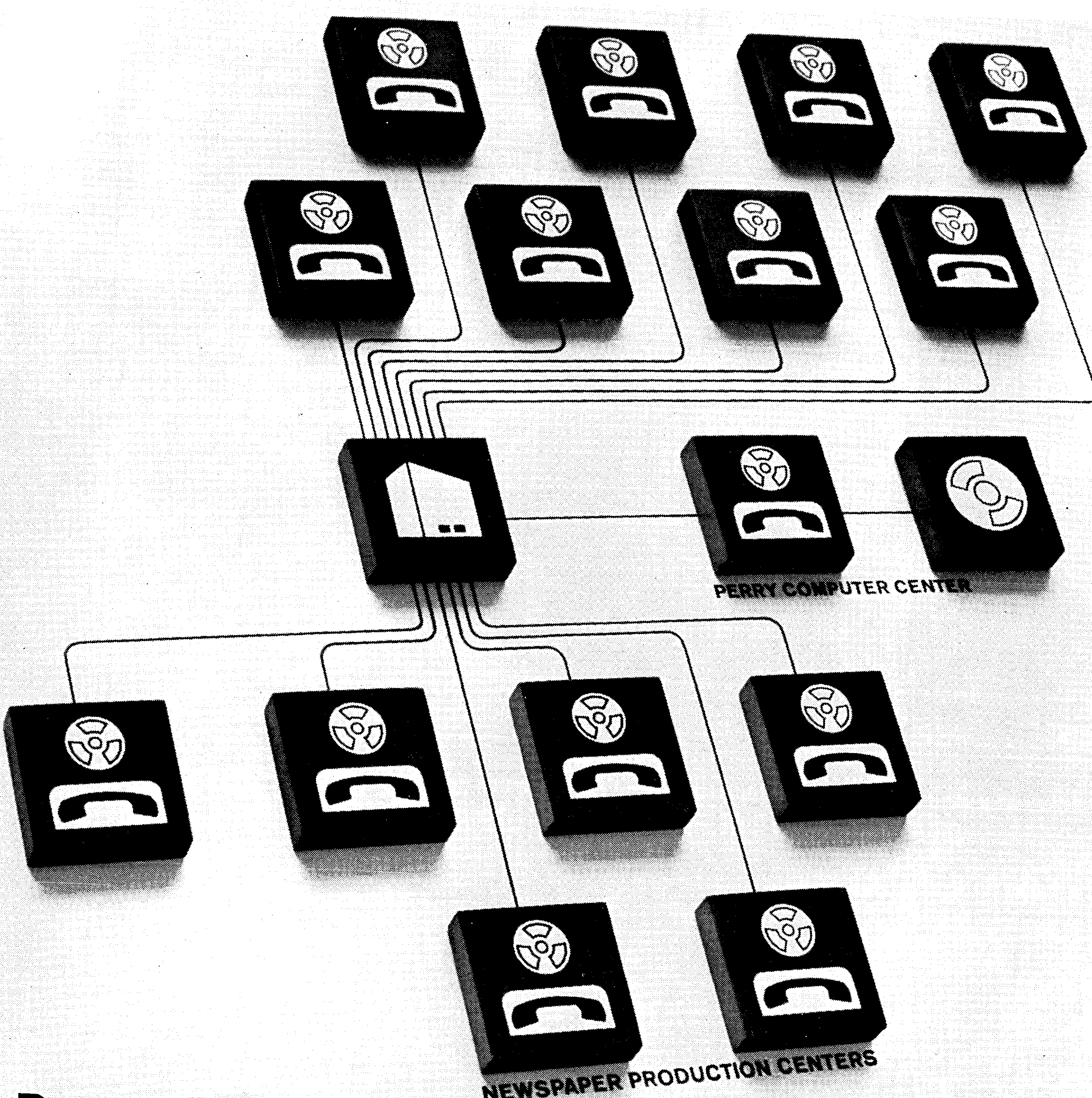
February, 1968

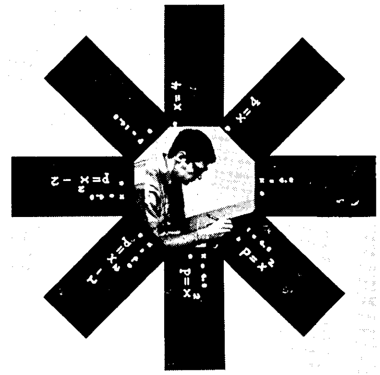
computers and automation

Software, Programming, and Future Developments


PERRY COMPUTER CENTER
NEWSPAPER PRODUCTION CENTERS

computers and automation

FEBRUARY, 1968, Vol. 17, No. 2



The front cover shows illustrations of a graphic programming system being developed at System Development Corp., Santa Monica, Calif. The "spokes" of the wheel show some examples of interactive character recognition and computational ability provided by the system; the picture at the center shows a user seated at a graphic display console. For more information, see "An Interactive Programming System for the Casual User," beginning on page 26.

ACROSS THE EDITOR'S DESK

Computing and Data Processing Newsletter

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LETTERS TO THE

Programmer/Correspondent Sought

I am a trainee programmer at a computer installation in Bulawayo, Rhodesia, and I feel that it would be helpful for me to correspond with a young programmer in America. I am 22 years of age.

I would be extremely grateful if I could get in touch with anyone willing to correspond with me either by pen or by tape recordings. Can you help me?

M. J. FROST
5, Rosal House
12th Ave./Rhodes St.
Bulawayo, Rhodesia

(Ed. Note — *This seems like a good opportunity for some desirable exchange. If someone is interested, please write direct to Mr. Frost.*)

FCC Inquiry and Applications of Computers

The Univac Division of the Sperry Rand Corp. would like, in its response to the Notice of Inquiry of the Federal Communications Commission, 9 November 1966, to reproduce the list of "Over 1200 Applications of Computers" from The Computer Directory and Buyers' Guide, 1967 (the June, 1967 issue of *Computers and Automation*). Full credit will, of course, be accorded.

The Inquiry, as you probably know, is a far-reaching one consisting of ten major questions bearing upon data processing and communications, addressed to participants in the data processing industry. Our purpose in quoting your list of applications is to show in item-by-item form, as you have done, how extensive these applications are.

H. Y. GREENBERG
Director of Data Communications
Univac Div. of Sperry Rand
Philadelphia, Pa. 19101

(Ed. Note — *Permission granted.*)

Study in the U.S.

My company has awarded me an industrial scholarship which I intend to use visiting the United States to study aspects of computer project management, planning and control.

From the events calendar published in your magazine, it is apparent that you are closely in touch with the data processing training scene. Do you have a comprehensive list of EDP courses and seminars to be held in the spring of 1968?

I am particularly interested in any courses organized by the Departments of Continuing Education in American universities or colleges.

D. L. BOWLAND
Company Systems Officer
Thomas Bolton & Sons, Ltd.
Froghall, Stoke-on-Trent
Staffordshire, England

(Ed. Note — We have no listing other than our "Calendar of Coming Events," but we suggest you contact the persons listed there. By now the courses organized in American universities probably number 50 to 100, and specific information could be obtained by writing to various universities in the area which you plan to visit.)

Training Programmers

I read with extreme interest John J. Mason's article, "Business Systems Analysis — An Orderly Approach," in your August, 1967 issue.

I am an Assistant Methods Analyst with The Prudential Insurance Company of America and would like to use this article when training our young programmers in systems development work.

It would be appreciated if you could send me a copy of this article or your permission to reprint it for my own use.

L. F. HUBER
Jacksonville, Florida 32211

(Ed. Note — *Permission granted.*)

E D I T O R

Battles By Computer — Final Results

May I call your attention to an editorial slip? Your article (Battles By Computer, November, '67, p. 12) stated that "Jack Dempsey became the champion (boxer) when he knocked out Gentleman Jim Corbett in the seventh round." That fight was only a preliminary bout in the 13 week world's championship elimination tournament. The final round was broadcast here in Washington, D.C., by WTOP on December 18, 1967. Rocky Marciano became the greatest boxer that ever lived, according to the computer, by knocking out Jack Dempsey in the 13th round of an otherwise even match (4 rounds each and 4 draws). Incidentally, he wins $10,000 and a golden belt for this.

WENDELL WEATHERFORD
Silver Springs, Md. 20901

Praise for Pictorial

Mr. Pierre F. Simon, head of our company, was very much impressed with your issue of December, 1967 (Annual Pictorial Report on the Computer Field) . Please send six additional copies to him and bill us accordingly.

MRS. SHIRLEY COHEN
Machine & Products Co.
New York, N.Y. 10005

Who's Who

We are interested in the Fifth Edition of *Who's Who in the Computer Field.* When will it be available for sale, and what will be its price?

LOUISE LA LONDE, *Librarian*
Control Data Corp.
Minneapolis, Minn. 55440

(Ed. Note — *See announcement in "Multi-Access Forum" in this issue.*)

c.a

EDITORIAL

The Problem of Keeping Up With One's Reading

Item: Recently a renewal notice from a subscriber came into our office marked: "Can't renew — management thinks too much time is spent in reading — I don't agree, but. . . ."

Item: The pile of material most of us have to read accumulates like snow in the ice age — it never melts, we never finish reading the pile. (I look forward to traveling on a plane or riding on the New York subway because I will have a chance to catch up on some reading.)

Item: The magazine *Business Week* helps the reader — because it has a page close to the beginning of the issue where everything in the issue is listed and briefly described so anybody can decide quickly what he wants to read and what he doesn't. *Computers and Automation* has adopted this system, going to a two-page table of contents.

How are we in the computer field to keep up with the reading we want to do and need to do? Is this possible?

For anybody who is ambitious and who is doing a lot of work, it probably is not possible. The quantity of ambition increases the amount to be read. The quantity of work to be done subtracts time away from reading.

If success is impossible, what solution should be adopted?

> *Scheme 1.* Separate between what will bite you if you don't read it, and what will not bite you if you don't read it — and read only what will bite you if you don't read it.

Take for example a notice of a parking violation. Most people will read it — the penalty for not reading it is drastic. Furthermore, the notice of the parking violation notice is definitely short, to the point, and often very clear: "If no response in 21 days, fine of $5."

Unfortunately, this scheme is far from adequate. Much more reading can be done, and the scheme provides an insufficient guide for selection.

> *Scheme 2.* Separate between what you can understand, and what you can't understand — and don't read what you can't understand.

Unfortunately, this scheme is also far from adequate. Most of us can understand a good deal of what we have no time or desire to read, including billboards and signs on buses; and this scheme also provides an insufficient guide for selection.

Once in a while, also, curiosity gets the better of me, and I read what I can't understand. Across the editor's desk the other day came a notice of a meeting on LSI. What was that? I read through the entire notice, and I could not find out anywhere what LSI was. Finally, I wrote a letter to discover — and found out that LSI stood for Large Scale Integration (of circuits). But I should have saved myself the trouble; I paid a penalty for my curiosity.

> *Scheme 3.* Get someone else to read for you and report to you.

This is the principle regularly used in producing book reviews. And a lot of people come to feel they have read a book because they have read a review of the book.

Unfortunately, I have almost never found a summary, digest, or review to be at all equivalent to the impression that I myself receive from reading something for myself. So this scheme is not really adequate, though perhaps in special circumstances, with careful training of your assistant, it may work. (As a computer person, I confess I keep hoping to program a computer to read for me — but I don't think it will happen for some years to come.)

In *Computers and Automation*, we try to publish for "book reviews" short reports saying what is in a book, and what its level is, so that a reader can decide for himself whether a book is likely to be worth examining.

> *Scheme 4.* Separate between what you won't remember if you read it and what you will remember if you read it — and try not to read what you won't remember.

For example, the daily newspaper is full of reports about events that will make almost no difference and will be forgotten two months from now. Therefore, try to read the daily paper using the principle of not reading anything that won't make any difference two months from now.

This scheme really saves a lot of time. In fact, this principle, suitably applied, leads to almost never reading more than a small fragment of the Sunday newspaper!

> *Scheme 5.* Make a treaty with the author, the publisher, or the reporter to save your time reading.

For example, the treaty should provide: (1) The most important part of the story should be put down first. (2) Headings should be used so the reader can find his way about. Etc., etc., etc.

This is rather a good scheme. Not all ideas are equally important. An author and an editor can make an article inviting and helpful by putting important ideas in prominent positions, and wording them carefully.

Over and over again in putting together the issues of *Computers and Automation* we try to save our readers' time in reading. We try to use helpful devices for this purpose. All suggestions from our readers will be welcome. Suppose only one-tenth of an issue of *Computers and Automation* or less is read by a reader — yet if he finds half a dozen ideas that make a real difference to him, then the bargain is reasonable.

To conclude, let me quote Samuel T. Coleridge (1772-1834), poet, philosopher, author of "Kubla Khan" and "The Ancient Mariner":

> There are only four kinds of readers:
>
> The first is like the hour-glass; their reading being as the sand, it runs in and runs out, and leaves no vestige behind.
>
> The second is like the sponge, which imbibes everything and returns it in nearly the same state, only a little dirtier.
>
> A third is like a jelly-bag, allowing all that is pure to pass away, retaining only the refuse and dregs.
>
> And the fourth is like the slaves in the diamond mines, who, casting aside all that is worthless, retain only pure gems.

Edmund C. Berkeley

EDITOR

The UNIVAC® 9400. High performance complement to the family of successful UNIVAC 9200 and 9300 computer systems. A powerful medium-sized real-time system with capabilities previously found only in larger, more expensive systems.

Newest addition to the UNIVAC 9000 Series, the UNIVAC 9400 offers a wide choice of applications whether they be direct access, sequential batch processing, or communications-oriented processing.

Communications configurations provide for up to 64 duplex line terminals, with the number of possible remote devices almost unlimited. Utilizing an intermix of codes and speeds, the UNIVAC 9400 can communicate with a full range of peripheral terminals, the UNISCOPE® 300 visual display unit and the DCT-2000 as well as many other processors such as the UNIVAC 1108 and 494 Systems.

Designed with a supervisor control program for multiprogramming, the UNIVAC 9400 will run up to five main-chain programs at the same time. For example: 1) responding to inquiries from remote terminals, 2) updating accounts receivables, 3) updating "in process" inventory, 4) sorting disc or tape files, 5) solving complex mathematical equations —all can be processed concurrently.

Peripherals include industry standard discs and tapes. Tape systems can be expanded from 4 to 16 drives, from 34 to 192 KB. Disc configurations provide from 2 to 8 UNIVAC 8411 Disc Drives. Each has a 7,250,000 byte capacity and 75 millisecond average access time.

The complement of software includes full COBOL and FORTRAN, RPG and BAL, among others, in tape and disc-oriented systems plus other proven programming and testing packages.

A basic UNIVAC 9400 tape or disc system is available at monthly costs beginning at about $6,000. Extend it, expand it, make it grow with you. Yet—no matter how big you make it—it can still be part of one large computer family—the UNIVAC 9000 Series.

If you're ready to move up, please call UNIVAC.

The voice that answers will be human.

UNIVAC

Univac is saving a lot of people a lot of time.

SPERRY RAND

Designate No. 23 on Reader Service Card

The voice at the other end of this telephone isn't human.

If you've never talked to a computer before, we'd like to introduce you.

MULTI-ACCESS FORUM

1968 PREDICTION FOR THE COMPUTER INDUSTRY

Isaac L. Auerbach, President
Auerbach Corp.
121 N. Broad St.
Philadelphia, Pa. 19107

It is my belief that the computer industry will grow between 12 and 15 percent during 1968. The main area of growth will be an increase in the economic yield, over-all efficiency, and productivity of present in-place computer installations.

During 1968, informed business leaders will pay much greater attention to the computer as a device which affords the potential of significant profit — in production scheduling, man-loading, economic forecasting, marketing, and corporate planning. It is important to have the computer work where the action is, and this is on the operational side of business.

In spite of this growth, however, the year 1968 may be characterized by some measure of relative economic confusion and hesitation, resulting from a possible tightening of Federal expenditure due to concern over dollar devaluation. It is conceivable that a resultant profit squeeze could curtail business expenditure for new plant construction and capital equipment. And this would affect the computer industry — now clearly a major capital equipment supplier.

Although some new technological developments in the field will be introduced in 1968, nothing revolutionary is expected to disrupt the operation of current in-place equipment. One area of major need is peripheral equipment (input and output equipment), where greater reliability is becoming more important. The economic impact of laser and photo-optic technological advances will probably be negligible. Developments in computer-assisted education and instruction should continue at a brisk pace, with emphasis on new techniques to improve basic teaching programs, as well as the use of improved consoles in the student-machine relationship.

THE GENERAL SERVICES ADMINISTRATION WANTS MORE FOR THE UNITED STATES' COMPUTER DOLLARS

Based on a report by Richard Wightman, Electronic News, **December 18, 1967**

The General Services Administration intends to take a more active part in the purchase of data processing equipment by the various agencies in the Federal government. GSA was given the "sole responsibility" for buying such equipment for Federal use through legislation which was passed two years ago; but government departments have continued to be supplied individually, meeting their own needs as required. Because of concern that it may, in fact, be illegal for individual departments to make such purchases, GSA recently sought the opinion of the Comptroller General of the United States, and was advised that the two-year-old law does provide "exclusive authority to GSA to procure all general-purpose ADP and related supplies and equipment for use by other Federal agencies."

The purpose of the new GSA procurement policy will be to cut costs and to promote competition among computer manufacturers. Because of lack of money and staff, GSA officials predict that it might be a few years before the policy becomes fully effective. But as one official put it, "The situation now is as if IBM had been selling to a series of independent department stores — rather than to the department store chain. If IBM has to sell to the chain, we should do much better in the way of volume bulk and group discounts."

UTAH COMPUTER RESEARCHERS CREATE "IDEA PHOTOGRAPHS"

Dr. David C. Evans, Director
Computer Service Department
University of Utah
Salt Lake City, Utah 84112

Researchers at the University of Utah are using a computer to create three-dimensional, halftone "photographs" of a man's ideas. The research opens the door to a large area of creative visual electronics, with remarkable possibilities in nearly every field from entertainment and education to architecture and medicine.

The group of scientists working on the project has made "photographs" of objects that exist only in the minds of those at the computer controls. The photograph-like reproductions were "materialized" by the computer, which had been previously programmed in the mathematics appropriate to light and shape.

This development opens up many future possibilities such as:

1. Motion pictures in three dimensions which give the illusion of live action;
2. Computerized architecture, which would allow the designer to spend ninety percent of his time on creative work; this would include three-dimensional building design, eliminating the need for blueprints in the design process, and allowing the designer to show viewers (through a special set of "goggles") how the structure will look on the site; and
3. Realistic visual aids which will modify teaching methods in education.

The scientists are working under a four-year, $5 million contract with the Advanced Research Projects Agency, Department of Defense, Washington, D.C., to increase communications and graphic techniques between man and computers.

In the halftone research, which is part of the project, the group is working initially with geometric shapes, like cubes, pyramids, and spheres. These building blocks, once they are programmed into the computer, are "stretchable" and can be manipulated into many different combinations of design forms and shapes.

One of the practical applications of halftone research may come in the field of architecture. The new computer graphics should allow an architect to design a building on a large cathode-ray tube instead of a drawing board. He will need to do so only once, and he will be able to do so in perspective, right down to the last detail. In the process, the computer can rotate the design for a view from any angle. The architect can magnify any section for close-up examination, and can remove walls to look inside any part of the structure.

The University of Utah group is working closely with Dr. Ivan Sutherland of the Aiken Computation Laboratory, Harvard University, Cambridge, Mass. Dr. Sutherland is experimenting with a set of "goggles" which makes the computer graphics appear three dimensional; he has made a "helmet" fitted with a pair of cathode-ray tube "lenses" that show computer images in a stereoscopic pair.

AUTOMATION AND THE PROPOSED MINIMUM ANNUAL INCOME: SUBJECT FOR DEBATE

I. From Martin Haufmann
217 West 15th St.
Hays, Kansas 67601

I am a debator at Ft. Hays State College, Hays, Kansas. This year's resolution is:

> Be it resolved that the Federal Government guarantee a minimum annual cash income to all citizens.

We are developing an argument relating automation to the above resolution. Our argument is based on the premise that a fear of automation exists among the general public, and that this fear is blocking or hindering the development of automation. Because automation offers a great many advantages, we would advocate the annual income to remove this fear.

We need information on public fear of automation: that it exists, that it is widespread, that it is a major block to automation. We also need information supporting automation.

We need to have quotable material, such as statements by authoritative persons. Any help you can give us will be appreciated.

II. From the Editor

One of the best references we know is the report of the National Commission on Technology, Automation, and Economic Progress, *Technology and the American Economy,* Vol. 1, 115 pp., published by the Superintendent of Documents, Washington, D.C., February, 1966. It is available for 75 cents. We suggest that you order a copy.

Also, we publish an annual index in each January issue of *Computers and Automation* indexing all the material published in the previous twelve months. The index should also be helpful to you.

CONTRIBUTIONS WELCOME TO "WHO'S WHO IN THE COMPUTER FIELD"

I. From J. G. Schofer
Program Administrator
Chrysler Corp.
1100 South Tibbs Ave.
Indianapolis, Ind. 46241

In regard to your "Who's Who in the Computer Field, Fifth Edition, 1968, we are enclosing six entries for your consideration.

Chrysler Corporation, Indianapolis Foundry, is the site of the first computer process control of cupola melting. We have used data processing in this plant for a number of years for payroll, accounts payable, quality analysis, downtime reporting, preventive maintenance program, inventory control, linear programming and the other normal D.P. applications. In 1965 we contracted with Control Data Corporation for a Model 636 computer for process control.

Enclosed are four articles written about our process control computer installation. Our Plant Manager, Mr. P. F. Moore, was formerly a manager in the Corporate Systems Department. Mr. Moore addressed the National Convention of American Society for Quality Control in Chicago, June 2, 1967. The speech was about our process control computer. Since June, Mr. Moore and our Plant Comptroller, Mr. C. S. Orban, have talked to three regional groups of American Society for Quality Control in Indianapolis, Detroit and New Brunswick, New Jersey.

We are very proud of our installation and we would appreciate your consideration of the six people described on the attached sheets for inclusion in "Who's Who In The Computer Field" — Fifth Edition, 1968.

II. From the Who's Who Editor:

We thank you for your entries, and we are sure they will be worthwhile additions to the Who's Who. Thank you for your friendly cooperation in our assembling of information for it.

The Fifth Edition of *Who's Who in the Computer Field* will be published by *Computers and Automation* during 1968.

The Fourth Edition, 253 pages, with about 5000 capsule biographies, was published in 1963. The Third Edition, 199 pages, was published in 1957.

In this edition, we hope to include upwards of 10,000 capsule biographies, including as many persons as possible who have distinguished themselves in the field of computers and data processing. If you know of people who should be included, please tell us their names and addresses.

If you wish to be considered for inclusion in this "Who's Who", please complete the following form (which may be copied on any piece of paper) or provide us with the equivalent information:

1. Name? (Please print) ____________
2. Home Address? ____________
3. Organization? ____________
4. Its Address? ____________
5. Your Title? ____________
6. Your Main Interests?

Applications	( )	Mathematics	( )
Business	( )	Programming	( )
Construction	( )	Sales	( )
Design	( )	Systems	( )
Logic	( )	Other	( )
Management	( )	(Please specify) ____________	

7. Year of Birth? ____________
8. Education and degrees? ____________
9. Year Entered Computer Field? ____________
10. Occupation ____________
11. Publications, Honors, Memberships, and Other Information? ____________

(attach paper if needed)

12. Associates or friends who should be sent "Who's Who" entry forms?

Name and Address

____

When completed, please send to:
Who's Who Editor, Computers and Automation,
815 Washington St., Newtonville, Mass. 02160

ACM PROFESSIONAL DEVELOPMENT SEMINARS

Association for Computing Machinery (ACM)
National Headquarters
211 East 43rd St.
New York, N.Y. 10017

A number of ACM Professional Development Seminars have been organized and scheduled. The titles of seminars include: "File Structures for On-Line Systems;" "Time Sharing Systems;" "The Selection and Evaluation of Computer Personnel;" "Decision Tables for Computer Systems Design and Programming;" "Information: Its Storage, Retrieval, and Management;" and "Computer Graphics."

Eight different seminars have been scheduled in 26 cities during January, February, and March.

Prices range from $15 to about $95, depending mainly on the length of the seminar.

A catalog of the seminars is available on request to the ACM.

AWARD TO BE GIVEN FOR OUTSTANDING CONTRIBUTION IN THE FIELD OF AUTOMATIC CONTROL

Donald P. Eckman Award Committee of the American Automatic Control Council
c/o Systems Research Center
Case Western Reserve University
University Circle
Cleveland, Ohio 44106

A certificate and cash award of $300 will be granted for an outstanding contribution in the field of automatic control at the 1968 Joint Automatic Control Conference.

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

- Contributions may take the form of technical or scientific publications, theses, patents, inventions, or combinations of the above in the field of automatic control.
- Applications will be accepted in support of candidates who are less than thirty years of age.
- The contribution for which the Award is sought must represent work performed prior to the age of 27 while a resident in the U.S.A.
- Supporting evidence must include a full professional resume and letter of recommendation by at least one responsible supervisor.
- All supporting documents shall be in the English language.

Nominations for the award should be submitted to the above address prior to April 15, 1968.

AUTHORS' ADDRESSES INCLUDING MAIL CODES

I. From the Institute for Scientific Information
325 Chestnut Street
Philadelphia, Pa. 19106

Since many journals are read widely both inside and outside of the United States, international scientific communication will be greatly aided if addresses of authors including zip codes are given. Many foreign countries also have recently instituted new mail coding systems; therefore, we hope you can also include mail codes for foreign authors.

II. From the Editor

Commencing at once, *Computers and Automation* will seek to publish complete addresses for all authors.

Designate No. 20 on Reader Service Card

THE PROGRAMMING PROFESSION, PROGRAMMING THEORY, AND PROGRAMMING EDUCATION

Larry L. Constantine
Information & Systems Institute, Inc.
14 Concord Lane
Cambridge, Mass. 02138

"The classic challenge has been that programming lacks: (1) an ordered body of knowledge, (2) active interaction between the field's practitioners and that body of knowledge, and (3) a systematic educational process for imparting the knowledge to new entrants to the field. How are we meeting this challenge?"

The question whether or not programming is a profession today remains unresolved. Perhaps ultimately, the issue will be settled not by definitions and debate, nor by social decisions, but by the conduct of the would-be professionals in the field. Much of what constitutes a profession is a matter of professionalism — a complex of attitudes, formal practice, ethics, and social structure.

Beyond this, however, are matters which are certainly important to the emergence of a programming profession, but also may be critical to the viability of programming as a legitimate, unique field of endeavor.

The classic challenge has been that programming lacks (1) an ordered body of knowledge, (2) active interaction between the field's practitioners and that body of knowledge, and (3) a systematic educational process for imparting the knowledge to new entrants to the field. [1] This challenge is nearly as valid today as when stated four years ago. It is incumbent on us in the field to examine the origins of the difficulty and the potential solutions to the dilemma. It is the purpose of this article to consider one aspect of the problem: the relationship between current education in the programming field and that portion of an ordered body of knowledge about programming which does exist.

The relation between education and programming theory is very relevant not only to the professional future of programming but to the cost and quality of its *practice,* both today and tomorrow.

Programming Theory

Programming theory needs to be divided into two parts: the theory of programs and the theory of programming. Clearly, though the scope and treatment of the two theory bodies are distinct, they are interrelated, just as the theory of X's is interrelated with the theory of making X's, whatever X may be.

What is a theory?

In practice, a theory (or theory body) is a model, a model representing supposed underlying principles of operation or behavior. A theory explains, or accounts for, phenomena and observations; and it also enables the making of true predictions about the phenomena covered, including predicting the results of departing from norms of operation or behavior.

To have an acceptable theory, we require in addition to the model, a usable definition of the scope of phenomena covered by the model as a theory. That is, we must be able to say, independent of the application of the theory itself, for any given phenomenon whether or not it is an instance of those things included in the theory.

Finally, we judge a theory on its validity (correctness), relevance (appropriateness) and applicability (practical value), though only the first factor (validity) is a requirement of all theories.

It is crucial to note that the theories of programs and programming are distinct from either the theory of computers or the theory of computation.

The theory of computers is basically a theory that states what a computer is, its principles of operation, its behavior under prescribed conditions, and fundamentals of its construction. This theory is extensively covered, perhaps even well developed, but certainly not well integrated. Indeed, most of what would be a part of a theory of computers would probably not be considered as such by its authors.

The theory of computation deals with *computing,* independent of computers. The theory includes what a computation is, what can be computed and what cannot, and specific questions such as the equivalence of computations and their transformation. This theory is both well developed and well integrated, but it is usually not alluded to by this name; usually it is called *recursive function theory.*

Neither programs nor programming are covered by the theories of computers or computing (or, for that matter, by any number of computer-related theory bodies such as the theory of algorithms, numerical analysis, or computational linguistics). The available university-recognized theory bodies are generally irrelevant, because they exclude or minimize the phenomena of most importance to the practicing professional programmer, namely, programs and programming.

To be specific, a theory of programs must say what a program is (not what it should be or could be or is similar to); what are its constituents and their interrelationships; what its characteristic modes of behavior are; and what happens when you do certain things to it. Moreover, we would want such a theory to have clear implications for the construction of programs with certain characteristic behavior (such as *reliable* behavior).

Similarly, a theory of programming would identify just what that phenomena is, what it means to program or create a program, what the characteristic behavior of the programmer is, what influence programming practice has on the cost and quality of the product (programs), and what can be done to change (ideally, improve) the practice and the product.

As practitioners, we do not require that either theory be mathematical, only useful. This may well be a factor separating academicians from practitioners, the former placing a premium on mathematical formulation.

Existence of Programming Theory

Significant portions of both the theory of programs and the theory of programming do exist today.

The existence of programming theory is proved by the simple exhibition of at least one model constituting *a* theory of programs and one for *a* theory of programming. To do so in any depth is however outside the scope of this article; nevertheless, to fail to outline examples would be to risk losing credibility. In each case premises are stated and then the basic model is presented. References to *some* of the background and further explication are found in the references at the end of this article.

The presentation of a portion of each of these two theories is important to the central thesis of this article: that much more is known about programs and programming than is being recognized and taught. Even more important is the fact that both theoretical views are representative of what is going on in industry but not in the universities.

A Structural Theory of Programs

We call the theory of programs set forth here "a structural theory of programs." This is deliberately chosen to contrast with the algorithmic theory of programs, which treats programs merely as algorithms, that is, orderly procedures for the computation of results.

The algorithmic theory of programs revolves around problems of order, sequence, and efficiency. By definition in this theory, a program is merely a sequence of instructions constituting an algorithm for the computation of some value(s). This characterization is correct; the algorithmic theory or view of programs is unquestionably valid. However, the algorithmic view is insufficient to account for the most important aspects of programs *as they exist today.*

The basic assumption of the structural theory of programs is that a program is a system, that is, a finite, structured collection of components which performs some task. Among the components may be other systems. Thus a program is composed of both statements (instructions, commands, etc.) and collections of statements. In fact, from the standpoint of significance to programming, the latter is enormously more important. Thus:

> A program is an ordered set of statements and aggregates of statements defining, describing, or directing the performance of some task. A program is a system and is thus defined by its inputs, outputs, transformation function, its boundary, components, and their interrelationships. The aggregates of statements are called modules, and a module is a program.

This definition leads to a model of a program based on constituents which are larger than the basic statements and to a concentration on the interrelationships among these components. To illustrate the nature of the theory and some of its conclusions, consider the crucial question of program cost, which must be strongly related to ultimate program complexity.

Structural Representation of A Program

A structural representation of a program on a statement by statement basis is illustrated in Figure 1. Each of the arrows represents a direct reference within one statement to another statement, or to some part of another statement, or to something also referred to by another statement, or an arrow represents an implicit connection, such as related processing effects or sequential execution. The intent of Figure 1 is to represent the sum total of all interrelationships among elements of the program, that is, the complete *structure.* Any real program is a very complex structure when modeled in this manner.

Now in practice, no real program above a certain critical size is ever actually implemented as such a *monolithic* structure — as a single, linear, unbroken sequence of code. In the sense of containing phases, segments, procedures, blocks, subroutines, macros, or other externally defined aggregations, all programs are *modular.* [5, 8]

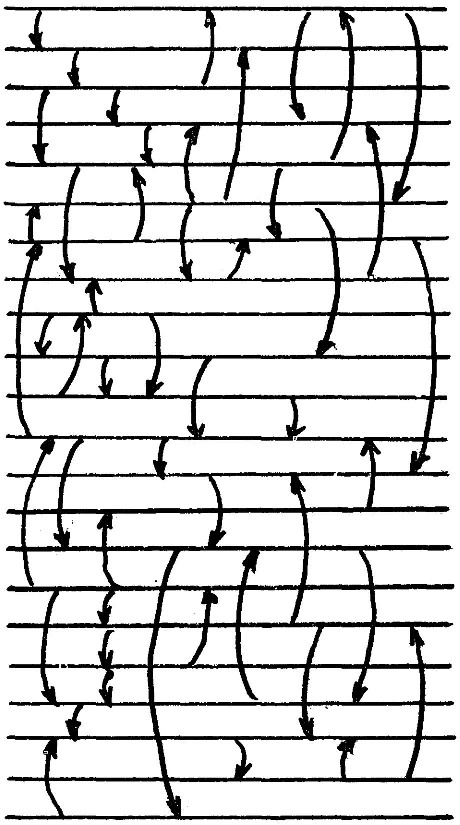


Figure 1 — Program as a system of statements.

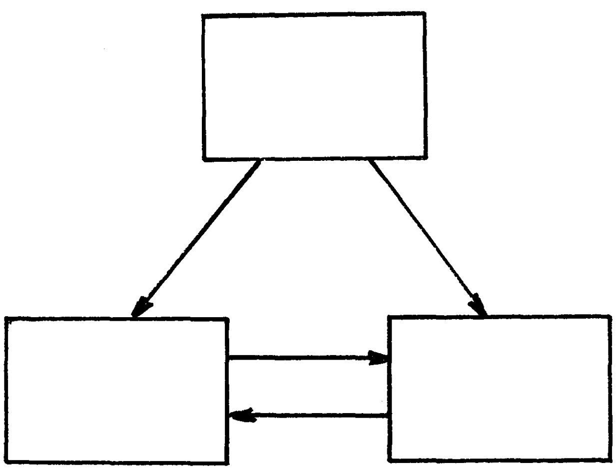
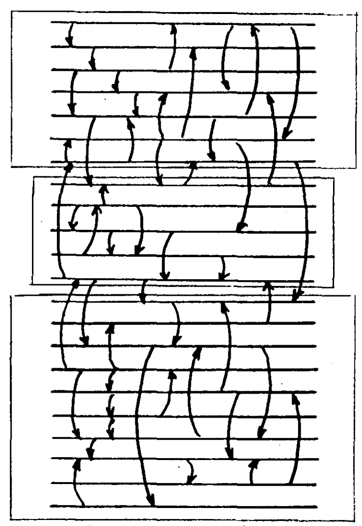


Figure 2 — Program as a system of modules.

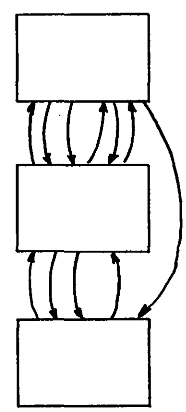
The *physical* structure defined by such aggregates can be considered to be superimposed on the *inherent* structure of the statements. Externally, then, a program is really more like Figure 2, that is, a number of "large" components, with (sometimes) fewer, more explicit interconnections. In a sense, one cannot eliminate the inherent structure. Figure 3a represents one aggregation superimposed on the program of Figure 1, resulting in the system structure of Figure 3b. Another aggregation scheme for the same program is shown in Figure 3c giving the structure of 3d. In a very definite sense, the latter structure is simpler. The components of the modules of Figure 3c and 3d are more cohesive, more related, while the modules themselves are more independent, less related.

Numerous factors are influenced by the aggregation (or in practice, segmentation) scheme. The separability of the programming task and the success of such separation will depend on the number and kind of intermodular interconnections. Ease of maintenance is largely a function of limiting the *scope* of changes. Structures with minimal intermodular connections and maximum functional cohesiveness of module content will tend to minimize the cost of correction and changes. In fact, a mathematical cost model, based on the structural theory of programs and an understanding of human information processing even indicates a strategy for minimum debugging costs. Both the components and interconnections in programs are heterogeneous sets. Modules can be classified by physical characteristics (subroutine, macro, etc.) and by constructive basis (coincidence, similarity of function, etc.) connections may be differentiated on a functional basis (input-output coupling, common environment connections, etc.). On these bases, one can make successful predictions about implementation difficulties, maintainability, and generality of the components.

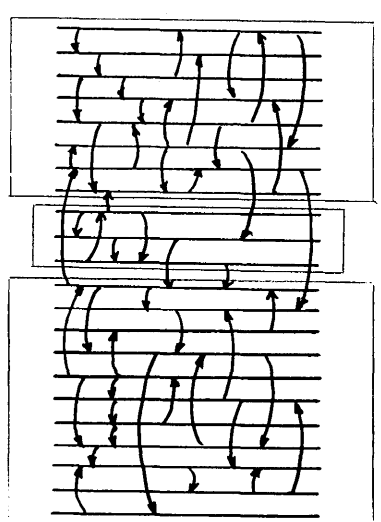
The structural theory of programs is most significant because of its implications and impact on actual program development. This is intimately tied up with the theory of programming to be discussed below.



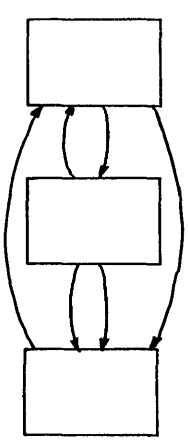
a) Scheme 1 Aggregation



b) Scheme 1 System Structure



c) Scheme 2 Aggregation



d) Scheme 2 System Structure

Figure 3 — Influence of aggregation (segmentation) on system complexity.

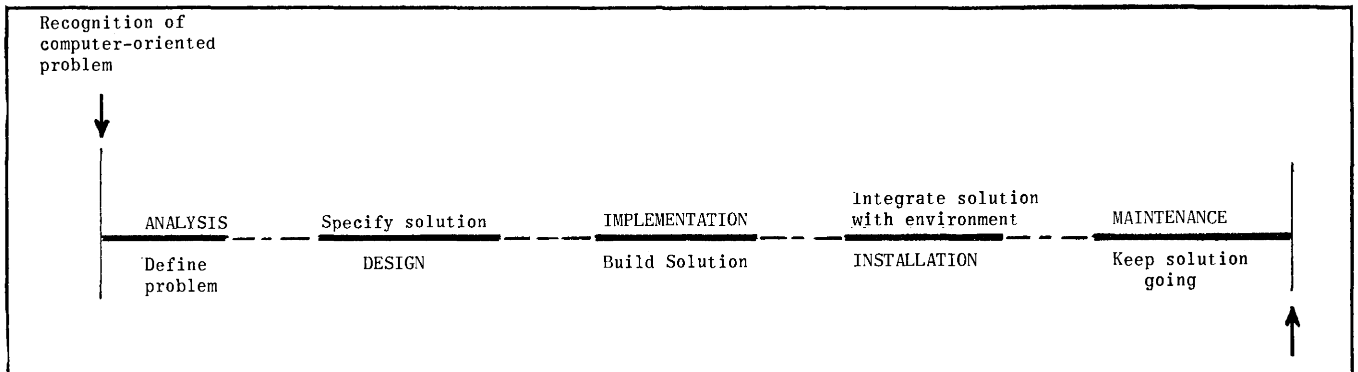


Figure 4 — Phases of programming.

A Process Theory of Programming

Almost directly from the structural theory of programs, follows a theory of programming [3]:

> Programming is a systems problem-solving process directed toward the creation of a program whose function is the solution of some portion of a given problem. Programming is performed by people. It is an engineering function which seeks optimality.

From this definition it is clear that:

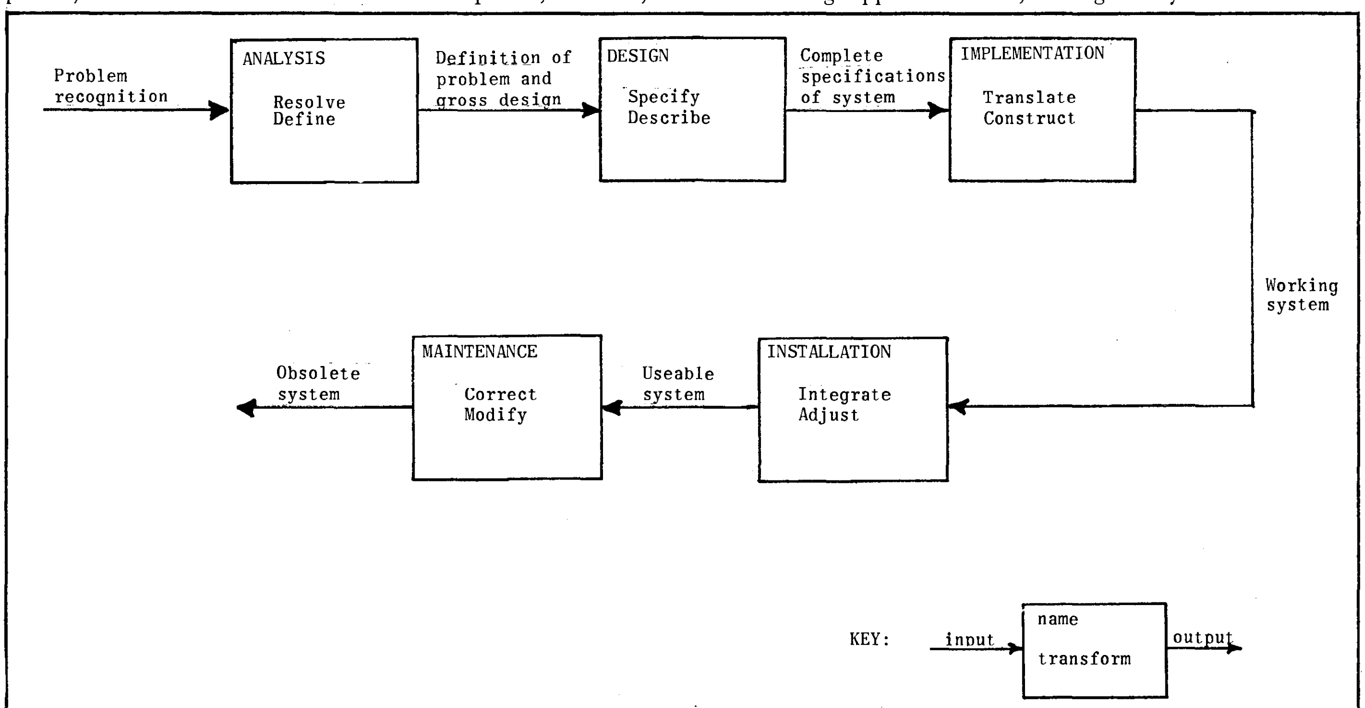
- — programming is not an instantaneous event;
- — it is an error-prone process;
- — it does not begin with writing the first line of code;
- — it does not end with writing the last line of code;
- — it is a subset of problem solving in general.

As a process, programming is divisible into phases on the basis of distinct characteristic actions and orientations. These phases are part of virtually all "inventive" problem solving, that is, human creation of a system. By definition, the operations represented by the phases in Figure 4 are a part of all programming. In practice, some phases are accomplished by non-programmers, and the division of labor varies from organization to organization. Often, explicit performance of certain functions is bypassed, resulting in the implicit (and poorer) realization of these functions in later phases, or worse, expensive and repetitive return to the functions of earlier phases.

Figure 5 simply represents the programming process as a system. The pivotal role of the design function is most important. By the definition of a program, design must specify not just the realization of the function (the algorithm or procedure) but the input-output morphology, the system boundary, the components, and their interrelationships. Particularly the last two system aspects are usually "designed" by the incidental side effects of the implementation process.

Since design must specify (describe, represent) the unimplemented program, by definition, it employs models. Potentially, any system model or documentation technique is a design tool. Because system design involves very rapid evolution, some tools may be less usable than others. Note also that tools for specifying the design of *all* system characteristics are needed. By definition, the flowchart and the decision table are not panaceas for program design. If we carry our analysis of the design function to its logical conclusion, it follows readily that morphological (external form) and structural (internal form) characteristics have more profound and direct impact on major design objectives than algorithmic considerations do. System generality, durability, and utility are all largely determined by form rather than method.

If programming is a human problem-solving process, then clearly, psychology and particularly the psychology of problem solving applies. Indeed, a large body of literature is



relevant and provides additional refinements to the theory. The problems of stimulus binding and functional fixity, the effects of considering alternative approaches, and the influence of problem complexity, have all been studied in engineering and the results apply to programming as well.

The marriage of the structural theory of programs and the process theory of programming is a formal procedure for the design of modular systems. It can be demonstrated that a systematic design approach which segments a system on strictly functional lines, proceeding downward through a hierarchical structure, tends to produce "near optimal," highly decoupled systems.

Theory and Practice

Both of the theories discussed are largely *ex post facto,* representing attempts to integrate a considerable body of everyday experience about what makes programs cost so much. It is not surprising then to find in industry both the explicit application of these two theories and the more widespread implicit use.

The advantage of a formal understanding of theory is twofold. First, by integrating diverse specialized experience, theory converts intuition and isolated instances into a systematic approach. Thus we find companies using a formal, systems problem-solving approach to programming which begins very early in the life history of programs. More and more, programmers attack the problem of generating viable, understandable programs, rather than merely efficient code. Powerful design tools which also aid in debugging and maintenance are being developed. The formalized hierarchy chart is the best example.

Experience has shown that much of this is part of the hard-won understanding of senior professionals, irrespective of their exposure to theoretical foundations. But, and this brings us to the second reason for a theory, the understanding based only on experience is not easily passed on to new programmers. It is quite safe to say that virtually *all* new programmers are more concerned with details, tricky coding, and the rapid generation of instructions than with the enormously more important considerations of logical transparency of the code to others, integral and extensive commenting, generality of control interfaces, and ease of modification. The programmer whose experience is not just right may never learn these things.

Programmer Education

It is probably true that a majority of programmers get their first exposure to programming through the university. The nature of this education is a function of two major, largely detrimental factors.

First is a general lack of communication between industry and the university relative to what is required of the computer professional. This results in little appreciation for what programming *really* is today or what industry needs are in the area. Second is the widespread university attitude toward programming. On the simple question of what programmers *do,* little agreement emerges between the university and the more advanced segments of industry. The university position *appears* to be that:

> Programmers perform a detailed, complex, but routine clerical task involving the translation of algorithms into language forms acceptable to computers.

This is a task performed mostly by undergraduates and research assistants. Training for its performance consists of exposure to the basic concepts of algorithms, coding details, and language problems. Advanced education consists of treatment of specific techniques or technical fields, such as listing processing, or assembler operation.

In contrast, the programmer's function in industry is emerging as being analogous to that of the hardware engineer with a heavy emphasis on human factors. [9] Perhaps the occasionally seen title of *software engineer* is the best label. The software engineer performs those functions implied by the structural theory of programs and the process theory of programming. He *designs* (engineers) systems whose components are program modules. He is concerned with the same objectives as the hardware engineer, endeavoring to develop inexpensive, reliable, and maintainable systems. For the company whose programmers still write efficient code instead of designing good systems, programming costs continue to rise, not just relative to hardware, but *absolutely.* And such programmers still complain about the non-usability of others' programs or marvel at the number of correction sessions late at night required by system blow-ups.

Attitudes Toward Programming

In few fields is there such disparity between outside needs and the role being played by university education. The disparity would be easily attacked if it were only a problem of communication; but the difference in attitudes toward programming creates a stronger barrier. If programming is merely a clerical task, then it does not warrant a theory. If it is routine and founded on elementary operations, then one or a very few courses on programming *per se* are all that can be expected of the university.

But universities do programming too. It would seem that they have as much at stake in an emerging theory of programming as does industry. An example might illuminate this point.

The head of a major university information project recently remarked that one of the most important results of his three years of "research" in information retrieval problems was the idea of having a flexible, generalized user control interface with extensive parameterization. His programmer has been known to pride himself in writing code so good that no one else can understand it. The modifications to the system to parameterize it were expensive.

Now, I contend that this can hardly qualify as a research result. If this researcher had had any of many thousands of good programmers from industry, armed with programming theory and an understanding of human factors, he would have had his program right the first time, by design, not research.

Just how deep the attitude toward programming and toward industry's attitude toward programming runs at the university may be appreciated through a second example. A discussion between an "outsider" and a key figure in one of the most prestigious time-sharing projects quickly centered on implementation problems of large systems. At several points in the account of the *post hoc* "modularization" of one system and the enormous communications problems of a later system the outsider was able to anticipate portions of the discussion on the basis of programming theory. Oddly enough, the university man summed up the discussion by remarking that all the problems proved that programming was still in the artisan stage and that, alas, no theory existed.

This collective blind spot on the part of the university orthodox is, of course, not universal, but neither is it uncommon. The attitude which underlies it is however almost certainly more common than the actual bias against considering alternative characterizations of programming.

Prospect

It is important to industry and the university that the discrepancy between needs, practice, and education be resolved. Should the university fail to keep pace, it may find itself in the same position relative to programming which it not too long ago found itself in regard to monolithic circuit technology, with all the real expertise in industry. Moreover, a growing percentage of university graduates are going into programming as a primary career field regardless of their official majors. It is therefore a part of the university's responsibility to provide the relevant background.

Just what is this background? Much of the curricula now available is perfectly suitable. Most universities include courses in basic programming, systems programming, programming linguistics, automata theory, and the like. What we could add to these is some exposure to systems approaches to programming or programming theory or both. Without this exposure it takes too long on the job to overcome the biases of the purely "algorithmic view." Full semester courses are critically needed in systems analysis, program design, and software design. Synopses of proposed contents for these courses are given in Table 1.

TABLE I - PROPOSED PROGRAMMING COURSES

1. Program Systems Analysis (3 sem. hours) - The systems approach, problem identification and definition in information processing, systems studies and surveys, the feasibility study. Data collection and evaluation. Process identification and design, random sequential processing. Data base organization and design. Input-output specification. Communication with system designers and implementers. Simulation techniques for systems analysis. Documentation.

2. Program Design (3 sem. hours plus computer lab) - The programming process. Programs as system, systems characteristics. Structure of programs, physical aggregates, basis for aggregation. Modularity-determinants, measures, costs. Hierarchical program structures, recursive hierarchies, operational recursion. Non-hierarchical structures, program strings, data controlled structures. Design objectives and realization of each: generality, utility, durability, efficiency.

3. Software Design (3 sem. hours plus computer lab) - Design of languages, system and support software. Problems of utility programs and large systems. Major software systems; the assembler, compiler, supervisor, applications packages, etc. Language forms, constituents, design of language features. User aspects of data and control interfaces. Language processor design. Load-time assemblages, imbedding, and other special approaches to software design.

The implementation of this program would be relatively straightforward. The content of the systems analysis course is widely known and there is no dearth of qualified instructors. This is somewhat less true of the proposed courses in program design and software design, though there is evidence of substantial willingness by those in industry to cooperate in setting up such courses.

In some respects, a shift in orientation is more important than a shift in content, although new content is one way of achieving the change in orientation. Far too many of the typical university graduates emerge with entirely the wrong attitude toward programming. This attitude is typified by their descriptions of good programmers. [7]

> ". . . and X is great. He sat down and in two days at the console wrote the entire game-playing program. It was great. It took the rest of us weeks to even figure out what the program was about."

> "I think Y is the best programmer I know. He doesn't even need to flowchart."

> "Z can debug in binary from the console lights. He keeps his programs in his head, the patches get so sophisticated that they can't be assembled and I've never seen anyone who could write tighter code than Z."

It takes several years of intensive professional experience to substitute a better set of values. The new programmer is doubly handicapped when he has neither the proper technical background nor the proper orientation.

Finally, it seems critically important to bring the university into the mainstream of programming practice for still another reason. The theory emerging from industry is tentative, incomplete, and perhaps too compromised by its pragmatism. We vitally need the theoretical contributions which the university can make, not just in mathematical optimization but in the structure of programs, not only in compiler design but in the psychology of programming. Without this contribution, formal university theory and practice will continue to be two unrelated worlds.

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C.a

MARKET REPORT

Control Data Corporation Plays Increasingly Important Role in World Computer Market

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Stanmore, Middlesex
England

When Control Data Corporation three years ago wrecked the chances of IBM's top machines with the sales success of its super-scale 6600, and almost succeeded in wrecking its own company structure at the same time, it began on a course which in the next two years will bring it into full confrontation with the giant of the world computer market and not just in the market now ripening for explosive expansion — Europe.

All the signs and portents are there to read. With every move CDC makes to broaden its product range, improve its software arsenal, and acquire other important groups, so does its strategic position improve.

Any company which can come through the hardware troubles CDC faced and overcame with the first several 6600 machines should never run into this form of loss again. "Never" is a long, long time, but stockholders will not forget the $1.68 m deficit for 1966, even though it was in part due to fast expansion and demand for rental on a lot of expensive hardware. They will make sure, as far as they possibly can, that CDC management treads warily with the next challenge to IBM, its extremely powerful and versatile 3500. But it is just to say that this management team succeeded with a big hardware problem where others threw in the sponge.

CDC Leads in Super-Giant Market

And how does CDC look on the doorstep of 1968? Good; some would say very good. It is indisputably the leader at the moment in the super-giant market, a factor which will assume growing importance as time-sharing spreads. It has an immense range of excellent peripherals, so good that there can be few big EDP manufacturers who are not using one or another of them. In this area, CDC is second only to IBM. Perhaps more important still is that stockholders are in good heart after the spectacular income rebound for 1967 to close on $250m — a figure described by IBM as the annual turnover "threshold" below which a mere computer operation is not viable.

Only a favourable assessment of market sentiment could have brought CDC to float its latest public offering of $100m worth of debentures and common stock to oil credit arrangements and help in the many acquisitions and agreements the company has on hand.

Effect of the CDC/CEIR Merger

One of the factors in market attitudes is undoubtedly the very great success the super-scales are enjoying in Europe. Another must be the successful consummation in the company's protracted negotiations with CEIR, achieved by a share exchange in a ratio of 1 CDC common stock to 6.35 shares of CEIR, of which nearly 1.7m were outstanding at the beginning of October.

Though the effects of the acquisition of this major software, applications and management advice house — which has a first-class international standing — will not be felt for probably a year or more, the move will be of immense importance as time sharing systems grow in complexity and numbers.

If the time-sharing enthusiasts are proved right, systems designed on a general-purpose, time-shared basis installed and operating all over the world should reach the 1,000 mark by 1971. As the world's total computer population by then should have reached the 60,000 mark, the ratio would seem to make the contribution from time-sharing somewhat paltry. But it must also be remembered that these 1,000 systems could have as many as 50,000 terminals which, in the absence of the time-sharing concept, would have been larger or smaller computers in their own right. This puts an entirely different complexion on the prospect and underlines just how important this market may be, particularly as the terminals would range from a simple teleprinter keyboard to a full-blown satellite computer.

There are some 50 time-sharing operations in the U.S. at present with a further 200 or so on order. Every manufacturer is working hard at perfecting time-sharing capabilities with one or several machines in its range. Some claim to have licked all the problems involved, but not CDC.

Extensive Use of Time Sharing May Be Delayed

The company's attitude to what has been described as "the new revolution in computing" by Professor Stan Gill at Imperial College, London, is that large-scale general purpose time sharing is *not* just around the corner. The reduction of theory to technology involves complex problems, solvable only by protracted, painstaking study and a large amount of experimental running.

This view was expressed publicly at a recent CDC symposium in London held to present the company to the data processing fraternity, now that Britain is to have two or maybe three 6600 giants in 1968.

The company's intentions were defined as embodying a two-fold approach — experimentation and evolutionary product development on a modular basis.

There is no doubt that CDC will find software teams within CEIR that are capable of handling major time sharing installations — the CEIR offshoot in Britain, now a fully-owned subsidiary of British Petroleum, is tackling a 400-terminal concept for major commercial users in and around London. This is no "piece of cake" and it has to be completed to schedule, since the operation must run as a normal profit-making activity, ergo delay would be doubly serious.

Concentration of Expertise

Added to CDC's own efforts in time-sharing, CEIR's skills will present a formidable concentration of expertise in a totally new dimension of computing.

At this moment in time, the company has already taken three important steps into this dimension. It has completed development of operating systems for all machines giving background batch processing, with utility routines for handling associated data flow in the foreground and an interface permitting the preparation of more foreground programs and their addition as modules.

The second step has been to provide the hardware allowing multi-access submission of batch jobs — terminals, printers, small computing devices and the like. With them goes the software which the company logically calls Export/Import.

The third stage, now under experimental operation, is a software suite for remote multi-access file manipulation in a hierarchy of capabilities. It has been called Respond. Both the foregoing interface with the basic operating system.

There are many more moves ahead, particularly in conversational mode programs, and the company is particularly enthusiastic about the new freedoms conferred on time-shared systems by an extended core storage, with capacity up to 5m characters having rather low cycle time, but with an unprecedented data transfer rate of 60 m characters/second.

The company's top machine, the 6600, counted 26 installed and working and a further 17 on order at mid-year, by which date IBM had not yet installed any system of equivalent size. Taking one step down the scale to the compatible 6400 and 6500 (first installation as recent as mid-1966) 16 were in and 22 on the books. There is no direct equivalent for IBM but the somewhat larger 360/75 counted 24 in and 39 to go.

The 3500

CDC has said specifically that with the 3500 for delivery by mid-1968, it is gunning for the 360/65-67 market. This represented at mid year respectively 100 and 10 machines installed and 300 and 50 on order.

The 3500, CDC says, out-performs the 65, costs 18 per cent less for outright purchase of equivalent configurations and leases at 20 per cent less than the quoted average of $50,000 per month for a 65. It has been running a 3500 for eight months and is proving the "Intebrid" circuit concept which links monolithics and hybrids with the former predominating.

With this machine goes an operating system called Master 1, which has been working on a number of the earlier 3300 machines since March to provide memory-paging and program-relocation. Master 2 gives the ability to handle multi-access and comprises the Respond and Import/Export suites referred to earlier.

Master 3 is intended to provide conversational mode operation and Master 4 ability to hook in extra processors.

Peripherals

While the main equipment side of CDC's activities is forging ahead, the company has not forgotten its other major activity, peripherals and the two most recent additions to its repertoire are of more than pasing interest.

One is a tape transport capable of operating data transfer up to 15 times faster than the equipment with which we are familiar. It has a 36-track head, works at 150 inches per second and will put 4 billion bits of data on a 3,600 foot reel.

Recording is either in continuous mode of variable length records with no inter-record gaps, or in variable length records with one-inch inter-records.

The other item is a user terminal, the "200", with CRT and keyboard line printer and card reader of which up to 200 can be linked to a single 6600 for remote batch and real time applications.

The European Market

All the foregoing applies with special emphasis to the first line of operations, the American market. But the company has been making a particularly vigorous effort in Europe where the EDP market is set for expansion at an annual rate far higher than that of the U.S.

In four years of campaigning for a worthwhile foothold in France, despite IBM's domination of that market, three 6600 computers are now installed there at Sud Aviation (which is building the Concorde), at Electricite de France, and — importantly — at the big Metra operational research bureau.

Metra International is one of the two backers of a London data centre keyed to a 6600 to be fully operational by July 1968. Metra's Société d'Informatique Appliquée, which installed and operated a 6600 in Paris in the latter half of 1967, will give London a flying start with massive software support.

Paris is already handling work for the U.K. users and these jobs will be transferred with no interruption.

Freeman, Fox Wilbur Smith, the London consulting engineers, form the other backing for this project which will put the first 6600 into Britain. This means that there will be the same number of data centres using the 6600 in Europe as in the U.S.

A second system of this size will follow shortly after at the politically highly charged site of London University. It will have the Metra Machine for back-up and will be critically observed from all over the United Kingdom, where academics have been engaged in bitter strife over shortages of computing power for the best part of five years.

Seven colleges will have terminals linked to the machine and there seems to be no doubt at all that once it is in and working, the British manufacturers, who have bitterly opposed the introduction and want it to be declared a purely temporary measure, will not prevent the system from expanding considerably to take in computer-assisted design and many other activities.

Other important academic centres in Britian now starved of computing power will clamour for similar facilities provided the system works well and, although money is tight, the convincing argument that without the proper tools no research worker will stay in Britain will be used on the Government.

The CERN European nuclear research centre in Switzerland to which Britain contributes one-fifth of annual spending money, has five CDC machines including two of the larger ones.

That CDC considers Britain an area of major importance for its future is shown by the fact that the company proposes to set up one of its well-known Computer Institutes in the U.K. There are four in the United States and one in Germany. These give training on the company's machines and software to staff, customers and — most important — to outside students.

The next move in Europe if the company is to make rapid inroads on the established position of IBM is a sharp expansion of its manufacturing base in Holland and an alliance, if not a merger, with an independent European EDP company. There are not many of these left and in the past 12 months there have been rumours involving CDC with UT and Philips of Eindhoven, among others.

MULTIPROGRAMMING:

WHAT IT IS . . .

WHEN TO USE IT . . .

WHAT TO LOOK FOR . . .

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"If there are several jobs to perform within a computer system, and if these jobs need not be performed sequentially, then it is feasible to use multiprogramming — which is a compromise between sequential (single) programming and multi-computer operation."

When several programs are present in a computer system with a single central processor, and each program is executed during the unused central processor time of the others, the system is a *multiprogramming* system.

The following discussion may help you determine whether such a system offers a reasonable solution to your programming problems.

Why the Need for Multiprogramming?

Multiprogramming is used in an attempt to maximize the efficiency of the central processing unit.

In most conventional scientific and data processing systems, programs are executed in sequence. The operator places a deck of cards in the card reader and presses the "read" or "execute" button. The cards are read into memory, then control is transferred to the beginning of the program. It is executed from beginning to end, performing its computation and input-output operations; then the next program is read in and operations are repeated.

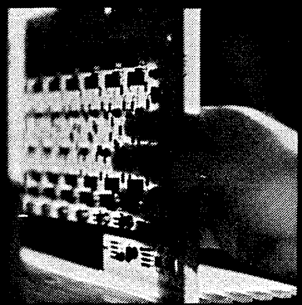
In many systems, the input/output operations, such as reading cards or magnetic tape or printing on a line printer, are performed in sequence with the computations. When an input or output is required, computation is halted, then resumed when I/O is completed. This wastes central processor time.

How Is Computing Efficiency Increased?

There is an intermixed method — employing an automatic interruption feature — for sharing the time requirements of computation and I/O to increase computing efficiency of the system. After I/O has been initiated, computation continues; when the operation is complete (e.g., a card is read or punched, or a line is printed), a signal causes computation to be interrupted automatically. Control is transferred to a program which initiates the next I/O operation, then returned to the computation.

This intermixed operation continues throughout the execution of the program. Computations are not held up waiting for input or output, nor are peripheral devices slowed down

Michael Mensh is Product Manager, Software, at Honeywell's Computer Control Division. Previously, he was a regional programming manager with G.E.'s process computer activity, and a development engineer with the Atlantic Refining Company. Mr. Mensh received his bachelor's degree in chemical engineering from Cornell University in 1955.



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waiting for computations. This is a first step toward multiprogramming.

In the above example, consider what happens if the computation should require data contained on a card in the reader. Computation must be halted until the card has been read; then it can continue. At this time, the computational portion of the programming system is at an impasse and central processor time is again being wasted. If there were another program in memory to be executed, then the time could be utilized. This is the second step toward multiprogramming.

How Does Multiprogramming Work?

In multiprogramming systems, the automatic interrupts control the sequence of input and output operations and the execution of the programs which contain the computations and I/O requests (but not I/O execution). These interrupts may occur as a result of an operator's request (e.g., pushing an "execute" or "start" button), an environmental condition affecting the computer system (e.g., an off-normal control condition in an industrial plant), or the passage of time. This last criterion allots "time-slices" to each program which are shared equally on a rotational basis between programs — a technique often used in time-shared computer systems.

In a multiprogramming system, the programs are executed in an interleaved fashion. A portion of one program is executed, then a portion of another, and so forth. Externally, all of the programs appear to be executed in parallel.

Where Would Multiprogramming Be Used?

If there are several jobs to perform within a computer system, and if these jobs need not be performed sequentially, then it is feasible to use multiprogramming, which is an economical compromise between sequential (single) programming and multicomputer operation. Ideally, each job should be performed on separate computers, all executing at the same time, or on parallel processors of one of the large scale computers. Systems of this sort are likely to be too expensive for any but large scale users; so performance must be sacrificed to some extent in order to meet financial requirements.

Some examples of situations where multiprogramming would be used are:

1. Process control
2. Scientific open-shop operation
3. Time-sharing systems

In a process control environment, the interrupts which cause control to be switched from one program to another are the result of changes in plant conditions. Such changes might be the result of a process unit in the plant varying from the control setting, the shutdown of a pump motor, or the failure of the plant electrical system. Any of these conditions would cause control to be transferred from the program being executed to the program required for proper response to the emergency condition. When the abnormal situation has been corrected, control would return to the interrupted program.

Switching from program to program is accomplished in a more orderly manner in open-shop scientific and time-sharing systems. In both cases, requests are initiated by an operator and control is passed between programs on the basis of:

1. Operator requests
2. Time allocated to each program
3. I/O and mass storage requirements

The major differences between the open-shop scientific and time-sharing systems lie in the methods of operator communication. In one case, it is primarily from the computer site; in the other, it is accomplished over long distances to and from the computer by time-sharing terminals. Thus, the time-sharing system must have a considerable proportion of its time allotted to the job of communications.

What Does Multiprogramming Cost?

As you may have guessed by now, a multiprogramming system is not simple nor inexpensive. Something must keep track of such facts as: which programs have been interrupted, which I/O devices are in use and by whom, and what is next in line for execution. The program that performs this function is as much a part of the computer system as is the central processor or the line printer. It is called the "monitor" or "executive" program and may occupy from 500 to 32,000 locations of computer memory — depending on its functions and the sophistication of the system. This program is usually complex, with extensive table or list manipulation and memory allocation capabilities. The monitor, typically, will occupy 30 to 60 percent of the working memory of the multiprogrammed computer.

Multiprogramming is also costly in time. Central processor time is used for saving machine conditions each time an interrupt occurs. More time is used to restore machine conditions as they were prior to interruption, before re-entering the interrupted program. This is required so that individual job-oriented programs in the system can ignore the fact that they are periodically interrupted. (If each program had to recognize the possibility of interruption and prepare for it, the job of programming would be nearly insurmountable.) The scheduler's jobs of allocating resources such as memory and peripheral devices and deciding which program should be executed next also take central processor time. From 5 to 30 percent of the available time of the central processor can be used up in the scheduler's overhead.

Because of the difficult job the executive programs have to do and because of the pressures to conserve memory, these executive programs are among the most sophisticated in the computer industry. Many man-years are spent by the computer manufacturers and software system designers to obtain the ultimate in elegance. These programs are extremely difficult to understand and nearly impossible to change — even when a change is desirable for some specific purpose.

Characteristics of the executive software for a multiprogramming system are:

1. The existence of all programs other than those with which he is concerned must be invisible to the programmer.
2. The executive software must be extremely general in order to provide appropriate response for situations unforeseen by the individual programmer.

Is Multiprogramming Worth the Price?

Considering the sacrifices in time and memory overhead and the high degree of sophistication required, are the benefits of a multiprogramming system worth the price? If the assignment requires parallel processing of a number of jobs and financial limitations dictate only one central processor, then, of course, it's worth it.

Usually the decision is not so clearly defined. The potential user must determine the degree of parallelism of the jobs. Could many of them really be done sequentially? Could the jobs be redefined and re-organized so that a simple, specific scheduling method could be used? Could a user put up with the extra response time? Considering the memory and other auxiliary features often required for multiprogramming (memory protection, bulk memory, etc.), would two computers do a better job at nearly the same cost?

These are questions that must be asked — and answered — before the manager can make a wise decision. Many times, a careful investigation of the system requirements will uncover timing factors and storage needs that rule out multiprogramming executive software. The alternative is to design and manufacture special purpose software to handle the requirements of the system. This software will take some time and money to produce, but it will be simpler, faster, and occupy less memory than the general multiprogramming executive. In some cases, a subset of the general software can be used, as is, or slightly modified to handle a specific job. This, too, should be investigated. After examining the advantages and drawbacks of general and special-purpose software, the user can make an intelligent decision.

What Should You Look for in a Multiprogramming Software System?

You should look for one that just meets your needs. You should not select software that forces you to accept many features not required by your system. If the system software is to be loaded, initiated, and allowed to run for long periods of time with no change, then such things as on-line compilation and debugging are not required.

On the other hand, many software systems are evolutionary. Programs are constantly being revised, old ones being removed and new ones being added. For these systems, on-line assembling or compilation and extensive debugging features with good memory and system protection are requirements. The executive software should be modular enough to allow a choice of only those features necessary for the computer system while allowing later additions of more modules for increased capability. Additions to the system should be performed with little or no modification to the existing software.

A good executive software package will also have the following features:

1. It will be coded efficiently for low storage requirements.
2. Response time to interrupts will be rapid — less than 500 microseconds from receipt of interrupt to response program.
3. Overhead time will be low — less than 10 percent of total central processor time.
4. Programmer communication will be straightforward both at the assembly language and compiler levels of coding.
5. It will have the ability to handle many different I/O devices — interchangeably and simultaneously.

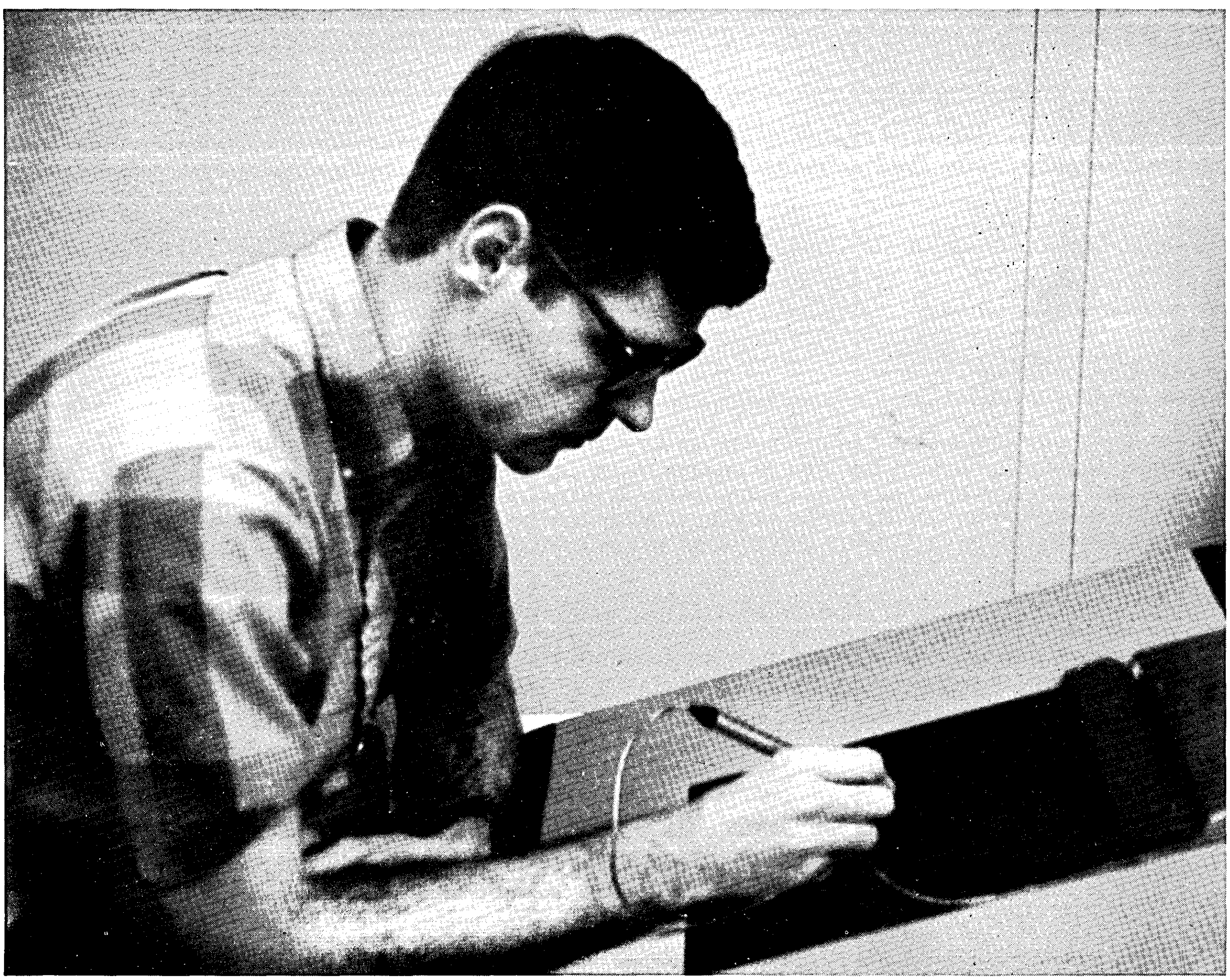
Other important features of this software are good, clear documentation and an easy-to-use operator interface. Documentation is often overlooked when evaluating these systems, but there is no substitute for good manuals at the user level. Above all, *the software chosen should be available at delivery time.* Many users have had systems installed only to find that there was "one more little bug" in the executive software. Often, this prevented the entire installation from going on line. To insure that the software is, in fact, working, it should be field tested and demonstrable in the factory.

A careful user will establish benchmarks for operating characteristics, features and documentations, before the demonstration, in order to insure the correct choice for his system and satisfactory performance in his installation.

AN INTERACTIVE PROGRAMMING SYSTEM

"If we examine the current levels of attainment in both hardware and software, we find we have 'turned the corner' in enough areas to permit specification of an interactive programming system for the casual user."

Figure 1. User seated at Graphic Table Display Console.

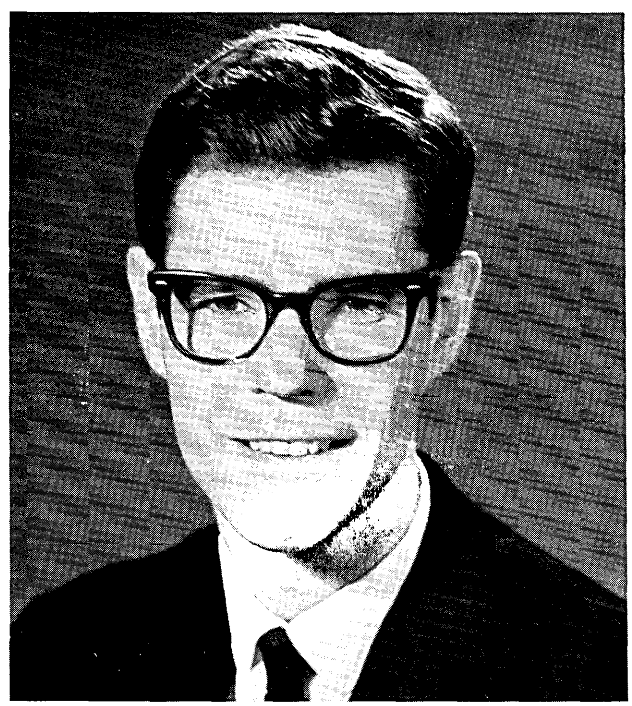


FOR THE CASUAL USER

Morton I. Bernstein and Thomas G. Williams
System Development Corp.
2500 Colorado Ave.
Santa Monica, Calif. 90406

Morton I. Bernstein is a senior computer systems specialist at SDC in the Research and Technology Division. He is a graduate of the University of Pittsburgh, B.S. mathematics, 1952. Mr. Bernstein came to SDC in April of 1965. Prior to that time, he was an advisory programmer with IBM and a programmer for The RAND Corporation.

Thomas G. Williams was born in Bellefonte, Pa. He received his professional training at the Carnegie Institute of Technology, where he received three degrees in electrical engineering: B.S., 1962; M.S., 1963; Ph.D., 1966. At present he is a senior operations research analyst with SDC in the Research and Technology Division.



One of the fondest dreams of the programming world is to provide the casual computer user — particularly the scientist or the engineer — with a system that is economical, simple to use and understand, and requires no notational change in the way problems are conceived and stated.

If we examine the current levels of attainment in both hardware and software, we find we have "turned the corner" in enough areas to permit specification of this ideal system. In fact, many of the required components either exist or are in development. The only element in doubt is the economic one, but the trend in this area is encouraging.

Hardware Capabilities

Considering the design of such a system, we find the following hardware capabilities are required:

1. A user terminal that allows the user to express his problem in a natural way. Such a terminal should be as easy to use as a pencil and paper. The terminal must provide graphic output and freehand graphic input. It must have local computing power to provide the rapid feedback needed by a user in an interactive graphic environment.
2. A central computer system that is capable of handling the load imposed by a large number of users at remote, interactive consoles.

Software Capabilities

On the software side, we require a bit more:

1. A time-sharing system that can accommodate a variety of users, numbering between 50 and 100 per time-shared central processor, and that will give rapid interactive response to all, not just a select few.
2. For the user to input his problem statement and proposed solution by hand, we must have software able to perform the real-time recognition of his inputs.
3. For the user to provide his input in the canonical notation of his discipline, the recognized input must be parsable into computer-usable form. In particular, software to edit and parse two-dimensional notations in their proper context must be available.

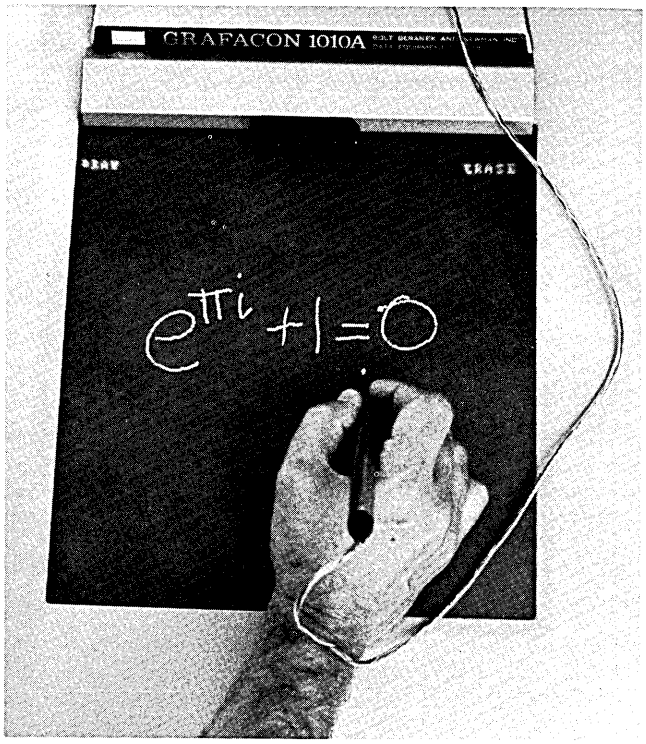


Figure 2. User's view of the displayed image as he writes at the GTD Console.

4. Since present recognizers and parsers are not infallible, the software must continuously provide the user with the current interpretation of his input.
5. Given the above, the parsed statements must be translated into statements acceptable to current problem- or procedure-oriented languages. Another alternative is to generate specific languages peculiar to each situation on the assumption that such languages would be preferable to more generalized or "universal" languages.

With the advent of time-sharing and on-line interactive graphics, a great deal of development has taken place in many of the above areas, though not necessarily with the idea of creating an ideal system. Time-sharing systems are no longer a fad; they are a reality. Both hardware and software advances have been sufficient to prove the concept desirable to a great many installations. On-line real-time interactive graphic systems — though in their infancy — are no longer confined to the laboratory as research curiosities. They are paying their way in many places. Improved, innovative hardware has helped materially in achieving a measure of acceptability for graphics.

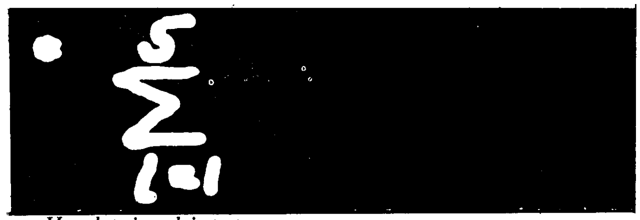
A Prototype System

The question then is, how close to realization is such a system? Most of the required components already exist and have been put together at System Development Corporation, as a prototype system. For the hardware, the user terminal is a RAND Tablet (Grafacon 1010A), for input to the computer, and a CRT display for output. The CRT image is rear-projected onto the Grafacon, so that input and output images are coincident. Figures 1 and 2 show the terminal and the projected image. The terminal is connected through a peripheral processor (a PDP-1 computer) to the AN/FSQ-32 computer, which is the central processor for the system. Details of the terminal and computer interface were described by Gallenson at the 1967 Fall Joint Computer Conference.[1]

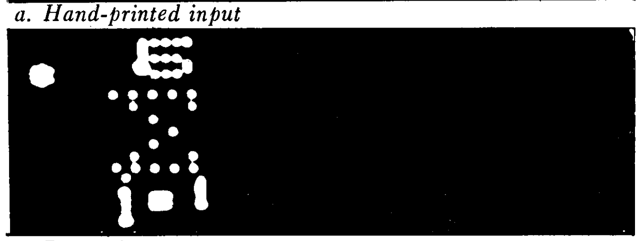
The major software component of the system is the Q-32 Time-Sharing System (TSS).[2] TSS currently serves in excess of 30 users at one time with a limitation of 47K words as the maximum program size. To support the terminal, we have prototype versions of a handprinted-character recognizer, an editor, and an expression analyzer, all of which operate under TSS.

The character recognizer is in the final stages of development.* It uses a character dictionary built for each individual user, and can recognize alphabets in excess of 80 characters. The editor permits characters to be erased or written over; entire expressions may also be deleted. The analyzer is a part of the PLANIT[3] course-writing and computer-assisted instruction system. It will compute the value of an expression written in ordinary mathematical notation. Figures 3 and 4 show some of the input forms and resultant displayed output. The parsing algorithm and allowable notation are still quite limited, but we are working on more sophisticated parsing and editing facilities that will

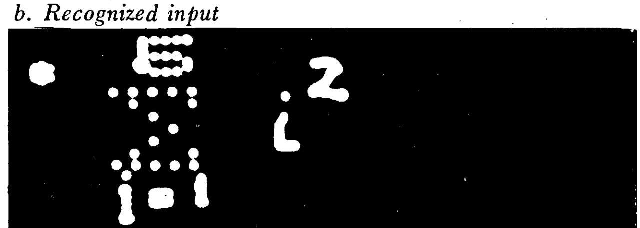
*Portions of this work were supported by the Advanced Research Projects Agency and the National Aeronautics and Space Administration.



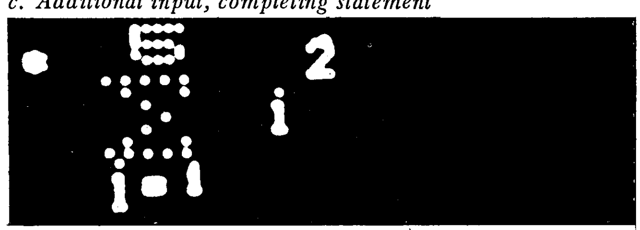
a. Hand-printed input



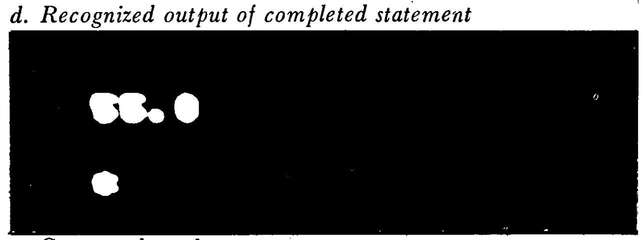
b. Recognized input



c. Additional input, completing statement

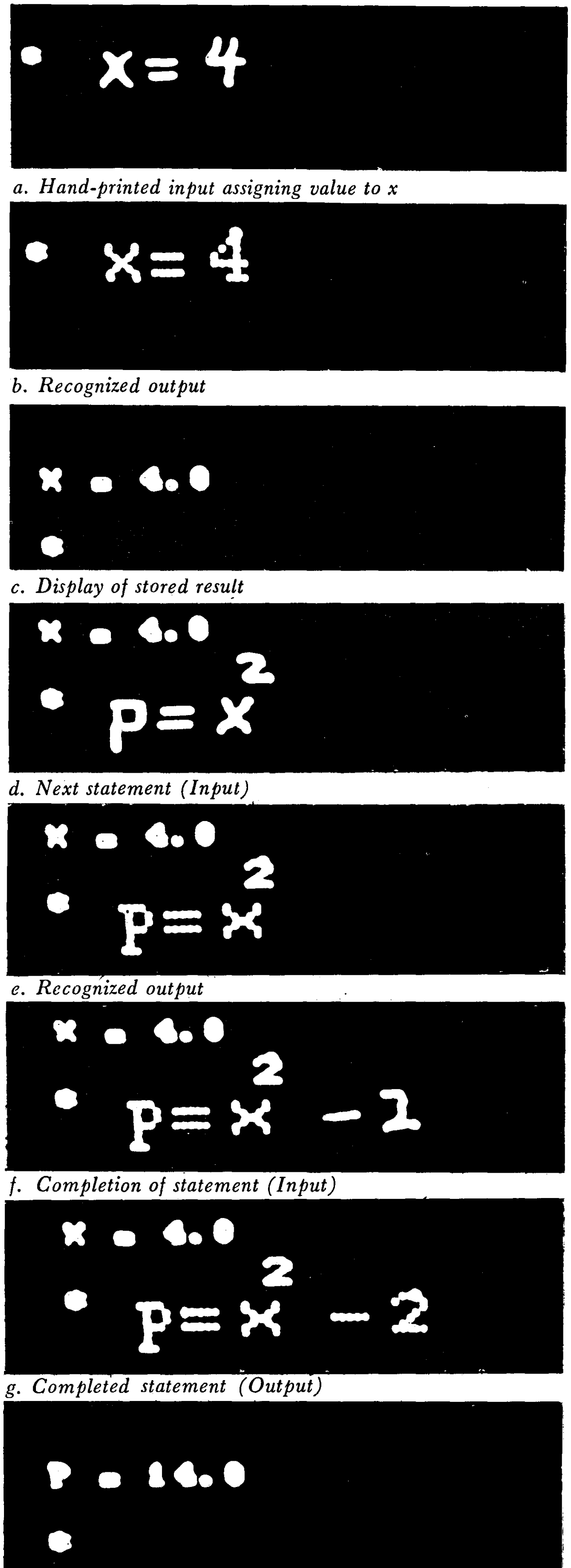


d. Recognized output of completed statement



e. Computed result

Figure 3. An example of interactive character recognition and computational ability provided by the system.



a. Hand-printed input assigning value to x

b. Recognized output

c. Display of stored result

d. Next statement (Input)

e. Recognized output

f. Completion of statement (Input)

g. Completed statement (Output)

h. Computed result using prior definition

Figure 4. Another example of interactive character recognition and computational ability.

allow the user the same freedom of expression he has using a blackboard or a pencil and paper.

Areas to be explored in the immediate future include the problem of creating special languages that can take advantage of the character set extensions which the character recognizer provides, plus the parsimony of two-dimensional notation.

The major deterrents to making this system generally available are economic. The interactive console is expensive. Time-shared computers have yet to reach the desired number of 100 simultaneous users in a general-purpose system. The communications costs of using remote consoles over long distances are still prohibitive. In time, these problems will yield to solution. Part of the impetus for their solution will come from potential users who know that such systems are at least technically feasible.

Acknowledgement

The continuing progress made on this project owes a great deal to many individuals for support, constructive criticism and direction. In particular, Henry Howell, for his work on the character recognition program, and Charles Frye, for his efforts in integrating the character recognition program into the PLANIT system, deserve special mention.

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C.a IDEAS: SPOTLIGHT

MIND STRETCHING

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Given:

$$3^2 + 4^2 = 5^2$$
$$20^2 + 21^2 = 29^2$$
$$119^9 + 120^2 = 169^2, \ldots.$$

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One of those key properties is friction, both static and dynamic. And one way to reduce friction is by lubricating the surface of the tape. But this "trick" solution is short-lived and tends to distort start/stop performance.

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PROPRIETARY PROTECTION OF COMPUTER PROGRAMS

Sheldon J. Dansiger, President
EDP Associates Inc.
527 Lexington Ave.
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"A proprietor of software can greatly increase the protection of his program, but only at the cost of greater cash outlay or slower turnaround time."

A few years ago a movie came out of Hollywood called "Picnic." It was a financial success. The movie had a theme song which enjoyed as much success in record stores as the picture had in movie theatres. The theme was an original one, but it was played in conjunction with an old melody called "Moonglow." As might have been expected, the author of "Moonglow," instituted a lawsuit, and claimed that his melody was the dominant theme and that he was entitled to the great bulk of the royalties.

The case was finally settled in court; a judge gave a necessarily subjective opinion as to how important each of the two melodies was and, in effect, answered the question whether the song was basically a copy of "Moonglow" or a great deal of it original.

The music business has suffered for many years from this problem. No objective method has ever developed for settling these disputes. In the last few years, the EDP field has suffered from the same problems of authorship and ownership in the area of proprietary protection of computer programs.

Many claims have been made that one program is merely a slight reworking of another program previously in existence. It therefore behooves a man who wants to market his program to inspect all methods of marketing. He should consider protection along with his other factors of cost, speed, and price.

Four Ways to Market Software

Basically four ways exist to market a program that you have developed:

1. Selling the program;
2. Leasing the program;
3. Offering the program through real-time access;
4. Offering the program through a service bureau.

It is up to you to decide which method best fits your needs.

Sale

In an outright sale, the program, all running instructions, listings, flowcharts, and formats are sold to a client, and the client promises to keep the information confidential.

However, since the reproduction of source and object decks is very simple, it is really only a matter of time until copies of the program have begun to circulate unrestrictedly in unauthorized areas. This method of sale is the simplest, but the most dangerous.

Leasing

The leasing of a program has the advantage of a greater total profit over a longer period of time.

The disadvantages include the same danger of unauthorized people obtaining possession of the program, the added problem of continued maintenance of the program, and the problem of billing for its use and collecting.

Real-Time Access

The real-time method consists of the program being set in your own central computer, and customers who wish to utilize the program are equipped with terminals. A program used in such a manner can only be misappropriated by highly sophisticated means. But this method requires a large capital outlay, and a large monthly expenditure to maintain it. This in turn requires a higher price to be charged for the product, and makes it harder to sell the program. In fact, the cost of the protection might cause the financial death of the product.

Service Bureau Access

With the service bureau method, the customer sends his information to you; you process it, and return it to him. This provides the highest possible level of protection of the program and a reasonably low running and maintenance cost. But the method is effective only for those customers who can accept the comparatively slow turnaround time.

To sum up, a proprietor of software can greatly increase the protection of his program, but only at the cost of greater cash outlay or slower turnaround time. In other words, it comes back to the old slogan, "you pays your money, and you takes your choice."

Sheldon Dansiger, President of EDP Associates, Inc., formed his company with three associates in June 1967. It now has over forty employees. He has been involved with computer software services for nine years. He has a B.A. in Accounting, and is the author of several other articles which have appeared in *Computers and Automation,* including "Embezzling Primer" in the November, 1967 issue.

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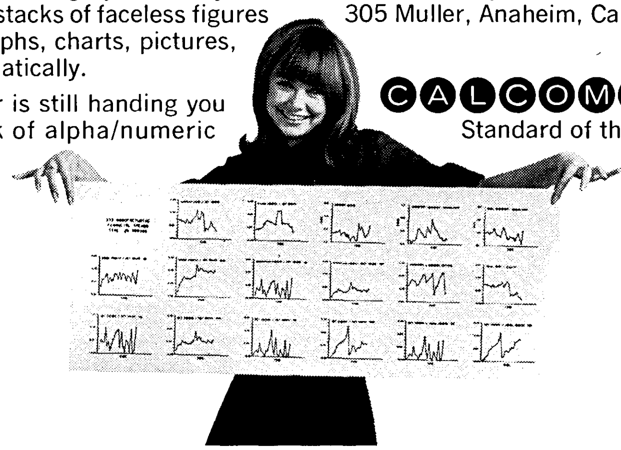

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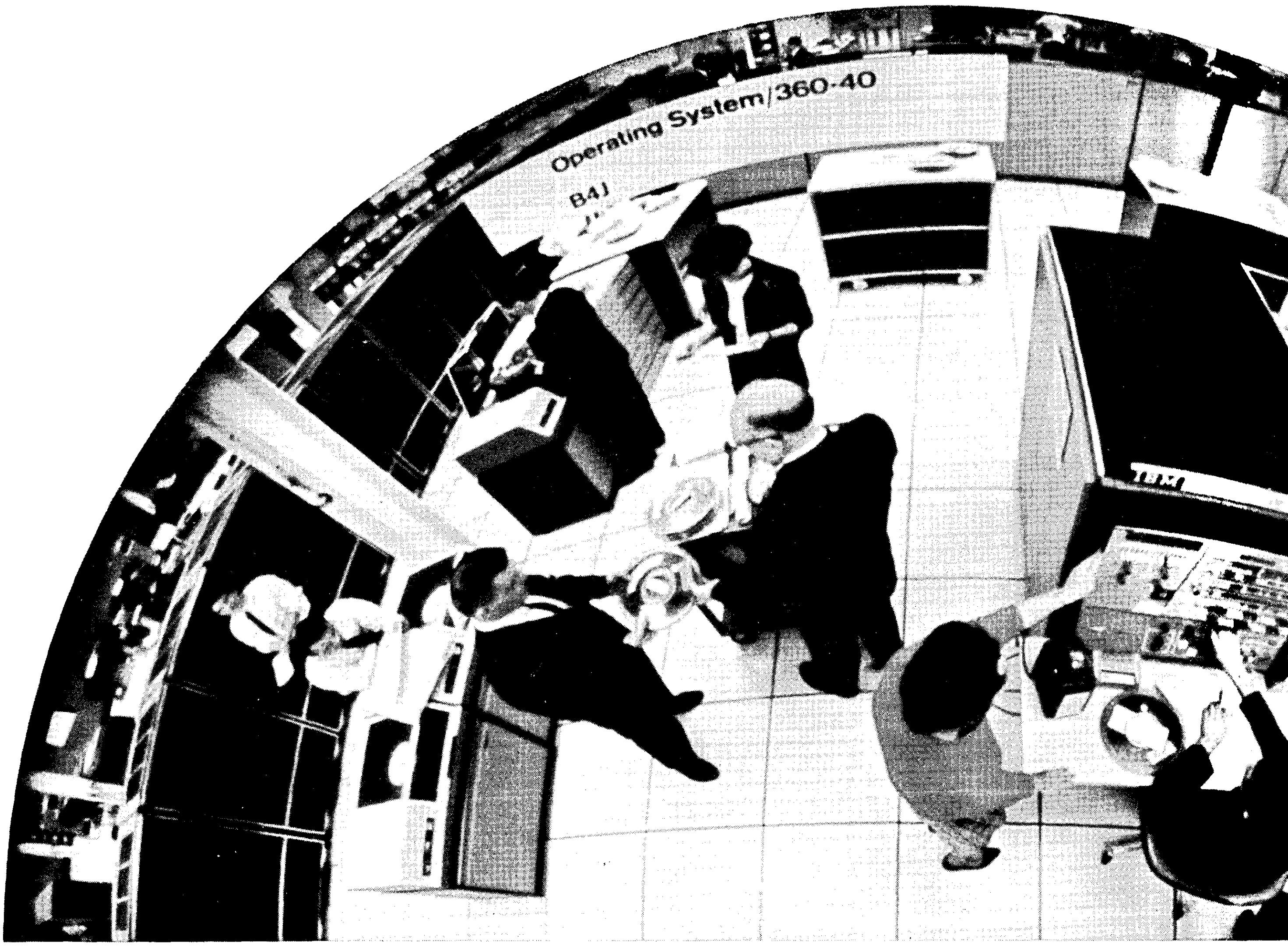

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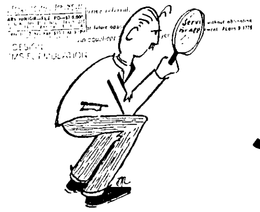

JOBS AND CAREERS IN DATA PROCESSING

Computers Open New Path to Rapid Promotions in Business

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Van Nuys, Calif. 91406

"In 1965 there were probably no more than ten men in top management who could write a computer program; today there are at least 1,000 companies where the presidents can write programs faster than trainees," writes Robert N. Farr in "EDP Education and the Objectives of Management."

Is computer education then the new passport to top jobs?

Not in itself. But it is becoming one of the basic "languages" which executives today require in order to work effectively in finance, marketing, distribution, production, research and development, and engineering.

"A business education without knowledge of computers is not complete," comments Professor Alan Row of the University of Southern California in Los Angeles. There the Graduate School of Business Administration teaches computer usage in over 20 business courses.

Industry's investment in computers is vast. Obtaining executives who speak computer language therefore has become a main factor in the search for management talent.

Booz, Allen & Hamilton, Inc., in a study of computer usage of 33 successful manufacturing firms in the U. S., reports that companies "with the most successful computer operations are those in which top management is vitally interested and participates actively in the [computer] operation."

The concern about computer education and the inadequate supply of top management familiar with the computer dramatizes an even more urgent problem: the uncertain trickle of young people into computer training and positions at the implemental level.

Employment in offices is changing drastically. Clerical workers are being displaced by a new technological "office elite," who have special training, higher pay, and upward mobility. EDP managers constitute an unprecedented management group. They frequently occupy critical positions as "interpreters" between top executives and technology on the one hand, and between raw data and department heads on the other.

This shift in skill requirements is also noted in a recently published report, "Technological Change: Its Impact on Industry in Metropolitan Chicago." There it is stated that "an estimated 30 to 40 percent of administrative and clerical workers will find their jobs eliminated or greatly changed as a result of technological development over the next 20 years."

Thus a big task ahead for government, industry, and education will be explaining to young people the new "career topography," so they can see where advancement opportunities lie.

Talk of automation is frequently played down because of the supposed fear it creates in those oriented towards traditional skills. "But the facts have to be faced. Some jobs are on their way out and others are on their way in. A more concerted and well-planned effort needs to be made to bring high school and college graduates into contact with the new opportunities. Business is searching desperately for new talent; but a majority of the applicants just don't speak the new "language" of business.

What are the options open to business?

One route taken by a number of firms is "in-house" training. Although this approach is expensive, it has the big advantage of keeping experienced employees in touch with both the problems and the new technology for solving them. This route is favored by banks for employees who are already trained in bank systems and who are being transferred into computer areas. But not all good employees can make this shift. Age is a factor, and so is compatibility with computer operations. When the program can be implemented, however, it pays well. Long-time employees have a clearer picture of the job that must be done; the task of the bank is to educate them to instruct the computers to do it.

Second, computer manufacturers are doing good training, but they are also handicapped by a manpower shortage. The overall problem of drawing young talent into the field is reflected again here.

The third way in is offered by computer training schools, such as our Institute of Computer Management. Reputable ones are well-equipped (ICM, for example, has an IBM 360 System Model 20 in each of its schools); they provide "hands-on" training, and invite inspection and investigation. The schools are seeking to attract high school graduates.

ICM executives, for example, meet with guidance counselors, business education teachers, and school department heads, and provide information on career opportunities in computer-oriented fields. They also speak before school assemblies and explain the aptitudes and training needed to qualify. Student leaders and editors of school papers are invited to visit the schools and are encouraged to write papers and essays on computer subjects.

The objective is to interest high school students in computers as a very real factor in their own futures. Computers are glamorous but forbidding to the average student. We try to present the computer as a tool in every-day existence — and a tool which a student can fairly easily learn to operate.

Developing attitudes, building confidence, persuading young people to change to newer occupations, pointing out differences betweeen dead-end situations and opportunity situations — these appear to be the big jobs ahead if computer capacity is to be adequately implemented. The penalty for not doing this is a technological slowdown in the middle of the nation's biggest capital investment in information handling equipment.

WORLD REPORT – GREAT BRITAIN

ICT and English Electric May Merge

The year ended with a double bang in Britain's EDP community. The first rocket to go off was lit by Chairman A. T. Maxwell of the International Computers and Tabulator Company who admitted, for the very first time, that talks had been held with English Electric towards the formation of a single British mainframe company. The second was a prices rocket with IBM's charges for outright purchase soaring by as much as 10 percent and Burroughs by up to 15 percent with an average of 7½ — both companies being victims of devaluation.

The merger mood has been intensified in Britain since the bitter battle by our General Electric Company to gain control of Associated Electrical Industries, a cliffhanger that went on for several weeks. But merger talk about leading U.K. computer concerns has been heard off and on for two years.

Now that one party to the talks has admitted their existence — English Electric has of course stayed mum — nothing but damage can be done to both companies by further procrastination.

Briefly, the place would be to draw together the computer activities of ICT now running at $160m a year and over 5 percent up on 1965/66, with those of English Electric which, of course, englobes Elliott Automation computers, since these were taken over at the merger between English and Elliott — two companies which have many other interests besides EDP.

To this big nucleus with its estimated annual turnover of, say, $240m, would be added sections of other companies germane to its activities such as the memory sub-group of the big Plessey organization and/or the thin film store operation by E.M.I.

But, other British concerns which have licenses to make U.S.-designed computers in Britain would be "encouraged" to desist and instead work with the new "British Computer Corporation," as the computer fraternity has christened the new hybrid.

All this would take place under the wing of the Ministry of Technology, but the Industrial Reconstruction Corporation would play no part in the merger, although it was set up for this kind of operation. Instead, the Government would take a holding in the company, put unofficially at 25 percent, which would presumably represent an outright purchase on behalf of the keystone company of the manufacturing plants built by other partners — willing and unwilling — to this complex deal.

For and Against the Merger

The snags are many and obvious. The advantages are also clear. There is truly no room in Britain for two domestic companies at each other's throats while IBM, Burroughs, Honeywell, and Univac walk off quietly with key contracts, which is what has been happening over the past five years.

ICT has made a great sales success in Britain with its 1900 series computers, which are exceptional in not being IBM-oriented. In fact, with close on 1000 machines sold, including 300 overseas, ICT has done better in three years than RCA with Spectra 70 plus English Electric with its version of these computers (System-4) and Siemens with its RCA based range.

But ICT still is not big enough to make a lasting success of its operation. It has had a Government Cash injection of $12m and is undoubtedly favored in certain contract awards coming directly under the aegis of the Government. However, its turnover is probably only half what is required to make an internationally viable computer operation. Its sales in Europe and Commonwealth countries have been encouraging but patchy, particularly in Europe where France and Sweden have been good clients but where Germany has virtually limited purchases to university machines.

The volume of production must go up if the company's cash flow is to improve enough to make its stock an attractive proposition. Hence the merger talks.

But the three moves sketched out above indicate only what the Government would like to see happen. The intended victims, that is the companies which would be asked to give up various computer-oriented activities, have other views.

Plessey and Ferranti May Be Included

Plessey is a company of international stature supplying components to the whole of the European electronics industry, including memories to all the computer makers bar one. If it has not yet bought ICT, this is only due to frowns from the Ministry of Technology. But neither the Ministry nor the Government could legally prevent Plessey from buying ICT as a major captive market taking at a guess some $60m worth of microcircuits and memories a year, once it has moved into the microversion of the 1900.

Ferranti, which sold its digital computer department to ICT five years ago along with the knowhow behind Atlas, might also come in, for the same reasons as Plessey and with the added inducement that Ferranti process control computers are compatible with the 1900. But all this is speculation. It remains to be seen how much money the government will have to put down to create a meaningful national operation. Some industry sources think that $100m would be a good round figure and it would enable the new group to go quickly into the super-scale market.

(Please turn to page 38)

WORLD REPORT — AUSTRALIA

The first recession to hit the computer industry in Australia is taking a heavy toll of the returns of the suppliers. Profits have nose-dived and in some cases have turned into losses.

Profits Go Down

IBM Australia Ltd. reported a net profit of $A326,206 for the first six months of 1967, compared with $A1,414,191 for the full 12 months of 1966. The company made its first interim report following its $A2.7 million public debenture issue earlier this year. With an estimated 40 per cent of the local market in terms of value of computers installed and on order, IBM remains the leading supplier in Australia.

Among other major American suppliers to the Australian market, Control Data suffered a loss of $A167,016 for the year ended May 31, compared with a profit of $A222,112 in the previous year.

The leading British supplier, International Computers and Tabulators, incurred a loss of $A96,619 for the year ended September 27, as against a profit of $A183,389 in the previous 12 months.

Honeywell has yet to report for the year just ended, but is expected to show a better performance than some of its competitors. In the year to December 31, 1966, the company, which also markets building, air conditioning and industrial automation systems in Australia, more than doubled profit to $A919,326.

According to one analysis of the recession, the rate of computer ordering has fallen by between 30 and 35 per cent over the past 12 months. Previously it was running at an exceptionally high rate following the introduction of the "third generation" ranges of equipment which attracted a large number of replacement orders.

The replacement demand now appears to have run its course and, in the absence of any important new product announcements recently, the current level of orders appears likely to continue for some time.

Computer Census Shows Increase in Spite of Slump

The slump was not reflected in the latest computer census by the Commonwealth Department of Labour and National Service which showed that the number of digital computers in use in Australia increased by 30 per cent from 410 to 533 in the 12 months to June this year. According to the department, 176 machines were on order on June 30, 1967.

In value terms, however, the increase was much less than 30 per cent. The highest rate of growth was among small computers costing less than $A100,000, which rose from 115 to 166, with another 54 on order.

Easily the leading company in this category was Digital Equipment which has so far delivered more than 40 of its low-priced PDP-8 and PDP-8S computers. Digital recently placed on the local market its PDP-8I machine which is offered for as low as $A11,500.

Where the Computers Are

The survey by the Department of Labour and National Service also showed that, at the other end of the scale (the $A1 million and over class), there were 15 digital computers in operation on June 30 compared with 13 the previous year. Four more were on order.

The government sector had nine out of the 15 machines in use in the highest cost category. The remaining six were distributed among the manufacturing and commercial, education, and data processing bureau sectors.

The education sector, comprising mainly the universities, had six large machines costing $A500,000 or more and 26 small machines in the under $A100,000 cost bracket.

In the geographical distribution, the survey revealed, three-quarters of the digital machines and two-thirds of the analogue machines were installed in New South Wales and Victoria.

Competition Becomes More Intense

Looking to the future, it seems certain that the existing competition among the suppliers in this relatively small but potentially lucrative market will become even more intense.

Univac re-established itself in the market early in 1967 with a major twin-computer order for the Overseas Telecommunications Commission, and is concentrating on seeking a share of the large-scale sector. Its operational installations in Australia include 10 medium and large-scale computers at N.A.S.A. establishments in Canberra and Western Australia.

Later last year, Fujitsu Limited became the first Japanese computer manufacturer to enter the market, beginning initially with an advertising campaign and with operations through a Japanese trading company.

As in the United States and Canada, General Electric, through its Australian subsidiary, is pushing ahead with the phased introduction of time-sharing. Early this year it will offer Australia's first bureau time-sharing service — a GE-235 installed in Sydney — to commercial customers, and plans are in hand to open a second service in Melbourne.

The computer business here also is bound to feel the impact of any revitalisation of the British manufacturing industry into a government-backed giant computer corporation. The main companies involved in the discussions now going on in London with the support of the Ministry of Technology are I.C.T. and English Electric both of which are strongly represented in Australia — I.C.T. through a wholly-owned subsidiary and English Electric through a 60 per cent interest in Australian Computers Pty. Ltd.

First Australian-Designed Computer Announced

The first computer to be designed and built in Australia for the commercial market was announced by E.A.I.-Electronic Associated Pty. Ltd., a subsidiary of the Massachusetts analogue manufacturer, in December.

The computer is a real baby machine. The size of a cash register, it is priced at $A1200 and is intended mainly as a trainer for students in universities, colleges and schools.

Named the EAI-180, it is smaller and less expensive than any machine produced by the parent company, and has a 76 per cent Australian-made content. This is expected to rise to more than 85 per cent when the local subsidiary of the Fairchild organization begins manufacture of integrated circuits at a South Australian plant this year.

EAI-Electronic Associates expects to obtain more than 40 orders within the first 12 months and believes there is a potential market in this country of 200 units. Potential export markets are also believed to exist in New Zealand and some south-east Asian countries, where the need for inexpensive training computers parallels the situation in Australia.

The venture has stimulated interest in local computer circles in the possibility of establishing manufacturing operations to meet other needs of the local market.

W. R. Cooper
Wahroonga, N.S.W.
Australia

WORLD REPORT — GREAT BRITAIN

(Continued from page 36)

Effect of IBM Price Increase

Will the IBM price rise of 10 percent, effective for all equipment on order at January 1, affect the merger issue? It cannot fail to, since the company has 40 percent of the U.K. market. But it may affect it in an unexpected way. Although observers might say that the moment is ripe to strike a decisive blow for the U.K. Corporation, it must be remembered that the English Electric equipment is compatible with IBM and not that of ICT. Any cancellations of IBM will thus benefit English Electric and, provided the latter pulls quickly out of production troubles, this could strengthen its resolve not to comply with Government ideas.

But apart from this consideration, there is the fact that ICT prices should not go up by more than four percent overall, improving its competitive edge *vis a vis* IBM. The year could end with a serious slippage in IBM's share of Britain's market and the emergence of Honeywell as a serious contender for the position of alternative maker, with the added attraction that all products are built in Scotland rather than France, Germany, Italy, or the U.S.

Ted Schoeters
Stanmore
Middlesex
England

CALENDAR OF COMING EVENTS

Feb. 22-23, 1968: Management Conference, the Association of Data Processing Service Organizations (ADAPSO), Jung Hotel, New Orleans, La.; contact W. H. Evans, 947 Old York Rd., Abington, Pa. 19001

March 11-13, 1968: Life Office Management Assoc. (LOMA) Automation Forum, Chase Park Plaza Hotel, St. Louis, Mo.; contact Warren Kayes, Life Office Management Assoc., 757 Third Ave., New York, N.Y. 10017

March 14-16, 1968: Sixth Annual Symposium on Biomathematics and Computer Science in the Life Sciences, Shamrock Hilton Hotel, Houston, Texas; contact Office of the Dean, The University of Texas Graduate School of Biomedical Sciences at Houston, Div. of Continuing Education, P. O. Box 20367, Houston, Texas 77025

March 18-21, 1968: IEEE International Convention & Exhibition, Coliseum & New York Hilton Hotel, New York, N.Y.; contact J. M. Kinn, IEEE, 345 E. 47th St., New York, N.Y. 10017

Apr. 3-5, 1968: The Numerical Control Society Annual Meeting and Technical Conference, Marriott Motor Hotel, Philadelphia, Pa.; contact Mary Ann Devries, Numerical Control Society, 44 Nassau St., Princeton, N.J. 08540

Apr. 23-26, 1968: Cybernetics Conference, Munich, F.R., Germany; contact H. H. Burghoff, 6 Frankfurt/Main 70, F.R. Germany, Stresemann Allee 2, VDE-Haus

Apr. 30-May 2, 1968: Spring Joint Computer Conference, Atlantic City Convention Hall, Atlantic City, N.J.; contact American Federation for Information Processing, 345 East 47th St., New York, N.Y. 10017

Apr. 30-May 3, 1968: The Association for Educational Data Systems Convention, Hotel Texas, Fort Worth, Tex.; contact Convention Coordinator, Assoc. for Educational Data Systems, 1201 16th St., N.W., Washington, D.C. 20036

May 1-3, 1968: Sixth National Workshop Conference of the Interagency Data Exchange Program (IDEP), Ambassador Hotel, Los Angeles, Calif.; contact Peter Amedeo, Grumman Aircraft Engineering Corp., Bethpage, Long Island, N.Y. 11714

May 1-3, 1968: Joint National ORSA/American TIMS Meeting, St. Francis Hotel, San Francisco, Calif.; contact Miss Joan T. Sullivan, Computer Usage Co., Inc., 3181 Porter Drive, Palo Alto, Calif.

May 3-4, 1968: Fifth Annual National Colloquium on Information Retrieval, University of Pennsylvania, Philadelphia, Pa.; contact Dr. David Lefkowitz, Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, Pa. 19104

May 8-10, 1968: Electronic Components Technical Conference, Marriott Twin Bridges Motor Hotel, Washington, D.C.; contact F. M. Collins, Speer Res. Lab., Packard Rd. & 47th St., Niagara Falls, N.Y. 14302

June, 1968: Sixth Annual Conference of The Special Interest Group on Computer Personnel Research of the Association for Computing Machinery; contact A. J. Biamonte, Program Chairman, West Virginia Pulp and Paper Company, 299 Park Ave., New York, N.Y. 10017

June 12-14, 1968: Annual Meeting, The Association of Data Processing Service Organizations (ADAPSO), Waldorf-Astoria, New York, N.Y.; contact W. H. Evans, 947 Old York Rd., Abington, Pa. 19001

June 25-28, 1968: DPMA International Data Processing Conference and Business Exposition, Statler Hilton Hotel, Washington, D.C.; contact Mrs. Margaret Rafferty, DPMA, 505 Busse Hgwy., Park Ridge, Ill. 60068

June 25-27, 1968: Second Annual IEEE Computer Conference, International Hotel, Los Angeles, Calif.; contact John L. Kirkley, 9660 Casaba Ave., Chatsworth, Calif. 91311

July 8-11, 1968: SHARE-ACM-IEEE Fifth Annual Design Automation Workshop; Washington, D.C.; contact H. Freitag, Program Chairman, IBM Thomas J. Watson Research Center, P.O. Box 218, Yorktown Heights, New York, 10598

July 15-18, 1968: Fifth Annual Design Automation Workshop, sponsored by SHARE-ACM-IEEE Computer Group, Washington, D.C.; contact Dr. H. Freitag, IBM Watson Research Ctre., P.O. Box 218, Yorktown Heights, N.Y. 10598

July 29-31, 1968: Conference on Pattern Recognition (IEE Control and Automation Div.), National Physical Laboratory, Teddington, Middlesex, England; contact Conference Dept., Institute of Electrical Engineers, Savoy Place, London, W.C.2, England

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

Aug. 27-29, 1968: Association for Computing Machinery National Conference and Exposition, Las Vegas, Nev.; contact Marvin W. Ehlers, Program Committee Chairman, Ehlers, Maremont & Co., Inc., 57 West Grand Ave, Chicago, Ill. 60610

Oct. 14-15, 1968: System Science & Cybernetics Conference, Towne House, San Francisco, Calif.; contact not available

Oct. 20-23, 1968: International Systems Meeting, Systems and Procedures Assoc., Chase-Park Plaza Hotel, St. Louis, Mo.; contact Richard L. Irwin, Systems and Procedures Assoc., 24587 Bagley Rd., Cleveland, O. 44138

Oct. 28-Nov. 1, 1968: Business Equipment Manufacturers Assoc. (BEMA) Annual Business Equipment Exposition and Management Conference, International Amphitheater, Chicago, Ill.; contact Laurance C. Messick, Business Equipment Manufacturers Assoc., 235 East 42nd St., New York, N.Y. 10017

Oct. 29-31, 1968: Fall Joint Computer Conference, San Francisco, Calif.; contact AFIPS Headquarters, 345 E. 47th St., New York, N.Y. 10017

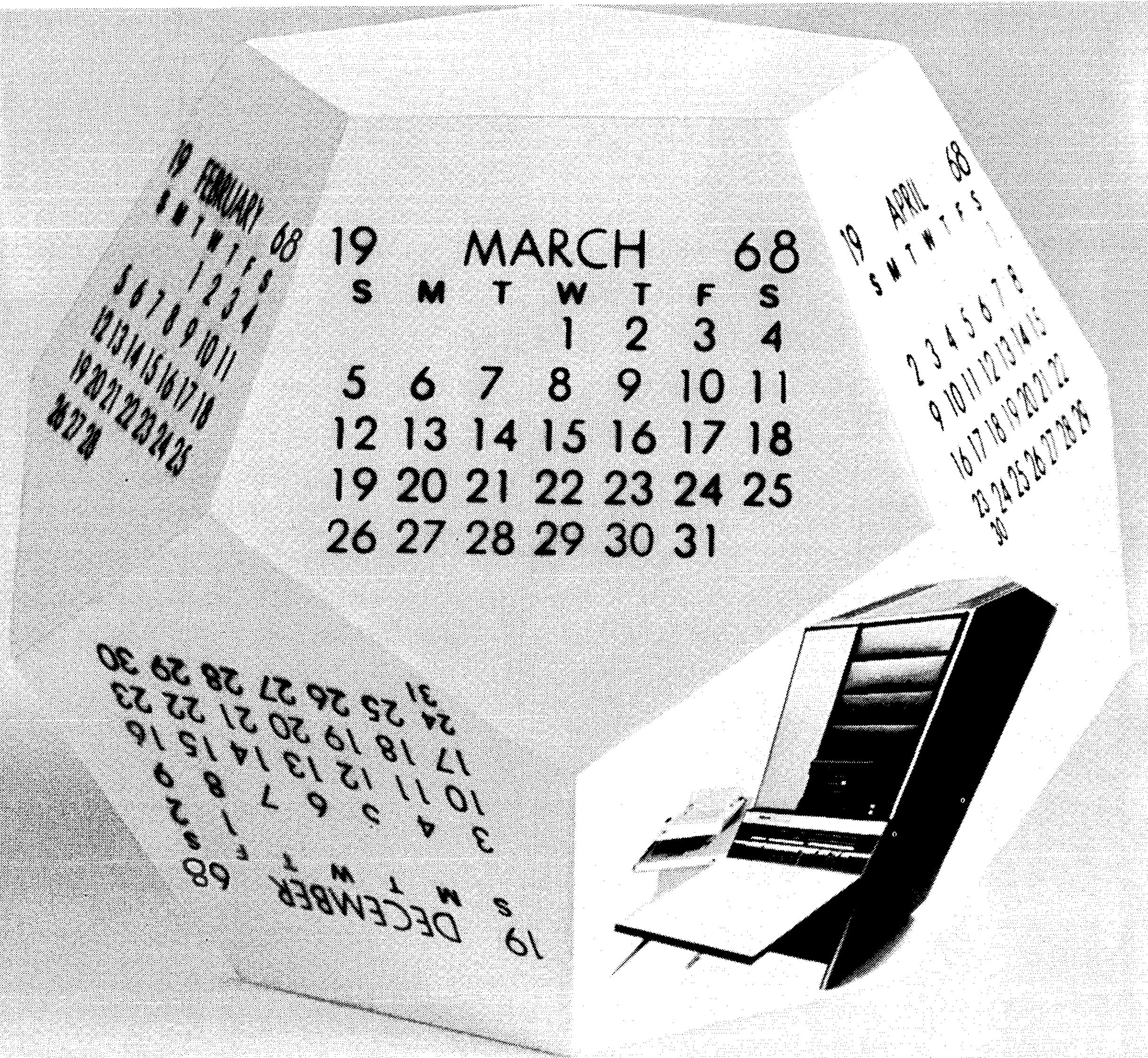
Nov. 17-21, 1968: Engineering in Medicine & Biology Conference, Shamrock Hilton Hotel, Houston, Texas; contact not yet available

Dec. 9-11, 1968: Fall Joint Computer Conference, San Francisco Hilton Hotel, San Francisco, Calif.; contact American Federation for Information Processing (AFIPS) 345 E. 47th St., New York, N.Y. 10017

May 13-15, 1969: Spring Joint Computer Conference, War Memorial Auditorium, Boston, Mass.; contact American Federation for Information Processing (AFIPS), 345 E. 47th St., New York, N.Y. 10017

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

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



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ACROSS THE EDITOR'S DESK

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APPLICATIONS

NAVAJO TRIBE USING COMPUTER TO PERFORM MORE THAN 125 DISTINCT PROJECTS

In a land of contrasts, where Navajo children are learning both the "new math" and the traditional art of handweaving rugs, tribesmen are using an IBM System/360 to help control tribal expenditures and to manage a million-dollar-a-month income. A staff of twenty-one, eighteen of whom are Navajos, man the data processing center on day and evening shifts.

During the day, young Navajos may be using their computing system for a variety of purposes: to run a statistical analysis of oil leases; to produce budget up-dates on construction projects; or to prepare utility bills. At night, many tribesmen sleep in scattered and isolated camps. Because they prefer it that way, some Navajos will go to bed on dirt floors in mud and log huts, wrapping themselves in sheepskin, as their ancestors slept.

The Navajo Tribal Council, a 74-man elected legislative body, governs the tribe's affairs. The tribe's main source of income is derived from royalty payments on oil, gas and uranium leases, scattered across the Navajo nation's mile-high, 15-million acre reservation in Arizona, New Mexico, and Utah. Other tribal enterprises include two motels, two restaurants, a saw mill, a coal mine, and a crafts guild which sells handwoven rugs and silver and turquoise jewelry.

Tribal funds are spent in such activities as developing the resources of the land, digging water wells, operating courts and a police department, and improving housing and roads.

Raymond Nakai, tribal chairman and a former radio broadcaster in Flagstaff, said, "Contrary to popular belief, individual Navajos do not receive income from mineral rights or fron the federal government. The Navajo people still earn their living from their farms, or wages from the increasing number of new industries attracted to the area. However, per capita income is low."

The tribe uses its computer system to perform more than 125 distinct projects, varying from preparing statements for the tribe's credit union members to maintaining an inventory of all livestock on the reservation. The livestock inventory enables the tribe to quickly know how to distribute grain supplies during winter emergencies.

Other computer applications include inventory of all tribal equipment, analysis of water well drilling costs and maintaining circulation lists for subscribers to the Navajo Times, a weekly publication owned by the tribe.

"Dineh" or "The Prople", as the Navajos call themselves, are investigating ways to apply the computer in planning for their future. The tribe now is making master plans for some 40 new communities on the reservation. They will be looking at ways to use their computing system to help determine population trends and to predict such needs as water supply, utility, service, sewers, streets and shopping centers.

ESSEX PLANT COMPUTER TESTS THERMOSTATS AUTOMATICALLY

Thermostats that do everything from controlling the cooking temperature of a roast to keeping a guided missile on target are being tested by a computer under the conditions they will encounter once in use. The advanced electronic testing system was put into operation at the Controls Division of Essex Wire Corp., Mansfield, Ohio, soon after installation last year of an IBM 1800 data acquisition and control system.

Operations Manager Chandler Stevens said the computer, linked to automated testing devices, puts each of the Stemco thermostats made at Mansfield through its paces, testing it at temperatures ranging from minus 30 degrees to 500 degrees

Farenheit. "As a result," Mr. Stevens said, "we know the performance record of a thermostat before it is shipped to the Army and we are assured through testing that it will not cause a missile to stray off course."

Explaining the role of a thermostat in a guided missile, Mr. Stevens said, "A thermostat simply is an on-and-off switch which responds to temperature changes instead of being physically activated. It controls the temperature level within the missile where electronic circuits and other sensitive devices are housed. As a missile climbs into the atmosphere, the cooler outside air must be offset with more heat inside the missile to keep all guidance circuits operating properly. On reentry, the reverse is true."

— Here, Dottie Henry begins to load a batch of dime-sized thermostats that control the heat level in computers, into an air heated "testing pot"

The company's IBM 1800 computer monitors tests and provides instructions for eight thermostat testing stations, each of which can check a batch of 35 thermostats at a time. In six of the stations, thermostats are bombarded with heated air to test their reaction to changes in temperature. It takes 20 minutes to test each batch at prescribed increments up to 500 degrees Farenheit. At two of the testing stations, thermostats are immersed in water heated at increments of one degree at a time, up to 210 degrees Farenheit. This test requires about 30 minutes as it also checks to insure the thermostat is hermetically sealed.

The method for testing a thermostat, water versus air, is based on its intended end use or on performance specifications outlined by the user. If a thermostat does not perform properly, the computer will identify it and indicate the phase of the test it failed. The device is then removed and either adjusted or scrapped, depending on the nature of the failure.

DOCUMENTARY EVIDENCE FOR COURT CASE ORGANIZED BY COMPUTER AT INFORMATION ENGINEERING

A computer was used recently to organize a mass of documentary evidence for a court case. The citations were arranged in several ways: by date, by document numbers, and by every principal person involved. A key-word-in-context index (a concordance) to the citations was prepared.

The significant result is that pieces of evidence were brought together in a way that enabled the attorneys to perceive relationships among these pieces that would not otherwise have been discovered. The manipulations required to organize the data would have been impractical by any manual technique.

The work was carried out for a client by Information Engineering, Philadelphia, Pa.

TEXAS INSTRUMENTS USES COMPUTER-CENTERED CIRCUIT CALIBRATOR

A computer-centered circuit designer/calibrator, fabricated and delivered by IRA Systems Inc. of Lexington, Mass., now is fully integrated into the production of diode/resistor circuitry at the Control Products Division of Texas Instruments Inc., Attleboro, Mass. Replacing a manual calibrator which averaged seven minutes per circuit, the IRA system averages one minute per circuit. This seven-times reduction has enabled a corresponding decrease in labor and substantially increased accuracy, with virtual elimination of human error.

The circuit designer/calibrator is capable of automatically finding a set of three interdependent resistors needed to match a diode pair or quad to five different voltage/ampere ratios. The system is built around a small third-generation computer, a precision digital voltmeter, programmable resistors, an ASR 33 teletype, a computer-selectable current source and a device-select matrix. The calibrator also final-tests circuits after the selected resistors are soldered to the diode circuits.

The interface hardware, precision current generator, circuit scanners and system software were designed and developed by IRA Systems Inc. after a thorough analysis of the particular requirements of the diode circuit production procedure. A unified systems approach to this problem turned this complex job into a "turnkey" operation in approximately 100 days.

NATIONAL BUREAU OF STANDARDS INSTITUTE FOR MATERIALS RESEARCH APPLIES AUTOMATION AT THE CRYSTAL DATA CENTER

The Crystal Data Center of the Institute for Materials Research has as a major mission the revision of Crystal Data Determinative Tables. These tables, when completed, will appear as a National Bureau of Standards (NBS) publication within the National Standard Reference Data Systems (NSRDS) series. The tables will contain crystallographic data abstracted from the scientific literature and comprise a bibliography for the use of crystallographers, mineralogists, chemists, and physicists.

The first edition of Crystal Data, which was published in 1954 by the Geological Society of America as Memoir 60, contained about 6000 entries including data current to January 1, 1952. In 1963 the second edition appeared as Monograph Number 5 of the American Crystallographic Association and contained around 13,000 entries current to January 1, 1961. The third edition, being prepared under the general management supervision of the Crystallography Section of the NBS Institute for Materials Research, will contain approximately 30,000 entries and be current to January 1, 1967.

The third edition will be produced by tape-controlled photocomposition. The editing of the tape will be done by computer.

The text and data are being keyboarded into punched-paper tape, partly from the previous edition and partly from sheets on which new information has been recorded. One-fourth to one-third of the information is new. Keyboarded data are processed through a phototypesetting machine which produces a film positive. The film positive is proofread and corrections marked.

All data from these tapes are transcribed automatically on magnetic tape by a special transcriber. The magnetic tapes are fed into a general purpose computer, which first inserts the corrections and then performs a variety of editing tasks. The information is arranged into the order in which it is to appear in print. The computer then prepares two alphabetical indexes — one by chemical formula, one by chemical compound name. These are put automatically into the arrangement in which they are to be printed.

Finally, the computer deletes certain keypunched signals which are not wanted in print and breaks the copy into lines of proper length, inserting spaces between paragraphs, breaking into pages, inserting page headings and page numbers. The output of the computer is recorded on magnetic tape which is converted to 15-level paper tape. The latter drives a photocomposition unit operated by the Government Printing Office.

Production by computer should save time — the second edition took three years to produce — and avoid errors in routine indexing through its automatic checking features. Another great advantage is expected to be the ease of inserting future corrections and additions; completely up-to-date information always will be available on tape and can be printed more frequently with less effort.

COMPUTER IS OPERATING DRILLING RIG FOR HUMBLE OIL

First use of a digital computer to control oil-well drilling operations is being carried out by Humble Oil & Refining Company in the Bayou Carlin oil field of South Louisiana, the company has announced. Humble, chief United States affiliate of Standard Oil Company (New Jersey), said the computer-control system was developed and now is receiving its first test in the company's Louisiana drilling program for the purpose of obtaining efficient operation of drilling rigs at the minimum cost. Studies are continuing at the drilling site, according to Humble, both to develop further the potential of the new control system and to measure its economic benefits.

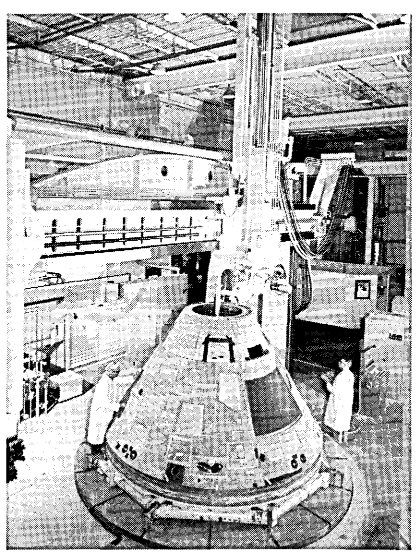
The computer assists in the drilling process by scanning and analyzing electrical signals from sensing devices on the rig floor. The signals provide a measurement of various drilling factors, such as the weight on the drilling bit and the speed at which the drill pipe is turning. The rate of penetration through the underground formations is tested automatically at different bit weights and rotary speeds, and the computer determines the combination of bit weight and rotary speed which will result in the lowest drilling cost.

Minimum-cost drilling forumlas which the company developed are used in the computer system, being developed in conjunction with the Rucker Company, Systems & Control Division, Oakland, Calif. Incorporated into the minimum-cost formulas are various drilling measurements — including the drilling rate, formation properties, the rate of drilling bit wear, and associated costs.

The electronic equipment includes a Honeywell DDP-116 high-speed digital computer.

IBM COMPUTER HELPS CENTURY-OLD MACHINE TURN OUT HEAT SHIELDS FOR ASTRONAUTS

The massive turret lathe pictured below, built 40 years before the Wright brothers flew the world's first airplane, is playing a vital role in America's space program. The 25-ton machine — with an assist



from an IBM computer — is shown shaping an ablative heat shield designed to protect astronauts during their fiery return from outer space. These shields, for Apollo space vehicles, are made in Lowell, Massachusetts by the Space Systems Division of Avco Corporation.

Each heat shield must withstand temperatures ranging from 150 below zero to 5,000 above. And, since a shield is subjected to different temperatures at different points on its surface, Avco engineers save weight — and, consequently, fuel — by varying thicknesses at these points. The hotter it gets, the thicker the shield... and vice versa.

An IBM System/360 Model 75 is used by Avco to calculate the required thicknesses of the shield at one half million points. The computer then produces 50,000 feet of punched tape that guides the turret lathe through the intricate shaping process. The shields are made of a resinous material developed by Avco scientists.

TWO MILE LONG ELECTRON BEAM PROBES ATOM WITH AID OF COMPUTER

A beam of electrons traveling at almost the speed of light through a two-mile long copper tube, ends in a room at the Stanford Linear Accelerator Centers (SLAC), Stanford, Calif. Three massive spectrometers, one weighing 1,700 tons, are used by nuclear physicists to probe the submicroscopic world of the atom. Each spectrometer contains a maze of magnets which directs atomic particles so that they can be measured.

The electron beam also bombards various substances such as hydrogen and copper, creating a shower of new atomic particles. These particles are directed into chambers where their tracks are photographed. With these photographs, scientists can see how particles interact, collide and curve when influenced by magnetic fields.

By a process of electronic scanning, each photo is converted into a series of numbers, which is stored in an IBM System/360 Model 75. Once in storage, the data from the spectrometers and the photo chambers can be converted into meaningful charts and graphs and displayed on a television-like device for the physicist.

ORGANIZATION NEWS

FOUR TOP COMPUTER MANAGEMENT OFFICIALS FORM COMPUTER LEARNING CORP.

Four computer executives from Control Data Corporation and Planning Research Corporation have resigned from their management positions to form a new company specializing in computer education and training. Forming the new company — called Computer Learning Corporation — are:

Thomas E. Stone, a former Vice President of Control Data Corporation who will serve as President of the new company.

Swen A. Larsen, the head of one of the largest computer training organizations in the world. He established and was president of Control Data Institutes in the United States and Europe, (a wholly-owned subsidiary of Control Data Corp.) and until his resignation from Control Data, he also headed Automation Institutes of America, a chain of some 50 computer schools across the United States. He will serve as Vice President of Computer Learning Education Centers.

Robert F. McIntosh, a former General Manager, Management Control Systems Division of Planning Research Corporation, a Los Angeles Computer firm. He will serve as Vice President of Education Development and Consulting Services.

William C. Thompson, former Regional Manager of Applications Analysis at Control Data Corporation, who will serve as Vice President for Management Education and Special Services.

Mr. Stone said in a statement that the new organization will provide a full range of computer education and training programs for three major areas of need by the computer industry: 1) Young men and women looking for a career; 2) the computer professional trying to keep posted on the latest software and hardware applications/techniques and; 3) the executive and manager who wants to learn practical applications of computers and data processing.

Mr. Stone said, "It is my judgment that more organizations will follow our lead in providing a 'one-stop' computer education/training center to supply the vast needs consumed today and tomorrow by the computer industry. To keep up with this dynamic technology people of all sorts must be trained, retrained, educated and reeducated — that is where we come in."

GE AND SYSTEMS CAPITAL CORP. AGREEMENT MAKES SOME GE COMPUTER LINES AVAILABLE FOR LONG-TERM LEASING

General Electric and Systems Capital Corporation (SCC) have concluded an agreement that will make several General Electric computer lines available under a variety of long-term leasing arrangements. In a joint announcement, the two companies said that under the SCC plan General Electric will sell GE-115s, GE-200 and GE-400 line computers to SCC which will in turn arrange for long-term leasing to computer users who elect this arrangement. The new plan will be in addition to standard GE sale and lease agreements.

Systems Capital Corporation, with administrative offices in Phoenix and Philadelphia, Pa., specializes in the development and implementation of leasing programs in a variety of industries. SCC will offer the General Electric computers at a range of rental prices which diminish as the length of lease increases. Four-year leases will be available at 92.5 percent of each year's standard rental cost; five-year leases at 90 percent; six-year leases at 85 percent.

Louis E. Wengert, Deputy Division General Manager of GE's Information Systems Division, said that the arrangement represents a significant step forward in the financing of computer systems. Mr. Wengert pointed out that under the new "4-5-6" plan, GE computer users would have available the most comprehensive and flexible set of financing plans in the industry.

PARAGON SYSTEMS ENTERS DIGITAL PERIPHERAL FIELD

Paragon Systems, Inc., Houston, Texas, is entering the expanding field of independent digital peripheral equipment manufacturers. Paragon Systems has designed and is manufacturing high speed digital I/O peripheral devices; analog and digital graphic display and hardcopy recording equipment and is performing custom interfacing tasks for other firms.

William W. Witt, president of Paragon Systems, stated that the company plans to design, manufacture and market applications-oriented digital peripheral equipment including a complete graphics terminal product line with hardcopy produced on dry write strip recorders and an on-line digital plotter product series.

NCR, SANDERS ASSOCIATES ANNOUNCE MULTI-MILLION-DOLLAR AGREEMENT

The National Cash Register Company and Sanders Associates of Nashua, N.H., have announced a multi-million-dollar agreement covering world-wide marketing of Sanders data display systems for use with NCR computers. The new data display system, to be known as NCR 795, offers on-line, visual communication between the user and the company's 315 family of data processing equipment. Any data ordinarily included in a computer printout can be flashed on the display screen for instantaneous use. First deliveries of the equipment are scheduled for this month.

Owen B. Gardner, NCR's data processing vice-president said, "This agreement will enable our customers to benefit from the most advanced commercial data display system available. It will result in a variety of applications in retailing, banking, and industry."

Sanders Associates has been in the field of display technology for six years. The company's display systems are installed at Cape Kennedy and the Marshall Space Center for automatic checkout of the Saturn V missile.

COMPUTER APPLICATIONS INC. PURCHASES HOME TESTING INSTITUTE/TVQ, INC.

Computer Applications Inc., New York, N.Y., has purchased Home Testing Institute/TvQ, Inc., a leading market research firm engaged in product testing, consumer surveys and TV audience research. HTI/TvQ, Inc., established in 1953, is based in Manhasset, Long Island, N.Y.

John A. DeVries, president of Computer Applications, said the purchase of HTI/TvQ, Inc., is consistent with the firm's long established philosophy of extending and fortifying a broad base of operations in the fast-paced information industry.

Henry Brenner, founder of HTI/TvQ, Inc., will remain with the company in his present capacity as president, Mr. DeVries said.

MOHAWK DATA SCIENCES TO ACQUIRE DASA

V. E. Johnson, Chairman of the Board and President of Mohawk Data Sciences Corp., and Richard S. Leghorn, President of DASA Corporation, announced jointly that their corporations had reached agreement in principle for the tax-free acquisition by MDS of the assets of DASA for shares of MDS common stock.

The acquisition is subject to approval by the Boards of Directors of both companies and the stockholders of DASA, the preparation and execution of a definitive agreement and plan of reorganization, and the compliance by both companies with the terms and conditions to be contained in the agreement.

MDS, which is listed on the American Stock Exchange, manufactures and distributes auxiliary electronic data processing equipment. DASA is engaged in the business of manufacturing and distributing telecommunication and peripheral data products and microfilm reproduction equipment.

Mr. Johnson stated that it is the intention of MDS to continue DASA's operations at Andover, Mass., under its present officers and management.

COOK ELECTRIC COMPANY AND LABORATORY FOR ELECTRONICS AGREE TO MERGE

Directors of Cook Electric Co., Morton Grove, Ill., and Laboratory for Electronics, Waltham, Mass., have agreed to merge, a joint announcement has disclosed. The agreement is subject to approval of shareholders of the two electronics manufacturers.

Henry W. Harding, Presdient of Laboratory for Electronics, will be Chairman of the combined operations, and John H. Mangle, President of Cook Electric, will become President.

Laboratory for Electronics is a diversified manufacturer of electronic products, including aircraft navigational systems, computer memory arrays, automatic traffic control systems, and nuclear process control systems.

Cook Electric Company is a 70-year old manufacturer of a wide variety of telephone products, automatic controls, data handling equipment and space/defense communications systems.

EDUCATION NEWS

OHIO STATE TO GRANT DEGREES IN THE FIELD OF COMPUTER AND INFORMATION SCIENCE

Ohio State University, Columbus, O., will grant its first degrees in the field of computer and information science at the close of the winter quarter, which began January 3rd. The Ohio Board of Regents on December 15, 1967, approved the granting of bachelor's, master's and doctor's degrees by the university's Division of Computer and Information Science.

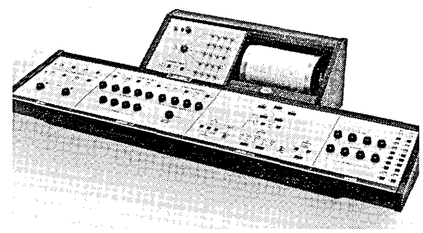
The division is a teaching department created last summer in the College of Engineering to carry on teaching and research in such fields as computer systems organization and programming, numerical analysis, and the theory of information with its application in natural and artificial information-processing systems. In addition, the division operates a Computer and Information Science research Center under a grant from the National Science Foundation.

The division also cooperates with the university's neighbors — Battelle Memorial Institute and Chemical Abstracts Service — both in its teaching and research programs.

ARKAY INTERNATIONAL ANNOUNCES DESKTOP TEACHING MACHINE

A new desktop teaching machine that simulates a full-size digital computer ... containing input, output, arithemetic, core memory, program drum and control units ... has been announced by Arkay International, a Division of Comspace Corporation, Brooklyn, N.Y. Computer Trainer Model CT-650 is designed for use in junior and senior high schools, vocational schools and in industry.

The device is easily programmed to carry out addition, subtraction, multiplication, division, and other mathematical and data processing functions. These operations are performed through manual rather than transistor switching, thus enabling the student to program, follow and understand each step in sequence, and correlate them to those of standard digital computers. The program drum stores up to 90 programmed instructions on a single mylar sheet.



Computer Trainer Model CT-650

The CT-650 plugs into a standard 110 volt outlet and operates at very low voltage, making it safe for students to use. It comes complete with an operating manual and a comprehensive course of study "The Craft of Computer Technology", including Student's Textbook, Laboratory Manual and Teacher's Handbook.
(For more information, designate #41 on the Reader Service Card.)

COMPUTER RELATED SERVICES

COMPUTER CAMPAIGN SERVICES, A NEW COUNSELING SERVICE

A new bipartisan counseling service to acquaint political candidates and committees with the use of computers in campaigns has been announced by Albert M. Kreger, President of Tech-Ed Systems, Inc., Washington, D.C., computer systems firm. The new division, to be called Computer Campaign Services, is the outgrowth of a conference last fall at which, for the first time, a small group of experts in computers met with several of the country's foremost political consultants to determine the practical methods of using computers to help win elections.

Director of Computer Services for Computer Campaign Services will be Dr. Jack Moshman, presently Managing Director for Management Sciences of EBS Management Consultants, Inc. Chief consultant to Democratic candidates will be Joseph Napolitan, President of Joseph Napolitan Associates, Inc., a political counseling firm with offices in Washington and London. The chief Republican counsel will be F. Clifton White, President of F. Clifton White & Associates of New York. Mr. White is best known as the organizer of Senator Barry Goldwater's victory at the Republican National Convention in 1964. Executive Director of Computer Campaign Services will be Richard Smolka.

The new organization will meet with candidates or committees and deliver to them a written report analyzing how computers can be used in their campaigns and the cost of computer programs. "We will be in a position to implement the program for the client, if he wishes," said Kreger, "or he can utilize his own computer facilities." In addition, the firm can provide continuing assistance to elected officials and legislative bodies after the elections.

"There is a great uncharted area where computers can be of vast benefit to officeholders and legislators," Kreger said. "We intend to demonstrate how computers can make government easier to understand and less expensive to operate."

NEW PRODUCTS

Digital

IBM ADDS MODEL 25 TO SYSTEM/360

IBM Corporation, White Plains, N.Y., has built another bridge between its old and new computing systems with the announcement of a versatile new System/360 for users of small and medium sized computers. The System/360 Model 25 can operate as an IBM 1401, 1440 or 1460. It also can process a full range of System/360 Model 30 jobs, and users can convert to a larger System/360 without reprogramming.

Design improvements incorporated in the Model 25 include: a main memory that operates in less than a millionth of a second; a small "scratch-pad" memory made of tiny monolithic circuits and five times faster than the main memory; and an easy-to-use console that reduces operator training time and increases operating efficiency.

The "scratch pad" memory (held by the girl at the console) is designed to increase the computer's processing speeds. The computer can switch up to 64 bytes of data

in and out of the device in 180 billionths of a second. This is equivalent to reading and writing more than 500 full-length novels a second.

With the new console, many functions formerly keyed in by separate buttons on the console, now are entered directly through the system's typewriter keyboard. These include a variety of commands and inquiries, as well as job interruptions. For example, a programmer working at the console can display and alter a portion of main memory by simply typing in his instructions.

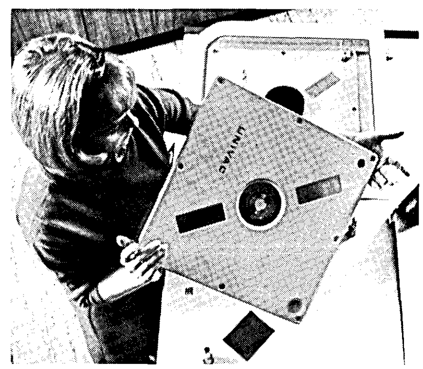
The versatile Model 25 is designed to bring a wider choice to users of small and medium sized computers in converting to System/360.
(For more information, designate #42 on the Reader Service Card.)

Memories

DIRECT ACCESS STORAGE SYSTEM FOR UNIVAC 9000 SERIES

A new, low-cost, direct access storage system designed for the UNIVAC 9000 series computers has been announced by Sperry Rand's UNIVAC Division, Philadelphia, Pa. The new system, known as the UNIVAC 8410 Disc File, makes it possible for users to bridge the costly gap between punched card and direct access processing. Suitable for field-installation on any UNIVAC 9200/9300 System, the 8410 Disc File provides removable direct access storage of 3.2 to 12.8 million bytes, or 6.4 to 25.6 million digits in packed decimal format.

A basic 8410 System includes a master dual disc drive expandable one drive at a time to a total of eight drives. Each drive holds a reversible disc cartridge (illustrated) with two storage surfaces — one of which is on-line. By interchanging disc cartridges, unlimited storage is provided for applications which require serial processing.



Each disc drive can access 10,000 160-byte records plus an 8000 byte fast access track called the Fastband. All disc drives contain a fixed head for reading and writing on the Fastband and a movable arm with two heads for the remainder of the disc surface. The average time required to locate and read a record on a random basis is approximately 135 milliseconds. Fastbands can be used for program storage, index tables, or storage of frequently accessed data files.

Another feature of the UNIVAC 8410 Disc File is a high-speed buffer permitting all disc reading, writing, checking, or searching to be performed simultaneously with 9200/9300 processing and peripheral operations.
(For more information, designate #44 on the Reader Service Card.)

MEMOREX 630 SERIES DISC DRIVE

A new and improved disc storage drive unit for advanced computer systems — the Memorex 630

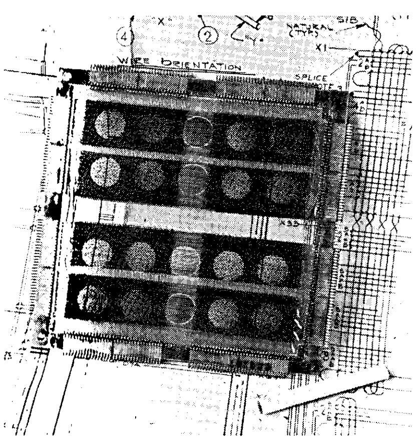
Series Disc Drive — now is available from Peripheral Systems Corp. of Sunnyvale, Calif., a subsidiary of Memorex Corp., Santa Clara, Calif.

The newly developed 630 Series Disc Drive, fully compatible with IBM 2311 disc drive equipment, is plug-compatible with the IBM 2841 Controller, and accommodates Memorex Mark I or IBM 1316 disc packs. In addition to providing variable length recording, the new disc drive can be supplied with the exact adapter interface required for systems integration.

The Memorex 630 Series incorporates an improved access mechanism which is said to deliver the fastest access time in the industry. A head load/unload mechanism provides quicker settling times during loading. Together the two features provide faster data throughput.
(For more information, designate #45 on the Reader Service Card.)

INDIANA GENERAL INTRODUCES NEW MOLDED MEMORY PLANE

A new memory plane for coincident-current applications in commercial, military and industrial computers is available from Indiana General Corp., Keasbey, N.J. The plane, named Cor-Gard, includes supporting plates to prevent core mat sag, encapsulating compound over solder connections and a foam pad (optional) over the cores, resulting in high resistance to shock and vibration.



— New Cor-Gard memory plane measures 5.675 in. square between contact pin tips.

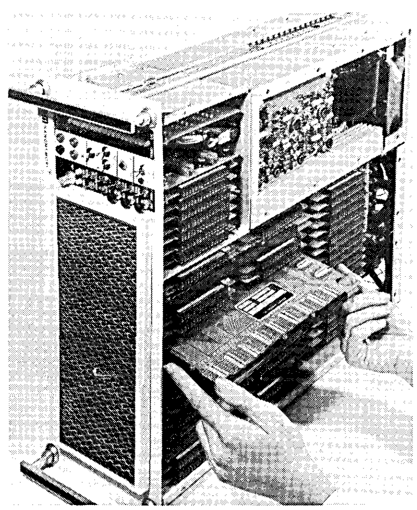
For ease in stacking, the plane offers these advantages: all X, Y, sense, and inhibit wire terminations are inside the frame, eliminating the chance of damage during handling and soldering; planes fit flush, one against the other, providing structural rigidity; pins of an upper plane can contact pins of a lower plane allowing dip soldering; and a frame is replaceable (without disturbing any mat wires) by heating the pins and sliding a thin blade between them.

Flexibility in design is made possible by accommodating a variety of winding configurations with up to 32 sense and inhibit terminals. The plane is available, off-the-shelf, with 30-mil Ferramic® cores in several matrices. The plane also can be strung with 20-mil cores.

Although Cor-Gard is designed for coincident current applications, it can be modified for linear select memories on special request. The plane meets temperature requirements of MIL-E-5400 and MIL-E-16400.
(For more information, designate #46 on the Reader Service Card.)

ELECTRONIC MEMORIES ADDS 900 NANOSECOND SYSTEM TO NANOMEMORY LINE

A compact, 900 nanosecond 2-1/2D core memory system now is available from Electronic Memories, Inc., Hawthorne, Calif., to complement its 650 nanosecond NANOMEMORY® Model 2650, announced in September. The new NANOMEMORY 2900 system is packaged in a 7-inch high sliding drawer which mounts into a standard EIA 19-inch wide cabinet.



A combination of integrated circuit electronics and a 2-1/2D drive system provides the NANOMEMORY 2900 with a cycle time of 900 nanoseconds and an access time of 400 nanoseconds. Operating modes are read/restore, clear/write and split cycle.

The ease of maintenance is one of the benefits of the new series. In the photo, a worker is shown removing one of the system's compact core memory stacks. Surrounding integrated circuit electronics are mounted on printed circuit cards as are panel lights and switches for maximum maintainability.

The system can handle up to 16,384 words x 18 bits, 8,192 words x 36 bits or 4,096 words x 36 bits without any modification of the 7" high x 19" wide x 21" deep configuration.
(For more information, designate #43 on the Reader Service Card.)

Software

AUTODIAGRAMMER / Software Resources Corp., Los Angeles, Calif. / This proprietary program, developed by ARIES Corporation and being marketed throughout the western United States by Software Resources, produces accurate and standardized flowcharts of pro-

grams written in IBM System/360 Basic Assembly Language. The use of AutoDiagrammer eliminates a significant part of the time needed for program documentation and shifts the burden of flow chart production from the programmer to the computer itself. The system, which operates on any 360 with 32K bytes of memory, is available for sale at a purchase price of $1,200.
(For more information, designate #47 on the Reader Service Card.)

AUTOMATED CIRCUIT CARD ETCHING LAYOUT (ACCEL), MOD 1 / Sandia Corporation, Albuquerque, N.M. / ACCEL is a set of computer programs which produces the design information required for construction of printed circuit boards. The original ACCEL program, developed jointly by Sandia and the Thomas Bede Foundation, reduced the time consumed by that part of the production process for which it was designed from 3-6 weeks to 1-2 days. The circuit designer's schematic drawing and parts list is transferred to punched cards and fed into the ACCEL system for processing. ACCEL then edits the engineer's data, resolves the schematic into a node-component list, looks up physical and electrical data for the parts used in the circuit, and notes any errors in the data. Then, in sequence, it locates the components on the board, lays out the interconnection pattern between components, and generates the output plots on a Stromberg Carlson 4020 CRT plotter. Improvements in the new version — titled MOD 1 — reduce computer running time for each circuit because of increased programming efficiency and faster algorithms in the placement and routing programs. The programs are in FORTRAN II for the IBM 7090/7094 computer series. A users' manual and magnetic program tape are available to interested organizations.
(For more information, designate #48 on the Reader Service Card.)

COBOL-AID / Computer Results Corporation, West Springfield, Mass. / A COBOL Cross Reference Aid for IBM S/360 programs has been released for national distribution. The time-saving program, called COBOL-AID, analyzes the Procedure Division of COBOL source programs. Every data name, literal, and library name is cross referenced to the page and line number where it is used on the source program listing. COBOL-AID may be used for individual programs, or multiple programs which process common data files. Three COBOL written source programs and two IBM DOS sort programs with DOS job control make up the COBOL-AID package. With slight modification, the system could be used by any COBOL installation.
(For more information, designate #49 on the Reader Service Card.)

GENCO / Software Resources Corp., Los Angeles, Calif. / A new program generator that vastly simplifies file maintenance programming, called GENCO, accepts shorthand-type input statements and transforms them into a complete modular COBOL file maintenance program. GENCO can be used by COBOL programmers — including trainees — the company said, to generate logically sound and error free programs. GENCO operates on an IBM System/360 with 128,000 bytes of storage. The COBOL file maintenance programs produced by GENCO can be compiled on a smaller 32,000 byte 360.
(For more information, designate #50 on the Reader Service Card.)

MIS/LEASING / The Service Bureau Corp. (SBC), New York, N.Y. / The new Management Information System, called MIS/Leasing, has been created to enable automobile leasing companies to manage their business more efficiently and economically by providing them with a series of meaningful management reports. In addition to the basic accounting information, the program processes all existing leasing records and supplies the lessor with a series of monthly reports that permit him to pinpoint any item that requires attention before it becomes a trouble-maker.
(For more information, designate #51 on the Reader Service Card.)

MODEL 101 / Computer Corporation of America, Cambridge, Mass. / The new high-speed information retrieval software system, called Model 101, is designed for use with IBM System/360 hardware using disc packs as the data storage medium. The Model 101 is specifically designed for purchase as a "packaged" software system for use in a wide range of applications requiring maintenance of large data files and rapid retrieval of filed information. Data input and output is handled by COBOL-compatible magnetic tape, permitting integration of the Model 101 with existing systems. Alternately, input and output may be handled through punched cards and high speed line printer. Hardware requirements include: IBM System/360, Model 30 or larger with 65K bytes of core storage (minimum); 1 to 4 Model 2311 disc drives for data storage; DOS operating system; three magnetic tape drives, line printer, and card reader.
(For more information, designate #52 on the Reader Service Card.)

PAYROLL ACCOUNTING SYSTEM / Software Resources Corp., Los Angeles, Calif. / This IBM/360 payroll accounting system handles all Federal, State and Local tax withholding and reporting requirements. It also produces a wide variety of management reports. The package also has the flexibility of providing for multiple payrolls within the same company. The system requires only 32K bytes of memory and 3 disc drives. It is programmed in standard Basic Assembly Language and operates under DOS. Selling price of the system, which includes complete documentation and installation support, is $12,000. Delivery can be made within 30 days.
(For more information, designate #53 on the Reader Service Card.)

TELLER - REGISTER UNIT MONITORING PROGRAM (TRUMP) / Honeywell Electronic Data Processing, Wellesley Hills, Mass. / A complete software system which controls more than 80 different on-line banking operations and peripheral devices has been added to the Series 200 computer family. TRUMP can be run on any Series 200 computer, from the small model 120 up through the medium-scale model 8200, and provide any size bank, savings and loan association or other financial institution with simultaneous on-line and independent batch processing. TRUMP controls and handles inquiries from on-line communication devices and enables the computer system to process off-line jobs without sacrificing efficiency.
(For more information, designate #54 on the Reader Service Card.)

Data Collection

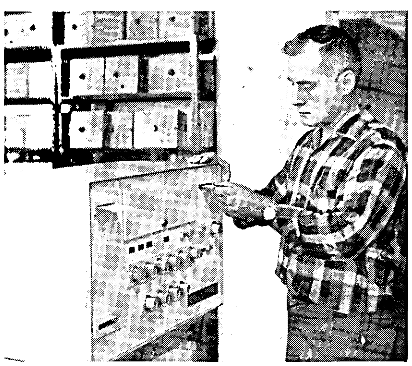
DATA COLLECTION SYSTEM FROM ELECTRON OHIO INC. FOR INDUSTRIAL PLANTS

A new Data Collection System has been developed by Electron Ohio Inc., Cleveland, Ohio, that simplifies payroll records, reduces in-plant paperwork and increases plant productivity.

The system, called the Electron Ohio SHOPTROL Data Collection System, consists of:

1. Electronic Badge Readers located at various employee check-in or time-clock stations. These provide an automatic signal input to the system whenever employees insert their plastic badge representing arrival and departure time or indirect labor assignments. The stations may also be used for indirect labor reporting.

2. Electronic Data Transmitter — located throughout the plant for recording continuous facts



on inventory, labor distribution, machine loading, material movement and other production data.

3. Central Data Collector — this computer-compatible, electronic device in the plant control center collects all operational data from all plant stations for immediate computer processing, or records it on punched cards, paper or magnetic tape for subsequent computer use.

The new Data Collection System is designed for use in metalworking plants, textile mills, processing plants, warehouses and other industrial plants where manufactured goods are produced by employed labor. (For more information, designate #55 on the Reader Service Card.)

Peripheral Equipment

MOTOROLA READER ENTERS DATA FROM PUNCHED OR MARK-SENSE CARDS AND DOCUMENTS

Motorola Instrumentation and Control Inc., Phoenix, Ariz., a subsidiary of Motorola Inc., has developed an inexpensive desktop reader for acquiring data from mark-sense documents, mark-sense cards, punched cards, or combined mark-sense/punched cards.

The MDR-1000 reader provides a simple means of entering into a data processing system, in computer language, data marked or punched on cards or marked on standard 8½ x 11" documents. Cards can be fed into the new device singly, or automatically in batches of up to 500 with an optional automatic hopper.

Input format for the MDR-1000 is standard Hollerith coding arranged in either 80- or 40-column spacing. Data can be handled in either bit serial or bit parallel form. Bit serial data rates can be either 10 characters per sec (110 bits per sec) or 105 characters per sec (1050 bits per sec). Bit parallel data rate is 75 characters per sec (750 bits per sec). Parity can be either odd or even. Besides USASCII, other codes, such as BCDIC, PTT6, and Binary are available on request.

Document rates at 10 characters per sec are 5 sec per card for 40-column spacing and 10 sec per card for 80-column. At 105 characters per sec, document rates are 0.5 sec per card at 40-column spacing and 1 sec per card at 80-column spacing.

Communications facilities can be either a 150-Baud channel or voice-grade circuit. The telephone transmission is by Data-Phone Model 202C, 103A, or their equivalents. (For more information, designate #58 on the Reader Service Card.)

REMOTE RECORDING FOR IBM'S MAGNETIC TAPE SELECTRIC TYPEWRITER

IBM's Office Products Division (New York) has announced a Remote Recording feature for its Magnetic Tape SELECTRIC Typewriter (MT/ST). The device enables one MT/ST to send typewritten information to another MT/ST at any location over a telephone line.

When the original copy is typed on the MT/ST, all characters, punctuation marks and spacing are automatically recorded on magnetic tape. If the operator makes a mistake, she merely backspaces and types over the incorrect copy, automatically correcting the tape. When the typing is completed, she "plays out" the tape at speeds of up to 150 words per minute. This creates error-free "hard-copies" on both her MT/ST and that machine at the remote location. In addition, a duplicate corrected tape is reproduced at the receiving location.

Controls on the telephone data set permit operators to hold telephone conservations, exchanging instructions or other information. They also allow documents to be communicated automatically when there is no operator in attendance.

The advantage of the Remote Recording system over regular message wire services is the way in which the information is produced at the receiving location. Documents are "played out" exactly as they are typed, with the same indentations, spacing and overall appearance as the original. (For more information, designate #57 on the Reader Service Card.)

ANALOG-TO-DIGITAL CONVERTER, DATRAC IV, FROM EPSCO, INC.

EPSCO, Incorporated, Westwood, Mass., has introduced the DATRAC IV, a high-speed analog-to-digital converter plug-in module for data processing applications. DATRAC IV's conversion speed of one microsecond per bit allows up to 100,000 conversions per second. At top speed, the unit's overall accuracy is .05 per cent (plus-or-minus one-half the least significant bit). The self-contained unit measures 5 inches by 3 inches by 1 inch, and weighs eight ounces.

Operating characteristics of the DATRAC IV include 10 or 11 binary bit resolution, parallel output data for micrologic interfacing, negative 2's complement code and a 100,000 cycle word rate (KHz). Special features of the DATRAC IV include exclusive use of DTL integrated circuits for the input buffer amplifier, comparator, reference supply and all logic functions. Precision attenuator networks and switches are in discrete form.

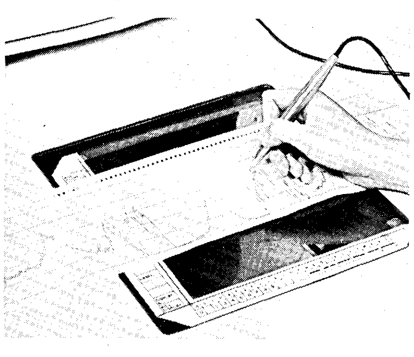
Signal conditioning and very high input impedance are provided with the addition of an optional buffer amplifier.

An external start capability permits synchronization from a system clock and conversion by external command. The DATRAC IV can be used for unipolar and bipolar operations.
(For more information, designate #60 on the Reader Service Card.)

GRAFACON 205-1 MAGNETIC TAPE DIGITIZING SYSTEM

A new graphical input system for off-line digitizing of graphic data from hard copy such as drawings, strip charts, maps, etc., or from projected slide or film images onto computer magnetic tape — has been introduced recently by Bolt Beranek and Newman's Data Equipment Div., Santa Ana, Calif. The Grafacon 205-1 Magnetic Tape Digitizing System is claimed to be several times faster to use than other graphic digitizing systems currently available.

The new system consists of the Grafacon 1010A Digital Tablet — a 10½" square production version of the RAND Tablet Graphic Input Device — with a stylus, alphanumeric keyboard, incremental magnetic tape recorder, and associated electronics assembled in a 30" H x 8½" L x 20" D cabinet.



Optional off-line digitizing equipment includes either the Model SS Storage-Oscilloscope for visual display of the data as it is digitized, or the Model PL X-Y Recorder Monitoring System for tracking the Grafacon stylus position.
(For more information, designate #62 on the Reader Service Card.)

DIGITRONICS MODEL 2540, PERFORATED TAPE READER

A new photoelectric, paper tape reader, the Model 2540, has been announced by Digitronics Corp., Albertson, N.Y. This third generation reader has a new patented readhead with built-in preamplifiers eliminating all electrical adjustments hitherto required and providing outputs compatible with integrated circuit electronics. The Model 2540 has been designed to read the widest range of commercially available tape (up to 40% transmissivity, .002 to .006-inch thick) and tapes within these specifications can be run without electrical or mechanical adjustments.

The Digitronics Model 2540 reader can operate at slow speeds up to 400 characters/second and is capable of stepping asynchronously at speeds up to 150 characters/second. It reads any 5 through 8 level EIA standard punched tape and provides sprocket and data channel outputs compatible with integrated circuit logic.

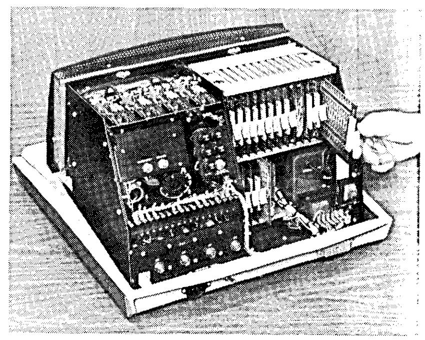
The basic reader consists of a readhead assembly and a unidirectional or bidirectional tape drive. An electronic unit featuring integrated circuit channel amplifiers and a power supply are optionally available. The reader is offered with a 19-inch wide panel for mounting in a RETMA rack or a 10-inch wide panel.
(For more information, designate #59 on the Reader Service Card.)

TEC DATA-SCREEN DISPLAY TERMINAL COMBINES FIXED AND VARIABLE MESSAGE DISPLAY

A new CRT desktop display system designed and built by Transistor Electronics Corporation (TEC), Minneapolis, Minn., offers completely flexible key arrangement and key legends on an optional keyboard. It will interface with most computer systems, hard copy devices, and standard communications links, including Dataphone and Teletype. When several units are used as inquiry terminals tied to a single computer, selective programming can be established so that confidential or restricted information is communicated only to the proper stations.

The CRT screen can be located on the left or right or in the cneter of the unit, in combination with the TEC-LITE DATA-PANEL Display System for concentrated information display. The device will accommodate up to 144 customized alphanumeric messages and special symbols, visible only when illuminated.

The compact package with 8-level code compatability (including ASCII, IBM, EBCDIC) includes cathode ray tube, character generator, 8 bit per character refresher core memory and control logic. All ad-



justments and controls are easily accessible. The eight-inch rectangular tube displays 128 stroke-written characters 3/8-inch high in eight rows of 16 characters, with 63 hz repetition which eliminates visible flicker. Displays of 200 and 512 characters also are available as standard models.
(For more information, designate #56 on the Reader Service Card.)

INTERFACE SYSTEM FOR USE WITH IBM 1130 COMPUTER FROM TIME SHARING ASSOCIATES

An Interface System for use with an IBM 1130 computer which expands the capabilities of the 1130 to provide a true on-line and terminally oriented system has been announced by Time Sharing Associates, Inc., Hartsdale, N.Y. With this interface, users can communicate to their 1130 computer over standard voice grade telephone lines and commercially available terminals.

This interface attaches to an 1130 via the IBM Storage Access Channel, feature code 7490. Computer instructions necessary to operate devices attached to the interface are standard 1130 I/O instructions and no additional modi-

fications are necessary within the 1130 system. This interface will allow users to attach teletypes, IBM 1050's, or IBM 2741's to an 1130 in numbers up to 15. In addition, a real time clock is available for use in a time shared environment.
(For more information, designate #61 on the Reader Service Card.)

Data Processing Accessories

AUDIO DEVICES NEW AUDEV K-68 MAGNETIC TAPE

Audio Devices Inc., New York, N.Y., has announced the availability of its newly introduced magnetic tape known as Audev K-68. This new tape features specially balanced characteristics for extended reliability in modern digital computer systems.

A new technical data sheet describing physical and magnetic properties of the new tape, notes that Audev K-68 averages less than one permanent write error per pass with a maximum of two permanent write errors in any given pass, in a 200-pass test.
(For more information, designate #63 on the Reader Service Card.)

"MINIREELS" OF MAGNETIC COMPUTER TAPE AVAILABLE FROM AUDIO DEVICES

"Minireels" of magnetic computer tape — 200 feet on a 6-inch reel — now are available from Audio Devices Inc., New York, N.Y. Vice president Herman Kornbrodt said, "The 'Minireels' are designed to fill a gap in tape packaging resulting from the growing use of auxiliary data processing units."

Such equipment is often located at scattered data recording stations which usually forward the tape to a central computer headquarters. In addition to facilitating mailings, which often are on a daily basis, the "Minireels" also offer cost-savings where the relatively limited data do not require standard 2400-foot reels. "Minireels" also make possible greater efficiencies where magnetic tape input equipment is used to replace punch card operations, Mr. Kornbrodt said.

Both Audev K-61 and Audev K-68 are offered in "Minireel" form, consistent with the company's policy of providing a complete line of computer tape to meet customer needs.
(For more information, designate #64 on the Reader Service Card.)

BUSINESS NEWS

COMPUTER SCIENCES CORP. APPLIES FOR WITHDRAWAL OF PROPOSED SHARES OFFERING

Computer Sciences Corporation of El Segundo, Calif., has applied to the Securities and Exchange Commission to withdraw a proposed primary and secondary offering of 300,000 shares of CSC common stock. A form S-1 registration statement covering the proposed offering has been on file with the SEC since July 31. The offering would have consisted of 100,000 shares to be sold by CSC and 200,000 owned by selling stockholders.

Fletcher Jones, president of Computer Sciences, said the company is seeking withdrawal of the offer because of changed conditions since the July filing date. CSC has increased its line of credit with the Bank of America, making its financing arrangements adequate for the near term, Jones stated.

LEASCO REPORTS INCOME RISE FOR FISCAL 1967

Leasco Data Processing Equipment Corporation, Great Neck, N.Y., has reported that net income after taxes in the fiscal year ended September 30, 1967 amounted to $1,389,000. This compares with earnings of $707,000 for the previous year.

In fiscal 1967, the Computer Leasing Division purchased $54 million of new equipment, approximately 200% higher than the $18 million purchased the previous year.

As of September 30, 1967, the division had a backlog of computers ordered but not delivered of $11,730,000 at cost, substantially above the $4,060,000 reported as of September 30, 1966.

Leasco, listed on the American Stock Exchange, is one of the largest multi-disciplined computer services companies, specializing in computer leasing and software systems and design.

COMPUDYNE REPORTS PROFIT FOR FISCAL 1967

CompuDyne Corporation, Hatboro, Pa., reports a net profit of $173,750 on total sales of $3,474,786 for the Corporation and its subsidiaries for the fiscal tear ended September 30th, 1967. This compares to a net loss of $161,118 on sales of $2,320,117 for the previous year.

CompuDyne manufactures various automated control systems for industrial applications.

ADAPSO SUIT TO BAR BANKS FROM SELLING EDP SERVICE IS REJECTED

A Federal Court Judge in St. Paul, Minn. recently dismissed a suit seeking to prevent national banks from engaging in the electronic data processing business.

The action was filed by the Association of Data Processing Service Organizations, Inc. (ADAPSO) based at Abington, Pa. and Data Systems Inc. of Minneapolis, against William B. Camp, Comptroller of the Currency of the U.S., and the American National Bank and Trust Company of Minneapolis.

The plaintiffs charged that making electronic data processing equipment available to the public "is non-banking business...in violation of the Nat'l Banking Act."

Judge Philip Neville dismissed the case on the grounds that the plaintiffs had no proper standing on which to bring suit. He termed the situation a "competitive" one and said, "Economic injury due to competition is not an actionable legal wrong."

The Judge noted in his ruling that, of the several cases relied on by the plaintiffs, most were not applicable to the case. He said several cases did relate to situations where the Federal or State Governments recognized that a particular field of competition was subject to regulation and restrictions as to the number who may engage in such business. He cited radio stations and insurance writers as examples. But, the Judge noted, "There is no such statute protecting data processors."

ADAPSO plans to file an appeal.

NEW CONTRACTS

TO	FROM	FOR	AMOUNT
Burroughs Corp., Detroit, Mich.	U.S. Air Force	Over 100 computer systems for Phase II of the Air Force base level data automation standardization program. Last July, the General Accounting Office, set aside an Air Force selection of equipment of a different manufacturer at a price approximately $54 million in excess of the present contract. Net savings to the taxpayer will be about $36 million	$60 million
IBM Corporation, New York, N.Y.	Office of the Mayor, New York, N.Y.	Development of a computer-based system that will dispatch police cars to scenes of emergencies seconds after they are reported	$4.7 million
Radiation Inc., Melbourne, Fla.	U.S. Air Force (acting as technical consultants and contract-agency for the British)	Building and installing a ground link of the United Kingdom's Satellite Communications Network. Radiation will design and build a 60' in diameter antenna system to be integrated into England's satellite communications network	$2.7 million
Planning Research Corp., Los Angeles, Calif.	State of New York	Design of a computer-based management information system and to assist the New York State Department of Mental Hygiene in the implementation of its Support Service System which will serve a total of 31 hospitals for the mentally ill and schools for the mentally retarded operated by the New York Department of Mental Hygiene for over 100,000 patients	$540,000
California Computer Products, Inc., Anaheim, Calif.	U.S. Army's Frankford Arsenal	The production of test equipment used for testing the Army's computerized field artillery fire control systems	$500,000
Systems Engineering Laboratories, Fort Lauderdale, Fla.	Union Carbide, Nuclear Division, Oak Ridge, Tenn.	Delivery of a dual computer multi-experiment data acquisition system for use in nuclear research at Oak Ridge National Laboratory	$450,000
Computer Sciences Corp., El Segundo, Calif.	General Dynamics Corp.	Development of a computer-based information system which will assure an adquate supply of spare parts for the new F-111 aircraft under any operating conditions	$430,000 minimum
Data Products Corp., Culver City, Calif.	American Totalisator Co., Towson, Md.	Eight Model 4500 high-speed LINE/PRINTERS for use on-line in conjunction with specially designed computers in race track totalizer systems	over $172,000
Bryant Computer Products, Walled Lake, Mich.	Pacific Division, AAI Corp.	Twenty Auto-Lift memory storage drums which will be used with AAI Pacific's Series 1000 Microcircuit Test System Computer for program storage	over $135,000
Digital Equipment Corp. Princeton, N.J.	Applied Data Research, Inc.,	Fifty PDP 8/I computers to be used in such ways as 1) leasing them to other computer users; 2) leasing them in conjunction with its proprietary software product ESI (Engineering and Scientific Interpreter); 3) in conjunction with ADR's Control Systems Division; and 4) internally on various ADR research and development programs	—
Scientific Data Systems, Santa Monica, Calif.	Astrodata Inc.	Two Sigma 2 computers as prime components in systems that will be used by Marquardt Corporation to test advanced air-breathing and rocket engines	—
	The Minuteman Division of North American Rockwell Corp., Anaheim, Calif.	An SDS Sigma 7 computer to assist its engineers in evaluating and refining the inertial navigation system used in the USAF Minuteman III intercontinental ballistic missile	—
Fabri-Tek, Inc.	U.S. Navy	Eighteen Bi Tran Six Computer Educational Systems which will be used for training navy and marine technicians in the use of computers	—
Planning Research Corp., Los Angeles, Calif.	U.S. Navy Fleet Missile Systems Analysis and Evaluation Group (FMSAEG)	Extending the scope and coverage of the current statistical analysis procedures of the Navy's FARADA (Failure Rate Data) Program	—
Programming Sciences Corp., New York, N.Y.	International Paper Co.	Development of a simulator that will eliminate the need for costly telecommunications equipment for debugging	—
Recognition Equipment Inc., Dallas, Texas	The Standard Oil Company (Ohio)	An Electronic Retina Computing Reader and two Bar Code Reader/Sorters to be added to the company's marketing accounts systems; the equipment will be on a lease basis and is valued at $1.2 million	—

OF	AT	FOR
ADVANCE 6130	Ohio State University, Chemistry Department, Columbus, Ohio	Operation as an on-line controller with an x-ray diffractometer used in basic research and analysis of single-crystal structure
Control Data 3300	Latter-Day Saints Hospital, Bio-Physics Laboratory, Salt Lake City, Utah	Use in a program of The University of Utah, in conjunction with the National Institutes of Health and the Latter-Day Saints Hospital, to determine the feasibility of using a central computer to process a wide variety of physiological signals obtained from patients in remote hospital locations in diagnosing and treating cardio-vascular diseases and cancer
IBM System/360, Model 40	Texas National Bank of Commerce, Houston, Texas	"On-line" computerized data processing system for savings and loan associations (system valued at $1 million)
IBM 1130	Dept. of Sociology and Anthropology, Brown University, Providence, R.I.	Use of its students and faculty
NCR 315	Business Data Processing, Santa Barbara, Calif.	Boosting current capacity; BDP has outgrown two data processing systems since opening four years ago
	Seaboard Allied Milling Corp., Kansas City, Mo.	Helping control production in half a dozen flour mills; also keeping account of elevator inventories
NCR 500	Rust Engineering Company, Pittsburg, Pa. (4 systems)	Initial use on site locations in four states; each system will handle payroll for 750 to 1500 employees, as well as job distribution reporting
RCA Spectra 70/35	Newark (N.J.) College of Engineering	Educational, research and administrative use
	Ft. Lauderdale, Fla.	The nucleus of a city government information system
	The Missouri Dept. of Health & Welfare, Division of Welfare	Speeding paperwork for state programs and institutions; Medic-Aid, Aid-to-Dependent Children, hospitals, rest homes, mental institutions, etc.
RCA Spectra 70/45	Cincinnati, Ohio	Control of a government information system and to handle data processing for the city and 36 other communities in Hamilton County
	Delcos, Inc., Denver, Colo.	Use by the U.S. Air Force for high-speed search and retrieval of complex legal references; called "Project LITE" (Legal Intelligence Through Electronics), it eventually will service all government agencies using computer communications
	Bell Lines, Inc., Charleston, W. Va.	Part of a five-state communications system linking the company's 22 freight terminals
	American Can Company, Metuchen, N.J.	The hub of a nationwide communications system
RCA Spectra 70/55	McDonnell Automation Co., a division of McDonnell-Douglas Corp., St. Louis, Mo.	Design of aircraft and space vehicles, support for several parent company divisions; also available for its clients such as banks, schools and other manufacturing companies
Sigma 2	Black Dot, Inc., Crystal Lake, Ill.	Controlling Mergenthaler Linotron 505 phototypesetting machine including editing and page make-up
Sigma 7 (and a Sigma 2)	Lawrence Radiation Laboratory, Livermore, Calif.	Pattern recognition experiments, graphic display development and general scientific applications
UNIVAC 418	Cable and Wireless Ltd., Hong Kong	Handling international telegraphic traffic on the new SEACOM submarine cable connecting Southeast Asian centers between Hong Kong and Australia
UNIVAC 494	Kawasaki Steel Corporation, Japan (2 systems)	Production and inventory control; scientific and engineering programs; payroll processing; both systems will be tied-in to existing UNIVAC 494, which is being used as center of a real-time business information system linking the Mizushima and Chiba plants and four Kawasaki business offices located in Kobe, Tokyo, Hiroshima and Nagoya (systems valued at $2.5 million)
	Danderyd Hospitai, Stockholm, Sweden	The nucleus of what is believed will be the most advanced medical data processing system in the world. The installation will be a totally-integrated medical system, encompassing every aspect of medical management, control and treatment
UNIVAC 9200	Daniel, Mann, Johnson & Mendenhall, Los Angeles, Calif.	Internal accounting
	Franlee, Mt. Vernon, N.Y.	Merchandise inventory control and sales analysis
	Investors Preferred Life Insurance Co., Little Rock, Ark.	Handling general insurance accounting applications; replaces punched card equipment
	Oakdale Corporation, Erie, Pa.	Payroll processing, accounts payable and management reports
	Pacific Molasses Co., San Francisco, Calif.	Billing and General accounting operations
UNIVAC 9300	Alabama Public Health Dept., Montgomery, Ala.	Expediting its processing including statistical data on births, deaths, communicable diseases; also compiling/comparing historical medical information
	Hahn Furniture Co., Pittsburg, Pa.	Sales analysis, inventory control, mailing list preparation, delivery load scheduling, payroll processing, accounts payable and receivable and general accounting

MONTHLY COMPUTER CENSUS

The following is a summary made by "Computers and Automation" of reports and estimates of the number of general purpose electronic digital computers manufactured and installed, or to be manufactured and on order. These figures are mailed to individual computer manufacturers from time to time for their information and review, and for any updating or comments they may care to provide.

Our census has begun to include computers manufactured by organizations outside the United States. We invite all manufacturers located anywhere to submit information for this census. We also invite our readers to submit information that would help make these figures as accurate and complete as possible.

The following abbreviations apply:

(R) - figures derived all or in part from information released directly or indirectly by the manufacturer, or from reports by other sources likely to be informed
(N) - manufacturer refuses to give any figures on number of installations or of orders, and refuses to comment in any way on those numbers stated here
(S) - sale only
X - no longer in production
C - figure is combined in a total (see adjacent column)
E - figures estimated by "Computers and Automation"
? - information not received at press time

AS OF JANUARY 15, 1968

NAME OF MANUFACTURER	NAME OF COMPUTER	AVERAGE OR RANGE OF MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	MFR'S TOTAL INSTALLATIONS	NUMBER OF UNFILLED ORDERS	MFR'S TOTAL ORDERS
I. United States Manufacturers							
Autonetics (R)	RECOMP II	$2495	11/58	30		X	
Anaheim, Calif.	RECOMP III	$1495	6/61	6	36	X	0
Bailey Meter Co.	Bailey 756	$60,000-$400,000 (S)	2/65	14		5	
Wickliffe, Ohio	Bailey 855	$100,000 (S)	4/68	0	14	10	15
Bunker-Ramo Corp. (R)	BR-130	$2000	10/61	160		X	
Canoga Park, Calif.	BR-133	$2400	5/64	62		X	
	BR-230	$2680	8/63	15		X	
	BR-300	$3000	3/59	18		X	
	BR-330	$4000	12/60	23		X	
	BR-340	$7000	12/63	19	297	X	0
Burroughs (R)	205	$4600	1/54	38		X	
Detroit, Mich.	220	$14,000	10/58	31		X	
	B200 Series, B100	$5400	11/61	800		31	
	B300 Series	$9000	7/65	370		150	
	B2500	$5000	2/67	35		95	
	B3500	$14,000	5/67	24		74	
	B5500	$22,000	3/63	74		12	
	B6500	$33,000	2/68	0		17	
	B7500	$44,000	4/69	0		6	
	B8500	$200,000	8/67	0	1370 E	5	390 E
Control Data Corp. (R)	G-15	$1600	7/55	285		X	
Minneapolis, Minn.	G-20	$15,500	4/61	23		X	
	LGP-21	$725	12/62	159		X	
	LGP-30	$1300	9/56	322		X	
	RPC-4000	$1875	1/61	73		X	
	046/136/636	?	-	28		C	
	160*/8090 Series	$2100-$12,000	5/60	594		X	
	924/924A	$11,000	8/61	30		X	
	1604/A/B	$45,000	1/60	59		X	
	1700	$3500	5/66	48		C	
	3100/3150	$10,000	12/64	87		C	
	3200/3300	$16,250	5/64	132		C	
	3400	$18,000	11/64	20		C	
	3600/3800	$48,750	6/63	57		X	
	6400/6500/6600	$52,000-$117,000	8/64	49	(as of	C	
	6800	$130,000	6/67	0	1938 6/30/67)	C	320 E
Digital Electronics Inc. (R) Plainview, N.Y.	DIGIAC 3080	$19,500 (S)	12/64	10	10	1	1
Digital Equipment Corp. (R)	PDP-1	$3400	11/60	59		X	
Maynard, Mass.	PDP-4	$1700	8/62	55		X	
	PDP-5	$900	9/63	114		X	
	PDP-6	$10,000	10/64	22		X	
	PDP-7	$1300	11/64	165		C	
	PDP-8	$525	4/65	1050		C	
	PDP-8S	$300	9/66	549		C	
	PDP-9	$1000	12/66	81		C	
	PDP-10	$7500	12/67	1		C	
	LINC	?	9/66	90	2186	C	450 E
Electronic Assoc., Inc. (R)	640	$1200	4/67	15		27	
Long Branch, N.J.	8400	$12,000	7/65	21	36	4	31
EMR Computer Div. (R)	ASI 210	$3850	4/62	26		X	
Minneapolis, Minn.	ASI 2100	$4200	12/63	7		X	
	ADVANCE 6020	$4400	4/65	16		9	
	ADVANCE 6040	$5600	7/65	8		2	
	ADVANCE 6050	$9000	2/66	18		8	
	ADVANCE 6070	$15,000	10/66	9		0	
	ADVANCE 6130	$1000	8/67	6	90	36	55
General Electric (N)	115	$1340-$8000	12/65	500 E		600 E	
Phoenix, Ariz.	205	$2500-$10,000	6/64	C		X	
	210	$16,000-$22,000	7/59	C		X	
	215	$2500-$10,000	9/63	C		X	
	225	$2500-$26,000	4/61	200 E		X	
	235	$6000-$28,000	4/64	100 E		C	
	255	$15,000-$26,000	10/67	C		C	
	265	$17,000-$28,000	7/64	C		C	
	405	$5120-$10,000	11/67	C		C	
	415	$4800-$13,500	5/64	300 E		70 E	
	420	$18,000-$28,000	7/67	C		C	
	425	$6000-$20,000	6/64	100 E		C	

NAME OF MANUFACTURER	NAME OF COMPUTER	AVERAGE OR RANGE OF MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTAL-LATIONS	MFR'S TOTAL INSTAL-LATIONS	NUMBER OF UNFILLED ORDERS	MFR'S TOTAL ORDERS
General Electric (con'd)	435	$8000-$25,000	9/65	C		C	
	625	$31,000-$135,000	4/65	C		C	
	635	$35,000-$167,000	5/65	C		C	
	645	$40,000-$250,000	7/66	C	1490 E	C	850 E
Hewlett-Packard (R)	2116A	$600	11/66	70		C	
Palo Alto, Calif.	2115A	$412	11/67	11	81	C	24 E
Honeywell (R)	DDP-24	$2500	5/63	85		X	
Wellesley Hills, Mass.	DDP-116	$900	4/65	200		30	
	DDP-124	$2050	3/66	46		33	
	DDP-224	$3300	3/65	50		8	
	DDP-516	$700	9/66	85		154	
	H-120	$3900	1/66	650		240	
	H-200	$8400	3/64	1130		87	
	H-400	$8500	12/61	120		X	
	H-800	$28,000	12/60	89		X	
	H-1200	$3800	2/66	175		130	
	H-1400	$14,000	1/64	12		X	
	H-1800	$42,000	1/64	21		X	
	H-2200	$12,000	1/66	78		71	
	H-4200	$20,500	6/67	0		20	
	H-8200	$35,000	4/68	0	2740 E	5	780 E
IBM (N)	305	$3600	12/57	C		X	
White Plains, N.Y.	360/20	$3000	12/65	6000 E		6000 E	
	360/25	$5530	1/68	C		C	
	360/30	$9340	5/65	6000 E		3500 E	
	360/40	$19,550	4/65	3000 E		2000 E	
	360/44	$12,180	7/66	C		C	
	360/50	$32,960	8/65	C		C	
	360/65	$56,650	11/65	C		C	
	360/67	$138,000	10/66	C		C	
	360/75	$81,400	2/66	C		C	
	360/90 Series	-	10/67	C		C	
	650	$4800	11/54	C		X	
	1130	$1545	2/66	2700 E		4500 E	
	1401	$6480	9/60	7650 E		X	
	1401-G	$2300	5/64	1700 E		X	
	1401-H	$1300	6/67	C		C	
	1410	$17,000	11/61	C		C	
	1440	$4300	4/63	3600 E		C	
	1460	$10,925	10/63	1400 E		X	
	1620 I, II	$4000	9/60	1500 E		C	
	1800	$4800	1/66	C		C	
	701	$5000	4/53	C		X	
	7010	$26,000	10/63	C		C	
	702	$6900	2/55	C		X	
	7030	$160,000	5/61	C		X	
	704	$32,000	12/55	C		X	
	7040	$25,000	6/63	C		C	
	7044	$36,500	6/63	C		C	
	705	$38,000	11/55	C		X	
	7070, 2, 4	$27,000	3/60	C		X	
	7080	$60,000	8/61	C		X	
	709	$40,000	8/58	C		X	
	7090	$63,500	11/59	C		X	
	7094	$75,500	9/62	C		X	
	7094 II	$82,500	4/64	C	37,700 E	C	18,300 E
Interdata (R)	Model 2	$200-$300	-	0		3	
Oceanport, N.J.	Model 3	$300-$500	3/67	24		75	
	Model 4	$400-$800	-	0	24	5	83
National Cash Register Co. (R)	NCR-304	$14,000	1/60	24		X	
Dayton, Ohio	NCR-310	$2500	5/61	14		X	
	NCR-315	$8500	5/62	625		150	
	NCR-315-RMC	$12,000	9/65	80		50	
	NCR-390	$1850	5/61	600		6	
	NCR-500	$1500	10/65	1550	2893	580	790 E
Pacific Data Systems Inc. (R) Santa Ana, Calif.	PDS 1020	$550-$900	2/64	135	135	20	20
Philco (R)	1000	$7010	6/63	16		X	
Willow Grove, Pa.	2000-210, 211	$40,000	10/58	16		X	
	2000-212	$52,000	1/63	12	44	X	0
Radio Corp. of America (R)	RCA 301	$7000	2/61	635		C	
Cherry Hill, N.J.	RCA 3301	$17,000	7/64	75		C	
	RCA 501	$14,000	6/59	96		X	
	RCA 601	$35,000	11/62	3		X	
	Spectra 70/15	$4500	9/65	160		125	
	Spectra 70/25	$6500	9/65	85		57	
	Spectra 70/35	$10,400	1/67	52		135	
	Spectra 70/45	$22,000	11/65	80		107	
	Spectra 70/46	$34,400	-	0		C	
	Spectra 70/55	$34,300	11/66	5	1190 E	14	420 E
Raytheon (R)	250	$1200	12/60	175		X	
Santa Ana, Calif.	440	$3500	3/64	20		X	
	520	$3200	10/65	27		0	
	703	(S)	10/67	11	233	23	23
Scientific Control Corp. (R)	650	$500	5/66	24		0	
Dallas, Tex.	655	$1800	10/66	7		26	
	660	$2000	10/65	4		0	
	670	$2600	5/66	1		0	
	6700	$30,000	10/67	0	36	1	27

NAME OF MANUFACTURER	NAME OF COMPUTER	AVERAGE OR RANGE OF MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTAL-LATIONS	MFR'S TOTAL INSTAL-LATIONS	NUMBER OF UNFILLED ORDERS	MFR'S TOTAL ORDERS
Scientific Data Syst., Inc. (N)	SDS-92	$1500	4/65	100 E		20	
Santa Monica, Calif.	SDS-910	$2000	8/62	200 E		30	
	SDS-920	$2900	9/62	200 E		20	
	SDS-925	$3000	12/64	C		C	
	SDS-930	$3400	6/64	200 E		30	
	SDS-940	$10,000	4/66	C		C	
	SDS-9300	$7000	11/64	C		C	
	Sigma 2	$1000	12/66	30		160	
	Sigma 5	$6000	8/67	C		C	
	Sigma 7	$12,000	12/66	C	920 E	C	360 E
Standard Computer Corp. (N) Los Angeles, Calif.	IC 6000	$10,000-$22,000	5/67	7	7	12 E	12 E
Systems Engineering Labs (R)	SEL 810	$1000	9/65	24		X	
Ft. Lauderdale, Fla.	SEL 810A	$900	8/66	33		29	
	SEL 810B	?	-	0		7	
	SEL 840	$1400	11/65	4		X	
	SEL 840A	$1400	8/66	17		28	
	SEL 840 MP	?	-	1	79	6	70
UNIVAC, Div. of Sperry Rand (R)	I & II	$25,000	3/51 & 11/57	23		X	
New York, N.Y.	III	$20,000	8/62	67		X	
	File Computers	$15,000	8/56	13		X	
	Solid-State 80 I, II, 90, I, II & Step	$8000	8/58	222		X	
	418	$11,000	6/63	118		33	
	490 Series	$35,000	12/61	190		30	
	1004	$1900	2/63	3200		20	
	1005	$2400	4/66	960		140	
	1050	$8000	9/63	285		16	
	1100 Series (except 1107 & 1108)	$35,000	12/50	9		X	
	1107	$55,000	10/62	33		X	
	1108	$65,000	9/65	80		75	
	9200	$1500	6/67	110		900	
	9300	$3400	7/67	30		650	
	LARC	$135,000	5/60	2	5340 E	X	1860 E
Varian Data Machines (R)	620	$900	11/65	75		0	
Newport Beach, Calif.	620i	$500	6/67	53	128	292	292
		I. U. S. Manufacturers, TOTAL		—	59,000 E		25,200 E

II. Non-United States Manufacturers

NAME OF MANUFACTURER	NAME OF COMPUTER	AVERAGE OR RANGE OF MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTAL-LATIONS	MFR'S TOTAL INSTAL-LATIONS	NUMBER OF UNFILLED ORDERS	MFR'S TOTAL ORDERS
AS Regne Centralen (R)	GIER	$2600-$9200	12/60	36		2	
Copenhagen, Denmark	RC 4000	$3000-$20,000	6/67	1	37	1	3
Elbit Computers Ltd. (R) Haifa, Israel	Elbit-100	$4900 (S)	10/67	4	4	31	31
G.E.C. Computers & Automation Ltd. (R)	90-2	-	10/65	5		C	
Wembley, Middlesex, England	90-10	-	8/66	1		C	
	90-20	-		0		C	
	90-25	-	7/66	2		1	
	90-30	-	10/65	1		1	
	90-40	-		0		C	
	90-300	-	11/66	1		1	
	S-2	-	1/68	0		1	
	S-5	-		0		C	
	S-7	-		0		C	
	GEC-TRW130	-	12/64	2		X	
	GEC-TRW330	-	9/63	7	23	X	5 E
International Computers and Tabulators Ltd. (R)	1901 to 1909	$4000-$27,000	12/64-12/66	543		390	
London, England	1200/1/2	-	-/55	60		0	
	1300/1/2	$3500	-/62	192		9	
	1300	$5200	7/62	112		3	
	1100/1	-	-/60	20		0	
	2400	-	12/61	4		0	
	Atlas 1 & 2	$70,000	-/62	5		1	
	Orion 1 & 2	$40,000	1/63	16		1	
	Sirius	-	-/61	22		0	
	Mercury	-	-/57	13		0	
	Pegasus 1 & 2	-	-/56	36	1023	0	404
Saab Aktiebolag (R)	DATASAAB D21	$5000-$14,000	12/62	30		0	
Linköping, Sweden	DATASAAB D22	$8000-$60,000	5/68	3	33	8	8
Union of Soviet Socialist Republics	BESM 4	-	-	C		C	
	BESM 6	-	-	C		C	
	MINSK 2	-	-	C		C	
	MINSK 22	-	-	C		C	
	MIR	-	-	C		C	
	NAIRI	-	-	C		C	
	ONEGA 1	-	-	C		C	
	ONEGA 2	-	-	C		C	
	URAL 11/14/16	-	-	C		C	
	and others				2000 E		500 E
		II. Non-U.S. Manufacturers, TOTAL		—	3120 E		950 E
			Combined, TOTAL	—	62,000 E		26,000 E

c·a

PROBLEM CORNER

Walter Penney, CDP
Problem Editor
Computers and Automation

Problem 682: Changing a Bit

"I'd like to get the guy who erased it," said Bob, looking at the blackboard where a few 1's and 0's appeared at the top and a few others at the bottom, with a freshly erased expanse of blackboard in the middle.

"What was there that was so important to preserve?", Al wanted to know.

"It was a set of the 16 four-bit numbers arranged so that only one bit changed each time." Bob went on with his calculations, adding a number here and crossing out one there, but he couldn't seem to get what he wanted.

"It shouldn't be too difficult to make up a whole new set, and not use these fragments you have."

"Yes," said Bob. "But yesterday we used them in a program to control the order in which we handled four variables. We wanted to take them in all possible combinations. Now we'll have to do things in the same order in this program or we won't get comparable results."

"O.K. Let me see. I can make out the first four: 0 0 0 1, 0 0 1 1, 0 1 1 1 and 0 1 0 1. And the last four are 1 0 0 0, 1 1 0 0, 1 1 1 0 and 1 1 1 1. Right?"

"Right. Now fill in the ones in between, changing only one bit at a time and we'll be all set."

How should the sequence be completed?

Solution to Problem 681: Integer Part of a Number Given in Floating Point Form

The key is getting the integer part [N] of a number N written in floating point form. This is given by (N + 10000E0) — 10000E0. To get the inches, first compute the fractional part of N as N — [N]. Multiply this by 12, round up by adding 0.5 and take the integer part of the result the same way.

BOOKS AND OTHER PUBLICATIONS

Neil Macdonald
Assistant Editor
Computers and Automation

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

Reviews

Stark, Peter A. / Digital Computer Programming / The Macmillan Co., 866 Third Ave., New York, N.Y. 10022 / 1967, hardcover, 526 pp., $9.95

This textbook for programmers is divided into 5 sections: Section I, "General Computer Organization;" Section II, "Machine Language Programming" Section III, "Symbolic Programming" Section IV, "Programming and Mathematical Techniques" and Section V, "Problem Oriented Languages," which uses FORTRAN IV as an example.

Liebelt, Paul B. / An Introduction to Optimal Estimation / Addison-Wesley Publishing Co. Inc., Reading, Mass. 01867 / 1967, hardbound, 273 pp., $11.75

This book is concerned with optimal ways to deduce information from data and is directed at the college senior or graduate. Chapters include: Linear Algebra; Elementary Concepts of Probability Theory; Linear Estimation Theory; Continuous Dynamic System Estimation. It has: an Appendix, Transition Matrices from Coefficient Equations; an answer section; an index; and a bibliography.

This book is in the area of statistics and probability, and is advanced and mathematical.

Harper, R. J. / Data Processing Managers / Lyon Grant and Green, London / 1967, paperbound, 88 pp., 21 s. net.

"Data Processing Managers" is a study of the roles and characteristics of thirty Data Processing Managers. The study was carried out in 1966 at the Research Department of the Administrative Staff College.

DeGroot, Adriaan D., author; editor, George W. Baylor; translators, several, cooperating / Thought and Choice in Chess / Basic Books, Inc., 404 Park Ave. S., New York, N.Y. 10016 / 1965, hardbound, 463 pp., $10.50

This book originally appeared in Dutch in 1946 as the doctoral dissertation of the author at the University of Amsterdam. The purpose of his study was to arrive at a generalized description of the structure and the dynamics of the thought process as a basis for theory formation. This was accomplished through a thorough and systematic analysis of experimental sessions in which a subject was presented with an unfamiliar position taken from an actual chess tournament or match game and asked to find and play a move as though he were engaged in a tournament game, while verbalizing as fully and explicitly as possible his plans, calculations, and considerations in making his decision. These experiments served as the basis for the body of the book. The subjects included chess players of varying strengths, including masters and grandmasters (A. Alekhine, M. Euwe, P. Keres, R. Fine, S. Flohr, and S. Tartakower).

NEW PATENTS

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

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

November 28, 1967

3,355,720 / Melvin M. Kaufman, Levittown, N. J. / Radio Corporation of America, a corporation of Delaware / Memory using charge storage diodes.

3,355,721 / Joseph R. Burns, Trenton, N. J. / Radio Corporation of America, a corporation of Delaware / Information storage.

3,355,722 / Harold R. Grubb, Owego, John W. Haskell, Endwell, Philip A. Lord, Vestal, and Edward F. Rent, Endicott, N. Y. / International Business Machines Corporation, Armonk, N. Y., a corporation of New York / Compact semipermanent information storage unit.

3,355,723 / Robert John Clark, Dorion, Quebec, Canada, / Radio Corporation of America, a corporation of Delaware / Diode-capacitor bit storage circuit.

3,355,725 / Alexander McKeon, Los Gatos, Calif. / International Business Machines Corporation, New York, N. Y., a corporation of New York / Information storage matrix.

3,355,726 / Ralph J. Koerner, Los Angeles, Calif. / by mesne assignments, to The Bunker-Ramo Corporation, Stamford, Conn., a corporation of Delaware / Three state storage device.

December 5, 1967

3,356,993 / Richard S. Sharp, Sierra Madre, Calif. / Burroughs Corp., Detroit, Mich., a corporation of Michigan / Memory system.

3,356,995 / Robert R. Leonard, Dover, Edward G. Fassino, Natick, and James F. Beatty, Westwood, Mass. / Honeywell Inc., a corporation of Delaware / Information handling apparatus.

3,356,996 / Paul Niquette, Palos Verdes Estates, and Charles E. Wallace, Playa Del Ray, Calif. / Scientific Data Systems, Inc., Santa Monica, Calif., a corporation of Delaware / Data transfer system.

3,356,998 / Melvin M. Kaufman, Levittown, N. J. / Radio Corporation of America, a corporation of Delaware / Memory circuit using charge storage diodes.

3,356,999 / Umberto F. Gianola, Florham Park, and Fred B. Hagedorn, Berkeley Heights, N. J. / Bell Telephone Laboratories, Inc., New York, N. Y., a corporation of New York / Cryogenic memory circuit.

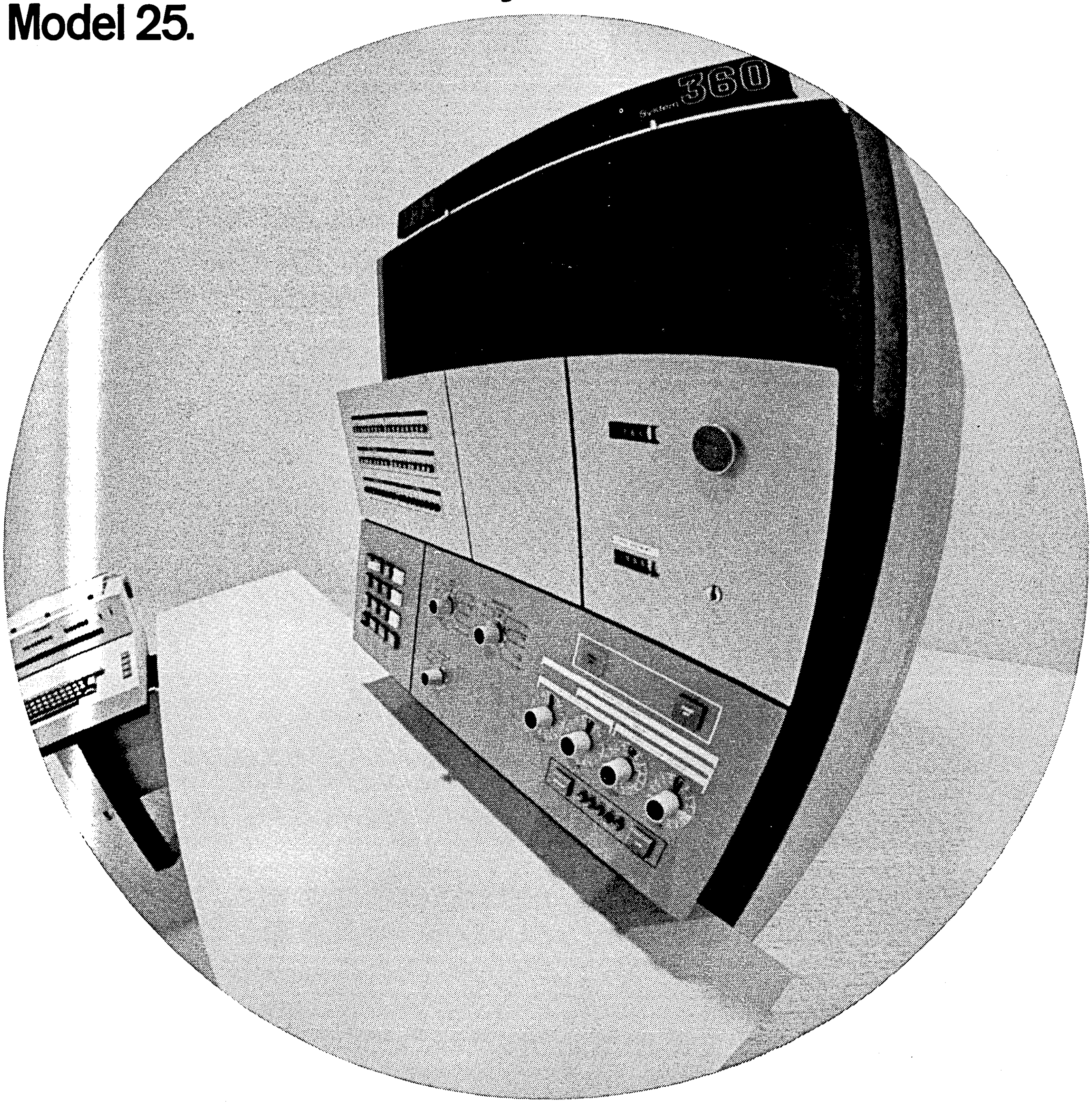
December 12, 1967

3,358,157 / John Noel Shearme, Chesham Bois, England, / Minister of Aviation in Her Britannic Majesty's Government of the United Kingdom of Great Britain and Northern Ireland, London, England / Selective gate circuits.

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.

The computer with a future is still expanding. IBM introduces the new System/360 Model 25.



It's a system to grow with. IBM engineers say Model 25 is bigger than it looks. It sets a new price-performance standard for a system of its size.

The reasons are simple. To reduce Model 25's size, price and power requirements, we built control units for many peripheral devices right into the central processing unit.

To boost performance, we introduced a new high-speed working storage area.

This growth system has the same instruction set and flexibility as the larger models. For example, Model 25 can use most System/360 input-output devices with whatever combinations of tape, disk and card systems you need.

Flexibility means Model 25 will even run existing IBM 1401, 1440 and 1460 programs without reprogramming. It means Model 25 can use high-level operating systems as well as PL/I, FORTRAN and COBOL—the same program languages used in larger systems. It means utility programs are ready and waiting in IBM's program library—as are System/360 application programs tailored for such industries as finance, manufacturing, process and distribution.

It all adds up to this: as your business grows, your System/360 will be able to grow with it. Programmers will be more productive. Your installation investment will be lower. And you'll see results faster.

That's Model 25... a system to grow with. IBM®

What good is getting an answer in microseconds

if set-up takes weeks?

Computer set-up time is cut from weeks to less than an hour...with the new Hewlett-Packard 2115A. Here's a computer especially designed for fast, simple set-up whether for a scientific computation application or for hooking up a complete computer instrumentation system.

Take the hardware...just use standard plug-in cards, plug in the peripheral cable...and the interface is complete...a snap. The same story of simplicity is true for the software, using standard peripheral drivers. Your system's ready to go to work in *under an hour.*

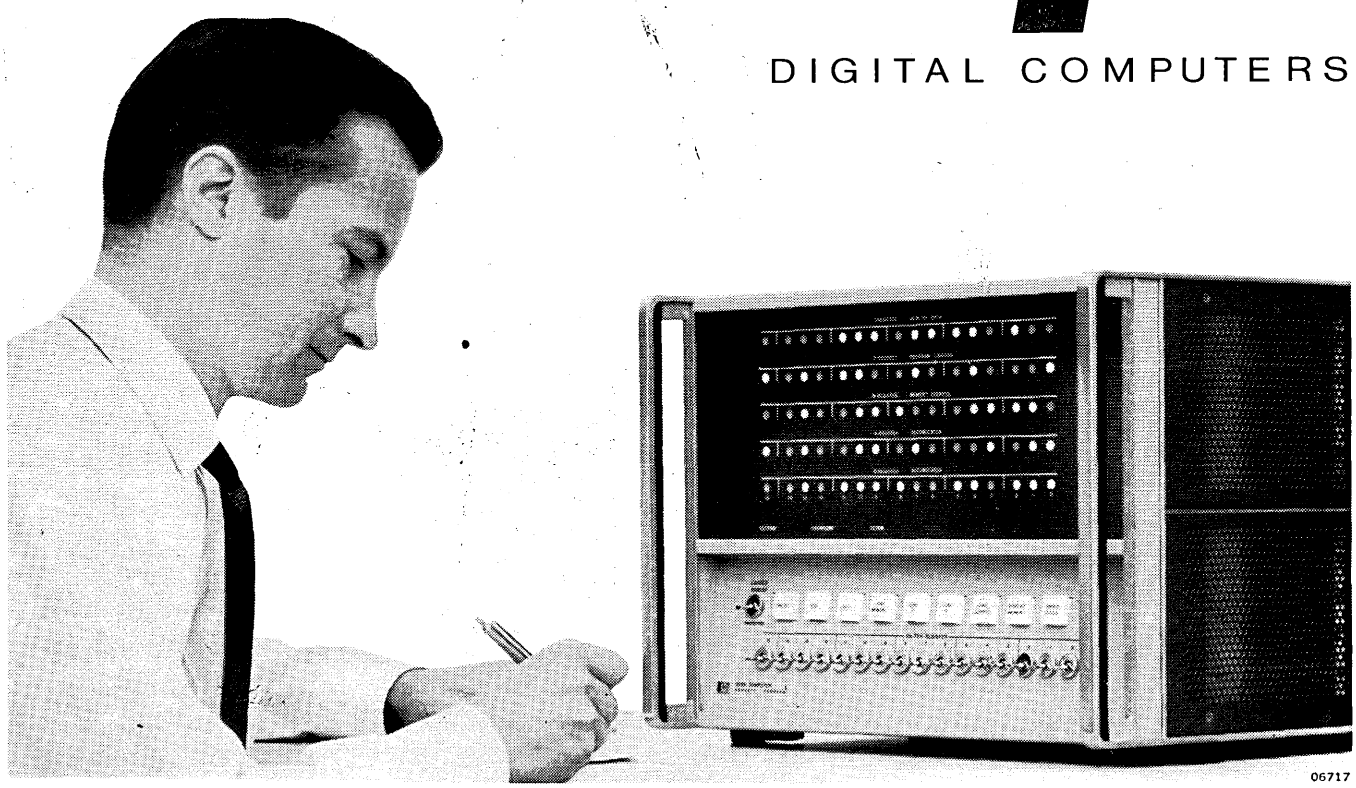
The 2115A offers extensive software, including FORTRAN, ALGOL and BASIC compilers and a relocatable assembler. Other features you get with this powerful small computer include 16-bit word length, 2 μsec cycle time, 4K or 8K memory; 8 channels of I/O in the main frame, 40 channels with an external extender. The standard plug-in interfaces are offered for all the usual peripherals . . . and general-purpose interfaces are available for your particular I/O devices.

Price, including Teleprinter, $16,500.

Make your move now toward time-saving, work-saving computer set up. You can do it with a call to your local HP field engineer. Or get all the information by writing Hewlett-Packard, Palo Alto, California 94304; Europe: 54 Route des Acacias, Geneva.

HEWLETT hp PACKARD

DIGITAL COMPUTERS



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Designate No. 12 on Reader Service Card