875	1/61	50	X
	160*/160A/160G	Y	$1750/$3400/$12,000	5/60;7/61;3/64	450	1
	924/924A	Y	$11,000	8/61	30	X
	1604/1604A	Y	$45,000	1/60	58	X
	1700	Y	$2200	5/66	0	30
	3100	Y	$7350	12/64	60	36
	3200	Y	$12,000	5/64	94	18
	3300	Y	$15,000	9/65	3	35
	3400	Y	$25,000	11/64	18	18
	3500	Y	$30,000	6/66	0	4
	3600	Y	$58,000	6/63	49	10
	3800	Y	$60,000	2/66	0	16
	6400	Y	$40,000	1/66	0	11
	6600	Y	$110,000	8/64	8	5
	6800	Y	$140,000	4/67	0	2
Digital Equipment Corp.	PDP-1	Y	$3400	11/60	60	X
	PDP-4	Y	$1700	8/62	55	2
	PDP-5	Y	$900	9/63	112	1
	PDP-6	Y	$10,000	10/64	14	7
	PDP-7	Y	$1300	11/64	51	50
	PDP-8	Y	$525	4/65	130	275
El-tronics, Inc.	ALWAC IIIE	N	$1820	2/54	21	X
Electronic Associates, Inc.	8400	Y	$7000	6/65	4	6
Friden	6010	Y	$600	6/63	325	179
General Electric	115	Y	$1375	12/65	15	410
	205	Y	$2900	6/64	42	8
	210	Y	$16,000	7/59	52	X
	215	Y	$6000	9/63	54	2
	225	Y	$8000	4/61	136	2
	235	Y	$10,900	4/64	64	8
	415	Y	$7300	5/64	93	61
	425	Y	$9600	6/64	54	50
	435	Y	$14,000	10/64	22	25
	625	Y	$14,000	12/64	12	26
	635/645	Y	$45,000	12/64	4	28
Honeywell Electronic Data Processing	H-120	Y	$2600	1/66	15	270
	H-200	Y	$5700	3/64	750	100
	H-400	Y	$8500	12/61	122	5
	H-800	Y	$22,000	12/60	86	3
	H-1200	Y	$6500	2/66	0	42
	H-1400	Y	$14,000	1/64	12	1

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-1800	Y	$30,000	1/64	16	6
	H-2200	Y	$11,000	1/66	1	44
	H-4200	Y	$16,800	2/66	0	8
	H-8200	Y	$35,000	3/67	0	3
	DATAmatic 1000	N	$40,000	12/57	4	X
IBM	305	N	$3600	12/57	168	X
	360/20	Y	$1800	12/65	30	4100
	360/30	Y	$7200	5/65	650	3200
	360/40	Y	$14,500	4/65	475	900
	360/44	Y	$12,000	9/66	0	400
	360/50	Y	$28,000	8/65	21	360
	360/62	Y	$55,000	11/65	1	X
	360/65	Y	$46,000	11/65	2	110
	360/67	Y	$49,000	9/66	0	24
	360/75	Y	$78,000	2/66	0	68
	360/90 Series	Y	$140,000	6/67	0	6
	650	N	$4800	11/54	250	X
	1130	Y	$850	11/65	30	2000
	1401	Y	$4500	9/60	6600	180
	1401-G	Y	$2000	5/64	1350	60
	1410	Y	$14,200	11/61	740	20
	1440	Y	$3300	4/63	2800	220
	1460	Y	$9000	10/63	2250	160
	1620 I, II	Y	$2500	9/60	1700	20
	1800	Y	$3700	1/66	0	140
	701	N	$5000	4/53	1	X
	7010	Y	$22,600	10/63	185	25
	702	N	$6900	2/55	8	X
	7030	Y	$160,000	5/61	7	X
	704	N	$32,000	12/55	38	X
	7040	Y	$18,000	6/63	115	8
	7044	Y	$35,200	6/63	120	20
	705	N	$30,000	11/55	61	X
	7070, 2, 4	Y	$27,000	3/60	335	5
	7080	Y	$55,000	8/61	75	X
	709	N	$40,000	8/58	11	X
	7090	Y	$63,500	11/59	43	1
	7094	Y	$72,500	9/62	122	5
	7094 II	Y	$78,500	4/64	109	20
ITT	7300 ADX	Y	$18,000	9/61	9	6
Monroe Calculating Machine Co.	Monrobot IX	N	Sold only - $5800	3/58	150	X
	Monrobot XI	Y	$700	12/60	580	100
National Cash Register Co.	NCR - 304	Y	$14,000	1/60	26	X
	NCR - 310	Y	$2000	5/61	21	X
	NCR - 315	Y	$8500	5/62	385	60
	NCR - 315-RMC	Y	$12,000	9/65	8	25
	NCR - 390	Y	$1850	5/61	1070	35
	NCR - 500	Y	$1500	10/65	150	750
Philco	1000	Y	$7010	6/63	20	0
	2000-210, 211	Y	$40,000	10/58	18	1
	2000-212	Y	$52,000	1/63	10	1
Radio Corporation of America	Bizmac	N	$100,000	-/56	3	X
	RCA 301	Y	$6000	2/61	643	5
	RCA 3301	Y	$11,500	7/64	49	18
	RCA 501	Y	$14,000	6/59	99	2
	RCA 601	Y	$35,000	11/62	4	X
	Spectra 70/15	Y	$2600	11/65	14	80
	Spectra 70/25	Y	$5000	11/65	6	40
	Spectra 70/35	Y	$7000	4/66	0	35
	Spectra 70/45	Y	$9000	11/65	3	120
	Spectra 70/55	Y	$14,000	5/66	0	12
Raytheon	250	Y	$1200	12/60	172	2
	440	Y	$3500	3/64	14	3
	520	Y	$3200	10/65	3	5
Scientific Control Systems	650	Y	$500	12/65	0	2
	660	Y	$2000	10/65	2	1
	670	Y	$2600	12/65	0	2
Scientific Data Systems Inc.	SDS-92	Y	$775	4/65	32	40
	SDS-910	Y	$2000	8/62	160	13
	SDS-920	Y	$2700	9/62	104	12
	SDS-925	Y	$2500	12/64	15	33
	SDS-930	Y	$4000	6/64	83	30
	SDS-9300	Y	$7000	11/64	24	10
Systems Engineering Labs	SEL-810	Y	$750	9/65	4	13
	SEL-840	Y	$4000	11/65	2	3
UNIVAC	I & II	N	$25,000	3/51 & 11/57	28	X
	III	Y	$20,000	8/62	85	1
	File Computers	N	$15,000	8/56	18	X
	Solid-State 80 I, II, 90 I, II & Step	Y	$8000	8/58	280	X
	418	Y	$11,000	6/63	60	28
	490 Series	Y	$35,000	12/61	85	60
	1004	Y	$1900	2/63	3300	160
	1005	Y	$2400	2/66	0	150
	1050	Y	$8000	9/63	280	80
	1100 Series (except 1107)	N	$35,000	12/50	12	X
	1107	Y	$60,000	10/62	29	2
	1108	Y	$65,000	9/65	5	16
	LARC	Y	$135,000	5/60	2	X
				TOTALS	32,142	16,112

X = no longer in production.

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

ORDER PROCESSOR... BILLER... PRODUCTION SCHEDULER— YOU NAME IT!



Teletype communications equipment is capable of performing all these functions for you because it is the most versatile, reliable, and least costly equipment for the collection and distribution of data.

Besides being able to handle multicopy business forms, Teletype Model 35 ASR (automatic send-receive) sets can be equipped with horizontal and vertical tabulators to speed the preparation of long, complicated order forms. In addition, after completing a business form, a formout feature automatically adjusts the machine to the starting point of the next form.

Speeds The Flow of Data Paper tape punches and readers of Teletype Model 33 and 35 ASR sets add additional speed and efficiency to your flow of data and business information. Messages and data can be punched off-line providing errorless paper tape for later transmission on-line at full capacity. On the Model 35 ASR, fixed data can be stored on paper tape and later combined with variable data to save retyping.

Both Teletype Model 33 and 35 ASR sets can communicate directly with business machines and computers that operate on the same permutation code approved by the American Standards Association for information interchange. And, the new 4-row keyboard makes operation easier—no more need to "shift" between letters and numbers.

Automates Order Processing Automatic order processing is only one of the many improvements in business communications provided by Teletype equipment. As an order is typed on a Teletype machine, the details are transmitted to accounting, production, and shipping departments. These departments can receive the information on their own specific forms—thus production, shipping, and billing forms are completed at the same time with maximum accuracy. This instant communication keeps inventories at a profitable minimum.

Cuts Truck Routing Costs A nationwide trucking firm has cut costs and improved customer service through a communications network using Teletype equipment. The firm's five regional offices use Teletype sets to send daily progress reports over communications channels to the home office. This information is fed into a computer, which recommends the most efficient use of drivers and vehicles. Then, the routing and scheduling information is transmitted back to the branch offices.

That's Why They Want It These important business applications explain why Teletype Models 33 and 35 are used by the Bell System and others who require reliable communications at the lowest possible cost. To learn more about these uses of Teletype sets, write to: Teletype Corporation, Dept. 88C, 5555 Touhy Ave., Skokie, Illinois 60078.

TELETYPE

machines that make data move

Designate No. 12 on Readers Service Card

CALENDAR

(Continued from page 42)

April 20-22, 1966: 4th Annual National Conference of the Interservice Data Exchange Program, Waldorf Astoria Hotel, New York, N.Y.; contact Peter Amedeo, Grumman Aircraft Engineering Corp., Plant 5, Bethpage, N.Y.

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

April 21-23, 1966: Conference on the Impact of Computers on Education in Engineering Design, University of Illinois at Chicago Circle, Urbana, Ill.; contact Prof. Steven J. Fenves, Dept. of Civil Engineering, 212 Engineering Hall, Univ. of Ill., Urbana, Ill. 61803

April 22, 1966: Symposium on Computer-Aided Basic Research, Stevens Institute, Hoboken, N.J.; contact Dr. Ivan Flores, EE Dept., Stevens Institute, Hoboken, N.J. 07030

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

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

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

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

May 12-13, 1966: Third Annual National Colloquium on Information Retrieval, University of Pennsylvania, Philadelphia, Pa.; contact Mr. Ashley W. Speakman, E. I. DuPont Co., Centre Road Building, Wilmington, Del. 19898

May 16-18, 1966: Third Annual SHARE Design Automation Committee Workshop, Jung Hotel, New Orleans, La.; contact Joseph Behar, Secretary, IBM, 425 Park Ave., New York, N. Y., 1002?

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

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

May 24-27, 1966: GUIDE International, Queen Elizabeth Hotel, Montreal, Canada; contact Lois E. Mecham, GUIDE International User Organization, c/o United Services Automobile Association, 4119 Broadway, San Antonio, Texas, 78215

May 25-27, 1966: Spring Joint Conference of the Univac Users Association and the Univac Scientific Exchange, Royal York Hotel, Toronto, Canada; contact Murray Hepple, UUA Secretary, c/o Harris Trust & Savings Bank, 111 Monroe St., Chicago, Illinois 60690

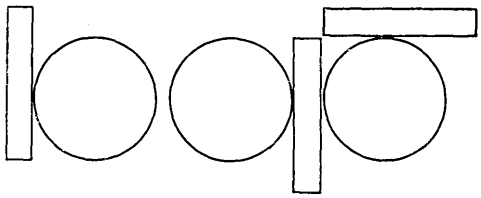
May 30-June 1, 1966: National Conference of the Computing and Data Processing Society of Canada, Banff Springs Hotel, Banff, Alberta, Canada; contact Mr. K. R. Marble, Mgr., Systems and Computer Services Dept., Western Region, Imperial Oil Ltd., Calgary

June 15-17 1966: IEEE International Communications Conference (Sequel to Globecom Meetings), Sheraton Hotel, Philadelphia, Pa.; contact Lewis Winner, 152 W. 42 St., New York, N. Y. 10036

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 / readers service number.

BRANDON
APPLIED SYSTEMS, INC.
and
computers and automation



are pleased to announce the fifth series (Spring, 1966) of seven

TECHNICAL COURSES IN DATA PROCESSING

— conducted by Brandon Applied Systems, Inc.

— sponsored by Computers and Automation

"Management Standards for Data Processing"

a 2-day course for managers and senior personnel on management control and standards. This course is based in part on the book of the same name, by Dick H. Brandon. (D. Van Nostrand Company, Inc., Princeton, N.J. 1963.)

Washington, D.C. — March 23, 24
New York, N.Y. — April 6, 7
London, England — May 17, 18

"Operations Control"

a 1-day course to provide operations managers and supervisors with a body of techniques and discipline for operations control.

Washington, D.C. — March 22
New York, N.Y. — April 5
London, England — April 25

"Computer Systems Analysis Techniques"

a 2-day technical course on the techniques of systems analysis and computer feasibility study. This course is designed for experienced analysts and supervisory personnel.

Washington, D.C. — April 20, 21
London, England — April 27, 28
New York, N.Y. — May 11, 12

"Management Audit of Data Processing"

a 1-day course for data processing management, senior management responsible for the data processing function, management analysts, and organizational specialists.

Washington, D.C. — April 19
London, England — April 29
New, York, N.Y. — May 10

"Appreciation Course in Data Processing"

a 2-day course for top executive and departmental management covering the basic principles of data processing.

London, England — May 19, 20
Washington, D.C. — June 1, 2
New York, N.Y. — June 15, 16

"Introduction to Data Communication and Time Sharing"

a 1-day course intended for data processing managers, departmental managers, and others using data communication equipment or time-sharing techniques.

Washington, D.C. — May 4
New York, N.Y. — May 25

"Computer Selection"

a 1-day course for management and technical personnel contemplating acquisition or replacement of a computer system.

London, England — May 16

For the Spring, 1966 course catalog write or phone or mail coupon:

BRANDON APPLIED SYSTEMS, INC.
30 East 42nd Street, New York, N.Y. 10017
212-YUkon 6-1518

TO: Brandon Applied Systems
30 East 42 St.,
New York, N.Y. 10017

Please send me the Spring, 1966 course catalog. My name and address are attached.

Designate No. 16 on Readers Service Card

He's got a 2-million-dollar computer right at his fingertips

(and 49 others time-share it with him)

If you can use a typewriter... if you know simple algebra... you can command a 2-million-dollar IBM computer right from your own desk.

That's because IBM time-sharing makes a powerful computer *yours*. Whenever you need it and for as long as you need it during the business day. Wherever you are.

The photo tells the story. That's an IBM 1050 terminal and just about all you have to worry about. It's linked to a large computer at one of IBM's Datacenters.

Even with 49 other people using the computer at the same time your line is never busy.

The only other accessories you need are a private telephone line and a conventional telephone data set. IBM's QUIKTRAN program lets you use simple algebra to communicate with the computer. And if you understand algebra you can learn how to use QUIKTRAN in just two hours.

IBM expands service

Businessmen and technical specialists alike have responded to the convenience and simplicity of time-sharing. So much so, that IBM just doubled its service in New York and Los Angeles... and will add QUIKTRAN facilities in other major cities in 1966.

Simplicity means you can touch-type or hunt-and-peck your data right into the computer.

Convenience means you never have to leave your desk.

With QUIKTRAN you can debug your problem as you write it... instead of waiting for the final answer and then hunting for an error. Your work is processed immediately and you get your answer in seconds.

Time-sharing frees your staff

Think what a cluster of no-waiting terminals can mean for your company.

Key staff members aren't constrained by computer schedules.

You work out problems at your own pace.

You can commit each step to the computer as you develop it.

You buy only as much time as you need. $325 a month for 25 hours. The terminal rents for $125 a month (plus line costs).

Want to get in touch with a large-scale computer right away?

We've got connections.

IBM®

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