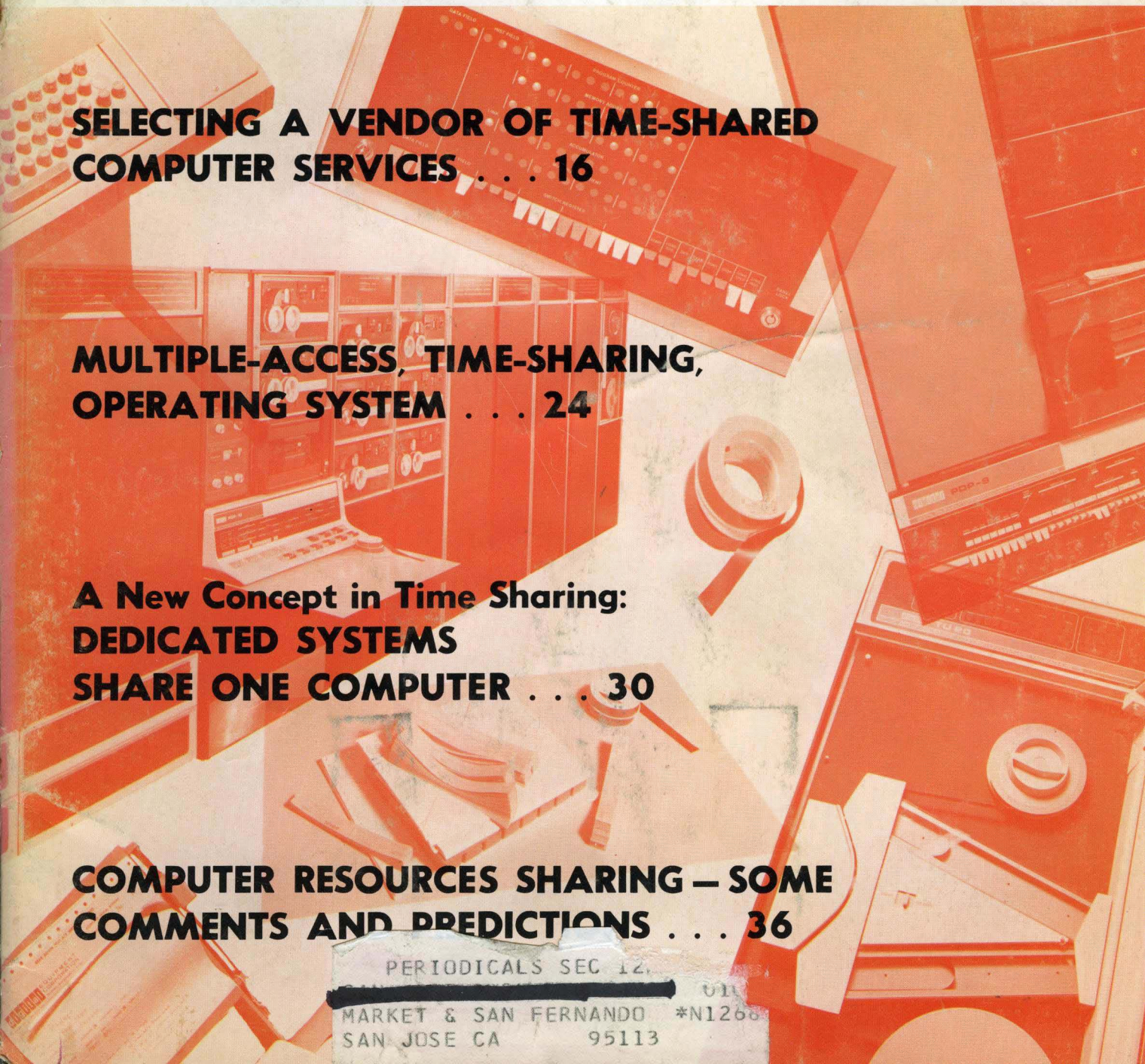
October, 1968

computers and automation

Special Feature: Time Sharing



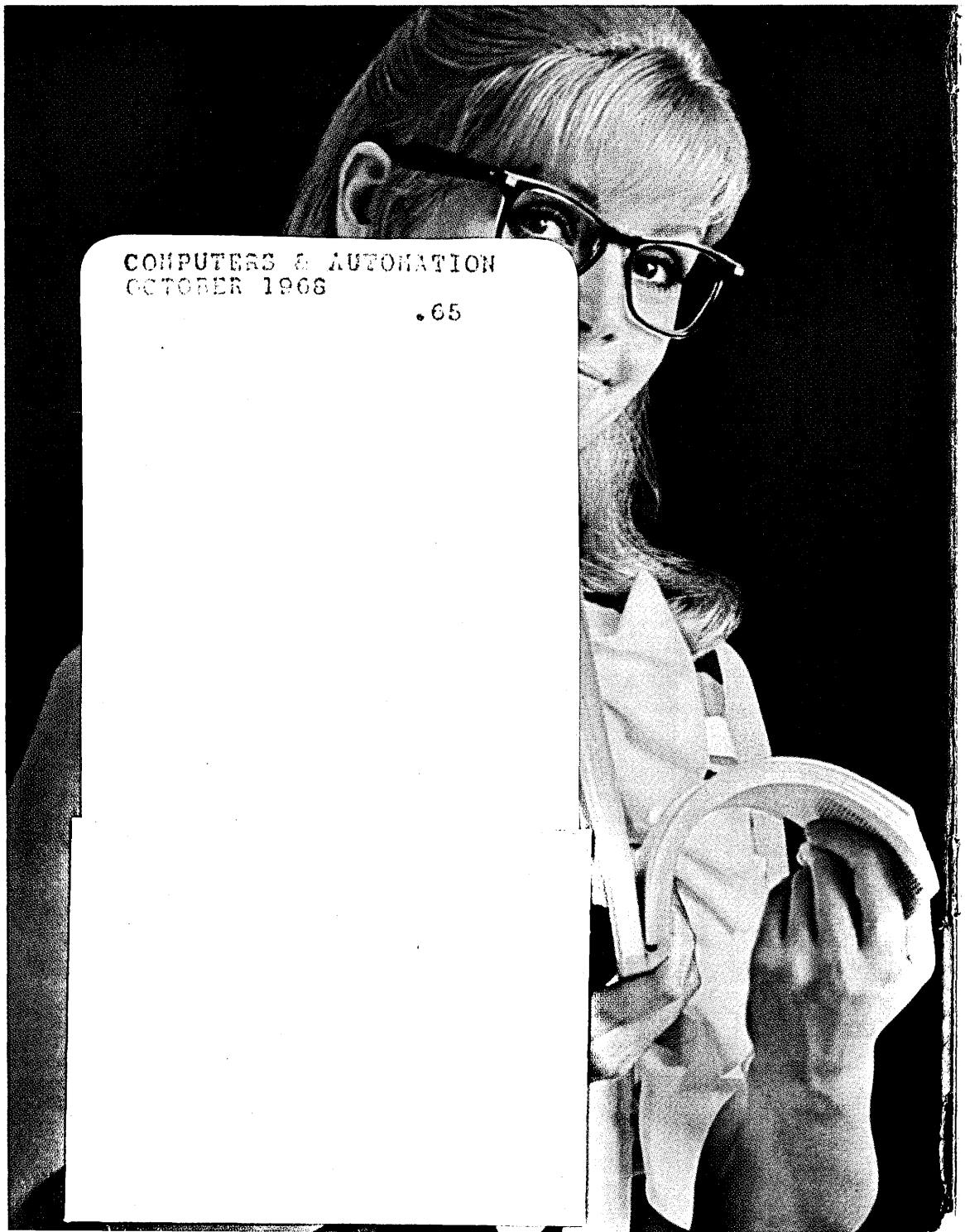
Susie Meyer meets PL/I

The story of how a single language answers the question, "Can a young girl with no previous programming experience find happiness handling both commercial and scientific applications, without resorting to an assembler language?" Let's face it. The cost of programming just keeps going up. So for some time to come, how well you do your job depends on how programmers like Susie Meyer do theirs.

That's the reason for PL/I, the high-level language for both scientific and commercial applications.

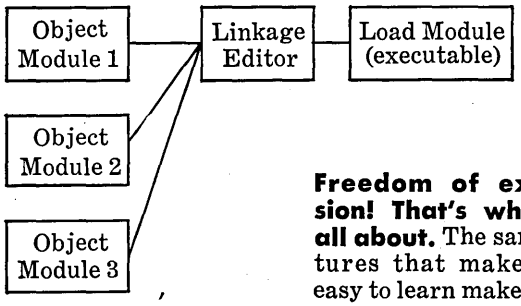
With PL/I, programmers don't have to learn other high-level languages. They can concentrate more on the job, less on the language.

So think about PL/I. Not just in terms of training, but in terms of the total impact it can have on your operation.



Take it a step at a time. Programmers don't have to learn all of PL/I to use it. Take New York Life Insurance Company for example. First programmer trainees get a good grounding in computer basics. Then a combination of PL/I self-study courses and workshops readies them to code meaningful and useful programs.

As the new programmers gain skill and experience they use other parts of the language on tougher problems. Most importantly, they learn while doing.



Freedom of expression! That's what it's all about. The same features that make PL/I easy to learn make it easy to use. First of all, programming time can be shortened by using a single high-level language. In most cases, assembler languages aren't even needed anymore.

There's also a feature that simplifies coding for inexperienced programmers. It automatically makes a choice among alternatives. The language itself provides a new ease of writing. It's neither cryptic nor verbose. The result is a new freedom of expression – freedom from arbitrary language restrictions—freedom to concentrate on application development.

A bright future for Susie. PL/I has growth built in. As your system grows, PL/I will grow right along with it.

Continued growth of PL/I means a brighter future for your programmers. It also means continued use of your programs and equipment—with a minimum impact on your investment.

It's time to get involved.

We'd like to get you more involved with PL/I. As a first step, send this coupon for more information.

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Letters To The Editor

Computer Training Schools

I am writing with reference to your March issue, with special reference to the "Test for Evaluating Computer Training Schools" on page 25. As past President of the New Hampshire Personnel and Guidance Association, I was constantly faced with the problem of giving advice with respect to the quality of our computer training schools. The test on page 25 would be particularly useful in assisting some of our guidance counselors to make an evaluation.

Is there any objection to my making copies of this "Test" for distribution to the Executive Board of the New Hampshire Personnel and Guidance Association? In addition, I would certainly like to have a copy of your March publication for my reference shelf.

VAN A. HARTMAN
Dean of Student Personnel
Plymouth State College
Plymouth, New Hampshire 03264

In your March issue there appeared several excellent articles on EDP education. Our city has been subjected at various times to poor quality high-priced private schools. Although none of these schools has survived for any great length of time, they do manage to take a lot of hard-earned money with them when they move to the next city.

With your permission, I would like to publish all or part of page 25 of your March issue — "A Test for Evaluating Computer Training Schools" — in our local newspaper.

JOHN CUSHING
Director of Data Processing
Sudbury, Ontario, Canada

(Ed. Note — *We were glad to give Mr. Hartman and Mr. Cushing permission to reprint page 25 of the March issue as they requested — with our standard reprint clause inserted in an appropriate place.*)

Social Issues and Science

I am a student of the social effects of automation and technology, and I want to express my admiration for the courageous involvement of past issues of your magazine in important social issues involving science. The "technology of oppression", as described by Herbert Marcuse in *One-Dimensional Man* (Beacon, 1964), is increasingly becoming of great concern, especially to scientists who understand it and help create it. I recommend the above book to you and your readers.

RICHARD OCHS
Washington, D.C. 20005

Right Answers

Slightly over a year ago you sent me a copy of "Right Answers — A Short Guide for Obtaining Them". In the introduction, this one-sheet summary is identified as a summary that is to be expanded into a forthcoming book.

What is the status of that book?

If it has been published, where may I order a copy and at what cost?

JAMES L. GILDERSLEEVE
Senior Systems Engineer
General Electric Co.
Phoenix, Ariz. 85029

(Ed. Note — *The book of which "Right Answers — A Short Guide for Obtaining Them" is a part has as the tentative title,* General Science and Problem Solving, or Common Sense, Elementary and Advanced. *John Wiley and Sons will publish the book, which I hope will be done about a year from now. If you would like to order a copy when it comes out, please tell me, and I will put your name on the list to be notified of its publication and price.*)

Computer Art

Your August, 1968 copy (featuring your 6th Annual Computer Art Contest) was fascinating. I am a math teacher in Arlington County. We have introduced the time shared GE BASIC System into our present math sequence. I have just finished developing supplementary materials for our existing courses. We in Arlington are convinced that the computer will add much to the curriculum, particularly in terms of a new, stimulating approach to the existing courses.

In connection with this, I am sure the students will enjoy seeing the entries in your art contest.

G. P. O'SHAUGHNESSY
Washington Lee High School
Arlington, Va. 22201

computers and automation

Vol. 17, No. 10 — October, 1968

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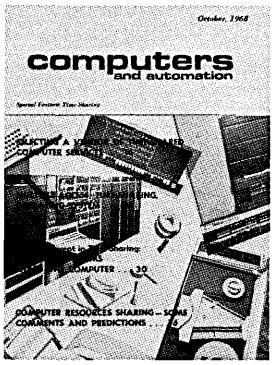
computers and automation

October, 1968, Vol. 17, No. 10 *The magazine of the design, applications, and implications of information processing systems.*

Special Feature: Time Sharing



Regular Features

Editorial

C&A Worldwide

Fifteen Years Ago in Computers and Automation

Jobs and Careers in Data Processing

Multi-Access Forum

Departments

EDITORIAL

Remote Batch Processing and Other Good New Ideas in the Computer Field

In one of the articles of this issue ("Selecting a Vendor of Time-Shared Computer Services" by A. G. Hammersmith) a fairly new term appears a number of times. It denotes a relatively new subdivision of computer activity: "remote batch processing." With a high speed communication line between the data station and the central processor, and high-speed input and output, the remote processing of data in batches can often make good sense.

This new idea will become a source of millions of dollars of income for a number of energetic, enterprising people in the computer field. And this idea — along with a number of other new ideas in the computer field — raises some interesting general questions:

- What is a significant idea?
- How do you tell the difference between good ideas and poor ones?
- Where do relatively unnoticed, good ideas in the computer field come from?

There is little doubt that the application of good new ideas in the computer field, bursting as it is with expansion in many directions, will help many people become millionaires, as well as help many organizations make major contributions to the advancement of society.

As explained in an earlier editorial[1], the word idea here means particularly:

> a hypothesis, a concept, an estimate, or a guess which leads to, or may lead to, useful and fruitful results.

For example, the following idea does not exist yet, but I can see no theoretical barriers to its future existence:

> a complete and very powerful central processor unit no larger than a football which (1) will be "plugged in" to a console, (2) will be made of large-scale-integrated (LSI) circuits, and (3) will cost when new no more than about $2000.

I think such a central processor unit will exist before 1978 and will be marketed before 1980.

An idea which was avidly pursued by a number of computer people for many years in the 1950's was the idea of

> automatic translation by programmed computer from one foreign language to another.

This idea encountered shoals and has almost been wrecked on rocks, because nearly all the investigators tried to develop the idea without paying attention to a major variable: meaning in context. This is the kind of meaning which produces change in the grammatical function of the words in the following, almost-parallel, three sentences:

> Time flies like an arrow: *Noun, verb, prepositional phrase.*
> Fruit flies like a banana: *Adjective, noun, verb, object of a verb.*
> Notice flies like a dragon-fly: *Imperative verb, noun, prepositional phrase.*

It is worth distinguishing between ideas that we can call *thousand-horsepower ideas* and *flypower ideas.*[2] In mathematics, for example, the thousand-horsepower ideas apply widely in human affairs; they give answers to many problems; they provide ways for understanding many situations and processes; they express models that you can carry around in your mind and that give power to understand many events and processes in the real world. Examples of thousand-horsepower mathematical ideas include: next along a line; variable; formula; graph; etc.

Then there are mathematical ideas that are essentially frills and trifles, and as far as we can see they will always remain frills and trifles. These ideas apply only narrowly; they give answers to only a few problems; they are models for understanding only a few situations; they do not give many clues to the behavior of the real world. An example of a flypower idea is this: if you take the number 142,857 and add it to itself, you will get the same digits in the same order but starting at a different digit, 285,714. This is an example of what is called *cyclic order.* The preservation of cyclic order when adding one number to another is unusual, amusing, puzzling — and one can find more examples; but when all is said and done, the idea of cyclic order of digits preserved when numbers are added does not apply widely, does not give answers to many problems, does not give power to understand many parts of the real world. It is a flypower idea.

In the computer field, what is called *residue arithmetic,* it seems to me, is a flypower idea. I do not see any possibility that this idea will become widely useful or important in computer circuits. On the other hand, the idea *computer-assisted* (as in such phrases as "computer-assisted instruction, computer-assisted explanation, computer-assisted documentation, computer-assisted translation") is certainly a thousand-horsepower idea. The idea emphasizes something most desirable, the close interaction of computer and human being where each contributes its forte to the solution of baffling problems.

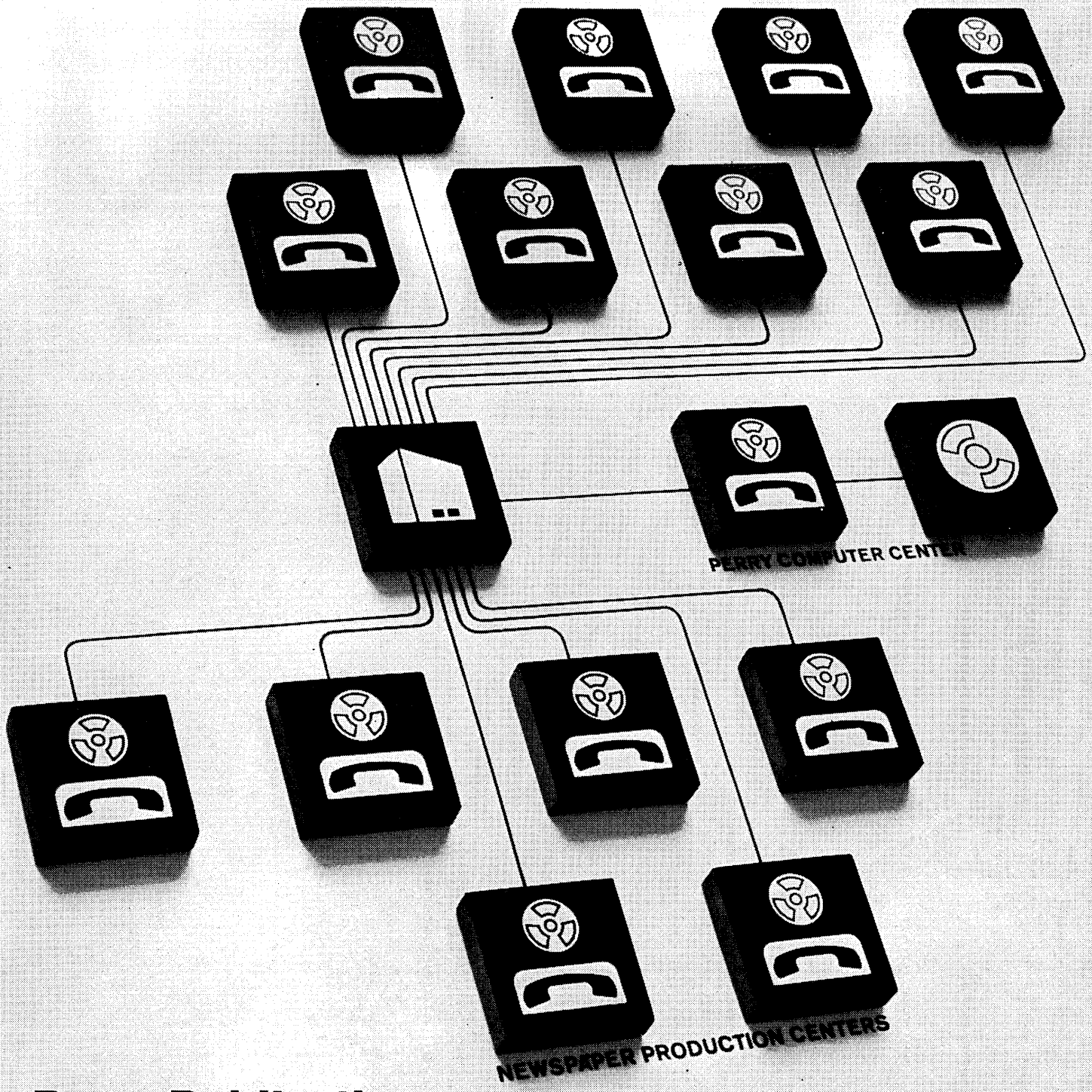
Where do relatively unnoticed, good ideas in the computer field come from?

Many good ideas result from new combinations of previous ideas. "Remote batch processing" results from a combination of "batch processing" plus "remoteness".

The idea of "scientific kit" plus the idea of "computer circuits" has led to a number of projects in the computer field, whereby a scientific educational kit with the content of computing and computer circuits has been designed, produced, and marketed.

The combination of "learner-controlled instruction" (see the article by Nate A. Newkirk, "Innovation in Teaching — Why Industry Leads the Way", in this issue) with "computer-assisted" produces "computer-assisted learner-controlled instruction". I think this idea will produce millions of dollars

(Please turn to page 43)



Perry Publications is making headlines with this system

The system was designed so Perry's 26 daily Florida newpapers could use one computer center in West Palm Beach.

Every day the Perry papers send their display advertising and editorial matter to the center to be prepared for typesetting machines.

Since speed is essential, Perry set up 14 transmitting-receiving centers where newspaper copy is put on paper tape. The tapes are sent via Type 2 Dataspeed*Service (at 1050 words per minute) to West Palm Beach.

At the center, tapes are read into the computers at 1000 characters per second, using photoelectric readers. The computers have a 50,000 word dictionary programmed into them, so that copy can be prepared in newspaper column widths and words hyphenated, where necessary.

The output of the computer is a new tape which is returned by Dataspeed service and fed directly into typesetting machines.

If moving information in a hurry will help you make more efficient use of your computer installation, talk with our Communications Consultant. He'll help you plan a system to beat any deadline.

Dataspeed Service
Bell System Central Office
Computer

AT&T and Associated Companies

*Service mark of the Bell System

C.a

MULTI-ACCESS FORUM

WHAT ARE THE CHALLENGES FACING THE COMPUTER INDUSTRY?

(Based on an address by J. Stanford Smith, Vice Pres. and Group Executive, Information Systems Group, General Electric Co., at the DPMA 1968 International Data Processing Conference, Washington, D.C., June 1968.)

Data processing managers today are operating about $20 billion worth of computer systems around the world. In the United States alone, about 40,000 computers worth almost $13 billion are being operated. What challenges must be solved to move the electronic information systems from their period of youthful promise to the condition of productive maturity?

The following are the most important challenges facing the industry, according to the testimony of users themselves:

1. There is a need for better understanding between data processing management and operating management.

Operating management feels that data processing managers, for all their competence, either don't understand or don't concentrate on the needs of the business. And of course, the data processing managers complain about the fuzzy and even misleading inputs they get from operating managers. Until this gap is closed, users feel that the information systems field will be clouded by disappointment on all sides.

What can be done to close this gap? Let me suggest three answers:

First, insist on involvement by line operating management in information systems development. We observe that the companies which are most successful in using computers regularly use operating people on computer development projects, either as members of a project team, or as short-term members of the data processing organization.

Second, in your exploration of new projects for management approval, concentrate on what is important to the business. The key test for a project is not computer feasibility, but relevance to the business. The key question: what is its potential impact on company profits?

Third, become involved personally in the total business process.

At the present time, only a handful of the people who reach top management posts have come up through data processing. I think this will change. Electronic information systems will live up to their enormous potential as generations of data processing managers think, feel and act as overall business managers. Men who train themselves in this direction may well set the pattern for future executive management.

2. There is a need to find the most productive ways to use the new time-sharing capabilities.

Three years ago, no more than 500 terminals were on-line to time-sharing computers. Today, General Electric alone serves more than 50,000 time-sharing customers, and the field is one of the most rapidly growing businesses in the world. Such rapid growth indicates that time-sharing systems are serving a keenly felt need for users large and small. But what is their place in your total information systems picture?

Objective cost studies may lead you to the use of time-sharing services as supplements to your in-house batch-processing systems, for peak loads or special services. And, as you may know, computer systems are now available which can handle batch, remote-batch, and time-sharing efficiently, all within the same system. This gives you a number of realistic alternatives to consider in planning your installations.

Users report that on-line computer services, which usually offer a variety of program packages, can help relieve the shortage of programmers. And above all, the simple time-sharing terminal serves as an exciting introduction for management to the discipline and power of data processing.

3. The rush of technological advance must be brought into better balance with the real needs of users.

Information systems technology is growing so very rapidly, it is almost impossible to keep the various phases in balance with each other. Generally speaking, the technology of the central processor has been running ahead much faster than the technology of input-output and storage devices. And software has been running behind hardware.

There are two fundamental thrusts in the information systems field; the thrust toward wider and more profitable *applications,* and the thrust toward better *price-to-performance ratios* which come from advancing technology. All too often these two fundamental thrusts are in direct conflict.

The user can help relieve this conflict and imbalance by accepting the value of standards in programming and perhaps by investing more at the outset in preparing his applications in a well-documented fashion. Then his basic structure can be more easily translated to new equipment, and can even be advanced to a higher order of integration.

The manufacturer can help by providing a planned, evolutionary path forward that maintains the past user investment without putting the user into a strait-jacket that prevents the expansion of applications. He can also concentrate valuable talent on developing higher level languages and generalized data management systems.

4. There is a demand for greater speed in the standardization of systems and software.

Realistic standards can cut out wasteful re-invention of wheels. Important work is being accomplished in the areas of programming languages and magnetic tape standards. We now have in COBOL an efficient and accepted programming language for the business user. The ASCII (American Standard Code Information Interchange) is now a Federal Government standard as well as the U.S. standard for magnetic tapes; it is also consistent with the International Standard Code.

Standardization in these two areas will return tremendous benefits:

An altimeter is just one of hundreds of components on every U.S. Air Force plane. Each is a potential trouble spot. The Air Force has skilled mechanics to detect faulty parts on the ground, and it has given them access to a UNIVAC® real-time computer system to locate replacement parts from inventory in a matter of seconds. And, the parts can be delivered to the flight line in about twelve minutes.

The warehouse location, quantity on hand and cost of 65,000 parts is in the memory of a UNIVAC real-time computer system.

When the mechanic orders a replacement altimeter, the computer notifies issue clerks and indicates where it's stored. The computer checks its memory again. This time to see how many altimeters should be on hand. If inventory is now too low to meet expected demand, it initiates a re-order and updates accounting records for Base Level Supply Command.

Multiply that altimeter order by a few hundred an hour and you have a rough idea how much work the Air Force gets out of this UNIVAC inventory system. A total system with forecasting, control and cost-cutting functions built in.

There's a UNIVAC system at virtually every Air Force base. 166 systems to be more precise. All equipment and procedures are the same. Personnel have to be trained only once to use any of them.

UNIVAC computer systems are also being used by people in business, government and science. And you don't have to own an air force to have one working for you.

UNIVAC

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

SPERRY RAND

Designate No. 10 on Reader Service Card

According to the instruments this plane is at 32,000 feet.

Air Force mechanics can ask a computer system for a new altimeter. They can get it delivered in about twelve minutes.

It will protect your investment in programs, reduce conversion time and expense, make additional programmers available, and aid communication between equipment of different manufacturers.

I am not speaking of standards that prematurely freeze hardware technology or application packages in the present state of the art. This could stunt the growth of what obviously is still a very young technology. But both user and supplier would be able to make more progress through the development of language standards that go beyond the code standards on which the industry is currently working.

5. There is a most urgent need for a much broader scale application of our nation's education resources in preparing people to understand and productively participate in the information revolution.

It is estimated that there are 120,000 programmers in the U.S. today. But it is claimed that there is a need for 180,000 programmers, and that we'll need half a million by 1973. Regardless of the accuracy of these estimates, they indicate the dimensions of the challenge: to quadruple either the numbers or the effectiveness of the data processing manpower now available, and do it in the next five years!

There are some things that all of us can do to improve the *effectiveness* of the available people. Standardization, good documentation, higher-level languages, and good data management systems are all good powers of people.

Every maturing profession must develop people for technical support. The computer industry needs to develop a logical work structure that enables high school graduates, college graduates, and Ph.D.'s each to concentrate on the areas of work where they can make their greatest contribution.

There are at least six major ways that computers fit into the educational picture.

1. Computer-aided instruction appears to have great potential, although it is still largely in the research stage.
2. Computers can be more widely used for the administrative work of the educational establishment. This can help control the skyrocketing costs of education, and more effectively utilize our instruction resources.
3. Every college and university should be offering professional-level courses in the computer sciences.
4. Both high schools and colleges should be training people for careers in programming and systems analysis.
5. Every college student should have the opportunity to develop computer literacy; to read and write computer languages, and use the computer as comfortably as an older generation of engineers and figure manipulators used the slide rule. He will need this experience to fulfill his future career and contribute to the work of his generation.
6. A personal, hands-on acquaintance with a computer terminal should be part of the experience of every liberal arts student. Otherwise, he simply will not understand the greatest revolution of our times and the computerized society in which he will live.

The solution to the challenges facing the industry lie in having each man and woman associated with it look up from his daily tasks, and accept appropriate responsibility for the good of society.

Maturity for the Computer Age will arrive as each of us, individually, matures in his own commitment to the task.

CONVERTING STAFF TO A COMPUTER: TWO VIEWS

I. Based on a report by Elsbeth Ganguin in The Financial Times, London, England, for August 14, 1968.

After 121 years in business, the Woolwich Equitable Building Society is about to undergo a great change. It has got itself a computer. Within the next two years, the computer will take over all members' accounts: 350,000 share accounts, 20,000 deposit accounts, and 15,000 savings accounts.

Many of the Woolwich's 1300 employees will be affected by the computer, in one way or another. And though the computer will have to be served by perhaps 65 people once it is fully operative, in two years' time the company will have about 150 fewer employees than it would have had without the computer. But the company has pledged that no one will be fired.

From the start, the Woolwich took its staff into its confidence. Even before management consultants were called in, the general manager sent a note around stating what was afoot. This practice was continued when, a year later, the decision was made to install a computer, and again when the computer had been ordered.

Having been fully informed, the staff took the anticipated changes calmly. The first step was to appoint a data processing manager. He was a Woolwich man from the organization and methods department. In fact, only one senior man, the systems and programming manager, came from outside.

Next the Woolwich asked for volunteers for four jobs as systems analysts. About 20 volunteered. They were given aptitude tests. The four best candidates were picked and sent to several courses before their appointments as analysts were confirmed. They were then set the task of preparing the "systems" to be adopted by the computer once it arrived.

A few months later the Woolwich sent around another request for volunteers, this time for six programmers. About 35 employees volunteered. Again aptitude tests were given, and the six best candidates were sent to school. This process was repeated again for more programmers and computer operators.

In order to keep faith with its employees, the Woolwich decided on an introductory period for the computer of two years, since a natural wastage of 150 employees could be expected in that time.

But such natural wastage does not, of course, solve the whole problem; it just solves that of numbers. For the rest, there is the need for a re-deployment program. For example, the Woolwich now has some 30 senior control clerks, many of whom have been with the organization for over 30 years. They will be hit, because their jobs will vanish. So they have to be transferred to jobs which, in many cases, someone younger could do. This can be a delicate situation.

Then there are the girl specialists, like addressograph, accounting machine of comptometer operators. Their jobs will go, as will anyone's "ledger" occupation. But they will be needed until the computer is fully operative. To help bridge this uncomfortable gap, the Woolwich has hired some married women on a two-year engagement only.

So some problems remain. But complete frankness with the staff, the endeavor to fill the new computer vacancies from within, and, no doubt, the pledge to retain employees, seem to have guaranteed smooth running-in of the changes. Indeed, everyone has been invited to see computer films, in office hours, just to make sure that all loopholes are filled.

SOFTWARE PROFESSIONALS

WE'RE LOOKING FOR PEOPLE WITH PROBLEMS

We have plenty of solutions. What we need are problems...and people who are good at thinking them up.

We're lucky to have some of the most outstanding software people in the country out here in Sunnyvale, California. And we need the best. Because our assignment is the total information system segment of orbiting satellite systems. Includes planning, commanding, data management and post flight analysis. We not only design information systems to fill present needs, but anticipate and project information system segments of space systems that will most likely be needed in 1970 or '75.

It should come as no surprise to learn we have more operational software development and more operating on-orbit experience in complex spacecraft than anyone in America.

Now, since most people are trained as problem-solvers, the people we hire will be quite extraordinary. In a way, we're asking for trouble. That is, we're asking for people who habitually create more problems than they're worth...to most other companies.

What we'll do when we find them is make their problems worth more. With us, they'll be creating more worth than problems, even though they're still creating problems.

Get it?

If you do, you may have real problems. The kind we're looking for.

If you're one of the professionals with a degree in EE, Physics or Math and have 2-10 years applicable experience, see if you can create problems for us in any of the following areas:

MATH SPECIALISTS—COMPUTER APPLICATIONS Provide detail design, development, maintenance, modification and improvements for command and control, event and data evaluation computer programs for use on assigned satellite projects.

PROGRAMMERS Coordinate with systems engineers, ops analysis engineers, and users and/or the customer to determine basic requirements for computer program development and modification. Document, design, flow chart, code, check-out and validate computer programs.

ANALYSIS ENGINEERS—COMMAND AND CONTROL Provide technical coordination to assure compatibility of computer software programs and data base for operational vehicles and on-orbit operational support for the hardware/software interface areas. Background in analysis and operation of airborne systems and sub-systems with emphasis on digital command and telemetry systems. Knowledge of computers, associated software. An understanding of software logic and Jovial language required.

SPECIALISTS—VALIDATION AND TEST Establish test procedures, at the system, sub-system, and module level from preliminary and final design specifications of software programs. Conduct extensive validation tests to ensure compatibility with all developed programs.

Please send details of your educational background and experience, including salary requirements, to Mr.E.Cutter, General Electric Co., Space Systems, Room 40-K, 1003 West Maude Ave., Sunnyvale, California 94086.

Command & Information Systems Operation
SPACE SYSTEMS

GENERAL ELECTRIC

An equal opportunity employer (m/f).

II. Based on a reply to the above by Ronald Yearsley in The Financial Times, **London, England, for August 16, 1968.**

The report by Elsbeth Ganguin concerning the computer staffing policy of a leading building society, commendable as it was in solving its problems by extensive internal recruitment and training, could be a model of doubtful validity for other organizations.

The following case history reveals some of the weaknesses of internal recruitment. A particularly well-established engineering company decided after little thought to purchase a computer, which was ordered and scheduled for delivery in 18 months. The company decided to recruit its systems analysts internally, because the applications to be put on the computer were considered complex and it was thought external recruits would take too long to understand the company's routines and philosophy.

Hence, three senior clerical staff were appointed as systems analysts. They were sent on a computer manufacturer's course for three weeks, which gave an introduction to computing and programming. On their return, they began to design the new computer system. This system was based largely on the old routines of the company's punch card installation. The senior management of the company took no direct interest and gave little guidance to these men.

At that time there was little formal systems training available. Because of their lack of understanding of programming, these men had no chance to comprehend the potential of the proposed computer (and its limitations), and produced a "hodge-podge" of a system which would use the new computer merely as a fast printer repeating some of the sterile and redundant routines of the punch card installation.

It was later discovered that the computer selected had too small a configuration to cope with the system that had been designed. The computer configuration was increased, and its delivery delayed by 11 months. In that time some of the system was redesigned and senior staff recruited externally. The cost to the company of this experiment was a little over £50,000.

This is a tragic tale, for nowhere else in the organization would one expect to find a function of comparable importance carried out by people with so little training or experience. The reason for such practices providing an easy alternative to external recruitment is the rapid growth of computing in this country, which has out-stripped the supply of adequately trained people. The average user finds it difficult to staff his installation with a good mix of business and computing skills. The analyst, in particular, requires the qualities of a good detective, with curiosity, observation and logical power, coupled with a comprehension of the capabilities of the software of the computer at his disposal.

A computer installation is as good as the people who staff it, and good people are demanding inflated salary levels at the moment. But high salaries alone are not the answer. Employers must remember that the retention of staff is equally as important as recruitment. In order to achieve this, the installation needs to be well managed and needs to operate in an enlightened company where there is high-level support for the computer department.

The advantage internal recruitment does bring is to solve to some degree the problem, so apparent in mobile computer people, of staff turnover. This posture, however, does have the danger that the installation will be inbred, and easily satisfied with its performance in the absence of external yardsticks. The external recruit does bring new ideas and act as a catalyst of change.

Peering into the future may be rash, but in the short term we can see the heavy demand for trained staff continuing. Training programs undertaken by such firms as the Woolwich Equitable Building Society will help to some degree in solving the problems. But quality rather than quantity is crucial and is not easily attained if the proportion of experienced people in a given installation is low. There is little point in the recruitment externally of a few able technicians who will spend the bulk of their time teaching the uninitiated analysts and programmers recruited internally how to reinvent the wheel.

1969 IEEE COMPUTER GROUP CONFERENCE — CALL FOR PAPERS

Donald L. Epley
Technical Program Chairman
1969 IEEE Computer Group Conference
Dept. of Electrical Engineering
Univ. of Iowa
Iowa City, Iowa 52240

The 1969 IEEE Computer Group Conference will be held in Minneapolis, Minnesota, June 17-19, 1969. The purpose of this Conference is to report and explore recent, original developments in "Today's World of Real Time Systems."

Subjects of interest include real time systems for process control, message switching, inventory control, time sharing, command and control, and biomedical computing. Papers are invited describing new developments in software, languages, system organization and interface design including peripheral equipment, special purpose systems, system models and analysis, and hardware.

Potential participants are requested to submit for consideration by the Conference Program Committee a 50-word abstract suitable for publication in the *Computer Group News,* and a 1000-word illustrated digest suitable for publication in the Conference Digest. The phone number and complete mailing address of the senior author should be specified for possible later questions and revisions. Four copies of the abstract and digest should be submitted by January 10, 1969. Authors will be notified of the Program Committee's decision by March 1, 1969.

In addition, authors may submit complete papers for independent review and consideration for publication in a special issue of the *IEEE Transactions on Computers.*

All material should be sent to the address above.

INTERNATIONAL JOINT CONFERENCE ON ARTIFICIAL INTELLIGENCE — CALL FOR PAPERS

Dr. Donald E. Walker
Program Chairman (U.S.A.)
The MITRE Corp.
Bedford, Mass. 01730

The first International Joint Conference on Artificial Intelligence is scheduled for May 7-9, 1969, in Washington, D. C. The Conference was initiated by the Special Interest Group on Artificial Intelligence of the Association for Computing Machinery. Other co-sponsoring groups currently include: American Federation of Information Processing Societies, American Society for Cybernetics, Association for Computational Linguistics, British Computer Society and its AISB Group, Institute of Electrical and Electronics Engineers (Computer Group, Man-Machine Systems Group, System Sciences and Cybernetics Group), Pattern Recognition Society, Simulation Councils, Inc., Society of Instrument and Control Engineers of Japan. Additional organizations, both in the United States and abroad, are considering sponsorship.

Papers for the Conference are requested in the following areas:

- *theoretical foundations of artificial intelligence* (limitations of specific machines, mathematical models)
- *heuristic problem solving* (frameworks for learning, game-playing)
- *theorem proving*
- *pattern recognition* (feature extraction, learning techniques, patterns in 1, 2, 3 dimensions, related linguistic processes)
- *computer "understanding"* (question-answering systems, self-organizing systems)
- *linguistic research relevant to artificial intelligence*
- *integrated artificial intelligence systems* (robots, learning control systems)
- *hardware and software specifically relevant to artificial intelligence* (higher-level languages, sophisticated graphic and acoustic I/O devices)
- *man-machine symbiosis in problem-solving*
- *psychological and physiological modeling* (of aspects of intelligent behavior in biological systems, perception, neural networks)
- *applications of artificial intelligence work*

Manuscripts must be received by January 15, 1969. Specifications for their preparation can be obtained from the Program Chairman. Please submit manuscripts and address inquiries about the program to the address above.

WHO'S WHO IN THE COMPUTER FIELD, 1968-69 — ENTRIES

Who's Who in the Computer Field 1968-1969 (the Fifth Edition of our Who's Who), will be published by Computers and Automation during 1969. The Fourth Edition, 253 pages, with about 5000 capsule biographies was published in 1963. The Third Edition, 199 pages, was published in 1957.

In the Fifth Edition we hope to include upwards of 10,000 capsule biographies including as many persons as possible who have distinguished themselves in the field of computers and data processing.

If you wish to be considered for inclusion in the Who's Who, please complete the following form or provide us with the equivalent information. (If you have already sent us a form some time during the past eight months, it is not necessary to send us another one unless there is a change in information.)

WHO'S WHO ENTRY FORM
(may be copied on any piece of paper)

1. Name? (Please print)_____
2. Home Address (with Zip)?_____
3. Organization?_____
4. Its Address (with Zip)?_____
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. Do you have access to a computer? ( )Yes ( )No
    a. If yes, what kind of computer?
    Manufacturer_____
    Model_____
    b. Where is it installed:
    Manufacturer?_____
    Address?_____
    c. Is your access: Batch? ( ) Time-shared? ( )
    Other? ( ) Please explain:_____
    d. Any remarks?_____
    _____
13. Associates or friends who should be sent Who's Who entry forms?

Name and Address

_____
_____
_____
_____
(attach paper if needed)

When completed, please send to:

Who's Who Editor, Computers and Automation,
815 Washington St., Newtonville, Mass. 02160

C.a

NUMBLES

Number Puzzles for Nimble Minds — and Computers

Neil Macdonald
Assistant Editor

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

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

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

Numble 6810:

```
        S P E E C H  was given to man to
      X     H I D E
        P E D E I P S
    O E H E D A P
  O M C E H S I
P S T E D P E
= P C E H S G A A C S,        G U M = D O G
+ H P A T E H C H A D T
= H I S T H O U G H T S

and perhaps   75327  84901  37107   96
```

CALIFORNIA COMPUTER PRODUCTS SPONSORS ART COMPETITION

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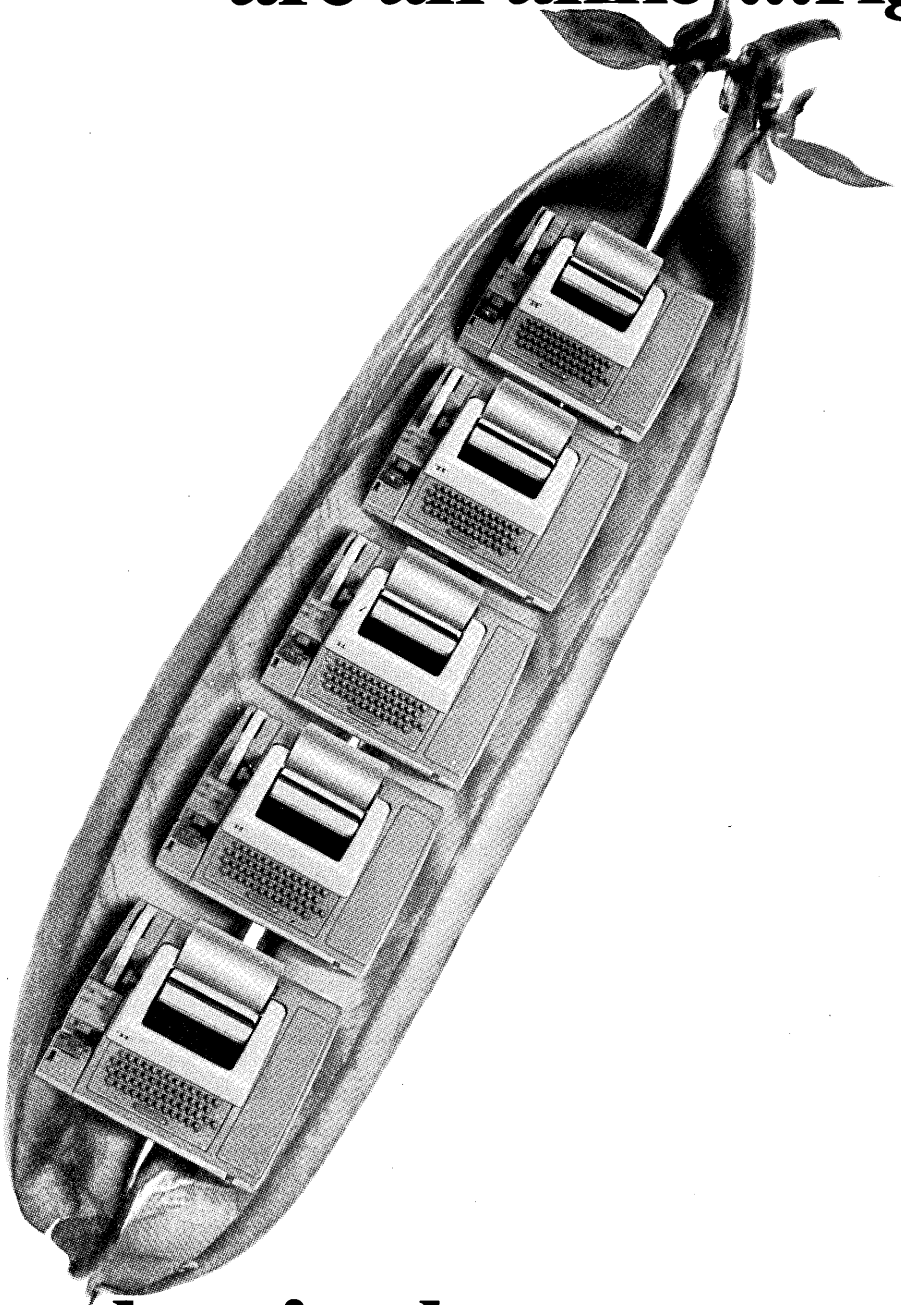
California Computer Products Inc. is sponsoring an international computer-plotter art competition, offering scholarships of $5000, $3000 and $2000 to accredited colleges or universities selected by the first three winners, plus cash awards of $500, $300 and $200, with additional awards of $50 each to 50 runners-up.

Deadline for entries is November 1, 1968. Requests for additional information and contest entries should be sent to the address above or any CalComp branch office.

Computer time-sharing services are all alike...right?



wrong...here's why

Your time-sharing service should have certain features. Most services have some of them. Graphic Controls has them all! For example: ☐ Programming classes, application seminars, plus Technical Consultants in all disciplines, to help you get full benefit from the service ☐ 24 hour computer service ☐ Advanced communication techniques for local dial-up service ☐ Around the clock programming assistance ☐ Your choice of several completely conversational programming languages including the latest, BASIC+ ☐ The best hardware available . . . always . . . because we're not limited by computer manufacturer affiliation. For the full story on why we're different and why it's important to you, write or phone Ken Draeger, Marketing Manager. Area Code 716-853-7500.

COMPUTER SYSTEMS DIVISION
GRAPHIC CONTROLS CORPORATION
189 VAN RENSSELAER STREET, BUFFALO, NEW YORK 14210

Designate No. 21 on Reader Service Card

SELECTING A VENDOR OF TIME-SHARED COMPUTER SERVICES

Alan G. Hammersmith, President
Time-Sharing Enterprises, Inc.
251 DeKalb Pike
King of Prussia, Pa. 19406

"Time-sharing systems cannot be compared directly on the basis of cost. Some systems may appear, from reading pricing schedules of vendors, to be much more expensive than other systems. This may not *be true."*

Selecting a vendor of time-shared computer services is becoming increasingly difficult because of the many vendors and types of services available today. Many of these vendors are using the same computer with "special features", lower cost, better response, better customer service, etc. For new users the question becomes, "which service should I select for my particular use and applications among all of the various services being offered?" For experienced users the question becomes, "am I using the right system for my particular kind of applications?"

Section I of this article deals with some general information relative to time-sharing and the systems available. Section II is directed toward the non-user and how he should go about selecting a vendor. Section III is for the user already using time-sharing. Section III points out the various changes that have occurred recently and provides some food for thought in evaluating whether or not you are using the right system. Section IV gives some conclusions and comments about the industry in general.

Many companies are using time-sharing for a variety of reasons and applications. This article does *not* contain all of the answers; it merely attempts to point out some of the items to consider when evaluating and selecting a vendor.

Mr. Hammersmith is president of Time-Sharing Enterprises, Inc., a consulting firm specializing in Time-Sharing/Remote Access Systems with publications covering the various aspects of this industry. He was formerly associated with Com-Share, Inc. (as a senior sales engineer), and with General Electric Co. He received a B.A. in mathematics at the Univ. of Calif., and pursued engineering studies at the Univ. of Sydney, Sydney, Australia.

I. TIME-SHARING/REMOTE BATCH: GENERAL COMMENTS

It is currently estimated that there are over 5,000 companies using time-sharing services. For an industry that is less than four years old this represents a rapid growth. There seems to be no "typical user" of time-sharing. Some companies with one or two employees are making heavy and effective use of the service. Some very large companies with their own in-house systems are also heavy users of time-sharing. However, it is generally agreed that once a company tries and uses time-sharing it is likely to be a continual user.

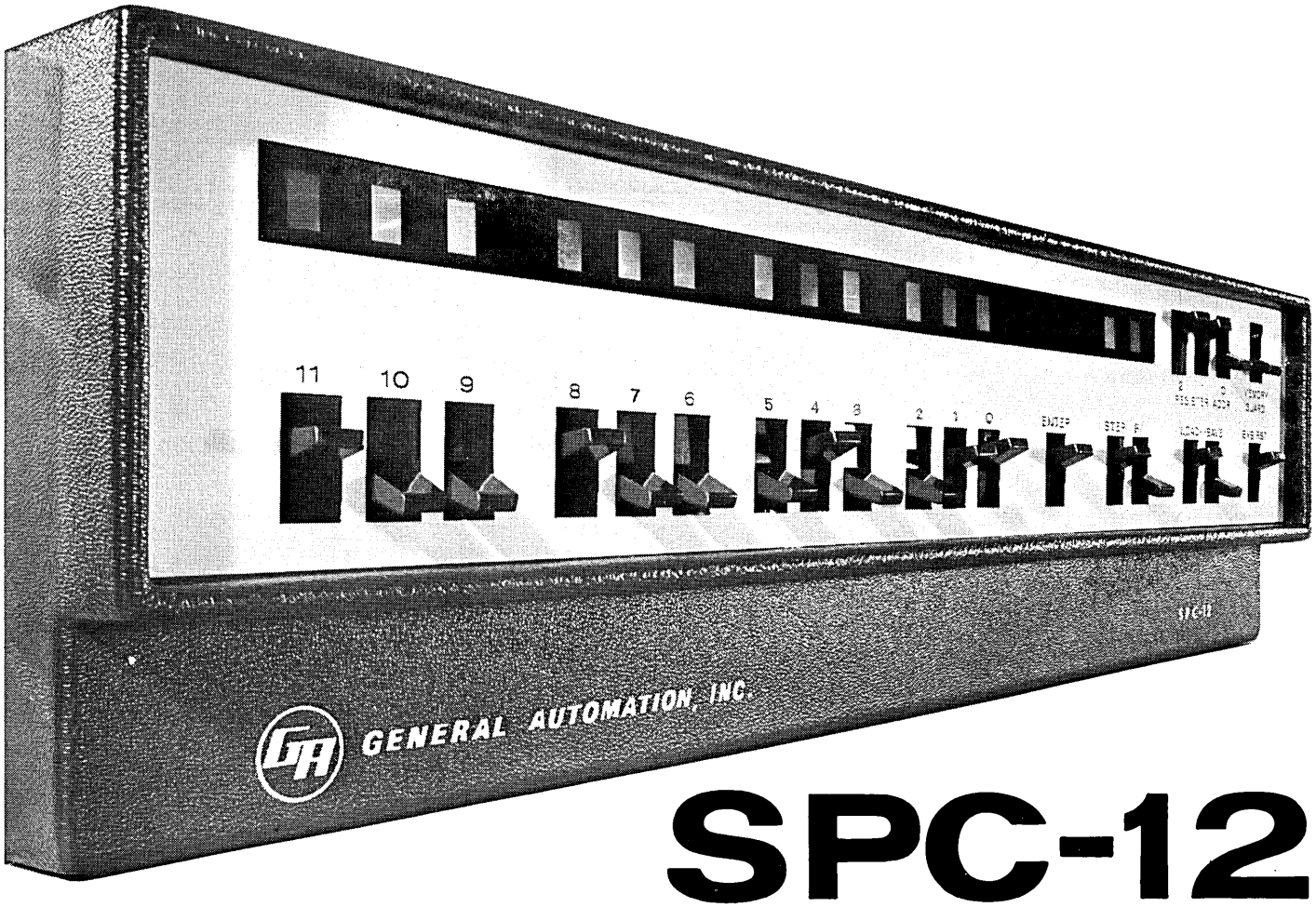
The General Electric Company is undoubtedly the largest supplier of time-sharing services in the United States. IBM ranks second. Com-Share, Inc., ranks third, relative to the number of users. Many new vendors have appeared in the market place recently. New companies are being formed every week to provide similar services. Many large corporations are getting ready to form large nationwide time-sharing and/or remote batch networks. Although many changes have occurred in the past three to four years, the next three to four years should create many new and drastic changes within the industry.

The Market Changes

Up until a short time ago the market was a vendor's market. With the addition of all the new services made available, it is now definitely a users' market. This means that users of these services are provided a wider choice of systems and capabilities for much less cost. Costs are expected to drop still further because of the highly competitive nature of this new industry.

Some of the most significant developments that have occurred within the last year or so include:

- The entry of many new vendors.
- The addition of many different types of services and capabilities with larger and faster core and storage facilities.
- The portable teletype, which is a vast addition in flexibility.
- Remote batch systems, with high-speed lines and large core.



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That's just half the story. Most computers require expensive engineering and black boxes to work in a control system. Not the SPC-12. It comes with economical functional modules which adapt the SPC-12 easily to instrumentation, computer peripherals, keyboards and displays, sensors and communication networks. With these functional modules and its power, the SPC-12 achieves a new cost/performance ratio and makes computer control practical in your system today. Programming aids and application software of course. Call or write for more information about the SPC-12—the new automation computer.

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Designate No. 11 on Reader Service Card

The future for the time-sharing industry should be exceptionally interesting. We should see an increase in the number of vendors and capabilities in the market place. There should also be an increased use of in-house systems, thus changing the role of the D.P. Manager. Large data bases with company proprietary information will be placed on these in-house systems. The D.P. Manager will then be in a position to provide this service plus some basic computing power; engineers and programmers will still continue to use outside services for their sophisticated problems and applications. High speed input/output devices will also greatly change the industry.

Time-Sharing

A time-sharing system can best be described in the following example: If a user has a program to run which requires two minutes of central processor time, the time-sharing or time-slicing system will allocate small portions of the processor to run the job. After each time-slice or "shot" at the processor the program will get swapped out of core to a drum or disc. Some systems allow the program or portions of the program to remain in unused portions of core. The amount of processor time allocated for each "shot" varies anywhere from a fraction of a second to one (sometimes more) second(s).

Let us assume that the user is on a computer system that allows one full second of central processor time per slice. The user in order to run his two minute program would, therefore, get 60 x 2 or 120 shots at the processor.

A time-sharing system therefore allows the user a high degree of interactiveness with the computer. Interactiveness can occur at any time while the user is connected with the system. Files and programs can readily be created and changed. Execution can be interrupted and restarted. Some systems allow sophisticated debugging techniques whereby a user can stop execution at various specified points in the program and examine the contents of counters and variables. These counters and variables can then be changed and execution continued from that point or any other point in the program. This debugging technique allows the programmer to make a step by step or block by block trace of his program. A remote batch system does not allow interactiveness during execution.

Remote Batch

Remote batch has probably been the most significant capability developed commercially within the last year. This capability will drastically alter both the time-sharing and batch-processing industries within the next couple of years. Many production jobs that are presently being run on time-sharing systems should be converted to remote batch systems. This conversion will save the user many dollars. Also, many in-house batch systems are greatly overloaded. Many of the batch jobs being run today should be placed on a remote batch system. Comparisons have shown that the cost of a remote batch processing run can be one-tenth the cost of a batch processing run. Use of an outside remote batch service would reduce the load of an in-house system for other development and uses. Data Processing managers should look carefully at this capability.

A remote batch system operates basically in one of two different ways.

(1) Uninterrupted run to completion. Under this type of system the same job as described above would enter the system and the processor would run that job until it was completed. The processor would not operate on any other jobs until that particular job was completed.

(2) Interrupted run to completion. Under this type of system the job would enter core and the system would allocate fixed or variable blocks of time for the job. In other words, there may be three jobs in core and the processor would run around processing the three jobs until one job was complete and then another job would enter the system.

Remote batch is becoming more and more popular. These systems are used mostly for large production runs where program interaction and fast response time is not necessary. Also, these systems usually have high speed lines available which allows high speed printing at the user's location.

Time-Sharing vs. Remote-Batch

Time-sharing and remote-batch systems cannot and should not be compared entirely on the basis of "apparent" costs. These two systems were designed to do basically different types of jobs. The person evaluating or investigating systems should first identify whether the system is time-sharing or remote-batch oriented. It is difficult enough to compare one time-sharing system with another, let alone compare a time-sharing and a remote batch system.

The following computer systems are generally considered to be time-sharing systems:

GE-255
GE-265
GE-420
GE-M605
GE-635 (as offered by GE's Information Systems Department)
SDS-940
IBM-360/50
IBM-7044 (Quicktran)

The following computer systems are generally considered to be remote-batch systems:

B-5500
GE-635 (as operated by GE's Missile & Space Division)
Philco-212
Univac 1108
IBM-360/50-65 (combination)

Confusion in Cost Comparisons

Time-sharing systems cannot be compared directly on the basis of cost. The various systems available contain a wide variety of capabilities. Some systems may appear, from reading pricing schedules of vendors, to be much more expensive than other systems. This may *not* be true. Some systems offer a wide range of capabilities and power. These systems are usually a little more expensive, but the additional capabilities may greatly facilitate designing and programming of certain types of applications and therefore reduce your total job cost. On the other hand, if a user does not require the special features and power of the more expensive systems, it obviously would not be wise for him to pay this extra cost.

The following is a list of the major reasons why it is dangerous to compare systems solely on a cost basis:

1. Response Times: Different systems provide different response times. While waiting for a response from the computer, you are paying for the programmer to sit idle at the terminal. You are also (usually) paying a connection cost. This response time can be very annoying to the programmer and his "terminal thumb-twiddling time" may cost you more than the vendor's connection charge. Many users and potential users fail to include this cost in their comparisons.

2. System Loading: As a new system gets more and more users, the connect time increases. Some systems are more sensitive to increased number of users as well as to the increase of sophisticated users which put more of a burden on the system. Certain vendors will load a system heavier than others. This "sluggishness" should be temporary until the vendor receives delivery of another machine.

3. CPU Charge for Swapping: Some vendors charge the users central processor time (CPU) to swap them in and out of core. This practice is more prevalent among those systems that do not have a high speed disc (or drum) on the system. The user is therefore paying more for the system overhead. The access time of a high speed disc (or drum) is usually in the area of 15 to 20 milliseconds, while a low speed disc has an access time of about 200 milliseconds. In some cases the user can be paying up to 5 or 6 seconds of CPU time for each second his program is actually using. As the system load increases more and more swaps are required, therefore costing the user more to run a program at one time than to run the same program at another time.

4. Telephone Line Charges: If two time-sharing vendors that you are evaluating are both in your local calling area, telephone line charges do not become a consideration. However, if you do have to make a long distance phone call to a computer, these charges can become excessive — especially if you have long response times. Again, do not forget that your cost for the programmer to sit idle may be the major cost factor.

5. Terminal Costs: Some vendors do not allow teletypes (Model 33 or 35) on their systems. These terminals are probably the cheapest general purpose terminals available today (i.e. the Model 33). The user should seriously look into the many portable terminals available. These units are very reliable and provide the user with additional flexibility. Some locations have had trouble with these portable units but this is more the exception than the rule.

II. THE NON-TIME-SHARING USER

The first question to answer is whether or not you should be using a time-sharing or remote-batch system. There is no easy set of rules to assist you in making this decision.

- If you suspect that time-sharing may have a place in your company, the most reasonable thing to do is try it for a while.
- If you have never used computers before, a time-sharing system should be tried.
- If you have a batch computer that is heavily loaded, you should try putting some of the production programs on a remote batch system.

If you have someone within your company that has used time-sharing or remote batch, his advice should be consulted. You can also call in an independent consultant who would be able to assist you in evaluating the necessity of using such a service. Assuming it is decided to try a remote system, the consultant could then provide you with valuable assistance in selecting the best vendor and system. If you feel a demonstration would be helpful, contact one of the vendors in your area.

What To Consider

1. Identify Services

Identify all the available services within your geographical area. This should include both time-sharing and remote-batch systems.

2. Consultants

If you are in an area where only one or two services are provided, your selection decision is relatively simple. If, on the other hand, you are in a major metropolitan area you might have ten or more services from which to select. In this case, it would be much cheaper for you to call in an independent consultant to assist you in the evaluation. The consultant must be familiar with all of the systems and not just a casual user.

The consulting firm should be able to:

a) Review your operation for potential applications.
b) Outline your specific requirements with you.
c) Present to you information on the available systems in your area including — vendors, hardware and software, description, languages, terminals and costs.
d) Select two or three vendors to be called in for discussion and/or demonstration.
e) Assist you in asking the vendor representative pertinent questions.
f) Assist in all vendor negotiations and expediting.

For example, in the New York City metropolitan area there are over ten vendors offering this kind of service. For you to evaluate all of them would take two to four weeks. A consulting firm should be able to accomplish all of this in one or two well-spent days, thus greatly reducing your evaluation and selection costs.

3. Time-Sharing — Remote Batch

Separate all the available computers (services) into time-sharing and remote batch. Decide which of these types of services you require. If you have elected not to use an independent consultant, call in a vendor representative from each type to assist you in your selection.

4. Vendors By Computer

The next step is then to select the computer that best suits your needs. List all the vendors that use that computer. Some systems are easy to use whereas other systems may be more complicated to use but offer greater capability. Determine whether you require simplicity or capability. Determining this will assist you in selecting the computer that will fill your needs. You are then left to selecting the best vendor who uses that computer.

5. Costs

Next, compare the relative costs of the various vendors. This comparison is admittedly not an easy task; but if you have narrowed your selection down to a particular computer, the task will be much easier. When talking to vendors, always ask if there are any "other" costs that you are likely to incur.

Rating Form

The Vendor Data Sheet provided in Chart 1 should be of assistance to you in evaluating vendors. Depending on your experience with computers, you can select the various items from Chart 2 (Summary of Additional Points to Consider) to add to the Data Sheet in Chart 1 to tailor your evaluation to your particular requirements.

What To Avoid

1. Benchmarks

Benchmark problems can be helpful in evaluating what a particular service will cost. We must however warn you to BEWARE of benchmarks, for they can be misleading. An experienced salesman can prove almost anything he wants to

Chart 1: Vendor Data Sheet

Vendor Name: _____
Vendor Address: _____
Vendor Contact: _____
Title: _____ Phone: _____
Computer(s): a. Time-Sharing _____
b. Remote Batch _____

Languages Program Size Features

_____
_____
_____

Terminals: _____
Number of lines into area: Now: _____ Planned: _____
Date: _____

Costs
Minimum per month: _____
One-time charge: _____
Connect charge: _____
Input/Output charge: _____
CPU charge: _____
Storage charge: _____
Phone charge: _____
Other charges: _____

Machine Hours
Monday through Friday: _____
Saturday: _____ Sunday: _____

Interactiveness (Excellent, Good, Fair, or Poor)
Modification of Data: _____
Modification of Program: _____
During Execution: _____

Other Information

---

with a benchmark. Do not tell one vendor what it cost or how long it took to run the same benchmark on another system until he has run your benchmark and given you the output. Turn-around-time and cost are sensitive to the number of people on a system at a given time. It is also critical as to what kind of users are on the system and what they are doing when your program was executed. Remote batch systems are much less sensitive to these variations.

2. Unique Features

Avoid any "unique features", particularly in the area of programming language features. Many vendors use these as strong selling points; however, if you use these "non-standard" capabilities you will be locked into that vendor for a long time. If at a later date you decide to change vendors, your programming conversion costs would be prohibitive and these time and cost saving "features" could eventually cost your company plenty. Many users today are in this exact position since they did not avoid the use of "unique features".

3. Library Packages

Avoid being oversold on a vendor's library and application packages. Many users have selected a vendor based on such packages only to find out that the packages were not general enough to solve their particular problem. Very few time-sharing users make use of the packages available. It is often easier to write your own package than figure out the documentation on an available package. Most vendors have an adequate supply of library routines and packages.

What to Expect from Your Time-Sharing Vendor

1. A Free Trial Period: Most vendors will allow you one to two weeks of free computer time while you are trying their system. You should ask for this free computer time. The amount of free time you will receive will be dependent upon the potential amount of usage by your company. Most vendors have available portable teletypes which they might loan you during this period. You will, however, be expected to pay any telephone charges that are incurred during this free trial period.

2. Training: The vendor should supply you with all of the necessary training in their system and in any programming languages that you may desire. If you have a large number of employees within your organization that require programming training, you may arrange that the vendor is to train one person in your organization who will then train the remaining people. It is not reasonable to expect the vendor to train large numbers of people from your company; however, some vendors periodically offer programming classes which your people would be invited to attend.

3. Periodic Assistance & Additional Training: Each vendor should be staffed sufficiently to provide you with periodic assistance and any additional training you may require. Situations will probably arise while you are on the system concerning things that you do not understand. A simple phone call to the vendor should readily clear up these matters. Do not hesitate to call and ask for assistance. All vendors are very anxious to satisfy you with their system and have you understand it completely so that you can use it effectively. A few minutes spent by the vendor can save you and your people many frustrating hours.

Vendors will also provide you with additional training sessions as new features are added to their system and new people are added to your organization.

4. Updates and System Changes: It is very important that the vendor notifies you as soon as possible of all updates and changes to their system. During the initial periods of your negotiations, you should inquire as to what system and procedure they use for keeping you up to date on the modifications.

5. System Down-Time: Every computer, whether it is time-sharing computer or a batch processing computer, will "go down", become inoperative from time to time. The disadvantage of a time-sharing system is that when it is inoperative some twenty to forty customers could be affected. If a system does crash and your teletype is disconnected, wait five minutes or so and then re-dial. Most systems are able to recover within a short period of time. You will, however, sometimes experience one or two hours of down-time, but this should be infrequent.

6. Loss of Files (Programs and Data): During certain types of "crashes" your programs and data files can be temporarily or permanently lost. This situation should happen infrequently. In most cases these files can be recovered. The recovery should be done by the vendor at his expense with your assistance.

7. Credit for Lost Time: Most vendors give credit for lost and/or unproductive time. This time is frequently credited against your bill; however, it is often easier for your salesman to allow you an equivalent amount of minutes or hours on one of his user numbers.

8. Vendor Assistance: Do not expect the vendor to spend full time with you after your initial training period. He should have to spend less and less time as you become familiar with his system. Do not forget that your vendor has many other customers that may need and require assistance. If you do need help, however, ask for and insist on receiving help.

Chart 2: Summary of Additional Points to Consider

1. System — General:

   Response time — for unloaded and loaded system
   System loading by vendor
   Mix of sophisticated vs. non-sophisticated users
   Front-end computer
   Hardware swapping device (disc or drum)
   Paging
   Floating point hardware
   Reduced rates for guaranteed usage
   CPU charges for swapping
   Ease of use; degree of user orientation
   System commands for user and management monitoring
   System recovery capabilities
   Languages and subsystems available
   Library programs — availability, language, and documentation
   Teletype linking — with computer operator and/or other users
   Input/Output devices (terminals)
   Card, tape input/output (at computer center)
   On-Line/Off-Line peripheral availability
   Full and/or half duplex
   Upper/Lower case characters

2. Communications:

   Communication cost and availability
   Terminals operating on system
   Terminal cost (include data set charges)
   FX lines, WATS, In-WATS
   Number of lines going into system
   Number of high-speed lines and their usage

3. Systems and Languages:

   Editing features — ease and flexibility
   Languages available
   Reliability of compilers
   Re-entrant compilers
   Language features
   Language standardization
   Size of programs that can be compiled and executed
   Binary storage of programs
   Overlays, chaining, linking
   Input/Output format flexibility
   Assembly language capability
   Assembly language subroutines in compiler languages
   Debug, trace, map
   Plotting routines
   Numerical control language
   COGO/GEOM
   ECAP

4. Files:

   Type of files
   Flexibility of use and modification
   Storage availability and cost
   Maximum file size
   Maximum number of files open during execution
   Purging of files by vendor
   Binary storage of data
   Random files (identify languages)
   File security features
   Hardware protect

5. Organization:

   Length of time in business
   Length of time hardware/software has been operational
   Financial backing — availability
   Number of computer centers
   Organizational structure
   Number and location of systems software people
   Number and knowledge of sales and customer support personnel
   Salesmen — commission or salary
   Personnel turnover rate
   Procedure of correcting known system bugs
   Speed of correcting known system bugs
   Manuals — accuracy, clarity, ease of reference
   Procedure for keeping users up to date on changes and new features
   Availability of back-up system(s)
   Additional hardware ordered

---

9. Writing Programs: Vendors will not write your programs. If you have a program you want written that has general applicability to other users, there is a possibility that the vendor may be interested in working with you on the program. If the program has value only to you and your company, you should expect to pay for their programming services. Your alternative would be to hire a consultant to do your programming.

III. THE TIME-SHARING USER

Those users that have not recently evaluated the many new vendors and services being offered should do so soon. Many of the new vendors are offering attractive CPU and connect rates and, particularly, reduced storage charges. If you use large amounts of storage, there is a good possibility that you could reduce your total cost by changing vendors. Quite a few of the remote batch services that are being offered and that are expected to be offered, can offer you extremely reasonable rates — particularly on production jobs. Remote batch systems should be thoroughly evaluated.

Changing Vendors

Changing vendors is not an easy task. The cost for converting from one system to another can be quite expensive. Conversion costs should be fully researched before you seriously consider changing vendors. We have listed below some of the factors that should be considered before changing vendors:

1. Program Conversion Costs: If you have many frequently used programs stored on your present system, it will be expensive and time consuming to convert these to another system. This is particularly true if you have utilized some of the "special features" that some vendors offer within their languages. Most difficulties in converting programs from one system to another will occur in the area of file handling. Converting programs that use large and multiple files can be time consuming and therefore expensive. If there are a considerable number of programs to be converted, this program conversion should take place at the computer center where access to the high-speed line printer is available. You can either have a senior person from your organization do this conversion work, hire someone from your new vendor to do the conversion, or hire an independent consultant who is familiar with both your old and new systems.

2. Retraining: If there are only one or two people within your organization that use time-sharing, your retraining problem is not a serious one. Some companies have twenty, thirty, or more people using time-sharing. Retraining all these people is not only expensive but often frustrating because of the personal preference involved in using a system with which each individual is familiar. The large users of time-sharing within your organization should play an important role in selecting a new vendor since these users are the people that will have to spend a major portion of their time working on the new system.

3. A New System: Initially, many new systems that are being made available are not heavily loaded. These systems will provide you with very quick turn-around during demonstrations and very attractive rates to run benchmark programs. When making your evaluation you should understand that as a system becomes loaded your response time will get longer and your cost to run a particular program may increase. Do not become over impressed with quick response time since this may get worse as time progresses.

4. Line Availability: It is important to know the number of lines available within your particular geographic area versus the number of users expected to use these lines. Busy signals are frustrating. If you have to make a long-distance call to access a new system you are considering, be sure to include these costs in your evaluation.

5. Control Characters: The use of control characters in editing programs and data can initially be confusing. On some of the new systems, control characters play an important role in the editing capabilities. For those users that use the system periodically, control characters may be too confusing. For those users who spend a considerable amount of time on a time-sharing system, the use of control characters and the ability to type ahead will save the programmer many hours of editing.

6. Full Duplex Vs. Half Duplex: Many of the new systems provide a full duplex capability. Not all of these systems, however, allow you to "type ahead". For extensive users of time-sharing, this can be a significant asset particularly in the area of editing. For periodic users, this can be a confusing feature.

7. In-House Systems: With the present availability of small time-sharing systems, increasing pressure will be exerted in getting in-house time-sharing systems. It would, however, be a mistake for medium-to-small-size companies to get an in-house system with the idea of making significant software changes to the system. We visualize that in-house systems will be used primarily to store company proprietary data bases and also permit use of some very simple computing language such as the BASIC language.

Any attempt to run a sophisticated FORTRAN or higher level compiler language on an in-house system would, in most cases, lead to confused and unhappy users. It would be best for large time-sharing users to use a combination of in-house systems and the commercial systems being offered on the outside.

IV. CONCLUSIONS AND THE FUTURE

The time-sharing/remote batch industry has expanded rapidly within the last several years. This expansion is expected to continue to increase at an even faster rate within the next several years. Many large corporations are starting nationwide networks that will have a marked effect on the existing vendors and the cost of these services.

The largest reduction in cost should be in the area of data storage. Larger discs are being made available at a lower cost per storage unit. Many of the new applications will deal with large data bases for retrieval systems and management information systems. Some users will require that their proprietary information be maintained on their own in-house system. Others will allow their data to reside on a vendor's system. The companies that are willing to put their data on other machines will have access to a more sophisticated and powerful hardware/software capability.

In-house personnel systems will also play an important role. These personnel systems will contain information on people (college graduates, etc.) being interviewed. This information will then be available to the many divisions and locations throughout the country. Once information is on the system it is immediately available to all other locations. This capability will greatly reduce the cost of interviewing and increase the "hire ratio" since corporations will then be in a position to find the best match of person to job. Systems such as these have already been highly successful and rewarding.

The aerospace industry and other mobile industries will also be developing (some have already) in-house personnel systems dealing with the background and skills of their present employees. Searches can then be conducted for contract purposes. These two types of personnel retrieval systems are particularly popular because of their English language searches and ease of use.

Today there are many small companies offering remote access services. It is difficult to project what will happen when the "giants" start rolling. One likely possibility is that these small companies will be bought up primarily to obtain experienced people. Experienced people within this industry are at a premium. This will be *the* major problem area for large corporations in establishing nationwide networks.

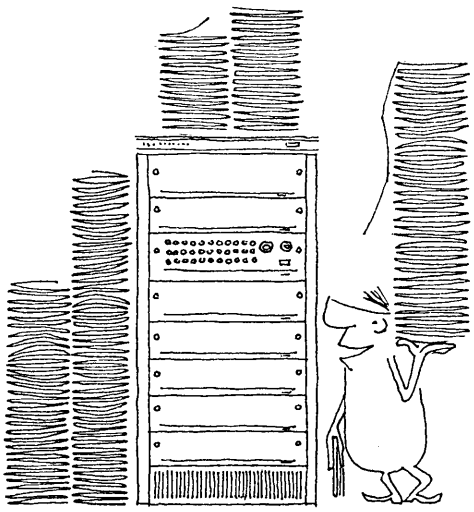
Prices for remote access services have dropped considerably since the first commercial offering in early 1965. Today it is difficult for those companies to make a profit with the existing competition and pricing schedules.

Start-up and development costs are very high. New vendors are finding it extremely difficult, for reasons stated earlier, to get potential customers to leave their present vendor and sign a contract with them. Most new vendors, although some are very well financed, greatly over-estimate their expected revenue and underestimate their development, start-up and cost of sales expenses.

The above reasons coupled with the possibility of a general consolidation of vendors, further emphasize that users should avoid the "unique features" being offered by vendors particularly in the area of programming languages. It would be wise to standardize as much as possible.

Time-sharing and remote batch systems offer the user many opportunities. People today are able to take advantage of new computers that do not exist in the batch processing environment. Many new and valuable applications are rapidly being developed. Many users are at last able to make the computer actually *work* for them. ■

If you're acquiring data, the 703 can get it for you wholesale.



And that means more of it faster, and with less cost, work and worry. Raytheon Computer's $15,000 703 has system characteristics built-in... 1.75 usec cycle time... 16-bit word ...memory expandable to 32K...byte and word manipulation ...real-time priority interrupt... options like direct memory access, multiply/divide, expandable I/O bus.

Peripherals? Up to 256 including all the conventional high and low speed, mass and non-mass devices plus—from Raytheon Computer only—analog data acquisition instruments like the MINIVERTER®, 100KHz ADCs and a long line of analog and digital IC modules for expanded logic, interfacing and control.

Software? A real-time monitor, an executive, assemblers, debugging aids, real-time FORTRAN IV and SENSOR, a unique hardware diagnostic program that spots malfunctioning IC elements so you can plug in a new one and be back on the air in a few minutes.

About the only other thing you'll need to get a 703 into your system is a call to a sales engineer. Raytheon Computer, 2700 S. Fairview St., Santa Ana, Calif. 92704; Phone (714) 546-7160. Ask for Data File CB-161. In Europe and the Mid-East, write Raytheon Overseas, Ltd., Shelley House—Noble St., London E.C.2, England, Phone: 01 606 8991, Telex 851-25251.

RAYTHEON

Designate No. 12 on Reader Service Card

"One of the main requirements in a successful time-sharing system is a powerful file-management package oriented towards terminal use."

MULTIPLE-ACCESS, TIME-SHARING, OPERATING SYSTEM

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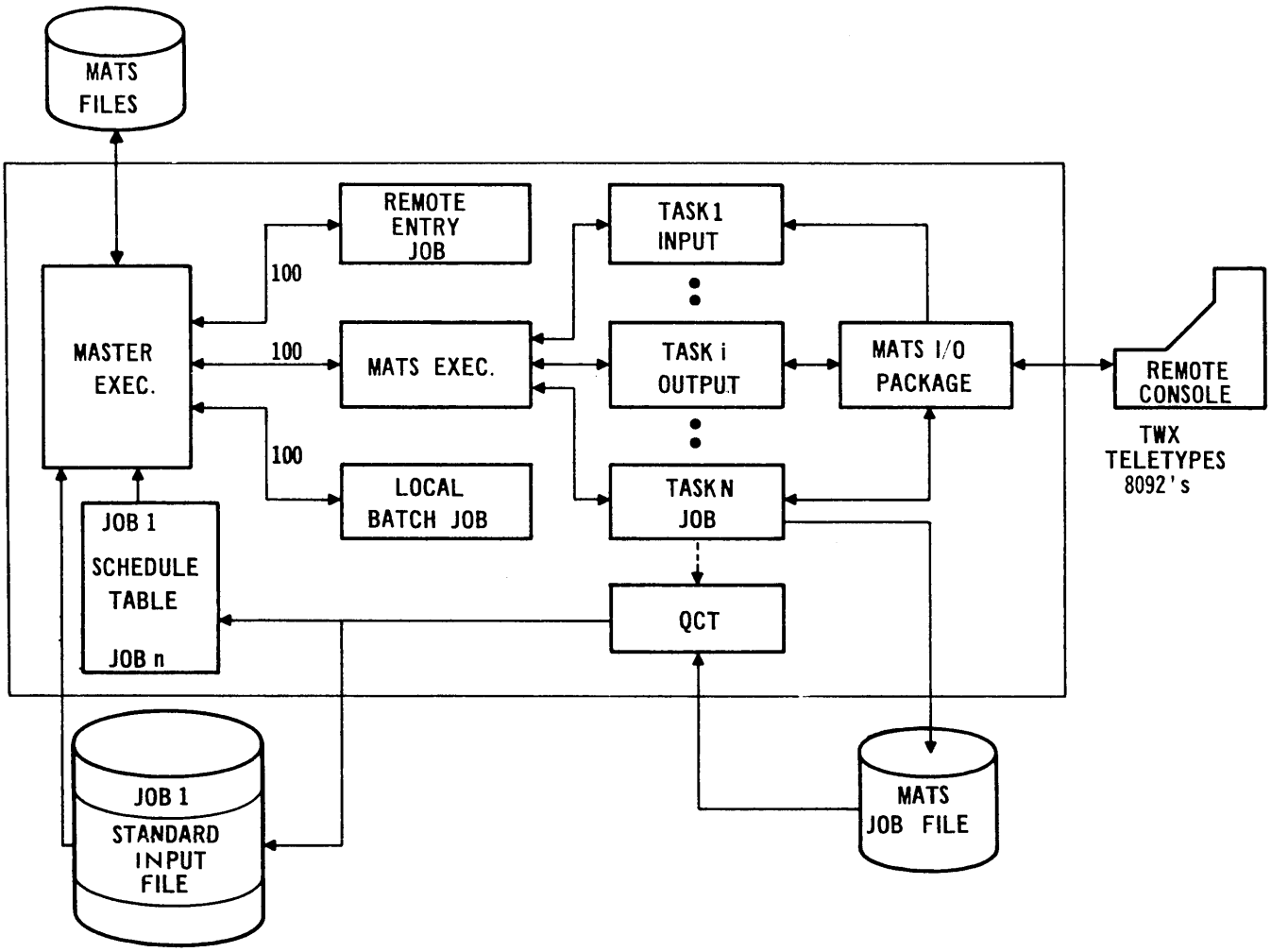


Figure 1: MATS/MASTER System

The need for better techniques to utilize large computers has been recognized for some time. There is a definite point beyond which it becomes impractical to submit batch work via the time honoured methods. Due to the awesome throughput power of modern computers, the Computation Center can become swamped in cards and listings and the computer itself will probably be inefficiently used.

It is generally impractical to spread smaller computers around to spread the load, because of higher cost and less efficiency.

Several steps can be taken to rectify this situation. The most obvious one is to tie several remote load centers to the main installation via some means and then allow these terminals to submit batch work to the central site. This in itself is not sufficient for two reasons:—

1. Some users cannot afford the necessary remote hardware.
2. Generally speaking, such terminals are not efficient if used in the normal batch manner. This is in part due to the high rate of card reading and printing needed to do normal business work.

To rectify these objections a system could be set up whereby most of the source material to be submitted is kept at the central site on some storage medium. This would reduce the amounts and kinds of data to be transmitted from the remote site. In order to give the smaller users a suitable environment, such devices as teletypes or CRT's could be used as terminals. It is now necessary to produce input-output and file management routines to support these various terminals. We are still talking about submitting jobs strictly in a "batch" mode. A final obvious step is to allow the terminals to become interactive.

Currently at our Laboratories at Northern Electric Co. Ltd., we are supporting a file management system called MATS (for "Multiple Access Time Sharing") which allows users at various types of terminals to manipulate source and data files and to submit these for multiprogrammed queued batch. We are also supporting an interactive computational language.

Terminal Oriented File Management

One of the main requirements in a successful time sharing system is a powerful file management package oriented towards terminal use. It must be easy to use and must impose a light load on the host computer. It must be able to efficiently handle high speed devices such as readers and printers, as well as low speed devices such as teletypes and CRT's.

To be practical the file management system must be capable of handling efficiently the extremely large jobs which are encountered in any general time sharing computer. It is this latter restriction which makes the design of a package like MATS extremely difficult.

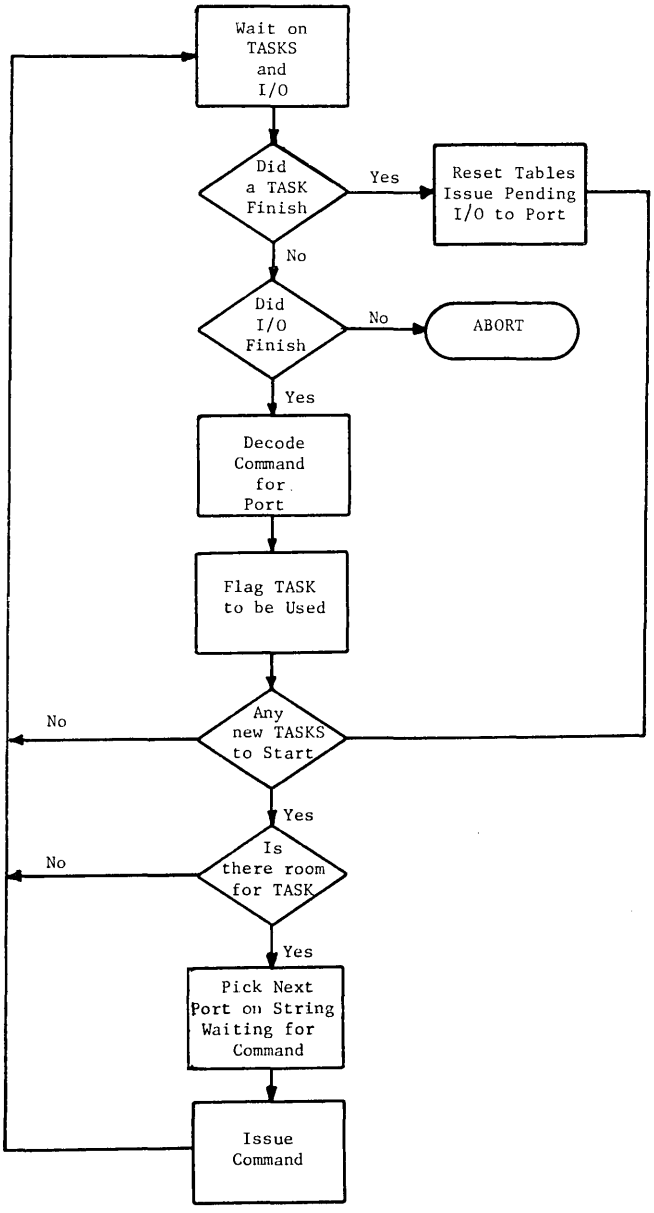
Associated with this file management system must be an effective interface to the normal batch stream in the computer. In order that the terminals be effective, users must be able to quickly and easily submit their jobs irrespective of their size or complexity. Typically, in our system, these jobs may encompass scientific work, sorts, or large simulations.

It was recognized rather early in the development of our terminal system that we could not afford either the core or peripheral units required to base the design of our package on the time-honoured concepts of core swapping, etc. We decided that it was more practical to build both our file management and interactive terminal languages around a good multiprogramming monitor rather than vice versa.

The flow of control in the MATS/MASTER system is as shown in Figure 1. Typically, several jobs are simultaneously being multiprogrammed. Each task in the system is given a share of the CPU time on a cyclic basis. Such occurrences as interrupts and priority levels tend to confuse the issue mightily. One of these tasks being multiprogrammed is MATS EXEC. Normally MATS EXEC is in a wait state pending an interrupt from one of the terminals. As such it is completely ignored by MASTER.

Whenever a user at a terminal indicates he would like service, MATS is put in the ready string and given control. His request is decoded and the appropriate task flagged to handle it. A scheduling algorithm in MATS then examines the current core available to MATS and the current mix of tasks in action. If it is possible, it picks a task which will fit in optimally from those which have been flagged for use. If it cannot start a new task it puts itself in wait state on both terminal I/O and currently executing tasks (see Figure 2).

Figure 2: Simplified MATSEXEC Flowchart



With one exception all MATS tasks are allowed to run concurrently with MATS EXEC. This exception is a utility routine used to examine or rectify faults in the MATS tables. Once a task has been given control, it has access to the necessary tables to allow it to continue processing user requests independently of MATS EXEC. This feature can reduce overhead substantially.

It has become apparent that the response time at a terminal under heavy load conditions can be changed markedly by varying the scheduling algorithm in MATS EXEC. For light load conditions it appears to make little difference. Under maximum load conditions MATS EXEC will handle up to five ports simultaneously. All others must wait until the resources in use come free.

File Structure

We have tried to keep the files manipulated by MATS as compatible as possible with those of the MASTER monitor system. Due to the algorithms used in MATS some differences must exist. MATS will operate on two kinds of files which will be called MATS files and MASTER files.

MASTER files are made up of variable length records blocked in the standard MASTER fashion. MATS must recognize this type of file for two reasons:—

1. All output returned to files from FORTRAN, etc., is in this format and this output must be listed at the terminals.
2. Large data files are typically read in at a card reader. There is generally no need to convert them to MATS files; thus, if MATS will handle them correctly, overhead is saved.

MATS files have the following attributes (see Figure 3):—

1. A header record which identifies a file as being a MATS file.
2. A trailer record which is in reality a software EOF mark.
3. A binary sequence number at the beginning of every record.

Some thought was given to using line numbers to identify particular records rather than sequence numbers. This idea was however dropped as our users preferred sequence numbers. The use of these sequence numbers would have been simplified if fixed length records had been used and the sequence number inserted at the end of the record, for this is how such records are treated by MASTER. Due to limitations on random access this was not possible. (Variable length records give better than a 2 to 1 reduction in mass storage usage.)

Periodically, files get damaged due to hardware or software failures. MATS keeps a continuous check on all currently open files and will signal a user who has a bad file. Several routines are available which will recover files in most cases where they have been damaged.

MATS files are protected in a rather stringent manner. The default protection is by department and user number. The non-default condition is — Filename (ACCSEC).

ACCSEC — BLANK — gives default protection

- — S — files which can be altered only by Systems Group, but are available to all groups for copying
- — D — files are protected by department number
- — N — no protection
- — Other — other than the above options can be used. In this case, the files are protected by department, user and the specified security characters.

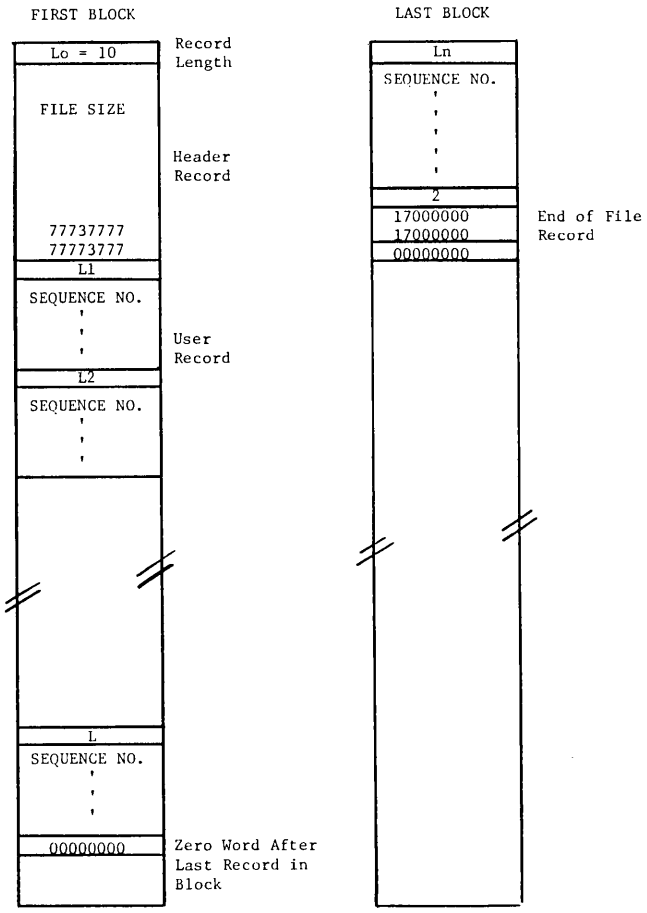


Figure 3: MATS File Format

MATS Language

Generally speaking we tried to keep the MATS language as simple as possible. It was believed that the commands available to the users at the terminals should be completely divorced from the realities of the operating system. The same philosophy was followed with respect to all diagnostics. In some cases specific system diagnostics are printed out; however, this is a rarity.

Such details as file security are handled automatically by the system. Unless the user specifies otherwise the standard MATS security options will be applied to all files created by MATS.

The commands can be categorized under the following headings:—

- — IDENTIFICATION
- — FILE CREATION
- — FILE MANIPULATION
- — JOB SUBMISSION
- — I/O
- — UTILITY

They are summarized in Table I under the above headings. Rather than try to describe each command a typical MATS session is given in Figure 4 and the purpose of each command will be explained here.

Table I
Mats Commands

```
Identification
     LOGIN, Case No., User No., Dept. No.
     LOGOUT

I/O Commands and File Creation
     INPUT, Filename(Accsec)
     CONTINUE
     OUTPUT, Filename(Accsec),Start Seq. No.,End Seq. No.,Characters/Line
     READ, Filename(Accsec),Device
     SPOOL, Filename(Accsec),Device,Start Line,End Line,Abandon

File Access Commands
     OPEN, Filename(Accsec)
     CLOSE, Filename(Accsec)
     DELETE, Filename(Accsec)

File Manipulation Commands
     APPEND, Filename(Accsec),Start Seq. No.,End Seq. No.,Resequence
     DUPLICAT, Filename(Accsec),Start Seq. No.,End Seq. No.,Resequence
     ERASE, Start Seq. No.,End Seq. No.
     INSERT, Start Seq. No.,Seq. No. Increment
     LOCATE, Seq. No.
     MOVE, Seq. No.,To Seq. No.
     REPLACE, Seq. No.,Start Character Position,Data
     RESEQUEN, First Seq. No.,Seq. No. Increment
     SAR,/Character String to be found/,ALL
     SAR,/Character String to be found/,/New Character String/

MATS/MASTER File Conversion Commands
     JOBFILE, From Filename(Accsec),To Filename(Accsec)
     MATSFILE, From Filename(Accsec),To Filename(Accsec)

Job Submission Commands
     JOB, Filename(Accsec)1,.....,Filename(Accsec)20

Utility Commands
     CATALOG,Option 1,.....,Option 20
     DATE
     DUMP, Teletype No.
     FIXFILE, Filename(Accsec)
     HELP, Start Seq. No.,End Seq. No.
     TIME
     TO, Teletype No.,When
     TABS, Position 1,.....,Position 4
     QUEUE, Options.....
     UTIL, Options.....
```

Figure 4: Specimen MATS Session

```
     >LOGIN,X-543,49000,8630:
TTY NO IS 04
     >CATALOG,ULIB,DLIB:
CREATED  EXPIRES  LASTUSE  SC  TIMES  SIZE   USED   OWNER     FILENAME
081967   091967   082067   02  00005  00015  00014  MATS8630  BRIDGESA00049000
081767   091767   083067   04  00026  00047  00047  MATS8630  SIMULATE
081967   091967   082067   01  00001  00001  00001  MATS8630  TEST     00049000
END OF CATALOG LIST
     >OUTPUT,TEST,100,400:
000100  $JOB,X-543,49000/TS,8630,2,400,,BRIDGES TEST
000200  $SCHED,CORE=29,SCR=3,LIB=1,OUT=*PR4
000300  $FTN(L,X)
000400        PROGRAM TEST
     >CLOSE:
TEST  (   ) CLOSED
      TABS,10,20,30,40:
      INPUT,TESTDATA:
000100  67#78#826#3:
000200  66#79#928#32:
000300  @
     >OUTPUT:
000100  67    78    826    3
000200  66    79    928    32
     >LOCATE,200:
     >SAR,/928/,/828/:
   000200 CORRECTED
     >OUTPUT,200:
000200  66    79    828    32
     >CLOSE:
TESTDATA  (    ) CLOSED
     >JOB,TEST,TESTDATA:
JOB NO 02 ACCEPTED FOR LIB=1
     >LOGOUT:
TIME  00/01/30
     >
```

The control characters used in this example are:—

- `>` MATS is expecting a new command from the user (when output by MATS)
- `:` End of command or line of data
- `#` Software TAB character
- ALTMODE (shown as @ in Figure 4) End of INPUT data

Figure 4 shows both the input by the User and the reply by MATS; after most replies the > is printed to show that MATS is expecting a new command from the user. The user ends each command or line of data with the ":" character which causes MATS to interpret the information.

We will examine these commands as they are used in this example.

LOGIN,X-543,49000,8630:

Before the user can issue any useful commands he must "log in" using the LOGIN command. MATS checks that the user and department numbers are on the file of valid users kept by the Computation Center and if so prints the teletype number and allows the user to continue.

CATALOG,ULIB,DLIB:

This command lists information about the categories of files specified. ULIB and DLIB request a list of all files belonging to the user and to his department respectively. In this case BRIDGESA and TEST are user files and SIMULATE is a department file (see Figure 5).

MATS Identification: FILENAME (ACCSEC)

MATS ACCSEC	MASTER IDENTIFICATION		
	OWNER	FILENAME	ACCESS SECURITY
BLANK	MATSXXXX	FILENAMEYYYYYYYY	BLANK
D	MATSXXXX	FILENAME	BLANK
N	MATS	FILENAME	BLANK
S	MATSYST	FILENAME	BLANK
OTHER	MATSXXXX	FILENAMEYYYYYYYY	MATS ACCSEC

where XXXX is the User's Department Number

YYYYYYYY is the User's Employee Number

The other MASTER Identification Parameters are standard for all MATS files in both MATS and MASTER formats:-

Modification Security: Blank

Edition: Blank

Usage: 0

Block Size: 1280 Characters

All files are allocated on device type 854, Class B, in Sector Mode and Segmenting Permitted.

Figure 5: MATS File Identification

OUTPUT,TEST,100,400:

The user has previously set up a MATS file called TEST containing a FORTRAN program and he is using the OUTPUT command to check the control cards in the first four records. As it is a MATS format file, each record is printed preceded by its sequence number.

CLOSE:

This command introduces the concept of an 'open' file. The user may have one file open at a time. Many commands do not include a filename in their parameters and act only on this open file; other commands may have the filename unspecified and are then assumed to be referring to this open file. The OUTPUT command used previously has

opened the file TEST and the user is now closing it to enable him to have another open file later on.

TABS,10,20,30,40:

MATS has a software TAB facility for ease of inputting data or programs. This command sets up the four available tab positions to character positions 10, 20, 30 and 40.

INPUT,TESTDATA:

This command allocates and opens a file with the MATS filename TESTDATA and sets the teletype to INPUT mode. It now expects successive lines of data to be input, each line being a file record. MATS prints the next sequence number on each new line before switching the teletype to INPUT mode.

The user now types in numeric test data, four items to a line, separated by tab characters (#). He completes his file by typing the ALTMODE character. This causes the MATS end of file record to be written and the teletype switched back to COMMAND mode.

OUTPUT:

The user prints the open file of data he has just formed using the OUTPUT command (without a filename specified as it is the open file). Notice that the data in the file has had its tab characters replaced by the correct number of spaces.

LOCATE,200:

The user notices he has an error in the line of data with sequence number 200. He uses the LOCATE command to set a pointer to this line.

SAR,/928/,/828/:

The SAR command (Search and Replace) is now used to correct the data. This command looks for the character string 928 in the record pointed to by the previous LOCATE command and replaces it by the string 828. The first character in each string is used to define the end delimiter character for that string; in this example the character "/" is used though any unused character will do. The command acts on the characters inside the two delimiters. This system enables the normal separator character comma to be part of the character string.

OUTPUT,200:

CLOSE:

The corrected line is printed and the file closed.

JOB,TEST,TESTDATA:

The JOB command writes the JOB request to a mass storage file. A background routine called Queue Control will then pass the job over to a MASTER STANDARD input file, converting files from the MATS format to the required MASTER format and checking the $JOB and $SCHED cards in the first file TEST. The input file is then handed over to the MASTER Operating System for queued batch execution. The intermediate file of job requests is necessary for two reasons:—

1. Recovery in case of system hangup, and
2. A pool for job requests when the MASTER schedule table fills up.

The control cards were printed out by an earlier OUTPUT command (see Figure 4).

The $JOB card is in the format required at Northern Electric; an extra field for department number has been introduced between the standard MASTER fields of User Identification and Time Limit; the User Identification field is also restricted to:—

'User Number/Two Alphabetic Characters'

The user number and department number must agree with the LOGIN information of MATS.

The $SCHED card has two additional options introduced:—

LIB = 1 specifies this program is to be executed on the computer system presently running MATS. (LIB = 2 would have specified the other system.)

OUT = *PRN specifies the MASTER OUT file is to be spooled to a printer identified as *PRN. OUT = *XXX would have specified that the OUT file is to be written on the file *XXX and the omission of the OUT option would cause the standard computer system printer to be used.

LOGOUT:

The user has now finished his MATS session so he releases the teletype with the LOGOUT command. The processor time is printed out and the user is charged for a combination of this time and the real time between the LOGIN and LOGOUT commands.

MATS Error Diagnostics

MATS attempts to provide as complete a set of error diagnostics as possible both to assist the user in his use of the language and the Systems Department in correcting program faults. A large part of the MATS coding is associated with these diagnostics and with methods of preserving the users' files if a system error or machine fault occurs.

User Error Diagnostics

These arise when the MATS command does not understand the information typed in or is not able to successfully complete the command. Examples of the diagnostic message returned to the user are:—

ILLEGAL COMMAND
INVALID USER/DEPT. NO.
FILE DOES NOT EXIST
FILE IN USE
INVALID SEQUENCE NUMBER

System Error Diagnostics

These diagnostics arise when the MATS program finds one of its safety checks has failed or when MASTER returns an error after a file handling request. In general they are typed in a standard format on the teletype from which the command was issued.

AA Bn ERR DD

AA is a two letter code identifying the individual MATS task.

B is a one letter code identifying the function.

n is a single digit code to further identify B.

DD is the error code returned by a MASTER request.

e.g. CT L1 ERR 41

would be a LOCATE error 41 in the CATALOG task and is an attempt to locate to a block number outside the allocated area of the file.

Some diagnostics are returned to the console typewriter and an example of these would be:—

ILLEGAL TTY NO

when the command has found the teletype number passed to it by MATS is out of range.

Summary

A brief description of the Northern Electric MATS system has been given. The present system is the result of two years of effort and provides a good remote batch entry and file management system. Much future work remains to be done, mainly in the areas of time-slicing and the conversion of MATS into a more flexible package designed for a broader spectrum of usage. ■

A New Concept in Time Sharing: DEDICATED SYSTEMS SHARE ONE COMPUTER

Gerald J. Smolen, Manager
Transportation and Communications Systems
ARIES Corp.
Fairfield, N.J.

"The combining of several discrete, real-time, on-line information systems in one computer at a neutral site has obvious advantages to a great many businesses for which such a system on a proprietary basis would be too costly."

In a unique type of sharing, four dedicated real-time, on-line systems share one computer concurrently, and three similar systems share another, at our company's new data processing center in New Jersey. Although hardly "time sharing" in the usual sense of the term, this technique provides the same basic advantage: each user enjoys the benefits of a real-time EDP system for a fraction of what it would cost, for hardware, software, and operations, to establish a comparable in-house capability.

The seven separate shared, but dedicated, systems include a hotel/motel reservation system, a rental car reservation system, a military troop movement control system, an airline reservation system, a container control and freight administration system, and two steamship line reservation systems. Additional systems could be added to either of the two computers, the only limitation being the maximum response time which any one of the separate systems could tolerate. This type of sharing of dedicated information systems would be appropriate to virtually any system requiring immediate reference to up-to-the-minute information.

An unusual aspect of these two computer-sharing systems is that, although the hardware is owned by one of the subscribers in each case, the computers are located at a neutral site and operated, under contract, by Aries Corporation. This assures protection of proprietary information. It also has the advantage that system design, programming, and operation are performed by experienced Aries personnel, relieving the subscriber of the necessity of employing a large EDP staff merely to make such a system operational.

Before joining Aries Corp., Gerald J. Smolen was Project Supervisor and Senior Communications Analyst on the staff of the Director of Communications Projects, Information Systems and Services Div., Western Union Telegraph Co., and Senior Systems Analyst for the Data and Information Systems Div., ITT. He attended Newark College of Engineering and is presently pursuing a degree in mathematics at Fairleigh Dickinson University.

System Requirements

All seven systems presently sharing the two computers have the following requirements in common:

1. Large mass data storage.
2. Real-time operation.
3. Conversational communications mode.
4. Random intermittent processing.

The real-time, on-line hotel/motel reservation system is an excellent example. Many remote stations must be able to communicate at any time with a central computer having access to a large file of current information. Yet actual processing requirements are completely random. They depend only upon the receipt of individual requests for reservations. Thus, actual processing time is only a fraction of that available, but it must be available when requested.

Computer Operation

Each dedicated system shares a mass storage device while operating concurrently with the other systems within the central processing unit. Processing time is not distributed between users on a time basis, but is used as needed by each system.

Every system communicates with the computer through dedicated lines, and only one entry is necessary to begin processing. The line through which the message is received identifies the subscriber and determines and confines the programs and storage area to be used. This is in contrast to conventional time-sharing techniques in which an introductory conversation is required to identify the user and the proper program.

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Also, programs are dedicated and specific to each system, rather than general, as is the case with more conventional time sharing. This design eliminates introductory dialogue, affords complete protection of each system's programs and data, frees message texts and formats of inhibitions imposed by usual time-shared programs, and permits unlimited flexibility in the selection of remote equipment. The two system schematics illustrate (but do not limit) the diversity of remote equipment which can be employed.

Only control programs are permanently core resident. All application programs are stored on the drum. Message processing is initiated on a first-come, first-served basis, but subsequent processing is intermixed.

This technique takes advantage of the fact that the core executes program instructions in microseconds, whereas peripheral operations take milliseconds. For instance, if two messages arrive simultaneously, one is partly processed and then referred to the appropriate peripheral — to the drum for execution of an application program, let us say. The core is now free to switch from the control program for the first message and accept the second message. When that message is referred to the appropriate peripheral device, the core again switches programs, either to receive a third message for partial processing, or perhaps to receive the data requested from the drum in response to message number one. Thus, a portion of each program is executed in the core, then a portion of another, and so on. Processing of messages in this interleaved fashion increases core efficiency by eliminating the long waits for information to return from the slower peripherals as in sequential processing.

Although all programs appear to be executed simultaneously, the computer is constantly switching from one unique dedicated system to the other. Each message is handled in its turn, but the computer is able to take advantage of those fractions of a second during which each message does not actually require processing in the core memory.

Systems Description

As previously stated, two computers are presently operating with shared, dedicated systems. The older system, which has been in operation since early 1967, combines three separate reservations systems and a military troop control movement system using a Univac 491 central processing unit with a 32K, 30 bit-word memory. (See Figure 1.) Peripheral equipment at the computer center includes one (1) Univac Fastrand II drum with 128 million character storage capacity and an average access time of 90 milliseconds, four (4) Univac VIC tape drives, and one (1) Univac 1004 printer, punch, and card reader. This equipment is fully duplicated to insure 24-hour operation 7 days a week, 365 days a year.

Reservations Systems

The three reservation systems presently employ 1,800 remote Rixon Agents Sets located throughout the United States, including Hawaii and Canada. They communicate with the computer through 58 low-speed (10 characters per second) and 4 high-speed (2,000 bits per second) communications lines.

The hotel/motel system provides an interconnecting real-time reservation service for chains which either do not have the message volume to justify, or which want to avoid the capital outlay required by a proprietary system. The system also enables subscribers to offer a much wider choice of accommodations than a single-chain proprietary system, and thus better customer service.

The rental car reservation system provides real-time reservation service for a national car rental company. It can

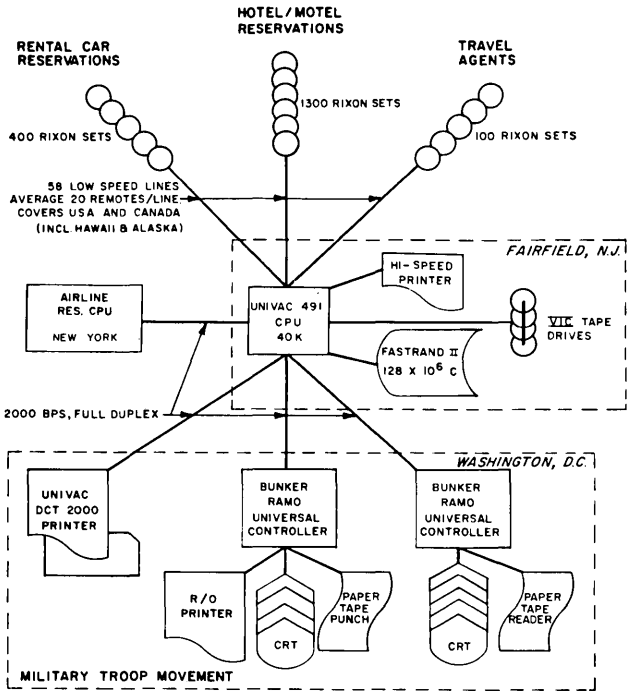


Figure 1

make reservations by type of car desired for up to a year in advance.

The airline reservation system is not yet in service. When it is, it will use identical remote equipment and the same communications lines as the other two reservations systems. The purpose of this system is to connect travel agents throughout the country with the automated reservations system of a national airline. Travel agents will no longer have to telephone for reservations, but will be able to reserve space on over 80 percent of the scheduled domestic airline flights in the same manner as presently done by computer through airline offices.

The two reservations services presently in service handle an average of 33,500 messages per day with an average response time of 2 seconds.

Troop Movement Control

The military troop movement control system is designed to determine the most efficient and economical method for moving troops within the continental United States. The computer is connected to a single remote control center containing the following equipment: 9 Bunker Ramo CRTs, 1 high-speed Univac DCT 2,000 printer, 1 Bunker Ramo paper tape reader, 1 Bunker Ramo paper tape punch, and 1 Bunker Ramo R/O printer. This system handles 4,000 messages per day.

Second System

The second shared computer handles three separate dedicated systems. It is a Univac 418 central processing unit having a 32k, 18 bit-word memory. (See Figure 2.) Peripheral equipment, storage, tape drives, printers, etc., is identical to that of the first system. Communication with remote sites is by means of 7 low-speed and 5 high-speed lines.

The first system on line with this computer is designed primarily to control the movement of shipping containers from the time they arrive in the United States until they embark again for a foreign port. Eventually, upwards of 15,000 of these "seagoing boxes" will be tracked through the system. Remote stations include sixteen (16) ASR 33 TWX

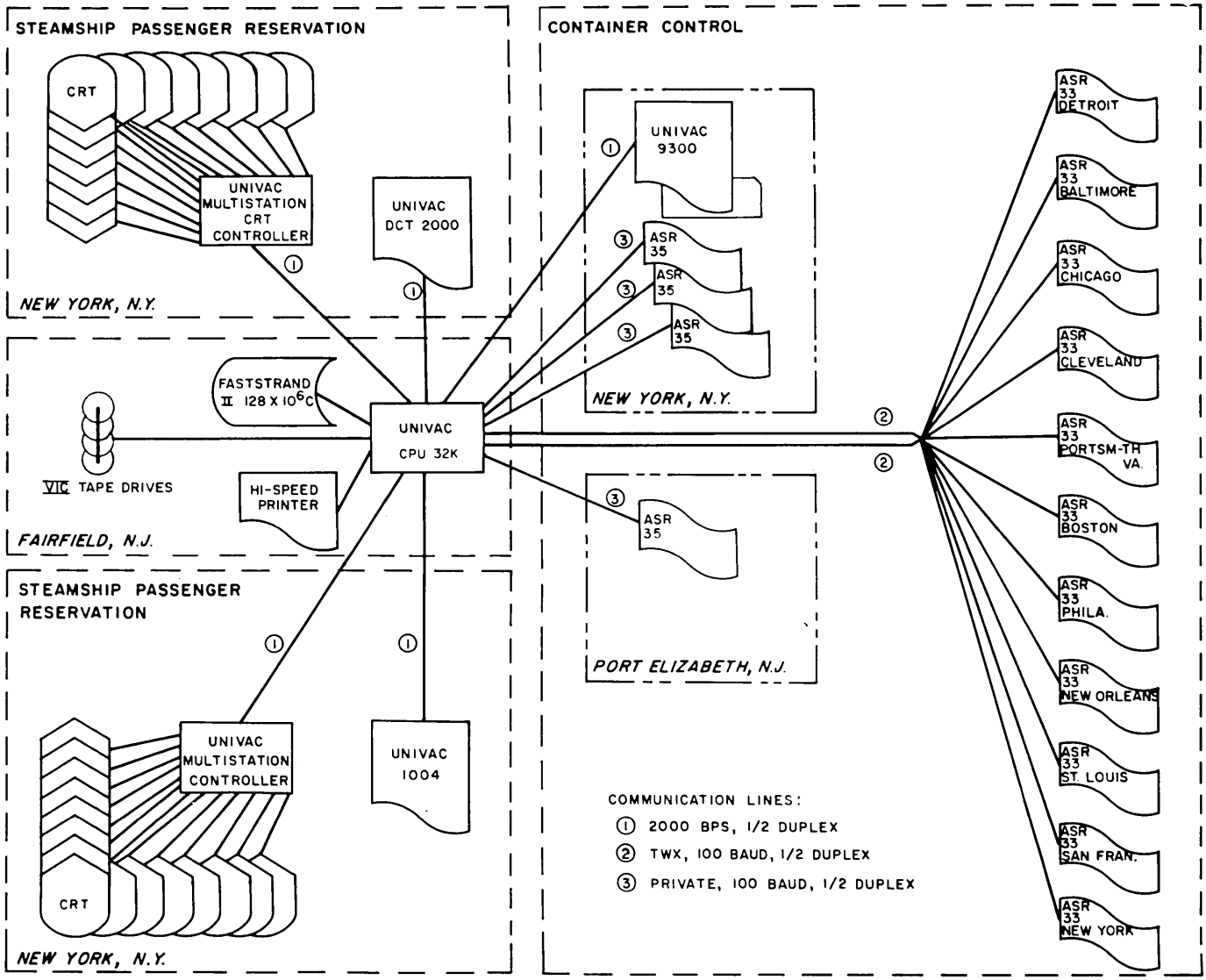


Figure 2

sites and five (5) ASR private line sites. This system is presently handling about 1,800 messages per day, and information about the location and status of any container is obtained in 7 seconds.

In addition to container control, the system is also used for freight administration and documentation. For this purpose it is connected to a remote Univac 9300 satellite computer, a high-speed printer, punch, and card reader.

Each of the two steamship line reservation systems connects the central computer to one remote location where inquiries for reservations are received by telephone. Reservations clerks communicate with the computer through Uniscope 300 CRTs and can reserve space within seconds. Just prior to sailings the computer will prepare reservations lists and tickets.

The steamship line reservation systems are an excellent example of the practicality and economics of this type of computer sharing. Although the lines are competitive, system design absolutely protects the integrity of proprietary information. However, because the programs are identical, the two lines were able to split software costs.

Evaluation

The combining of several discrete real-time on-line information systems in one computer has obvious advantages to a great many businesses for which a proprietary data processing system would be too costly. Although all but two of the systems presently operating are reservations systems, it should be apparent that a variety of management information systems could be accommodated in this manner. Some possibilities might be multi-list real estate systems, inventory control, information retrieval for comparative purposes, resource allocation, and many others. The only criteria of suitability is the need for large mass storage and real-time operation in a conversational mode.

This type of "time-sharing" is also ideal for demonstration or experimental real-time systems or for the early phases of systems which will eventually be large enough to justify their own central processing unit. Rather than start out with a smaller computer and then be forced to rewrite all of the programs in order to move up to a larger, more sophisticated device, the programs of the shared system can be applied directly without significant modification.

The approach also has the advantage of utilizing the talents of experienced system design and programming personnel, capable of getting such a system operational in minimum time and with a minimum of "bugs". It is interesting to note that several of the subscribers to these systems were able to go "on-the-air" with a real-time system without any programmers on their own payroll. Similar systems can put real-time EDP within the reach of many organizations which do not enjoy its benefits at the present time. ■

CALENDAR OF COMING EVENTS

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. 10-12, 1968: Data Processing Management Association, Div. 4 Fall Conference, Glenwood Manor Motor Hotel, Overland Park, Kansas; contact DPMA, Kansas City Chapter, P.O. Box 2425, Kansas City, Mo. 64142

Oct. 14-16, 1968: ECHO (Electronic Computing Hospital Oriented), Fourth Anniversary Meeting, Jung Hotel, New Orleans, La.; contact William H. Isaacs, Asst. Sec'y., ECHO, 8153 North Kolmar Ave., Skokie, Ill. 60076

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. 15-17, 1968: Switching & Automata Theory Symposium, Rensselaer Polytechnic Inst., Schenectady. N.Y.; contact S. B. Akers, Jr., Elec. Lab., General Electric Co., Syracuse, N.Y. 12301

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

Oct. 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. 24-25, 1968: The Association of Data Processing Service Organizations (ADAPSO), 24th Management Conference, Detroit, Mich.; contact Jerome L. Dreyer, Association of Data Processing Service Organizations, Inc., 420 Lexington Ave., New York, N.Y. 10017

Oct. 28-30: Seventh Computer Workshop for Civil Engineers, Purdue Univ. School of Civil Engineering, Lafayette, Ind.; contact Prof. A. D. M. Lewis, Purdue Univ., Lafayette, Ind. 47907

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. 7-8, 1968: The Association for Precision Graphics (formerly The Precision Plotter Users Association), Second National Conference, The Univ. of Southern Calif., Los Angeles, Calif.; contact William G. Reimann, Nat'l Chmn., Assoc. for Precision Graphics, c/o Litton Systems, Inc., 5500 Canoga Ave., Woodland Hills, Calif. 91364

Nov. 25-26, 1968: Society for Information Display (SID), 1968 National Technical Conference, Waldorf Astoria Hotel, New York, N.Y.; contact Richard Du Bois, Wagner Electric Corp., Tung-Sol Div., 200 Bloomfield Ave., Bloomfield, N.J. 07003

Dec. 2-4, 1968: Second Conference on Applications of Simulation (SHARE/ACM/IEEE/SCI), Hotel Roosevelt, New York, N.Y.; contact Julian Reitman, Norden-United Aircraft Corp., Norwalk, Conn. 06856

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

Dec. 12-13, 1968: Digital Equipment Computer Users Society (DECUS) 1968 Fall Symposium, Jack Tar Hotel, San Francisco, Calif.; contact Angela J. Cossette, Digital Equipment Computer Users Society, Main St., Maynard, Mass. 01754

Dec. 16-18, 1968: Adaptive Processes Symposium, Univ. of California at L.A., Los Angeles, Calif.; contact J. M. Mendel, Douglas Aircraft Co. Inc., 3000 Ocean Pk. Blvd., Santa Monica, Calif.

Jan. 28-31, 1969: International Symposium on Information Theory, Nevele Country Club, Ellenville, N.Y.; contact David Slepian, Dept. of Transportation, Washington, D.C.

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

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

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

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

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

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

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

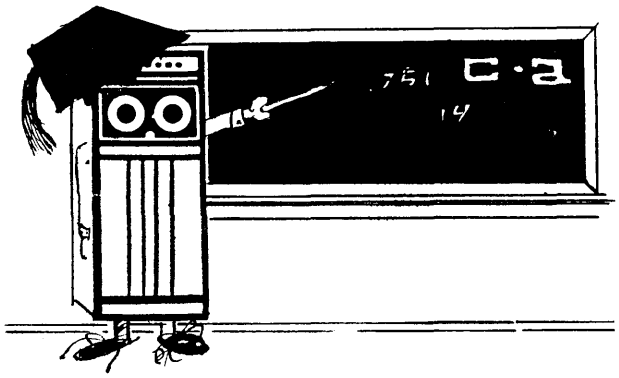
Aug. 11-15, 1969: Australian Computer Society, Fourth Australian Computer Conference, Adelaide Univ., Adelaide, South Australia; contact Dr. G. W. Hill, Prog. Comm. Chrmn., A.C.C.69, C/-C.S.I.R.O., Computing Science Bldg., Univ. of Adelaide, Adelaide, S. Australia 5000.

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

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

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

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



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

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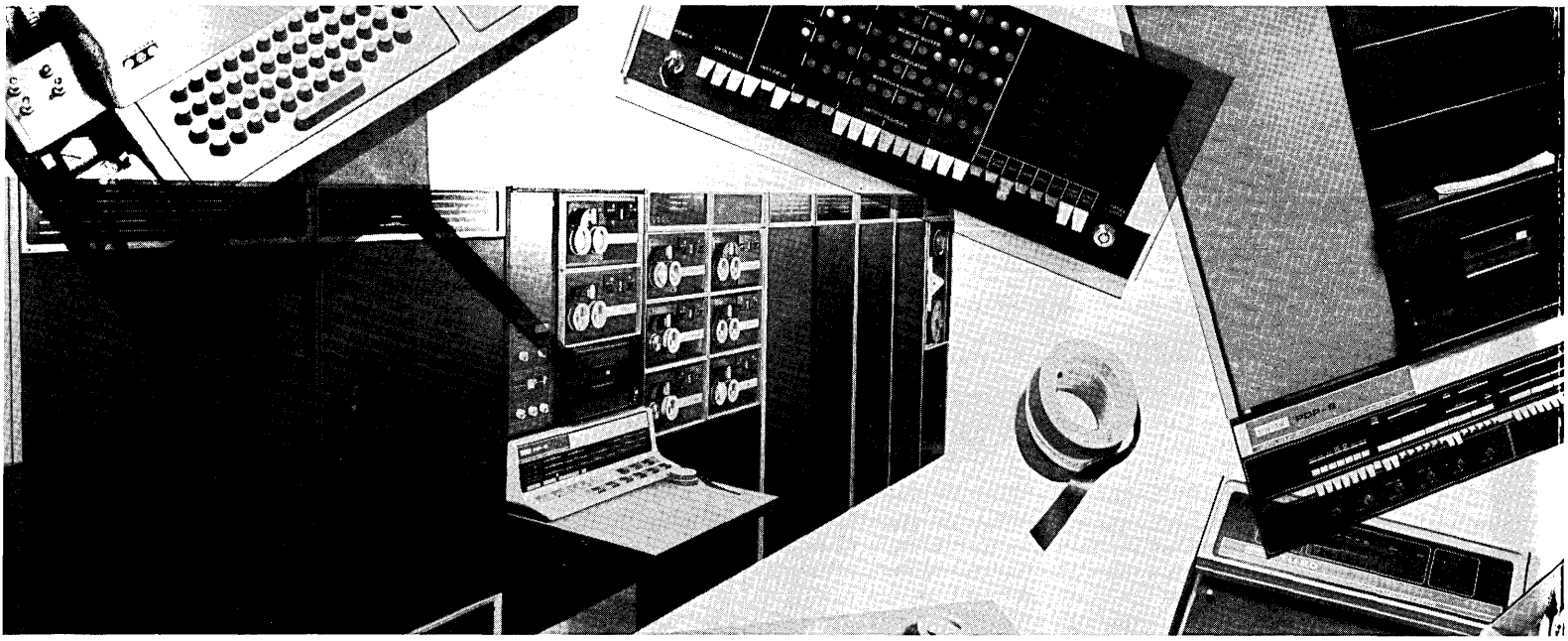

COMPUTER RESOURCES SHARING — SOME COMMENTS AND PREDICTIONS

Norman Doelling
Digital Equipment Corp.
146 Main St.
Maynard, Mass. 01754

"The evolution and rapid growth of time sharing in the future will follow several paths. . . . Among the services that will grow and become more advanced are the specialized information, storage and retrieval systems that are currently in their infancy."

Norman Doelling is marketing manager for Digital Equipment Corporation's TIME SHARE-8 systems, and head of the educational marketing effort for all DEC computers. He entered the computer field as manager of the TELCOMP time-shared computer service at Bolt, Beranek and Newman Inc., in Cambridge, Mass. He has bachelor degrees from Amherst College and the Massachusetts Institute of Technology, and a master's degree in electrical engineering from M.I.T.

Time sharing is an inadequate description of the most rapidly growing method of utilizing computers. Resource sharing would be a much more appropriate descriptive term. The key factor in the development of this method of computer utilization was one of cost: large computers and other computer system resources are, by many criteria, more economical than their smaller equivalents.

In operation, the cost per unit arithmetic operation, addition or subtraction, for instance, generally decreases as computer size and speed increases. Also, the cost per unit of information stored drastically decreases as the size of mass storage devices increases. In many cases, however, it is inefficient, and hence, expensive, to interrupt large computer systems to handle data communications from low speed input/output devices. The expense of frequently interrupting large computer resources, even for several microseconds, is considerably more than it would be if the resource were a small computer. This has had a hindering effect on the operation of some time sharing systems. It is a hindrance that is decreasing in importance as the small computers assume larger communications roles.

Man/Machine Interaction

Without question, however, is the fact that computer resources sharing offers the potential for economic utilization of computers in an interactive manner. In his classic paper, Dr. J. C. R. Licklider[1] described a man/machine interaction

[1] *IEEE Transactions in Human Factors in Electronics.* Dr. Licklider is Professor of Electrical Engineering and Director of Project MAC at the Massachusetts Institute of Technology.

and partnership in which the man used the computer as a convenient extension of his ability to calculate, store, retrieve and manipulate data. In this partnership, it was clear that man frequently required short bursts of computer power and infrequent access to portions of very large data files. This led to the concept that a computer system could serve simultaneously the needs of many users by interweaving user requests. Considering the large amount of time an individual requires simply to state his requests to the computer through a typewriter-like device, it was clear that the computer would not be overtaxed in the job of serving many individuals in this form of intellectual partnership.

Thus, the idea of offering small slices of computer time to each individual evolved, and with it, the name "time sharing." However, not only time, but also the central processor, core memory, secondary storage devices and input/output devices are all shared. Through the sharing of storage devices, individuals are able to share general-purpose programs, such as those for the analysis of electrical circuits, or the simulation of large systems, or the statistical analysis of data. Special programs also can be shared. Operating companies of the Bell System share a family of special programs called WATS (wide area telephone service). One affiliate wrote the programs which were put into a time sharing system; many affiliates use them. In addition, large data bases may be shared, accessed, and added to by the many users of the system. Individual programs, whether they are of a general or special nature, can be protected or retained for the specific use of a particular group of individuals through a system of file protection. Sharing of a single storage system offers substantial economies of scale.

Time sharing and/or resource sharing are concepts difficult to define specifically. In fact, one senior executive of a large time sharing utility once implied to me that he had been sharing time for many years before what we know as "time sharing" existed. When I quizzed him on this, he said: "Well, I used to have a batch machine, and I would offer it to Company A from 1:00 to 2:00; Company B from 2:00 to 2:15; Company C from 2:15 to 3:45, etc." Clearly, this was time and resource sharing. Generally now, however, we imply several "simultaneous" users of a computer, each of whom can get a response to a simple inquiry or data entry within a few seconds.

General-purpose time sharing had its origin about six years ago at the Massachusetts Institute of Technology, and at Bolt, Beranek and Newman. About three years ago time sharing was offered commercially for the first time. I recall the initial difficulties of selling time sharing commercially. It was a matter of first explaining the concept, and then selling the product. A demonstration of time sharing was necessary to convince prospects that computers could be utilized in this manner. Today, time sharing is available in virtually every large- and medium-sized city in the nation. In many cities, more than half a dozen services are available.

Present Systems

Time sharing or resource sharing systems differ from one another primarily in the flexibility they offer to the user. The least flexible systems are dedicated systems, which are designed to carry out one specific function. Airline reservations systems, on-line banking systems, theater ticket reservations systems, inventory control and invoicing systems are a few examples. Dedicated systems generally are simpler to operate and less expensive than the more general-purpose systems. For instance, an airline reservations system, no matter how large it is, normally only has one problem to solve. That is, it gets an air traveler a seat on the plane in which he wants to fly. Such a system might be put to other uses, like determining daily or monthly seating capacity throughout the airline system; but this use is secondary to its main function and follows from that function.

The limited set of functions of a dedicated system is the key to its simplicity and economy of operation. Executive software in the system need only recognize a limited set of inputs, thus making the software simpler to design and implement. A special, easy-to-understand language can be used, requiring very little knowledge of computers or computer programming on the part of those operating the system. In the case of the airline reservations system, the cost to install and implement it might have been $50 million, but nonetheless, the system is conceptually simple.

Single-Language Systems

Single-language time sharing systems are typified by IBM's Call 360/BASIC; Bolt, Beranek and Newman's TELCOMP; and the file-oriented Desk-Side Computer Service (FORTRAN only) offered by General Electric. Hewlett-Packard offers a small, single-language, time-shared computer, as does Digital Equipment Corporation among its variety of systems. DIGITAL's system, termed multi-user FOCAL (a JOSS-like language), is designed specifically for numerical computations in a wide range of general-purpose problem solving. Such systems have a variety of applications among security analysts, accountants, scientists, engineers, students in secondary schools and colleges, both on the undergraduate and graduate levels, etc. The primary advantage of a single-language system is that within the limitations of the single language, a fairly wide range of problems can be attacked.

"Few-language" systems in many cases do little more than a single-language system, but often do it more quickly and more efficiently. There is a wider range of applications, since there is more freedom to choose a language appropriate to the task at hand. The GE 265 computer system, offering ALGOL, FORTRAN and BASIC is the key example. General Electric, CALL-A-COMPUTER and various others offer this service throughout the country.

General-Purpose Systems

General-purpose, time-sharing systems are characterized by the availability to the user of machine and assembly languages. Access to machine and assembly languages means that a user can design a language of his own if he desires. In addition, standard languages such as FORTRAN, BASIC, JOSS and COBOL are usually available. The ability to build compilers and interpreters to use standard languages permits an almost limitless variety of computer applications.

Most general-purpose systems also permit assignment of devices, such as line printers, card readers and magnetic tapes, to individual users. Thus, complete resource sharing is offered. Digital Equipment Corporation's PDP-10 and Scientific Data System's 940 offer these capabilities; so does Digital's newly announced TIME SHARE-8 based on the company's small PDP-8/I computer.

Some large, general-purpose, time-sharing systems are capable of receiving and acting upon real-time inputs, like those that might be required for process control or on-line control of experiments. Batch processing can be carried on in the "background" of the real time. In the background/foreground arrangement in one system, a priority-interrupt feature permits a secondary task to be carried on by the computer while it is not busy with its primary job. However, when the system becomes busy with its primary job, the secondary task is immediately halted.

Larger systems offer users the ability to do time sharing and real time applications simultaneously. For instance, a university could conduct a real time control project at the

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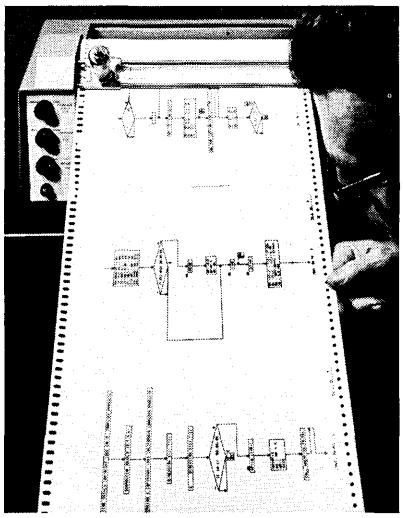

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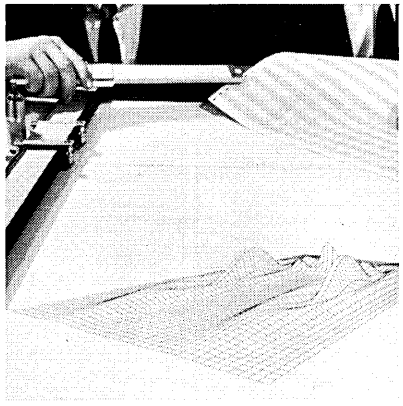

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same time the computer is being time-shared by its engineering department.

The Future

The evolution and rapid growth of time sharing in the future will follow several paths, with continued enrichment of the varieties of services offered to customers. Among the services that will grow and become more advanced are the specialized information, storage and retrieval systems that are currently in their infancy. We see two important trends.

Special-Purpose Systems

First, we can expect the continued evolution of small, general and special purpose time-sharing systems at lower and lower prices. A special-purpose system for use by several simultaneous conversational users can presently be obtained small, general-purpose computer system built around a small for less than $20,000. One company recently announced a small, general-purpose computer system built around a small computer which can serve 8 to 32 users with complete library and file capabilities at prices that start at less than $45,000. Machine language is available to all users, as well as a variety of assemblers and compilers. Resource sharing is available, peripheral devices can be assigned to users. We expect this sort of trend to continue and flourish.

Large Computing Complexes

Second, larger and larger time-sharing systems probably will continue to evolve as systems with multiple processors accessing a common large memory bank and common secondary storage devices. This redundancy in processors will provide faster processing power, and if not a "fail-safe" capability, at least a "fail-soft" capability through which "crashes" or failures will become degradations of performance rather than a total failure. If one processor goes "down", the others will remain "up", considerably slowing the response but still providing some service.

These large computing complexes will require sophisticated remote terminal devices that in themselves will be small computers, thus leading to a geographical distribution of computer power. Small computers already are being used by some time-sharing utilities as control devices for remote, high-speed line printers and card readers. The small, local computer serves as a control and high-speed multiplexing device to a large machine for remote batch processing or remote job entry. Small computers also are frequently needed to control increasingly complex display devices used as terminals for time sharing.

Smaller, "stand-alone" time sharing systems and sophisticated terminals on larger time sharing systems are two significant trends. The small, general-purpose computer can be used for local on-line interactive problem solving and to support complex displays. Editing programs, writing programs, debugging, some computation, and access to small files will be handled on the small system. Large computations and large files will be handled on larger systems to which the small system is remotely connected. It is reasonable to anticipate that the small, general-purpose, time-sharing computer will also be able to support a line printer and card reader for remote batch processing.

Thus, we can anticipate not only many more large central computer complexes for time sharing, but also a more diverse distribution of computing resources, storage resources, and peripheral resources. Some of these hierarchical computer systems ultimately will also be interconnected to provide convenient sharing of data, computation power, ideas and intellectual activity. ■

DATA PROCESSING SERVICES:

BANKING'S NEW PRODUCT

Dr. James A. O'Brien
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Cheney, Wash. 99004

"Some bankers believe that data processing services will eventually have a financial impact equal to or greater than the income produced by their well-run trust departments in terms of net fee income, new business, and business retention."

Commercial banks are offering data processing services to their customers that are quite different from the basic banking functions of granting loans, transferring funds, servicing deposit accounts, and performing trust services. Through their use of computers, banks are now offering a wide variety of new services to their correspondent banks, other financial institutions, business and professional firms, government and public organizations, and individuals. A partial list of such services is show below:

Correspondent Bank Services
- Demand deposit accounting
- Savings accounting
- Installment loan accounting
- Mortgage loan accounting
- Bond portfolio analysis
- Transit
- Trust

Services to Other Financial Institutions
- Savings bank, and savings and loan associations:
  - accounting
  - savings
  - mortgage loan accounting
- Credit unions:
  - share accounting
  - installment loan accounting
  - mortgage loan accounting
- Mortgage company accounting
- Insurance company accounting
- Finance company accounting
- Mutual fund accounting
- Securities broker accounting

Services to Business and Professional Firms
- Account reconciliation
- Payroll accounting
- Billing service
- Accounts receivable accounting
- Accounts payable accounting
- Freight plans
- Lock box plans, including the preparation of input for the customer's computer system
- Bill collection for utilities, insurance companies, and other businesses
- General accounting for small businesses
- Cost accounting
- General ledger
- Sales analysis
- Expense analysis
- Inventory control
- Integrated systems for particular industry groups
- Property management accounting
- Computer time rental
- Computer program "packages"
- EDP systems analysts and programmer services

Services to Government and Public Organizations
- County and municipal governments
  - Real property tax billing and collection
  - Municipal services billing
- Public schools
  - Class scheduling
  - General accounting

Services to Agriculture
- Feed-blending determination
- Farm and crop management recordkeeping
- Financial accounting services

Services to Individuals
- Integrated banking, including automatic debits to checking accounts for credits to savings accounts, installment loans, mortgage loans, and bond purchases
- Paying agent service
- Consolidated statements
- Income and disbursement analysis

Many banks began offering data processing services to their correspondent banks because they had extra time available on their own computer systems and because they could offer their correspondents the same EDP appli-

James A. O'Brien received his DBA in Finance at the University of Oregon. Dr. O'Brien has had industrial experience with computers at IBM and General Electric. His book, *The Impact of Computers on Banking*, in which portions of this article appear, has recently been published by Bankers Publishing Company.

Breakthrough in recordaputers

Here comes a man with a reel of mag tape and an innocent-sounding request. What he has is 2400 feet of parts lists in digital form, and what he's asking for is a film strip of selected portions of these records in readable, reproducible, enlargeable form.

He'll have plenty of time to wonder what he said wrong while he's waiting for the film. Eventually he will learn that it's bad news to ask for a selective, ordered output, which involves computer sorting and a new mag tape before the film making ever begins.

That's why we developed the FR-80, a film recorder that does all of this in one pass, either from mag tape or on line. And the resulting film has a resolution of 80 line pairs per millimeter — nearly twice as high as from any other equipment.

Do parts lists need this kind of sharpness? Sometimes, yes. High-quality alphanumeric images yield high quality reproductions. What's more, the next customer may well have a digital tape of engineering drawings, and *his* film will make E-size enlargements that are needle sharp. No other film recorder can match this.

We're in the business of visual information handling in other ways, too, with systems that interpret images under program control. Our delivered products are analyzing seismograms and oil well logs, cleaning up soiled engineering drawings, reading oscilloscope wave forms, interpreting medical x-rays, extracting information from theodolite photographs.

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cations that they were using for themselves. Some banks then began offering such services to other financial institutions such as savings and loan associations, credit unions, and mutual funds. Finally, the banks began to sell data processing services to their business and professional customers.

Long-range planning studies were made by many leading banks to evaluate the possibilities of new bank services through the use of EDP. These studies revealed that: (1) the market for such services consists of institutions which are too small to afford their own computers; (2) many banking applications of EDP can be used by other financial institutions; (3) a large part of the market for data processing services prefers to deal with banks because of banking's reputation for efficient and confidential handling of financial matters; (4) a large segment of the market for data processing services is already tied to a bank by an existing banking relationship.

Why Banks Offer DP Services

The three main reasons that banks offer data processing services are: (1) to earn a profit on such services through net fee income; (2) to obtain the additional deposits, loans, or trust business generated by the performance of a computerized service; and (3) to retain present banking customers who might be lost to competitors who offer such services. Some bankers believe that data processing services will eventually have a financial impact equal to or greater than the income produced by the well-run trust department in terms of net fee income, new business and business retention.

Correspondent Services

Many banks offer computerized checking account processing to small correspondent banks. The computer programs used by the large banks for their own demand deposit accounting usually require only a few minor changes before they can be used for the correspondent banks. Encoded checks and deposit slips are transported to the computer center of the large bank and processed over-night. These documents are returned to the small banks in the morning along with the necessary management reports. The large banks also prepare customer statements and other special required reports.

Account Reconciliation

The reconciliation of the demand deposit account balances of large business customers each month is a major computer service offered by commercial banks; it is one of the few services where a fee is not charged provided a minimum balance is maintained by the customer. Almost all other services are offered on a fee basis only. This service is currently unpopular with many banks, because it is viewed as a costly service that has not been a factor in increasing or retaining corporate deposit balances.

In one application the customer puts a five-digit MICR check number on the bottom right hand corner of the check. The computer can be programmed to sort the checks in account number order, list checks absent from the series and list all of the checks. The customer sends his outstanding file of checks (the check stubs of written checks) to the bank. The check stub information is transferred to punched cards and entered into the computer. Using the information from the checks received and the stubs the computer reconciles the account.

Payroll Accounting

The payroll service produces: payroll checks for employees (or can credit their checking accounts); individual employee earning statements; a payroll journal report which shows cumulative year to date totals of each employee's gross earnings, withholding tax and social security reports; quarterly social security and state unemployment insurance reports; W-2 forms for each employee; and other specialized reports.

The payroll service can produce deposit balances as well as fees. A payroll disbursement account must be maintained, thus providing the bank with the dormant funds that usually exist in such accounts. The payroll computer service also presents the bank with a unique opportunity for implementing "in-plant banking." The employees of a customer using this service become prospects for such services as crediting the net of an employee's pay to his checking account, automatic savings or Christmas Club deductions, or mortgage and personal loans with automatic payment features.

Professional Billing

The professional billing service is a computer service for major customers. It offers a billing and partial accounts receivable accounting service to doctors, dentists, lawyers, country clubs, and certain small business firms. This application is feasible only for firms with a comparatively small and stable accounts receivable turnover. The main customers of this service at present are doctors; therefore it is frequently called "doctor's billing."

This service usually includes the transmission of data over telephone lines to the bank's computer center from a data transmission terminal at the customer's office. Each day the customer's office personnel transmit information on charges and cash receipts to the bank using pre-punched customer cards furnished by the bank. The dollar amount of the charge or payment is "keyed in" using the numerical push buttons of the terminal. Payments are distinguished by a special one-digit code. A receiving keypunch unit at the bank records the electronic data on punched cards. These are entered into the computer system, where each account is updated. The computer provides the customer with a daily listing of the day's transactions, monthly customer statements, and monthly aged trial balances.

Income and Disbursement Analysis

Another frequently offered computer service for businesses and individuals, including farmers, is income and disbursement analysis. In this service a bank assigns income and expense codes to the checks of certain customers and then produces a monthly income and expense distribution report for these customers.

In one application, the customer writes a three-digit number on his deposit slips (income) and on his checks (disbursement). Each month data from the customer's checks and deposit slips that accompany his checking account statement are transferred to punched cards and processed by the computer. The computer distributes income and disbursement amounts according to the codes used, and produces an income and expense distribution report.

Bank Credit Card Service

The credit card operation of many banks can be considered a computer service, because many banks agree that it was unprofitable until the arrival of computer processing, because of the large volume of paperwork it entailed. Many

large banks throughout the country have recently started credit card plans. It has been estimated that over 1,000 banks and about ten million Americans were holding such cards in 1967.

Bank credit card plans allow businesses to offer "charge account" terms to their customers without the expense and problems of billing, accounts receivable, and credit management operations. Such businesses are able to offer credit terms and still operate on a cash basis as the bank will discount credit card sales invoices for cash. The discount rate used may vary between four and six per cent depending on sales volume and on the particular bank credit card plan.

Banks process the sales invoices by transferring the necessary transaction information into punched cards and completing standard billing and accounts receivable computer processing. The bank credit card customer receives just one monthly bill, even though purchases may have been made at several participating stores. Most bank credit card plans also include a feature of a consumer line of credit. Repayments due on outstanding loans are also included in the monthly billing.

Sales Analysis

The credit card operation of some banks includes the production of sales analysis and market research reports that are provided free to participating businessmen. These reports are the by-product of computerized credit card accounting which includes billing and accounts receivable accounting. Such banks acknowledge that they can offer their sales analysis and market research service only because their credit card operation is handled by computers. Some of the information that is available to a business participating in these bank credit card plans are: the names and addresses, the number, and total dollar value of purchases each month; average dollars spent during the current year; and total dollars spent during the previous year by each customer on a monthly basis. Selective lists of customers of a business are also available, such as customers who spend more than $25 a month, or customer accounts active during a specified period.

Conclusion

Banking's entry into the provision of computerized financial services has important implications for organizations which currently provide financial data processing services. Accounting firms and data processing service companies are the organizations that will be most directly affected by the development of competition from banking. Several accounting and data processing organizations are currently attempting to use legal and legislative action to forestall banking's entry into the data processing service industry. Whatever the result of these efforts, accounting firms and data processing service companies must now face the emergence of a new and powerful competitor providing data processing services.

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EDITORIAL

(Continued from page 6)

of income and enormous social advantages in a few years. Yet too often people in a herdlike manner and rather stupidly copy what seems the current fashion in new ideas — instead of exploring a deliberately new combination.

Fortunately, in the United States these days, there is a fine environment for going ahead with new ideas: (1) you do not have to receive permission or approval from some stupid, unimaginative authoritarian government or business; (2) you can put together the means of production quite easily — capital, materials, services, know-how, and entrepreneurial skill; (3) you can experiment on a small-scale before you go to production on a large scale; and (4) the whole process is interesting, exciting, and rewarding — emotionally and financially — if you do not make too many mistakes.

That is why in about three years the number of vendors of time-sharing services has gone from about 5 to about 5000.

Edmund C. Berkeley

Editor

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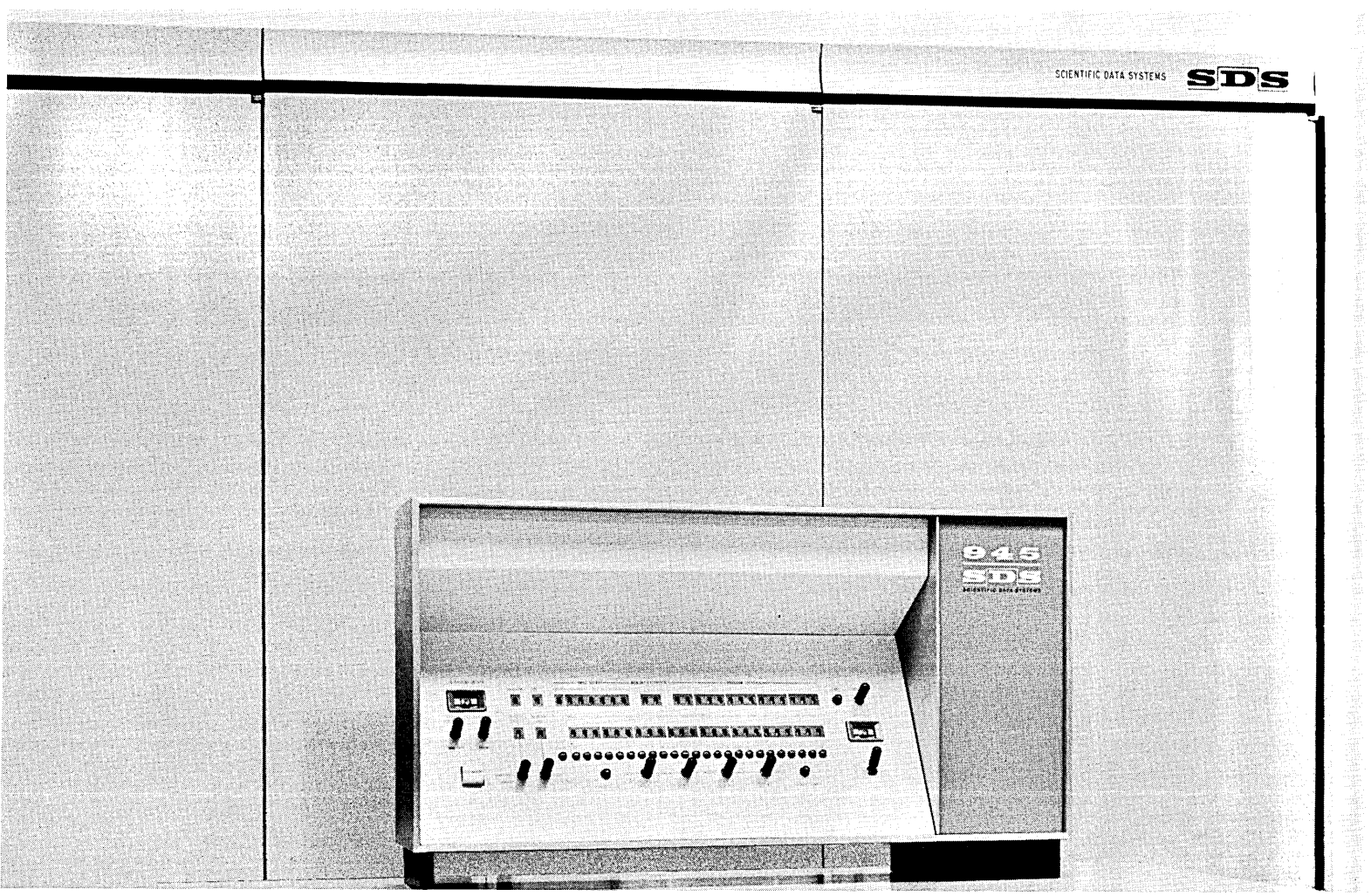
[1]See "New Ideas That Organize Information", *Computers and Automation,* December, 1967, page 6.

[2]See page 57, *A Guide to Mathematics for the Intelligent Nonmathematician,* by Edmund C. Berkeley, Simon and Schuster, New York, N.Y., 1967, 351 pp.



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Anyone who knows much about time-sharing knows that our 940 has the best time-sharing software you can get. Because there's more of it, and it can do more, and because it is working.

But up to now the only way you could get our 940 software was to get a 940, or rent time on one.

Now you can also get it with our new 945 computer. The 945 will cost you less than $15,000 a month. That's about $10,000 a month less than a 940. And it's as cheap as renting 5 full time terminals from a time-sharing service bureau. (You get 24 with the 945.)

In fact, the 945 is the least expensive time-sharing computer on the market. It's every bit as fast as a 940, it has the same excellent response time, and it uses the same software.

Which means that the 945 comes complete with Basic, CAL, conversational Fortran, Fortran II, a two-pass assembler, a text editor (QED), a debug package, a utility package and a complete library of special programs and routines. And even though the 945 is new, the software has been proven by the toughest customers you can find: time-sharing service bureaus.

Then why is the 945 so much cheaper?

Simply because fewer people can use it. The 940 is designed for service bureaus and large companies with hundreds of different users. The 945 is designed for companies and institutions with dozens of users.

The 945 can recognize up to 64 individual users. And up to 24 people can use it at the same time.

That, more or less, is the whole idea of the 945.

Less people can use it and more people can afford it.

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INNOVATION IN TEACHING — WHY INDUSTRY LEADS THE WAY

Nate A. Newkirk
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Computer Usage Education, Inc.
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"If in a company 500 technicians must at present spend four weeks per year in school to keep themselves up to date, and if a new education method can cut that time to two weeks, a reasonable estimate of the saving to the company is $300,000. To generate a similar amount of net profit, most companies would have to sell at least $3,000,000 more of their products and services."

In California, about 1961, an electronics firm introduced a new teaching method and reduced its engineering training program from six months to three months. Veteran company engineers soon asked to be allowed to enter it. They saw they were missing something.

In Nigeria, in 1964, a group of 50 Africans from six nations was seen studying 10 to 14 hours a day, month after month, using a new method.

In Belgium, in 1966, one instructor conducted two classes, covering two slightly different technical subjects in two different languages, simultaneously, using a new method.

In Canada, in 1966, a young man started conducting a six-week technical class for twelve students who had a better formal education than he. He'd never taught before, and he had less than a week to prepare. Most students finished the course in less than four weeks. The students thought the class was a great success. The teacher enjoyed every minute of it. He used a new method.

Not more than a handful of dedicated "industrial educators" (perhaps not even the man who started it all in California) are aware of the significance of this chain of events. This new teaching method is one of the innovations produced in industry education, and will be discussed more fully later.

The Lecture Method

But first, let's look at the conventional, centuries-old method of instruction — the technique most familiar to all of us — the "teacher-in-front-of-the-class" approach. Let's call it "the lecture method." (Although the term "lecture" has certain unpalatable connotations in industry education, it's still a fairly accurate description of what usually happens in classrooms, regardless of what's being taught.)

To start with, let's consider the assumptions that a teacher is required to make before he steps in front of a class and begins to "lecture":

1) The group is ready to learn.
2) The group is willing to begin where the teacher wants to begin.
3) Each student will learn at the same pace as the other students in the group, and will be able to keep up with the teacher's presentation.
4) Students will learn the material in the sequence in which the teacher presents it.

"Unrealistic," you may say. Right! Yet, no teacher can conduct a lecture class without assuming these conditions. The instructor's success with his class depends upon his ability to cover each topic in such a way that each individual is able to learn it — now, in the given sequence — in the time allotted for the class.

Result? A tremendous variety of successes or failures, depending upon many factors: the teacher's skill, patience, and knowledge of the subject, the number of students in the class, the similarity of their backgrounds, knowledge, intelligence, etc.

Your next question might well be, "If that's all true, how come the lecture method is still the most common method of instruction?"

I think the key reasons rest with the teachers themselves, and the emotions that motivate them to be teachers.

Teachers are smarter than most people, and they're strongly motivated to leave their mark on society by contributing their knowledge in the way that seems to affect the most people. They get their greatest satisfaction from seeing their students grow, change, and improve under their guidance. The vast majority of teachers thrive on their emotional role in the personal teacher-student relationship. Being human, they usually love to lecture. It seems the easiest way to prove that they know their subject. (Incidentally, for those who really know their subject, and who have been teaching it for a long time, lecturing requires very little pre-class preparation. That leaves time for study, research, student counseling, and other, less dedicated pursuits.)

Naturally, when someone comes along who advocates that teaching might be more effective by using other methods, most teachers react negatively.

Educational Systems

But the teachers are not the only ones to blame. Consider the entire public educational system. It still places emphasis on the very valid idea that a student must not be sent to

college, or out into the world, until he is mature enough to cope. (One obvious alternative, to teach a lot more in those thirteen years of preparation for college or leaving school, has been exploited considerably in the past decade, to be sure.) This objective is fine. But how do you evaluate a student's education with this intangible objective as a criterion?

Let's switch our thinking now to what we will call the industrial education system, the system of adult education usually provided by an employer. To avoid clouding the issue, I won't attempt to differentiate between education and training.

Industrial Education Methods

How is industrial education different? To the casual observer, the differences seem to be largely the subject matter and the age of the students. Plus the depressing fact that industrial teachers are often higher paid than the best paid teachers in our nation's public schools.

To the experienced educator, there are still greater differences. In industrial education, there is great emphasis on the quality of instruction. But the purpose of industrial education is "high quality, at the lowest possible cost, and with the greatest possible speed." And in industry you can usually measure your results.

Quality

Take the quality factor. Since most industrial education means teaching a specific skill, it's usually easier to determine if the student is able to do the work when he's finished. Either he can operate a lathe or he can't. Either he can use a desk calculator or he can't. Not all subjects being taught in industry are by any means as "yes or no" as those examples; but it's regularly easier to judge the effectiveness of industry teaching than it is to determine if a youngster is ready for college.

I am not saying that the industry educator does not face problems. Here are some factors that tend to complicate the quality judgment in industrial education programs:

1) Since education is frequently regarded as a "necessary evil" (that means it's not a direct revenue producer), it's hard to find a top executive who is willing to pay much more than lip service to the activity.
2) Not very many companies have an "Education Department". The function often rests with a particular department manager, or one of his designees, who regards education as an additional duty.
3) Even in some of the best organized industrial education departments in the world, it's not easy to find someone who's had formal training in schools of education. (Before you become too concerned about that fact, however, remember that only a small percentage of university teachers have had such training.)

Cost

What about the factor of cost? In public education, the taxpayer is at the mercy of the school officials (although they would have us believe it's the other way around). "Sure," you say, "but our town has turned down school budgets and bond issues." Let me express it this way. As I see it, the taxpayer is thoroughly boxed in. He wants his Johnny and Susie to have the best education possible. But the real problem is — he knows nothing about education. He is forced to rely, for the most part, on elected officials to represent him. If his local school board consists of people who are trained or experienced in school administration, his community is fortunate indeed.

In industry education, costs are also difficult to control, but there's one all-important difference. There's frequently a comparison available between the total cost of hiring people who have the required skills, and the total cost of educating people who don't. That comparison is continually being made, and it doesn't require any education expertise. It serves nicely, moreover, to keep the industrial educator honest.

Speed in Industrial Education

What about the factor of speed? It's clear that time is the greatest contributor to cost. Total teaching salaries, student salaries and classroom space are affected. But there are more subtle items also. What about student living and travel expenses if they must visit a distant location for training? That cost alone can easily become 50% of a company's total "per student" training costs. But by far the most subtle and important consequences of the speed factor may lie in its effect on the size and cost of a company's workforce. If in a company 500 technicians must at present spend four weeks per year in school to keep themselves up to date, and if a new education method can cut that time to two weeks, a reasonable estimate of the saving is $300,000 (see Chart 1). To generate a similar amount of net profit, most companies would have to sell at least $3,000,000 more of their products and services.

Speed in Public Education

Let's speak again of public education, for the moment. We've commented on the good job the schools have done since Sputnik in 1957 woke us up to the need for better education. But if you want to contemplate a really significant effect on teachers, students, and your annual school tax bill, how about having society accept the idea that a youngster is as adult today at 17 as he was 50 years ago at 18? It should follow then that he can enter college at 17. (Plenty of them are doing it right now.)

So why not bring the speed factor into public education? Let's eliminate one calendar year of school, but let's not do it by shortening the holidays, or by working longer hours, as recently announced by a Long Island school. Let's do it, as a well-known IBM executive is fond of saying, "By working smarter, not harder." If that sounds like a ridiculous idea, keep in mind that eliminating one entire school year constitutes an overall reduction of only about 8% in total school time required for our youngsters.

New Teaching Methods

Earlier, I commented that most teachers react negatively when it is suggested that there might be teaching methods which are superior to the lecture method. But, on the other hand, many top educators do realize the need for innovation. Dr. Mark Scurrah of the New York State Education Department Center on Innovation said in a recent speech, "We are terribly unimaginative as teachers. We seem to feel that talking is the only way to impart knowledge."

Why is it, then, that much more innovation occurs in industry education, especially since so few industry educators are trained as educators?

I believe that one important reason lies in "the system." (Don't forget the purpose of the industry education game: "High quality, at the lowest possible cost, with the greatest possible speed.") Every true educator is striving for quality, in public or industrial education. Cost and speed are simply more important in industry than in public education. Let me add two more examples that illustrate the importance of speed.

Chart 1

Company F's maintenance staff includes 520 technicians, who must spend 4 weeks per year in school to keep themselves up to date. How many technicians are required if this schooling can be cut to two weeks -- all other factors remaining equal? At present, 520 workers x 48 work weeks = 24,960 total work weeks. If each technician can work fifty weeks, instead of 48:

$$50 \overline{)\ 24.960} \quad 499 \text{ technicians required}$$

The expense of keeping those 21 extra technicians on the payroll can easily look like this:

21 salaries @ $8,000	$168,000
2 supervisors @ $12,000	24,000
Fringe benefits @ 15%	28,800
Floor space for 23 people, 100 sq. ft. each @ $5.00 per sq. ft. per year	11,500
Tools, equipment, etc. @ $200 per technician	4,200
	$236,500
Miscellaneous overhead (10%)	22,650
	$259,150

And what about training costs:

Eliminate 500 students for 2 weeks each	1,000 weeks
Then -	
Eliminate 21 students for 4 weeks each	84 weeks
Savings =	1,084 weeks

A cost figure of $50.00 per student week would be very low for most training operations, not including travel and living expenses.

	1,084
	x$50
Training cost saving	$59,200
Payroll cost saving	259,150
Total Saving	$318,350

The Value of Saved Time

Company A has an 18-month training program for newly hired salesmen. The sheer length of that program may have a direct bearing on that company's efforts to hire top candidates. Few fresh college graduates, especially those holding advanced degrees, are interested in entering an 18-month training program if they can avoid it. Usually, it simply means more delay in starting to earn "the big money". A substantial reduction in the length of that program, provided quality is maintained, might do more than any other single thing to raise the quality of that newly hired sales trainee, and thus, eventually improve the quality of the entire sales force.

Company B produces a specialty electronic product. It has a highly trained staff of technicians to service and maintain its product. The engineering department has developed a greatly improved version, and it is estimated that, when they start shipping it, profits will increase by $1,000,000 in the first year. But before it can be released to customers, the technicians must be trained. All else being equal, if the training program can be cut by one week, it might mean as much as $20,000 added profit, since shipments can begin one week earlier. Not to mention the cost savings resulting from the reduction in the training program.

Nearly all large organizations can cite better examples than these which will show the dramatic impact of reducing the length of their training program. Why not develop a similar rationale regarding public education?

The Difficulty of Bringing Students Together

The second important factor spurring innovation in industry education lies in the simple idea that it's frequently extremely difficult to bring students together for a class. After all, they have jobs, family responsibilities, and other demands on their time. Then too, there's the continual problem of the company "crisis du jour", that arises to prevent a key person from attending a class. These complications lead to all sorts of interesting methods to make certain that students make it to class as scheduled. One company often gives a student a day or two off, prior to class. They tell him they want him to be "fresh and alert". The fact is, however, it's nearly a foolproof method to get him away from business problems that might prevent him from attending class.

A third factor in encouraging innovation in industry education is the sheer physical problem of assembling students. That may involve high expenses in student living and travel and more lost time due to travel.

Unlike public education, industry education is frequently a "crash program", for many reasons like Company B's problem of preparing to market a new or improved product. There's also the frequent requirement to take a segment of a company's staff and give it a "one-shot program."

- Example: A company manufactures radios. They switch from tubes to transistors. A new technology must be taught.
- Example: A company introduces electronic data processing. Every executive and manager, not to mention every employee in affected areas, must be given an orientation program.

In these cases, adequate classrooms are frequently not available, and instructors are almost never ready and waiting.

The Student Himself

A fourth factor is the student himself. He is frequently unprepared, unmotivated and uninterested (just like some youngsters of our acquaintance), but the adult student is usually much quicker to react vocally to poor instruction.

Also, to complicate things further, the older we are the slower we learn. Therefore, the teaching method must be more challenging. If you don't believe this, try a little research in a typical education department. Examine two or three classes where the students were ranked in performance. Compare those rankings with the "age ranking" of the students. The youngest will often be grouped at the top of the class, and the oldest at the bottom.

A fifth factor that contributes to the urge to innovate in industry education is the character of the education staff itself — the managers, developers and teachers — whose motives may be considerably different than public educators. Let's examine this factor carefully:

1. Few industry educators consider education as their "career." For most, it is another in a series of diverse assignments.

2. Industry teachers seldom spend more than 50% of their time in class, actually teaching. For some assignments, 20% is considered a "full-time" teaching load.
3. Only a small percentage of industry teachers have taken education courses at the university level. Even fewer are, or have been, certified to teach in primary or secondary schools.

Let's imagine what goes on in the case of a bright businessman who is selected for a teaching assignment in his company's education department. First, he is aware that most of his predecessors have stayed in education for a relatively short time, perhaps only two or three years. The good ones have then moved on to better jobs. He also realizes that he's never taught before, except perhaps as an incidental part of a former job. Finally, if he's ambitious and bright, he knows that he must do something extraordinary in order to assure recognition and commensurate reward. This last thought is common to nearly every known situation. But remember, the industry educator is in a system that allows him to exploit his opportunity to excel. In that sense, he's in a considerably different position than a public school teacher. He realizes that to excel in teaching is expected. Perhaps, therefore, he begins to seek new and better ways to teach.

Innovative Methods of Instruction

What methods can he choose? A whole host of new and different techniques have come into being in the past 15 years or so. Most famous for several years was Programmed Instruction (P.I.), developed by B. F. Skinner of Harvard. Today it is Computer Aided Instruction (CAI) that makes the headlines. In between were many variations on the theme, each with some applicability in the education scheme.

Through nearly all of these innovations in instruction are some common threads:

- The student can learn on his own, rather than in a group.
- The student sets his own pace.
- The material is carefully structured in order to minimize the time required for learning a given amount of information.
- The student is actively involved in the learning process — he's not just sitting there listening.
- The student is kept abreast of his progress, or lack of progress.

At this point, think of a "new" teaching technique you are familiar with, in terms of those five factors. Do they all apply to the technique you picked? Probably. (How about "the book" as a means of learning? It fits every factor, except possibly the last one.)

There's another characteristic I didn't list that is common to nearly all of these techniques (including "the book"). There's no personal interface with a human teacher.

Job Security of Teachers

It's not hard to understand why teachers might resist these new methods. Their resistance should ring a bell with lots of us. Let me explain why by asking you a question. What is the usual reaction when employees hear that their company's getting a computer? Any fleeting worries about job security? Of course! With some it's more than a fleeting worry.

When the job security of any group is threatened, for whatever the reason, there is a natural resistance from the group. Why should teachers react differently when a new concept seems to threaten their security? I think I can hear you saying, "But very few people lost their jobs because of computers. In fact, there are more jobs now than ever, and unemployment is very low."

Right. And new teaching techniques will undoubtedly, in time, produce the same results. A result that is common to nearly every innovation introduced since the first prehistoric man hooked up a crude wheel to a cart.

But let's think back to another fundamental point that goes beyond job security. Remember our earlier discussion about the motives that teachers have, and the satisfactions that they derive from being teachers? Guiding students in their growth. The personal student-teacher relationship. The love to lecture. Now we're arriving at what I believe is the true source of teacher resistance to new teaching methods.

The real effect of innovation in the Industrial Revolution and the Computer Revolution was job displacement, not job replacement. Stagecoach drivers learned to drive buses. Wood carvers learned to operate wood lathes. Clerks learned to program computers. Now the Teaching Revolution is upon us. What will the teachers do?

Did you nod in agreement when I said that teachers are smarter than most people? If so, you might now agree that if a teacher can continue to gain personal satisfaction from his work, he'll probably continue to teach. So, let's consider one more factor. Dedicated teachers are often frustrated by their inability to give adequate attention to each student, especially in these days of over-crowded schools. They would love to pull the under-achiever up by his bootstraps, and push bright ones on to greater heights. But the class is too big, and the teachers have more material to cover than ever before.

Learner-Controlled Instruction (LCI)

These same positive and negative factors existed in California, in Nigeria, in Belgium and Canada. And in each case, an industry educator decided to try something new, a technique which at first glance doesn't seem new at all. Dr. Robert Mager pioneered this technique at Varian Associates in California in the early 1960's. He called it Learner Controlled Curriculum. I introduced it in IBM in 1963 and labeled it Learner Controlled Instruction. Here's how LCI works:

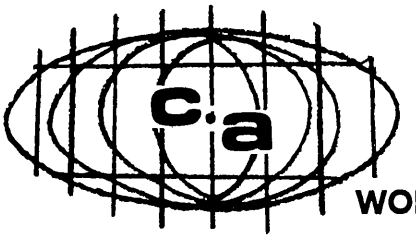
Each student is given a detailed list of specific "learning objectives." He is given suggestions for reading, reference, observation, inquiry, practice, or experimentation. He is told precisely how he must demonstrate that he has learned the subject at various stages (if appropriate) and when he has finished. He is advised that he may direct specific questions to the instructor in private, and that he will receive a specific answer. He is informed that there will be no formal class session, and that he may begin to learn in any manner he chooses. Finally, the student is told that, when he has completed all requirements, he is free to return to his job. He is then directed to a quiet place to study and the instructor establishes himself in a convenient location.

Please read that paragraph again carefully. In it, the essential ingredients for the success of LCI are stated precisely. The same technique applies equally well, by the way, for groups of students.

Categories of Subjects to Be Learned

Before we go on, let me remind you that there are two broad categories of subjects that we learn in life. One broad group consists of specific skills — mathematics, engineering, the sciences, machine operation, and computer programming, to name a few. The other broad group generally centers around the idea of changing a person's attitude or outlook — music appreciation, salesmanship, and public speaking, for

(Please turn to page 53)



REPORT FROM GREAT BRITAIN

ICL Goes for Big Machine

Looked at from the British point of view rather than internationally, the highlight of the past month must be the announcement that the UK is going back into the Big Machine Handicap for the first time since Ferranti sweated blood to build Atlas, to lose a lot of money and to teach about every other computer manufacturer in the world how giant machines should be tackled.

The announcement was made by Arthur Humphreys, the man whose drive made International Computers and Tabulators 1900 series a best seller, now managing director of International Computers, the merged UK computer force which has an annual market of some $300m of which one-third represents exports. He disclosed the fact that the company had decided to go ahead with a really big machine, using its own technology and calling it the 1908A. Fast ECL circuits developed for the 1906A would be the basis, together with multi-layer platter assembly and suppression of back-wiring.

It will start at a notional cost of about $4m and a reasonable configuration would have 20 times the power of the larger Atlas I, and if by that Mr. Humphreys meant the Atlas at Chilton, near the Atomic Energy Authority research centre at Harwell, then the 1908A can rank with the top machines anywhere. It can operate with a single or twin processors, or again in conjunction with the 1906A. A four-way interleaved store will be in modules of 125K words of 25 bits with 330 nanosecond cycle time.

The delivery date is set at 1972, which surprised and disappointed some, but the company contains a large number of former Ferranti staff who no doubt counselled caution in this development though it will have all the software and peripherals already developed by the company at its service. Two contracts are foreseen already, both for Government agencies, and it is to be hoped that many more are in the pipeline because without them the company should not undertake the job.

A Role for the System-4 Series

At the same time as he announced the new machine from the ICT stable, Mr. Humphreys spelled out the role for the System-4 series he took under his wing when the English Electric Computer Company was merged with ICT to form ICL. It is to be offered specifically to IBM users to take advantage of its compatibility with System-360, a compatibility designed into it by RCA which supplied the basic design to English Electric. There have been a few instances in the recent past in which a System-4 machine has actually displaced a 360 but they have come much later and are a lot fewer than English Electric led us to expect when the series was its pigeon. There have, of course, been recurrent rumours that by the end of this year Rolls-Royce would discard one of its 360/65 machines at Derby in favour of a System 4-70. Knowing what backing IBM gave for the installation of the Rolls-Royce machines before they went on the air, I will believe this when I see it.

Sales to Eastern Europe

One source of concern to ICL must be the future of its sales to east European countries following the tragic events in Czechoslovakia, one of its leading customers. ICL had succeeded in placing some $40m worth of business in the area since the policy of greater liberalisation of external trade began to be followed by the Comecon nations two to three years ago and a number of worthwhile contracts were in the offing. Even the U.S. Department of Commerce and the NATO strategic embargo group appeared to be softening their attitude to the export of quite powerful equipment to Poland and Bulgaria, not to mention the Soviet Union itself . . . the Department must sanction certain U.S. peripherals and components which the UK market so far does not supply. What the attitude of both will be now is anybody's guess, even though the Prime Minister, Mr. Harold Wilson, told Parliament that a trade embargo and the rupture of cultural relations would help nobody and the poor Czechs least of all. It is possible to see two consequences of the Soviet blunder: a much slower penetration of the supposedly lucrative eastern market by Britain and a speeding up in negotiations with European countries for joint projects in computing with ICL.

Two New Networks

There have been two extremely important developments in the network field. One is the decision of the Northern Stock Exchange to go for a full client and broker accounting service and ultimately operate it on-line to process clients' contracts in five major northern cities. It will start work off-line by next March and in about a year after that move to the on-line mode.

The other project is the much more ambitious one of establishing a nation-wide law retrieval system which has 5,000 potential terminal users in Britain. International Data Highways, which has the SCAN stockbroking on-line real-time service to its credit, is the author, and is sinking about $150,000 in the initial investigation of feasibility. It is thought that a pilot system could go alive with about 200 subscribers, and the most likely hardware for the full job is Univac 1108 machines.

The system would provide conversational interrogation of files containing statutes, reported and unreported cases, special instruments, and textbook commentaries on cases of major importance.

C.a PROOF GOOFS

Neil Macdonald
Assistant Editor

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

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

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

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

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

Proof Goof 6810
(Find three proofreading errors)

Search problems

Consider for the moment the problem of searching for submarines in the path of a ship or convoy during time of war. Dirigibles and small airships were used for this purpose. These craft moved slowly over the water at a low altitude and hence had a very high probability of detecting a submarine if it was under them and of not claiming to have detected one when none was there. But because such craft moved slowly they could not 'sweep' a very large area and hence could miss submarines which could come into striking range. If, on the other hand, a very fast plane was used for this purpose, it could cover a much larger area but the accuracy of its observations would be much lower because of its speed and higher altitude. In this case the improved coverage did not compensate for the increased error of observation.

In looking for something, there are two kinds of errors which can be made: (1) failure to detect what one is looking for because of inadequate coverage (*sampling* error), and (2) failure to detect what one is looking for even though one has looked in the right place, or erroneous 'detection' of the thing which is not there (*observational* errors). There are, of course, costs associated with both types of error and with the collection of information.

If one has a fixed amount of resources (time, money, or searchers) a decision must be made as to how much coverage to have (sample size) and what type (sample design). The larger the sample the less is the likelihood of sampling error, but the less time spent per observation, the more likely is an observational error to occur. The selection of an appropriate sample size and design with fixed resources is the *restricted* search problem. In the *unrestricted* version of this type of problem one must also decide how much resources to use in the process. The more resources employed, the greater is the cost of the search but the less is the expected cost of error.

You will probably have recognized by now that auditing is a search procedure and that it raises problems of exactly the type that we have described. Unfortunately, most persons who design auditing procedures are not aware of sampling error and they seem to assume that auditors never make observational errors. Several tests have been carried out to show that this assumption is not justified; that the frequency of auditing errors depends on the amount of time spent with a document and on the individual involved. Using this information it has been possible to design auditing systems for railroads, for example, which consumed less time and money and yield less error than the conventional system that was replaced.

Most accounting procedures can be viewed as searches. More generally, all problems of estimation and forecasting are search problems.

Many OR workers have also applied search theory to exploration problems; to determining what areas to explore and how to explore them. In one case involving exploration for nickel it was possible to develop a procedure which reduces the number of holes required to make the necessary estimates by almost 50 per cent. Similar procedures have been applied to prospect for coal.

Search theory is also applicable to the design of inspection procedures and quality control systems. Both types of error, sampling and reservations, are involved and the amounts of money to be spent on inspections must be determined.

There is another type of search problem in which the searching procedure in not under control, but the thing being looked for is under control. For example, most retailers cannot control the search patterns of customers in their store, but they can control the location and allocation of space to goods. This too is a search problem and the same type of theory is applicable to it. It has been used successfully, for example, in placing goods, counters, and departments in supermarkets and department stores.

— From *A Manager's Guide to Operations Research,* pp 53-55, by Russell L. Ackoff and Patrick Rivett, John Wiley & Sons, 605 Third Ave., New York. N.Y., 1963, 107 pp.

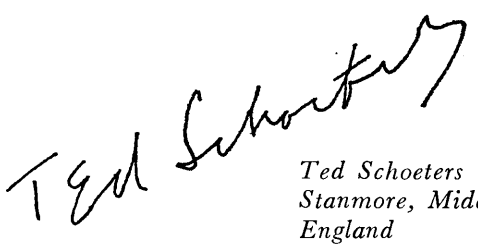
Solution to Proof Goof 6891:
Line 12: Replace "reuntied" with "reunited".

Solution to Proof Goof 6892:
Line 8: Replace "that" with "than".
Line 12: Replace "terrestial" with "terrestrial".

Report from Great Britain

(Continued from page 49)

These and the many other projects which depend on fast communications over the common carrier network are to some extent at the mercy of the study being carried out by Scientific Control Systems (formerly CEIR) on behalf of the Post Office, which finally abandoned its own somewhat archaic market research effort a few weeks ago, after coming under heavy fire from fluent spokesmen for the Real-Time Club at a large symposium — the spokesmen including Charles Ross of International Data Highways and Professor Stanley Gill of Imperial College. The argument in a nutshell is that the Post Office says a computer network should be able to make do with the existing telephone and telegraph lines. The real-time men say bitterly and not figuratively that it will be over their dead bodies.



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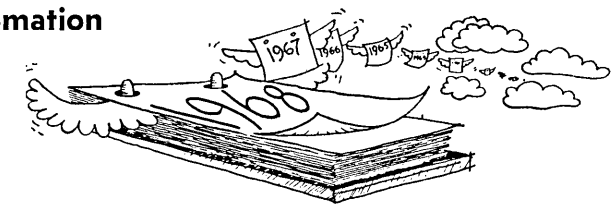
Stanmore, Middlesex
England



Electronic Equipment Applied to Periodic Billing

Reprinted from Vol. 2, No. 8 — November, 1953

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Newark, N.J.

It seems that in the world of business almost everyone's initial reaction to electronic office equipment has been one of hope and enthusiasm that a new era of higher standards of speed and efficiency is about to begin. It also seems that this initial hope and enthusiasm soon becomes mixed with the fear that the costs and complexities of electronics will make this new equipment impractical for business use. This secondary phase of doubt and fear is a rather dangerous place to be, because it is not necessarily a passing phase. There is great danger of business people becoming permanently stuck at this stage.

Stages of Investigation

In most business organizations the initial contact with electronic office equipment is generally brought about, it seems, by someone reading an article or hearing a talk on how this new marvel of the twentieth century will bring about the millennium of business efficiency. This inspirational approach generates the original enthusiasm for electronics, and the enthusiasm leads to wide investigation of anything and everything related to the field of electronics for business use. Out of this study some knowledge of the equipment is acquired and, more important, some appreciation of the problems involved is developed. At this point the investigator becomes perplexed with such problems as:

1. Are the costs going to be too high?
2. Are the possibilities for errors too great?
3. Is magnetic tape a practical medium for random reference?
4. Can the machines operate long enough at one time to produce a full day's work each day? etc., etc.

Here is where the secondary stage of doubt and fear as to the practicality of the equipment develops.

In the business world, if the potential benefits originally visualized are to be achieved, these problems cannot be ignored but must be solved.

A third and rather obvious stage, in order to get away from the stage of doubt and fear, may be to plunge into the use of electronic office equipment and compare how well and how cheaply the work can be done. For this purpose, we ordinarily try to translate a present procedure into the media and language of the new equipment. But it is my conviction that this method simply will not work satisfactorily, for the difference is likely to be insufficient to demonstrate clearly the potential advantages of the electronic equipment. The main reason for this is that present procedures have been tremendously conditioned over some years by the peculiar abilities of clerks and present equipment. To simply carry over these peculiarities to the new machines will not permit them to show to any great advantage. So when business executives finally see that drastic changes in procedures are needed to obtain the desired high efficiency from electronic equipment, then the progress toward improved methods is in danger of bogging down.

*Mr. Cooley is now the Director of Electronic Systems at the Prudential Insurance Co. in Newark.

Aims and Purposes

A logical outgrowth, however, of the third stage is to go back to first principles and to examine the *aims* and *purposes* of the work being done under the present procedure without too much regard for the way it is done at present. This fourth stage offers the greatest potential for the application of electronic equipment because it provides a fresh view of how the work might be performed and permits the unhampered use of the peculiar abilities of electronic office equipment.

File Maintenance

For example, when we develop a plan for use of tape processing equipment, we are forced to mechanize an area of work not often mechanized with card equipment. This is the area of file maintenance. With our file on magnetic tape we *must* use a machine to make changes, whereas with cards, we are likely to find it expedient to send a clerk to pick the cards to be changed and later refile the altered cards by hand. It is true that with a tape system we may punch a card with the new information. But then this card must be converted to tape and matched against the master record tape. A new tape will then be recorded with the new data substituted for the old where changes are necessary, and with all the unchanged data brought forward. This may be considered both a disadvantage and an advantage. It is a disadvantage to have to carry out a long machine operation when the proportion of changes is low; and with a card system we have a choice of manual or machine system and may do whichever we think is more efficient. But with the tape system we have no choice. Fortunately, it is usually found that file maintenance by speedy tape processing machines is a sound operation and that real savings can be made in mechanizing this phase of the work.

Automatic Operation

The peculiar advantage of electronic equipment, and it may be emphasized again and again, is that it is automatic and swift in operation. By virtue of its ability to work speedily from a long sequence of orders stored in the machine itself, lengthy processes can be carried out without any action on the part of the operator; delays and errors, so difficult to cope with satisfactorily in present systems, can be reduced tremendously; and scheduling the work so that machines are uniformly loaded should be much easier than with punch card systems. Of course, the development of the system, and the programming and the coding of orders, is a time-consuming job requiring great care.

The main cost saving from electronic office equipment should come through elimination of persons now doing routine picking and filing or operating semi-automatic machines. Another main benefit to be expected is improved systems owing to the downright necessity of closer study and better planning.

Lower Costs

This leads to a comment which is fundamental to any practical methods consideration. We do not make major methods changes just for the sake of change. We make them to gain real advantages, and it is my contention that the principal advantage that people in business are interested in is LOWER COST OF OPERATION! In business, we are not much interested in speed for speed's sake.

For electronic machines of high speed, high capacity — and high cost —, few facts with regard to economy have yet been established to my satisfaction. The cost of producing this equipment, taking research and development into consideration, is very high indeed, resulting in high cost to the user. Business users cannot bear these high costs unless there is a real saving to them over any other method. The evaluation and comparison of costs is the main research job of methods men studying electronic possibilities and, I predict, the uncertainties present in this study will continue for some time to come.

Periodic Billing

An important business application for electronic office equipment is "periodic billing". This term is here used in a very broad sense to refer to many tasks related to billing which depend on the same large file of business records. Of course, the prime example I am familiar with is billing of insurance premiums, including related jobs such as computing policy dividends, agent commissions, and policy loan interest, and subsequent accounting for premiums received. Another example is publishers' problems in mailing magazines to subscribers and following up for renewals. A third example is the billing jobs of public utilities.

Billing Insurance Premiums

What are the requirements of billing insurance premiums? In the first place, a policyholder may choose how often he wants his premiums billed: annually, semi-annually, quarterly or, in some circumstances, monthly. The average frequency in our case is two and a half times per year.

Dividends are calculated on the policy anniversary. The policyholder may choose how his dividend is to be used. The popular choice is to use the dividend to reduce the premium; and we use the entire dividend on the policy anniversary. So once a year the amount billed is the "premium less the dividend". This means that in a case billed quarterly only three premiums of a particular year are repetitive and the fourth one is different. Most of the remaining policyholders let the dividends accumulate at interest. In these cases the premium *is* constant. But a supplementary operation is needed to carry forward the amount of dividend to that policyholder's credit.

A great many changes affect the records necessary to carry out billing. The majority are address changes, which run as high as 25 per cent in a year. Other changes are in frequency of premium payments and other contract changes. Because billing, dividend computation, commission payments to agents, and so on, are all tied together and should be handled together, the job gets rather complicated.

Let us try to visualize the application of electronic computers to the job. First, many items in the records must be changed, and these changes must be fed into the system in some way. Our natural inclination is to use punched cards for this purpose. We must work from source documents of various forms, and a manual key operation is still necessary to convert the data into mechanical form. Card form has the advantage that it can be converted to tape form by a semi-automatic process producing input for the computer. And the cards themselves can be used to good advantage in maintaining a file to serve the purposes of "random look-up". Some of our worries about the difficulties of random access to a tape record can be alleviated by keeping this card record file.

All the large scale operations can be performed from the tape records. It is an advantage that all input be by tape for we are forced to mechanical maintenance of the fundamental records; in fact, this should be one of the best sources of saving, both direct and through improved accuracy.

It should be obvious that we must search for a combination of allied jobs. We should plan to use the capacities of the new machines as completely as possible. If we are to achieve the greatest economy of operation we cannot preserve barriers between departments with different responsibilities. If we are to have a single record in one area of tape for all data about a policy, then we must get all accounting reports required at the same time, in the same run of the tape.

Although I don't know intimately the publishers' problems and the problems of the utilities, it would seem that their data handling might be quite similar to ours. They too have a good-sized address file to maintain, with traffic problems; that is, they need up-to-date address data for billing purposes simultaneously with random reference and maintenance reference.

Random Reference

In regard to random reference, one school of thought seems to be that reference for any purpose can be deferred to a periodic search time. Thus if all records are on magnetic tape, the plan would be to run all tapes every so often and during this run insert all new data, delete all obsolete data, and extract all desired reference information. It is often suggested that such a run can be made once every twenty-four hours.

Whether such a plan can be considered satisfactory is very much an open question. It is true that *most* references *can* be delayed as much as twenty-four hours without serious difficulty. But it is *not* established that delays causing trouble will be few enough so that this plan can be accepted. The argument seems to boil down to this: the savings through using tape and tape-handling devices as the substitute for a real "automatic file" with random reference, have to be so great that powerful objections to the delays will be overbalanced. This means, I think, that faster and more economical tape-handling methods, or some other entirely new method, must be developed. Unless this is done, I am afraid most of us will consider it necessary to maintain card records of some sort. This fact, perhaps, points up again the need for flexibility in changing from card form to tape form and vice versa. In other words, we should not be restricted entirely to either medium but should use whichever fits the job requirements best. Fortunately, development of better card-handling machines is still going on in spite of the emphasis on tape as the modern medium.

With automatic equipment in which a large number of processing steps are completed in a single operation, it is very important that the maximum be done at once. Therefore, work requirements and machine abilities must fit closely. We have always fitted our work to suit the equipment available. With more automatic equipment, it is even more important that the machine be fitted to the job. In recognition of this, some of the new machine designers are planning to make the machines quite flexible in regard to adding additional capacity when necessary. Only experience will show conclusively whether they have achieved sufficient flexibility to meet our needs.

One question we must resolve is whether business users should expect competition alone to bring about the best designs. Since all manufacturers try to build for average needs for all their potential customers, it is by no means certain that their designs will give a particular company the maximum benefit. Just as other industries have benefited by special designs, custom-built for their purposes, so might we benefit by equipment designed especially for us.

In conclusion, I believe there is a great potential in the development of "electronic machines". But let's proceed with eyes wide open and without preconceived notions in regard to great savings of operating cost; and let's realize that lower costs *must be* attainable in order to justify the profound changes in organization and procedure which will inevitably be necessary.

Newkirk, "Innovation in Teaching"

(Continued from page 48)

example. The technique I've described is remarkably well suited to the "skills" group of subjects, but the "attitudes" group of subjects may be taught best by some form of active voice communication between teacher and student. A natural tendency is to consider most borderline subjects as unsuitable for LCI-type techniques. That may well be the same kind of error that was often made when determining if a certain task could be done by a computer. We're still amazing ourselves with the things computers can do.

Why a Student Likes LCI

Why does a student like LCI? That's easy. He studies when he feels like it, and he day-dreams when he feels like it. (The fact that he may leave whenever he finishes, is sufficient motivation for 99% of the students.) He can proceed at his own pace, in other words.

He can select his own best method of learning. He might choose to read, experiment, observe, ask questions, or, more likely, a combination of those methods.

The student can start his learning at whatever point he wishes. And he may choose any sequence of topics that he wishes (where appropriate). These two points are extremely significant, and they are based on the simple idea that no student is completely ignorant of a subject to be learned. Each student, in other words, has some point of departure that is unique to him. That puts him in the position of being the only person who knows at what point, and in what sequence, he should begin to fill in the gaps in his knowledge of the subject. These two points also are the key items that are not taken into consideration by any other "automated" teaching method with which I am familiar, although Computer Aided Instruction (CAI) has the potential to assist the student in this regard.

Computer Aided Instruction

Speaking of computers for the moment — let's ask the question, "Does the LCI technique exclude the use of automated instruction techniques"? Not at all. Variety is the spice of student life, too. An industrial education center in San Francisco is using computer terminals, video tape, programmed instruction, and audio tape in various combinations for various subjects. The student comes to regard these devices as simply another reference source. He may find himself turning to any one of them to watch, or listen to, a short description or explanation of a particular subject, in the same manner as he turns to a book or a reference manual. The important difference is that he chooses the medium, and that he has the instructor to turn to when he's stuck. Programmed instruction (PI) and CAI does not usually accommodate those two ideas. I look forward to the day when it does.

What is the reaction of the student to LCI? Nearly every student I've talked with dreads the day when he must return to "conventional" learning methods. Enough said.

Why a Teacher Likes LCI

What is the effect of LCI on the teacher?

From the start, the teacher never concerns himself with preparing his lecture. Rather, he is deeply involved in defining what is to be learned, in stating it clearly and logically, and in gathering materials that will contribute to the student's ability to learn. He soon discovers that a well-written definition of the learning objective leads him almost automatically to the point where tests, or other methods of verifying the student's knowledge, can be prepared relatively easily.

The teacher also discovers that his conceptual knowledge of the subject is more important than recalling precise details. I once taught a complex technical subject in LCI mode, which I hadn't studied or worked on for four years before walking into that class. But because my conceptual knowledge was sound, I could answer questions easily.

Still another effect on the teacher, of course, is the idea best expressed by a man who pointed out that LCI enabled him to concentrate his efforts on the individuals in the class who most needed the instruction. This deceptively simple point scores highest with teachers who scorn PI and CAI.

Selection of Teachers

There's another important effect, not only on the teacher, but on the selection of the teacher. When using LCI, the main prerequisites for teacher selection change considerably. The principal emphasis should be on locating someone with a high level of competence in his subject (I didn't say "education," I said "competence"). The LCI teacher does not lecture. Therefore, his ability to stand up in front of a class and articulate is simply not important. Every public and industry education administrator will appreciate the impact of that difference. His job of finding qualified teachers is different, and easier.

How can we summarize the choice of methods up till now available to a teacher? On one side of the teaching ledger is the lecture method. On the other side are Programmed Instruction and CAI. On the one side, the teacher feels that he is everything — on the other side he feels that he is nothing. In the middle lies Learner Controlled Instruction and other new methods, with much fertile ground for improvement.

The challenge of the next decade requires that all educators concentrate on researching and developing instructional methods that stress a closer personal relationship between student and teacher. If that goal is made clear, I believe nearly all teachers will join in the search, since they won't be worried about developing methods that essentially eliminate their lecturing jobs. Further, more competent persons may be attracted to the teaching profession, because the prerequisites will undoubtedly change.

Learner Controlled Instruction is only one innovative technique. There are many more, yet to be discovered, that serve the specific mutual interests of both student and teacher. The consequences of using such teaching methods could be a marvelous and revolutionary change for the better in education. ■

C.a

PROBLEM CORNER

Walter Penney, CDP
Problem Editor
Computers and Automation

PROBLEM 6810: A CHESSBOARD MATRIX

"Why so glum?" Al asked as he entered the Computer Center and saw the unhappy expression on Bob's face.

"Oh, it's that matrix I had all set up. Now it's been cleared and I'm going to have a devil of a time trying to reconstruct it."

"What matrix was that? Not that 100 by 100 array we were working on, I hope."

"No, it was just a little old 8 by 8. It was going to be used in that Chess playing program Pete is writing — a way of numbering the squares in some crazy mixed-up order."

"Why didn't he just number the squares 1 to 64, or even use that two-element system, with A to H horizontally and 1 to 8 vertically?"

"I don't know," Bob shook his head. "There may have been some advantage doing it his way. There were two sets of numbers, one he called X numbers along the top and another set he called Y numbers down the left. The number in any cell was the sum of the X and Y numbers."

"And each number from 1 to 64 was produced once and only once this way?"

"Right! Now, if I could just figure out what those top and side numbers were, my problem would be solved."

"Don't you remember any of them?"

Bob thought a moment. "Yes, one of the numbers was 23."

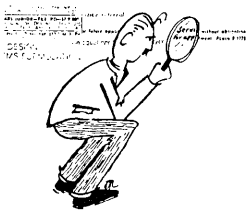
What were the other numbers?

Solution to Problem 689: Nimbonacci

A number ending in 0 or 4 will guarantee a win for the computer only if the starting number is less than 34. 34 would be a win for the first player, as would 44, 54 and a number of other values less than 100.

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.

C.a



JOBS AND CAREERS IN DATA PROCESSING

Computer Salary Survey

Source EDP
100 S. Wacker Drive
Chicago, Ill. 60606

The computer salary survey shown here is based on a complete analysis of the nationwide consulting and recruiting activities conducted by us during 1967. The survey is limited to positions within organizations which use computers.

In attempting a survey of computer salaries, several obstacles present themselves. First, a meaningful salary survey should be representative and not affected by extremes. For this reason, we have chosen to indicate for each category presented, the median salary rather than the mean.

Second, job categories have been divided into two main groups — management positions and non-management positions. While not always the case, salaries for management positions depend to a large degree upon the size of computer systems installed or on order and are so organized. Salaries for non-management positions depend to a large degree on length of experience and are so organized. Salaries for all positions are of course affected by other factors besides these, including level of education, geographic location, and type of industry. For simplicity, no attempt has been made to isolate these conditions but the reader should make some allowance for these in analyzing the data.

The salary figures shown are those of applicants when first applying for a new position. Typical salary increases received upon accepting new employment ranged from 5% to 15%; yet there were occasional increases as high as 40%.

Computer Salary Survey

		Annual Salaries in Dollars		
		15th Percentile	Median	85th Percentile
NON-MANAGEMENT POSITIONS				
Commercial Programmers and Programmer/Analysts				
Experience:	6 months - 1 year	7,200	8,400	9,300
	1 year - 2 years	8,800	9,800	10,700
	2 years - 4 years	10,300	12,200	13,200
	Over 4 years	10,800	12,900	14,800
Scientific-OR Programmers and Analysts				
Experience:	6 months - 1 year	9,400	10,600	11,800
	1 year - 2 years	10,500	12,100	13,900
	2 years - 4 years	12,200	14,600	16,900
	Over 4 years	14,300	16,600	20,400
Systems (Software) Programmers				
Experience:	1 year - 2 years	10,100	11,400	12,700
	2 years - 4 years	12,300	13,800	15,400
	Over 4 years	13,400	15,900	18,800
Senior Systems Analysts and Project Leaders				
Experience:	2 years - 4 years	11,900	14,000	15,900
	Over 4 years	12,800	15,600	18,300
MANAGEMENT POSITIONS				
Systems Managers				
*Size:	Medium	14,600	17,000	20,500
	Large	15,900	22,100	26,700
Programming Managers				
Size:	Medium	13,900	15,700	17,900
	Large	15,100	18,100	21,600
Operations Managers				
Size:	Small	8,300	10,200	12,500
	Medium	10,100	11,800	14,800
	Large	14,200	17,600	21,800
Information Systems Directors				
Size:	Small	12,600	14,900	17,600
	Medium	18,900	23,100	26,600
	Large	21,000	30,500	44,000

*Installation size is defined in terms of monthly installed or on order computer rental as follows: Up to $15,000, Small
$15,000 to $60,000, Medium
Over $60,000, Large

ACROSS THE EDITOR'S DESK

Computing and Data Processing Newsletter

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APPLICATIONS

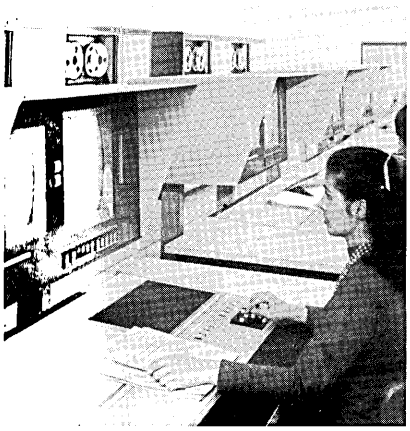
SOUTHERN PACIFIC RAILROAD DOES FILING BY TELEVISION SIGNALS

The first commerical version of the Ampex Videofile information system (developed and manufactured by Ampex Corporation, Redwood City, Calif.) is solving the large scale document filing and retrieval problems of the Southern Pacific Company, San Francisco, Calif. The system permits faster filing and retrieval of the railroad company's freight waybills and related documents. Since railroads are required to keep waybills (basic legal documents describing each freight shipment) for four years, the filing job involved is enormous.

The Southern Pacific system occupies one-eighth the floor space required for present paper files. It has a total capacity exceeding 20 million documents and is designed to accept more than 400,000 new documents monthly and retrieve 100,000 each month on request. Documents can be filed on the average of one every ten seconds and retrieved on the average of one every six seconds.

This is how the system works at Southern Pacific:

An operator places a document on a glass plate. A television camera underneath the plate scans the document and converts its image to television signals. These are sent through a small computer to one of eight large tape transports and recorded on magnetic video tape. As this occurs, the operator checks



the television monitor display (see picture above) of the document she is entering and, with her right hand, uses the keyboard to assign a digital address code to the document, so it can be found again at any time. This second set of signals also are recorded on the tape, just in front of the document recording.

To retrieve documents, a punched card bearing the document's address code is fed into a digital card reader mounted on the tape transport. Data from the cards "tell" the transports which document recordings to find. (Tape search speed is 380 inches per second — twice that of computer-industry tape transports.) Once found, the document recording is played back by the transport into intermediate holding equipment (buffer system). There a metal disc magnetically records the incoming signals, duplicating the document recording. The disc later plays these recordings back into a specially developed printing device (shown below), which produces the document image on paper.

Since the magnetic disc merely duplicates the original document recording on tape in the master file, no entry is ever "out of file" to other requests.

PREFABRICATED WALLS BUILT AUTOMATICALLY WITH COMPUTER-DIRECTED MACHINE

A machine that can build in a week the walls for 500 homes has been developed by three lumber company executives of M. Kellner & Son Lumber Company, Fresno, Calif. The device, directed by an IBM 1130 computer, can construct the interior and exterior walls for an average-sized two-bedroom house in about 20 minutes. The machine was designed by Minor Gee (director of the firm's product engineering department); Bruce Butler (supervisor of Kellner's data processing engineering section); and Ray Kellner (general manager of the company).

Stretching 120 feet across the main floor of the lumber company building, the equipment resembles a series of steel-topped rectangular tables. A conveyor chain — similar to those that tow automobiles through car washes — runs through its center. Electronic signals that activate the machine are transmitted by its control unit, which reads instructions generated on paper tape by the computer. The IBM 1130 has been programmed to determine the internal support pattern needed for a wall based on the outside dimensions. It also prints out the precise amounts of materials, including the specific number of nails, that will be needed for each wall.

When the machine has received the instructions, it starts constructing the outside frame of a wall, using building materials fed into it from hoppers. As the wall frame moves through the machine on the conveyor chain, supporting devices such as braces and studs automatically are cut to size and nailed into place. Relatively easy walls — those with few windows or doors — move through the machine faster than those with more complicated patterns. The machine has the capacity to produce 20 feet of wall per minute. Costs of the prefabricated walls are lower than those of hand-made walls because the machine is so accurate that it wastes no material.

APOLLO BIOMEDICAL DATA TO BE PROCESSED IN REAL TIME

NASA doctors will use a computer to help them evaluate the astronauts' conditions in real time during the Apollo VII flight this fall. Medical officers, manning consoles in the Mission Control Center at the Manned Spacecraft Center, Houston, Texas, will have the "on-line" processing power of one of the world's largest computer installations — the Real Time Computer Complex. Real time biomedical data processing is part of NASA's Apollo Bioenvironmental Information System (ABIS). ABIS has been designed to provide NASA medical officers with an effective data acquisition, analysis and display system which will enable them to provide medical monitoring for crew safety and professional medical mission management, and give them a better understanding of the effects of spaceflight on man.

Part of the Apollo VII programming system, developed by a team of IBM programmers, is a program which enables the computer to process some

of the biomedical data on the astronauts which is being telemetered back to earth. After processing, the data is transmitted to NASA medical officer and flight controller consoles — almost as fast as events are happening in the spacecraft orbiting the earth. The display changes every second, reflecting the most current information. (During the Mercury and Gemini programs, real time medical analysis was limited to manual evaluation of raw data transmitted back to earth from the spacecraft.)

The MSC medical team, with the aid of real time data processing, will be able to identify the trend of changes in the astronauts' conditions. Heart and respiration rates will be processed and displayed — either individually or combined as a crew display. In addition, the range of the rates and standard deviation information are computed and can be included in the display. This information will be combined with spacecraft or suit data giving the medical officer a single display from which he can evaluate the environmental conditions the astronauts are encountering and their physical and biomedical reactions to these conditions. The doctors also hope to be able to evaluate how well the astronauts rest during sleep periods, and if their responses to the conditions and events of the flight are "normal."

PUTNAM MUTUAL FUNDS USES IBM COMPUTER TO FURNISH UP-TO-THE-MINUTE INFORMATION

A newly installed IBM System/360 Model 40, at The Putnam Management Company, Inc. of Boston, Mass., gives shareholders "instant" information about their accounts. By telephoning a clerk and providing the proper identification, a shareholder with the Putnam Group of Mutual Funds can get a report on his transactions for the entire year in as little as three minutes. Previously, it might have taken up to five days to get the same information.

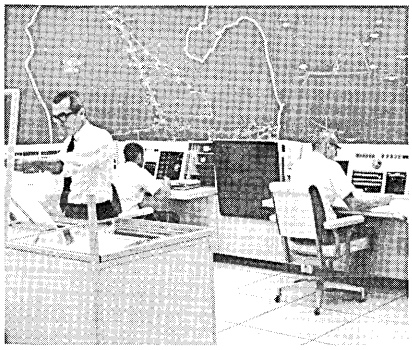
The telephone calls go to one of four operators seated at IBM 2260 visual display stations. Upon receiving the proper identifying data, the operator keys the inquiry into the computer. Within seconds, the account information is shown on the television-like screen of the display station and related to the shareholder by the operator. Nearly 1,400 shareholder accounts are interrogated each day.

Preparation and receipts of customer orders, including computer printing of the certificate, also is speeded up. Orders now are processed in three-to-four days — formerly this required up to a week-and-a-half.

WEATHER-CONSCIOUS COMPUTER MONITORS MICHIGAN GAS SUPPLY

A weather-conscious computer in Jackson, Michigan, has been placed in the role of an electronic watchdog, guarding against interruption of gas service to any of the 780,000 Consumers Power Company gas customers in Michigan's Lower Peninsula. The computer — an IBM 1800 data acquisition and control system — scans more than 600 statewide checkpoints. The checkpoints consist of measuring devices located in 86 gas metering, gas regulating and gas compressing stations across the Company's gas service area.

The computer, using multiple leased telephone lines, takes continuous readings from these instruments, measuring such things as gas pressure, density, temperature and specific gravity. It alerts technicians in the event any of these drop below or rise above pre-established levels. The computer, linked to six typewriter-like terminals, provides a summary on all instrument readings every two minutes.



— Gas control supervisor Herb Young is shown (left) examining summary printout

If the computer detects a potential problem, an alarm light is turned on, pinpointing the location of the condition requiring attention.

In addition, during winter months, special weather forecasts are fed into the computer throughout the day. Based on these forecasts, the computer calculates the probable increased demand for gas and suggests to technicians what steps should be taken to assure an adequate supply for the duration of the cold spell.

COMPUTER FORMULATES DYES, MATCHES COLORS, FOR TODAY'S BRIGHTER FASHION SHADES

An IBM 1130 computer at Phoenix Dye Works, Cleveland, Ohio, is helping to satisfy the fashion world's demand for new and different colors. The computer has the capacity to print-out as many as 21 different basic dye formulas, each of which may be used to produce multiple shadings. The computer also calculates the cost for producing any shade selected by knit goods manufacturers served by Phoenix.

The process begins when the customer brings in a sample of a color to be matched in quantity. Phoenix engineers then determine the true characteristics of the color through the use of a spectrophotometer, which measures the amount of light reflected from the shade at various wave lengths, compared to a standard white.

Punched program cards are fed into the computer, which combines certain dye formulas and determines the basic dyes needed to produce the desired color. The cost per pound to apply the correct amount of dye to certain fibers also is calculated by the 1130. The computer then matches the curve of light reflectance from the spectrophotometer with reflectance readings of standard dyes applied in various concentrations to a given fiber, which are stored in its memory.

James B. Egee, the company's director of research, said use of the computer has cut the time required to formulate dyes for color matching from three or four days to as little as two hours. He said Phoenix uses the computer to match about 300 new and different colors per month — many with names like midget mauve (light violet), snappy dragon (a green), and electric currant (a red).

WARD PLANT USES COMPUTER TO GET BUSES TO SCHOOL ON TIME

Ward School Bus Manufacturing, Inc., of Conway, Ark., one of the country's largest school bus assembly firms, utilizes an IBM System/360 Model 20 to help custom-tailor more than 3,500 buses a year. Most of them must be assembled and delivered by Labor Day or they'll miss the first day of class. Making this deadline is complicated by dependence on automotive chassis manufacturers for the motor, frame

and wheels. Ward adds the body, seats, windows, doors, heating systems and special options.

Ward's computer-stored records on hundreds of option combinations enables the firm to keep track of dozens of safety standards for each of the 50 states and customer specified options. In addition to the many safety standards, the computer's files contain records on 16,000 items from raw materials and fabricated stock which are used in building the nine basic Ward bus models.

When an order is received, the requirements are matched against records of stock on hand. The bus is scheduled for construction. Computerized job analysis provides a listing of stock parts required. Any shortages noted are placed on order. The computer uses reports from work stations to track progress of the bus through production to delivery.

A program now being developed will enable the computer to schedule production steps, allocating parts to the right work station at the right time.

EDUCATION NEWS

PROJECT LOCAL AIDS STUDENTS IN BETTER UNDERSTANDING OF MATH/SCIENCE CONCEPTS

Five small computer systems are being used as teaching aids for high school math and science courses in as many greater Boston (Mass.) school systems. The computers, ordered by the Laboratory Program for Computer Assisted Learning (Project LOCAL), Westwood, Mass., were manufactured by Digital Equipment Corporation and built around their PDP-8/I system. Each configuration varies slightly to meet the particular needs of the school.

Member schools participating in Project LOCAL include Westwood, Lexington, Natick, Wellesley, and Needham. All five systems are equipped with time sharing terminals. The Wellesley and Needham systems will be connected to other schools within those towns. Robert N. Haven, Project LOCAL Director, said, "The primary use of the computers will be to aid students in better understanding mathematics and science concepts and improve their problem solving skills."

The new equipment also gives the schools the opportunity to investigate applications in the areas of educational administration and educational / community research. Having the computers available 24 hours a day on the school premises will allow the machines to be used for additional activities, such as adult education or in-service training.

Project LOCAL II is a continuation of a planning and pilot program initiated fourteen months ago to demonstrate and evaluate the use of the computer in secondary mathematics instruction and to train teachers in computer programming usage. Supported in part by a federal grant, the five participating communities utilized a time-sharing bureau last year and provided service to about 450 pupils and teachers. This year officials expect to be serving 1,100 pupils. The Project has been, and will be, disseminating its innovative practices to the surrounding area by training teachers outside the member school systems, Mr. Haven added.

CONTROL DATA INSTITUTE IS BUILDING CAMPUS-TYPE COMPUTER TRAINING FACILITY

Mr. Perry C. Smith, Director of Control Data Institute of Waltham (Mass.) has announced that "due to the rapid growth of the computer industry and the increasing demand for computer technicians and programmers, a new campus-type computer training facility is being built in North West Industrial Park at the shopping center off Rte. 128 in Burlington, Mass." The Burlington school will be six times the size of the present Waltham school.

The new Control Data Institute of Burlington, opening early this month, will offer morning, afternoon and evening classes in computer programming, technology, computer maintenance, special courses in FORTRAN and COBOL and a variety of introductory and advanced courses for local industrial and business employees. The new computer school will also provide free lifetime placement services for students taking career courses and a variety of financial plans and free aptitude tests for all potential students.

Control Data Institute is a private school system, devoted entirely to teaching the principles and concepts of computer maintenance and programming. It is one of fifteen schools throughout the United States and Europe sponsored by Control Data Corporation.

GHETTO AREA RESIDENTS TO USE SANDERS DATA DISPLAY SYSTEMS IN COMPUTER COURSES

Display systems which enable operators to "talk" to computers in simple English will be used by Heuristic Concepts, Inc., New York, N.Y. to train residents of ghetto areas in the fundamentals of computer input technology. Initially four 620® Data Display Systems and two 720® Data Display Systems will be used at Heuristics' Heurcon Institute in the South Bronx and Harlem areas. The systems are manufactured by Sanders Associates, Inc. of Nashua, N.H. Heuron plans to use the Sanders systems at all the 40 training centers it will establish throughout the country, including the Harlem area of New York City and the Watts section of Los Angeles, Calif.

Thomas Mann, director of Heurcon Institute said, "Our courses in computer input technology will provide a background to enable graduates to obtain positions as beginners in the data processing fields...Because the Sanders equipment can be operated by semi-skilled personnel, they provide the ideal tool for teaching computer communications."

Heurcon Institute, Inc., a subsidiary of Heuristic Concepts, Inc., operates without government grants and trains the under-privileged and the hard core unemployed.

CDC COMPUTER SCHOOLS RECEIVE ACCREDITATION

Control Data Institutes in Dallas, Tex., and Detroit, Mich., have been accredited by the National Association of Trade and Technical Schools (NATTS). NATTS accreditation, in addition to assuring that the schools have met rigid standards, means that students may now apply for federally-insured loans under the National Vocational Student Loan Act. These are federally-subsidized, low-interest, long-term loans.

Announcement of the accreditation was made by Layton G. Kinney, general manager of Control Data Institute, an education division of Control Data Corporation.

Newsletter

NEW PRODUCTS

Digital

SPC-8, A NEW GENERAL PURPOSE COMPUTER FROM GENERAL AUTOMATION, INC.

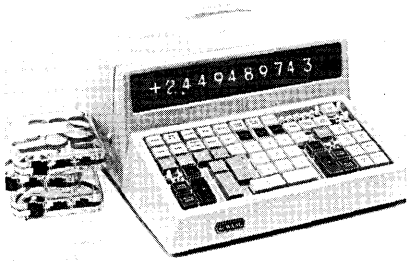
The Automation Products Division of General Automation, Inc., Orange, Calif., has announced a new general purpose digital computer which includes a 4096-word memory at a total price of less than $5000. The new computer, designated the SPC-8, is designed particularly for use in custom data processing and control systems, in R&D laboratories, and in universities.

The basic SPC-8 includes a 4096 by 8-bit word memory, expandable to 8192 words, with a full cycle time of 2.2 microseconds. The processor includes a parallel adder, three addressing modes, six 12-bit registers, two accumulators, a hardware index register, 46 commands, a priority interrupt system, and a teletypewriter interface. SPC-8 software includes a one-pass conversational assembler, a basic utility system for correcting and modifying programs, a math package, and computer test programs.

Options include a real time control group, real time instruction set, direct memory transfer channel, power fail detection and automatic restart, an additional 4096-word memory module, and more than 30 functional and interface modules. (For more information, designate #44 on the Reader Service Card.)

WANG DESK-TOP COMPUTER "LEARNS" PROGRAMS

Model 380 Programming Keyboard from Wang Laboratories, Inc., Tewksbury, Mass., memorizes operator keystrokes on magnetic tape, and repeats as programs of up to 640 steps. Plug-in magnetic tape cartridges may be erased and reused, or snapped out and retained. Keys are provided for all Wang calculator functions and for operation of optional, compatible system modules including extra data storage registers, typewriters, teletypewriters, etc. The Model 380 can make programmed decisions, loop, and branch. A comprehensive 246 page



— Wang's Model 380 Programming Keyboard

program library is furnished free. (For more information, designate #45 on the Reader Service Card.)

DYNAMICS RESEARCH CORP. ENTERS COMPUTER MARKET WITH LOW-COST MACHINE

Dynamics Research Corporation, Stoneham, Mass., has entered the computer market with the DRC-44 — a general purpose 24-bit machine with a one microsecond memory cycle. DRC President John S. Anderegg, Jr., said the machine is expected to find wide acceptance in applications where characteristics demanded by the military, such as high reliability, ease of maintenance and ability to operate under difficult environmental conditions, are important.

The DRC-44 is a digital computer with fixed point and stored program operation and random access memory expandable in 4000 word units. Full memory cycle time is one microsecond, with an input/output transfer rate of 24 megacycles. Its basic six index registers can be expanded modularly and it direct addresses 65,000 words when operating with three index registers. The DRC-44 has multilevel indirect addressing capabilities, seventy-eight available instructions, priority interrupt on all input/output channels.

Available software includes a symbolic assembler, input/output packages including alpha numeric, trace programs, on-line debugger, symbolic editor, diagnostic routines and basic mathematical subroutines.

Military applications of the DRC-44 include navigation systems, reconnaisance, communications, radar, display and fire control. Industrial applications include process control, vehicular traffic control and oceanographic studies. (For more information, designate #43 on the Reader Service Card.)

COMPUTER AUTOMATION INC. MARKETS SECOND "PROGRAMMED DIGITAL CONTROLLER"

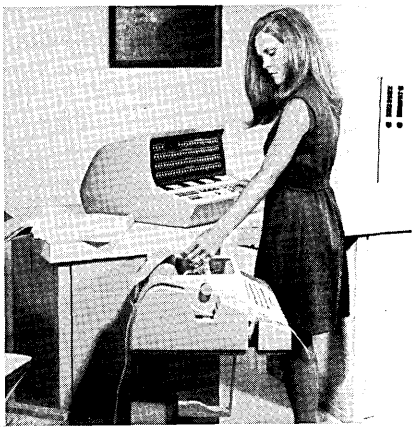
A second "Programmed Digital Controller," has been placed on the market by Computer Automation, Inc., Newport Beach, Calif. Model 816, with a 4,096 word 16-bit memory and over 140 basic instructions, is priced at $11,900.

The 816 has multilevel indirect addressing, hardware index register, immediate instructions, conditional jumps, parallel processing, block input and output, three priority interrupts and a scan instruction standard in the basic controller.

Many standard peripherals are available and include teletype, magnetic and paper tape, disc, and modems.
(For more information, designate #42 on the Reader Service Card.)

DATACRAFT CORPORATION ANNOUNCES SERIES 6000 COMPUTER SYSTEM

Datacraft Corporation, Fort Lauderdale, Fla., known to the computer industry for its magnetic core memory products, has entered into the field of computers with the Series 6000 Computer System. The heart of Series 6000 is the DC-6024 digital computer which is designed for use in simulator, process control and scientific applications including multiprogramming, time sharing, real-time and off-line uses.



The basic DC-6024 processing unit includes five 24-bit general purpose registers, three of which also may be used as index registers; 4K-word memory (12,288 bytes); hardware multiply/divide/square root; and four true levels of priority

interrupt. The basic I/O includes an ASR-33 Teletype.

The mainframe and memory cycle time is 600 nanoseconds; memory may be expanded up to 65K words (196,608 bytes) in 4K or 8K word increments. The Central Processing Unit (CPU) can address memory at the word, byte and double word levels. It also has multilevel indexing and indirect addressing.

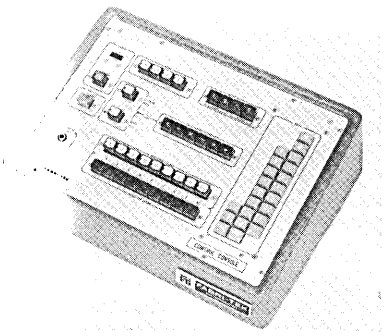
A full line of compatible peripheral equipment also will be available from Datacraft.
(For more information, designate #41 on the Reader Service Card.)

Special Purpose Systems

FABRI-TEK INTRODUCES NEW CONTROL KEYBOARD CONSOLE FOR BI-TRAN SIX COMPUTER

Fabri-Tek Inc., Minneapolis, Minn., has introduced a new Control Keyboard Console for use with its BI-TRAN SIX Computer Education System. This new Control Keyboard permits complete control of the computer education system from a remote position.

This remote control capability allows the instructor to operate the BI-TRAN SIX from his desk and from any other position in the classroom, and to face the class while operating the system. In addition, all registers in the computer can be loaded octally from the keyboard.

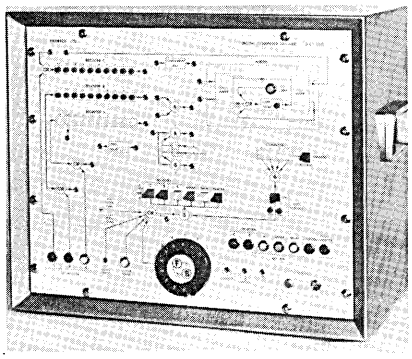


Two control keys permit the instructor to perform mathematical operations without a stored program and to give an effective demonstration of binary arithmetic. They also simplify setting up either manual or external I/O operations, reduce initial programming time requirements and allow more effective teaching of system concepts. (For more information, designate #80 on the Reader Service Card.)

FEEDBACK LTD.'S LOW-COST COMPUTER TRAINER COVERS WIDE RANGE OF BINARY OPERATIONS

The basic principles of digital computing can be learned on a small-scale replica of a computer central processor, known as the DCT 350. The DCT 350, developed and manufactured by Feedback, Ltd. of England, covers a wide range of binary operations. It is designed to force the student to think about the processes involved by operating at its best only when 'organized' by the trainee.

Serial binary operations which can be performed include shifting, addition and accumulation, ones and twos complementation, subtraction using either form of complement, multiplication by successive addition or by add and shift, and division by successive subtraction.



The simplicity of the equipment is said to make it a valuable visual aid for lecturers demonstrating computer arithmetic processes. The routing needed to perform a specific operation is constructed with only two or three patched connections, and initial digits can be introduced into the registers by manual input and shift manipulation. The required operation then can be performed by either manual keying in a step-by-step manner, or use of the pulse dial, or the pulse generator. Fully-automatic operation can be demonstrated on the programmed pulse counter.

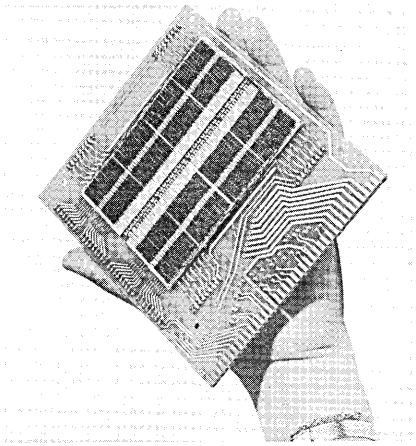
The instruction manual carries background information on computer arithmetic and forms the basis of a number of laboratory exercises. The DCT 350 costs $2105 to customer FOB New Jersey.
(For more information, designate #81 on the Reader Service Card.)

Memories

ELECTRONIC MEMORIES INC. ADDS NEW STORAGE CAPACITY TO MICROMEMORY® 1000 SYSTEM

Electronic Memories, Inc., Hawthorne, Calif., has introduced a 1,024 words x 8-bit version of its MICROMEMORY 1000 Core Memory System to complement the existing 4,096 words x 8-bit model. The 1K and 4K types will use identical electronics.

The 1K x 8-bit Model will have a new 3D stack design with the cores mounted on a single, pluggable



printed circuit board, measuring less than 7/10th of an inch. The overall 1K x 8-bit system occupies 300 cubic inches compared with 400 cubic inches for the 4K x 8 version.

The company will also make available a "field expansion kit", which will permit a 1K x 8-bit MICROMEMORY System to be converted to a 4K x 8-bit system by the user.
(For more information, designate #47 on the Reader Service Card.)

SDS RAPID ACCESS DATA STORAGE SYSTEM

Scientific Data Systems, Santa Monica, Calif., has introduced a new extended-performance Rapid Access Data (RAD) disc file storage system for use with SDS Sigma computers. The new RAD, Model 7231/7232, has a storage capacity of 6 million bytes, with data transfer rates of up to 384,000 bytes per second. The Model 7231 RAD controller controls up to four Model 7232 RAD storage units, providing a maximum storage capacity of 25 million bytes per controller. The

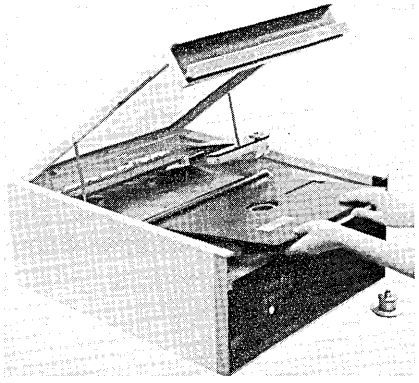
system is applicable to a wide range of real-time and batch processing tasks.

Average access time to any segment of the disc file system is 17 milliseconds. Use of one fixed read/write head per data track in the RAD storage unit completely eliminates head-positioning delays, permitting much faster accessing than is possible with moveable-arm disc files. For protection of restricted areas of the file, each 7232 storage unit contains 16 write lockout switches. Each switch locks out 32 data tracks.
(For more information, designate #50 on the Reader Service Card.)

RANDOM ACCESS MEMORIES FROM INFOTECHNICS INC.

Infotechnics, Inc., Van Nuys, Calif., has announced a new series of inexpensive, random access computer or video memories using either rigid or flexible magnetic disc as a storage medium. MDM-Z Series are modular designs using a single disc encased in a protective cassette which also serves as an interchangeable loading cartridge. Both disc surfaces are used at once by utilizing two groups of independently moving magnetic transducers, one servicing the upper disc surface and the other the lower.

All machines in the series are provided in the form of a desk-top cabinet (23.5" L x 21.2" W x 10" H) and include the following: (1) a disc handling mechanism, a cassette loading frame, and a synchronous



motor with a quick stopping electric brake; (2) from 1 to 4 random access prime movers each handling one head according to the Z designation; (3) all necessary power supplies required for the positioners and the information handling electronics; and (4) all electronic circuits servicing independently each head, and all solenoid driving amplifiers.

The machines record in serial mode, and they use the self clocking Manchester 1 code. A maximum of 128 tracks on each disc surface is used. Each head carries its individual preamplifier, which provides a satisfactory signal level before any degradation occurs.
(For more information, designate #46 on the Reader Service Card.)

NEW 256-BIT READ-ONLY MEMORY BY NATIONAL SEMICONDUCTOR

A monolithic, 256-bit Read Only Memory has been added to National Semiconductor Corporation's line of MOS memories. The device, designated the MM420, contains all of the control logic and the memory on the same chip and is packaged in 8 lead TO-5 configuration. Included on the chip are the counter decoder, address logic and the sense amplifier. An end of sequence output is provided to allow expanding of the serial bit length without using external components.

The memory array Read Only characteristic is achieved by programming the metalization pattern during fabrication of the device. In operation, the memory functions as a serial, monolithic readout.

The MM420 is suited for character generators; read only drum type memories, micro programming for control and operating programs, and memory systems that are completely interrogated on command.
(For more information, designate #49 on the Reader Service Card.)

Software

AUTOSCAN/LOG / Programming Services, Inc., Woodland Hills, Calif. / This proprietary software package is designed to automatically generate "on-line" computer programs in the process control field. AUTOSCAN/LOG is written in assembly language for user's computer. The program is used for the following data acquisition functions; analog inputs; pulse signals read from external registers or counter; synchronous inputs; asynchronous inputs; and interfaces with any other system function such as closed-loop regulation. Memory requirements for a 16-bit machine are about 5500 words for a 100 variable input list. I/O requirements are either card or paper tape and the program is available for systems without mass memory.
(For more information, designate #51 on the Reader Service Card.)

COMPREHENSIVE PAYROLL ACCOUNTING SYSTEM (CPACS) / General Electric Co., Phoenix, Ariz. / CPACS comprises a series of computer programs that operate with any GE-400 computer system configuration including a central processor with 16,000-word memory; card reader; card punch; magnetic tape subsystem with five tape handlers; and high-speed printer and console typewriter. The automated payroll processing systems operations range from paycheck disbursement to tax deductions to commission payments to accruing of employee benefits. CPACS will process the complete payroll of a geographically centralized or decentralized organization of 1,000 or more employees.
(For more information, designate #52 on the Reader Service Card.)

FIXED ASSET ACCOUNTING / American Software & Computer Co., Atlanta, Ga. / This COBOL system is designed for the IBM System/360, Model 30, with 32K using tape or disc DOS, and the Honeywell H-200 with 24K. The package calculates depreciation, investment tax credit allowance, and tax recapture, providing information for both corporate reporting and government tax use; it permits selection of five depreciation methods as well as producing a projected depreciation schedule, a property listing, and additional financial information.
(For more information, designate #53 on the Reader Service Card.)

MAGIC / Information Management Inc., San Francisco, Calif. / This new aid for the COBOL programmer runs on System/360 computers under DOS or OS on as little as a 32K-byte configuration. MAGIC produces full formatted COBOL source programs from user defined abbreviations. During this process, MAGIC also acts as a standards enforcer by prohibiting or flagging all non-allowed elements and performs syntax checking on each statement. Abbreviation expansion, program formatting, subset enforcement and syntax checking are provided in combination within a single execution.
(For more information, designate #54 on the Reader Service Card.)

PAYROLL SOFTWARE SYSTEM / American Software & Computer Co., Atlanta, Ga. / This software package, writ-

ten in COBOL, is designed for an IBM System 360 with 65K under DOS or OS. It features 50 state accounting, sequential cost allocation, multiple deductions, multi-company (5 levels) accounting, and personnel records. Federal, state, and city taxes are compiled for quarterly 941-A reporting. It handles hourly, salary, overtime, commissions, bonuses, and advances. Employees may be paid by cash or check with a payroll statement issued for cash payments. Deposit slips can be provided where direct employee deposits are made to a bank. Personnel record is provided which includes job classification and other personnel information.
(For more information, designate #55 on the Reader Service Card.)

PERSONAL TRUST ACCOUNTING SYSTEM / Aries Corp., McLean, Va. / Developed in conjunction with Union Trust Company of Maryland, the system is designed for effective and efficient management of personal trust accounts by providing data needed by Trust Officers and customers. It is written in COBOL and is designed to become part of a complete bank Central Information File with remote inquiry terminals, or to stand alone as an operating entity. This package presents information in over sixty report formats, contains eight master files and has standard formatted transactions. Interest and dividend transactions are generated automatically for posting when due. Most reports are prepared automatically, but many can also be produced on request. The system is priced at $35,000, without major modification.
(For more information, designate #56 on the Reader Service Card.)

POLE (Public Opinion Logical Expectation) / Economatics, Pasadena, Calif. / Sales of a particular item now can be forecast with a greater degree of accuracy using the new proprietary package, POLE. POLE will analyze the returns of a public opinion poll taken on a new product and compute the minimum and maximum sales that can be expected. If the polling territory is divided into segments, POLE also will predict sales for each segment and time period during which the volume, or lack of it, can be expected. The program is written in FORTRAN IV and can be used on any second or third generation computer. The cost is $4,000 and includes the FORTRAN deck, a demonstration and a user's manual for reference.
(For more information, designate #57 on the Reader Service Card.)

RENTAL SYSTEM / Computer Radix Corp., New York, N.Y. / RENTAL SYSTEM handles real estate accounts receivable, processing the invoices and payments of commercial tenants, residential tenants, and/or mortgages at an unlimited number of properties. The procedures involved in the operation of this system include: the creation and maintenance of a master file, the gathering and tabulating of billing information, the computation and recording of amounts due, the allocation and posting of amounts paid, and the preparation of listings for reference and control purposes. As a package, the system will consist of six main-line programs, one preparatory program, two auxiliary programs, and three utility programs.
(For more information, designate #58 on the Reader Service Card.)

SSTPAC (a stand alone diagnostic monitor system) / Programming Sciences Corp., New York City, N.Y. / SSTPAC, written for the IBM System/360, will provide full on-line diagnostic services for any device capable of operating with a System/360. Originally developed for use with alpha-numeric CRT display terminals, SSTPAC has been generalized for use with disc or tape drives, printers, plotters, optical or film scanners, audio response units and all other System/360 compatible devices.
(For more information, designate #59 on the Reader Service Card.)

THREE-D SYSTEM / California Computer Products, Inc., Anaheim, Calif. / The software system allows a computer user to produce perspective drawings of surfaces, "walk around" a surface in successive drawings, generate stereoscopic view of a surface and, with the CalComp Model 835 microfilm plotter, produce animated films automatically. The THREE-D software package is a set of FORTRAN subroutines designed for use with any CalComp plotting system to draw three-dimensional views of any surface that can be expressed as a single-value function of two variables. THREE-D is compatible with any on-line or off-line CalComp plotting system and with any digital computer using the FORTRAN IV language. It is available for a one-time lease charge of $3,000.
(For more information, designate #60 on the Reader Service Card.)

CORRECTION

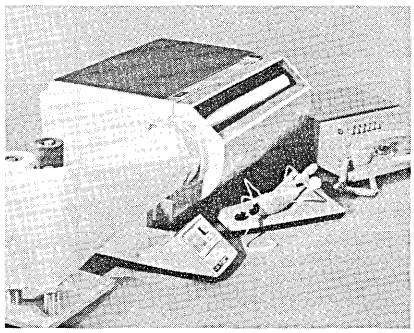
The Software section of our August 1968 issue contained an announcement of SIM 1401 available from Datamation Services, Inc. The address was shown as Lynbrook, N.Y. The correct address is New York, N.Y.

Peripheral Equipment

XEROX PHONE DEVICE WORKS AFTER HOURS

Xerox Corporation, Rochester, N.Y., expects to begin deliveries this fall of a new model of its Telecopier. The Xerox Telecopier is a transceiver that can send and receive an exact duplicate of any document — printed, sketched or photographed — across a continent or a corridor over ordinary telephones. The new model — Telecopier II — when equipped with the new accessory devices, will receive $8\frac{1}{2}$ x 11 inch documents over an unattended telephone.

Accessories available for the Telecopier II, shown in the picture, permit unattended reception, bridging communications gaps caused by time-zone differences and other after-hours situations. When used



with a Bell System Dataphone, Telecopier II can receive transmission calls automatically and turn on the machine. A new accessory, the Xerox roll feed, will supply paper and carbon for as many as 200 documents.

Also available for Telecopier II will be a Xerox data set adapter. This device insures that an unattended receiving unit "hangs up" at the close of a transmission call. It is provided for parts of the country where telephone company equipment doesn't accomplish this automatically.
(For more information, designate #63 on the Reader Service Card.)

Newsletter

DOCUMENT READER-SORTER ESPECIALLY FOR BANKERS

A low-cost document reader-sorter for banks has been added to the computer product line by Honeywell's Electronic Data Processing Division, Wellesley Hills, Mass. The device reads magnetic ink-encoded documents at speeds up to 600 documents per minute and sorts them into 11 different pockets (10 accept and one reject). The device, called the Type 232 MICR Reader-Sorter, can be operated as a free-standing unit or on-line to any Series 200 computer, including Honeywell's small-scale Model 110 system. The 232 reader sorter will be available in January.
(For more information, designate #69 on the Reader Service Card.)

NEW TRANSLATOR CAN LINK COMPUTERS AND ANY COMMUNICATIONS NETWORK

Model 180 Master Translator units, developed by Advanced Space Age Products, Inc., Alexandria, Va., can link computers and/or any automated, tape operated, coded communications network — regardless of make or model of the machines — speed differentials — network size — or types of tapes. The Translators can be incorporated into direct-wired local networks, or with national/international operations using Bell system and interconnected communications services. The Model 180 covers the entire spectrum from punched to magnetic tapes, and can translate between modes at speeds up to 50,000 characters/second.

As an assembly of solid-state, plug-in, etched circuit modules, Master Translators can be customized to serve any specific network requirement ... modules may be added or changed at any time to accommodate changing requirements. No additional test equipment is required as every Model 180 has its own integral system to check out unit operation.
(For more information, designate #70 on the Reader Service Card.)

STROMBERG DATAGRAPHICS SD 4360 PRINTER

A 7,000 line-a-minute computer printer is available from Stromberg Datagraphics, Inc. (a subsidiary of General Dynamics), San Diego, Calif. The printer, called SD 4360, is compatible with most existing computer-generated magnetic tapes, including third generation systems. Using a non-impact printing technique, it translates digital computer data into readable text and displays it on the face of a CHARACTRON® Shaped Beam Tube where it is photographed on film.

The SD 4360 records letters, numbers and symbols at rates up to 30,000 per second. Business forms or other fixed images can be merged with the computer data to eliminate costly preprinted forms. Information is recorded in standard computer page format of 132 characters per line and 64 lines to the page at a throughput rate of 120 pages a minute.

The printer, operating off-line from a tape station, requires only simple, straight forward programming. Interfaces, input signals and formats, programming, operating procedures and printed output follow standard EDP practices.
(For more information, designate #62 on the Reader Service Card.)

ONE COMPUTER TALKS TO ANOTHER WITH DATAMETRICS' COUPLER

A new series of intercomputer couplers, from Datametrics Corp., Van Nuys, Calif., now permit various models of the Univac Computer to "talk" to IBM 360 Computers with both alphanumeric and binary data. The maximum transfer rate is approximately 330,000 bytes per second. The various models include: Univac 418, 418II, 418III, 491, 492, 494 and 1108 and IBM System/360 Models 30 through 75.

The coupler houses the control logic for communication between computers. In the idle condition, the coupler continuously searches for an initiating command from either computer. When such a signal is received, the command (write) is stored in a command buffer register. The coupler then determines the availability of the other computer to receive data. If there is an accommodation, the coupler requests an output word from the initiating computer. Upon acceptance of the output word by the coupler, the data is stored in a holding register. When the receiving computer is capable of accepting data, the coupler control logic gates the data on to the I/O bus lines. Software is available for a wide variety of applications.
(For more information, designate #66 on the Reader Service Card.)

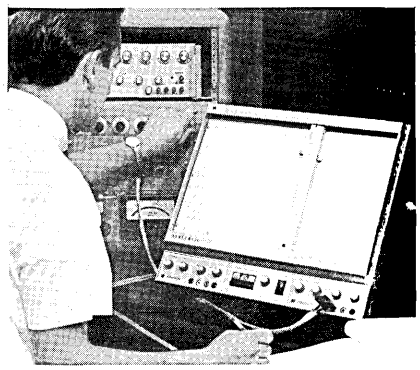
DATA INTERFACE CORPORATION ANNOUNCES PLOTTER TERMINAL FOR TIME-SHARE USERS

A low-cost digital plotter for time-share users, by the Data Interface Corporation of Tarzana, Calif., provides software convenience not always available in more expensive conventional plotters. The Data Interface Plotter Terminal, designated the Model PT-1, is completely compatible with any Teletype terminal and its Data Set or telephone coupler.

The PT-1 provides software convenience because it plots data while the data is printed on the user's time-sharing Teletype terminal. The X and Y data to be plotted is simply scaled to provide the desired plot size, and is then printed in columnar format. Thus, plotting can be done in any time-sharing language which has a columnar format capability. When used with an ASR Teletype, the Teletype can be used to capture plot-control printout data on paper tape, so that plots can be duplicated off-line.
(For more information, designate #65 on the Reader Service Card.)

NEW X-Y RECORDER BY HONEYWELL

An X-Y recorder designed to display low-level data signals for industrial, medical and general laboratory use has been introduced by Honeywell's Test Instruments Division, Denver, Colo. The Model 530 X-Y recorder records (on either $8\frac{1}{2}$ x 11 inch or 11 x 17 inch paper) cartesian coordinate graphs of the relationship between two functions of DC or slowing changing AC voltages, or one of these functions as it varies with respect to time.



Listed features include true differential input, common mode rejection, high speed, time base (Model 530T) and computer reference optional capability. Model 530 is said to incorporate design and op-

erational features that permit excellent recordings by non-technical, minimum-trained personnel.

The recorder weighs 27 pounds and is available for delivery within 60 to 90 days after receipt of order, Honeywell said.
(For more information, designate #68 on the Reader Service Card.)

NEW DATACOUPLER LINKS ANY DIGITAL TAPE RECORDER TO ANY SIGNAL SOURCE

A new and versatile datacoupler, from Datatron, Inc. of Santa Ana, Calif., provides the user with extensive data acquisition and reduction capability at moderate cost. When equipped with one or more of its many options, the Model 1000 Datacoupler links any digital tape recorder in record or playback mode with multichannel analog or digital sources, computers, telephone data sets and teletype equipment.

Other options permit performance of data reduction tasks, such as automatic tape search, input of selected data to computers or printers, or data conversion for quick-look oscillographic display. Most options consist simply of one or more printed-circuit cards. Provisions within the basic unit allow for insertion of up to 18 printed-circuit option cards.

Each basic Model 1000 contains necessary timing, control and interface logic for direct entry into a customer-specified tape recorder, plus a power supply sufficient to drive a full quota of options.
(For more information, designate #64 on the Reader Service Card.)

Components

LIBRASCOPE'S NEW OPTICAL SHAFT ENCODERS

Two new optical encoders — one a Mil-Spec model, the other an industrial model — have been introduced by Librascope Group of General Precision Systems Inc., in Glendale, Calif. The new optical encoders are incremental types providing 2,000 counts per shaft revolution.

The Mil-Spec size 11, Model 9623-11-1 is a gallium arsenide infrared optical encoder with internal thresholding and signal amplification circuits. Service life is bearing-limited, and approaches the one-billion revolution, 1,000 rpm life of present Librascope magnetic shaft encoders.

The industrial Model 9623-23-1, size 23, optical encoder has easily replaceable filament emitters derated for service life in excess of 50,000 hours. It is designed for use with point-to-point numerical control systems and for digital shaft position readout systems.
(For more information, designate #73 on the Reader Service Card.)

"MIDGI-COUNTER", SMALLEST DECADE COUNTER, BY PINLITES INC.

Pinlites Inc.'s newest contribution to the field of digital display systems is the MIDGI-COUNTER, companion to the Fairchild, N.J. firm's recently announced Midgi-Coder. This new miniature decade counter can count at rates up to 10 MHz. A TTL data pulse is counted and converted to seven segment code using integrated circuitry. The unit is capable of driving any of the firm's standard readouts (Midgi-Lites®). Both military and commercial versions are available and are designed for 5 volt operation.
(For more information, designate #72 on the Reader Service Card.)

Data Processing Accessories

COMPUTER ROOM PAPER SHREDDER

The Shredmaster Conveyor-400, manufactured by Shredmaster Corp., Freeport, N.Y., is a clean, efficient way to destroy obsolete computer print-outs (in either batch or continuous forms), IBM cards and tab cards. With it's fast moving conveyor belt feed, the Conveyor-400 can shred up to 2500 pounds of paper per hour. It also can destroy books, magazines, plastic cards, aluminum duplicating plates, even entire files of old records while the contents are still in their file folders. The shreds are caught in a large, dust-free disposable plastic bag at the rear of the machine. The Conveyor-400 has heavy duty caster which allow the machine to be moved to areas where it is needed.
(For more information, designate #76 on the Reader Service Card.)

CHARTPAPER FOR DIGITAL INCREMENTAL PLOTTERS BY CALMA COMPANY

CALMA Company, Santa Clara, Calif., has introduced a complete line of precision chartpaper for digital incremental plotters. CALMA precision chartpaper is available in 12-inch and 31 inch widths. In addition to the standard types in stock, CALMA offers 30-day delivery on special grid patterns, colors and base materials.
(For more information, designate #74 on the Reader Service Card.)

MAGNETIC "FLOW CHART" KITS BY NATIONAL CYBERNETICS

A new control boards programming kit, for flow-charting, has been placed on the market by CYBER-CHART Division of the National Cybernetics Corp., Westbury, N.Y. Designed specifically for desk use, the CYBER-CHART "Flow Chart" kits contain a new special marking pen and eradicator fluid in addition to a lightweight metal chalk board and a complete assortment of magnetic

flowcharting symbols in the universally adopted American Standards Association shapes.
(For more information, designate #77 on the Reader Service Card.)

COMPUTER RELATED SERVICES

BOWLERS' SCORES IN SIX STATES TO BE COMPILED BY COMPUTER

This season, the performances of 150,000 bowlers comprising 3,000 leagues in six states are being compiled and updated every week by a computer at the offices of the new American Bowling Computer Service, Inc., (ABCSI), Crawfordsville, Inc. The computer, an IBM System/360 Model 30, figures individual averages and handicaps and team averages and standings, as well as listing team and individual high game and series.

The firm supplies participating leagues with pre-printed team record forms each week. After bowling, the participants fill in their own scores and submit them to the league secretaries who have only to return the forms to ABCSI in pre-addressed envelopes. When the completed forms are received by the firm, they are run through an IBM 1287 optical reader, which scans the hand-printed entries, and feeds the information directly into the computer.

Woodson (Bud) Hobbs, ABCSI president, said the cost of the service is eight cents per bowler per night. Thus, a 10-team league with five-man teams would pay four dollars per week. Mr. Hobbs predicts that his operation will be servicing 500,000 bowlers in 10,000 leagues by January — a third of the potential customers in the Indiana-Illinois-Wiscosin-Michigan-Ohio-Kentucky area. He said ABCSI hopes to eventually expand its operations north to Toronto, west to Kansas City, east to Pittsburgh, and south to North Carolina.

AGRICULTURAL ADVISORY SERVICE AIDS FARMER AND HIS SUPPLIERS

Doane Agricultural Service, Inc., St. Louis, Mo., has assembled an 8,000-farmer survey panel, its farm management team and an IBM System/360 to advise agri-industry of equipment and chemical products wanted by farmers in coming months, and to help farmers improve productivity. The IBM System/360 Model 30 will be used to analyze historical and current data to provide meaningful information on current and projected agricultural needs as well as market forecasts.

H. G. E. Fick, president of Doane's said that many of the nations major farm equipment and chemical manufacturers make use of computer-based analysis for marketing plans. Doane reports current farm needs and assesses the probable reception which new products would receive based on responses by its nationwide panel. The surveys also help determine the demand among farmers for products not yet on the market.

To aid the individual farmer the System/360 soon will be applied to helping determine the most profitable use of land, labor, livestock, capital and machinery. Farmers planning their next crops already benefit from Doane's computerized profections of market demands and price levels.

The firm will also offer enterprise accounting which will provide farmers with unit costs of producing crops and livestock. These costs will be analyzed to assist farm managers in making management decisions.

TIME-SHARING SERVICES

TYMSHARE, INC. OPENS NEW FACILITY IN SEATTLE

Tymshare Inc. has announced a new conversational computer service in Seattle to serve the Washington, Oregon, and greater Northwestern region. T. J. O'Rourke, president, reports this is the first in a series of new district offices Tymshare will open. Tymshare, within the last three years, has developed a nationwide network of computer centers providing over 2500 on-line users with immediate access to third-generation computers.

Tymshare has created a complete spectrum of conversational languages. The Seattle office will provide the first demonstration in the Northwest of the firm's new Super BASIC, a language incorporating the power of FORTRAN and the simplicity of the widely-used BASIC interpretive language. For engineers, scientists, and professional programmers, Tymshare has extended the command power and versatility of FORTRAN IV & II, EDITOR, and other conversational languages. Pre-stored applications packages are available for design, civil engineering, numerical control, and simulation.

NCR OPENS TIME-SHARING DATA CENTER IN MONTREAL

Three of Canada's largest financial institutions are among the initial users of the National Cash Register Company's new time-sharing data center which opened last month in Montreal, Quebec. This new NCR time-sharing center is the company's first on-line service in Canada. It replaces a downtown facility which has been handling off-line processing only.

The new center, in addition to offering on-line data processing to financial institutions in Montreal and Toronto, also will provide off-line processing for a wide range of businesses. The center has three NCR 315 computer systems and other electronic equipment with a total value of approximately $2 million.

E.L.I. INDUSTRIES, INC. FORMS NEW SUBSIDIARY — E.L.I. COMPUTER TIME SHARING

Organization of E.L.I. Computer Time Sharing, Inc. (East Paterson, N.J.) as a new subsidiary of E.L.I. Industries, Inc., has been announced by Leonard Sandberg, President and Chairman of the Board of E.L.I. Industries. At the same time, Mr. Sandberg announced that E.L.I. Computer Time Sharing is headed by President Leonard A. Kreuter. He will direct the subsidiary's movement into mathematical and commercial time-sharing services for business, industry and others.

MEETING NEWS

THE LAW OF SOFTWARE — 1ST ANNUAL CONFERENCE

The Computers-in-Law Institute of The George Washington University has scheduled a conference on "The Law of Software" to be held in Washington, D.C., October 22 and 23.

Conference sessions will include: The Business Outlook; The Patent Outlook; The Copyright Outlook; and The Antitrust Outlook.

The American Patent Law Association, the Association for Computing Machinery, and the Data Processing Management Association are cosponsoring this first annual event. Registration forms and additional information may be obtained from: Computers-in-Law Institute, The George Washington University, Bacon Hall, 2000 H St., N.W., Washington, D.C. 20006.

ORGANIZATION NEWS

NEW PROPOSALS FILED BY AT&T WITH FEDERAL COMMUNICATIONS COMMISSION

American Telephone and Telegraph Co. (AT&T) has submitted new, liberalized tariff regulations to the Federal Communications Commission (FCC). AT&T's earlier request that the FCC reconsider its decision relative to the foreign attachments tariff was rejected. The FCC ruling provides that the old tariff will, however, continue in force until Nov. 1, when a new tariff presumably will replace it.

AT&T's new proposals would allow more customer-provided equipment to be connected to the telephone network. Perhaps the most significant change in the new proposals is an optional arrangement for connection of customer data terminal equipment. At present, such connections are made through the company's Data-Phone data sets.

Under the new provision, the customer would have a choice of using his equipment to do the modulating and demodulating or using the Data-Phone data sets. Should he choose to use his own equipment, it would be connected to the terminals of the network control unit through a telephone company-provided protective device which would limit signal levels. Charges for this device would probably be about $2 a month.

LEVER BROTHERS FORMING DATA PROCESSING SUBSIDIARY

Lever Brothers Co. of New York is forming a subsidiary, Lever Data Processing Services, Inc. Headed by R. W. McGeary, the company will offer computer time sales, service bureau operations, consulting and recruiting, software and application development, and educational programs.

SWEN A. LARSEN, FORMER CONTROL DATA EXECUTIVE, FORMS NEW COMPUTER FIRM

A new organization, Computer Age Industries, Fairfax, Va., has recently entered the computer education field. According to Swen A. Larsen, Pres., the company will provide training and services to computer users and manufacturers; establish resident schools in many areas, for training in various computer skills; and develop and market products and services related to the fields of Training, Information Handling and Computing. The first school will open this month in Fairfax.

FINANCIAL AND BUSINESS NEWS

Box Score of Sales & Income for Computer Field Firms

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

COMPANY	PERIOD	SALES		NET INCOME		NOTES
		Current Period / Previous Period	(%)	Current Period / Previous Period	(%)	
Analysts International Corp. (AIC), Minneapolis, Minn.	Year ended June 30, 1968	$1,233,000 / $670,000	(+84%)	$89,000 / $169,000	(Loss)	
Beckman Instruments, Inc., Fullerton, Calif.	Year ended June 30, 1968	$130,315,880 / $129,854,364	(+1.1%)	$4,155,610 / $6,088,446	(-32%)	Sales and earnings below original expectations due to severe cutbacks in government-sponsored research programs
California Computer Products, Inc., Anaheim, Calif.	Year ended June 30, 1968	$16,648,000 / $11,381,000	(+4.6%)	$1,209,000 / $1,156,000	(+4.5%)	
Data Processing Financial & General Corp., New York, N.Y.	Year ended May 31, 1968	$17,370,032 / $4,774,592	(+264%)	$3,786,252 / $1,727,459	(+119%)	
Datatronic Rental Corp., Chicago, Ill.	Year ended June 30, 1968	$1,404,873 / $388,363	(+265%)	$173,289 / $70,155	(+149%)	
Lear Siegler, Inc., Santa Monica, Calif.	Year ended June 30, 1968	$477,545,774 / $416,346,353	(+15%)	$18,033,081 / $15,272,629	(+18%)	
Optical Scanning Corp., Newtown, Pa.	Year ended June 30, 1968	$5,620,960 / $2,661,984	(+111%)	$583,582 / $193,488	(+202%)	Company entered fiscal 1969 with highest backlog of orders in its history
Planning Research Corp., Los Angeles, Calif.	Year ended June 30, 1968	$23,435,008 / $19,660,295	(+19%)	$1,364,832 / $1,126,644	(+21%)	Figures adjusted for "pooling of interest"; exclude 2 most recent acquisitions
SCM Corporation, New York, N.Y.	Year ended June 30, 1968	$744,758,000 / $705,160,000	(+6%)	$13,059,000 / $25,076,000	(-48%)	
Systems Engineering Laboratories, Ft. Lauderdale, Fla.	Year ended June 28, 1968	$12,032,000 / $8,027,000	(+49%)	$1,002,000 / $304,000	(+229%)	

NEW CONTRACTS

TO	FROM	FOR	AMOUNT
Federal Electric Corporation (FEC), worldwide service associate of ITT	U.S. Air Force	Continued operation and maintenance of the Air Force Western Test Range's technical facilities	$28,380,570
Northrop Corp., Beverly Hills, Calif.	Lockheed Missiles and Space Company, Sunnyvale, Calif.	Automatic test and readiness equipment for the U.S. Navy Poseidon missile system	$16 million
RCA Defense Communications Systems Division, Camden, N.J.	Western Union	Development of new equipment for modernization of the Defense Department's AUTODIN Communications Network	$14.5 million
Burroughs Corp., Defense, Space and Special Systems Group, Paoli, Pa.	Naval Ordnance Systems Command	Electronic devices	$6.9 million
Bryant Computer Products, a division of Ex-Cell-O Corp., Walled Lake, Mich.	Scientific Control Corp., Dallas, Texas	Purchase of Bryant memory systems	over $4.3 million
Sylvania Electric Products, Inc., a GT&E subsidiary, Waltham, Mass.	Naval Ship Systems Command	An addition to an existing contract for computers that will integrate tactical data aboard U.S. warships	$3.3 million
Bristol Company, Waterbury, Conn.	Algonquin Gas Transmission Co., Boston, Mass.	A complete computer-based data acquisition and supervisory control system for firm's gas pipeline system	$1,929,000
Sylvania Electric Products, Inc., a GT&E subsidiary, Waltham, Mass.	U.S. Marine Corps	Construction of a tactical transportable electronic dial telephone central office	$1.9 million
Radiation Inc., Melbourne, Fla.	Douglas Missile and Space Systems Division of McDonnell Douglas Corp.	Development of the Command Subsystem Group (CSG) for the USAF Manned Orbiting Laboratory (MOL) Program	$1.8 million
Computing and Software, Inc., Panorama City, Calif.	National Aeronautics and Space Administration	Specialized data processing services at NASA's Goddard Space Flight Center in Greenbelt, Md. and the Langley Research Center, Hampton, Va.	over $1.5 million
Ampex Corporation, Redwood City, Calif.	American Republic Insurance Co.	A Videofile information system to automate the filing and retrieval of insurance policy documents	$1.3 million
Systems Engineering Laboratories, Ft. Lauderdale, Fla.	Boeing Company, Seattle, Wash.	Seven SEL 840MP Computers which will be used to control training devices	$1,260,000
EPSCO, Inc., Westwood, Mass.	Japanese Government — the Japanese Ground Self-Defense Force, and the Maritime Self-Defense Force	Mobile Target Tracking Systems	$1,220,000
General Instrument Corp., Hicksville, N.Y.	NASA, Marshall Space Flight Center	Design, development, fabrication, testing and evaluation of an integrated circuit random access distributed data gathering system	$793,279
EMR Computer, Minneapolis, Minn.	Digitech, Ltd., Calgary, Canada	A digital seismic processing system; it will be used by the firm to provide complete seismic data processing services to geophysical contractors and petroleum companies	over $500,000
Computer Sciences Corp., Los Angeles, Calif.	Emerson Electric Co., St. Louis, Mo.	Development of computer programs required for an automatic system which tests aircraft electronic equipment	over $500,000
Computer Applications Inc., New York, N.Y.	New York State	A study of 1968 automobile accidents in New York State which will investigate the relationship of auto design to the incidence and severity of auto accidents	$300,000
Control Data Corp., Minneapolis, Minn.	U.S. Army Strategic Communications Command (STRATCOM)	A Control Data 6500 computer system to replace four computer units currently in use at Fort Huachuca, Ariz. The CDC 6500 will help maintain and control STRATCOM's world-wide communications network and also will perform data processing applications for proving ground, garrison and tenant units at Fort Huachuca and Federal offices in the area	—
Goodyear Aerospace Corp.	Scientific Data Systems, Santa Monica, Calif.	Sixteen SDS Sigma 5 computers and related equipment; the computers serve as a key element in the 2F90 flight trainers Goodyear is building for the Naval Training Device Center	—
Call-A-Computer, Raleigh, N.C.	Standard Computer Corp., Santa Ana, Calif.	Development and installation of a large, fourth generation, time-sharing-oriented computer system for centers across the nation; first system would be installed in Los Angeles in December with an unspecified number of others to follow in 7 other cities	—
General Precision Systems Inc., Librascope Group, Glendale, Calif.	North American Rockwell Corp. (NAR), Columbus, Ohio	L516M disc memories scheduled for Navy shipboard use	—
Planning Research Corp., Los Angeles, Calif.	Quinton Engineers, Ltd.	A forecast of aviation activities to be used as a basis for Quinton's design of the Long Beach Airport Master Plan	—
Lockheed Missiles & Space Co., a division of Lockheed Aircraft Corp., Sunnyvale, Calif.	State of Minnesota	Help in designing an information system to aid in planning the administration of criminal justice	—

NEW INSTALLATIONS

OF	AT	FOR
Burroughs B300 system	Second National Bank, Ashland, Ky.	Automating banking operations such as checking accounts, savings accounts, installment loans, etc. (system valued at over $400,000)
	Associated Data Services, Inc., Naperville, Ill.	Demand deposit accounting, savings, installment loans, and various customer services (system valued at over $400,000)
Burroughs B340 system	Capitol Bank and Trust of Springfield, Ill.	Automating bank's proof and transit, demand deposit, and savings and installment loan operations (system valued at over $180,000)
Burroughs B3500 system	Electronic Processors of Birmingham, Ala.	A variety of functions including demand deposit accounting, billing, inventory control, payroll, automated mailings and sales analysis (system valued at almost $1 million)
Control Data 3300 system	University of Arkansas Medical Center, Little Rock, Ark.	New techniques in patient care and hospital management; also medical research and routine business data processing applications
Control Data 6000 system	United Computing Systems, Inc., a subsidiary of United Utilities, Inc., Kansas City, Mo.	Expanding commercial time-sharing services on a toll-free basis throughout the nation
Digital Equipment PDP-10 system	First National City Bank, New York, N.Y.	Helping solve operations research and problems of an analytic nature such as: bidding on bond issues and determination of bond coupon schedules: analysis of industries, etc., to aid in investment decisions
EMR 6130 system	Parke, Davis & Company, Ann Arbor, Mich.	Real-time access for personnel from individual laboratories for monitoring experiments on an around-the-clock basis
GE-635 system	Strategic Air Command, Offutt Air Force Base	Use as the hub of a complex data handling system designed to use on-line visual display consoles (system valued at $4 million)
Honeywell Model 120 system	Watkins Products, Inc., Winona, Minn.	Inventory, accounting and sales analysis; a complete inventory and manufacturing control system will be developed
Honeywell Model 200 system	Eureka Williams Co., Bloomington, Ill.	General accounting, payroll and market analysis
IBM System/360 Model 20	Golden Hours Convalescent Hospitals, Long Beach, Calif.	Helping four Southern California hospitals meet the growing demands of Medicare and Medi-Cal's programs
IBM System/360 Model 40	National American Bank of New Orleans, La.	The core of a computer audio response system which can handle up to eight information requests at once
NCR 500 system	British Transport Hotels Ltd., a division of British Rail, Paddington, England (four systems)	Payroll operations for workforce of over 7,000 employed in headquarters, in B.R. hotels and catering services throughout the country — other accounting operations will be added later
RCA Spectra 70/35 system	State University of New York, Albany, N.Y.	General accounting operations — the entire budgetary operation as well as statistical reporting
RCA Spectra 70/45 system	Travelers Insurance Company, Hartford, Conn. (seven systems)	Applications involving life, health, casualty and group insurance programs (systems valued at $9.2 million)
RCA Spectra 70/55 system	Lincoln National Life Insurance Co., Fort Wayne, Ind.	Record-keeping functions for individual life policies and handling communications directly with branch offices
SDS Sigma 7 system	Meharry Medical College, Nashville, Tenn.	Connection on-line to medical testing instruments in a new multiphasic clinical screening program designed to help prevent serious illness by detecting problems early, while they are more easily cured
UNIVAC 1107 system	French National Institute of Health and Medical Research (INSERM), Villejuif, France	Administration, hospital control, appointments and scheduling medical treatments, electrocardiological projects, laboratory analysis, dietary and several other applications embracing the entire medical field; a primary research project will investigate the causes of lung cancer
UNIVAC 9200 system	Accurate Parts Inc., Kokomo, Ind.	General accounting, inventory control, sales analysis, and payroll
	E. H. Bindley Drug Co., Terre Haute, Ind.	General accounting, customer billing, accounts receivable and payable and inventory control
	T. J. Bettes, Houston, Texas	General ledger accounting; replaces older equipment
	Hilton Corporation, Melbourne, Australia	Handling accounts receivable and payable, processing sales statistics, and for costing work of the apparel and hosiery manufacturing firm
	Western Montgomery County Vocational Technical School, Limerick, Pa.	Instruction in computer operation and programming; will also be available to adults at evening classes, and will be employed in administrative applications
UNIVAC 9300 system	Henrico County, Va.	Government administrative applications as well as school administration and library applications
	Record Club of America (RCOA), York, Pa.	Keeping up-to-date records of members and informing them of new recordings; also for mailing list selections, order processing, inventory control and sales analysis
UNIVAC 9400 system	C. H. Masland & Sons, Carlisle, Pa.	Processing data dealing with purchasing, manufacturing, shipping, billing, customer services, marketing, finance, and personnel of the Carlisle carpet manufacturer

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 - figure estimated by Computers and Automation
? - information not received at press time

AS OF SEPTEMBER 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	17		3	
Wickliffe, Ohio	Bailey 855	$100,000 (S)	4/68	0	17	15	18
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	
	B500	$3800	10/68	0		70	
	B2500	$5000	2/67	57		117	
	B3500	$14,000	5/67	44		190	
	B5500	$22,000	3/63	74		8	
	B6500	$33,000	2/68	4		31	
	B7500	$44,000	4/69	0		13	
	B8500	$200,000	8/67	1	1430 E	5	550 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	311		C	
	3400/3600/3800	$18,000-$48,750	6/63	79		C	
	6400/6500/6600	$52,000-$117,000	8/64	77		C	
	6800	$130,000	6/67	0		C	
	7600	$150,000	12/68	0	1900 E	C	300 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	51 E		X	
Maynard, Mass.	PDP-4	$1700	8/62	32 E		X	
	PDP-5	$900	9/63	101 E		X	
	PDP-6	$10,000	10/64	21 E		X	
	PDP-7	$1300	11/64	102 E		C	
	PDP-8	$525	4/65	1275 E		C	
	PDP-8/S	$300	9/66	900 E		C	
	PDP-8/I	$425	3/68	450 E		C	
	PDP-9	$1000	12/66	250 E		C	
	PDP-10	$7500	12/67	22 E		C	
	LINC-8	?	9/66	150 E	3354 E	C	450 E
Electronic Assoc., Inc. (R)	640	$1200	4/67	42		18	
Long Branch, N.J.	8400	$12,000	7/65	21	63	4	22
EMR Computer Div. (R)	ASI 210	$3850	4/62	C		X	
Minneapolis, Minn.	ASI 2100	$4200	12/63	C		X	
	ADVANCE 6020	$4400	4/65	C		C	
	ADVANCE 6040	$5600	7/65	C		C	
	ADVANCE 6050	$9000	2/66	C		C	
	ADVANCE 6070	$15,000	10/66	C		C	
	ADVANCE 6130	$1550	8/67	23	89	C	37
General Electric (N)	115	$1370-$5000	4/66	720 E		600 E	
Phoenix, Arix.	130	$4350-$15,000	-	0		C	
	205	$2500-$10,000	6/64	C		X	
	210	$16,000-$22,000	7/60	C		X	
	215	$2500-$10,000	9/63	C		X	
	225	$2500-$16,000	4/61	200 E		X	
	235	$6000-$18,000	4/64	130 E		C	
	255 T/S	$15,000-$19,000	10/67	C		C	
	265 T/S	$17,000-$20,000	10/65	C		C	
	405	$5120-$10,000	2/68	C		C	
	415	$4800-$13,500	5/64	380 E		70 E	
	420 T/S	$17,000-$20,000	6/67	C		C	
	425	$6000-$20,000	6/64	130 E		C	
	430 T/S	$15,500-$19,000	-	0		C	
	435	$8000-$25,000	9/65	C		C	
	440 T/S	$22,200-$27,000	-	0		C	
	625 T/S	$31,000-$125,000	4/65	C		C	
	635 T/S	$35,000-$167,000	5/65	C		C	
	645	$40,000-$250,000	7/66	C	1900 E	C	900 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
Hewlett-Packard (R)	2116A	$600	11/66	106		C	
Palo Alto, Calif.	2115A	$412	11/67	140		C	
	2116B	$650	5/68	34		C	
	2114A	$250	5/68	55	335	C	50 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	
	DDP-516	$700	9/66	155		150	
	H632	$2700	-	0	564	?	218
Honeywell (R)	H-110	$2500	8/68	0		90	
EDP Division	H-120	$4000	1/66	650		240	
Wellesley Hills, Mass.	H-125	$5000	12/67	22		75	
	H-200	$8500	3/64	800		87	
	H-400	$11,000	12/61	52		X	
	H-800	$28,000	12/60	59		X	
	H-1200	$9500	2/66	175		130	
	H-1250	$12,000	7/68	0		20	
	H-1400	$14,000	1/64	7		X	
	H-1800	$50,000	1/64	16		X	
	H-2200	$26,000	1/66	88		71	
	H-4200	$26,000	8/68	0		20	
	H-8200	$50,000	12/68	0	1869 E	5	700 E
IBM (N)	305	$3600	12/57	C		X	
White Plains, N.Y.	360/20	$3000	12/65	7700 E		4200 E	
	360/25	$5330	1/68	C		1800 E	
	360/30	$9340	5/65	7400 E		2300 E	
	360/40	$19,550	4/65	3500 E		1100 E	
	360/44	$15,000	7/66	C		C	
	360/50	$32,960	8/65	C		C	
	360/65	$69,850	11/65	C		C	
	360/67	$138,000	10/66	C		C	
	360/75	$81,400	2/66	C		C	
	360/85	$115,095	-	0		C	
	360/90 Series	-	10/67	C		C	
	650	$4800	11/54	C		X	
	1130	$1545	2/66	4000 E		4300 E	
	1401	$6480	9/60	6300 E		X	
	1401-G	$2300	5/64	1460 E		X	
	1401-H	$1300	6/67	C		C	
	1410	$17,000	11/61	C		C	
	1440	$4300	4/63	3360 E		C	
	1460	$10,925	10/63	1140 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	42,100 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	700		150	
	NCR-315-RMC	$12,000	9/65	105		50	
	NCR-390	$1850	5/61	1200		6	
	NCR-500	$1500	10/65	2000		580	
	NCR-Century-100	$2645	-	-		C	
	NCR-Century-200	$7500	-	-	4039	C	1050 E
Pacific Data Systems Inc. (R) Santa Ana, Calif.	PDS 1020	$550-$900	2/64	145	145	10	10
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	63	285	26	26
Scientific Control Corp. (R)	650	$500	5/66	30		1	
Dallas, Tex.	655	$1800	10/66	50		25	
	660	$2000	10/65	8		7	
	670	$2600	5/66	1		0	
	6700	$30,000	10/67	0	89	1	34

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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	95 E		160	
	Sigma 5	$6000	8/67	C		50	
	Sigma 7	$12,000	12/66	C	1045 E	C	320 E
Standard Computer Corp. (N)	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	72		47	
	SEL 810B	?	-	1		11	
	SEL 840	$1400	11/65	4		X	
	SEL 840A	$1400	8/66	37		24	
	SEL 840 MP	?	1/68	6	144	20	102
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	200		35	
	1004	$1900	2/63	3000 E		20	
	1005	$2400	4/66	1150		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	230		850	
	9300	$3400	7/67	125		550	
	9400	$7000	5/69	0		60	
	LARC	$135,000	5/60	2	5592 E	X	1670 E
Varian Data Machines (R)	620	$900	11/65	75		0	
Newport Beach, Calif.	620i	$500	6/67	208	283	430	430
		I. U.S. Manufacturers, TOTAL		—	67,000 E		23,400 E
II. Non-United States Manufacturers							
A/S Norsk Data-Elektronikk	NORD 1	$1000	8/68	5	5	2 E	2 E
Oslo, Norway							
A/S Regnecentralen (R)	GIER	$2300-$7500	12/60	37		1	
Copenhagen, Denmark	RC 4000	$3000-$20,000	6/67	1	38	1	2
Elbit Computers Ltd. (R)	Elbit-100	$4900 (S)	10/67	24	24	40	40
Haifa, Israel							
English Electric Computers	LEO I	-	-/53	3		X	
Ltd. (R)	LEO II	-	6/57	11		X	
London, England	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
GEC-AEI Automation Ltd. (R)	Series 90-2/10/20/25/ 30/40/300	-	3/63-1/68	12		C	
New Parks, Leicester, England	S-2	-	1/68	1		0	
	S-5	-		0		C	
	S-7	-		0		C	
	GEC-TRW130	-	12/64	2		X	
	GEC-TRW330	-	3/63	9	25	X	8 E
International Computers	1200/1/2	$900	-/55	62		X	
Limited (R)	1300	$3000	-/63	79		X	
London, England	1301	$5000	-/61	127		X	
	1500	$6000	-/62	125		X	
	1100	$5000	-/60	23		X	
	2400	$23,000	-/61	4		X	
	Atlas 1 & 2	$65,000		6		X	
	Orion 1 & 2	$20,000	-/63	17		X	
	Sirius	-	-/61	22		X	
	Mercury	-		19		X	
	Pegasus 1 & 2	-	-/56	33		X	
	1901	$4000	9/66	328		112	
	1902	$4800	7/65	189		24	
	1903	$6500	7/65	99		20	
	1904	$12,200	5/65	58		5	
	1905	$13,000	12/64	31		3	
	1909	$5500	8/65	17		1	
	1906	$28,000	12/66	4		1	
	1907	$29,000	12/66	9		0	
	1904E	$16,000	1/68	8		34	
	1905E	$16,500	1/68	4		15	
	1904F	$17,000				9	

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
International Computers Limited (cont'd)	1905F	$17,500				12	
	1906E	$29,300				2	
	1907E	$30,300	3/68	1		1	
	1906F	$31,200				2	
	1907F	$32,500				2	
	1901A	$3700	3/68	1		102	
	1902A	$3600				72	
	1903A	$10,600	9/67	2		7	
	1904A	$18,600				1	
	1906A	$54,000			1268	1	426
Japanese mfrs.	Various models	-	-	C	2074 E	C	500 E
The Marconi Co., Ltd. Chelmsford, Essex, England	Myriad I	£36,000-£66,000	3/66	26		19	
	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	32		2	
Linkoping, Sweden	DATASAAB D22	$8000-$60,000	5/68	1	33	11	13
Siemens Aktiengesellschaft Munich, Germany	2002	54,000 (Deutsche	6/59	42		-	
	3003	52,000 Marks)	12/63	34		2	
	4004/15/16	19,000 "	10/65	67		18	
	4004/25/26	32,000 "	1/66	30		9	
	4004/35	46,000 "	2/67	59		63	
	4004/45	75,000 "	7/66	53		42	
	4004/55	103,000 "	12/66	3		3	
	301	2000 "	-	-		8	
	302	4000 "	9/67	10		8	
	303	10,000 "	4/65	65		8	
	304	12,000 "	-	7		22	
	305	14,000 "	11/67	17	387	27	210
Union of Soviet Socialist Republics	BESM 4	-	-	C		C	
	BESM 6	-	-	C		C	
	MINSK 2	-	-	C		C	
	MINSK 22	-	-	C		C	
	MIR	-	-	C		C	
	NAIRI	-	-	C		C	
	ONEGA 1	-	-	C		C	
	ONEGA 2	-	-	C		C	
	URAL 11/14/16 and others	-	-	C		C	
					2500 E		700 E
		II. Non-U.S. Manufacturers, TOTAL —			6700 E		2000 E
		Combined, TOTAL —			73,700 E		25,400 E

BOOK REVIEWS

Neil Macdonald
Assistant Editor
Computers and Automation

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

Reviews

Lipidus, Leon, and Rein Luus / Optimal Control of Engineering Processes / Blaisdell Publishing Co., 275 Wyman St., Waltham, Mass. 02154 / 1967, hardbound, 476 pp., $12.50

The topic of this book is "control of the physical behavior of systems by means of mechanical, electrical, electromechanical, electronic . . . devices which function without direct human intervention or supervision".

"Mathematical ideas are brought out to the reader gradually so the student without a strong mathematical background will understand new, complex ideas."

The book tries to "bridge the gap" between theory and solution of problems in process control.

There are six chapters — among them are "Fundamental Definitions and System Structures", "Control of Linear Systems", and "Stability and Control of Linear Systems". Bibliography; index.

This book is mathematical, on the graduate level, and assumes a knowledge of calculus, matrices, vectors, differential equations, etc.

Lecht, Charles Philip / The Programmer's PL/I — A Complete Reference / McGraw-Hill Book Co., 330 West 42nd St., New York, N.Y. 10036 / 1968, hardbound, 427 pp., $11.95

The purpose of this book is to present "highly detailed individual discussions of each element of the PL/I language", which is "the latest" combined scientific and commercial computer programming language. The book tries to present the PL/I language as it is generally implemented on a wide variety of computer systems. The book defines and discusses PL/I, outlines the rules for a PL/I program, presents this language's attributes, its applications, and detailed descriptions, and covers input-output (I/O), asynchronous operation, and list processing.

There are 7 chapters and three appendices. "Definitions", "Statements", "Attributes", and "I/O Organization" are among the chapters. No index. No bibliography.

Shinners, Stanley M. / Techniques of System Engineering / McGraw Hill Book Co., 330 W. 42 St., New York, N.Y. 10036 / 1967, hardbound, 498 pp., $14.00

The purpose of this book is to provide the student with up-to-date knowledge in the theory of systems engineering and its practical applications. Chapters include: "Performance", "Reliability", "Schedule", "Cost", "Maintainability", "Optimization", "Testing", and "Instrumentation". Appendices include: problems, and answers to selected problems. Index. The author is head of the Research Section at Sperry Gyroscope Co., and Adjunct Professor in Electrical Engineering at the Polytechnic Institute of Brooklyn. He arranged the book for "easy self-study with ample illustrations and practical problems".

The author assumes a capacity to understand integrals. There are bibliographies at the ends of chapters and an index.

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.

August 6, 1968

3,396,368 / Azizuddin Hashim Ismail Lakhani, Taplow, England / British Telecommunications Research Limited, Taplow, England, a British company / Electrical signalling arrangement for control of tape transmission system.

3,396,369 / Abraham Brothman, Dumont, and Michael Gomery, Saddle River, N.J., and Allen H. Miller, Laurelton, N.Y., and Lee Horowitz, Cedar Grove, N.J. / Sangamo Electric Co., Springfield, Ill., a corporation of Delaware / Quaternary decision logic system.

3,396,373 / Radoslav Didic, Sandweg 21, Bad Hersfeld, Germany / Ferrite ring core data transmitter.

August 13, 1968

3,397,390 / Robert C. Minnick, Redwood City, Calif. / Stanford Research Institute, Menlo Park, Calif., a corporation of California / Logic array for associative memory.

3,397,391 / Gerald H. Ottaway, Hyde Park, N.Y., and Helmut Painke, Sindelfingen, Titus Scheler, Boblingen, and Helmut Will, Sindelfingen, Germany, and William V. Wright, Poughkeepsie, N.Y. / International Business Machines Corporation, Armonk, N.Y., a corporation of New York / Compact storage control apparatus.

3,397,392 / Seymour Henig, Kensington, and Ervin C. Palasky, Silver Spring, Md. / United States of America as represented by the Secretary of Commerce / Information storage and category selector.

3,397,393 / Paul H. Palmateer, Wappingers Falls, and Wilbur D. Pricer, Pleasant Valley, N.Y. / International Business Machines Corporation, Armonk, N.Y., a corporation of New York / Capacitor read-only memory with plural information and ground planes.

3,397,394 / Hisao Maeda, 211 Minamisenzoku-machi, Ota-ku, Tokyoto, Japan; Hisaaki Maeda, heir of said Hisao Maeda, deceased / Thin film magnetic core matrix memory device.

August 20, 1968

3,398,400 / Heinrich Rupp, Stuttgart-Botnang, and Albert Norz, Stuttgart-Zuffenhausen, Germany / International Standard Electric Corporation, New York, N.Y., a corporation of Delaware / Method and arrangement for transmitting and receiving data without errors.

3,398,402 / Serge Delaigue, Chaville, and Rene Rauche, Orly, France / International Standard Electric Corporation, New York, N.Y., a corporation of Delaware / Simplified data-processing system.

3,398,403 / Bernard Ostendorf, Jr., Stamford, Conn. / Bell Telephone Laboratories, Inc., New York, N.Y., a corporation of New York / Data processing circuit.

3,398,405 / Carl B. Carlson, Arcadia, and Robert V. Bock, Sierra Madre, Calif. / Burroughs Corporation, Detroit, Mich., a corporation of Michigan / Digital computer with memory lock operation.

August 27, 1968

3,399,382 / John E. Thron, Cambridge, and Thomas O. Holtey, Newton Lower Falls, Mass. / Honeywell Inc., a corporation of Delaware / Data transfer system.

3,399,389 / William D. Bohannon, Jr., Graham, N.C. / Western Electric Company, Inc., New York, N.Y., a corporation of New York / Magnetic memory matrices.

3,399,390 / Rabah A. Shahbender, Princeton, N.J. / Radio Corporation of America, a corporation of Delaware / Integrated semiconductor diode matrix.

3,399,394 / Perrin F. Smith, Saratoga, Calif. / International Business Machines Corporation, Armonk, N.Y., a corporation of New York / Cyclical random access magnetic data storage system.

3,399,396 / Kendal T. Rogers, Mountain View, Calif. / Varian Associates, Palo Alto, Calif., a corporation of California / Superconductive data storage and transmission apparatus.

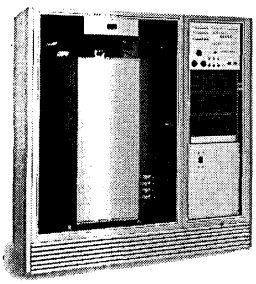
ADVERTISING INDEX

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.

Buy as much of our plug-in mass storage system as you need at 27¢ a thousand characters.

You can start with one Bryant memory drum or disc file and end up with as many as eight. Increasing your system's capacity from 8 million to 5 billion characters. All at 27¢ a thousand characters anywhere along the line.
And there's plenty to offer for the money.

For example, the universal controller system interfaces to just about any computer made with the push of a plug. It can operate in several different modes, both serial and parallel. It features word transfer rates from 50 microseconds to 900 nanoseconds per word—to and from two computer central processors. And it comes with a software package, complete with handler and maintenance routines (if specified).



XLO-1000 Controller plug-in Auto-Lift Drum System

Skeptics beware. We're out to make Bryant Believers out of you. Write and see. Ex-Cell-O Corporation, Bryant Computer Products, 850 Ladd Rd., Walled Lake, Michigan 48088.

BRYANT COMPUTER PRODUCTS

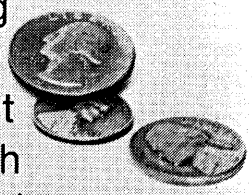
XLO®

EX-CELL-O CORPORATION

Designate No. 19 on Reader Service Card

Is it possible to get a really good computer for less than $10K? How about $9,950 and some odd change?

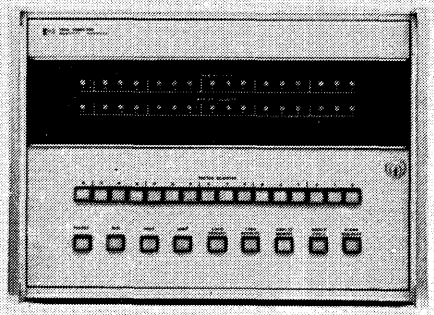
That's what the new Hewlett-Packard 2114A will be pegged at. But it'll heave to just like its big brothers. Throwing around big 16-bit words. Storing 4000 (or 8000) of them at a time in memory. Fetching them out of memory in two microseconds. It'll tie in I/O devices with standard plug-ins and use the same set of programming languages—FORTRAN, ALGOL and Conversational BASIC. It may be the littlest computer in the HP family... but even at that it more than holds its own against its big brothers.



That's right. The HP 2114A offers the most desirable price/performance ratio of any computer on the market. And it won't take up much room, either, not even on your desk. One compact package 12¼" tall houses both processor and power supply.

Yet the economy model is fully compatible with all the 2115/2116 software and I/O interfaces. The main frame accepts either 4K or 8K memory, has eight I/O plug-in slots and operates within a wide temperature range. Low-cost options include parity error check and power-fail protection.

If you think this powerful little computer is right for you, get more information from your local HP field engineer. Or write Hewlett-Packard, Palo Alto, Calif. 94304; Europe: 54 Route des Acacias, Geneva.



HEWLETT hp PACKARD

DIGITAL COMPUTERS

Designate No. 15 on Reader Service Card

06810