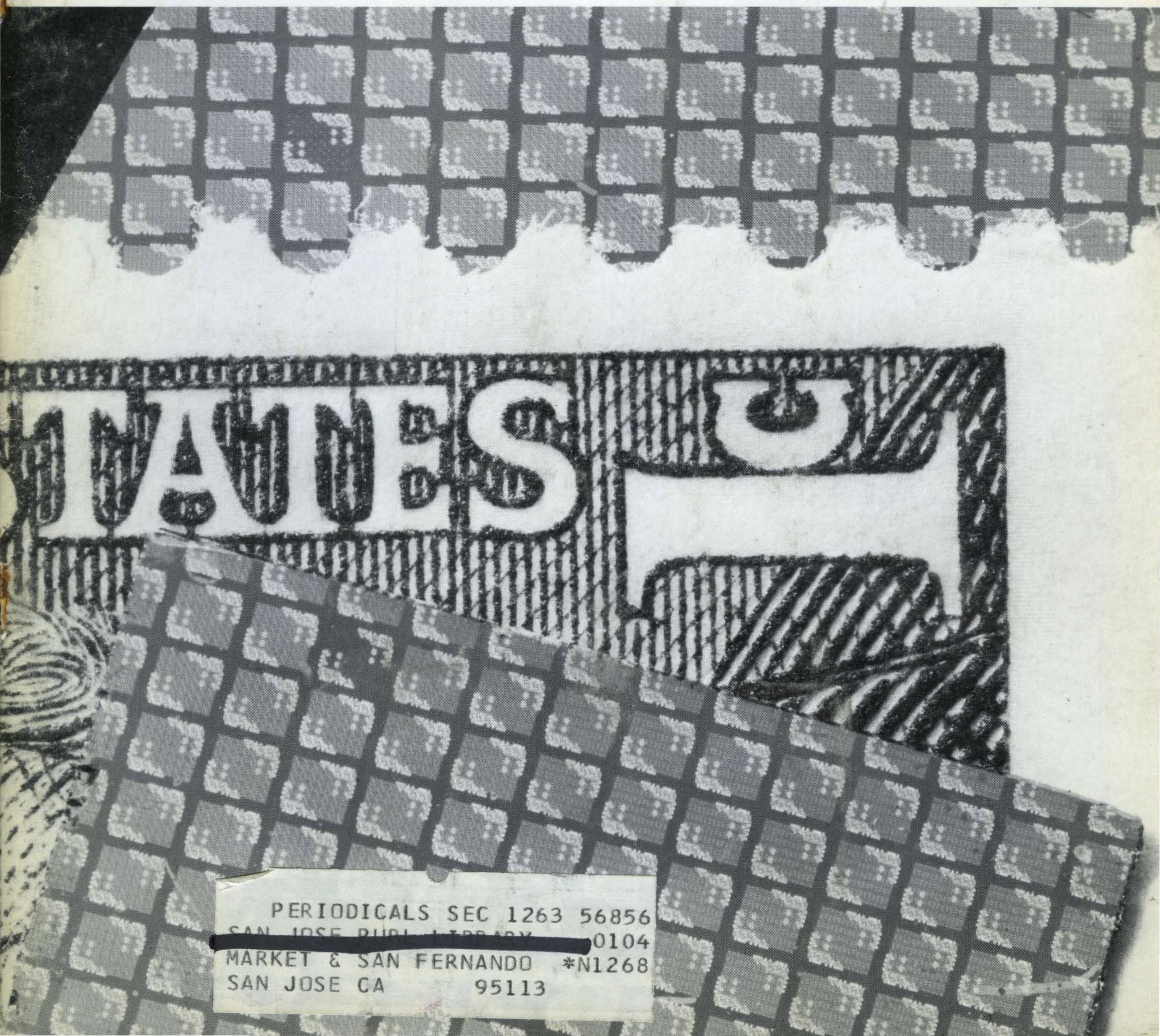
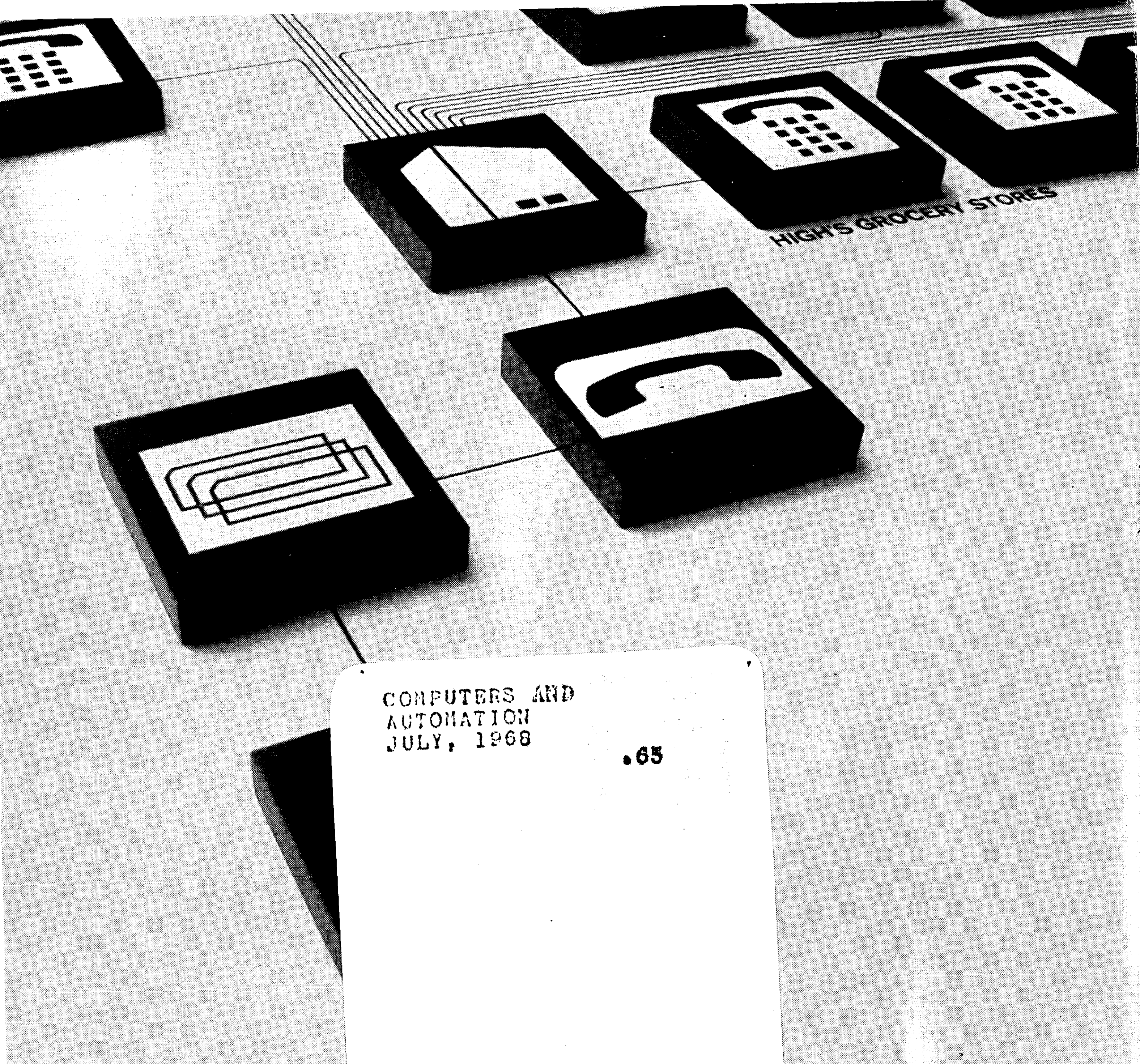
July, 1968

computers and automation

Almost a Million Electrical Components





High's Dairy u
to keep their p ... poove.

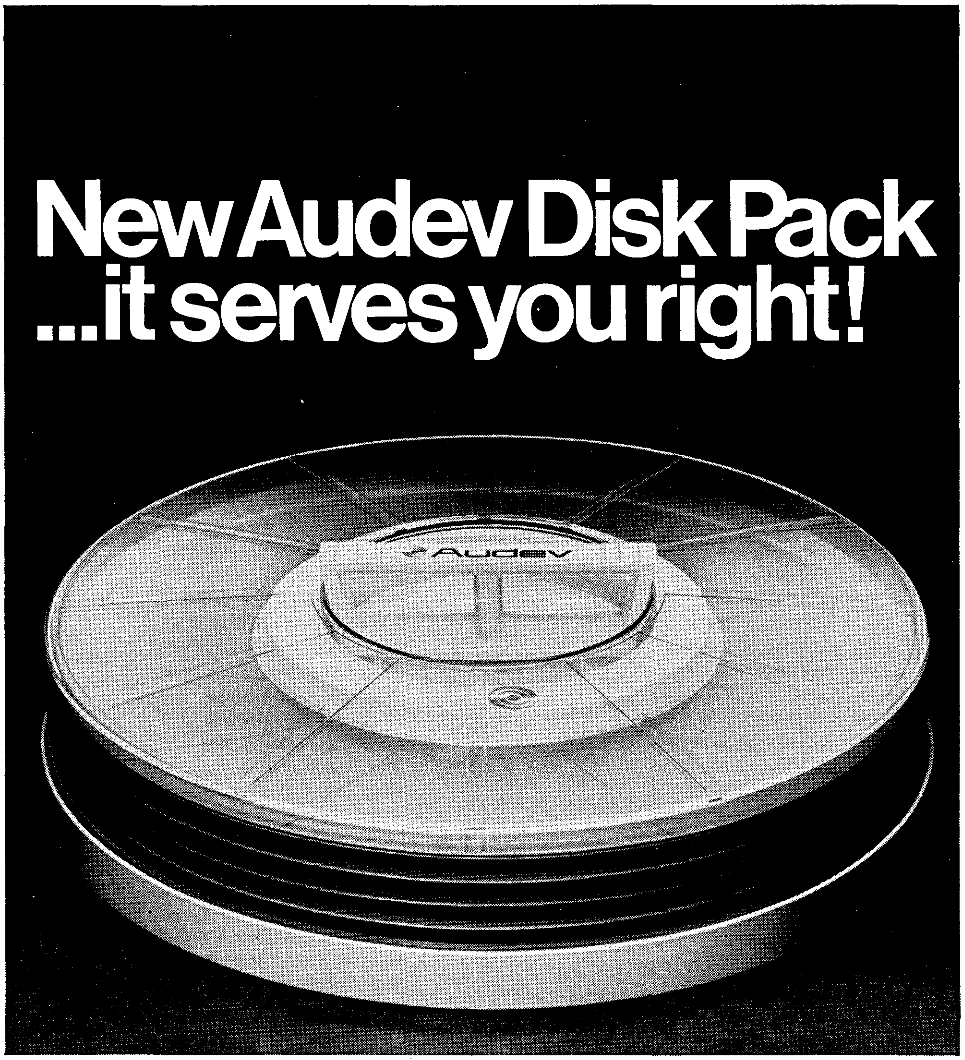
Maybe you never thought you ... ers. At the cen-
ager of a retail dairy store inv ... inate in Data-
communications. ... th five transla-
... nches.

But it's happening right now a ... half with this
stores operated by High's Dairy F ... r to adjust his
Washington, D.C. metropolitan a ... e's a sudden
... r demand.

This system for ordering dairy ... nt is the man
ples standard Touch-Tone® phone ... vith communi-
store and the computer center a ... ms.
Instead of writing out all the items ... nt-size.
manager calls the computer cente
regular telephone network—and

- Touch-Tone phone service
- Data-Phone data set
- Computer Center
- Card Punch
- Bell System Central Office

Not another disk pack?



We're not satisfied just to lease or sell you an Audev Disk Pack. Maybe you won't be satisfied just to have a unit that meets the most exacting physical and magnetic parameters in the industry? Possibly, you need more than Audev's complete compatibility with all existing 100 and 200 track drives. That's why a full measure of old-fashioned Audev service is packed with each Disk Pack.

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Audev
DISK PACKS AND COMPUTER TAPE

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Letters To The Editor

Computers and Education

The March issue of *Computers and Automation* was especially interesting to me. I am a mathematics teacher in high school in suburban Minneapolis and have recently taken some computer courses and become interested in this area of mathematics-related work in high schools. The topic of "Computers and Education" decided for me that I would accept your invitation for comments and suggestions.

Are there any publications specializing in computers and/or programming for teachers? It seems to me that a good many math teachers might appreciate such a publication or such a department in a current publication. If it were known by math teachers that such a department existed in a computer magazine it would be quite a good way to keep informed in the field and should be a good source of potential subscribers. Why not put such a department in C&A, make it known through such an organization as National Council of Math teachers, or the various state organizations of math teachers, and see if there is enough demand for a section aimed at secondary school use of computers and programming?

I enjoy your magazine and feel it is a good way of keeping informed on developments in the field of programming at a nominal cost.

CHARLES HUTCHINSON
Crystal, Minn. 55427

(Ed. Note — *There are publications specializing in computers and programming for teachers and people in education, and there will be more and more. As to our having a department on this subject, we like your idea, and we will try to find someone who might handle this as a department.*)

Notice to Ing Jaroslav Kucera, Prague

We thank you for your letter of March 18, and we wish to reply to it — but your letter does not have your street address. Would you please tell us your street address?

The Editor

The Ten-Mile Gap — Comments

I read with great interest the article in your March issue, "The Ten-Mile Gap — Part I: The Problem". I felt that the article clearly set out one of the major causes of unrest in our cities today. It is very encouraging to see someone in a position of responsibility take positive action to help correct some of our social problems today. While your article did not mention specific methods of overcoming the problem, I'm sure you are well aware that defining the problem is usually the hardest part of solving it.

I hope that this letter, along with any others that you may have received, will help spur you to greater efforts in attacking the problem created by those of us who do not have the proper attitude toward social concern.

R. M. MERRITT
Manager
ISD Systems & Procedures
Wilcox Electric Company, Inc.
Kansas City, Mo. 64127

Law and Computer Technology

It may please you to know that my article, "The Impact of Data Processing Technology on the Legal Profession", in your April issue has generated many more inquiries than the first publication of the article in a legal magazine.

If I write anything I think you might be interested in, I'll surely advise you.

VAUGHN C. BALL
Univ. of Southern Calif.
Law Center
Los Angeles, Calif. 90007

CAUML Comments

Your January editorial ("Access to Information and a Mailing List of All Computer People") has us in complete agreement. We would like to have our names included in your name and address files: . . .

I find your magazine very helpful in this rapidly changing field.

KENNETH W. KEMNER
Vice President
Automated Data Processing, Inc.
St. Mary's, Pa. 15857

computers and automation

Vol. 17, No. 7 — July, 1968

Editorial Offices
BERKELEY ENTERPRISES, INC.
815 WASHINGTON STREET,
NEWTONVILLE, MASS. 02160

CIRCULATION AUDITED BY
AUDIT BUREAU OF CIRCULATIONS

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computers and automation

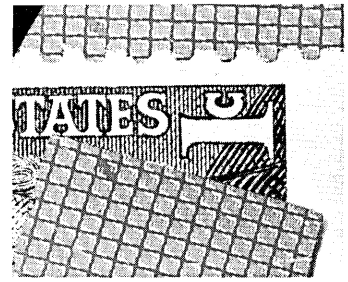
July, 1968, Vol. 17, No. 7

The magazine of the design, applications, and implications of information processing systems.

Special Feature:

Computer Installations: Experiences and Lessons

Regular Features



The front cover shows how almost a million electrical components can be made on silicon wafers the size of a postage stamp — and not much thicker. They were fabricated using new techniques for integrated electronics developed at Bell Laboratories, Murray Hill, New Jersey. Each little square, small enough to be visible through a postage stamp perforation hole, contains 672 transistors and resistors. *See page 55 for more information.*

Departments

C.a

EDITORIAL

Who's Who in the Computer Field — and Who Are the Distinguished Computer People?

As our readers know, we are in the process of preparing for publication another edition of *Who's Who in the Computer Field,* the fifth edition 1968-69. We have probably received over 500 entries from just mentioning the project in the pages of *Computers and Automation* and publishing the entry form (see the entry form on a page following this editorial).

Every day when we open our mail, we find half a dozen more entries for the *Who's Who,* and sometimes a lot of them. We are grateful for the initiative of those people who have sent us these entries. We expect to put out a mailing in July addressed to over 60,000 people in the computer field inviting their entries for the *Who's Who.*

But the major problem with a good *Who's Who in the Computer Field* is finding and including the distinguished people in the computer field: Who are they? And how do we find them? In fact, what is a "distinguished person"?

The dictionary gives for the definition of "distinguished":

1. conspicuous; marked
2. noted; eminent; famous
3. having an air of distinction; having an appearance of eminence or superiority.

This is slightly helpful; we certainly wish to include persons who are eminent or famous, or appear to be. But what are the observable criteria?

Most of the time we can rapidly observe evidence of distinction:

1. Accomplishments: A man who has accomplished a great deal is distinguished. Accomplishments are measured in worthwhile things produced: research successfully completed; computing devices designed; computer programs produced; papers written; books published; etc.

2. Positions: A man who has held important positions is distinguished. An officer of a company is distinguished; a manager of a computer installation is distinguished; a head of a government bureau is distinguished; a supervisor of a group of computer people is distinguished.

Sometimes a person of no worth is placed by accident in an important position, and thereupon he holds it for a while, for better or worse. Often among the former ruling families of Europe, a prince came to the throne only to show by his behavior, his unfitness to rule; even so, he was remembered.

3. Degrees, Awards, and Honors: A man who has received an award or honor, or who has obtained a degree from a school, or who has received a certificate showing courses studied and passed, is distinguished — more or less, depending on various factors, such as the nature of the degree or honor, and the standing of the organization awarding it.

In the field of computers and data processing, all holders of the Certificate of Data Processing from the Data Processing Management Association are certainly distinguished; the certificate represents study, experience, and passing a professional examination.

4. Memberships: A man who is a member of a society with significant requirements for admission is distinguished; but if all he has to do is pay dues to the society, he surely has not earned any distinction.

5. Seniority: Finally, there is seniority: a person who entered the field of computers and data processing a long time ago is distinguished. His major accomplishments may be in mathematics or management, he may no longer be working in the field, but it is desirable to include him, if possible.

Are there accordingly enough ways of being distinguished in the field of computers and data processing so that almost everybody in the field is distinguished?

Perhaps — but not everybody. A person who has been in the field two years as an ordinary programmer is not "distinguished"; a person who has been two years in the field as a salesman of hardware is not "distinguished".

But there is another part of the problem. How do we find (for entry in the *Who's Who*) the persons who are the "most distinguished" people in the computer field? And for that matter, how do we identify the "most distinguished" people?

The "most distinguished" people in the computer field are those who have made the largest or most significant contributions to the advancement of the field. They have been heads of important computer laboratories. They have designed the most important developments in the construction of computers. They have formed or guided the activities of the important associations, groups, schools, conferences, etc., in the computer field, leading to dissemination and fertilization of computer knowledge. They have been invited by the U. S. Congress and other bodies to testify as authorities on the state of the computer field. Or they have done similar outstanding things related to the computer field. When the history of the computer field is written, significant changes will be attributed to them. Among these people are Howard H. Aiken, former head of the Harvard Computation Laboratory, where the first automatic digital computer began operation in 1944; and John W. Mauchly and J. Presper Eckert, whose computer ENIAC was the first electronic digital computer that operated at 5,000 additions per second in 1946.

Recently, I went to the library of a computer field association to see if I could find a list or data on the 500 to 1,000 most distinguished people in the computer field. There was no such list. The only data there consisted of some biographical information on some 50 people in the computer field who had recently given some lectures. It is unlikely that any library anywhere contains such a list.

So we appeal to the readers of *Computers and Automation:* Please send us the name, location, and basis for distinction of those dozen or two dozen persons whom you think are the "most distinguished" in the computer field (see the blank at the end of this editorial). We will tally the responses; and we hope we will be able to present a report to our constituency on those persons whom our readers consider to be the "most distinguished" in the computer field.

This problem cannot today be solved by a computer; only people can solve it.

Edmund C. Berkeley
Editor

NOMINEES FOR "MOST DISTINGUISHED" COMPUTER PEOPLE

I nominate for "most distinguised" persons in the computer field, the following: (attach more paper if necessary)

In my country, which is ______________________________:

Name	Address or Location	Basis for Distinction
• ____________	____________	____________
• ____________	____________	____________
• ____________	____________	____________
• ____________	____________	____________
• ____________	____________	____________

In my region, which is ______________________________:

Name	Address or Location	Basis for Distinction
• ____________	____________	____________
• ____________	____________	____________
• ____________	____________	____________
• ____________	____________	____________
• ____________	____________	____________

In my professional area, which is ______________________________:

Name	Address or Location	Basis for Distinction
• ____________	____________	____________
• ____________	____________	____________
• ____________	____________	____________
• ____________	____________	____________
• ____________	____________	____________

Sent in by:

Name______________________________Title______________________________

Organization______________________________

Address______________________________

When completed, please send to WHO'S WHO EDITOR, Computers and Automation, 815 Washington St., Newtonville, Mass. 02160

ENTRY FORM FOR WHO'S WHO

If you wish to be considered for inclusion in Who's Who, please complete the following form 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 Distinctions?____________________

(attach paper if needed)

12. Associates or friends who should be send "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

computers and automation

Bulletin Board

Coming Issues

The AUGUST issue special feature is:
THE SIXTH ANNUAL COMPUTER ART CONTEST
The winning entry in our annual contest will appear on the cover of this issue, and we expect to publish more than 20 examples of computer art inside. Closing date for contest entries is Friday, July 5.

The SEPTEMBER issue special feature will be:
JOBS AND CAREERS IN DATA PROCESSING
A recent survey forecasts that by 1970, the computer industry will need 100,000 more programmers, 130,000 more analysts, and over 50,000 more EDP managers and supervisors. Where will they come from? How will they be trained? Who will train them? .... these are some of the questions which our September issue will explore.

The OCTOBER issue will have a special feature on:
TIME SHARING
Time sharing, its growth, its applications, its successes and failures, and its significance, will be up for discussion in this issue.

Recent Articles in C&A

THE PROGRAMMING PROFESSION, PROGRAMMING THEORY, AND PROGRAMMING EDUCATION, by Larry L. Constantine, Information & Systems Institute, Inc. (Feb., 1968)
"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 FULL CONTROL OF OPERATIONS IN DATA PROCESSING, by Russell W. Fenske, Univ. of Wisc. (April, 1968)
"There are some characteristics which typify a data processing operation which is out of control: peak loads require more and more overtime of personnel; other departments increase their complaints about late deliveries of important information and reports; the work stations and machine areas become clogged with backlogs of jobs; 'crises' occur and closer together; and the effects of infrequent equipment breakdowns cause traumatic reactions in the whole organization."

COMMUNICATIONS DATA PROCESSING SYSTEMS: DESIGN CONSIDERATIONS, by Lester A. Probst, FAIM (May, 1968)
"The key to the successful implementation and eventual operation of a communications data processing system is a well-planned, well-organized, and well-managed effort by a competent study team."

BULLETIN BOARD ENTRIES

If you are a subscriber or reader of Computers and Automation and would like us to list something of interest on our "Bulletin Board", please send it to us for consideration. We want to publish announcements that may be of general concern or value — either here, in "Letters to the Editor", or in "Multi-Access Forum".

Services for Our Readers

C&A Computer has Arrived

We have acquired a powerful, modern, small, general-purpose computer (a Digital Equipment Corporation PDP-9 with 8000 registers of core memory, each 18 bits long, and with one microsecond cycle time). It is especially suited for education, study, and research. Young people who are children of our subscribers are eligible to come play with it, use it, and learn computing. For more information Circle No. 4 on the Reader Service card. We are also inaugurating a "hands-on-the-computer" course for supervisory management, "Course C12: Computing, Programming, and Systems Fundamentals". For more information, see page 43 of this issue.

Financial Market Place

Sometimes large organizations ask us if we know of small, upsurging computer companies who are looking for more financial muscle to grow and expand. Sometimes small companies ask us if we know of sources where they can obtain such muscle. If you are in either category, write us your specifications in brief, and we shall try to bring about introductions. (See also "C&A Financial Market Place" on page 17 in this issue.)

Who's Who in the Computer Field

We plan to publish a "Who's Who in the Computer Field 1968-69", which we hope will contain at least 10,000 capsule biographies of computer people. If you would like to be considered for inclusion, please see the entry form on page 7 of this issue. For more information, see pages 6 and 7 of this issue.

C&A Data Base

We are setting out to produce a data base of general service to the computer field, containing names of over 200,000 people in the computer field, together with information about organizations, installations, computers, etc. For more information, see page 16 of the May issue, or circle No. 2 on the Reader Service Card.

C&A Universal Mailing List

Computer persons who are interested in receiving through the mail information about new developments in the computer field are invited to join the C&A Universal Mailing List. For more information see page 7 in the April issue, or circle No. 3 on the Reader Service Card.

Readers Service

If you would like more information about any topic mentioned in our magazine, to be sent to you with minimum effort on your part, we suggest you use the readers' service card. It is valid up to 60 days after the first of the month of issue. If it does not have a number or a space suiting the topic you are interested in, just mark it up to tell us what you want.

Is this the year of the Biomediputer?

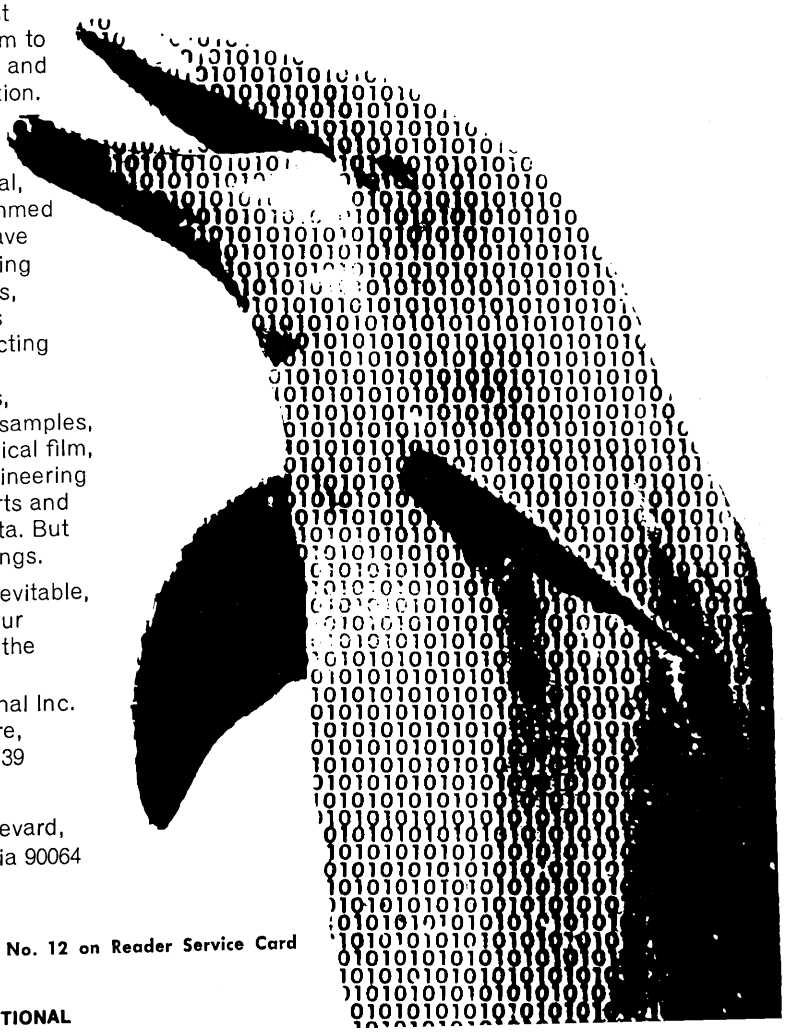
An electric eye — guided by a computer — looks through a microscope at a blood smear. Seated at a scope displaying this picture, a diagnostician aims a pointer at a large, dark blood cell and interrogates the computer: "How many like this are there in the sample? What is its average diameter? How many larger ones are there? How many smaller? In the last 100 slides we examined, were there any like this? If so, display those slides."

He's asking questions only an extraordinarily sophisticated machine could answer. But these things are not impossible, indeed, in the evolution of information-handling machines, they are inevitable.

As surely as numbers were coded to make adding machines possible, and letters were coded to make the telegraph possible, and arithmetic was coded to make computers possible, so visual information has to be coded in order that we can manipulate it at high speed. Not just translate it from one form to another, but interpret it and act upon the interpretation.

That is our business, manipulating visual information using optical, electronic, and programmed devices. Systems we have delivered are now reading oscilloscope wave forms, analyzing seismograms and oil well logs, extracting positional data from theodolite photographs, examining biomedical samples, interpreting oceanological film, cleaning up soiled engineering drawings, making charts and graphs from digital data. But these are only beginnings.

We are pushing the inevitable, you might say. And your inquiry may influence the direction.



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INFORMATION INTERNATIONAL

c.a

MULTI-ACCESS FORUM

GOOD COMMUNICATION BETWEEN PEOPLE, BETWEEN MACHINES, AND BETWEEN PEOPLE AND MACHINES — AND OBFUSCATION

I. From Robert P. Bigelow
Hennessey, McCluskey, Earle and Kilburn
60 State St.
Boston, Mass. 02109

Your May editorial of Obfuscation strikes a tender spot. As a member of a profession which has been damned through the years for writing turgidly, even to the extent of 96-word sentences, I feel that both a defense and an explanation are warranted. Many of the documents which lawyers draft are intended primarily to communicate with other lawyers. We have our own lingo and our own style; we have an ability to communicate to each other. The same can be said for other professions and industries, be it medicine, actuarial science or computers.

The communications problem arises when members of different professions attempt to communicate with each other, or members of one profession try to communicate with each other about something that is not common to their profession. For example, the 96-word sentence produced by the lawyer was probably completely understandable to another lawyer. Unfortunately, you are an actuary. Have you ever seen some of the life insurance policy language drafted by actuaries? And neither the lawyer nor the actuary has done a very good job in communicating to the layman who buys the policy.

As an example of the second type of communication failure, take discussion between you and your associate editor on movable partitions. It is probable that two architects or two space planners, or one of each, would have had little difficulty in understanding each other.

Your editorial points up the special precautions which need to be taken when persons of differing background are attempting to converse.

II. From James Peacock, Managing Editor
EDP Industry Report
60 Austin St.
Newtonville, Mass. 02160

Your discussion of obfuscation in the May issue touched a sore point in my constitution. I applaud you for publishing this and I sincerely hope it will lead to serious consideration of the important point you make in your editorial.

Naturally, as a writer, I couldn't help playing with your "Memorandum for Assistant Editors from the Editor". My first inclination was to submit a Number 8:

> 8. When a higher level of work interaction among scientists, theorists, and naval engineers has been noted to exist, there has been detected an increasing correlation in the occurrence of progress in the discovery of unsuspected areas for systematization of scientific and design calculations.

But efforts in this direction could be extended virtually ad infinitum. Therefore, I felt required, also, to submit a Number 0, to retain the numbering scheme in your Memorandum:

> 0. As mathematicians, theorists, and naval engineers work together more closely, they have found new and unsuspected areas in which scientific and design calculations can be made more systematic.

As far as the more important portion of your editorial is concerned, I hope to make some more contributions later on.

III. From the Editor

We appreciate the helpful comments of Robert Bigelow and James Peacock.

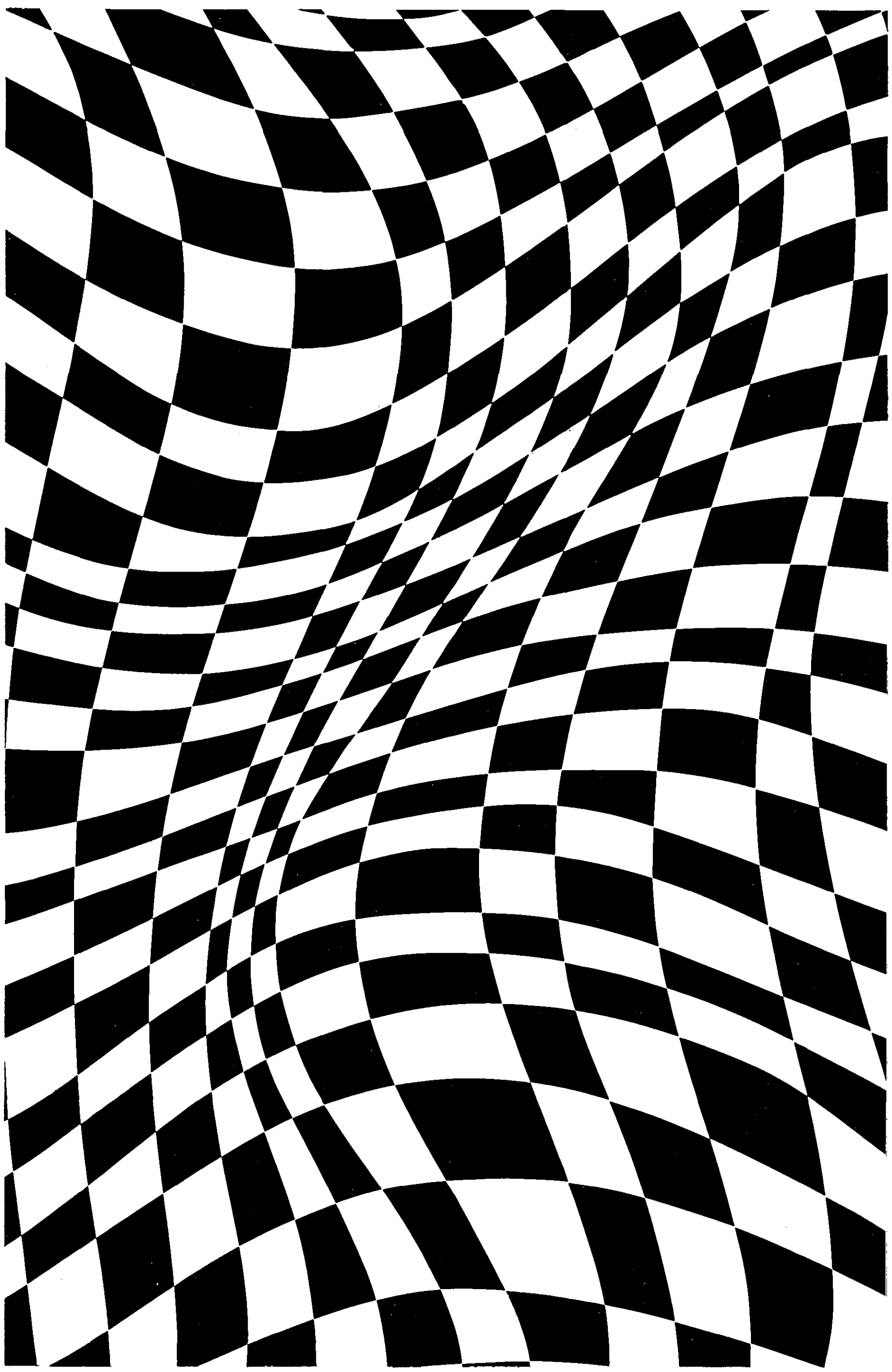
The conveyance of clear and correct ideas from one human being to another, or to a machine, or from a machine to another machine or to a human being, is becoming a more and more important problem.

A computer program for playing championship checkers now exists: How should it convey ideas for championship play to a human being?

With the arrival of our own computer, *Computers and Automation* is starting a laboratory on computer-assisted instruction, computer-assisted explanation, computer-assisted documentation, and computer-assisted conveyance of ideas.

We hope the day will come when an assistant editor can give a plan for an article to the computer, and the computer will produce a reasonably good first draft, such as a clever secretary with an adequate file of information could produce.

In the meantime, the frailties of human beings are again emphasized: there is a wrong word in our May editorial "How to Obfuscate, and How Not To", as printed. In line 6 in the left-hand column, please replace the word "Definition" with the word "Derivation".



SEPARATE PRICING FOR HARDWARE AND SOFTWARE

Richard C. Jones, President
Applied Data Research Inc.
Route 206 Center
Princeton, N.J. 08540

The issue of separating the pricing of hardware and software is the issue of free competition. In virtually every phase of our lives, we favor competition and the right of a consumer to make the buying decision. Our country was founded on this basis, and our legal system, presumably, is constructed to protect this right.

In discussing the separation of the pricing of hardware and software there are two aspects of the problem: legal considerations and user considerations.

Legal Considerations

It is our strong belief that the current pricing practices are in violation of anti-trust laws. These laws were formulated to promote free competition. History has proved that in this type of market environment, prices go down while quality and service improve.

One of the well-known techniques for restricting free, competitive markets is the so-called tie-in sale; the technique by which a producer in a strong position in one market expands his strength by forcing consumers to purchase, along with the desired product, other products where the producer does not enjoy as pronounced a favorable position.

These arrangements have been time and again held to be in restraint of trade: United Shoe Machinery was prevented from continuing the practice of selling only to shoe manufacturers who used their equipment exclusively; Eastman Kodak was prevented from selling film processing along with film; IBM was prevented from restricting the use of their equipment only to those who punched cards of IBM's manufacture.

The two key groups — IBM and the Justice Department — have recently declined an invitation to present their views on the legal aspects of this issue.

We have developed and are marketing an automatic flowcharting package called AUTOFLOW. IBM distributes a software package that is intended to solve a similar problem. Our system has a price tag; IBM's system is included in the price of the machine.

Because we felt this was an unfair competitive practice, we obtained professional advice from a law firm specializing in anti-trust and an economist who has consulted with the Justice Department as an "expert" on related matters. Both of these sources felt our position has merit. We have presented our views to the Justice Department and so far have received no reply. This is not surprising since, in their investigation of the computer industry, separate pricing is only one of many issues.

When we purchased our IBM 360/40, we inquired as to the price without software. We were told it was the same. I wonder — does that mean that their software isn't worth anything, or that the price is loaded with things we don't want? I object to paying my *unfair* share of software I don't want. I further object to any manufacturer's attitude that the user is incapable of making a buyer's decision.

User Considerations

If, as we contend, the present pricing practices constitute restraint of trade, economic theory would predict that the effects of such restraint would be clearly visible in terms of inferior products at high prices. We think that such effects are present.

It is our contention that the user is paying for the lack of competition in software in at least five areas:

1. The *pricing of equipment* includes the cost of highly specialized packages which are applicable to a very small segment of user population.
2. The *efficiency of software* is an issue over and over. The introduction of competition by companies who sell software on its merits would place emphasis where it belongs.
3. The *amount of equipment required* is of primary concern to manufacturers. Software that does not sell equipment or that reduces memory and peripheral requirements beyond those otherwise required are not in the manufacturer's interest.
4. *Excessive user personnel and unnecessary costs* result from the present approach which includes overelaborate, difficult-to-use, systems software.
5. The *maintenance of software* currently leaves much to be desired. Placing the economic emphasis where it belongs would improve the situation.

If separate pricing for software existed today, the user would be benefiting in each of the areas above. He could make a decision to buy software either from the manufacturer or from other sources of supply. Separation would not only greatly widen the user's choices, but would also compel the manufacturer to produce much better software.

Competition historically has benefited the consumer. The software area certainly needs to be improved. A competitive software market could be a major factor in its improvement.

A STANDARDS COMMITTEE FOR PRIVATE DATA PROCESSING SCHOOLS HAS BEEN FORMED BY DPMA

Education Dept.
Data Processing Management Association
505 Busse Highway
Park Ridge, Ill. 60068

The first meeting of a newly-formed DPMA Private Data Processing Schools Standards Committee was held in May in Chicago.

The fourteen members represent the computer manufacturing industry, education, government, private EDP schools, and associations.

At the meeting, four sub-committees were organized and charged with making a study and recommendations on: management and sales methods; instructional personnel qualifications; curriculum development and implementation; and graduate placement.

Over a thousand private EDP schools exist today, because size 8-10 perfect con by Christian D'or, $80

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BASIC, FORTRAN, AID, MACRO. Gen purp syst prvdes tme-shring plus batch plus rl-tme data acquis all smltnsly. Oustand hi perf ftures incl: 32K wd mem expndble to 262K. 36 bit wd. 366 pwrfl instructs, hi spd swap disk, lrg disk files, reentrant hrdwr. Typ price 32 terml syst $500,000. Why py mr?

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COMPUTERS · MODULES

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...NTS of 3 rm apt. bdrm ... conditioner orienta... ...s etc call data processing needs qualified personnel. Many of these schools give creditable training, but others are not so conscientious. The result has been that many poorly trained or unqualified people have received employment in data processing, and later find that their knowledge or skills are inadequate.

This practice is grossly unfair, to the students who pay for but do not receive adequate training, and to the business organizations which later employ them. The place to stop or curtail this practice is with those schools that are not providing adequate instruction.

The new committee will endeavor to provide guidelines for instruction, and make them available, so that all private EDP schools that are sincerely motivated will have meaningful yardsticks to apply.

COMPUTER PROFESSIONALS FOR PEACE (CPP) ARE PROGRAMMING A COMPUTER TO PRODUCE VOTING LISTS TO AID PEACE CANDIDATE CAMPAIGNS

Edward Elkind, Chairman, CPP
711 Amsterdam Ave.
New York, N.Y. 10010

A number of computer professionals, concerned about the role of computers in war and for peace, have organized themselves in New York City. Started by five people in January, Computer Professionals for Peace has approximately 70 paid-up members now, and is carrying out a varied program of pro-peace activities.

Members will use their computer skills in peace-related activities. For example, a committee of CPP members is now programming a computer to produce voter lists to be used in the campaigns of peace candidates. Other proposed activities include free computer services to peace organizations, free-lance computer work in return for donations, and a free program of instruction in computer skills for the disadvantaged.

CPP is seeking to provide a range of activities for members of varying viewpoints who nevertheless abhor the prime use of computers for military purposes. Besides expanding its membership and programs in New York, CPP hopes to attract members and form local chapters elsewhere.

Following are some excerpts from the CPP statement of purpose:

"We, as professionals in the computer field, have become increasingly aware that modern warfare is decisively dependent on the use of computer technology. The burden of moral responsibility for the potential destructiveness of our professional endeavors has convinced us that we must have a voice in the ultimate use of our skills. For this reason, we have joined together to express our concern by word and action, and to seek to change those national policies which we believe are leading to catastrophe.

"Our immediate concern is the war in Vietnam. The present policy of the United States government is no longer credible. Optimistic forecasts have finally been lost in the sounds of recent battles in the cities of Vietnam. We claim to be repelling a foreign invader when, in fact, Americans are the foreigners. We are propping up a corrupt and tyrannical regime which has given its own people more than sufficient cause to revolt. We are destroying the people we claim to be defending and, in the process, killing thousands of American soldiers.

"While the problems of poverty, urban decay, and racial tension are increasing at home, with increasing neglect, more and more of our young men are being drafted to fight and die. The human energies and material resources of the United States are diverted from meeting pressing domestic needs. Our taxes are devoted to destruction abroad instead of being used for construction at home. . . .

"We, as computer professionals, wish to contribute to the creation of a world in which the constructive potentials of our skills can be fully realized for the betterment of mankind. We wish to improve the quality of human life by using computers to solve problems of hunger and deprivation, not to implement more sophisticated weapons systems destructive of human life.

"We invite computer people to join Computer Professionals for Peace. We seek to provide a focus for educating other members of our profession, and a means for expressing our views as a professional group."

ASSOCIATION OF INDEPENDENT SOFTWARE COMPANIES FORMED

Association of Independent Software Companies
P.O. Box 4548
Washington, D.C. 20017

The Association of Independent Software Companies was formed in May in Washington, D. C. A principal objective of the organization will be to foster, advance, and promote trade and commerce in the interests of those profit-seeking companies engaged in the business of supplying services for the analysis, design, coding, testing, documenting, and installation of information handling systems for operation with electronic data processing equipment.

The fact that this association is formed at this time is a sign of the continuing maturity of the computer software field. The total business of the originating members sums to over one hundred million dollars annually.

The founding member firms are: Applied Data Research, Inc.; Aries Corp.; Auerbach Corp.; Computer Applications, Inc.; Computer Usage Development Corp.; Computing and Software, Inc.; Comress; Informatics, Inc.; The Merle Thomas Corp.; Planning Research Corp.; and Wolf Research and Development Corp.

In the coming months the Association will concern itself with such subjects as: competition from the not-for-profit organizations; protection of proprietary programs; clarification of the role of contractor with respect to civil service; and the question of separating procurement and pricing of hardware and software.

Inquiries about membership in the Association from organizations are invited, and may be directed to the Membership Chairman at the above address.

DATA PROCESSOR CONNECTS NEEDS WITH RESOURCES DURING AFTERMATH OF WASHINGTON CIVIL DISORDERS

The Jonker Corp.
26 Summit Ave.
Gaithersburg, Md. 20760

A data processing system loaned to the Washington, D. C. Government by the Jonker Corp. helped thousands of persons whose homes and possessions were lost in the civil disorders that occurred in Washington April 5-7.

The $6000 system was installed April 8th at the Citizens Information Service located in the Old District Court House at 451 Indiana Ave., N.W. Through April 12th the data processor met more than 1000 individual requests for resources. The system was manned by employees of Jonker Corp. and Systemetrics Corp. Both personnel and the equipment were loaned to the city free of charge.

Here is how the operation worked: all available resources which had been volunteered to the Citizens Information Service — workers, homes, food, clothing, etc. — were indexed on "optical coincidence" cards. By utilizing light which shines through punched holes, the system matched needs to resources in a matter of seconds.

For example: if a request was received for volunteer workers to man a clothing distribution center in N.W. Washington, the system rapidly identified the volunteer individuals who lived closest to the need — and who were available to work during the day. The names and telephone numbers were given to operators who contacted the volunteers.

An electronic digital computer could not have been used effectively in the crises because several weeks would have been needed to program it effectively. The Jonker J-301 system was answering inquiries within 20 minutes after installation.

David A. Delo, Executive Director of Systemetrics (Washington based consultants in urban affairs and municipal problems who researched and wrote portions of the recent Kerner Report) said that "from our experience and background in investigating the riots of last summer, no city had previously utilized this type of a disaster system. The Jonker Termatrex system provided a good basis for a disaster control information system".

OPEN LETTER TO ALL MEDICAL COMPUTING PROGRAMS

E. R. Gabrieli, M.D., F.C.A.P.
Director, Clinical Information Center
Department of Social and Preventive Medicine
State University of New York at Buffalo
Meyer Memorial Hospital
462 Grider St.
Buffalo, N.Y. 14215

At the recent conference of the New York Academy of Sciences on "The Use of Data Mechanization and Computers in Medicine" substantial progress was reported by several lecturers. The currently available hardware seems adequate; the medical knowledge and software is rapidly developing. The aim of a national, and international health information network with supporting data banks, seems to be almost within reach.

The great problem we are faced with is to maintain compatibility among the individual projects. Standardized criteria for diagnosis, uniform coding of therapeutic procedures, patient identification, compatible design of the data bank, are some important considerations. Education of health professionals to utilize the new technology, education of the public to eliminate the distrust of automation, fear that privacy is in danger, are equally critical issues. Coordinated planning is urgently needed.

In order to facilitate communications in the area of planning a full session of a symposium (to be held in Buffalo, New York, September 19-21, 1968) will be devoted to reviewing the currently available plans. The major health agencies have responded promptly to our call for plans.

By this open letter we invite opinions, recommendations, and plans from all projects concerned with medical data handling. All material received will be compiled in a semiformal publication which will be available to all interested parties.

AUTOMATIC DATA PROCESSING MUST DEAL WITH SOCIAL PROBLEMS: DR. H. R. J. GROSCH

Association for Computing Machinery
211 East 43 St.
New York, N.Y.

Speaking at the National Bureau of Standards, Gaithersburg, Md., on May 16th, Dr. Herbert R. J. Grosch declared that the real measure of the computer profession is what it does to close the gap between solving clean, scientific problems and solving messy social, political, and economic problems that beset our country today.

Dr. Grosch is the Director of the Center for Computer Sciences and Technology at the Bureau of Standards. He gave the keynote address at the Seventh Annual Technical Symposium of the Washington, D. C. Chapter of the Association for Computing Machinery, attended by over 600 persons.

Dr. Grosch stated that we can no longer say about social problems, "It is not our business". Computer professionals are concerned, and the power of the computer is a positive necessity in the solution of current urgent social problems. New groups, which may include the present computer associations as well as social and economic groups, will be necessary for discussing and studying these problems with computers.

RAPID EFFICIENT STARTING OF ACQUAINTANCESHIPS IN THE COMPUTER FIELD

Roger Barnard
101 Western Ave.
Cambridge, Mass. 02139

At the conference of the International Federation of Information Processing Societies this summer, some thousands of computer people will be coming together from all over the world. They will want to know each other. Can we apply our professional mastery of computer technique to the problem:

> How to make it easy for perhaps 3000 computer people gathered in Edinburgh for a week in August to become quickly acquainted with each other, and quickly find out mutual interests and backgrounds, and become friends?

It seems to me much good could be accomplished by the following proposed information system:

- Have each person who registers for or arrives for the conference fill out (if he wishes) a form telling his background, interests, current activities, current problems, hobbies, what he is currently working on or thinking about.
- Convert the information on this form into a punched card (of a special type, which I shall describe), for this person to carry with him.
- Encourage each person (who feels so inclined) to match his card with the card of somebody — met during the conference — by holding the two cards together up to the light to reveal where there is overlapping of holes — so that common interests will be at once detected.

The existing anthropomorphic system consists of diffident, gently inquiring, and sometimes fatiguing conversation between two relative strangers, who are only wearing badges showing their names and organizations. The existing system does not work quickly or positively. It may take as long as ten or fifteen minutes to find out most of the answers about mutual interests, and some mutual interests may not be discovered at all. Who has not felt the sense of wonder and delight in making a new friend, when one says (or feels like saying), "Where have you been all my life?"

The proposed system could be amusing and exciting, and could very quickly show two individuals encountering each other (on a bus, or in adjacent seats, etc.) what sorts of interests they had in common. Of course, it would not replace the existing system of exploratory conversation — but it would supplement it and give it a running start.

In regard to some details of the proposed system: (1) In the proposed system it would be important to choose the parameters reasonably well, and assign each a fixed column in the punch card. An example of a parameter would be "interested in problem-oriented programming languages"; (2) It would be necessary to punch successive degrees of a parameter in such a way that a high degree of the parameter would produce punching of each lower degree of that parameter — only in this way would overlapping holes show mutual interest when the cards were held up together to the light; (3) It would be necessary that each column of the card be interpreted, because people would not be able to remember that, for example, column 54 meant "hobby: collecting butterflies".

Interesting statistical information about attendees at the conference could, of course, be derived as a byproduct.

On some occasions in the past when this idea has been mentioned, it has been promptly squelched, as too unusual or too mechanical. But it seems to me that social mores about computer society meetings have now changed considerably. The proposal could now be judged on its merits as an information system, rather than on its nonconformity with old anthropomorphic ways of doing things.

TELEOPERATORS AND HUMAN AUGMENTATION

Edwin G. Johnson and William R. Corliss
National Aeronautics and Space Administration
Washington, D.C. 20546

Teleoperators are general-purpose, dexterous, cybernetic machines. Like a storekeeper's lengthy tongs, they enable men to manipulate things from afar. Some teleoperators help a man proceed as if he himself were in a hostile environment, where actually he could not work. Some enhance his strength and adroitness.

Although developed for handling radioactive materials and exploring space, some teleoperators already have been adapted for use underseas. Their further development may be expected in industry, rehabilitation centers, and amusement parks.

Since 1948, some 3,000 manipulator arms have been built in the United States. More than 80 percent were shipped to atomic energy installations. These "master-slaves" are only the advance guard of an army of man-machine systems now assembling to serve man in a variety of ways, such as salvaging ships at the bottom of the sea and enabling armless persons to feed and care for themselves.

For more information, see a recent survey by the Atomic Energy Commission and NASA entitled "Teleoperators and Human Augmentation". This survey is a synthesis and ordering of knowledge of these new devices, and an assessment of the impact of teleoperator design on technology as a whole. It stresses principles that will continue to be valid despite further changes in this technology; and explains the principal subsystems of those now being used. Demands placed on the subsystems in a broad range of applications are listed, and actuating, sensing, and terminal devices are discussed.

The survey is identified as NASA SP-5047, and is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

WINNING ENTRIES IN THE IFIP CONGRESS COMPUTER-COMPOSED MUSIC COMPETITION

IFIP Congress 68
23 Dorset Sq.
London, N.W. 1
England

First prize in the IFIP Congress 68 computer-composed music competition has been awarded to Iannis Xenakis of France. The piece of music that won the award is for a string quartet and was composed by a Fortran program run on an IBM 7090 computer.

Second prize goes to "ZASP", a piece of electronic music submitted by Peter Zinovieff and Alan Sutcliffe of the U.K. This composition is performed under the control of a DEC PDP-8/S computer and was composed on an I.C.T. 1905 computer.

A quartet for strings in C major submitted by Lambert Meertens of the Netherlands received a sepcial mention by the judges.

It is hoped to perform the winning entries at IFIP Congress 68 during a musical concert to be given in the Usher Hall, Edinburgh, on Thursday evening August 8th.

Members of the adjudicating committee were: Dr. A. P. Speiser (Chairman), Professor Henk Badings, Professor Dr. Heinz Zemanek, Mr. Lionel Salter, and Professor Stanley Gill. Dr. Speiser is the President of the International Federation for Information Processing. Professor Badings is Professor of Composition at the Hochschule für Musik in Stuttgart. He is a leading contemporary composer, his best known work being the radio opera "Orestes" which won the Prix Italia in 1954. Professor Zemanek is the Austrian member of the IFIP General Assembly. Mr. Salter is Assistant Controller of Music, British Broadcasting Corp. Professor Gill is Professor of Computing Science and Director of the Centre for Computing and Automation, Imperial College, London.

C&A FINANCIAL MARKET PLACE

$70 Million Firm Seeks Service Bureau in Northeast

I. From K. Wiswell
Company 687
New York, N.Y.

I've noticed your May 1968 "Bulletin Board" on introducing large organizations to upsurging computer companies.

We are a $70 million distribution firm with a wholly owned service bureau as a separate profit center. We are interested in acquiring — for cash — another service bureau in the northeast United States where the management is strong and where a substantial part of the revenue is coming from one or two proprietary applications that can be marketed to many other prospects.

We have substantial capital and marketing resources to add to such an enterprise.

We are not interested in a "catch-as-catch-can" job shop that does a little of everything with no field of particular specialization and expertise.

How should we next proceed?

II. From the Editor

Nothing we know of at the moment matches your requirements. We are publishing the statement of your interest; and we will see what results.

If any reader is interested, please write: C&A Financial Market Place, Computers and Automation, 815 Washington St., Newtonville, Mass. 02160.

1969 SPRING JOINT COMPUTER CONFERENCE — CALL FOR PAPERS

T. H. Bonn
Technical Program Committee Chairman
1969 Spring Joint Computer Conference
Honeywell EDP
200 Smith St.
Waltham, Mass. 02154

Original technical papers are invited on all aspects of the computer and information processing field for presentation at the 1969 Spring Joint Computer Conference to be held May 14-16, 1969, in Boston, Mass.

Papers must be submitted by Oct. 7, 1968.

The main purpose of the 1969 Conference is to stimulate those engaged in research, advanced development, design, and use of computers and their programs to communicate their ideas and experiences freely through presentation of high quality technical papers.

Authors should not be limited to the general fields of hardware, software, systems, and applications but should also consider the technical-social aspects involving the use of computers. It is suggested authors submit original ideas and experiences relating to secrecy and privacy, the inquiry by the Federal Communications Commission into data communications, the design and promulgation of standards in the industry, problems of competition, and the direction of the industry's growth.

Five copies of the entire paper should be submitted, including a 100-to-150-word abstract and a text of not more than 7,500 words. A full set of rough illustrations, when applicable, should accompany the text and be keyed to it. Final texts will be published in the conference proceedings by the American Federation of Information Processing Societies (AFIPS), sponsor of the Joint Computer Conferences.

PROGRAM GENERATORS:

James R. Ziegler, Pres.
Turn-Key Computer Applications
27608 Silver Spur Rd.
Rolling Hills Estates, Calif. 90274

How good are program generators?

When, where and to what extent can they be used profitably?

These questions are vital. And they are becoming more critical all the time. Consider: The population of automatic computers is exploding at the rate of more than 1,000 installations of machines per month. Even if the software segment of the information processing industry lives up to its forecasts and quadruples by 1975, available personnel will still make up only a fraction of the programming pool needed to install these systems under tried-and-true techniques.

In this unfolding crisis, program generators have been regarded, on the one extreme, as a panacea to solve the bulk of the computer users' problems. The opposing extremists tend to see generators as useless, as instruments of frustration for the really skilled programmer.

The real value of generators seems to lie somewhere in between these extremes. But, where? The time has come when a lot of people will need to know just how they can use program generators and to what extent they can rely on them.

Program Generators

Most appraisals (and appraisers) tend to treat program generators as something new and largely untried. However,

James R. Ziegler holds an M.A. in mathematics from Pennsylvania State University and has taught programming and mathematics at the University of California at Los Angeles for the past 19 years. He was formerly director of Advanced Programming Research for the National Cash Register Company. He is a frequent lecturer, is the author of the book *Time-Sharing Data Processing Systems* (Prentice-Hall), and several definitive papers on advanced programming techniques.

HOW GOOD ARE THEY?

"Program generators have been regarded, on the one extreme, as a panacea to solve the bulk of the computer user's problems . . . and on the other extreme as useless instruments of frustration for the really skilled programmer. The real value of generators seems to lie somewhere in between these extremes. But where?"

this is not the case. The writer, for example, has been working actively with the development and application of program generators for more than six years. It is safe to say that there are thousands of generated programs — particularly involving business applications — which are running successfully today. But, it is just as safe to state that there are many other cases where application of generators has been attempted unsuccessfully.

The big need, then, is to develop an understanding among data processing management people of where and how program generators can be used profitably. As the basis for such an understanding, let's begin with a definition:

Definition

Program generators are *techniques* for applying computers for the performance of extensive functional sequences rather than individual steps or discrete operating commands.

To illustrate:

Generator functions are commonly called programming macros. The term implies an expansiveness of capability. Typically, all programming instructions for the formatting and printing of records for a complete report can be triggered through the execution of a single generator macro function. By comparison, thousands of lines of coding might be necessary to accomplish the same results under assembly or compiler techniques.

Macro Functions

As a general rule, macro functions are developed for the common denominator jobs of application programming. Examples: file organization, file updating, sorting, collating and so on.

This approach is designed to make for more logic and less detail in the programming cycle. Where the use of generators can be optimized, program development time can be abridged 50 to 80 per cent because step-by-step coding, the most time-consuming part of the job, is reduced in those proportions.

Another important aspect of the definition is the reference to generators as programming techniques. By exclusion, it was intended to indicate specifically that generators are NOT programming languages.

This is an important distinction!

Auxiliary

A generator is auxiliary to a compiler for some established programming language native to the system on which it runs. That is, the actual coding created by a generator must be further interpreted by an assembly or compiler program for actual execution. The value of the generator to the user can be affected greatly by this inter-relationship.

As with any other type of programming, a key procedure in the use of generators is de-bugging. With generated programs there is a special condition: Users tend to be relatively unsophisticated. Therefore, the level, or levels, of compiler-generator relationship can be critical in final program implementation. Consider:

Some generator techniques provide capabilities for program traces (selective printouts of instruction sequences) or dumps (extensive listings of memory content) only in low-level assembly language. This means that program implementation calls for minute understanding of the inner workings of the system. Other generators, on the other hand, make multi-level system tracing available.

Multi-Level Capabilities

Multi-level tracing capabilities were incorporated into the generator technique with which the author was associated — BEST (Business EDP Systems Technique). This generator was developed by NCR for use with its 315 family of computers.

To illustrate the multi-level capabilities, the programmer, under one option, can call for a trace covering system functions and logic only. Under this alternative, the computer prints out mnemonic descriptions incorporated into the original macro function specification documents. Thus, the programmer doesn't have to get into programming languages at all.

Alternatively, however, this generator can deliver partial or complete listings of the compiled program in NEAT, a standard assembly-level language for the 315. For fine analysis, memory data dumps are also available.

This illustration, in itself, says a lot about the utilization of generators in active business data processing installations:

First, before any program can be prepared — whether it is to be generated or hand coded — an effective system must be designed. As with any other type of programming, the more efficient the functional design of the system, the better the program will run.

Second, generator techniques do not eliminate the need for programming or programmers. Neither are generators tools for novices only. An experienced programmer can make better use of his time through generation techniques because the coding stage of program development is greatly abridged. Thus, the experienced programmer can spend proportionately more time designing his system.

For novice programmers, generators do represent a method for becoming productive sooner. But, the need for systems and programming language knowledge at the debugging stage should be kept in mind. Typically, a novice programmer can begin working in an installation after one to two weeks of training (based on BEST experience). At this point, he is ready to work under an experienced person. The novice, however, handles the whole job. He develops his flow chart and gets this approved first. Then he fills out the data record layout forms which define the data to be input into the system and to be output from the system. He also fills in the parameter sheets which direct generation of coding for individual macro functions.

Documentation

Herein lies another advantage for properly-applied generator techniques. Documentary discipline is inherent in the use of generators. Specific forms are needed for every programming operation. Therefore, each program generated must be completely documented on a step-by-step basis.

This documentation is also valuable for the "desk debugging" of programs before input cards are punched. Then, at each subsequent step toward final system implementation, the generator itself can be used to output any documentation required for checkpointing or de-bugging.

The point is that it is vital for data processing managers to realize that program generators are not a potential cure-all for their total programming problems. Rather, they are designed primarily to alleviate the headaches of one aspect of system development, coding.

In this respect, it should also be remembered that, even within a generator-developed program, there may be places where it is quicker — or more efficient in terms of processor time — to hand-code one segment of a program. It is a common practice, for example, to use generator techniques for input/output and housekeeping operations while hand coding is applied for computational and decision-making segments of a program. For example, a generator might be used for record input, file organization, file maintenance, sorting, collating, output formatting, and report or document printing. However, experienced programmers frequently prefer to use hand coding for computation or decision operations.

The ability to combine generator and hand-coding techniques, in turn, leads to consideration of the commonly-asked question on the efficiency of generators in terms of processor utilization. Many programmers feel that all generated programs run inefficiently, that generator techniques should not be used except on rarely-run jobs or for installations which have a lot of processor time to waste.

This can be true in situations where program generators are inefficiently used. However, it is also true that the sophistication and experience of the individual programmer can make a big difference in the efficiency of the programs derived from generators, just as it does with hand coding.

Based on personal experience with hundreds of applications of the BEST program generator, the truth seems to read something like this:

There is no such thing as optimum programming — generated or hand coded. For the sake of comparison, it was estimated that BEST-generated programs were at a level of machine efficiency equivalent to hand coding written by a programmer with two years of experience.

This estimate was based on situations where programs were 100 percent generated. In situations where experienced programmers stepped into the picture and used combination techniques, making use of both generated and hand coding within the same programs, results were quite different. On the average, experienced programmers use BEST for about 80 per cent of their coding requirements and write the rest by hand. In such cases, highly efficient programs are delivered in 35 to 45 per cent of the time which would be required if the job were entirely hand coded.

Business Programming

These experience-estimated figures tend to help pinpoint the place of generators, at least in the field of business programming:

- Generators represent an avenue for getting novice programmers into productive work faster — provided the shop in which they work has at least one senior person available to guide them.
- For experienced programmers, generators can reduce the time required to activate new jobs.
- Programming costs can be reduced, particularly for reports or for small and/or intermittently-run programs.
- Where tight deadlines make conventional coding impossible, generators can help to get a lot of work "on the air" in a hurry.

In Practice

The practice of these general principles can be illustrated effectively with two examples which come to mind.

One of the first extensive uses in the country for program generation techniques in a complete system conversion took place at the NCR Data Processing Center in Los Angeles. Because of conditions beyond local control, management of this Center received notice suddenly that the NCR 304 system on which all jobs were being run was to be replaced by an NCR 315. This created a requirement to reprogram some 40 customer jobs involving four to five programs each. These new programs had to be rewritten, debugged and on-the-air within the 90-day period.

At the time the decision was made, the Center had no personnel with 315 experience. Immediately, five persons were enrolled in schools for one week of training each in the NEAT compiler and the BEST generator. The conversion, involving more than 150 separate programs, was completed on time. In this instance, BEST utilization was 100 per cent.

Later analysis indicated that operating efficiency averaged about 80 per cent of optimum. In some cases, the original programs were patched with NEAT coding to improve throughput on frequently run jobs.

As a continuing practice, each incoming job is analyzed to determine frequency of use, machine time requirements and other factors. On the whole, BEST is used for more than 80 per cent of programming requirements. For reports, BEST utilization averages 95 per cent.

Another specific experience involved a medium sized department store (about $40 million in annual sales) with a crash requirement for conversion of its accounts payable procedures to a computer. The conversion also involved two subsidiary applications: a purchasing report and an expense journal subsidiary to general ledger posting.

The store had a master file of 2,500 vendors. Payables transactions averaged about 500 daily, 10,000 per month.

Starting from scratch, an experienced system designer was retained to define the problem. Data and job definitions were completed and signed off in about four weeks. These established a need for some 45 programs, 10 of them sorts. The processing itself involved mixed-record input streams with up to 100 different types of transactions to be validated and segregated into appropriate application files.

These programs were written in five weeks by five people. About 4 per cent of the coding was hand written. The rest was BEST generated.

The system was installed and de-bugged in 11 man/weeks. Running efficiency was at maximum printer speed for all applications. In other words, processing productivity was always ahead of output capability. (The system used a 450-line-per-minute printer and four slow speed tape handlers. Efficiency criteria were rated accordingly.)

In summation: Although they do not represent a total solution to all problems, generators do have a valid place in the software picture for many users. The value derived from generators, as with any other programming technique, depends on the skill applied in their use.

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THE IMPACT OF DIGITAL COMPUTERS UPON STEEL WORKS OPERATIONS

W. E. Miller, Manager
Metal Industry Systems Engineering
General Electric Co.
One River Rd.
Schenectady, N.Y. 12305

"The increased use of digital computers for process control and the effectiveness of digital computer control is limited only by our capacity to create new ideas, organize our thoughts and the process functions in a logical manner, anticipate process and operator malfunctions . . . and provide for them."

An order of magnitude change in man's ability to perform a task has usually resulted in a profound influence on his way of life. Such change is represented by today's commercial jet aircraft, which are roughly an order of magnitude faster and larger than the first commercial airplanes. Application of the digital computer to process control promises change by an order of magnitude more significant and beneficial than these jet aircraft, which have so greatly altered our personal and business ways of life.

While process control via local regulators such as automatic gage control on the hot strip mill have brought benefits in productivity and product quality, these sophisticated systems are not the final answer; they must be set and reset by human operators, who have the limiting human traits of varying attention, concentration and accuracy. Process computer systems not only overcome these human weaknesses, but are being used in some cases in adaptive modes.

Growth of Process Computer Applications

The first on-line real-time application of a digital computer to process control occurred in 1958 in the petro-chemical industry. Since then the growth has been exponential; there are now approximately 1600 process computer applications throughout the world. Digital computers for the control of industrial processes have, in a relatively short period of time, achieved a position of importance and acceptance unparalleled by any other industrial change in the last four decades. It is difficult to estimate future growth; in 1966 the Midwest Research Institute, Kansas City, Missouri, predicted a total of 3000 process computers in all industries by 1970, and a further increase to 10,000 by 1975. There is little doubt that this is the era of the digital computer, for plant operations, for finance and engineering, for space exploration, for automatic landing of aircraft through all kinds of weather, and more besides.

The Steel Industry

The steel industry is already a significant user of digital computers for process control. The exact number is difficult to estimate, but is probably close to 300. Recent strong competitive demands have been imposed upon steel producers to improve continually their product quality, yield and productivity. These have resulted in a hope that adaptive and self-learning control techniques might be achievable via digital computers. Steel plant process control via local regulators such as automatic gage control on the hot strip mill are reliable multi-loop systems and have brought benefits in productivity and product quality.

Adaptive Techniques in the Hot Strip Mill

As an example, a recently patented system as used on a hot strip mill stores data on grades of steel to be rolled, mill and drive characteristics, effects of rolling variables and a mathematical model of the rolling process. The system calculates and selects the best settings of the mill controls prior to rolling of each specific bar.

Once the identity and final product specifications of the steel to be rolled are established, the system sets up the mill based upon data derived from the process model. It determines, for example, initial roll openings and roll speeds and then readjusts the mill as the bar proceeds from stand to stand to compensate for measured departures from anticipated rolling characteristics.

Throughout the entire rolling operation data is acquired from the process. This information is used for updating the process model to improve the quality of subsequent bars.

A significant aspect of this system is the adaptive capability. More efficient production and better quality steel products result from an adaptive system.

The high production rate and high contributed product value, especially of the hot strip mill, provides the economic return required, while the extensive prior work on automatic gage control has provided the process model and know-how required to develop the computer instruction programs for these and other rolling mill systems.

There are many types of reversing hot mills, possessing varying aptitudes for computer control. Most universal slabbing mills, structural mills, and blooming mills have been operated very satisfactorily by card program systems. Beginning in 1967 however a significant percentage of new mills were purchased with computer set-up. At the end of 1967 the percentage for the year was so high as to predict very few new card program systems.

Plate mills are, however, different; they are finishing mills with operating characteristics that tax the ability of human operators. Program control systems are of little merit since the incoming ingot characteristics are variable, and it is impossible to predict consistently the rolling schedules that will make the width required in the finished plate. Then, too, the finished plate is a final shipped product, having quality requirements for flatness, cross-sectional shape, and accuracy of gage and width. Thus, on-line computer systems for plate mills and other reversing finishing mills have significant value.

Progress in Steel Making Systems

The amount of effort being expended on data logging and investigation of operation of Basic Oxygen Steel Making is rapidly adding to the knowledge and understanding of this process. It is very probable that many, if not all, of the installations presently fitted with digital computers for data logging, or for predictive calculations for the operators' guidance, will soon become direct closed-loop controllers with adaptive feedback.[1]

On-line computer control systems for large continuous processing lines are a natural response to the recent rise in coil-form orders for strip products. Such production created a need for continuous digital-type production data analyzers and accumulators. Upgrading these machines to computer systems has not been an unnecessarily expensive step, and has usually resulted in a system possessing much greater capabilities with economic advantage. Applications are found primarily on tinning, continuous annealing, and shear and cut-up lines.

Improving Plant Yield

Potentially, the digital computer offers steel works the most significant improvement in profit and user market position of the decade. Steel works processes are characterized by large investment, large throughput value, and large raw material and in process inventories. Steel users demand and receive plate, strip and sheet products to their specifications based upon "best current practice" which may be twice as tight as "commercial tolerances".[2] As a result mill yield, i.e., the ratio of tons shipped to ingot tons poured has declined; a decline in the USA of 5½% between 1962 and 1964 prompted the question, "How Much Steel Makes a Ton?"[3]

Criteria for Justification of Computer Control

Rationally, any process is suitable economically for computer control if any of the following criteria apply. Several justification examples have been selected from the many that could be cited for the various steel works processes.

1. Throughput Value

- The product throughput value is high enough to justify the added cost of the computer system. —

With a hot strip mill throughput of $1,000,000 to $2,000,000 per day, the added investment is equal to one or two day's production.

2. Quality Effects upon Subsequent Processes

- The quality of product produced has a decisive effect upon following process efficiency. —

Two or three coils rolled to the same nominal gage in the hot strip mill are welded together for further reduction in the tandem cold strip mill. Thickness variations at coil ends cause step changes in thickness at the welds, and while tolerated contribute to strip breakage, or cobbles in the cold strip mill, damaging rolls and causing mill delays. Computer control of the hot strip mill can cut this effect by more than two to one. Hot strip mill computer control also, reduces end-to-end hardness variations and strip-body-to-strip-body thickness variations, further facilitating cold mill operation.

3. Determination of End Product Quality

- The process decisively determines the end product quality regardless of succeeding processes. —

Shape, size and thickness should be obtained on the plate mill. Losses in the plate production process are very significant. Whereas the slabbing operation may give an ingot-to-slab yield of 86 to 88 percent, the ingot-to-plate yield may average 70 to 75 percent with particular plates varying significantly from the average yield. Computer control offers crown control, gage control and width control to minimize shearing scrap losses.[4]

4. Process Complexity

- The process is complex, having many variables requiring frequent, rapid, and accurate adjustment for most economic operation. —

On the hot strip mill, the incoming metallurgy, temperature, width and thickness can all be varying as the bar goes through the mill. Besides, there are internal disturbances, or noise, such as improper operator adjustments, thermal variations in the mill, and electric sub-systems even during the 90 seconds a bar is in the finishing stands. There are system element interactions or coupling; a change in strip tension changes rolling pressure and strip thickness, while at the same time width-profile and flatness can also be affected. There are changing biases, such as mechanical wear, thermal level changes, electrical drifts, and crew operation capabilities.

The effectiveness of the computer system is well proved in this process.

5. Unstable Processes

- The process is inherently unstable, subject to rapid drifts requiring continual manual attention. —

As slabs are heated inductively, the coil inductance changes non-linearly. Capacitors must be switched to compensate for the change. In effect, the power supply is tuned to the load and the power factor corrected.

Each slab heater consists of a number of coils. All the coils are used when heating large slabs, while fewer may be needed for smaller slabs.

After the slab has been heated, the computer regulates the desired temperature by switching the heater off and on intermittently. Thrysistor power switches are used for this purpose.

If there are six furnace lines, each consisting of three heaters, and the heaters are rated 15,000 KW, 10,000 KW, and 5,000 KE, then the process could not be controlled manually. Computer programs are required to cope with the control requirements due to non-linear varying inductance, temperature control, power demand equivalent to a city of 160,000 inhabitants, and the logistics of receiving, transferring, and delivering 680 tons of steel slabs per hour. The digital computer unquestionably implements the process in a manner that will bring important savings to steel producers and users.

Knowledge is the Key to Results

Today, it would be hard to find a steel man who would argue against the computer for a hot strip mill. There are too many successful installations to dispute success.[5] Yet, we are still on the threshold in applying digital computers for directing and controlling processes. Today, there are process computer enthusiasts and process computer pessimists; there are believers and doubters. A key to resolving these significant and often quite emotional differences in opinion is improvement in presenting knowledge and information, evaluating *all* the alternatives including that of no action, and in reaching a decision based on total value.

A digital computer as a piece of hardware connected to a process drive system can be a stupid beast, valueless, and even a potential hazard to production. A digital computer properly structured into a total system and with a carefully organized program in its memory can be a delight to operators and customers and a pleasant profitable venture for management. Unfortunately, management is only slowly becoming aware of the problem of getting results.

System Structuring Becomes More Critical

Application of digital computers to control of processes has focused attention upon system structuring. Process drive and control systems as used in steel works have become increasingly larger in total horsepower, the functions provided, automatic sequencing, and the various process and product qualities that are automatically regulated.

Systems Structure Must Be Practical

A system must be designed and structured for performance, reliability, and cost. The system must be practical to implement within the capabilities of real people that will exist during design and start-up. It is rare that any two suppliers will create exactly the same sub-systems, or exactly the same total system structure; it is improbable that detail hardware implementation will be the same. Thus, the user-purchaser will always have a difficult evaluation to perform; and the comparison is not apples with apples, or apples with oranges, but fruit salads with fruit salads.

The expensive intangible factor in bid evaluation is the software portion of system design and structuring. Equipments can be compared, but the comparison of software takes real depth in understanding, cold logic in evaluation, and a review of history will show either a previous exciting success, or a dismal failure in avoiding the temptation of the apparent bargain.[6]

Software is just as essential as hardware in the system structure. Understanding is critical to success. Every intended action and every intended relationship must be expressed in mathematics or concise English. All these expressions must then be arranged in correct sequence.

Performance, reliability, and cost will be optimized by a proper balance between hardware and software, and through a corresponding balance between analog and digital techniques. Neither is always better than the other.

Large, complex systems require a "top-down" engineering view.[7,8] Each sub-system must be specified and designed with total system value and performance in mind. Each sub-system must contribute to the value of the whole. The digital computer will contribute significant value when we use its remarkable capability to multiply the human operator's task capabilities per unit time.

Systems Design

Today, practically all digital computers applied to steel works processes are structured into the total drive and control system. Several early computer installations were attempted on the basis of experimentation and regression analysis. However, experience proved that controlled experimentation on a large key production facility was a mere fond hope; the steel plant processes were too complex, with non-linear inter-relationships. The chance of "discovering" these relationships and the necessary systems structure was concluded to be practically nil. The only sure thing turned out to be expense.

Systems design involves creativity, innovation and analysis. Analysis of complex systems is best handled through a multi-level approach. This approach involves: (1) decomposition of the complex system into a set of sub-systems, each of which can be easily handled in terms of satisfying a local or sub-system objective; and (2) coördination of the solutions of sub-system problems via computer simulation, so that the objectives associated with the overall system are satisfied.

The approach is iterative in that one works from the total system to the many sub-systems and back and forth, until a model is developed that satisfies the real world of required performance, time, and value.

Comprehensive system development and design work prior to manufacture and installation assure a minimum implementation period consistent with the priorities of production and profit generation associated with high-through-put processes.

A comprehensive system design program will produce knowledge and data permitting development of sound and realistic planning for the system installation and start-up. Task times and costs become definable and finite and can be scheduled with critical path network techniques.

Permanent Effect upon Profitability

The higher productive capacity of new rolling mills and the increased functional complexity of their drive systems have brought corresponding increases in the dollar value of the investment and increased investment risk to steel companies. The trend to dependence upon digital computer automation and increased factory preassembly of the electric control system makes the purchaser more dependent upon the performance of his electric drive system supplier and the system supplied. Thus, this purchasing decision not only has higher initial value, but of even more significance is the permanent long term effect upon the profitability of the total mill investment.

A new hot strip mill has a throughput value of $1,000,000 to $2,000,000 per day. A 0.5% difference in yield, 250 days per year over 10 years is equivalent to an additional $12,500,000 to $25,000,000 before taxes. Degrees of sophistication in computer systems may provide differences in process yield. The present value of estimated variations in system performance and process yield should be part of the investment decision. Risk analysis involving assignment of probabilities to various levels of performance for various systems can be used to convert intuitive analysis to value analysis.

Installation Time Is Costly

The investment decision is further complicated by the tremendous complexity of the installation and start-up tasks. The investment does not produce value until saleable products are ready for shipment. The pressures for time compression are tremendous.

The net result is that more tasks must be carried out simultaneously. Extensive manpower and material resources are required with corresponding management planning and flexibility of resource assignment to meet critical path needs. Planning must evaluate the costs for time compression against the capital charges for the idle investment. Also total costs may be greater if production is commenced before installation is completed. Alternatives need to be evaluated on a cost-benefit basis.

If start-up of a hot strip mill is unnecessarily delayed, the capital earns no income. Interest charges alone at 5% amount to over $400,000 per month. Delays whether the result of inadequate planning or inability of suppliers are costly. On time start-up has value. Structured planning and analysis permit value based selection of the available start-up alternatives.

Cost-Benefit Analysis Reduces Uncertainty

Cost-benefit analysis really requires assignment of probabilities to achieving various levels of performance. Actual risk is how much we stand to lose if we fail, multiplied by the probability of failure. A final decision can be true value based, with confidence of minimum risk and lowest uncertainty. When such analyses are not made then risk is replaced by uncertainty. The decision must be made upon intuition. Intuition can turn out to be expensive when $25,000,000 or $125,000,000 is affected, and in reality applies a very low value function to accurate information.

The decision tree/probability approach to cost benefit analysis is work; but work that can be successfully used to prove the justification for, and would expand the use of digital computers for the control of processes.

Rationalizing Against Structured Analyses

We have experienced almost a standard rationalization against the use of structured approaches for decision making and planning. This rationalization is about as follows:

a. People won't give you accurate information;
b. The available information is conflicting;
c. Yes, lots of information is obtainable;
d. Evaluation of the information is impossible;
e. Structured approaches are too much work;
f. Structured approaches tie you down;
g. Structured approaches, not followed, will later haunt you;
h. Experience and intuition are just as good (as logic);
i. OK, we will use it.

This final acceptance is usually accompanied by a sickening realization of being trapped by the inevitability of change, and of this new, unexpected, silent, logic-oriented master looking down from the office wall!

The Value of Software

There is a dawning realization of the significant importance of software, the intangible factor that we recognize as logical, but brush aside because we can't explain it to the satisfaction of our peers. Yet, they, too, subconsciously sense its value for it is their stock and trade; their ability to logically sort the information, consider alternative courses of action, evaluate potential results and select or create the proper program to follow.

The system engineer must create a systems design or plan to suit the project or problem requirements. He is also involved in determining capability of proposed sub-systems and may work with other engineers to create new sub-systems required for the total system design.

The success of a computer controlled rolling mill installation is completely dependent upon the team of engineers and analysts who put many man years into creating, defining, flow charting and coding the design and also every possible course of action that might logically be encountered in operating a rolling mill. (See Table I.) These engineers and analysts must also be intimately familiar with the mathematics of the plastic flow of metal in the roll bite, roll bending, roll flattening, mill stretch and more. Every routine must be logically organized, assigned a priority level and put together into the computer memory.

Secret of Success

The secret of success here as almost everywhere is creativity and an organized, structured approach based upon a broad and firm foundation of analytical and process knowledge. Significant, planned advance development is a pre-requisite to computer control of a complex multi-variable process. Expectations of success from controlled experimentation and regression analysis for model synthesis have led some to almost infinite time and expense and project abandonment because of production requirements.

To quote the trade journal *Iron Age,* "It would be hard to find a steel man who would argue against the computer for a hot strip mill. There are too many successful installations to dispute success."[5] The same people are applying similar approaches to the rolling of slabs, plates, cold strip, slab reheating, continuous casting, and steel making. Many of these process installations are being implemented now. All will be completed during the coming year. Many firms are well advanced into the era of the digital computer for process control.

Outlook for the Future

The increased use of digital computers for process control and the effectiveness of digital computer control is limited only by our capacity to create new ideas, organize our thoughts and the process functions in a logical manner, anticipate process and operator malfunctions, and provide for them. If we miss only a few, and in advance, recognize and plan for our limitations, the odds are that we will have a successful installation. There are many in the world today. They will number in the thousands in ten years, and like other order of magnitude changes will have a profound effect upon our personal and business lives.

TABLE I

ENGINEERING DEVELOPMENT ACTIVITY
PLATE MILL PROCESS MODEL

(Does not include primary data input, tracking, logging, sequencing programs)

		ENGINEERING/PROGRAMMING MAN WEEKS	
		ESTIMATED	ACTUAL
I	PLATE TEMPERATURE STUDY	10/8	12/2
II	ROLL FORCE PREDICTION	30/8	21/4
III	SHAPE CONTROL	30/12	35/5
IV	PRE-INSTALLATION TESTING	20/0	20/5
V	SCHEDULE GENERATION & FEEDBACK ANALYSIS	60/20	66/25
VI	COORDINATION & FACTORY TESTS	16/2	19/8
VII	ON SITE ACTIVITY	24/0	*
	TOTAL	190/50	*173/49

*Not completed at time of paper preparation

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OPTIMIZATION OF A NUCLEAR POWER PLANT BY HYBRID COMPUTER

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"Both the economy and the fast result-yielding capability of the hybrid approach were demonstrated: the ten times faster-than-real-time speed of the hybrid model gives speed advantage over the digital approach by a factor of 200; the economic advantage of the hybrid over the digital approach was found to be about 400 to 1; and the economic advantage of the hybrid over the pure analog approach is estimated to be about 50 to 1."

The purpose of this paper is to summarize a nuclear power plant study performed with the aid of the Electronic Associates, Inc. 8900 Hybrid Computer System (See Appendix). Both the subject of the study and the computational technique are somewhat unusual.

The objectives of the study that led to the use of a hybrid computer facility are described, then the physical system is outlined, and the programming techniques that resulted in the computer model of the power plant are described. In conclusion, some of the significant engineering results are listed.

Objectives

The primary objective of the study was to examine the plant responses to a set of predetermined test cases. Subsequently, the optimal control settings had to be established to determine the safest and most economical plant performance. Since previous experience in the design of reactor control systems had shown manual optimization to be a very time-consuming process, it was proposed to develop an automatic optimization method for the control system design. Plant faults were simulated to determine plant behaviour under fault conditions.

The Physical System

The plant, as shown in Fig. 1, consists of a single turbine, a nuclear reactor, four boilers, (only one is shown in Fig. 1) and the system of controllers which regulates the supply of energy from the reactor to the turbine. The reactor, with its associated four boilers in a surrounding annulus, is inside a cylindrical concrete pressure vessel. Underneath each boiler, also inside the pressure vessel, is a centrifugal variable-speed gas circulator. Steam from each main boiler passes through a tube plate into a heater outside the pressure vessel and is taken in four steam mains to the high pressure turbine. From the outlet of the high pressure turbine, the steam returns to the pressure vessel where it passes through the reheater. It then returns to the low pressure turbine.

The two major features of the reactor are that the fuel elements are uranium dioxide pellets in stainless steel cans, and that the major fraction of the gas flows downwards through the core to cool the graphite moderator before it is heated as it flows upwards over the fuel elements. In this reactor, power control is effected by movements of the sector control rods according to superheater steam temperature variation or changes in power demand, usually indicated by grid frequency variation.

Boiler Features

Each of the four boilers consists of a main high pressure boiler, and a reheater. The gas from the reactor flows downwards over the secondary superheater, the reheater, the primary superheater, the evaporator and the economizer from which it goes to the gas circulator inlet. The upper part of the primary superheater, the reheater, and the secondary superheater are made from austenitic steel, which can be subject to stress corrosion should final evaporation occur within it, causing the deposition of dissolved salts. Thus, one aspect of the problem was to arrange the control system response so that the final evaporation point does not move into the austenitic steel regions of the boiler.

The boiler feed pump is driven by steam exhausting from the high pressure turbine. Its speed is controlled by adjustment of its turbine throttle valve.

Control System

The overall station control scheme consists of seven feedback control loops controlling reactor gas outlet temperature, reactor gas inlet temperature, superheater steam temperature, superheater steam pressure, reheater steam temperature, reheater steam pressure and feed valve position.

Reactor gas outlet temperature is controlled by adjusting the position of the sector control rods. The setpoint of the reactor gas outlet control is adjusted by the superheater outlet steam controller. Over the normal control range the setpoint of this controller remains constant.

Reactor gas inlet temperature is controlled by adjusting the boiler feed valve position. The resultant changes in feedflow give the required controlling effect. The change in feedflow is caused by the change of valve position and subsequently by the changes in feed pump speed made by the feed valve position controller.

Superheater steam pressure is controlled by adjustment of the high pressure turbine throttle valve through the speeder motor. The integrating effect of the pressure controller tends to cancel, in the long term, the actions of the proportional speed governor.

Reheater outlet steam temperature tends to follow superheater steam temperature, being influenced similarly by reactor gas outlet temperature. A spray in the superheater supplements this effect to provide accurate control of reheater steam temperature. The setpoint remains constant over the normal load range.

Reheater pressure is controlled by the action of a proportional controller acting upon the low pressure turbine throttle valve. The setpoint of the reheater pressure control is scheduled through a lag network.

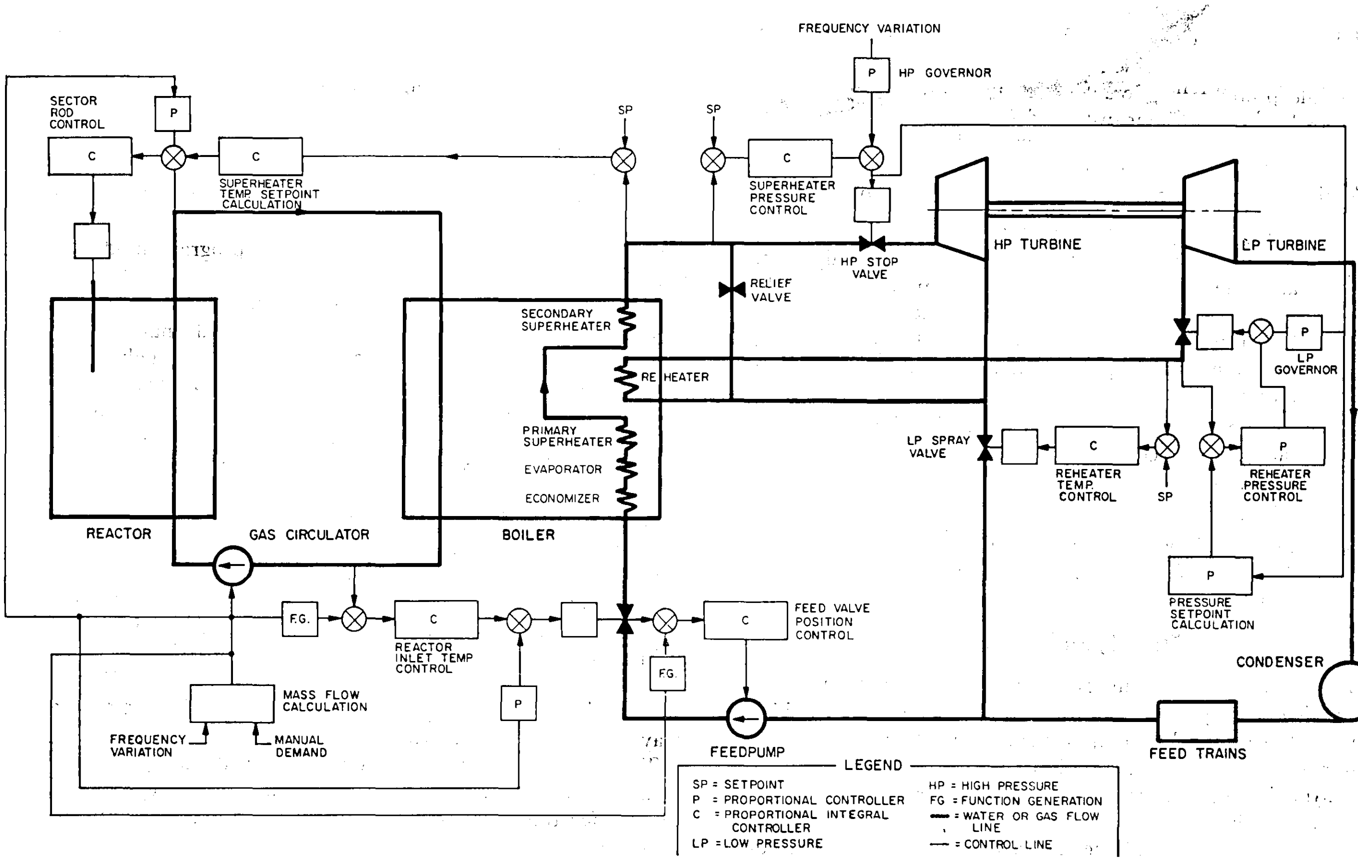
The Advantages of a Hybrid System

The increase in size and complexity of generating stations has led to a corresponding demand for larger and more comprehensive simulation studies. However, the cost of computation imposes an economic limit on the size and complexity of the mathematical models that can be represented. To this end, a number of studies were carried out to determine the most economical means of simulating the kinetic behavior of a power station and its control system.

The Pure Digital Method

In the past, the simulation of the kinetic behavior of the plant has been the traditional role of the analog computer. However, since the customer did not have enough analog computing equipment, it appeared logical and attractive to extend the application of digital computers to the simulation of the power station plant. In fact, the customer had several digital simulation languages which were specifically designed for this purpose, apart from the normal FORTRAN facilities.

Fig. 1. THE PHYSICAL SYSTEM



Two such languages, the DSL-90 and the CSMP/360 were tested for use in this simulation problem and two fundamental difficulties were found:

1. Digital calculations are performed serially, not in parallel. Thus, although each separate arithmetical calculation may be carried out in microseconds, so many calculations need to be done serially, that the total computation time will be very long for a large complex simulation.
2. The simulation of the kinetic behavior of power station plants generally involves the time integration of sets of non-linear ordinary differential equations. For a true solution, these integrations should proceed continuously in time and in parallel, but the discrete serial nature of the digital computer requires instead the substitution of numerical integration formulae, subject to numerical instabilities and truncation errors.

The present control problem has been simulated on the IBM 360/75 using the CSMP language. The speed of computation is about twenty times longer than the problem speed, i.e., ten minutes of time in the actual plant was represented by three hours twenty minutes on the 360/75 computer. Past experience has shown that the optimization of such a complicated control system requires about 3,000 separate computer runs. Assuming a calculation cost of $600/hour for the IBM 360/75, the total cost of this study would be over $6,000,000. Such a study would be clearly uneconomical as well as impractical, since it would require over 400 days of continuous use of the computer. Even if such computer could be devoted to one problem exclusively for 400 days, the design effort could not be predicated on such sluggish analysis. Under such conditions, the designers would simplify the original equations to remove the high frequency terms, even though the range of validity of the model would thereby be drastically reduced.

The Pure Analog Method

The high cost of using digital methods for these problems led the team to consider the use of an analog computer for the problem solution. An analog computer performs all calculations simultaneously and integrates continuously, in contrast to the serial methods of the digital computer. This parallel mode of calculation leads to much faster simulations.

Analog simulation also has its disadvantages, however:

1. Each multiplication, integration or addition, etc., must be performed on separate units of equipment, and the size of the computer required is directly proportional to the size and complexity of the simulation model. For the present problem an analog computer with approximately 500 amplifiers were required.
2. Analog computers have extremely limited logical facilities. In contrast, the digital computer has powerful, flexible logic.
3. The setting-up of a conventional large analog computer is usually very time-consuming.
4. Analysis of the graphical output is usually time-consuming.

The Hybrid Method

To overcome the difficulties of pure digital and pure analog simulation, the hybrid computer has been developed in which the speed of the analog computer is combined with the logical power and flexibility of the digital computer. Some details of the hybrid programming considerations are given in the following section.

Both the economy and the fast result-yielding capability of the hybrid approach are readily demonstrated by the ten times faster-than-real-time speed of the hybrid model. One may note that this gives speed advantage over the digital approach by a factor of 200. Since the rental of an EAI 8900 is about half of that of an IBM 360/75, the economical advantage of the hybrid over the digital approach was found to be about 400 to 1. The merit of the hybrid method over the pure analog one is mainly the saving of tremendous amounts of time — both computer and analyst time — through automating the setup and the operation of the analog system. The hybrid method also permits simulation of certain system aspects, such as direct digital control, ideally suited for hybrid modelling. The economical advantage of the hybrid over the pure analog approach is estimated to be about 50 to 1 for this problem.

Programming

The main sections of the problem and the different parts of the hybrid computer used to implement their solution are shown in Fig. 2. The analog section of the hybrid computer was used to simulate the kinetic behavior of the plant, the computer model operating ten times faster than the actual plant. The digital section was used for the following tasks:

1. Overall control of entire simulation
2. Direct digital control of reactor sector rods
3. Automatic optimization of control parameters
4. Data logging, analysis and display
5. Automatic setup and checkout of analog consoles

Since the digital portion of the program embodies the majority of the unique features of the simulation, most of the following description centers on the digital subprogram.

Digital Program Structure

The structure of the digital program was organized as shown in Fig. 3. Most of the programming was done in FORTRAN, interspersed with assembly language statements wherever improved efficiency or facilities not provided in FORTRAN were required.

The heart of the program was a JOB SELECTION routine that would accept commands from card or typed inputs initiating the execution of a specified hybrid or digital function. For example, any analog mode or time scale may be initiated this way or any of the digital routines may be executed, individually or in sequence. This organization proved convenient for debugging and flexible for program modifications.

The INITIAL routine inputs all initial values for parameters used throughout the program, digital and analog alike. The input device desired can be selected through sense switch settings. After initialization, the new parameter values may be displayed on the line printer if so desired. Upon the execution of the routine, the control is transferred back to the JOB SELECTION routine, unless a sequence of routines has been specified.

Execution of the RUNTIME routine usually follows the execution of the INITIAL routine. It contains all run-time services such as analog-digital conversions, data logging and reactor rod controlling action. This routine is repeated every 10 milliseconds as long as the analog computer is in OPERATE mode.

At the end of each run the REDUCE routine is called to process the information produced by data logging and to display results on the line printer.

The optimization routine SIMPLEX evaluates plant performance during the previous run and determines control settings for the subsequent run in its search for the optimum performance.

Fig. 2 HYBRID PROGRAM ORGANIZATION

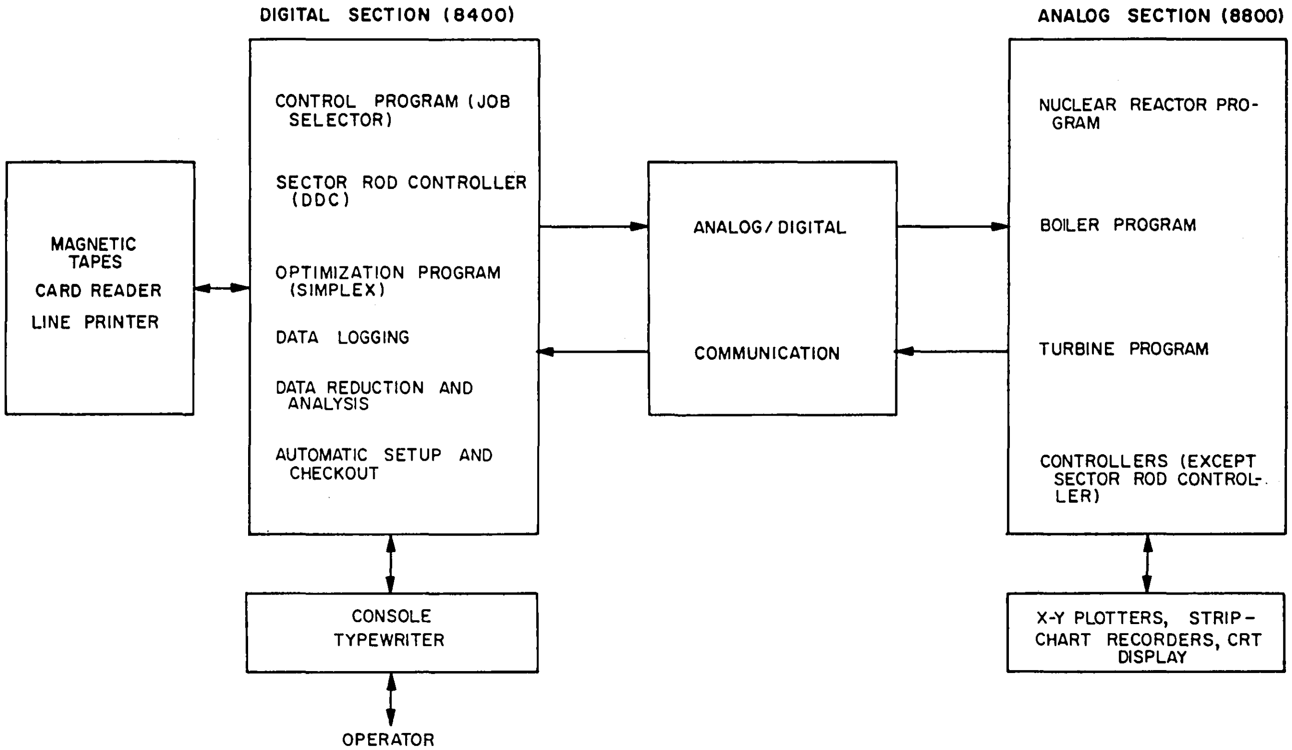
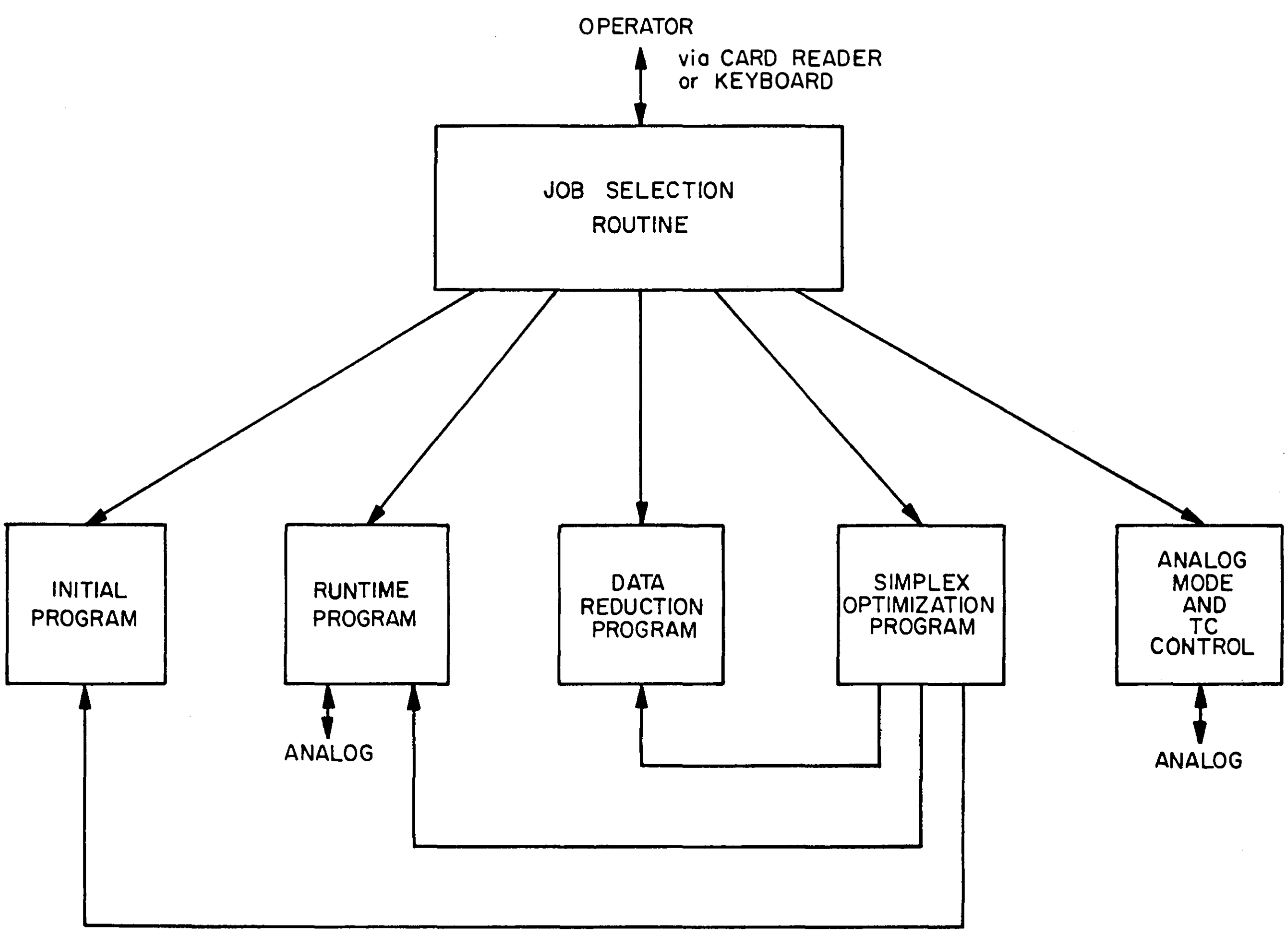
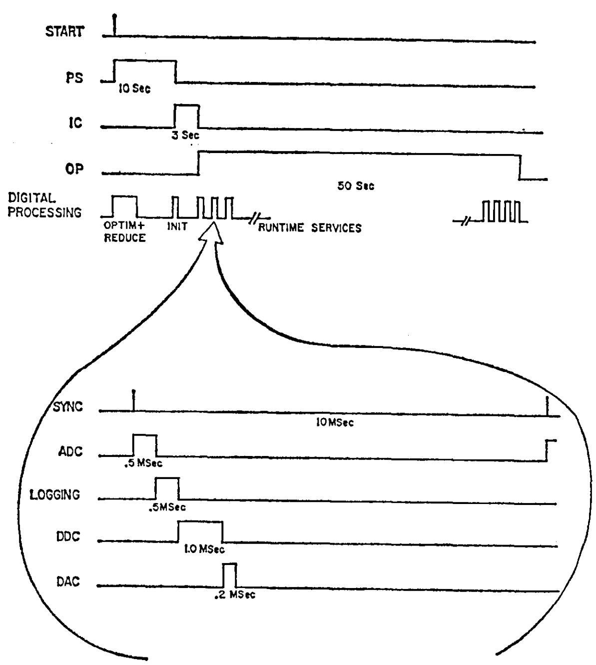


Fig. 3. DIGITAL PROGRAM STRUCTURE



Perhaps the best understanding of the operation of the hybrid model is gained by reviewing its timing assignments. Fig. 4 shows both the overall timing of the model and the detailed timing of the high frequency RUNTIME routine. The sequence starts with setting 12 potentiometers to desired control coefficient values (10 sec), followed by the initialization process while the analog is in IC mode (3 sec). Now the analog computer goes to OPERATE mode and simultaneously, the digital RUNTIME program takes control. Repeated once in every 10 milliseconds upon a synchronization pulse received from the analog unit, the RUNTIME routine samples analog variables, analyzes them, updates DDC action, and then awaits the beginning of the next 10 millisecond cycle. At the end of the run, indicated by a time-counter in the digital program, the analog computer returns to POTSET mode while the digital program performs data reduction and optimization on the results of the previous run. Overlapping the display of data on the line printer, the new control coefficients are set up on the analog computer in preparation for the next run.

Fig. 4. TIMING CONSIDERATIONS



As usual, the speed of the hybrid model was limited by the speed of the run-time digital program. While the execution time of RUNTIME is approximately 2.5 milliseconds, only one fourth of the 10 millisecond cycle time, the analog speed, or time scale, can be conveniently changed only in multiples of ten. Also, additional run-time services were planned which would have increased the execution time of RUNTIME. For these reasons, no attempts were made to increase the speed of the hybrid model.

In the following, the most important portions of the digital program are reviewed in more detail.

Data Logging and Analysis

A weakness of conventional analog computation lies in the analysis of the computer output. This output is in the form of pen recorder traces, and a considerable amount of engineering effort is required to extract relevant information from these recordings. With the hybrid computer, however, the important analog variables were sampled and logged by the digital program, and analysis of these variables was carried out on-line. A summary of this analysis was printed out on a line printer giving:

1. Maxima and minima of the variables during the run.
2. Times at which these maxima and minima occurred.
3. The allowable maxima and minima.
4. A warning message if the allowable maxima or minima were exceeded.
5. The times for the variables to settle within a given error band.

5.3 Direct Digital Control

If on-line digital control computers are installed in power stations, problems will arise in determining the correct algorithms to be written into the control software. For these problems, a one-to-one correspondence of the plant and its digital computer could be set upon the hybrid, and the control algorithms would be optimized. Such a study should point out any gross errors in the control concept, and should minimize plant commissioning time.

As a preliminary trial of a hybrid computer for this purpose, direct digital control of the reactor sector rods was included in the simulation.

The reactor outlet temperature error and gas mass flow were sampled by the analog/digital converter and passed to the digital computer. The control algorithm was calculated and the resultant required rod position was fed back to the analog computer via the digital/analog converter.

Control System Optimization

Since the controllers in a complex scheme interact to a considerable degree, the tuning of one controller will tend to change the performance of other loops. Using conventional analog computer methods, an iterative procedure is usually adopted until, hopefully, the process converges and produces satisfactory control responses. This procedure requires considerable intuitive skill on the part of the computing engineer.

For the hybrid study, the logical power of the digital computer was used to adjust the control coefficients in a more rational and efficient manner.

The optimization was carried out from an initial non-optimal state by the SIMPLEX routine. The plant was excited by an appropriate forcing function, the transients monitored by the digital computer and the objective function (integral of the sum of the squares of the errors with respect to time) or other functional form, calculated. A new set of controller parameters was determined using the logic of the SIMPLEX routine and the analog potentiometers set automatically to the new values. A transient was initiated and the process repeated until an acceptable minimum value of the objective function was found. The effect of this process on controller transient response was followed by the system analyst on the 8-channel recorders.

Initially, an attempt was made to optimize all the plant controllers other than the reactor gas outlet temperature controller, since this controller was thought to have optimal values from a previous study made in isolation from the rest of the plant. After a number of studies in which the program always converged to an oscillatory solution it was found necessary to optimize the reactor temperature controller with the other plant controllers. The three valve controllers and four temperature controllers were optimized in two separate groups to another objective function. Satisfactory optimal responses were found at 40, 70 and 100% load.

Automatic Setup and Static Check Program

The tremendous size of the analog program together with the need to take the problem off the machine at the end of each shift, made it imperative to use the digital computer to set up and check out the analog computer automatically. To aid the analog programmers, a potentiometer setting and read-out program was initially developed and this enabled the 500 potentiometers in both analog consoles to be set up in less than three minutes. From this stage, the program was further developed so that it would also perform a simplified static check.

Analog Program

Conventional analog programming techniques were used for off-line preparation of the model. The setup and the checkout of the program was automated as described in Section 5.5 by taking advantage of the on-line digital computer.

The most challenging part of the analog model was the simulation of the partial differential equations that describe the physical properties of the boiler. A parallel technique was used whereby the continuous time integration was accompanied with finite differences along the space axis. As a refinement on this technique, variable mesh length was used by defining mesh points where some steam property remains constant. The mesh lengths then became variables for which the equations had to be solved. The main advantage of this method was that the steam table functions became functions of one variable. This greatly reduced the number of function generators per mesh point.

Conclusions

The study yielded valuable results both from engineering and computational viewpoints. The most significant engineering results are the following:

1. Techniques of control system optimization were successfully demonstrated; however, it is evident that more research is needed in this area.
2. Iterative optimization of controllers was found to be impractical. The best approach appears to be the simultaneous optimization of all control parameters.

Some of the computational results are the following:

1. Hybrid approach to nuclear power plant simulation is an economical one. The evaluation of direct digital control is ideally suited for hybrid computation.
2. The program structure agreed upon appears to be a good one; the subroutine approach was easy to debug, and flexible to modify. The interactive JOB SELECTOR was well worth the extra implementation effort.
3. Hybrid computer hardware and software has improved markedly in the past few years. In particular, the convenience and efficiency of the "hybrid" FORTRAN was amply demonstrated.

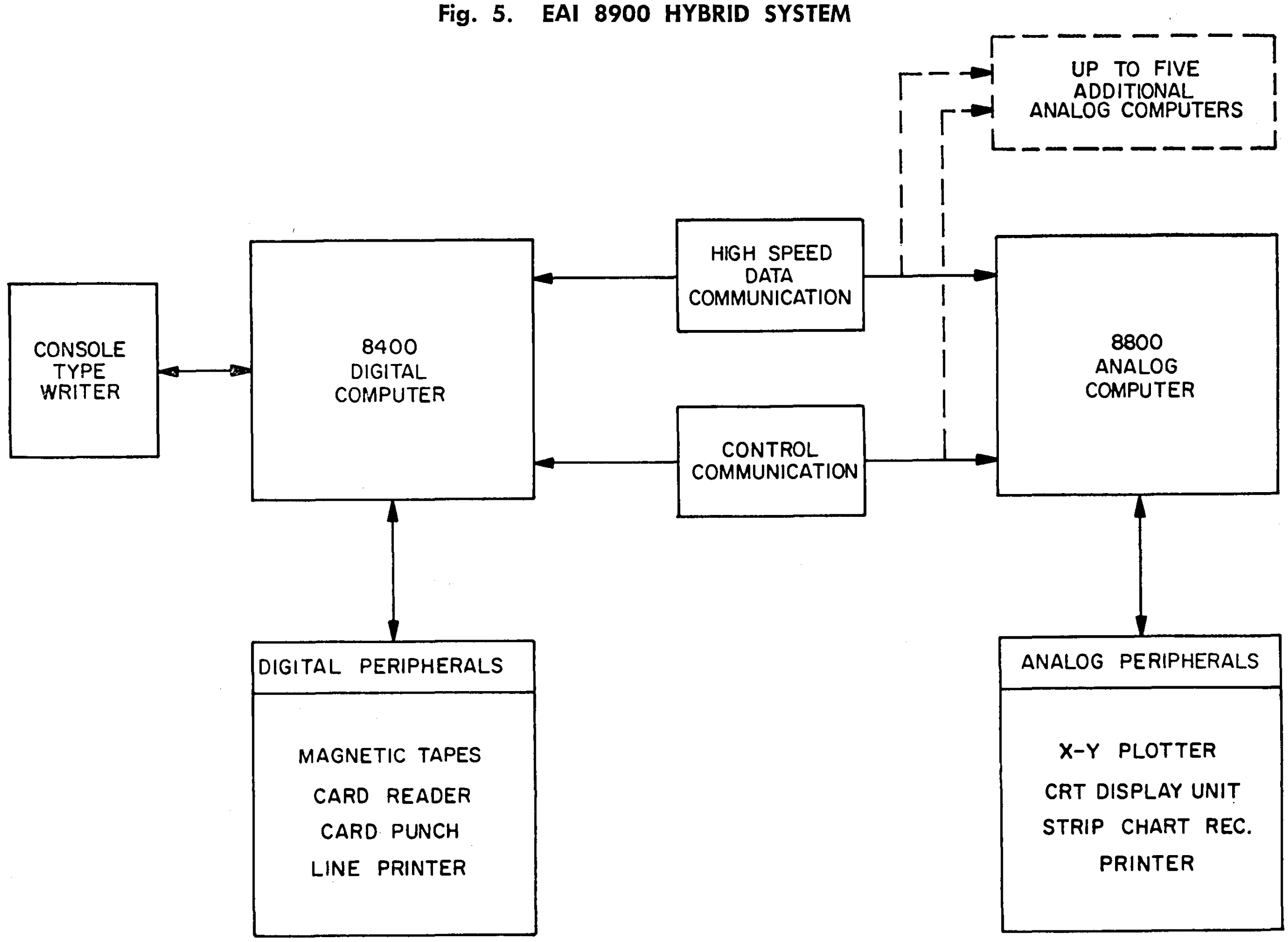
Acknowledgement

For the formulation of the entire problem and valuable assistance during the program preparation stage the author wishes to express his gratitude to the staff of Central Electricity Generating Board of Great Britain; in particular to R. G. Blake, R. K. W. Bowdler, P. M. Pigott, R. J. Smale and M. J. Whitmarsh-Everiss.

Appendix: The EAI 8900 System

The EAI 8900 Hybrid Computing System, shown in Fig. 5, is the digital computer 8400 and one or more 8800 analog computers interconnected with fast and diversified data and control communication channels. The EAI 8400 is a fast, 36-bit word floating point machine with 2 microsecond 16 to 64 K core memory. The 8800 is the largest commercially available analog computer with a maximum of 300 solid state amplifiers. A representative set of peripheral devices are shown in Fig. 5. The basic 8900 software package includes several hybrid programming languages under the control of a multiprogramming operating system. ■

Fig. 5. EAI 8900 HYBRID SYSTEM



American Dominance of World Computer Market

Ted Schoeters
Stanmore
Middlesex, England

Massive though U. S. exports of EDP equipment in 1967 may have been at $432.5m, up $100m from the previous year, these figures are far from reflecting the almost total dominance of the world market by American companies and their dependencies overseas.

Britain's exports were worth about $84m, but part of this represents equipment made from UK components by Honeywell which, of course, is U. S.-controlled and remits profits to the parent company.

IBM and its World Trade Corporation subsidiary now hold close to 72 percent by number of all machines on order in the world and, on a dollar count, probably have a still higher share. And, in spite of the way in which Europe is supplied from IBM factories in Germany and France, these two countries are the leading outlets for EDP equipment from other U. S. manufacturers, though the proportions of digital to analog equipment are revealing. Exports to West Germany were a record $68.8m, of which $17.8m were digital and $33m were analog. France took $67m worth including $35.6m digital and $11.7m analog, while Britain, despite the strenuous efforts of the domestic EDP producers, still imported a total $65.2m worth, of which digital computers accounted for $35m and analog for $14m.

It would be interesting to know how much IBM equipment figured in the 1967 U. S. exports, since the Montpellier plant is supposed to be able to make all machines up to the 360/65. At the same time, it would appear that most, if not all the 65's in Britain have come from the U. S. — certainly those earmarked for Rolls-Royce have.

Be that as it may, this total dominance of a market in which technology is progressing so fast that the cost of R&D must inevitably be very high, is a source of deep and growing concern to many governments, particularly those of Western Europe.

The Effect of the Space Race on Technology

These governments, particularly those with a left-wing flavor, are becoming increasingly aware of how much the U. S. advances in data processing techniques owe to the space and armament races with the Soviet Union. Much of the network technology now being drawn on to provide time-shared, real-time complexes stems from the missile surveillance screens and the various layers of early warning, identification and air space control set up for western hemisphere tasks.

The Brain-Drain

They resent the brain-drain. They resent also the hidden brain-drain on their own territory where so many U. S. subsidiaries and affiliates set up development laboratories and attract the best talents because they are able to offer a better wage structure based on practices in America.

Reaction to U.S. Dominance

The net result is that European governments have been goaded, at last, into salvaging indigenous industries and are likely to favor them with every contract which can possibly be influenced by central government agencies. Of course, American groups in Europe squeal. But the official attitude in Britain and Germany seems to be: "Don't make a fuss, you've had a good run for our money".

Burroughs, operating at long range from the U. S. on the British banking market, captured some important contracts from IBM (more of this anon), but once the total had reached about $100m — two 8800's, two 6500's, $24m worth of discs and the remainder terminals — it was made quite clear to Burroughs that unless a good deal of this and future equipment ordered from British sources were made in the UK, there would be an unacceptable imbalance in that company's trading in the UK.

The same will apply in the future to any other venture in Britain, and doubtless in other European countries, by American groups which begin to take a larger than normal share of any particular section of the EDP market.

This is not anti-Americanism as such but distrust of American selling methods and the acceptance of the prediction that before the end of the 1980's every advanced country will be spending each year five percent of its gross national product on computers and their programs. No government can afford to leave such a large proportion of its annual budget in the hands of organizations controlled from outside the country.

IBM Weathers Burroughs Bank Sales

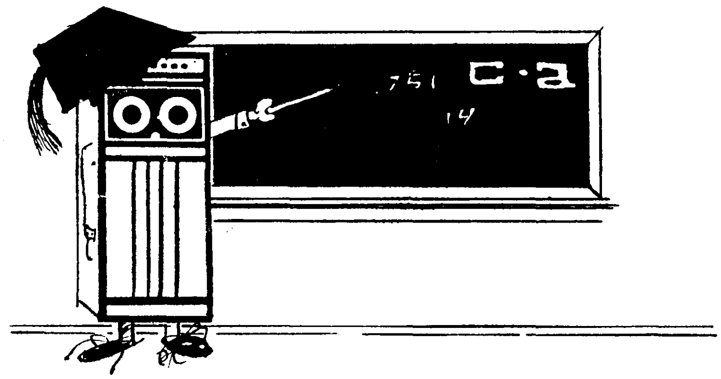
IBM, meanwhile, seems to have weathered the Burroughs onslaught in the major banks and is delivering 65's at a steady pace. All told, it may have ten or more of these large units to carry out big accounting jobs, mainly for City of London operations.

But IBM's involvement in UK manufacture is still considered inadequate by the British Government. It is true that IBM can claim exports worth about $80m a year. But because of that company's method of organizing manufacture in Europe, it is likely that a very large proportion of the basics for these exports come from plants outside Britain in the first place. At the same time, all systems, other than the baby 1130 made in Scotland, have to be imported.

Simple Assembly Not Enough

Unless and until IBM manufactures a good deal more in Britain, the scales in any British government department contract will be weighted against it by considerations such as import content and (!) degree of sophistication (from which domestic industries would learn), since Burroughs, NCR, English Electric (RCA), UNIVAC and ICT can all claim more recent machines than the 360. And even then, simple assembly will not be enough. Honeywell has been recognized as a "British company" insofar as government business is concerned because it uses as much as 70/80 percent UK components in its machines.

IBM would have to follow suit although its attitude always has been that "UK components are not of sufficiently good quality". It would be better to say bluntly that the IBM manufacturing policy for Europe at the present time necessitated mass manufacture of components in selected areas.



The experience of:

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

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

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

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

We have acquired a powerful, modern, small, general-purpose computer. It is a Digital Equipment Corporation PDP-9 with 8000 registers of core memory; it can perform 500,000 additions per second; etc. It is especially suited for investigation, experiment, research, and instruction.

Using this computer, and our experience since 1939 in many parts of the computer field, we have started to teach:

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617-332-5453

SYSTEMS ANALYSIS, COMPUTERS, AND THE FUTURE OF PROFESSIONAL SERVICES

Dr. Robert W. Krueger, President
Planning Research Corp.
1100 Glendon Ave.
Los Angeles, Calif. 90024

"Of all the inventions that came out of World War II, the greatest are two not generally recognized as inventions at all. The first was the federal research-and-development contract, joining government, industry, and the universities in pursuit of new science and technological goals. The second was that technique . . . called systems management, the instrument devised by innovative industry to attain these goals in the shortest possible time. The application of this technique to large social and economic problems, such as crowded cities, air and water pollution, may well be the biggest, most fertile of all 'new industries'."

The basic subject of this article is professional work in general — work performed by educated people practicing a profession. This is the territory of Planning Research Corporation.

The Market for Professional Work

Those not closely associated with this business may be surprised at the extent of the market for professional services. For all areas of professional work, including medicine, law, and major industry, the market currently represents about five percent of the gross national product, now $760 billion. In the year 2000, economists estimate that the U.S. gross national product will be about $2 trillion of 1965 dollars, and professional services will represent as much as 15 to 20 percent of that. These figures indicate something like a tenfold growth in the market for professional work over the next 30 to 35 years.

Professional Service Firms

The firms involved in professional services can be defined as being those engaged in work that does not require production or development. Some examples are management consultants, architect and engineering firms, computer service firms, and systems analysis firms like ours.

One characteristic of these professional service firms should be of particular interest. Whereas a hardware firm has large fixed costs, the firms we are discussing have almost entirely variable costs. They have no large capital investment in equipment. Their investments are almost entirely in people possessing a wide diversity of skills. To a large degree, these firms can increase or decrease in size in response to business demands and still remain profitable. Now, obviously, a well-run organization in our business is going to continue to grow, but even if it does not, it should still remain profitable — whereas a hardware firm, because of its large fixed costs, would not be able to do so.

Profitability

We have concluded, after much study of the subject, that a reasonable profitability rate for this kind of activity, after taxes, is generally on the order of five percent. (This corresponds to 20 percent before taxes and discretionary benefits.)

The market for professional services of the kind I have mentioned, excluding medicine, law, accounting, and the like, has been a subject of study for our own long-range forecasting. This is today's breakdown of that market:

- The current ordinary annual U.S. Department of Defense expenditure is $75 billion. Three to four percent of that amount constitutes a realistic yardstick for professional services.
- The Federal non-DOD expenditure is about $50 billion, and one to two percent is the yardstick for professional services.
- Collectively, state expenditures equal one-half the total Federal budget. Because the problems of state governments parallel those of the Federal Government (with the exception of DOD and NASA), there should be similar percentages for professional services associated with their expenditures. But at the present time, state and local governments do not appreciate this kind of professional work as much as the Federal Government, although they are beginning to. We estimate that state and local governments are currently spending $1 to $1.5 billion annually for professional services, and we think this will increase rapidly over the next few years.
- In addition to these governmental expenditures, domestic industrial organizations (manufacturing and nonmanufacturing) spend a considerable amount of their funds for professional services. We estimate that such funds from industry total $2 to $3 billion annually.
- All together, this is a potential market of somewhere around $7 billion a year, or slightly less than one percent of the gross national product of $760 billion.

Computer Software

Computer software encompasses approximately one-half this potential market. Our business parallels the market, with one-half of our income from computer software and one-half from other sources, largely systems analysis.

Systems Analysis

We have made a very careful investigation of the systems analysis activity in the United States; we have determined that this activity alone represents a market of $0.5 billion a year.

Since I am emphasizing systems analysis, a definition of a system is in order. A *system* is an aggregation of components or elements assembled and organized to produce a desired result. In the broad sense, the elements of a system are: equipment; procedures; people. A system may control nationwide inventories of a firm like General Electric; or it may provide a water supply to a city; or it may provide better urban transportation. A system may consist only of people — a team organized to accomplish a given result.

Systems analysis involves the search among a great number of combinations of equipment, procedures, and people for that alternative which best accomplishes a certain established objective, according to a certain criterion (or criteria). Such a criterion may be dollar cost, or minimum consumption of some other valuable resource, since minimum cost is not always the most important criterion. For example, rare resources, or time and not cost, could be most important. Also, systems analysis often first involves the search for the proper criteria and the methods for measuring cost and effectiveness.

Two Great Social Inventions

The editors of *Fortune* magazine have stated:

> Of all the inventions that came out of World War II, the greatest are two not generally recognized as inventions at all. The first was the federal research-and-development contract, joining government, industry, and the universities in pursuit of new science and technological goals. The second was that technique . . . called systems management, the instrument devised by innovative industry to attain these goals in the shortest possible time. The application of the technique to large social and economic problems, such as crowded cities, air and water pollution, may well be the biggest, most fertile of all "new industries."

Systems Analysis Work

The systems analysis activity in professional service organizations, like most other professional activities, is "think work" performed by people who are specialists in many different disciplines. Ideally it is performed in an interdisciplinary manner. "Discipline" is commonly used to refer to fields of specialization. With 26 disciplines represented on our professional staff, we are a multidisciplined organization.

People Who Do Systems Analysis

The people are a rare kind who prefer a semi-academic atmosphere and prefer interdisciplinary work. They are people who work in a professional service organization because they do not like to work in industry. They like to work on broad problems. They like to work with other disciplines rather than just their own. They have a discipline in depth of their own; in our organization it is desirable to have both broad and narrow capabilities.

The techniques for getting and keeping these people, creating the proper environment for their working together, and mastering the interpersonal relationships that are involved are of the highest order in organizations like Planning Research. The people must work together in teams; and there is a tendency, if they are not properly selected, to acquire people who do not work well together. So we attract the desired people by excellent fringe benefits; in our case the package amounts to approximately 29 percent on top of salary. We keep them by giving them really good working conditions, by our concern for the interpersonal relationships that exist, and through various checks and balances in the organization, with particular attention to the choice of capable managers who can properly relate to people and lead them.

We have been multidisciplined from our beginning; the five founders are themselves scientists and engineers. We incorporated in 1954 as one of the first private, for-profit, professional organizations emphasizing the applications of systems analysis. The founders are still among our top management, and ownership in the corporation is well distributed among them. The amounts of stock they own are significant and are strong motivations for each of the individuals to remain.

The principal difference between a firm like ours and the management consulting organizations is that our technique for problem solving is analytical, while theirs, depending heavily on experience, is judgmental.

The architect-engineering firms differ from us in that they are not multidisciplined. Some of them hire us, or firms like us, to do work such as economic feasibility and systems analysis studies, the conclusions of which dictate whether or not a particular project should be undertaken in a particular area on the basis of economic considerations.

The nonprofit systems analysis organizations are closest to us, in the sense that they are multidisciplined and multipurposed; many of them, like us participated in the early development. But they differ from us in the efficiencies related to the existence of a profit motive, which we have.

The Improvement of Operations

Economic feasibility studies and systems analysis, together with computer systems design and programming, represent a complete set of professional services related to the improvement of an operation in business or government. Computer service companies provide only the latter half of this work; we do all of it. This represents the most important difference between firms like us and the data processing service companies to which we are often compared.

The Solution of Complex Problems

Systems analysis is now recognized as the best approach to the solution of the complex techno-socio-economic problems of the day. Our general goal for the future is the attainment of all the professional skills needed to assess a problem area so that, with a systems analysis approach, we can make important contributions to the solutions of the problems. Such complete professional services we call "turnkey" professional services.

There are some major areas in which we are developing a turnkey capability. Automation design and implementation form an important part of all these areas.

Military Systems

The first of these is the one that gave birth to systems analysis — *military systems* analysis. Such analysis is usually concerned with determining the best weapons and logistic equipment for specified military missions and the best methods for using these weapons.

Space and Undersea Systems

The analysis of *space systems* began at about the same time we did, with goals (beyond military) being mainly scientific; now, however, many commercial areas, including communications and resource surveillance, are evolving. I will include *undersea systems* here, whose original emphasis was on submarine warfare. But the potential for commercial exploitation is now being recognized.

Urban Redevelopment

One of the principal problems of our whole community life is *urban redevelopment* — with its own massive problem of ground transportation. This is an area involving one of the most complex combinations of economic, physical, and social factors.

Total Distribution

An area of our work increasingly important to business is distribution. In the military this is called logistics. *Total distribution* includes every event that takes place in the distribution of a product — from the end of the production line to the ultimate user — including inventory control, market research, marketing procedure, warehousing, and shipment.

Total Development

Another broad area is sometimes called *total development.* This includes all the professional services preceding (and including the direction of) construction of large projects. Financial feasibility studies, economic analyses, and systems analyses form the general framework. There is architect and engineering work and there is systems management — the technical direction of a project. The applications are in resource development and, of course, in construction of somewhat more mundane things such as buildings; but resources, I think, represent the area of greatest application.

Countries with Untapped Resources

Some of the most promising potential applications are in countries with relatively untapped resources. Emphasis is now on South and Central America for agricultural and other products that are too expensively produced in the United States or that cannot be produced here at all. Organizations involved in total development, as we are, must have the capability to construct long-range economic development plans for entire political entities. These plans begin with analyses of investment possibilities in the private sector, make full use of private investment opportunities, and continue with analyses of public sector requirements and their interrelationships with public and private investment decisions.

Medicine

In the field of *medicine,* systems analysis has taken on a very strong aspect of automation analysis. Two major applications exist: institutional management; and clinical and research activities.

With systems analysis you can construct a mathematical model of a patient and from that construe the results of therapy. Of course, this leads eventually into physiological control by automation and physiological monitoring of intensive-care and recovery-room patients.

Automated storage and retrieval of information for doctors and for medical research has a large potential. The current idea, fostered by the Government, is to connect the research activities of various institutions through automatic storage and retrieval procedures such that information can be aggregated for the solution of problems for which a particular institution may have too little information. But let us think also in terms of integrating all the information available from private physicians. Ultimately, there may be a way for the physician to record his information simply, and, with proper coding, his results could be used in research. Medical problems could thus hopefully be solved with much more evidence and much earlier than otherwise.

Financial Systems

In *financial systems,* procedures that have been performed by hand are now automated; but this process often does not yield the best results; a complete systems analysis is desirable. You look at the overall company operations (and this is not being done adequately now) and select from alternative system designs the one that works most efficiently. That system may then be automated.

Such overall systems analysis and automation would ultimately include not only the main business operation, but also the management information systems necessary to establish sound and progressive business plans.

Resources Management

An area that has received much attention recently is *resources management.* Resources management started with a budget planning procedure the government, particularly the military, has been using during the last few years. Since then the civilian government agencies, and now some state governments, have begun using this approach. It is called "planning-programming-budgeting" or PPB — a kind of an elegant cost-effectiveness analysis applied over a projected period of, say, five years. Whereas the usual cost-effectiveness analysis might consider the best set of alternatives in a static situation and in a limited area, the planning-programming-budgeting method considers all related items in a total organization. Then it searches among alternative systems for the one that represents the least cost or the most profit over a period of years.

Resources management includes planning-programming-budgeting; but, whereas the PPB system determines the best practical allocation of resources to accomplish goals, resources management *manages the resources* after they have been allocated. The system therefore continually responds to the outside environment in a dynamic way; here again you need a lot of help from automatic data processing to provide this swift response.

Education

In *education* there is a need for continuing assessment: how can we improve what we are doing in terms of programs, including cost-reduction programs? in terms of the structure and relationship of teachers to schools? in regard to the structure of the different levels of schooling with respect to each other? in regard to the current distribution of skills that are desired to issue from the schools? What kind of graduates does the nation really need for future manpower pools? This is a largely misunderstood area, particularly in the use of vocational education. Vocational education should be used much more extensively for people in lower IQ levels. A lot of people at lower intelligence levels are wasting their time in academic education and so they are coming out with no skills at all.

Social Programs and Poverty

Finally, there are social programs, which represent a very large market for the type of work we do. We speak of an analysis of the anatomy of poverty — what causes poverty? A depressing but necessary procedure here is to project the poverty population of the future so that we will know the demands that the poverty population is going to make on Federal, state, and local assistance programs.

What can we do toward the economic development of depressed areas? the urban ghettos? the abandoned mine regions? the depleted agricultural areas? Again, vocational guidance is part of the solution, as are programs such as Operation Headstart.

In all the areas I have described, I think it is evident that there is an enormous and growing amount of work that needs to be done by firms doing professional systems analysis work with multidisciplined professional staffs. ■

C·A WORLDWIDE

REPORT FROM GREAT BRITAIN

ICL May Collaborate With American Firm

The belief is growing that Britain's new "national" computer force which will officially take shape in July under the name of International Computers, Ltd. (ICL) may, as one of its first moves, take the rather out-of-character step of coming to some form of *modus vivendi* with an American computer company. Of the many names mooted, Control Data Corporation is the most likely, and Arthur Humphreys, managing director designate of ICL, is not denying this.

For my money, collaboration is likely to come on software and peripherals in the first instance. Indeed there has been some help from CDC in the latter area already, and ICT (International Computers and Tabulators) now has an attractive magnetic disc store system for which it has just captured $1 million worth of business in the U. S.

Vital to any get-together is the Ministry of Technology's attitude and this is, at the moment, one of benevolent interest best expressed as: "There is no objection at all to such a conversation and to reaping the benefit of the advances America's enormous spending on technology makes possible."

Put more brutally and realistically this should read, "Any competitor with IBM is our friend."

But to come back to ICT/ICL peripheral work, the company does not have all that much money for research and development, so that when it does go all out for an idea, it has to be a good one. It has unveiled its latest work on mass optical stores and high speed optical character readers, and even the somewhat blasé British EDP writers are impressed.

Mass Optical Store Being Developed

The mass optical store which is now at the laboratory stage in the main R&D center at Stevenage is, to my mind, one of the more exciting developments in EDP for the last several years. It is far simpler in concept than work at Bell Telephone to solve the same problems.

Executive routines which alter very little, if at all, are growing in size and complexity. Inevitably in many instances they will occupy valuable core store space.

The answer ICT proposes is a read-only optical store with a two microsecond reading time for a 68-bit word in the form of a binary pattern of black and white dots carried on a glass plate which currently would have a 4M bit capacity, easily expandable.

The equipment has a CRT, a "minifying" lens, a mirror funnel, the plate, and a photomultiplier assembly. All-electronic control gives the high speed access and a most tentative cost figure for storage is one halfpenny per bit. Also tentative is the company's estimate of cost at one-quarter that of current random-access storage. However, the comparison is not really meaningful since the photo-store is a read-only system with no means, at present, of rapidly changing the memory discs or rapidly altering information on them.

Automated Handling of Credit Slips

ICT's 3000 character per second OCR reading head in a universal document transport is an important development in Britain, where the big banks have so far failed to agree on standardization outside the check clearing operation. This leaves unsolved the growing problem of automated handling of masses of counter credit slips — now about 1½m per day and growing at a rate of 10 percent annually. The same applies to direct debiting.

Now, there is pressure from the most active data processing enthusiasts in banking for the introduction of massive readers capable of tackling all the various forms of documents not now being handled by encoding and MICR.

There is little doubt that ICT, which has supplied the $3 million equipment for the Inter-bank Computer Bureau, will make a bid to provide bank OCR's. But it will have a hard fight against Character Recognition which already has captured a National Provincial-Westminster Bank contract, as well as that for the Post Office giro.

Miniature Line Printer

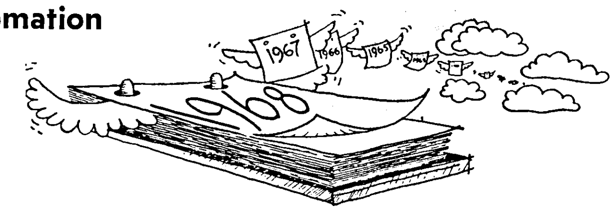
A third new peripheral at ICT is a line printer hardly bigger than a Teletype station intended, among other things, for remote terminal applications. It has been subjected to a long value engineering study and the hammer assembly, for instance, has only eight components against typically 22 elsewhere. Drive circuitry is mostly microminiaturized and multi-layer.

Incidentally, ICT has licensed Metronex in Poland to make one of its line printers for sale to other East European countries.

Ted Schoeters

Ted Schoeters
Stanmore, Middlesex
England

FIFTEEN YEARS AGO IN Computers and Automation



Computers in the Factory (Part 1)

Reprinted from Vol. 2, No. 7 — October, 1953

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The factory controlled by an automatic computer is a concept familiar to many people. Any faithful reader of the comic strips has seen blueprinted there robot machines with giant electronic brains, turning out widgets by the barrelful at a trifling cost. Yet a quick look at American industry today shows that despite the present advanced state of computer design, and despite highly automatic machinery in some mass-production and process industries, we have nothing yet approaching a computer-controlled factory. The fact is that the computer is not yet welcome on the production floor. Manufacturers do not doubt that the computer-controlled factory can make parts; their doubt is that it can make money. Showing that a computer can earn its keep in the factory has become a major challenge in the computing machinery field.

Some experiments have already been made on the application of computers to the control of metal-working machinery in a factory. Although computer-controlled machine tools have not yet been extensively shop-tested, experience with prototype machines suggests that under proper conditions a computer control can: (1) save engineering time; (2) reduce shop labor costs; (3) improve product quality; and (4) increase production.

Several factors, however, are tending to retard the introduction of computers into metal-working machinery. Among these are: (1) unfamiliarity of manufacturers with the capacities and limitations of computers; (2) unfamiliarity of computer engineers with metal cutting techniques; and (3) high cost of developing special-purpose computer controls. Nevertheless, as manufacturers gain experience with computers, we can expect that these retarding factors will decrease in importance.

Actually, certain analog computing components have been accepted in the shop for many years. All servo controls of speed and position, for example, involve facilities for performing summations. Many automatic controls for contour tracing include apparatus which regulates the speed of two machine slides so that the vector velocity of the cutting tool is of constant magnitude regardless of its direction.

Recent developments have shown, however, that more elaborate computers can be effective in governing all the operations of a metal working tool. Control devices having a digital data input, for example, offer several fundamental advantages in manufacturing applications. Usually a metal part is entirely described by means of numerical dimensions. If the part is to be cut, the rate of tool feed is also specified by a number. Operations in a sequence, and tool sizes may also be designated by numbers. The inherent capability of the digitally controlled machine is that it will take in all of these numbers and, after appropriate manipulations, reproduce them automatically, to predictable tolerances, in the finished part. Much of the engineering drawing, hand labor, and measurement of existing manufacturing methods are thereby eliminated. The speed, coordination, and accuracy of the finest machinist are readily exceeded, and the machine runs tirelessly for three shifts a day, with almost no human intervention.

The advantages of digital control, however, are not obtained without cost. For example, we often find upon analysis that a machinist has been supplying control information to his machine "by eye" or "by feel." Design and engineering procedures must be revised if this information is to be furnished to a computer in digital form. Computers and their associated servomechanisms for driving machines involve a quantity and variety of circuitry larger than that found in most metal-working plants. Consequently, special maintenance personnel are often required. Finally, and most important, a large amount of engineering is at present required to develop a computer control for a particular machining application and a particular machine tool. The original cost of computer control equipment, therefore, is usually very high. These factors have combined so far to restrict the use of computer controls to those applications where the abilities of the computer are especially valuable.

The principal problem facing builders of computer controls today, therefore, is to discover which metal-working applications are economically most favorable for their equipment. Two methods of solving this problem have been tried: (1) build a promising control unit, and then see where it can be used; and (2) find a promising application, build a control to meet it, and then try to find other users with similar applications.

Neither method has been entirely successful, but several interesting prototype controls have been produced.

The first computing machine tool control to be publicly

Part 2 of this article will appear in next month's issue.

announced was built by Arma Corporation. Arma built the device on its own initiative in 1950 to demonstrate a commercial application of the computer components which it had been selling to the military services for many years. The control device, called the ArmaMatic, directed the operation of a lathe. Although it had a digital input, the ArmaMatic was primarily an analog device. For each cutting step, and for each machine slide, feed rates and "stop" locations were specified by numbers coded into a wide punched paper tape. As soon as the tape was sensed by the control, the coded numbers were converted to command voltages. The machine tool was then driven until these voltages were matched by voltages appearing on induction generators and potentiometers attached to the machine slides themselves. Control tapes for simple work would be prepared in less than 30 minutes, and the machine was said to reproduce diameters accurately within 3 ten thousandths of an inch. Unfortunately, an increase in priority orders resulting from the Korean War forced Arma to turn its attention from the ArmaMatic, and there is no indication that this promising device has ever been put into actual use.

Another group of computing controls now in operation includes a device built by Daco Machine Company of Brooklyn, New York, a cam-milling control built by Bell Telephone Laboratories for the Navy, and a non-circular gear-cutter control devised by Dr. F. W. Cunningham of Stamford, Connecticut. This group of controls represents a sharply different approach to automatic machine control. Each control unit has no computing apparatus in it but each requires that computing apparatus be used in preparing its input data.

In each of these systems, digital input data is coded and recorded on punched tape or film. The presence of a hole in the tape or a spot on the film in a given location merely causes a certain element of the machine tool to advance one unit in a predetermined direction. Such a scheme results in comparatively simple apparatus for machine control, but it does require the preparation of a vast amount of input data. In order that lack of precision of the input data shall not contribute appreciably to errors in the finished work, the unit of advance in such a system must be smaller than the tolerance permitted in the machined part. Thus, if a part is to be made to a tolerance of thousandths of an inch, at least one thousand input commands must be programmed in tape for every inch of machine travel!

Auxiliary computing equipment is necessary in such a system to carry the programming burden. Cunningham found that the programming of a single non-circular gear required the encoding of nearly 20,000 film spots, and that the computations involved represented a week's work for a skilled calculator. Consequently, Cunningham is currently devising a computing system to "automate" the calculating process. In similar fashion, input data for the Daco device is prepared with the assistance of a special desk calculator originated in the H. H. Cousins Co. of New York, N. Y. In the case of the Bell cam-milling control, which is operated by the University of Texas, the University computes the location of about 1,000 points along the surface of the cam. Then an additional 23,000 points are determined by processing the original data in an interpolating computer located at the Naval Research Laboratory in Washington, D. C.

JOBS AND CAREERS IN DATA PROCESSING

Long-Range Planning in Personnel:

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The concept of corporate long-range planning is not new. Since 1955 most companies have recognized its importance and have implemented formal planning functions in their organizations. In fact, the position in medium to large companies usually commands a vice presidency. The job usually includes the responsibility of examining the company's strategy; its political, social, and economic environment; its strengths and weaknesses; its competition; and other factors to properly present to management a program or plan to optimize the company's resources. Many outstanding business writers, such as Peter Drucker, Ted Leavitt and Robert Anthony, have logically argued that top management must start from this point before it can properly implement the operational plans and controls it needs to direct the company to some objective.

This company objective is usually translated into a program for each of the company's functions, such as manufacturing (facility planning, warehousing); marketing (advertising programs, sales training, branch location); research and development (changes in technology); etc. Each function can then formalize its plans with some idea of integrating its own targets with other company functions (i.e., production units with sales goals). Conspicuous by its absence in most corporate plans and almost entirely absent from business journal discussions of long-range planning, however, is the personnel function.

The Need for Personnel Information

As companies gain experience with the long-range planning area, however, the need for personnel information increases, particularly the type of information which is best handled by the computer. I will explore why this factor is occurring.

Underlying a business plan for any company function is a need for quantitative analysis; that is, a numerical basis for determining what factors control change. It may be that a change in fixed assets, net sales, or some combination of the two determines how a particular activity such as personnel in the company is affected. It may be complicated by diversification, acquisition of a new company, reorganization or other factors. For example, in long-range planning for personnel one of the key components is manpower planning. How many of what skills do we need? When? How long does it take to find them? Train them? What are our sources now? Turnover rates? How much time is required in a job skill to reach competence? How many of tomorrow's managerial requirements do we have in-house? The problem is to find some frames of reference upon which to prepare and document meaningful plans. Historically and probably even today the data needed for this analysis is not available in a usable format. Most companies don't know how long it takes, or how much it costs, to find the specific skills a company needs, nor do most know how many of these skills are needed per sales dollar growth or even if this criteria is important. In many companies no one has the responsibility to know.

The personnel function probably more than any other cries for data within a company. It is not until long-range plans are written that some need for collecting this information is considered important. Operations management has excellent history on requirements for manufacturing a part; advertising knows what they spent per sales dollar and circulation by media; but personnel records usually answer only questions such as how many open requisitions there are, how many college graduates were hired, how many grievances and how they were handled. If asked if there is any young administrator who has a business degree, is between 35 and 50 years of age and can speak either French or German for a new assignment; or how many mechanics are available who are skilled in repair of a specific product — then the problems arise. Is the information available? Of course. Where is it? In thousands of personnel folders and training records full of hundreds of sheets of personnel actions and memos.

Applications

Until 1955 there were almost no solutions to the problem of storage and manipulation of personnel information. Payroll took care of the important changes such as address and salary and soon automated this data. It included benefits, dependent count, etc. Computer technology did not yet have the capacity to economically handle the vast amount of information relating to an employee. However, it does today with far more efficient computer systems and techniques:

1. The computer can capture all source information on personnel actions.
2. The computer can change and update this information immediately.
3. The computer can compare this information, match it, and rearrange it to assist in decision-making.
4. The computer can take historical relationships and project them under various alternatives. For example, how many direct salesmen per sales dollar at the rate of 4%-5%-6% growth.
5. The computer can keep track of job candidates; who was interviewed; what letters were written him; his acceptance or rejection; the source of his resume.
6. The computer can compare wage and salary structure with any other by job code; by location.
7. The computer can measure turnover, reasons, by department, by area.

The list of applications is, of course, much longer, and I recognize that some companies are using some of these ap-

The Impact of the Computer

plications. What is important, however, is that these applications must be related from the standpoint of a total personnel information system; what is the information needed to properly carry out managerial responsibilities; what information should be supplied to top management for their direction? What are the priorities of this information?

Our study at Time Share Corporation from an analysis of these applications indicates that collectively a tremendous effort has been expended by many corporations in the personnel data systems area over the past several years, but the percentage of companies in which personnel data systems have been utilized to support the corporate planning function is almost totally absent.

What Information Is Needed?

Why does the long-range planning problem play such a paramount role? Briefly, try to design a personnel information system without one! At some point in the system analysis of a personnel information system the question will arise — what information do I *really* need? The answer will most likely be that *I want to know where our actual performance is deviating from our planned program.* Some people call this "exception" reporting, but the underlying question is usually "exception" to what — to what we did last year? — to what the budget determines we should do? — to what I am trying to do as a manager? — to what the company is trying to do?

For example, one of the objectives of a company personnel strategy may be to retain outstanding scientific and engineering personnel. This objective must be translated into many programs:

- An evaluation of supply and demand
- A specification of numbers required and when
- An evaluation of foreign sources
- College recruiting
- General recruiting
- Scientific training
- Management development

Evaluating Current Capability

One of the requirements may be to evaluate current capability; that is, the numbers of technical personnel who now have this skill; turnover; where these people were found; their attitudes toward the company, etc.

Two sources of information are needed immediately: recruiting history information and a personnel inventory. Here is where the integration of personnel data into an information bank becomes paramount. As the company extends this manpower planning problem across all its disciplines — particularly in a highly technologically oriented environment — the manipulation of this information must be computer based.

Recruiting Reports

At the operational control level, i.e., the employment manager — needs weekly reports on his recruiting program which also relate to the time schedule and manpower requirements imposed by the corporate plan. He needs the detail of recruiting advertising effectiveness; status of candidates being interviewed; reasons for acceptance or rejection; salary offer trends; lead time to hire date; and other specific data.

By planning personnel activity in this framework — from strategy or objective to detailed program — the manager of the personnel plan has the ability to revise his goals through pertinent feedback of information. He can recognize that some technical skills may take six months to a year to find at a cost twice that of other technical disciplines, or that certain universities are not productive sources of PhD's for the company.

By integrating these programs with a computer-based information system the top manager in personnel is now in a position to effectively supply planning data to the long-range planning function. In parallel with manpower planning information other planning sub-systems in training, wage and salary administration, safety, turnover and absenteeism can supply similar information for the top personnel executive to format meaningful programs. Without a computer-based system the quantities of data required for such reporting becomes unmanageable.

Reducing Turnover

For example, a specific goal of the personnel function may be to reduce turnover. If collectively the company has a turnover rate of 8% a year, and a target is set to reduce it to 5%, the computer can be an effective tool as part of an overall program to measure morale. It can record dismissals, resignations, leaves of absence by department, by group, and by reason, and report them as often as economical and necessary. It can store trends. It can accumulate these data and report only when a department varies from target.

A similar program can handle grievances, absenteeism, lateness, accidents, etc. This does require, however, a determination of what information is relevant. It forces the personnel planner to focus on what is significant data.

To assume, however, that the ability of the computer to store and manipulate personnel data is the solution to long-range planning in personnel only compounds the errors made by other functional areas in their use of the computer. A long-range planning system itself requires thorough analysis and an understanding of the company's direction — the computer is a tool to supply the data which relates the company's progress in that direction.

PROBLEM CORNER

Walter Penney, CDP
Problem Editor
Computers and Automation

PROBLEM 687: COFFEE AND PI

"What's that on your flowchart?", Al asked, pointing to a brown crescent in one of the boxes.

"Coffee with cream, I think", Bob replied. "Whoever put his cup down on this sheet did a good job of clearing the contents of that box. The coffee made the ink run and now it's all blurred."

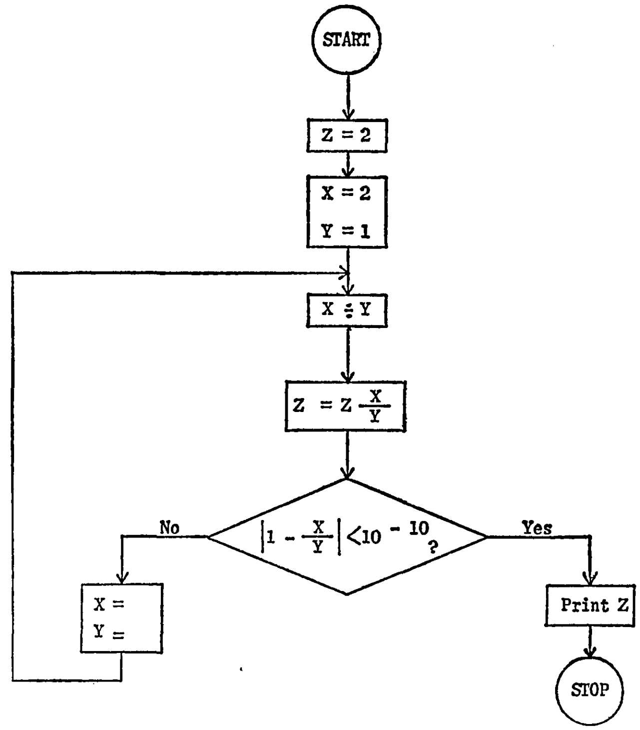
"What is the flowchart supposed to do?"

"Well, it's a flowchart for a program to compute π. But I'd have to know what's in that box before I can write the instructions."

Al took out a magnifying glass and studied the scene of the crime. "I can make out 'X =   ' and 'Y =   ' in that box."

"Fine!" Bob said, a little sarcastically. "Now just tell me what X and Y are equal to and I'll be all set."

What are the instructions in the box at the lower left?



Solution to Problem 685: Only Half Right

The value 41.78 was probably obtained by dividing 3990 by 95.5 instead of 95. Likewise 54.01 is the result of dividing 5136 by 95.5 The divisor locations were probably not cleared after each division (but the E locations were). When the 95 was written over the 105, the 9 replaced the 1 and the 5 the 0, but the unit's digit remained, so that the divisor used with 95.5. This is especially likely since the first division by 95 (before the register was contaminated by 105) was correct.

Comments on Problem 684: A Conversion Trick

Several sharp readers have noted that in addition to the published answer to Problem 684 ($173_{16} = 371_{10}$), both 1415_{16} and $18{,}499_{16}$ are also possible solutions, in that they also have the property that they are converted into decimal by reversing the digits (i.e., $1415_{16} = 5141_{10}$, and $18{,}499_{16} = 99{,}481_{10}$).

Our special thanks to David Christian, Poughkeepsie, N. Y.; Iver A. Iversen, Minneapolis, Minn.; Sidney Kaplan, Washington, D. C.; V. J. Maruska, Houston, Tex.; and Judy Thomas, San Diego, Calif.; for your solutions and comments.

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

IDEAS: SPOTLIGHT

FORKS AND COMPUTERS — AND SERVING THE CHANGING WORLD

(Based on a talk by D. V. Gonder, Vice President of Canadian National Railways, in October 1967, reported in *The Globe and Mail*, **Toronto, Canada, Oct. 31, 1967)**

There are tribulations for innovators. The habitual human propensity is to object to change. When the fork was introduced, there were surely mutterings from a good many persons who wanted to know what was wrong with fingers.

It is quite some time ago that the fork was introduced, and it is now generally accepted as useful. But human beings being what they are, they continue to resist changes in the design of an instrument that was originally used for spearing food.

There are businessmen with minds like that. There are lots of businessmen who are happy to get along with whatever they have inherited.

Technology must be the slave not the master. It is the business of the entrepreneur to serve the changing world in new ways. There are two ways of going about that. One of those ways is quite common and is usually wrong. It is to figure out what is better for the business operation and impose that upon the customers. The other is to figure out what is better for the customers and adapt the business system to that. That is the right way, too seldom followed.

The way computers are being used at present is a good illustration of the wrong way of going about introducing new methods into the business world. A man seeking to apply a computer may become angry with the computer because he gets a specific limited answer to a specific limited question. But the fact of it is that the applications engineer had not sufficiently identified the problem he wanted clarified before he asked his question.

The introduction of new technologies increases rather than obviates the need for clearer thinking and clearer understanding of what management is trying to accomplish.

CALENDAR OF COMING EVENTS

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

July 23-24, 1968: National Symposium on Modular Programming, Sheraton Boston, Boston, Mass.; contact Tom O. Barnett, c/o Information & Systems Institute, Inc., 14 Concord Lane, Cambridge, Mass. 02138

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

Sept. 16-18, 1968: International Symposium on Analogue and Hybrid Computation applied to Nuclear Energy, Versailles Palais des Congrès, Versailles, France; contact Claude Caillet, Centre D'Études Nucléaires de Saclay, Boite Postale No 2, Gif-sur-Yvette (Seine-et-Oise), France

Sept. 19-21, 1968: Symposium on the Use of Computers in Clinical Medicine, School of Medicine, State University of New York, Buffalo, N.Y.; contact Dr. E. R. Gabrieli, Clinical Information Ctre., Edward J. Meyer Memorial Hospital, 462 Grider St., Buffalo, N.Y. 14215

Sept. 22-25, 1968: Fourth National Annual Meeting and Equipment Show of the Data Systems Div. of the Assoc. of American Railroads, Pick Congress Hotel, Chicago, Ill.; contact Frank Masters, Trade Assoc. Inc., 5151 Wisc. Ave., N.W., Washington, D.C. 20016

Sept. 23-25, 1968: Journées Internationales de l'Informatique et de l'Automatisme, Palace of Congress, Versailles, France; contact Commissariat Général, Dr. Jacques Paul Noel, 37, Avenue Paul Doumer, Paris 16ème, France

Oct. 7-8, 1968: Association for Computing Machinery (ACM) Workshop on Microprogramming, Bedford, Mass.; contact Thomas L. Connors, Mitre Corp., P.O. Box 208, Bedford, Mass. 01730

Oct. 14-16, 1968: System Science & Cybernetics Conference, Towne House, San Francisco, Calif.; contact Hugh Mays, Fairchild Semi-conductor R & D Labs., 4001 Junipero Serra Blvd., Palo Alto, Calif. 94304

Oct. 18, 1968: Annual ACM Symposium on "The Application of Computers to the Problems of Urban Society", New York Hilton Hotel, New York, N. Y.; contact Justin M. Spring, Computer Methods Corp., 866 Third Ave., New York, N. Y. 10022

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

October 20-24, 1968: American Society for Information Science (formerly American Documentation Institute), 31st Annual Meeting, Sheraton-Columbus Motor Hotel, Columbus, Ohio; contact Gerald O. Plateau, ASIS Convention Chairman, c/o Sheraton-Columbus Motor Hotel, Columbus, Ohio

Oct. 28-31, 1968: Users of Automatic Information Display Equipment (UAIDE) Annual Meeting, Del Webb Townehouse, San Francisco, Calif.; contact Ellen Williams, NASA/Marshall Space Flight Center, Huntsville, Ala. 35812

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

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

Dec. 2-3, 1968: Second Conference on Applications of Simulation (SHARE/ACM/IEEE/SCI), Hotel Roosevelt, New York, N.Y.; contact Ralph Layer, Association for Computing Machinery, 211 East 43 St., New York, N.Y. 10017

Dec. 9-11, 1968: Fall Joint Computer Conference, Civic Auditorium (Program sessions), Brookshall (industrial and education exhibits), San Francisco Civic Center, San Francisco, Calif.; contact Dr. William H. Davidow, General Chairman, 395 Page Mill Rd., Palo Alto, Calif. 94306

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

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

May 14-16, 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

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

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

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

ACROSS THE EDITOR'S DESK

Computing and Data Processing Newsletter

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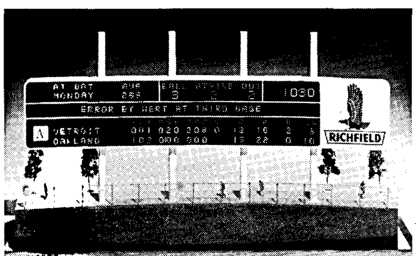
APPLICATIONS

OAKLAND ATHLETICS WILL HAVE FIRST COMPUTER-CONTROLLED STADIUM SCOREBOARDS

The first computer-controlled stadium scoreboards are being manufactured by the Conrac Corporation (Duarte, Calif.) and Information Concepts Inc. (New York, N.Y.) at a cost of $1,000,000 for the Oakland Athletics. The scoreboards will be installed in right and left field on light standards rising from behind the bleachers in the Oakland Alameda County Coliseum. One board will be operational early in the 1968 baseball season; the other will be operational later in the season.

The scoreboard system will be controlled by an IBM 1130 computer located in the press box. Two operators at the console control the system by keying in a simple code. Information used more than once is stored in the computer's memory.



Each scoreboard is 126 feet long, 24 feet high, and has a display area of over 2,400 square feet. The right field scoreboard will display information about the game in progress. Its companion left field "animation" board will show animated cartoons, informational messages, player records, — anything the team wishes to display.

Both scoreboards, which will be sponsored by Atlantic Richfield, will be used for football and soccer later in the year.

COMPUTER-CONTROLLED OPTICAL SYSTEM HUNTS NEW OIL SOURCES

Information International of Los Angeles, Calif., has installed a computer-controlled optical system at Mobil Oil Corporation's Geophysical Services Center in Dallas, Texas. The system, a general-purpose optical scanner called the Programmable Film Reader (PFR), may bring oil fields once thought dead back to life. It is the first such equipment put into operation by an oil firm.

The PFR now is automatically looking at, digitizing and transferring information from the more promising of Mobil's 400,000 well logs to magnetic tape for data processing. The result: new information on potential sources of recoverable oil from old oil fields.

Well logs are "pictures" of subsurface geological formations which can reveal sources of oil. Recorded as wavy lines on long rolls of paper, well logs have been used for years by petroleum geologists. Mobil's library of paper logs dates back to the early 1930's and encompasses the company's exploration activities around the world.

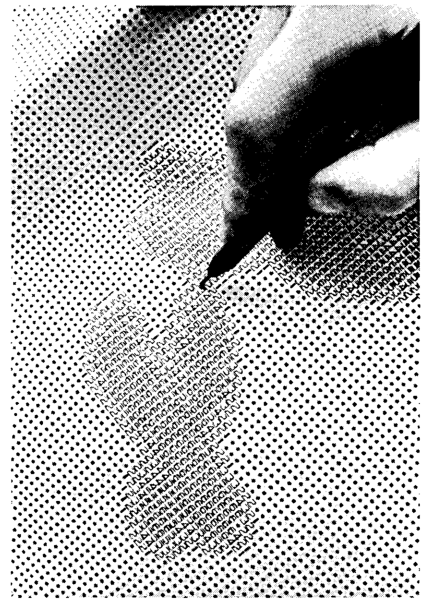
Before being processed by the PFR, the 100-foot paper logs are photographed by a continuous flow camera which reduces them to 20 inches of 35-millimeter film. Under program control, the PFR then uses a rapidly moving light point from a cathode ray tube to "look" at the film and select pertinent data. This selected information is digitized from more than a million pieces of information in each frame of filmed well log. It is immediately available as output without further processing.

Mobil plans other uses for Information International's PFR once the library of paper logs is recorded, interpreted and stored. These include rapid analyses of oil and gas reservoirs, interpretation of structural studies, and geological mapping.

COMPUTER ANALYSIS OF CHROMOSOMES SPEEDS RESEARCH INTO HEREDITARY DISEASES

Microscopic studies, in recent years, have linked a number of human disorders to abnormalities in chromosomes — the tiny particles in each body cell that determine hereditary traits. At the National Biomedical Research Foundation (NBRF), Silver Spring, Md., a computer has increased the speed of chromosome analysis as much as 500 times over manual methods.

Computer printed "pictures" of human chromosomes like the one in the photo are helping scientists locate the causes and effects of hereditary diseases and abnormalities. The recently installed computer, an IBM System/360 Model 44, utilizes a specially-designed scanner to convert microphotographs of chromosomes into digital replicas. The precise digital patterns then



are automatically analyzed by the computer to relate abnormal chromosome shapes and shadings to diseases such as leukemia, mongolism, color blindness and albinism.

Dr. Robert S. Ledley, NBRF president, said, "With the computer's aid, cytogeneticists are working toward reducing the birth incidence of abnormal babies." He also predicted that "the process would shed new light on the effects of drugs, radiation and aging on human chromosomes."

NATIONWIDE EARTH SCIENCE COMPUTER NETWORK IS NOW OPERATIONAL

The U.S. Geological Survey (USGS) has put its new transcontinental computing network into full operation between four satellite computers in the West and Midwest and Washington D.C. Housed in the Interior Department, an IBM System/360 Model 65 serves as the central processing plant for this new earth science computer network.

Using field computers as terminals, scientists and researchers transmit problem data and computer instruction to the Washington computer center via telephone line connections. Information from Survey facilities in Menlo Park, Cal., Denver, Colo., Rolla, Mo. and Flagstaff, Ariz., is stored on magnetic discs in the IBM 2314 direct access storage facility, capable of holding up to 230 million characters of information. The Model 65 automatically "pulls" job data and instructions off the discs in thousandths of seconds, processes the information and transmits problem solutions to sending terminals.

USGS research programs being assisted by the new computer tie-up include: a search for clues to new deposits of gold, silver, mercury and other heavy metals; the geologic mapping of the moon, and tutoring of astronauts for lunar exploration; monitoring of major earthquake-producing fault structures; mapping of remote stretches of the country; and cataloging of fossils uncovered in geological studies.

In addition to serving administrative, scientific and data processing needs for USGS, the network also will provide a wide spectrum of computational services for the Department of the Interior.

DETROIT FIRM ORGANIZES, SCHEDULES DOG SHOWS USING COMPUTER

Bow Dog Show Organization, Detroit, Mich., is using a computer to organize and schedule dog shows across the country at the rate of up to ten a week. The system is the only one of its kind in use among the half-dozen organizations that specialize in this work. Bow Dog Show President Theodore N. Bloomberg said that the firm's new computer (an IBM 1130) contains the names of 70,000 dog owners across the United States who have varying degrees of interest in showing their registered pets.

Dog owners are recorded in the memory of the IBM computer according to their geographical location, their willingness to travel, and the breed of dog. (In the U.S. there are 115 different breeds of dogs.) Periodically, cards are mailed to each dog owner for the purpose of updating records.

At the point the firm receives word that a kennel club has decided to engage the Bow Dog Show Organization, the firm must send out premium lists and entry forms to dog exhibitors within their prescribed traveling distance, print show catalogs, schedule judges and make all the necessary physical equipment arrangements for the show.

— Mr. Bloomberg is shown referencing a computer report in manipulating purebred dog miniatures atop a plate glass plot board

After the computer—printed mailings have been made to prospective entrants, the returned entry blank and entry fees are audited by the system and a completed catalog of participants prepared. The computer is programmed to produce a punched tape used to drive hot metal line casting machines in setting type for the catalog of up to 5,000 entrants for each show.

COMPUTER IS HELPING TO CHANGE THE SHAPE OF AIRPORTS AROUND THE WORLD

Rufus Phillips, president of Airways Engineering Corp. (A.E.C.), Washington, D.C., is shown with computer data that is beginning to change the shape of airports in the U.S. and around the world. The firm is believed to be the first to use a computer extensively for the master-planning of airports. A.E.C., an international airport architectural planning and design consultant, has undertaken design studies for 41 airports over the past ten years; 20 of them international airports.

The computer, an IBM 1130, is tackling airport design problems and mapping expansion plans for handling a passenger load that is expected to double by 1973, with the advent of jumbo and supersonic jets. The computer is equipped with its own automatic drafting table from which it can turn out construction drawings at the rate of a foot every eight seconds.

Mr. Phillips estimates there are upward of 600 design steps involved in planning a modern airport. Thus far, A.E.C. has used its computer to:

— create windroses (graphic designs of prevailing wind conditions) from analyses of up to ten years of weather data. Windroses are required to position runways to secure maximum wind advantage.

— locate runways and taxiways in the safest, most economical position and automatically generate the engineering profile and cross-section drawings used by contractors in actually laying down the runways, and,

— determine the size and the facilities needed at an airport, based on mathematical models of projected passenger loads.

COMPUTER SIMULATION OF SEMICONDUCTOR DEVICES

A new computation procedure which calculates the behavior of transistors, diodes and field-effect devices has been developed by Dr. D. M. Caughey of the Solid State Device Development group at the Northern Electric Laboratories in Ottawa, Canada. Both the internal behavior of a device and its external electrical performance can be simulated under static, large-signal transient, or small-signal operating conditions.

The computation procedure involves solving non-linear equations for the flow of holes and electrons and for voltage throughout a device with specified terminal voltages applied. From this solution, it is possible to derive distributions of the holes and electrons, of the electric field, of the recombination rate and the trapped charge. In addition, the terminal currents can be calculated, giving voltage-current characteristics, transient waveforms, and small-signal high-frequency parameters such as capacitance and transit time.

The computer simulation of devices now provides a tool for study of mechanisms within devices and for use in the improved characterization and application of devices such as in integrated circuits.

COMPUTER MAY HELP DETECT FORGERIES OF PRICELESS PORCELAIN

Forgeries of priceless 18th Century French porcelain will be easier to detect because of a museum curator's work with a computer. Carl Dauterman, Associate Curator of Western European Decorative Arts at The Metropolitan Museum of Art, New York, N.Y., is using a computer to classify and catalog the mysteries of Sevres, an often-faked porcelain art.

Each Sevres piece contains a series of coded symbols. These codes have been used by scholars for two centuries to identify the people who molded, painted and gilded a particular plate or serving dish. They also can indicate when each piece was made. Hidden in the intricate beauty of Sevres is a second set of numbers and marks that have been neglected by the scholars. These are the codes that interest Mr. Dauterman.

Using an IBM System/360 Model 30 computer at nearby New York University's Computer Center for the Humanities, all the data collected on the codings of more than 2,000 pieces of Sevres porcelain were fed into the computer. Names, duties and tenure dates of all Sevres artisans, taken from reference books and archives of the factory were stored in the computer memory. These records dated from 1745 to 1800.

By pointing out where the normal patterns of agreement vary between the two codes, and the stored background data, the computer will help detect a forgery. For example, the analysis may reveal that M. Bienfait, a painter of flowers at Sevres (1756 to 1762) worked particularly well with M. Leguay, a gilder, (1749 to 1795) and their specialty was vases. If however, M. Leguay turns up with a third party who was known to work almost exclusively on dinner plates in 1958, the scholar is wary of that particular vases's purported authenticity.

COMPUTER QUESTIONS PATIENTS AT MASS. GENERAL HOSPITAL

At Massachusetts General Hospital (Boston) a teletypewriter linked to a computer is "interviewing" selected patients. The experimental program, reported in the current issue of MGH News, is designed to learn how practical it is for machines to relieve the physician of the routine part of taking a patient's history.

The patient sits at a teletypewriter which, under computer control, prints out questions that require a multiple-choice answer, such as "Do you smoke?" If the patient answers that he does not, the next question will delve into another area. Should he respond that he does, the query will be, "How much do you smoke?"

A patient may be asked as many as 200 questions. His dialogue with the computer will take from 30 minutes to an hour to complete.

The system, which has been in operation several months, has been tried on more than 75 persons. It is reported to represent a "feasible means of collecting certain portions of the medical history". Both patients and physicians are enthusiastic.

ORGANIZATION NEWS

SCAM INSTRUMENT ANNOUNCES LICENSING AGREEMENT WITH IBM, LICENSING OF WESTINGHOUSE

A licensing agreement between IBM and SCAM Instrument Corporation, Skokie, Ill., involving a number of SCAM patents has been announced by Howard C. Warren, president of SCAM. (SCAM is a major manufacturer of industrial monitoring systems.)

One clause in the agreement with IBM forbids disclosure of its terms. The agreement with IBM grew out of a suit brought by SCAM, Feb. 6, 1967, alleging that IBM infringed three SCAM patents covering a data reduction system, an automatic process logging system, and a variable monitoring and recording apparatus.

Mr. Warren also announced a licensing agreement with Westinghouse Corporation covering six patents on data handling devices. Under terms of the Westinghouse agreement, SCAM will be paid royalties on use of the patents for the next five years. First payment of $50,000 already has been made by Westinghouse to SCAM, Warren said.

CONTROL DATA CORPORATION AND ELECTRONIC ASSOCIATES, INC. END ACQUISITION NEGOTIATIONS

Control Data Corporation has announced that Control Data and Electronic Associates, Inc. have terminated negotiations leading to the proposed acquisition of Electronic Associates by Control Data.

MERGER PLANNED BY COMPUTER LEASING COMPANY AND STANDARD COMPUTERS, INC.

Computer Leasing Company and Standard Computers, Inc., both have signed the formal agreement and plan of merger which calls for them to merge into a new Delaware corporation to be named Computer Leasing Company. The plan will be submitted for approval to the stockholders of both companies at meetings to be held this month (July).

Terms of the agreement call for shareholders of Standard Computers, Inc., to receive 1.9 shares of the common stock of the new company for each Standard share. Computer Leasing Company shareholders will receive one share of the new company for each share of CLC.

The two companies are engaged in substantially the same business of leasing computers and related equipment. The new combined corporation would have over $80 million in computer systems leased to users.

NCR TO MARKET CREDIFIER'S CREDIT-INQUIRY SYSTEM

The National Cash Register Co. (Dayton, O.) has entered into an agreement to market the Credifier Company's credit-authorization and inquiry system. This system, to be designated the NCR Credifier, has been test-marketed by NCR for about 18 months. Some 400 installations have been made, both by NCR and by the Credifier Company (Santa Monica, Cal.), many in major supermarkets, discount and department store chains.

The system is built around a central file which stores customer information on punched Mylar tape. Store clerks enter the number on identification cards by means of small keyboard devices located at convenient spots throughout the store, and linked to the central file. The system automatically "looks up" the customer's status, and signals the clerk with a red, green, or yellow light indicating the action to be taken.

The Credifier Company will continue to market the equipment in certain areas of the West Coast, supplementing NCR's nationwide marketing program.

CAELUS MEMORIES, INC. PROVIDES 3-YEAR WARRANTY ON DISK PACK

Caelus Memories, Inc. (San Jose, Calif.), now guarantees the CM VI for a period of three years. This guaranty is retroactive to cover all Caelus disk packs presently in use.

The warranty specifically provides that: "The Caelus Disk Pack is unconditionally guaranteed for three years, from date of shipment, against any defects in workmanship or material."

In announcing the Caelus three year warranty, president of Caelus, Mr. Philippe Yaconelli, stated: "Field performance, coupled with ever-mounting internal test data provide the assurance necessary to support our three year warranty."

The CM VI is a six-high magnetic disk pack designed for use with IBM 1311, IBM 2311 and compatible equipment.

APPLIED LOGIC CORPORATION ANNOUNCES NEW COMPUTER SOFTWARE ROYALTY PLAN

A new computer software royalty plan has been announced by the Applied Logic Corporation of Princeton, N.J. This new plan enables software firms and individual programmers to sell the use of their programs on a nationwide basis.... instantly, without becoming involved in any marketing operations.

This is accomplished by placing their proprietary applications programs and software in the Applied Logic Corporation's AL/COM computer time sharing system. Thus, when an AL/COM user at any location utilizes the proprietary program, the operation is automatically recorded and a royalty credit record is developed. The owner of the program is credited each time his program is used by an AL/COM customer and he is paid on a regular billing cycle.

All software and applications programs undergo an extensive evaluation by the firm's Quality Control Review Board before being inserted in the AL/COM time sharing computer system. Complete and accurate documentation for all software is assured by the standards established by the Quality Control Review Board.

This plan is, in essence, identical to that used to compensate song writers and musical performers when their records are played on a juke box.

NCR WILL MARKET ULTRONIC DATASETS WITH CENTURY COMPUTERS

The National Cash Register Co. and Ultronic Systems Corporation have reached an agreement covering NCR's marketing of datasets made by Ultronic for use with on-line NCR computer systems.

The equipment will be offered by NCR for either rental or purchase to on-line users of NCR's new Century Series computers and also NCR 315 computers. The datasets will be made to NCR specifications and will be known as the NCR 753 unit.

Ultronic Systems Corporation, situated at Moorestown, N.J., is a subsidiary of Sylvania Electric Products, Inc. The datasets are produced by Ultronic's Data Communication Products Division.

The marketing agreement is for a two-year period.

GRANITE EQUIPMENT LEASING ENTERS COMPUTER EDUCATION FIELD; ALSO ACQUIRES TRANSPORTATION ORGANIZATION

Granite Equipment Leasing Corp. (AMEX) has announced its entry into the computer education field via an agreement in principle to acquire the American Institute of Technology (AIT), a computer programmer training school based in Phoenix and Tucson, Ariz. Granite president Harvey Granat also announced the acquisition of Allied Tours Inc., a New York-based transportation services organization. The two transactions involve an amount of stock in excess of $4 million.

Mr. Granat pointed out that his company intends to further expand in the computer education field as a supplement to its computer leasing and data services operations.

Allied Tours Inc. specializes in bringing industry groups from Europe to the United States in conjunction with trade studies, industry conferences, etc. This area also is a new one for Granite. Present management will be retained in both organizations.

Granite Equipment Leasing Corp. and its subsidiaries lease third generation computers and other data processing equipment, executive aircraft, business, textile and packaging machines, automobiles and trucks. The company also furnishes a broad range of data processing services. Granite maintains regional branch offices in: Atlanta, Ga.; Boston, Mass.; Baltimore, Md.; Chicago, Ill.; Cleveland, Ohio; Philadelphia, Pa.; Los Angeles and San Francisco, Calif.

AFIPS ELECTS PRESIDENT

Paul Armer, the Associate Head of the Computer Sciences Department of the RAND Corporation, has been elected President of the American Federation of Information Processing Societies (AFIPS).

Founded in 1961, AFIPS serves as a national voice for over 40,000 computer professionals in the United States, and works to promote knowledge of the information processing sciences. It serves as the U.S. member of the International Federation of Information Processing.

Other AFIPS officers elected by the Board of Governors are:

<u>Vice President</u>: Dr. Richard I. Tanaka (Vice President for Program Development, California Computer Products, Inc., Anaheim, Calif.)
<u>Secretary</u>: Mr. Arthur I. Rubin (Manager, Computational Sciences—Hybrid, Martin Marietta Corporation, Orlando, Fla.)
<u>Treasurer</u>: Dr. Walter Hoffman (Associate Professor and Director, Wayne State University Computing Center, Detroit, Mich.)

SANDERS ASSOCIATES DIVISION SIGNS 12-YEAR AGREEMENT WITH FRENCH COMPANY

An overall expansion program, which includes manufacturing and selling flexible printed circuit products internationally, was announced by the Flexprint Division of Sanders Associates, Inc. The Division has signed a 12-year licensing agreement with Usines Dialectrique Delle of Belfort, France, granting them rights to produce and market Sanders' flexible printed circuit products in France. Under terms of the agreement, Sanders will conduct a familiarization course for a group of UDD personnel at Manchester, N.H.

UDD, which employs approximately 1,500 persons at its three manufacturing facilities, is one of France's largest suppliers of electrical insulating materials, printed circuit boards and magnet wire.

EDUCATION NEWS

RCA DISCLOSES PROGRAMS TO HIRE AND TRAIN HARD-CORE UNEMPLOYED

RCA has initiated special programs to hire and train hard-core unemployed in two major cities and plans to intensify its efforts in the company's plant communities throughout the nation, President Robert W. Sarnoff has disclosed. Addressing the 49th Annual Meeting of Shareholders, Mr. Sarnoff called for "bold new programs" by business and government to attack social injustice, stressing that such programs are now a compelling national necessity.

RCA has made specific job pledges to the program for the recruitment and training of hard-core unemployed being sponsored by the National Alliance of Businessmen in the nation's 50 largest cities. It also is loaning management personnel to assist the Alliance in several cities.

Detailing the accomplishments of RCA's own hiring and training programs in Boston and New York, Mr. Sarnoff said:

"In the Boston area, one of our plants, with the help of the Massachusetts Employment Service, recruited from the Negro and Spanish-speaking communities more than 200 people for on-the-job training. To support the program, we subsidized bus transportation at the start, and our local management arranged with the public school system for adult English courses where needed. Most of these people have become productive RCA employees.

"In New York City, another 200 disadvantaged people — mostly Negro and Puerto Rican — have been recruited and trained for work at two of our facilities in a variety of clerical, typing and messenger functions. None had any previous clerical experience. Many were school drop-outs with spotty work records. Some had police records. With intensive on-the-job instruction, they, too have become productive employees."

RCA plans to expand the recruitment and training or hard-core unemployed in the cities where it operates, Mr. Sarnoff said.

COMPUTER TUTORIAL FILM SERIES BY COMPUTER METHODS CORP.

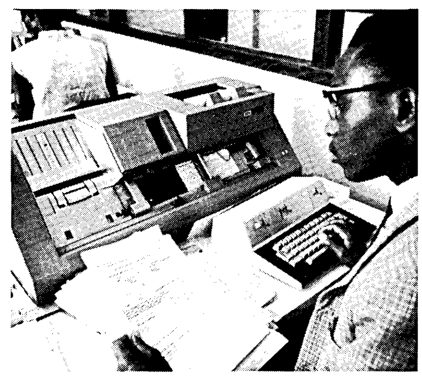
Computer Methods Corp. (a subsidiary of Coburn Corporation of America), New York, N.Y., has announced development of a film and text series designed to provide an efficient and economical means of professional education within the computing industry. As acknowledged by both manufacturers and users, sophisticated advances in hardware and software have far outpaced the educational level of the 200,000 computer programmers and systems analysts in the U.S. today.

The Tutorial Film Series for Professional Programmers and Systems Analysts, represents a new, efficient and economical method of staying abreast of current developments in the computer field, Irving Berstein, president of Coburn said. The first set on the series, "Data Communications" is available for sale now at $500, which, Mr. Bernstein noted, "is substantially less than the average cost incurred by one programmer attending a professional seminar". The film runs for 45 minutes, broken down into three 15-minute reels accompanied by three specially created full-size texts. The presentation is designed for use by programmers and systems analysts with a minimum of two years experience.

For customer convenience, the films have been produced in both super 8mm technicolor cartridges or 16mm color film. CMC plans to release nine more films in the near future. Amont these are such topics as: Programming Estimation and Scheduling Techniques; Computer Graphics and Display Techniques; Principles of Information Retrieval; and Time Sharing Hardware and Software Structure.
(For more information, designate #41 on the Reader Service Card.)

AFRICANS LEARN MODERN COMPUTER SKILLS

An educational program to develop skills in the operation of advanced computers was completed recently in the East African republic of Uganda. The program, conducted by IBM World Trade Corporation (New York) was attended by twenty-five young Africans, many of whom had never before seen a computer. IBM Corporation, the parent company, provided the course instructor, Michael J. Ward, of IBM's New Orleans Education Center. IBM World Trade sales and systems personnel in Kampala assisted in the intensive six-week data processing course.



— Edward Mbekelu, 24, a computer operator for East African Airways in Nairobi, shown operating a card punch, is preparing for a career in programming

The students — from Sudan, Ethiopia, Zambia, Kenya and Uganda — were chosen for their management potential and their aptitudes in machine operation. Some were computer operators with limited experience; others high school and college students with no computer experience. An IBM System/360 Model 30 computer installed at the Uganda Ministry of Finance was made available for the course. Classroom training covered areas of computer applications as well as machine operation.

CARE AND HANDLING OF COMPUTER TAPES IS SUBJECT OF 3M FILM

"The Conspiracy in Computer Room C," or proper care and handling of computer tapes, is the subject of a fifteen minute instructional film strip produced by the Magnetic Products division of the 3M Company, St. Paul, Minn.

The 16mm color, sound-on-film cartoon is designed to be shown to computer room personnel as a means of demonstrating the many ways in which careless handling of tapes can cause tape damage. It is important that computer room personnel be aware of the savings in time and dollars to be realized through exercising proper care and handling practices, 3M said.

The two principal, gremlin-like, characters are Professor Cy Bernetics and his assistant Chad, who, throughout the film, are instructing their followers in the many ways to disrupt computer room operation.

The film strip was shown by 3M, for the first time, at the Spring Joint Computer Conference in Atlantic City, N.J. It will be made available for showing in computer installations throughout the country.
(For more information, designate #42 on the Reader Service Card.)

CONTROL DATA AWARDS $13,000 IN SCHOLARSHIPS FOR STUDY AT CDI

Scholarships totaling more than $13,000 have been awarded to six area high school students by Control Data Corporation for study in the computer manufacturer's education program at Control Data Institute (CDI), Arlington, Va. Director of the Arlington CDI, Charles H. Hiser, said each scholarship covers all tuition and fees for whichever of the two basic courses the individual student will pursue: the six-month programming technology course or the ten-month computer technology course.

The six recipients were among some 100 high school seniors in the area who competed in a comprehensive exam given last April at the Institute. They will begin study at the Institute in September.

Four of the students will study computer technology and two, including one young lady, will enroll in the programming technology course. The students will have access to learning devices such as advanced Control Data computer systems, well-equipped laboratories and instruments and textbooks used in the computer industry.

IBM OPENS JAPANESE EDUCATION CENTER

A computer education center for business executives has been opened by IBM Japan Ltd. atop Mt. Amagi, 70 miles southwest of Tokyo. The center offers seminars in computer concepts and applications. Its courses are designed mainly for senior executives of IBM customer firms in Japan and other countries.

The center has already completed its first classes — one for a group of Japanese banking, manufacturing and utilities executives, another for executives from Japan and several other countries.

The new facility joins similar IBM education centers at Blaricum, The Netherlands, and Cuernavaca, Mexico, which also offer resident courses at the executive level. The centers draw speakers and participants from many countries, both from IBM companies and from a range of business, educational and government organizations.

TIME-SHARING SERVICES

ITALY'S FIRST COMMERCIAL TIME-SHARING SERVICE IS OPENED BY OLIVETTI-GE

Olivetti-General Electric has opened Italy's first commercially available computer time-sharing service in Milan, Italy. The new time-sharing system enables anyone with a telephone in Italy to gain access to a high-speed computer at a fraction of the cost of maintaining his own data processing system.

Standard telephone lines provide the link between the users and the central computer, a GE-200 series system like those employed in the French, Canadian, English, Australian and U.S. centers network. The system is maintained by OGE at its Milan headquarters. The center was the fourth to be opened by the General Electric Company outside the U.S. in the last eight months.

ITT DIVISION INAUGURATES 3RD GENERATION TIME-SHARING SERVICE IN NEW ENGLAND

ITT Data Services, Paramus, N.J., has introduced to New England a computer time-sharing service which puts "third generation" computers at the fingertips of businessmen, scientists and government agencies in the area by the simple dialing of a local phone number.

The new ITT data processing system, called Reactive Terminal Service, enables many users to solve problems by "conversing" from their offices with computers many miles away via standard communications devices such as teletypewriters, according to Robert A. Leonard, president of this division of International Telephone and Telegraph Corporation.

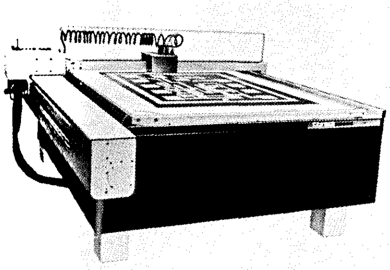
Among the unique features of the RTS service, Mr. Leonard listed the use of large-scale IBM System/360 Model 50 and 65 computers. He said that RTS service utilizes a proprietary software system developed by ITT which assures computer response to inquiries in as little as two seconds. It offers high-level programming languages such as FORTRAN IV (G-level), and is compatible with a broad variety of existing computer communications devices.
(For more information, designate #43 on the Reader Service Card.)

FAUL ASSOCIATES ANNOUNCES NEW TIME-SHARING PROGRAM

A new program involving time-sharing of a fully automatic drafting, plotting and measuring machine has been announced by Thomas L. Faul Associates, Inc., Skaneateles, N.Y., a leading manufacturer of precision drafting equipment. Time on one of Faul Associate's large, computerized "Coradomat 15" automatic artwork generators, normally used in surveying offices, computing centers, industrial planning offices and electronic firms, is being made available to anyone who has a need to use this complex machine.

All companies desiring to use the "Coradomat 15" will be able to do so by sending numerical instructions, drawings or tapes by mail, or, if faster service is wanted (e.g., overnight) Faul is prepared, on a contract basis, to send and receive data via a high-speed, tape-to-tape system.

All of the "Coradomat 15" functions such as construction of pencil proofs, drawing with a knife, drawing with a ballpoint pen, drawing with ink, drawing with jewel scribes, cut and strip work or drawing with a photobeam on film or photo plate are available to customers time-sharing this machine.



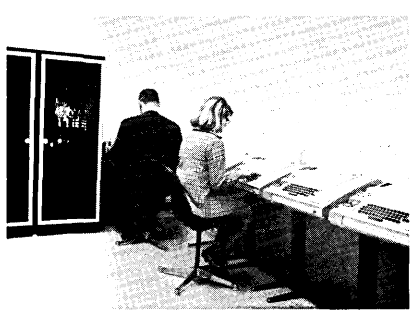
All charges for time-sharing are based on the number of hours of actual use of the "Coradomat 15" — there being a minimum charge of one hour for any single order.
(For more information, designate #44 on the Reader Service Card.)

NEW PRODUCTS

Digital

TIME-SHARE COSTS CUT 90% WITH NEW HP 2000A SYSTEM

A new 16-terminal time-shared system reduces user terminal costs considerably below that of conventional commercial time-sharing services. With only light use — 340 hours per month, equivalent to 4 terminals used 4 hours per day — the terminal cost is less than $7 per hour (exclusive of teleprinter and data communications charges).



HP 2000A Time-Sharing System

With all 16 terminals in use, the cost goes down to less than $7 per terminal per day.

The new HP 2000A Time-Sharing System (from Hewlett Packard, Palo Alto, Calif.) achieves this economy by restricting itself to one programming language — Conversational BASIC — and by using a relatively small computer. This computer, HP Model 2116, uses 16K of core memory, augmented by a disc memory with an additional 348K words. The disc may store 500 to 1000 average sized programs, and for large requirements, disc storage can be expanded. The computer has a 16-bit word length and a memory cycle time of 1.6 microseconds.

User terminals are standard ASR-33 or ASR-35 teleprinters (with Dataphone interface) available from HP, Teletype Corporation, or local telephone companies. Connection between system and user terminals is either direct-wired or via telephone lines. Conventional telephone Data Sets or portable acoustic couplers provide connection. Up to 16 teleprinters can be serviced simultaneously. The ability to accommodate a mix of direct lines and phone lines represents another innovation in time-shared systems.

The 2000A System also can be operated in a non-time-share or batch mode. Many peripherals are available for batch processing. Delivery of the Hewlett-Packard 2000A Time-Sharing System is expected to begin in late 1968.
(For more information, designate #45 on the Reader Service Card.)

GE UNVEILS DISC-EQUIPPED VERSION OF THE GE-405 COMPUTER

General Electric has announced a disc-equipped version of its latest and smallest medium-scale computer, the GE-405. Guy W. Fiske, marketing manager of the Company's Medium Systems Department, said the GE-405 memory size had been expanded to accommodate the DSU-160 storage unit. "With the new GE-405 disc system," Mr. Fiske said, "users will be able to take a simplified approach to implement multiprogramming. In effect, our customers will be able to execute large-scale concepts in a medium-scale system."

The new GE-405 will be able to handle a combination of tape, disc, card read, punch, print, and console operations on up to eight separate data paths.
(For more information, designate #46 on the Reader Service Card.)

SDS ANNOUNCES NEW SDS 945 — INDUSTRY'S LOWEST PRICED TIME SHARING SYSTEM

Scientific Data Systems, Santa Monica, Calif., has announced the third in its line of time sharing computers, the SDS 945, for delivery this year. Louis B. Perillo, SDS vice president for marketing, said the SDS 945 will lease for under $15,000 per month compared with $26,000 for a standard SDS 940 configuration (which accommodates a larger number of users). At under $15,000, the SDS 945 leases for less than any other time sharing computer presently available, Mr. Perillo noted.

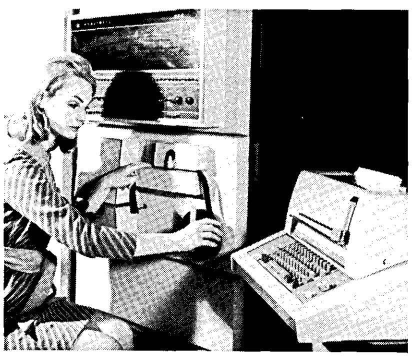
The SDS 945 can accommodate up to 24 simultaneous users and services 64 authorized users with total file space of 8 million characters. The processors and the time sharing monitor for the SDS 945 are identical to the software provided for the field-proven SDS 940, which has been in commercial use for more than two years.
(For more information, designate #48 on the Reader Service Card.)

HONEYWELL DIVISION ANNOUNCES NEW COMPUTER FAMILY

Honeywell Inc.'s Computer Control Division, Framingham, Mass., has announced a new family of integrated circuit computers for scientific and control uses. The division has introduced the H632 computer as the first of the new Honeywell Series 32 line of computing systems; larger and smaller computers will be added later.

T. Paul Bothwell, division vice president and general manager, said the H632 is designed for the solution of on-line real-time problems. He said extensive use of integrated circuits makes the system, which features full-word cycle time of 850 nanoseconds, the fastest and most compact standard 32-bit computer currently available.

The H632 is a multiprocessor system with capacity for up to four central processors and four input-output processors. The basic machine consists of one central processor and one input-output processor. Minimum memory capacity is 8,192 words, expandable to 131,072.



Standard software includes an assembler, FORTRAN IV compiler, basic operating system, math library, loader, media conversion programs and test and maintenance routines. Peripheral options include magnetic tape units, card reader, card punch, high-speed paper tape reader and punch, line printer and disc units.
(For more information, designate #47 on the Reader Service Card.)

UNIVAC DIV. OF SPERRY RAND ANNOUNCES UNIVAC 418 III

A new medium-scale computer system, the UNIVAC 418 III, was introduced recently by Sperry Rand Corporation's UNIVAC Division, Philadelphia, Pa. The new system is equipped for three-way simultaneous processing and provides almost twelve times the channel input/output speed compared to its predecessor systems, the UNIVAC 418 I and II. The simultaneous processing feature allows vastly increased throughput and decreased turn-around time, and virtually eliminates peak-load demands on the input/output channels.

The core storage of the central processor has a 750-nanosecond read/restore cycle time (comparable speed in the 418 II was two microseconds). It is modularly constructed to store from 32,768 to 131,072 18-bit words in one to four banks with one or two 16,384 modules per bank. The main storage can be accessed in three ways simultaneously by two Input/Output modules and the Command/Arithmetic section. Typical instruction time is 1.5 microseconds. A double precision add is completed in 2.5 microseconds. Floating point and binary conversions are additional hardware features.

The 418 III Real-Time System is designed for communications-oriented applications, such as message switching and data collection and distribution. Business and scientific applications can complement the range of the system's abilities.
(For more information, designate #49 on the Reader Service Card.)

THE DECADE 70, A NEW GENERAL PURPOSE COMPUTER

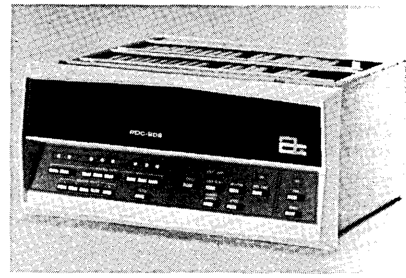
Decade Computer Corp., Los Angeles, Calif., has announced a new general purpose computer for scientific/engineering applications. The new system, designated the Decade 70, has a 4,096 word memory, expandable to 16,384 words. Speed is one microsecond for full cycle time. The processor, which includes power supply and up to 16K memory, is conatined in a 19-inch cube. In addition to the assembler, debug and utilities, software includes the CHAT engineering problem-solving language.

Standard with the system are hardware multiply and divide, memory parity, automatic power shutdown and restore, cycle steal, direct memory access, memory protect and programmable interrupt. Decimal arithmetic and variable word length are available on all models.

Other models and software packages are available for accounting and civil engineering.
(For more information, designate #53 on the Reader Service Card.)

COMPUTER AUTOMATION, INC. ANNOUNCES THE PDC 808 —

Computer Automation Inc., Newport Beach, Calif., has placed on the market a $6600 "Programmed Digital Controller", known as the model PDC 808. The 808 was designed to serve where control, monitoring, and data logging systems require a versatile interface.



The PDC 808 has a 4,906 word 8-bit memory and 73 basic instructions. Memory is expandable to 16K words and processing is parallel with 24 microsecond ADD time. A flexible I/O section has DTL logic levels. Two priority interrupt lines and a third interrupt request line are standard. Many I/O options are available — including teletype, high speed tape reader and punch as well as magnetic tape.
(For more information, designate #51 on the Reader Service Card.)

K & M ELECTRONICS ANNOUNCES GENERAL PURPOSE SYSTEM AVAILABLE FOR $15,000

A $15,000 general purpose computer system for use by small business firms and departments of larger companies now is being manufactured and marketed by K & M Electronics Co., Inc., Baltimore, Md. The KM-220 is available in two separate models with a number of optional features custom-made to the users requirements. Scientific computing capabilities are available as a standard feature and the system can be used in a real-time mode, either hands-on or on a remote basis through a data link.

S. R. Krause, president of K & M Electronics, said, "This is the only data processing machine between the desk calculator and the full-scale computer — both in price and function. By using a unique random accessible memory device, unlike any on the market today, this unit provides the greatest number of characters of storage per dollar. Additional cost benefits can be realized because it does not require an experienced operator who knows a computer language."

The economic break-through has been achieved by using a wide-width (6"-wide) magnetic tape on a continuous roll and scanning it on an xy axis for random accessibility of information, Mr. Krause explained. Additionally, the KM-220's data-link capability enables the user to transmit data between computers, taking advantage of the power and memory of the largest computers when necessary.
(For more information, designate #50 on the Reader Service Card.)

GE-100 FAMILY ADDS GE-130

General Electric, New York, N.Y., has broadened its line of small-scale business computers with the announcement of the GE-130. Power, speed and processing capability of the new computer fall between the other member of the GE-100 family, the GE-115, and the Company's GE-400 line. The GE-130 is manufactured by Olivetti-General Electric in Italy, as is the GE-115.

The GE-130 has a memory speed of two microseconds, compared to 6.5 microseconds for the smaller GE-115. The two computers are upward compatible in software and can use the same peripherals.

The new computer has monolithic printed circuits throughout the central processing unit. Memory size of the GE-130 ranges up to 32,000 eight-bit words. Its wider instruction repertory gives it more logic capability than the GE-115. A major feature is its interrupt capability, permitting the GE-130 to be used in low-cost, real-time applications.
(For more information, designate #54 on the Reader Service Card.)

HEWLETT-PACKARD COMPUTER UNDER $10,000 — HAS 16-BIT WORD LENGTH

Hewlett Packard, Palo Alto, Calif., has announced a new compact computer priced at only $9,950. A 16-bit word length is used to achieve important aspects of large computer performance in a desk-top unit. The new computer, Hewlett-Packard Model 2114A, is upward compatible with the wide range of software already developed for other members of the Hewlett-Packard computer family.

Model 2114A is a compact, completely self-contained unit housed in a single 12¼" x 16" x 25" cabinet that can sit on a desk or be mounted in a standard instrument rack. A 4K memory is standard, and 8K memory is accommodated easily in the main frame. The memory is organized into large 1024—word pages, two of which are directly addressable. Memory cycle time is 2 microseconds.

The computer has two independent accumulators. Computation can proceed in one accumulator without disturbing the input/output through the other. Direct addressability as memory locations allows inter-register operations, such as LOAD, ADD and COMPARE.

The input/output structure is organized with multi-level priority interrupt. Eight I/O channels are available for interfacing, each with assignable priority interrupt. A wide range of standard interface hardware is available for use with the new computer.
(For more information, designate #55 on the Reader Service Card.)

Memories

SMALL, HIGH-DENSITY DRUM MEMORY ANNOUNCED BY VERMONT RESEARCH CORP.

The Model 1004S Drum Memory developed by Vermont Research Corp., North Springfield, Vt., now is available in an optional version with nearly double the storage capacity. Identical in size to the original Model 1004S, the new high-density version packs a total capacity of 4,224,000 bits into a dust-tight enclosure measuring 17-1/2" in diameter by 12-5/8" high. It includes, within the drum case, all electronics required for head selection, writing and reading data. The total package weighs 75 pounds.

Other basic specifications of the new high-density 1004S option (with corresponding figures for the standard version in parentheses) are as follows: bits per inch, 1000 (650); bits per track, 33,000 (20,500); data tracks, 128 (128); operating frequency, 1.8 MHz (1.2 MHz).
(For more information, designate #56 on the Reader Service Card.)

SANDERS SERIES 500 MEMORIES

A compact, 8K x 40 random access core memory with a 2 microsecond full cycle speed is available from Sanders Associates, Inc., Nashua, N.H. The Sanders Series 500 Core Memory Systems are designed for commercial applications with all digital computers.

The Series 500 has an 800 nanosecond access time. It can perform over a wider temperature range and is less sensitive to shock and vibration than most commercial memories. The compact memory (19" x 11" x 5¼") contains three circuit module types. All modules and the memory stack are plug-in units that can be replaced quickly.

The system has an optional self test which provides the full test capabilities of zeros and ones, worst case, and worst case complement.
(For more information, designate #57 on the Reader Service Card.)

Software

<u>ALLTAX</u> / Management Information Service, Stony Point, N.Y. / ALLTAX, approved by all states, calculates all payroll withholding taxes using one standard formula. The system eliminates programming of individual formulas and substantially reduces future program maintenance and memory requirements. The package is available in basic COBOL for all compilers. Automatic program maintenance for existing withholding taxes and new taxes also is available at a nominal cost.
(For more information, designate #58 on the Reader Service Card.)

<u>DISK LIBERATOR</u> / Honeywell Electronic Data Processing, Wellesley Hills, Mass. / Users of disk-oriented competitive equipment can convert automatically to faster disk-oriented Series 200 computer systems using this new software system. Disk Liberator is aimed specifically at slower, second-generation 1400 series equipment and third-generation computers which run in an "emulation" mode. Computer programs written in Autocoder, Symbolic Programming System (SPS), or mixed SPS/Autocoder languages can be translated through Disk Liberator to Series 200 Easycoder

assembly language programs.
(For more information, designate #59 on the Reader Service Card.)

GEPEXS (GE Parts Explosion System) / General Electric Co., Phoenix, Ariz. / This random access application package is for use on medium-scale GE-400 Series information systems. GEPEXS provides the foundation for future development of a complete manufacturing information and control system. Oriented to an integrated data base, it serves virtually any kind of manufacturing operation, whether job shops, flow shops or process shops, whether the user produces a single product or a variety of products.
(For more information, designate #60 on the Reader Service Card.)

IMPEL (Insurance Management Performance Evaluation, Life) / The National Cash Register Co., Dayton, Ohio / IMPEL provides a complete management information system for life insurance companies. It is designed for use with the new Century Series family of computers. The new package program assists management in four vital areas: corporate planning, setting specific long-term and short-term goals, managing company operations, and performing basic accounting functions.
(For more information, designate #61 on the Reader Service Card.)

NEPTUNE / Metra Consulting Group Limited, London, England / Program NEPTUNE, developed in conjunction with the Port of London Authority, is a new evaluation program for testing unit-load economics. It is based on a cost model of container shipping systems. NEPTUNE estimates handling, transport, ancillary and latent costs for all parts of a container system operating between home inland area and an overseas port. The results are summarized by areas of activity; total and per container costs are calculated. The program is written in FORTRAN IV and is available for sale.
(For more information, designate #62 on the Reader Service Card.)

Peripheral Equipment

"THOUSAND-IN-ONE" ACCOUNTING MACHINE INTRODUCED BY NCR

The National Cash Register Co., Dayton, Ohio, has introduced a new modular accounting machine series which permits more than a thousand combinations of features to be offered by one basic unit. The new series, called the NCR 36, permits the addition of extra features as needed with minimum effort and cost. These can be added by NCR Technical Service personnel in the field, after the basic machine has been shipped from the factory.

The NCR 36 is designed primarily for the small businessman whose operation is growing. For the larger, computerized businesses using accounting machines for certain basic record-keeping functions, the punched paper tape created as a by-product of the accounting machine operation, becomes computer input.

All of the NCR 36 models provide a 72-character electric typewriter, 10 amount rows, four rows of keyboard dates and symbols, a 26-inch carriage, four counterlines, and a stand with table and drawer.
(For more information, designate #63 on the Reader Service Card.)

FIRST HYBRID-DIGITAL X-Y PLOTTER INTRODUCED BY ELECTRONIC ASSOCIATES

EAI Series 430 DATAPLOTTER, the first digital X-Y plotter with hybrid operating techniques, has been introduced by Electronic Associates, Inc., West Long Branch, N.J. The new system has digital data input and control, but analog drive of the plotting arm and pen for continuous, non-segmented plots. It plots at speeds up to 20 inches/sec with .002" resolution and maximum error of .010" over its entire 30" x 30" plotting surface. EAI reports it is the only plotter available to control and maintain its own optimum, variable operating speed.

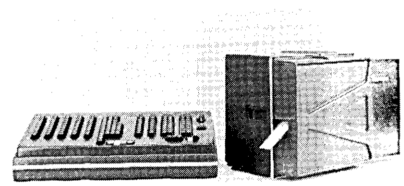
The 430 can be used with any digital computer which has a FORTRAN Compiler. EAI's optional 48-character symbol printer annotates the plots with up to 350 alphanumeric characters per minute.
(For more information, designate #64 on the Reader Service Card.)

KEYKODE© KN-14 PREASSEMBLED KEYBOARD

This 12-key data entry keyboard with momentary contact is supplied assembled to a printed circuit board for mating connector or for hardwiring to external circuitry by Nutronics of Paramus, N.J. Keykode KN-14 has 3/8" square keys on 5/8" centers in adding machine or telephone configuration. Standard colors are black on white. The light touch (5 ounces contact pressure), short throw (.1 inches), low profile (3" x 5" x 1" deep), and light weight (5 ounces assembled) greatly minimize operator fatigue and mounting effort. Life rating is 5 million cycles at 100 mil., 6v. dc. for computer data entry applications.
(For more information, designate #65 on the Reader Service Card.)

SPACE SELECTOR TERMINAL BY DI/AN CONTROLS, INC.

A terminal for generating air line tickets on-line and in real time has been developed by Di/An Controls, Inc., Boston, Mass. The machine is called the Space Selector Terminal (SST). Networks of terminals can be linked via commercial data circuits to remote reservations and accounting systems. Ticket and reservation requests can be entered via a keyboard and the computer responses, including messages, are printed out at 2400 lines per minute by a high speed printer.



SST has been designed especially to accommodate the current IATA ticket format, a configuration proposed for general use by all air lines to standardize data processing. SST can print data fields in the fonts necessary to optical character readers, allowing the re-entry of data into the accounting loop after use or redemption.

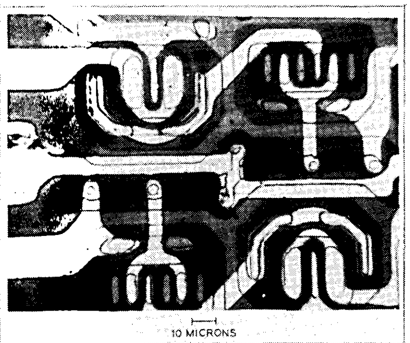
The prototype SST terminal prints out tickets and messages on card stock 0.09 inch thick, $3\frac{1}{4}$" wide, and $8\frac{1}{2}$" long. Twelve lines of variable data are imprinted on the IATA ticket. SST, like its Di/An counterparts in theaters and sports arenas, also can print a color design on the ticket face in any one of eight shades. Di/An Controls joined efforts with Moore Business Forms, Inc. in developing the $8\frac{1}{2}$ by $3\frac{1}{4}$ inch fan-fold ticket for machine processing.
(For more information, designate #66 on the Reader Service Card.)

RESEARCH FRONTIER

Cover Story

ALMOST A MILLION COMPONENTS PER SQUARE INCH USING NEW BELL TECHNIQUES

Bell Labs of Murray Hill, N.J., research and development unit of the Bell System, is developing integrated circuits for use in new switching systems and other telephone equipment. The techniques involved in the design and fabrication of these circuits were developed by B. T. Murphy and V. J. Glinski of Bell Labs. These new techniques can provide circuit arrays containing up to 100,000 bipolar-transistor logic gates per square inch of silicon — close to



— Two bipolar-transistor logic gates, shown magnified, are part of a Bell Labs high density circuit array

a million transistors and resistors per square inch (a density of five to ten times greater than is obtainable with conventional manufacturing methods).

Taking advantage of the fact that these circuits can be operated at two volts or less, the Bell Labs scientists fabricated the new circuits with very thin epitaxial layers, approximately one micron (about 40 millionths of an inch thick). The thin epitaxial layers allow a reduction in space between elements. By using narrower "stripe" widths and spacings (2 to 3 microns) the BTL scientists also reduced the size of elements themselves. The thin layers point the way to new approaches to isolation which may facilitate simpler processing and even higher packing densities.

In all structures that have been investigated thus far, the thin epitaxial layers result in transistors with higher inverse gain. In new circuits, this characteristic can be used for improving switching speed, reducing power dissipation, and improving noise margins. The new techniques are applicable to computer logic circuits and memory arrays.

MEETING NEWS

QUEEN ELIZABETH II IS PATRON OF IFIP CONGRESS '68

The Congress is the most important single event in the international calendar of the information sciences. It is held in a different country every three years. This will be the first occasion it has been held in the U.K. Patron of the IFIP Congress 68 is Queen Elizabeth II.

The inaugural speech of the IFIP Congress 68 will be given by Earl Mountbatten of Burma on Monday morning, August 5th, and the closing speech will be delivered by Sir Paul Chambers on Saturday morning, August 10th.

During the intervening five days more than 250 papers on computers, computing, and the information sciences will be given to an audience expected to number 4,000 delegates drawn from more than 40 countries.

ACM 1968 NATIONAL CONFERENCE AND EXPOSITION TO BE HELD IN LAS VEGAS

Members of the ACM and people in the data processing industry from all over the world are expected to attend the Association for Computing Machinery 1968 National Conference and Exposition to be held in Las Vegas, Nevada, from August 27 through August 29.

One of the significant highlights stressing the worldwide growth of the computer industry will be the "International Computer Discussion Panel" to be held on Tuesday evening. Dr. Walter Bauer, president of Informatics Inc. and moderator for the panel, said that eight panelists, four from the United States and one each from Japan, France, Great Britain and Russia will participate in the discussion.

Adding to the international flavor will be a special program of three selected technical papers from the IFIP Congress '68. Chairman of this session is Francois Genuys of IBM, France, and IFIP '68 program chairman. Authors from Denmark, Japan and Australia have accepted invitations to present their papers in Las Vegas.

A special feature of the conference will be a Computer Music and Art Festival. A special selection of computer-generated art work and computer-composed music will be open to the public at the Frontier Hotel. These works will be selected from the International Computer Music and Art Festival being held in Edinburgh, Scotland, this summer.

STANDARDS NEWS

NEW INSTRUMENT SYMBOLS & IDENTIFICATION STANDARD ISSUED BY THE INSTRUMENT SOCIETY OF AMERICA

The Instrument Society of America (ISA) has announced availability of its new 56-page S5.1 Standard on Instrumentation Symbols and Identification, replacing its 18-year-old Recommended Practice, RP5.1. The revised standard evolved from three years of extensive research and surveys among advisors and reviewers, including a formal 212-man international Board of Review.

Purpose of S5.1 is to establish a uniform means of designating instruments and instrumentation systems used for measurement and control, utilizing a designation system that includes symbols and an identification code. While the new standard applies specifically to industrial process instruments, it is flexible enough to meet many needs of specialized fields.

The new standard will be proposed as a USA Standard and will be presented to the International Organization for Standardization as the basis for an international standard on instrument symbols.

Price of the S5.1 Standard is $3.25 for ISA members; $4.75 for non-members. Send orders (including check, money order or company purchase order) to: Publications Department, Instrument Society of America, 530 William Penn Place, Pittsburgh, Pa. 15219.

NEW CONTRACTS

TO	FROM	FOR	AMOUNT
Sperry Rand Corporation, Univac Division, Philadelphia, Pa.	Air Canada, Toronto, Canada	Two UNIVAC 1108 Multiprocessor Computer Systems for use in a new reservations complex, known as RESERVEC II; full operation of system planned for spring of 1971	$10 million
Aerojet-General Corporation, Electronics Division, Azusa, Calif.	U.S. Army Frankford Arsenal, Philadelphia, Pa.	Production of 10 Forward Looking Infrared (FLIR) target acquisition, and fire and armament control systems for UH-1 Iroquois helicopters	$8,684,900
Cubic Corporation, San Diego, Calif.	U.S. Air Force, Aeronautical systems Div., Wright-Patterson AFB, Ohio	Classified contract to design, develop and produce a data transmission system	over $4 million
Computing and Software, Inc., Panorama City, Calif.	National Aeronautics and Space Administration	One year contract extension for its data processing services at the Goddard Space Flight Center in Greenbelt, Md.	$2.7 million
Scientific Data Systems, Santa Monica, Calif.	Tymshare, Inc., Los Altos, Calif.	Two additional SDS 940 computers which are scheduled for major metropolitan areas where Tymshare will establish new facilities	$2.4 million
ITT Federal Electric Corp.	U.S. Air Force, Oklahoma City Air Material Area	Implementing a communications control switching and display system at the Western Test Range including downrange sites on Wheeler AFB, Hawaii and on Eniwetok, auxiliary Air Force station in the Marshall Islands	$2 million
Stewart-Warner Electronics, Chicago, Ill.	Bunker-Ramo Corporation	Incremental agreement for purchase of electronic "Teletrade" stock and commodity ticker display systems, increasing size of original contract to over $17,000,000	$2 million
Sanders Associates, Inc., Nashua, N.H.	National Aeronautics and Space Administration	Maintenance of high speed electronic display systems developed and produced by the company to monitor, analyze and control vast amounts of data during computerized pre-launch checkouts of Saturn V launch vehicles	$1.7 million
Automation Industries, Inc., Ann Arbor, Mich.	U.S. Navy	Production of seven degaussing range systems and associated repair parts and services	$1,625,119
Litton Industries, Advance Data Systems, Beverly Hills, Calif.	Delaware River Port Authority	Computerized fare collection system for the Speed Line, which links downtown Philadelphia and suburban southern New Jersey; the 12-station, 14-mile-long commuter line is scheduled to open Feb. 1, 1969	$1.4 million
Ampex Corporation, Redwood City, Calif.	Anelex Corporation, Boston, Mass.	Model TM-7 digital magnetic tape transports; Anelex utilizes TM-7s in digital data print-out systems which it produces for computer manufacturers and end users	$1.2 million
Planning Research Corp., Los Angeles, Calif.	Rome Air Development Center, Rome, N.Y.	Continuing development and implementation of a data handling system at Aeronautical Chart and Information Center, St. Louis, Mo.	$1,045,000
DASA Corporation, Andover, Mass.	Western Electric Company	MAGICALL Automatic Telephone Dialers to be supplied over twelve months to Western Electric for distribution to the operating companies of the Bell System	over $1 million
Planning Research Corp., Los Angeles, Calif.	NAVSPASYSACT (Navy Space Systems Activity), El Segundo, Calif.	Performing work involving advanced concept formulation, technical feasibility studies and programming planning for both NAVSPASYSACT and the Astronautics Division of the Naval Air Systems Command (Washington, D.C.)	$908,000
Astrodata, Inc., Anaheim, Calif.	Raytheon Co., Missile Systems Div., Bedford, Mass.	A hybrid computing system comprising a Ci-5000 Analog Computer with a special hybrid software package, and an Intracom which will be integrated with Raytheon's CDC 6600 Digital Computer; the system will be used for missile system development studies	about $750,000
The Bunker-Ramo Corporation, Defense Systems Division, Canoga Park, Calif.	Air Force Systems Command, Electronic Systems Division	A tactical message and traffic analysis study	$736,000
Radio Corporation of America, New York, N.Y.	McDonnell-Douglas Corporation	32 data display units for use during development checkout and launch on U.S. Air Force programs	$521,000
Hewlett-Packard Co., Palo Alto, Calif.	Time Share Corporation, Hanover, N.H.	Five HP 2000A time-sharing computer systems which will be installed by the firm in the Northeast to serve clients in education, engineering and business	over $500,000
The Smithsonian Institution, Washington, D.C.	U.S. Office of Education	Three-year national pilot project to put fossils, flowers and fish on-line to a computer; a Honeywell Model 1200 will catalog more than 50 million specimens kept in the Institution's Museum of Natural History	$500,000
Honeywell Computer Control Division, Framingham, Mass.	National Aeronautics and Space Administration	Two Honeywell Series 32 computers for NASA's Electronics Research Center, Cambridge, Mass. for use in computer research studies	about $500,000

NEW INSTALLATIONS

OF	AT	FOR
Burroughs B300 system	Golden Dawn Foods, Inc., Sharon, Pa.	Billing, inventory control, payroll; also weekly perishable reports and profit and loss reports for independent supermarkets served by firm (system valued at $350,000)
Burroughs B340 system	Spring Branch Bank, Houston, Texas	Automating bank's proof and transit, demand deposit, savings and installment loan operations (system valued at over $180,000)
Burroughs B2500 system	Santa Ana College, Santa Ana, Calif.	Administrative and instructional purposes (system valued at over $415,000)
Burroughs B5500 system	Ebasco Services Inc., Analytical and Information Processing Services Dept., New York, N.Y.	Engineering applications (pipe stress analysis, power plant heat balance, etc.) and management applications including general accounting tasks
Control Data 6400 system	Hebrew University, Jerusalem, Israel	Teaching, administrative planning, and wide variety of scientific research applications
Control Data 6600 system	Lawrence Radiation Laboratory, Livermore, Calif.	Research and development programs in significant fields of interest to the Atomic Energy Commission (AEC); this makes the sixth computer of its scale in use at the laboratory
Honeywell Model 120 system	Worthington Foods, Inc., Worthington, Ohio	Management reports, a variety of accounting jobs, and inventory control
Honeywell Model 200 system	Advest Company, Hartford, Conn.	All billing and accounting involved in the sale and exchange of securities in all 20 of the firm's offices throughout New England and New York
Honeywell Model 1200 system	Albuquerque Public Schools, Albuquerque, N.M.	Accounting, payrolls, scheduling, grade reporting, library processing and test scoring for 80,000 students
IBM System/360 Model 30	Florida Department of Public Safety, Tallahassee, Fla.	The nucleus of an intrastate network known as the Florida Law Enforcement Communication System (FLECS)
IBM System/360 Model 40	Metropolitan Government of Nashville and Davidson County, Nashville, Tenn.	Comprehensive municipal data processing operations including motor vehicle registration, water-sewer customer listings, billings, etc.; also tied into the National Crime Information Center
IBM System/360 Model 44	Optical Research Associates, Pasadena, Calif.	Performing complex mathematical computations necessary in the exacting design of precision optical lenses for military and commercial use
IBM System/360 Model 65	Iowa State University, Ames, Iowa	Instruction, research. Student body has "virtually unlimited access to the computer". Also assists Iowa farm business community with management analysis reports, machinery depreciation studies, beef improvement program
IBM 1130 computer system	American Optical Co., Space-Defense Division, Pittsburgh, Pa.	Assisting engineers in designing complex lenses and other optical systems
RCA Spectra 70/35 system	Mississippi Valley Gas Co., Meridan, Miss.	First step in changing to computer record-keeping and, ultimately to a complete Management Information System
RCA Spectra 70/45 system	City Public Service Board, San Antonio, Texas	Linkage with a mass random access memory unit and video data terminals to form one of the most advanced public utility data processing systems
SDS 940 system	Data Central, Inc., St. Louis, Mo.	Use in firm's time sharing service center (system valued at $1.1 million)
SDS Sigma 2 and Sigma 5	Rutgers University	Studies in nuclear structure physics (system valued at $500,000)
SDS Sigma 5 system	Optek, Inc., Costa Mesa, Calif.	Handling the optical system manufacturer's entire data processing requirements
SDS Sigma 7 system	Woods Hole Oceanographic Institution, Woods Hole, Mass.	Research problems involving some of the yet unsolved mysteries of the sea; also for usual scheduling, bookkeeping and other business data processing jobs
UNIVAC 418 system	Netherlands Postal and Telecommunications Services (PTT), The Hague, Holland	Detecting unlicensed television and radio receivers; processing license payments; operating collection system for telephone billing, payroll, etc.
UNIVAC 1108 system	Computel Systems Ltd., Ottawa, Ontario, Canada	Processing scientific and statistical data for many departments of the Canadian Federal Government as well as industrial concerns (system valued at $2.5 million)
	The Fiat Company, Turin, Italy	Administrative applications, scientific work, advanced technical research and market planning (system valued at $2.7 million)
	University of Rome, Italy	Serving the needs of some 65,000 students; also will be available on a time-sharing basis to a number of scientific, research and educational organizations within the Rome metropolitan area (system valued at over $1.8 million)
UNIVAC 9200 system	York County Earned Income Tax Bureau, York, Pa.	Issuing tax notices and processing returns from about 200,000 taxpayers
	Norristown Area School District, Norristown, Pa.	Handling student account functions, school population census, report cards, payroll, school budgets
UNIVAC 9300 system	State of Idaho, Department of Employment, Boise, Idaho	Computing unemployment insurance benefits; also employer tax processing and accounting functions, employment and unemployment research and analysis applications, and business management functions

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 column to the right)
- E - figures estimated by "Computers and Automation"
- ? - information not received at press time

AS OF JUNE 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 UNFILLED 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	295		X	
Minneapolis, Minn.	G-20	$15,500	4/61	20		X	
	LGP-21	$725	12/62	165		X	
	LGP-30	$1300	9/56	322		X	
	RPC-4000	$1875	1/61	75		X	
	636/136/046 Series	?	-	29		C	
	160*/8090 Series	$2100-$12,000	5/60	610		X	
	924/924A	$11,000	8/61	29		X	
	1604/A/B	$45,000	1/60	59		X	
	1700	$3500	5/66	100		C	
	3100/3200/3300	$10,000-$16,250	5/64	261		C	
	3400/3600/3800	$18,000-$48,750	6/63	79		C	
	6400/6500/6600	$52,000-$117,000	8/64	63		C	
	6800	$130,000	6/67	0	(as of	C	
	7600	$150,000	12/68	0	2107 12/30/67)	C	360 E
Digital Electronics Inc. (R)	DIGIAC 3080	$19,500 (S)	12/64	11		1	
Plainview, N.Y.	DIGIAC 3080C	$25,000 (S)	10/67	1	12	1	2
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	1300		C	
	PDP-8/S	$300	9/66	700		C	
	PDP-9	$1000	12/66	85		C	
	PDP-10	$7500	12/67	6		C	
	LINC-8	?	9/66	105	2611 E	C	450 E
Electronic Assoc., Inc. (R)	640	$1200	4/67	36		16	
Long Branch, N.J.	8400	$12,000	7/65	21	57	4	20
EMR Computer Div. (R)	ASI 210	$3850	4/62	10		X	
Minneapolis, Minn.	ASI 2100	$4200	12/63	7		X	
	ADVANCE 6020	$4400	4/65	21		C	
	ADVANCE 6040	$5600	7/65	9		C	
	ADVANCE 6050	$9000	2/66	13		C	
	ADVANCE 6070	$15,000	10/66	5		C	
	ADVANCE 6130	$1550	8/67	10	75	C	27 E
General Electric (N)	115	$1370-$5000	12/65	620 E		600 E	
Phoenix, Ariz.	130	$1500-$10,000	-	0		C	
	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	130 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	380 E		70 E	
	420	$18,000-$28,000	7/67	C		C	
	425	$6000-$20,000	6/64	130 E		C	
	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	1800 E	C	900 E
Hewlett-Packard (R)	2116A	$600	11/66	96		C	
Palo Alto, Calif.	2115A	$412	11/67	79	167	C	32 E
Honeywell (R)	DDP-24	$2500	5/63	93		X	
Computer Control Div.	DDP-116	$900	4/65	200		30	
Framingham, Mass.	DDP-124	$2050	3/66	64		30	
	DDP-224	$3300	3/65	52		8	

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 UNFILLED ORDERS
Honeywell, Computer Control	DDP-516	$700	9/66	155		150	
Div. (cont'd)	H632	$2700	-	0	564	?	218
Honeywell (R)	H-110	$2500	8/68	0		C	
EDP Division	H-120	$3900	1/66	650		240	
Wellesley Hills, Mass.	H-125	$3900	12/67	20		75	
	H-200	$8400	3/64	1130		87	
	H-400	$8500	12/61	120		X	
	H-800	$28,000	12/60	89		X	
	H-1200	$9500	2/66	175		130	
	H-1250	$9500	7/68	0		20	
	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	2200 E	5	650 E
IBM (N)	305	$3600	12/57	C		X	
White Plains, N.Y.	360/20	$3000	12/65	7200 E		5000 E	
	360/25	$5330	1/68	C		1000 E	
	360/30	$9340	5/65	6600 E		3000 E	
	360/40	$19,550	4/65	3200 E		1500 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	
	360/85	$158,000	-	0		C	
	360/90 Series	-	10/67	C		C	
	650	$4800	11/54	C		X	
	1130	$1545	2/66	3400 E		4500 E	
	1401	$6480	9/60	7000 E		X	
	1401-G	$2300	5/64	1600 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	39,600 E	C	16,000 E
Interdata (R)	Model 2	$200-$300	-	0		3	
Oceanport, N.J.	Model 3	$300-$500	3/67	52		110	
	Model 4	$400-$800	-	0	52	5	105
National Cash Register Co. (R)	NCR-304	$14,000	1/60	24		X	
Dayton, Ohio	NCR-310	$2500	5/61	10		X	
	NCR-315	$8500	5/62	650		150	
	NCR-315-RMC	$12,000	9/65	80		50	
	NCR-390	$1850	5/61	660		6	
	NCR-500	$1500	10/65	1860		580	
	NCR-Century-100	$2645	-	-		C	
	NCR-Century-200	$7500	-	-	3284	C	1050 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
Potter Instrument Co., Inc. Plainview, N.Y.	PC-9600	$12,000 (S)	-	-	-	-	-
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	190		120	
	Spectra 70/25	$6500	9/65	102		57	
	Spectra 70/35	$10,400	1/67	60		135	
	Spectra 70/45	$22,000	11/65	110		85	
	Spectra 70/46	$34,400	-	0		C	
	Spectra 70/55	$34,300	11/66	7	1270 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	25	247	47	47
Scientific Control Corp. (R)	650	$500	5/66	27		3	
Dallas, Tex.	655	$1800	10/66	22		46	
	660	$2000	10/65	4		0	
	670	$2600	5/66	1		0	
	6700	$30,000	10/67	0	54	1	50
Scientific Data Syst., Inc. (N)	SDS-92	$1500	4/65	120 E		10 E	
Santa Monica, Calif.	SDS-910	$2000	8/62	225 E		25 E	
	SDS-920	$2900	9/62	200 E		20	
	SDS-925	$3000	12/64	C		C	
	SDS-930	$3400	6/64	235 E		30	
	SDS-940	$10,000	4/66	C		C	
	SDS-9300	$7000	11/64	C		C	
	Sigma 2	$1000	12/66	80 E		160	
	Sigma 5	$6000	8/67	C		50	
	Sigma 7	$12,000	12/66	C	1000 E	C	330 E

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 UNFILLED ORDERS
Standard Computer Corp. (B)	IC 4000	$9000	7/68	0		2 E	
Los Angeles, Calif.	IC 6000	$10,000-$22,000	5/67	7	7	12 E	14 E
Systems Engineering Labs (R)	SEL 810	$1000	9/65	24		X	
Ft. Lauderdale, Fla.	SEL 810A	$900	8/66	65		30	
	SEL 810B	?	-	0		9	
	SEL 840	$1400	11/65	4		X	
	SEL 840A	$1400	8/66	35		28	
	SEL 840 MP	?	1/68	5	133	6	73
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	77		X	
	File Computers	$15,000	8/56	13		X	
	Solid-State 80 I, II, 90, I, II & Step	$8000	8/58	210		X	
	418	$11,000	6/63	135		20	
	490 Series	$35,000	12/61	190		35	
	1004	$1900	2/63	3100		20	
	1005	$2400	4/66	1090		90	
	1050	$8000	9/63	280		10	
	1100 Series (except 1107 & 1108)	$35,000	12/50	9		X	
	1107	$55,000	10/62	33		X	
	1108	$65,000	9/65	105		75	
	9200	$1500	6/67	170		850	
	9300	$3400	7/67	85		550	
	9400	$7000	5/69	0		60	
	LARC	$135,000	5/60	2	5522 E	X	1710 E
Varian Data Machines (R)	620	$900	11/65	75		0	
Newport Beach, Calif.	620i	$500	6/67	140	215	410	410
		I. U.S. Manufacturers, TOTAL		——	62,800 E		23,300 E
II. Non-United States Manufacturers							
A/S Regnecentralen (R)	GIER	$2300-$7500	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	12	12	37	37
English Electric Computers Ltd. (R)	LEO I	-	-/53	3		X	
London, England	LEO II	-	6/57	11		X	
	LEO III	$9600-$24,000	4/62	39		X	
	LEO 360	$9600-$28,800	2/65	8		X	
	LEO 326	$14,400-$36,000	5/65	11		X	
	DEUCE	-	4/55	32		X	
	KDF 6	-	12/63	17		X	
	KDF 8-10	-	9/61	12		X	
	KDF 9	$9600-$36,000	4/63	28		X	
	KDN 2	-	4/63	8		X	
	KDF 7	$1920-$12,000	5/66	8		X	
	SYSTEM 4-30	$3600-$14,400	10/67	3		C	
	SYSTEM 4-40	$7200-$24,000	5/69	-		C	
	SYSTEM 4-50	$8400-$28,800	5/67	9		C	
	SYSTEM 4-70	$9600-$36,000	1/68	2		C	
	SYSTEM 4-75	$9600-$40,800	9/68	-		C	
	ELLIOTT 903	$640-$1570	1/66	52		C	
	ELLIOTT 4120	$1600-$4400	10/65	82		C	
	ELLIOTT 4130	$2200-$9000	6/66	23	348	C	110
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	1		0	
	S-5	-		0		C	
	S-7	-		0		C	
	GEC-TRW130	-	12/64	2		X	
	GEC-TRW330	-	3/63	7	20	X	3
International Computers and Tabulators Ltd. (R)	1901 to 1909	$4000-$27,000	12/64-12/66	708		372	
London, England	1200/1/2	-	-/55	62		3	
	1300/1/2	$3500	-/62	195		18	
	1300	$5200	7/62	114		5	
	1100/1	-	-/60	22		1	
	2400	-	12/61	4		0	
	Atlas 1 & 2	$70,000	-/62	5		1	
	Orion 1 & 2	$40,000	1/63	17		0	
	Sirius	-	-/61	22		0	
	Mercury	-	-/57	19		0	
	Pegasus 1 & 2	-	-/56	33	1201	0	400
The Marconi Co., Ltd.	Myriad I	£36,000-£66,000	3/66	26		19	
Chelmsford, Essex, England	Myriad II	£22,000-£42,500	10/67	3	29	9	28
N.V. Philips' Computer Industrie Apeldoorn, Netherlands	P1000	?	6/68	0	0	5 E	5 E
Saab Aktiebolag (R)	DATASAAB D21	$5000-$14,000	12/62	31		3	
Linkoping, Sweden	DATASAAB D22	$8000-$60,000	5/68	1	32	9	12
Siemens Aktiengesellschaft	2002	54,000 (Deutsche	6/59	42		-	
Munich, Germany	3003	52,000 Marks)	12/63	33		-	
	4004/15	19,000 "	10/65	57		25	
	4004/25	32,000 "	1/66	27		6	
	4004/35	46,000 "	2/67	43		55	
	4004/45	75,000 "	7/66	40		47	
	4004/55	103,000 "	12/66	3		3	
	301	2000 "	-	-		5	
	302	4000 "	9/67	7		10	
	303	10,000 "	4/65	64		10	
	304	12,000 "	-	-		26	
	305	14,000 "	11/67	12	328	24	205
USSR	Various models	-	-	C	2500 E	C	700 E
		II. Non-U.S. Manufacturers, TOTAL		——	4400 E		1500 E
		Combined, TOTAL		——	67,200 E		24,800 E

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.

April 2, 1968

3,376,554 / Alan Kotok, Belmont, and Chester G. Bell, Concord, Mass. / Digital Equipment Corporation, Maynard, Mass. / Digital computing system.

3,376,555 / Bently A. Crane, Parsippany, and John A. Githens, Morris Township, Morris County, N.J. / Bell Telephone Laboratories, Inc., New York, N.Y., a corporation of New York / Two-dimensional associative memory system.

3,376,556 / Leo J. Hasbrouck, Poughkeepsie, N.Y., Charles Richard Holleran, Saratoga, Calif., Lewis E. King, Highland, N.Y., and William P. Wissick, Sunnyvale, Calif. / International Business Machines Corporation, Armonk, N.Y., a corporation of New York / Storage reference priority in a data processing system.

3,376,563 / Vincent J. Korkowski, Minneapolis, Minn. / Sperry Rand Corporation, New York, N.Y., a corporation of Delaware / Discrimination, logic and memory devices employing a transfluxor core.

April 9, 1968

3,377,619 / Elliott R. Marsh, Endicott, and Albert A. Magdall and Francis R. Rausch, Vestal, N.Y. / International Business Machines Corporation, New York, N.Y., a corporation of New York / Data multiplexing system.

3,377,620 / John C. Sims, Jr., Sudbury, Mass., / by mesne assignments, to Mohawk Data Science Corp., East Herkimer, N.Y., a corporation of New York / Variable word length internally programmed information processing system.

3,377,621 / Lorenz A. Hittel and Homer W. Miller, Phoenix, Ariz. / General Electric Co., a corporation of New York / Electronic data processing system with time sharing of memory.

3,377,624 / Robert A. Nelson, Yorktown Heights, Ira T. Ellis, Jr., Ossining, and Lois M. Haibt, Katonah, N.Y. / International Business Machines Corporation, Armonk, N.Y., a corporation of New York / Memory protection system.

April 16, 1968

3,378,674 / Jacob Marinus Unk, The Hague, and Oscar Augustus Guinau, Haarlem, Netherlands / North American Philips Co., Inc., New York, N.Y., a corporation of Delaware / Information storage system.

3,378,776 / Jacob Goldberg, Palo Alto, and Robert A. Short, Redwood City, Calif. / Stanford Research Institute, Menlo Park, Calif., a corporation of California / Data shifting logic system with data and control signals advancing through the system in opposite directions.

3,378,818 / Hans Helmut Adelaar, Ekeren, Jean Louis Masure, Wilrijk, and Pe Tsi Chu, Antwerp, Belgium / International Standard Electric Corporation, New York, N.Y., a corporation of Delaware / Data processing system.

3,378,819 / Jacques Georges Lucien Hannicq, Bagnolet, and Maurice Guillaume Jean Burel, Courbevoie, France, / Societe Industrielle Bull-General Electric (Societe Anonyme), Paris, France / Data processing system with indirect addressing.

3,378,820 / Donald L. Smith, Stow, Mass., / Digital Equipment Corporation, Maynard, Mass. / Data communication system.

3,378,821 / Hans-Otto G. Leilich, Poughkeepsie, N. Y. / International Business Machines Corporation, New York, N. Y., a corporation of New York / Magnetic thin film memory apparatus with elongated aperture.

3,378,822 / Bruce A. Kaufman, Los Angeles, and Eduardo T. Ulzurrun, Hollywood, Calif. / The National Cash Register Co., Dayton, Ohio, a corporation of Maryland / Magnetic thin film memory having bipolar digit currents.

3,378,824 / Henri J. Oguey, Oberrieden, Switzerland / International Business Machines Corp., New York, N. Y., a corporation of New York / Nondestructive readout memory employing biaxial anisotropy.

3,378,827 / Friedrich Rudolph Hertrich, San Jose, Calif. / International Business Machines Corporation, Armonk, N. Y., a corporation of New York / Direct access data storage.

April 23, 1968

3,380,034 / Vaclav Cerny, Prague, Czechoslovakia / Vyzkumny ustav matematickych stroju, Prague, Czechoslovakia / Addressing system for computer memories.

3,380,035 / Klaus J. Hecker, Riverside, Calif. / United States of America as represented by the Secretary of the Navy / Multiple element analog storage system.

3,380,039 / George G. Pick, Waltham, Mass. / Sylvania Electric Products Inc., a corporation of Delaware / Read only magnetic memory matrix.

April 30, 1968

3,381,275 / Ilan Israely, Los Angeles, Calif. / Clary Corporation, San Gabriel, Calif., a corporation of California / Digital information transferring system.

3,381,277 / Anthony G. Stansby, Ontario, Canada / Northern Electric Company, Ltd., Montreal, Quebec, Canada / System for selective readout of an information store.

3,381,278 / Jack Knoll, Plainview, N. Y., and Kuei-yin Hsu, Stamford, Conn. / Teleregister Corporation, Stamford, Conn. / Data holding system.

3,381,279 / Arndt B. Bergh, Palo Alto, and Charles W. Near, Sunnyvale, Calif. / Hewlett-Packard Company, Palo Alto, Calif., a corporation of Calif. / Read only memory.

3,381,280 / Fred B. Hagedorn, Berkeley Heights, N. J. / Bell Telephone Laboratories, Inc., New York, N. Y., a corporation of New York / Superconductive memory.

3,381,283 / Ernst M. Gyorgy, Morris Plains, and Fred B. Hagedorn, Berkeley Heights, N. J. / Bell Telephone Laboratories, Inc., New York, N. Y., a corporation of New York / Open flux memory with sensing plane.

3,381,284 / Ray L. Riley, Los Angeles, Calif. / Hughes Aircraft Company, Culver City, Calif., a corporation of Delaware / Digital memory timing system.

May 7, 1968

3,382,482 / Robert B. Greenly, Binghamton, N. Y. / by mesne assignments, to Character Recognition Corporation, Binghamton, N. Y., a corporation of Delaware / Character recognition system.

3,382,492 / George R. Santana, Saratoga, Calif. / International Business Machines Corporation, Armonk, N. Y., a corporation of New York / Magnetic data recording formatting.

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.

Project CAUML

CAUML (Computers and Automation's Universal Mailing List) is a mailing list of all people interested in the field of computers and data processing. This list is:

- Operated by Computers and Automation as a service on a nonprofit basis;
- Automatically available to anyone (at a reasonable mailing list rental) who wishes to mail information bearing some reasonable relation to the interests of persons in the computer field;
- Supervised by a volunteer advisory committee of computer people;
- Subject to the provision that net income (audited) is to be contributed to improving education in the computer field.

Won't you help by sending us the names and addresses of computer people?

---------------(may be copied on any piece of paper)---------------

( ) Please include me in CAUML:

Name________________________________

Address________________________________

( ) Here are some more names and addresses for CAUML:

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(attach more paper if needed)

To: CAUML Editor, Computers and Automation
815 Washington St., Newtonville, Mass. 02160