January, 1969

computers and automation

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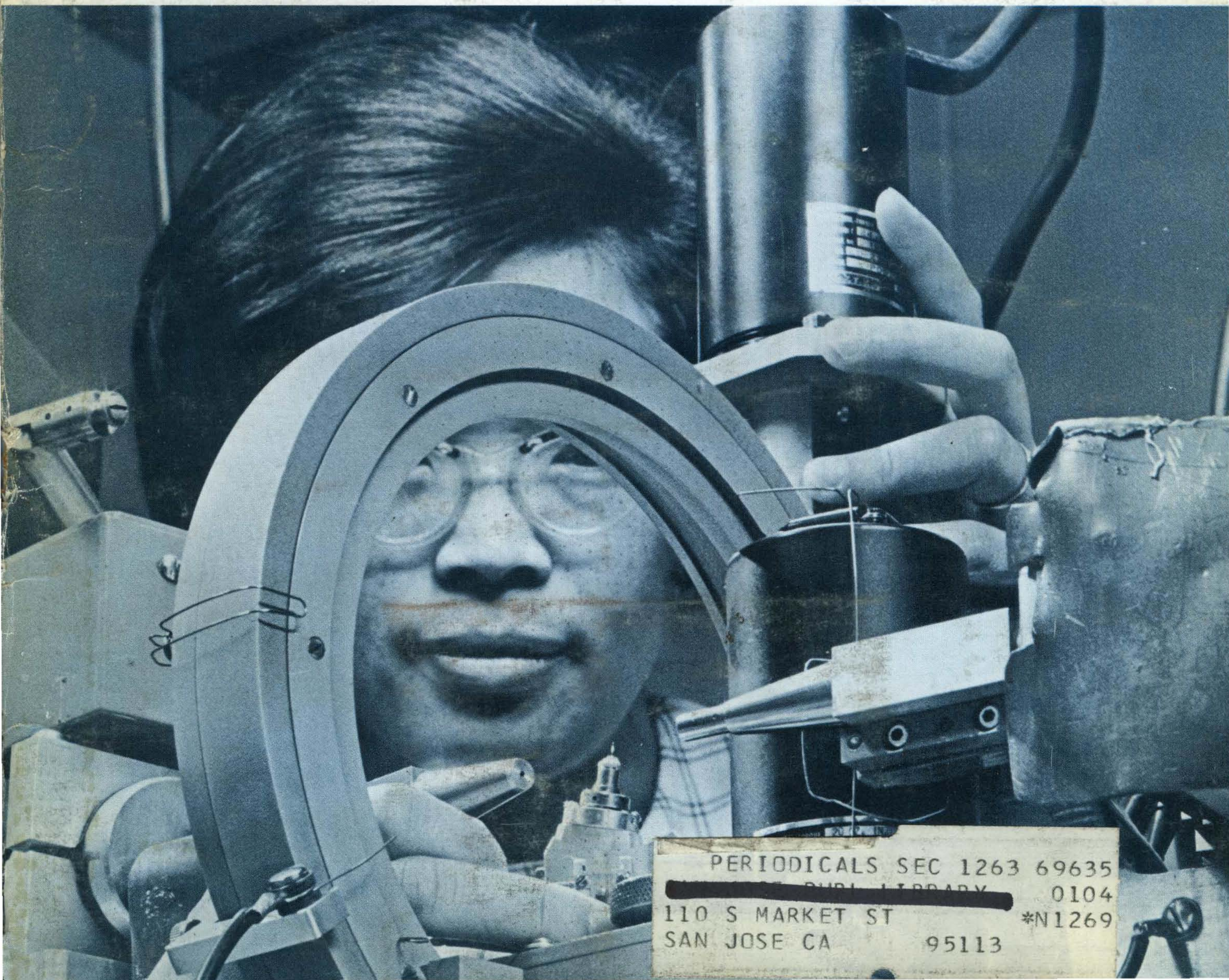

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computers and automation

Vol. 18, No. 1 — January, 1969

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computers and automation

January, 1969, Vol. 18, No. 1 *The magazine of the design, applications, and implications of information processing systems.*

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Retrospect, Prospect, and Trends in the Computer Field

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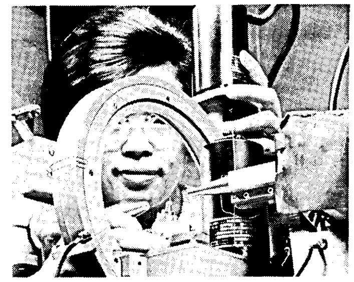

The front cover shows a laboratory technician positioning a tiny crystal of food on an X-ray diffractometer for analysis. The task is to isolate and identify each component contributing to a food's particular flavor and aroma. The instruments used in the analysis are controlled by a computer. For more information, see page 57.

NOTICE

C&A SUBSCRIPTION RATES CHANGE FEB. 1. YOU MAY RENEW AT OLD RATES BEFORE JAN. 31. SEE ANNOUNCEMENT ON PAGE 27.

Departments

Letters To The Editor

The Catching of Errors

We have read with interest your editorial in your September 1968 issue.

The question of whether errors are made and how they can be spotted is of vital interest in text entry for computer processing, and the published literature on it is exceedingly sparse. We are hoping that one day somebody will do a massive investigation.

C. J. DUNCAN, Director
Computer Typesetting Research Project
The University
10 Eldon Place
Newcastle upon Tyne 2, England

Your editorial "The Catching of Errors by Inspection" in the September issue should itself have had the benefit of closer inspection.

I refer to paragraph 8, second sentence: "For example, 'of,' 'on,' and 'or' fairly often take each other's place, when they should not."

From *Funk & Wagnalls*: EACH ". . . construction with a plural verb is incorrect."

Change "each other's" to "one another's" and you've got it!

R. J. LEMBACH, *Mgr.*
Computer Applications
Lederle Laboratories
Pearl River, N.Y. 10965

(Ed. Note — *You are right — we should have inspected more closely.*)

Numbles

I am submitting a "human" solution to your Numble 6810. I must admit it really had me going for a while.

The full message is: Speech was given to man to hide his thoughts, and perhaps "his phace to sho them" (his face to show them).

Your spelling is as atrocious as my logic. But then, maybe this documentation bit has some merit.

JOSEPH J. ROSA
Asst. Mgr., Applications and Op Systems
American Stock Exchange
86 Trinity Place
New York, N.Y. 10006

(Ed. Note — *Your solution is correct. The atrocious spelling is used to prevent good cryptanalysts from short-circuiting the numerical decipherment by attacking the words.*)

Proof Goofs

Proof Goof 6811 (Nov. 1968 issue) seems to contain a genuine proofreader's error, letting a "p" be used for a "b", basically a printer's error, since the author would not have written this error in his manuscript: in the fourth stanza, *lamps* should be *lambs*.

However, in context, "lamps" is not entirely a bad word, and a computer program with context-consciousness probably would not have detected this error. Surrounding words, relating in context to "lamps", include "night's shadows", "noon", "sun's last beams", and even, logically, the fact that a "blind old sheepdog" would not "miss them". (Being blind, he wouldn't miss lamps a bit, not one of them.)

Since this is a classic example of a printer's error, or compositor's error, it suggests that computer proofreading programs are unlikely to be successful unless they check every word, in context and connotation, with all possible common variants due to printers' and typists' errors.

Proof Goof 6810 contained several examples of poor English for which the author or the editor could be blamed (such as Par. 3, line 9, "how much resources" ("how many", because it is plural, or better, "what amount of resources"). "To prospect for coal", at the end of Par. 6, should better be "to prospecting for coal." These aren't proofreaders' errors, and I suspect the "reservations" error you cite is not a proofreading error, but is in the author's manuscript, a type of lapse of which most of us are guilty from time to time.

LEON DAVIDSON
Metroprocessing Associates
64 Prospect St.
White Plains, N.Y. 10606

Flexibility Appreciated

Please put my name and address on your mailing list for notification of publication of your forthcoming book, *General Science and Problem Solving.*

I would like to express my appreciation for your efforts in making C&A the flexible, open-minded medium for the exchange of ideas that it is. Please keep up the good work.

JOHN T. POWERS, JR.
Computer Usage Development Corp.
3181 Porter Drive
Palo Alto, Calif. 94304

c.a EDITORIAL

Tunnel Vision

The subject of the special feature of the January issue of *Computers and Automation* in each year is looking ahead and looking backward: "Retrospect, Prospect, and Trends in the Computer Field". Efforts to look in such a way always involve seeing, observing, and "tunnel vision".

Sometimes a tunnel is straight and short, and you can look through it, and see a little of what the world is like on the far side — part of a road, some trees, a little sky, not much more. The field of view is narrow; only when you have come out of the tunnel can you see the full wide-angled view of the world.

Many people suffer from tunnel vision — unless and until they learn better. They see only a small part of some territory for observation; they hardly observe or notice relations and implications; they seem partly blind, and definitely unobservant.

Metaphorically, tunnel vision occurs when you send an office boy to bring you something from the supply shelves, and he comes back and says, "It is not there." Then you go with him and show it to him and he says something like "Oh." (What he should have said the first time, of course, is "I did not find it," which is a fact, for when he says "It is not there," that is an inference.)

A person with tunnel vision says, "Well, the computer is not operating today and we can't use it until it is fixed." The person without tunnel vision says, "Well, our computer is not operating for the rest of today — but I have checked with Smith & Co. nearby for computer time; and it is OK to use their computer if you like."

There used to be a great deal of tunnel vision about computers in "the olden days", 20 and 25 years ago. Here are some examples:

- Computers are slow.
- Computers are unreliable.
- The machines are too complicated; they will never be mass-produced successfully.
- There may be a need in the United States for fifteen large-scale calculating machines — but that's all.
- A computer equal to a man's brain will be the size of the Empire State Building and take all the power of Niagara Falls to operate it.

And there is still nowadays a great deal of tunnel vision about computers:

- Computers are just another tool, like matches, for man to use.
- Computer people should not concern themselves with the social implications of computers — that is a job for other kinds of people.
- Computer people have no responsibility for the correctness of the data going into a computer — they are just mechanics whose work begins with the data.
- It is not possible for a computer to translate adequately from one natural language to another.
- Computers do not think — only human beings do.

One of the latest samples of that last assertion appears in "Wanted: Masters for the Machinery" by Mel Seligsohn, in the magazine *Moderator,* for November, 1968:

> Some people still believe that computers actually think. They don't. The extent of their "thinking" is to make a choice between two alternatives, depending upon instructions electronically programmed into them. The computer will do "A" if one condition exists, and "B" if a second condition exists.

Such a naive remark shows that the author has, for example, never heard of the checker-playing program devised by Dr. A. L. Samuels, now at Stanford University; this program plays championship checkers, improving its strategy from experience, and playing far, far better checkers than Dr. Samuels himself can play.

As for some suggestions for reducing the amount of tunnel vision, narrowness of thinking, in the computer field (and elsewhere), I would recommend some books that deal with fallacies. One book that I like very much is *Applied Logic* by W. W. Little, W. H. Wilson, and W. E. Moore, published by Houghton Mifflin Co., Boston, 1955, and used for many years at the University of Florida as a text for a course in effective thinking. Part I, entitled "Fallacies", and Chapter 1, "Fallacies of Neglected Aspect", particularly, contain an interesting and useful discussion of the relations between knowledge, thinking, and the real world.

For example, this chapter mentions the "argument of the beard". We commit the fallacy of the argument of the beard if we use the fact of continuous, gradual shading between opposites (such as black and white or good and bad) to obscure or deny the fact of real differences between the opposites:

> The name of the fallacy is derived from the difficulty in deciding how many whiskers make a beard. Surely one whisker is not sufficient. Possibly even 25 are too few. Then let us say 350 make a beard. Why not 349? 348? And so on. We would have trouble determining an exact minimum. Does this fact mean that there is no difference between having a beard and not having one?

The practitioners of symbolic logic, who are very pure logicians, seem never to talk about the 40-odd fallacies occurring in common everyday applied logic.

Perhaps a good New Year's resolution for computer people would be to reflect on tunnel vision, and how to get rid of it as much as possible. For after all, since we are all mortal, we are all limited to the severe narrowness of viewpoint from living in just one short time period amid the thousands of years of human history.

Edmund C. Berkeley
Editor

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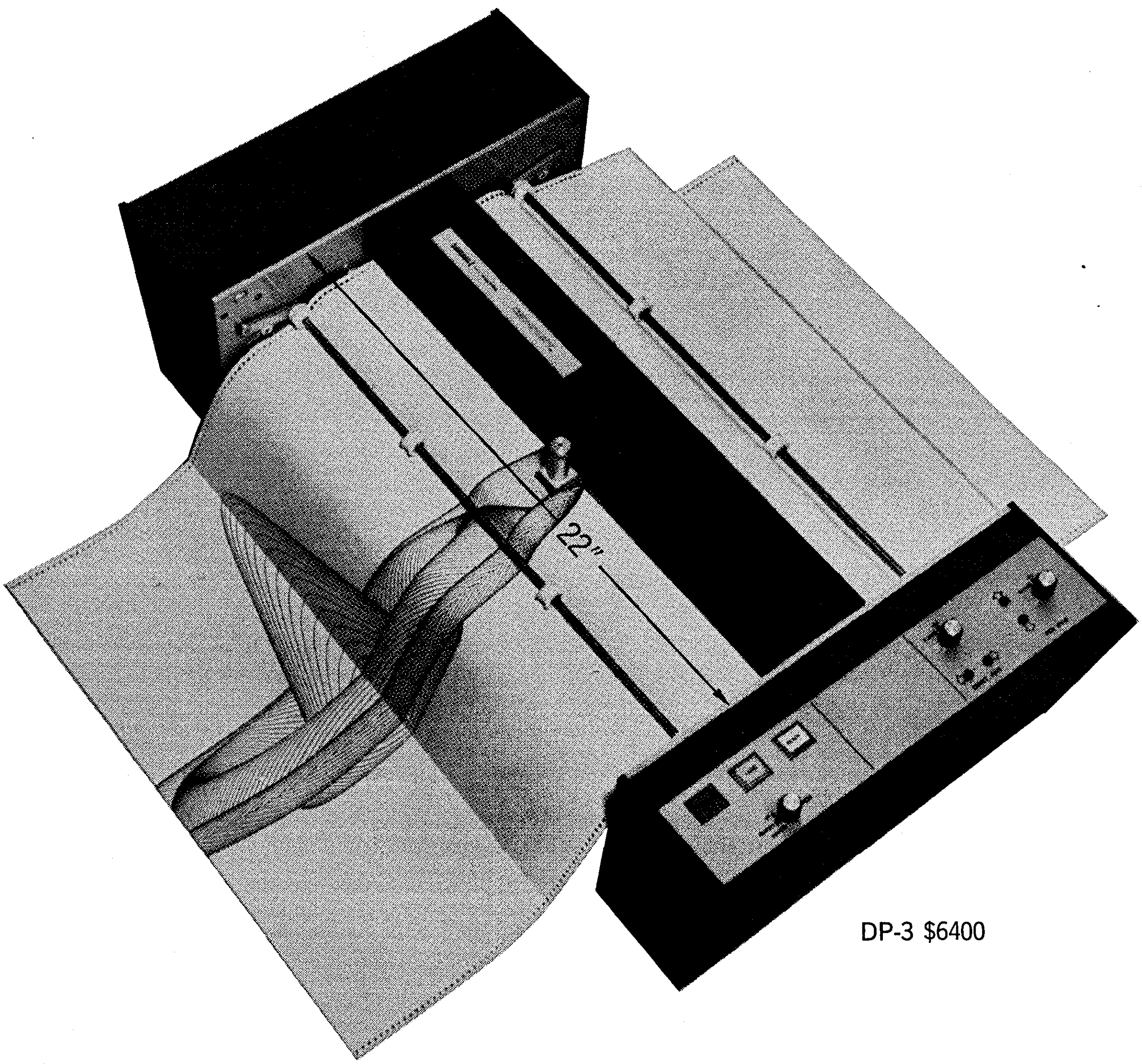

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MULTI-ACCESS FORUM

THE COMING CRISIS IN COMMUNICATIONS

John F. Kincaid, Asst. Sec'y of Commerce for Science and Technology, in an address presented to the Society of Reproduction Engineers in Philadelphia, Pa., Nov. 4, 1968

Historians of science and technology estimate that since 1900 the growth of our technology, both quantitatively and qualitatively, has surpassed that of all previous centuries. These technological achievements have created problems of a new order of complexity: streets, highways and airports are overcrowded; the forces of population growth and rising expectations are pressing against the restraints of outdated building codes and building methods; the air, rivers, and coastal waters are polluted; and we have failed, to date, to cope with the needs of the central city.

One of the newest, most challenging, and in the long run most urgent of these new problems is in the area of *communications*. Despite tremendous advances in communications technology, we appear to be moving at an accelerating rate toward a state of total confusion.

The problem, in my view, has three elements: the explosive growth in the rate of generation of new knowledge and new data; the lack of a systems approach to the various modes of communication; and the limitations of the communications target — man himself.

It is estimated that in just a decade and a half, we have stored as much information in the technical literature as in previous recorded history. There is no dependable estimate of the increase in data flow, particularly in the last few years as computers have been adding torrents of information to communication channels. But the fact that a single missile launch may generate enough data to cover 500,000 sheets of paper may give some idea of the amount of information that is being accumulated.

Regarded in a narrow context, this might be considered a source of pride. It is praiseworthy that the knowledge base is increasing. It is commendable that we are generating more and more precise data about more and more elements of our technology and our society. But the sheer volume is already beginning to generate much confusion.

How will this information be stored, and how will it be used?

Technologically, new advances in printing, computerized typesetting, microfilm, etc., are at least temporarily keeping up with the problem of storage. So, let us assume for the moment that we can continue to increase the speed of printing, and achieve still higher orders of reduction in line with the rise in data acquisition. Even so we are still faced with the problem of how to use the information, because we are not making any appreciable progress in expanding the individual man's capacity for intake of material.

This is the problem we must solve. And the communications industry must do its share.

The solution must fall within two primary areas of development. First, we must turn now to a fuller use of the tools of systems analysis and systems engineering to optimize research, development and operations over the total field of communications. Future communications systems will be too complex for conventional design approaches. In the world of tomorrow, communications will be a continuous spectrum, and each specialty will be an integral part of the whole. In that world of ultra-high speed data transmission, wired cities, and national information networks, we will process data, move data, reproduce data, store data, retrieve data — not words, not tables, not pictures, not designs: *data,* digital data, compatible with the computers which will link the transmission networks and process the material for its multiple end uses.

Second, we must learn to use the computer to refine the vast volumes of raw data we are generating, and carry out far more sophisticated analyses and syntheses. We have been designing computers that are like idiot savants — capable of fantastic speeds in computation, but sadly lacking in logic and judgment functions. Now we must learn to design computers that have more the capabilities of Ph.D.'s, able to analyze, synthesize, abstract, follow research paths, optimize designs, and organize vast quantities of partially relevant materials in terms of similarities or differences.

We must teach machines to do the routine thinking and routine decision-making, and free human beings for creative activity and high-order judgment functions.

Given the proper software, many third-generation computers can act as a brilliant complement to an inquiring mind, or serve as a capable partner to a design engineer or a public opinion analyst. They can even be programmed to consider human prejudices and emotions in solving complex problems such as the trend in election returns.

But if we put our minds to it, in a generation we can develop computer systems that will do even more. They will remove most of the drudgery from the educational process, make high-quality analyses, syntheses and abstractions of complex data, handle most of the chores of library search, and carry out sophisticated design functions dealing with complexities beyond human comprehension.

And that should be the goal of communications: to present the human brain with the maximum information — with the minimum effort. ■

OPERATION BOOTSTRAP IN THE COMPUTER FIELD — COMMENTS

Albert M. Kreger, Pres.
The Institute of Computer Technology, Inc.
Suite 100
2600 Virginia Ave. N.W.
Washington, D. C. 20037

The Institute of Computer Technology has been successfully training the disadvantaged in computer operations and computer programming (under the Manpower Development and Training Act) for over four years. (See "From Unemployed to EDP Professional," *Computers and Automation,* September 1967, page 30.) I would therefore like to address myself to the questions asked by the Los Angeles Chapter of ACM and to the points you desire to have discussed, both of which appear in your editorial in the November 1968 issue.

In answer to the ACM questions:

1. Training the disadvantaged in EDP occupations does not fall outside the "narrow fields of special interest" of such professional organizations as ACM. Every human being should be interested in training the disadvantaged. When, however, that training is concentrated in a specialized field such as in this case, certainly those individuals in professional societies in that field should have — for obvious reasons — an even greater interest in the training. Please note that the Institute has indeed received assistance from ACM (at both the local and national levels) as well as from DPMA.
2. What with the current demand for data processing personnel, certainly developing such technicians "without full educational credentials" does *not* constitute a disservice to members of the professional societies. A survey performed by the Institute for the Department of Labor disclosed that most of the professionals welcomed these technicians who were releasing them to perform higher level work. The survey also showed that a great many EDP practitioners feel the need for educational credentials is overstated and, indeed, a much smaller percentage of these practitioners than might be expected have a degree themselves. It should also be indicated that many of the Institute's graduates are pursuing degrees at night.
3. It is *not* "unfair to trainees to let them expect to work in professional areas without holding the engraved invitation of a college degree" because 90% of the Institute's graduates are doing just that.

As to the points you wish discussed:

1. Computer professionals can "contribute their knowledge and experience" primarily by teaching — on a full or part-time basis — in programs such as the Institute's Project PREPARE. Further, they can attend meetings such as those held by the Institute's alumni and present students and provide both inspiration and motivation. Once the trainee is on the job, the professionals can offer technical assistance (as well as further encouragement) when needed.
2. EDP professionals can render the Institute's graduates "more fully qualified" by offering assistance on the job, putting on in-house training programs, encouraging continuing education, and — yes — by setting up in the professional societies a membership level for which these graduates would be qualified. "Higher level" membership would require improved qualifications.
3. The employer's ability "to establish fair and equitable rules to apply to both people from ghetto areas . . . and his regular employees," in the Institute's experience, just has not been a problem. If it were, we'd resort to the type of "sensitivity training" which is often given to supervisors (and, sometimes, to all employees) in those programs which offer remedial basic education, counseling, placement, and follow up for the disadvantaged.
4. Sensitivity training (as well as other measures) can also be used to bridge the inter-personal gap between the suburban computer professional and the recently trained urban ghetto resident. The real problem is how to get the latter to *jobs* which are in the suburbs. While various government-sponsored transportation schemes do help in this matter, these schemes reduce the travel cost but *not the travel time.* The obvious answer here is to eliminate the barriers which prevent these newly trained data processors from *living* in the suburbs. ■

MINISTRY OF HEALTH COMMITTEE EXPLORES NEED FOR A MEDICAL COMPUTING LANGUAGE

Ministry of Health
Alexander Fleming House
Elephant and Castle
London S.E.1, England

In May, 1967, a Committee of eight persons, headed by Dr. D. White of the Ministry of Health, was formed to: "(1) consider the need for a medical computing language; and if the need exists to identify the problems involved in developing it; (2) to suggest solutions to the problems identified and estimate their cost; and (3) to advise on the implementation of the agreed proposals."

The Committee met on five occasions, and has now published their report. The conclusions they reached follow.

On the question of a command language, we accepted that within the generality of hospitals there will be functions common to all of them. To have a command language which was not also common would have a distinctly adverse effect. *We therefore recommend*: that where there are general procedures common to major installations, they should be summoned up from the computer by a standard set of commands. *We further recommend*: that a working party of users and potential users of planned National Health Service computers be set up as soon as possible to formulate such a common set of commands.

For an applications programming language which will carry the main burden of programming effort in the National Health Service, we concluded that until existing languages (or any modifications or extensions thereof) had been used experimentally, there was no justification for developing a special medical computing language.

We would not recommend any particular language at this stage, but instead we suggest that the programming system be so designed that programs written in any language can communicate with a common file structure and/or data base and that the object program segments derived from different high level languages be so arranged that they can be linked together to form a single program. (The I. C. T. software system operates more or less successfully in this way.) Such flexibility does not mean that we encourage the use of any language, for there are advantages to be gained if everybody talks the same one, two, or at most three languages. A dual purpose language is desirable and there are a number of languages promising in this field, for example BCL and POP 2, but we would hesitate to recommend them until they have been widely implemented. *In the meantime we recommend* confining work to FORTRAN and COBOL, with a view to changing over to a dual purpose language as soon as one appears to be viable.

On operating systems, we concluded that there may be a variety of computers throughout the Health Service, and that for the various routines required for a medical computing service, the National Health Service would have to lean heavily on the computer manufacturers and other specialists to provide the necessary software.

A limited number of copies of the complete 9-page Report of the *Medical Computing Language Committee* are available from the address above. ■

SOCIOLOGICAL EFFECTS OF COMPUTERS

Datafair 69, Conference Office
The British Computer Society
23 Dorset Square
London, N.W.1, England

One of the major topics of the Datafair 69 conference (to be held Aug. 25-29, 1969 in Manchester, England) will be the sociological effects of computers. Topics to be discussed include:

- The effect on the freedom of the individual brought about by the introduction of computers in manufacturing industry, public utilities and government.
- The social and organisational effects of introducing advanced computer systems.
- What co-operative or antagonistic attitudes exist in organisations considering the use of advanced computer systems.
- The problems of familiarisation, education and training in connection with computers, and the success or failure in overcoming them.
- What changes in management wage structure, job satisfaction and productivity occur after the introduction of computers systems.

Discussions will concentrate on practical problems rather than theoretical dissertations.

Datafair 69, the third such conference organized by the British Computer Society, will include a symposium on data processing in business and industry, and special presentations by international computer organizations. ■

3300-YEAR-OLD JIGSAW PUZZLE MAY BE SOLVED BY COMPUTER

(From a report, "Ikhnaton and the Computer", in Scientific American **for Nov. 1968)**

About 1400 B.C., Ikhnaton, an ill-fated monotheistic reformer in Egypt, built a temple at Thebes for the sun god Aten. The temple was built out of uniform sandstone blocks 24 inches long and 10 inches high. Its walls were sculptured and the scenes and inscriptions were decorated in a variety of colors. One of the most difficult jigsaw puzzles of history was created when the great temple was destroyed, and the blocks were all reused for later structures. For many years Egyptologists, digging through later ruins, have recognized and set aside the blocks with sculptured faces. Some 30,000 of them have been recovered to date.

Efforts by scholars to rearrange the scrambled blocks so as to restore the original appearance of the temple walls have failed. But now it appears that the great jigsaw puzzle may be on its way to solution through the use of computer matching techniques.

Recently the Egyptian Antiquities Service issued a permit to the University Museum at the Univ. of Pennsylvania to develop a project in cooperation with the Cairo service center of IBM Corp. to apply machine methods to the formidable task. Project workers have already photographed 25,000 of the blocks and coded their visual contents so that a computer can match block with block. Ray W. Smith, the director of the project, and his Egyptian colleagues expect that a photomontage restoration of the temple's decorated walls will be completed within a few months. ■

CORRECTIONS

In the December, 1968, issue, the titles on pages 64 and 65 were unfortunately reversed. The title "New Contracts" should have appeared on page 64, and the title "New Installations" should have appeared on page 65, as listed in the Table of Contents on page 5.

On page 5, the article "Handling Small-Area Data With Computers" was indicated by the coloring as part of "Special Feature: Annual Pictorial Report." This article was not part of that report. ■

SIXTH ANNUAL COMPUTER PROGRAMMING CONTEST FOR GRADES 7-12

Association for Educational Data Systems
AEDS Programming Contest
Chicago Board of Education,
Div. of Data Processing Education
Room 430, 228 N. LaSalle St.
Chicago, Ill. 60601

A contest designed to stimulate inventive interest among young students in the computer programming field is being sponsored for the sixth year by the Association for Educational Data Systems (AEDS). Deadline for entries in the contest is April 4, 1969; students in grades 7 through 12 are eligible to enter.

The Programming Contest winner will receive a $150 U.S. Savings Bond plus an all-expense-paid trip for himself and his teacher to the 1969 AEDS Convention in Portland, Oregon next spring. Second prize awards of $50 U.S. Savings Bonds will be given, and pupils who submit projects are eligible to receive a one-year subscription to a professional publication.

A project may be submitted by an individual or by a team of two or more pupils. If the grand prize is awarded to a team, the team must select just one of its members to make the trip to Portland.

Additional details and application blanks may be obtained by writing to the address above. ■

MAGNETIC DRUM MEMORY SYSTEM — CORRECTION

In the pictorial section of our December, 1968 issue, page 38, a new magnetic drum memory system being marketed by General Instrument Corp., Systematics/ Magne-Head Div., 13040 South Cerise Ave., Hawthorne, Calif. 90250, should have been described as having "high reliability (less than one recoverable error in ten to the eleventh power bits)".

The original press release we received describing this product said:

(less than one recoverable error in 10" bits).

The quotation marks used with a figure in such a case are a standard abbreviation for inches; and "10 inches bits" did not make sense to us. One confusion led to another — like Barnum's famous circus sign "To the Egress". We regret the mistake we unfortunately printed, "$10\frac{1}{4}$ bits", which also makes no sense.

For more information about this new magnetic drum memory system, circle #2 on the Reader Service Card.

WHO'S WHO IN THE COMPUTER FIELD, 1968-1969 — 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:__________
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COMPUTERS — PAST AND FUTURE:
The Costs of Computing; and Failure in Computer Programs

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"Despite all the attention that has been devoted to programming languages, they have not succeeded in making programming sufficiently easy nor sufficiently foolproof. Programming still remains our most critical bottleneck, and we don't have any really promising plan for overcoming it."

It is customary for *Computers and Automation* to start each new year with a survey of the computer field as a whole, its past development and promise for the future. In undertaking this assignment for the present year, I propose to concentrate on a few salient points; not, perhaps, the most important ones but those which seem to have received less attention in the literature than they deserve. Nothing will be said about hardware, nor about applications; the great promise for progress in these respects has been well publicized. I shall, instead, emphasize two problem areas; some aspects of the economics of computing costs, especially relating to programming languages; and the growing problem of failure in computer programs.

A Million Arithmetic Operations for 25¢

The very first electronic computer, ENIAC, gained a factor of 10,000 in speed — in round numbers — over the earlier manual computing methods. In the 23 years since then, through the successive generations of machines, computing has been speeded up by perhaps another factor of 10,000; so we are now 100,000,000 times as fast as we were 25 years ago. Thus, while computers and programming have become more expensive, the cost of computation has been reduced by a factor of 100,000. (All these figures are elusive estimates, each of which might in itself be wrong by a factor of 10 or more. Still, they indicate correctly the direction and rapidity of development). Currently, computing cost is estimated at 25¢ per million arithmetic operations. At this bargain price, it pays to do many things by computing which formerly had to be done by other means. Information retrieval, for example, used to be done in a way which could not by any stretch of the imagination be called computing, but now we have learned to break it down into steps which look like computing and can be done on computers (and which we have therefore come to call "computing"). And so with text editing and print composition, warehousing, and many other exalted or lowly tasks.

Will it get still cheaper?

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Dr. Alt received his Ph.D. in Mathematics at the University of Vienna in 1932. He became a U.S. citizen in 1944. Before undertaking his present responsibilities as the Deputy Director of the Information Division of the American Institute of Physics, he spent 15 years with the National Bureau of Standards, where he was responsible for the design of the information system for the National Standard Reference Data System, and for relevant research in problems of information retrieval, documentation, and computer technology.

Dr. Alt is a member of the American Mathematical Society, the ACM, the Association for Computational Linguistics, and Sigma Xi. He has published a book, *Electronic Digital Computers* (Academic Press, New York, 1958), and over forty articles in various technical journals.

Programming: A Major Expense

An interesting fact which has a bearing on this question was recently brought out. In the beginning, computers were considered expensive and every effort was made to utilize them fully and effectively. But as they became still faster and more elaborate, more jobs were required to feed them, and the jobs became more complicated; and so programming became a major expense and a bottleneck. By the mid-sixties only half of the total cost of computing went for hardware, and it was predicted that the fraction would be down to 20% in another ten years. Most recently, however, it has been estimated that the 20% level has already been reached. This means that if a typical computation laboratory spends, say, \$20,000 per month for machine rental (or for amortization and maintenance of purchased machines), another \$80,000 is spent on personnel for operating, keypunching, programming (in house or outside), file maintenance, scheduling, accounting, liaison with users, and supervision.

In this situation, even a drastic reduction in the cost of hardware, or a phenomenal increase in speed at an unchanged price, can have only a minor effect on the cost of computing as a whole. Lower programming cost is what is needed. Therefore, when a new computer is to be installed, salesmen and buyers instinctively talk little about speed and other performance characteristics, and much about logical organization, the order code, compatibility with existing computers, language compilers and operating systems — features which affect the cost of programming and operation.

The fact that programming is a major element of computing costs, and offers the principal opportunity for further reduction of these costs, is reinforced by at least two other reasons for trying to make programming easier. One is the shortage of programming personnel, which today constitutes a severe bottleneck and threatens to strangle further rapid growth of the computer field. The other lies in the increasing complexity of programs, which in some applications is getting out of control and has resulted in serious failures.

A "Good" Programming Language

What can be done?

The profession has long looked to the development of higher-level programming languages for relief. While much has been accomplished, much more remains to be done. It has long seemed to me that we have been troubled by widespread confusion of goals, and failure to recognize different goals as incompatible. According to some enthusiasts, a good programming language should be, among other things:

- easy to learn,
- easy to use,
- easy to implement,
- machine-independent,
- quick to compile,
- leading to efficient object programs, and
- general-purpose, i.e. applicable to a wide variety of problems.

So they proceed to try to construct one language with all these properties. But the more one simplifies the language in order to make it easier to learn, the clumsier does it become to use in the hands of the experienced programmer; one cannot please both the beginner and the expert. The more general-purpose and machine-independent a language, the harder it is to implement (i.e., to write compilers for it) and the more time and storage is consumed by compilation. To obtain most efficient object programs one must introduce features which in a subtle way give preference to one or another computer type, and one must make limiting assumptions about the class of problems to be handled. And so on.

Different Languages for Different Purposes

What we seem to need, then, is a variety of programming languages to serve a variety of purposes.

Now it is true that we already possess many programming languages, too many perhaps: we have a number of languages for scientific problems, others for business problems, still others for handling English and other human languages, for processing pictures, for manipulating mathematical formulas and other symbolic notations, for printing of text, for editing, for simulation, for machine tool control . . . But what we need may be specialization of languages in different directions: some languages for beginners, others for the experienced; some for computer people, others for laymen, and different languages for different kinds of laymen (clerks, housewives, students, physicians . . .); some for big problems and big machines, others for small ones; some for experiments and one-of-a-kind problems, others for production runs.

A Hypothetical Comparison

The argument is less trivial than might appear at first sight. Suppose someone were to compare PL/I with Fortran and Cobol. Let me emphasize that the following discussion is purely hypothetical, that I am using these particular languages only in order to make the argument more lively, and the "facts" stated are pure fiction. Suppose, then, that someone undertook a comparative evaluation of these three languages and found that PL/I performed less well than Fortran on scientific problems and less well than Cobol on business problems. He still could not argue that PL/I has no merit: for the price of somewhat poorer performance on problems of all types, PL/I buys the advantage of being one language instead of two. How much of an advantage is that? To the manufacturer, it means having to provide only one compiler, instead of two, for each type of machine produced; and to the user, having to train his programmers in only one language. The latter advantage is rapidly becoming unimportant; as the number of programmers grow, we can better afford to let different groups specialize in different languages. But the former advantage may be significant: the savings in compiler writing can be substantial, and may outweigh the loss due to less efficient object programs. Where the break-even point lies will depend on how many applications programs are written in a language during the lifetime of one compiler, i.e., in essence, of one computer type. It follows from this argument that greater diversification of languages ought to be advocated, especially by those manufacturers who produce large numbers of machines, while the smaller manufacturers, in their own interest, ought to favor concentration on a few general-purpose languages — a conclusion which does not seem to have always been fully appreciated.

The same considerations crop up in standardization, of which we hear so much. It is gratifying to know that efforts are under way at standardizing a variety of languages not only for different applications, but also for various ranges of equipment capabilities.

But programming languages are only one aspect of the problem. Despite all the attention that has been devoted to them, they have not succeeded in making programming sufficiently easy nor sufficiently foolproof. Programming still remains our most critical bottleneck, and we don't have any really promising plan for overcoming it.

High Failure Rate

What is worse, those programs which do get written have an intolerably high failure rate. We hear bitter complaints about computations going spectacularly wrong. One computer has billed a mail order customer for goods not bought, and attempts at correcting the account statements fail for months. Another has canceled an insurance policy, for no apparent reason, and it proves impossible either to determine the reason or to get the policy reinstated. A third has given wrong tallies of votes in the Congressional election, even though the program had been meticulously tested.

The Inadequacy of Human Language

I submit that the real root of this evil is the inadequacy of our ordinary human language for describing the problem before programming begins: specifying all possible combinations of circumstances which can arise in the course of the problem, and stipulating how the program is to react in each case. This is the reason for the sad fact, so well known to every programmer, that we continued to find "bugs" in a program for many months after it has passed its first successful trial run.

To put it differently: We have been saying for some time that computing can not only solve certain kinds of problems faster and cheaper than humans, but they can solve some problems so large that it would be altogether impossible for humans to solve them. We should now add that there are many problems within the capacity of computers which are too complicated for humans even to describe — although humans have been solving them quite well for a long time without first describing them completely.

The inadequacy of our human language for modern technology and modern complex organization becomes apparent in other contexts too, in cases not involving computers. A simple example is a set of instructions say for assembling a piece of furniture shipped in parts. We all know how often the printed instructions are quite unintelligible, especially if expressed in words alone, without pictures. Another is the oft heard complaint about lack of communication in an organization, despite frequent staff meetings, newssheets, etc.: it is not that people don't talk or write to each other, but that their words don't express what they would like to communicate.

Projects are under way to insure the proper working of computer programs by expressing in some unique formalism both what the program is supposed to do and what it actually does. One could predict that such efforts will succeed so far as the *actual* working of the computer program is concerned (the program itself is such a formalism, and it could undoubtedly be transformed into a simpler expression), but that the effort will run into grave difficulty, probably fail entirely, when trying to express the *desired* working of the program.

Pictures and Diagrams

Pictures and diagrams might help a little. Pictures (representations of a real object by similarity) have been around for a long time. Diagrams (representations of abstract relationships by symbolic analogies) are relatively recent, though the old genealogical trees might be considered precursors. It seems, however, that pictures and diagrams are suitable for representing just those situations which are also describable in words, although less briefly.

It is possible that the currently fashionable preference for diagrammatic representation is caused not by its merits but by the growing atrophy of reading skill, due to television and comic strips. Indeed, in earlier centuries language had been developed to great heights of proficiency for such disciplines as philosophy or law. Legal "jargon" is a truly powerful tool for expressing and communicating, at least among experts, situations too complicated for ordinary language. Pictures and diagrams, unless they can be developed far beyond their present level, may be a step back rather than a step forward.

Yet something must be done. More and more the failures in computer programs affect our daily lives, interfere with fairness and justice, and introduce serious dangers into our society.

What can be done?

I shall cite two approaches which offer some hope, though neither can claim assurance of success.

Artificial Intelligence

One is the continued pursuit of "artificial intelligence". Many of the problems studied under this general title are just those in which human language (and perhaps human intelligence) is weak:

- the process of learning — how does our store of knowledge get enlarged?;
- heuristic problem solving (learning by trial and error) and self-organizing systems;
- the relationship between structure and meaning of language (syntax and semantics);
- teaching computers to understand natural languages, including syntactic analysis and translation from one human language to another;
- recognition and manipulation of pictures or patterns and, especially, parallels in the handling of pictorial and verbal information.

In the long run, one may hope, this could give rise to systems for manageably simple descriptions of complex problems.

Man-Machine Interaction

The other approach is the use of man-machine interaction. It is more concrete and down to earth than the study of artificial intelligence. It offers some promise even for the near future, but only for a more limited group of problems. It follows more closely the example of the human approach to the problems. As we said above, some of the problems which we find most difficult to formulate and program have long been solved by humans without much trouble. Thus, election returns have been tallied, mail order bills rendered, insurance policies renewed, and credit ratings assigned, by human beings. In all these cases there never arose the need to formulate the problem completely, i.e., *all* the rules to be followed, complete in every detail. Rather vague rules were given to many operators, each of whom was concerned with only a small part of the operation, and was relied upon, if he encountered a situation not covered by the rules, either to make a decision or to ask for instructions. Why not try the same approach for the computer? This calls for man-machine interaction in (at least) every unforeseen situation; and that means, because of the high speed of operation, interaction at very short time intervals. For reasons of economy it usually requires time-sharing of the computer, and therefore — because it is impractical to assemble many on-line users in one machine room — remote access, though not necessarily over long distances.

This matter of "on-line computing" has been the subject of much study and experimentation in the past few years, beginning with Project MAC at MIT, and onward through a spectrum of projects of decreasing ambition, down to several commercially available systems of quite simple design. The latter are not likely to lead to spectacular improvements in the computing art, but the large research-minded systems for interactive computing, Project MAC and its peers, may well become a decisive force.

Programming Should Be Less Expensive and More Failure-Proof

In conclusion, two developments would contribute greatly to further growth of the computer field: programming should be made less expensive, and more failure-proof. One way to bring about the former would be to specialize programming languages not only according to problem areas, as in the past, but also according to types of users, size and repetitiveness of problems. The latter requires the invention of radically new formalisms for describing problems, supplementing human language. Such invention might result in the long run from the study of artificial intelligence, and, in the short run and in a more limited sense, from the further development of interactive computing.

To say all this is a wish, not a prediction. It ought to happen, but will it happen? One straw in the wind is that there is plenty of economic interest in, and financial backing for, anything that reduces the cost of programming. But this condition does not exist for making programs safe. Thus it may be realistic to hope for a strong effort on cost reduction, leading to more specialized programming languages. But for making programs safe, for new methods of problem specification leading to higher quality in programming, only a continuation of the present slow rate of progress seems to be ahead. Programming errors hurt the unorganized users and, above all, the public; and they have no good way of protecting their interests. The case is somewhat analogous to automobile design, where appearance and performance pay off, but safety does not. Perhaps we need a Ralph Nader in computer programming. ■

THE COMPUTER MEMORY MARKET:

An Example of the Application of Technological Forecasting in Business Planning

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"Even the most farsighted technical prophet will be without honor unless and until his advice appears to make good business sense."

One of the great aircraft designers in the era prior to World War II was a man by the name of William Bushnell Stout. He was, among other things, the designer of the famed Ford "Tin Goose". Mr. Stout dreamed of the day when every man would have his own airplane and, by the middle 1930's, it began to trouble him that this day was so slow in coming. Finally, he concluded that the real obstacle lay in the engines which were then available. "What we need", he announced in a speech to leaders of the aviation industry, "is an engine which develops 100 horsepower, weighs 100 pounds, and costs $100." Instantly, a member of the audience leaped to his feet and exclaimed, "And you shall have it, Mr. Stout — in 100 years!"

This story emphasizes a fundamental truth about technological forecasting. The most farsighted technical prophet will be without honor unless and until his advice appears to make good business sense. In no occupation is this principle more apparent than our own. Technical Marketing Associates is a management consulting firm, devoted primarily to product line planning and market studies, and working almost exclusively with clients whose businesses are technically oriented. What the client expects from TMA is information, interpretation, and advice which will assist him in reaching sound decisions regarding business problems. Although technological forecasting plays a part in almost every assignment which TMA performs, it must be regarded as a research tool — one of many tools available to help the client. With this in mind, what we would like to present here is not technological forecasting "per se", but one modest example of how technological forecasting has been combined with other techniques to assist a client in understanding a complex market opportunity.

David W. Brown is the Executive Vice President of Technical Marketing Associates, Inc. He received his B.S. degree at M.I.T. in 1948 and a Master of Business Administration degree at Harvard Business School in 1952. He is the author of various trade journal articles concerning industrial applications of electrical equipment, and a leader of the American Management Assoc. seminars on new product development and industrial market research.

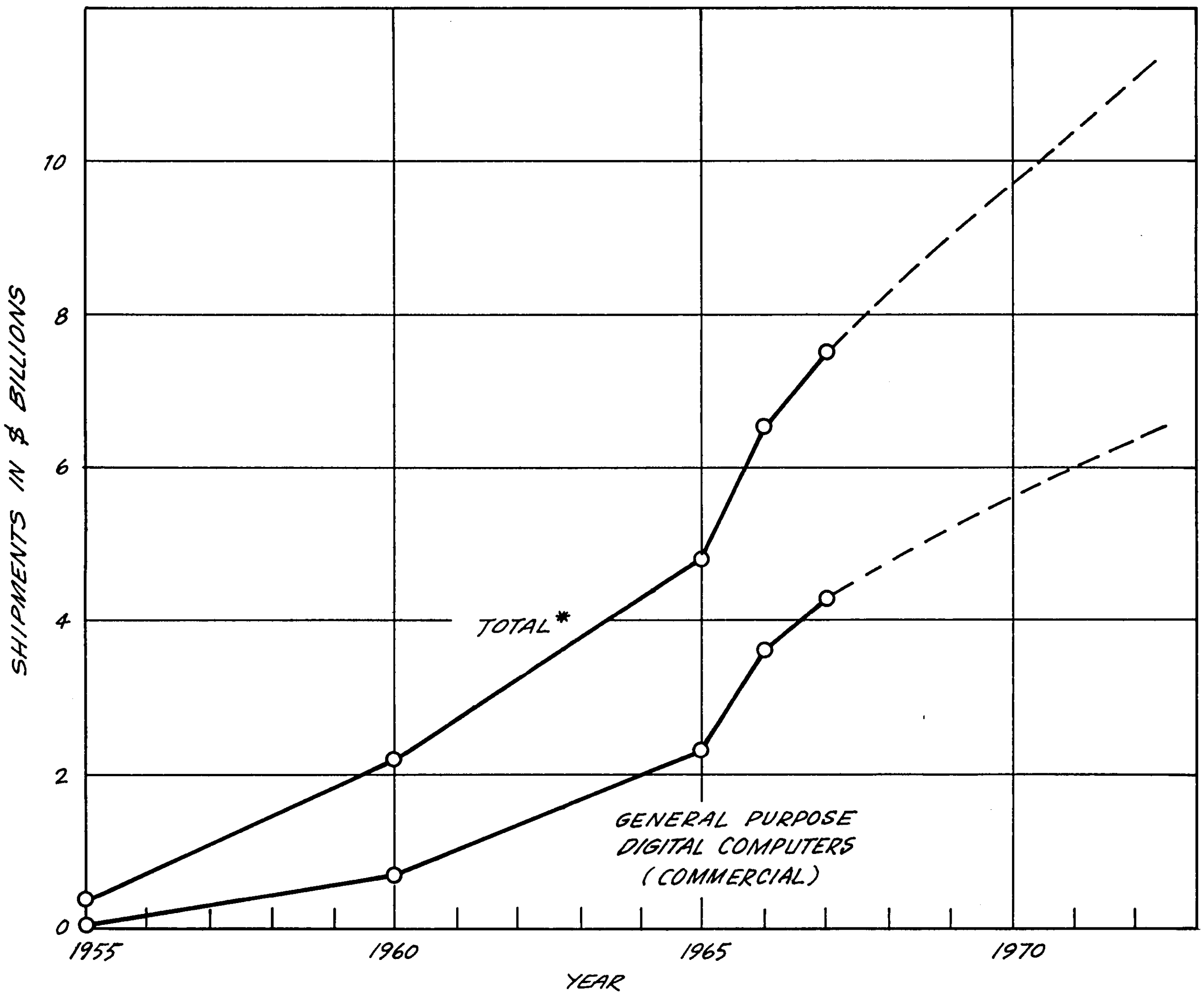
James L. Burkhardt is a Senior Associate at Technical Marketing Associates, Inc. He is a consultant to research institutions and private industry in experimental physics. He received his Ph.D. in Physics at M.I.T. in 1955, and has published numerous articles in the field of physics.

The Purpose of the Study

In the case which we discuss here, the client had been developing thin magnetic films which were potentially applicable as rapid-access memory elements for computers. By 1967, this work had been proceeding on a limited scale for about three years. Although the computer industry as a whole had progressed spectacularly during this period, the client saw no evidence of any large-scale trend away from the traditional ferrite core memories toward the use of thin magnetic films. Thus, the client considered the further pursuit of this development open to question. Was the thin film development leading to a "dead end" or were there market prospects for thin film technology which justified its continuance? If, indeed, there was a future market for thin film technology in the computer industry, how attractive would that market be, and what steps would the client have to take to capitalize on it?

Background Data

To provide a frame of reference for the study, a projection was needed of the future growth of the computer industry as a whole. We did not think it necessary for TMA to make such a projection on its own, since there were available many



* TOTAL INCLUDES GENERAL- AND SPECIAL-PURPOSE DIGITAL COMPUTERS, INDEPENDENT PERIPHERAL EQUIPMENT, SOFTWARE AND CONSULTING SERVICES, SERVICE BUREAU OPERATIONS, SUPPLIES AND SUPPORTING SERVICES.

ESTIMATED ANNUAL VALUE OF COMPUTER EQUIPMENT SHIPPED BY U.S. MANUFACTURERS

Exhibit 1

forecasts published by persons considered to be authorities on the industry. We selected as our basic projections the two curves shown in Exhibit 1. The upper curve in Exhibit 1 is a forecast of dollar sales of the data processing business as a whole, including not only computer main frames but also peripheral equipment, software, consulting services, service bureau operations, and the like. The lower curve is a forecast of dollar sales of computer "main frames" only. The main frame, of course, is the center of the computer, which performs the calculating operations. It is of particular interest to us because at its heart is the subject of the study: the random access main memory.

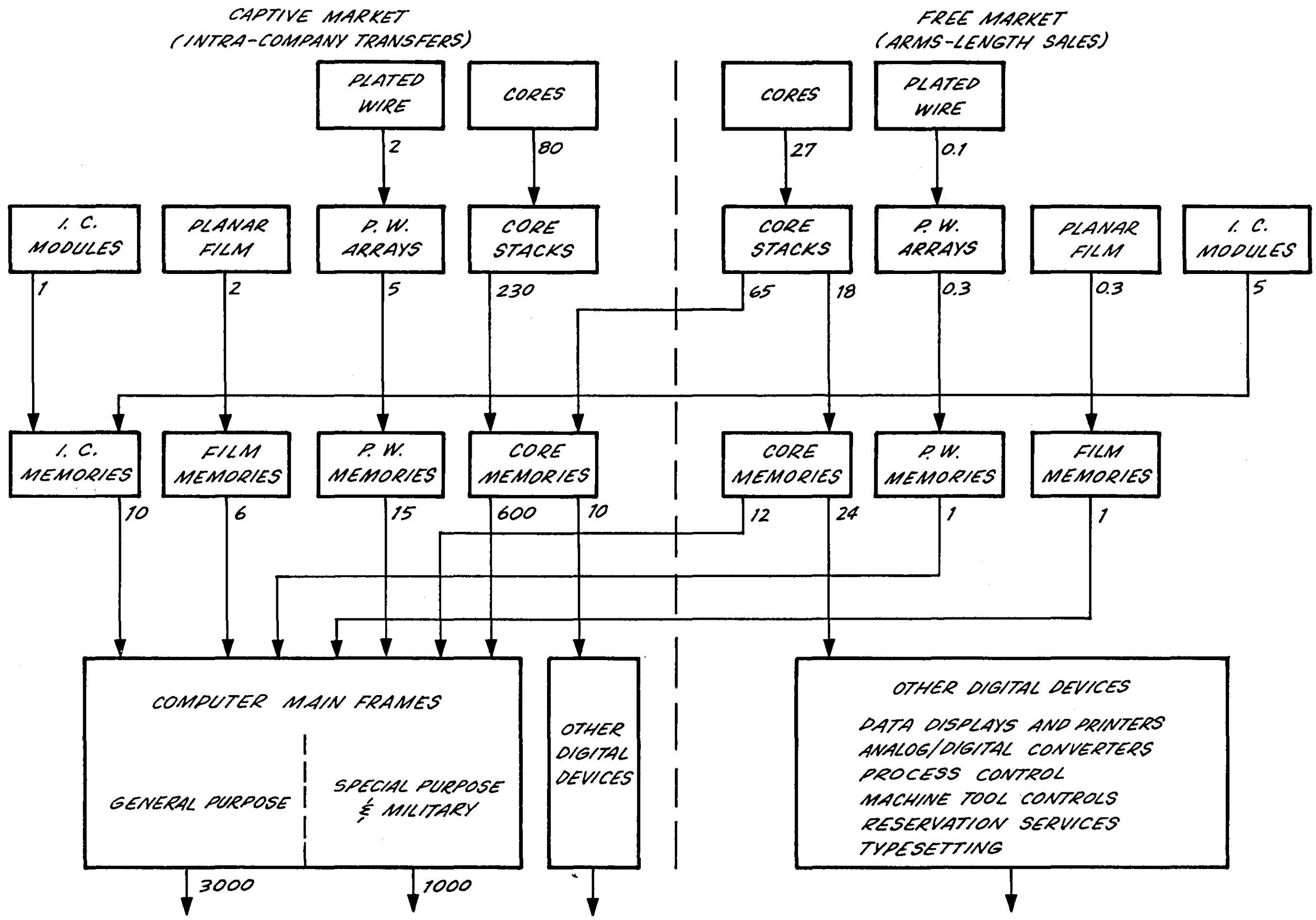
A peculiarity of the computer industry is the lop-sided distribution of the main frame business among the principal manufacturers, as shown in Exhibit 2. This tabulation highlights a problem which handicaps anyone making forecasts in the computer industry. One company, IBM, comprises more than two-thirds of the industry, and IBM has very strict policies which prohibit its employees from discussing future developments with outsiders, no matter how legitimate their interest. Consequently the future plans of two-thirds of the industry can only be deduced through such bits of second-hand intelligence as may filter out through IBM's security

Exhibit 2

COMPUTER SHIPMENTS BY COMPANY, 1966

	Amount ($ Million)	Percent of Total
IBM	2,500	68.3
Honeywell	270	7.4
Control Data	200	5.5
Univac	195	5.3
General Electric	190	5.2
National Cash Register	95	2.6
Radio Corp. of America	95	2.6
Burroughs	60	1.6
Scientific Data Systems	30	0.8
Others	25	0.7
	3,660	100.0

Source: E/D/P Industry and Marketing Report



INPUT-OUTPUT ANALYSIS OF THE COMPUTER MEMORY MARKET
FORECASTED 1967 SALES AND TRANSFERS IN MILLIONS OF DOLLARS
Exhibit 3

blanket. Nevertheless, the same laws of physics apply in Endicott, New York, as apply elsewhere, and we have had to content ourselves with the conviction that technological advances which make sense to the remainder of the industry will probably ultimately make sense to IBM as well.

The Memory Market in 1967

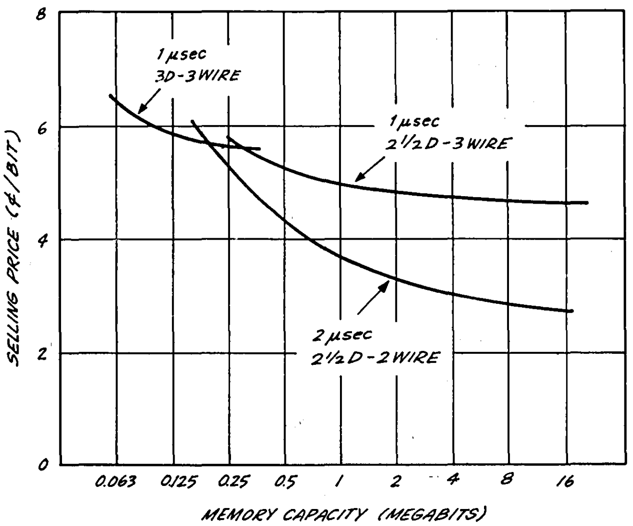
Narrowing our outlook to the rapid access memory market, we undertook next to construct for the client a chart illustrating its size and operation. This is shown in Exhibit 3. Since information as detailed as this is not available from any published source, it was necessary to compile the data shown in this exhibit by extensive interrogation of persons active in the memory industry itself.

Computer memories proved to be a big industry. The value of all the main memories made in 1967 was thought to be about $680-million. This is TMA's estimate of the total value which all the memories would have had, had they been sold on the open market. The majority, of course, were not sold at all. They were transferred within the captive portion of the market, shown on the left side of Exhibit 3, which was composed of the computer manufacturers themselves and the companies which they control. It was in the comparatively small free market, composed of independent manufacturers of memory systems, memory components and other devices, that the client's product would have to compete.

The numerals below the blocks in Exhibit 3 represent the estimated value in millions of dollars of the merchandise sold or transferred between each of the segments of the memory market in 1967. It may be seen that although the captive computer industry made most of its own memory systems and memory components, a certain portion was bought at each level from the free market. In fact, although the estimated total sales volume of the free segment was about $155-million, only about $24-million of it was finding its way into products other than those made by the captive market.

The memory market was also depicted as having several levels, each a supplier of components to the level below it. Total sales at the memory system level in 1967 amounted to about 15% of the total value of the main frames. Over the prior five years this percentage had been growing. The cost effects of demands for more capacity and more speed had been largely offset, in the calculating sections of the computer, by improved design and lower prices in electronic components. Not so in memories. Cost reduction in core memory systems had not kept pace, and increasing premiums had had to be paid for advances in memory size and cycle time. It appeared that by 1972, a typical memory would probably represent 25% to 30% of the total cost of the computer. Desire to keep this percentage from growing even further motivated the intense interest in new memory technology which permeated the industry.

At each level, the market structure in Exhibit 3 could be further subdivided on a technological basis. A glance at the figures shows that by far the greatest portion of all memories manufactured in either the captive or the free market used



SYSTEMS INCLUDE ADDRESS REGISTERS, DECODERS, DRIVERS, SWITCHING, CORE STACKS, SENSE AMPLIFIERS, INPUT-OUTPUT REGISTERS, AND TIMING.

ESTIMATED 1967 SELLING PRICE OF COMPLETE CORE MEMORY SYSTEMS AS A FUNCTION OF CAPACITY

Exhibit 4

conventional ferrite core technology. Magnetic thin film technology was used in two types of memory systems: those using plated wire and those using planar film. Together these technologies made up no more than 3% of the total market. The only other significant technology was that using integrated circuits, and it was an even smaller factor in the market. Were our client to think of himself as a potential manufacturer of magnetic thin film memory components, it can be seen that in 1967 the total value of the market for which he might compete was only about $700,000. Small wonder, then, that the client was concerned whether he should continue development work in this area.

Lessons Learned from Core Memories

Over the next five years, how were thin film memories likely to fare in competition with other types? This was the heart of our problem.

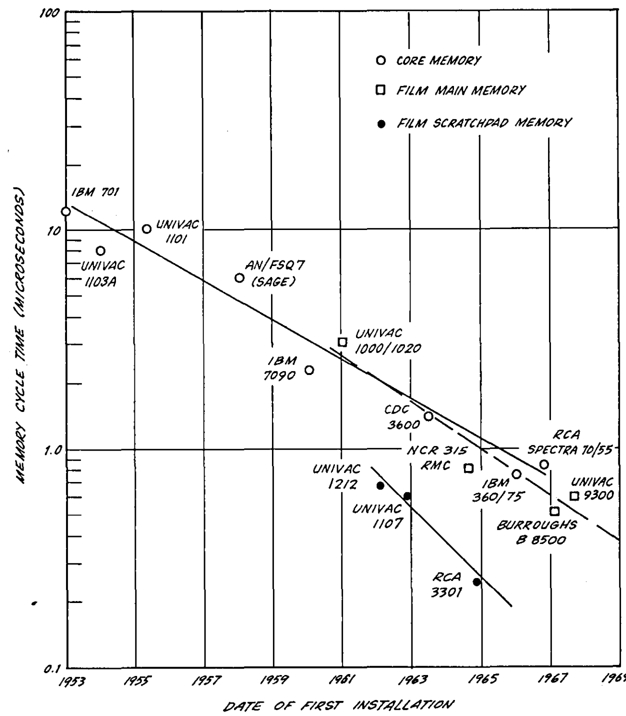
Memories, we learned, compete with one another the same way that computers do — on the basis of data handling capacity per dollar cost. The key measures of strength, then, are:

- Capacity (measured in bits)
- Speed (the inverse of cycle time in seconds)
- Price

As one memory designer put it, "We're looking for the most bits per second per buck."

Using this standard, we discovered that there are many good reasons why the magnetic core memory, despite many published predictions of its imminent demise, continued to dominate the memory market.

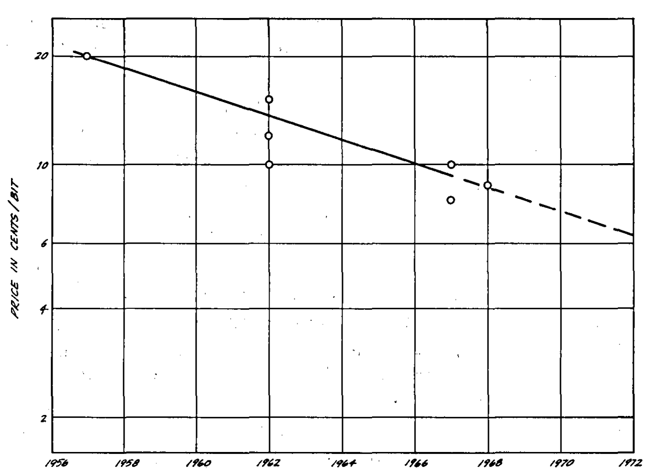
By 1967, for example, one could no longer talk about "the" ferrite core memory. There was no longer one such memory system; there were several. Ferrite core memories can now be organized in several different ways, each of which gives different performance specifications, and different cost tradeoffs. The intelligent engineer, therefore, will choose between these various organizations and select the least expensive one which is suited to his requirements. A study by a leading computer designer was adapted to yield Exhibit 4, in which we can see the relationships between the cost per bit, the speed, and the size of the memory system for each of three organizational schemes which are presently popular. These newer memory organizations offer more formidable economic competition to a new technology, like magnetic thin films, than did the 3D-4 wire core memory system which was the universal standard several years ago.



MEMORY CYCLE TIME vs. DATE OF INTRODUCTION FOR SELECTED "FAST" COMPUTERS

Exhibit 5

Futhermore, core memories have been getting faster. This can be seen by reference to Figure 5, in which are plotted the decreasing memory cycle times of a series of computer which have been introduced over the last 15 years, based on their published specifications. The newest computer with a core memory is more than ten times as fast as the computer introduced in 1953. It is interesting to observe that the computers using thin film memories have extended the speed



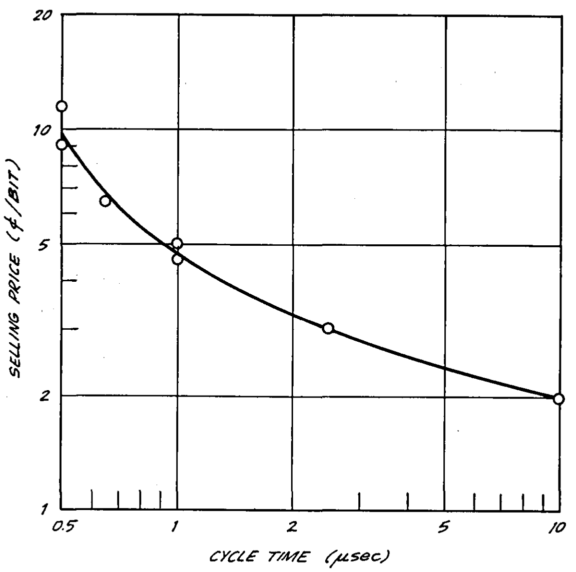
ESTIMATED PRICE/BIT OF COMPLETE 1,000,000 BIT MEMORY SYSTEMS OF FASTEST SPEED IN ORDINARY PRODUCTION

Exhibit 6

trend of core memories but have not substantially broken away from it. (The memories in the lower section of the chart are "scratch pad" memories, which are not directly comparable with main memories because they are not bound by the same economic constrictions.)

As core memory systems have become faster they also have become less expensive. Using figures provided by interviewees, we established the curve shown in Exhibit 6, showing the trend in price per bit of the fastest memory system of constant size in ordinary production. It may be seen that the cost per bit had been roughly cut in half, from about 20 cents in 1956 to about 10 cents in 1966, and we felt reasonably safe in extrapolating this trend out to about 6 cents per bit in 1972. This of course is the price per bit for the fastest memory in regular production; the price per bit of an average memory would be nearer to 5 cents per bit in 1966 and possibly 3 cents in 1972.

Finally, we found it instructive to examine the relationship between memory cost and memory speed at the time of our study. Exhibit 7, based on manufacturers' quotations, quantifies this relationship for a memory system of one million bits.



SYSTEMS INCLUDE ADDRESS REGISTERS, DECODERS, DRIVERS, SWITCHING, CORE STACKS, SENSE AMPLIFIERS, INPUT-OUTPUT REGISTERS, AND TIMING.

ESTIMATED 1967 SELLING PRICE OF 1,000,000-BIT COMPLETE CORE MEMORY SYSTEMS AS A FUNCTION OF CYCLE TIME

Exhibit 7

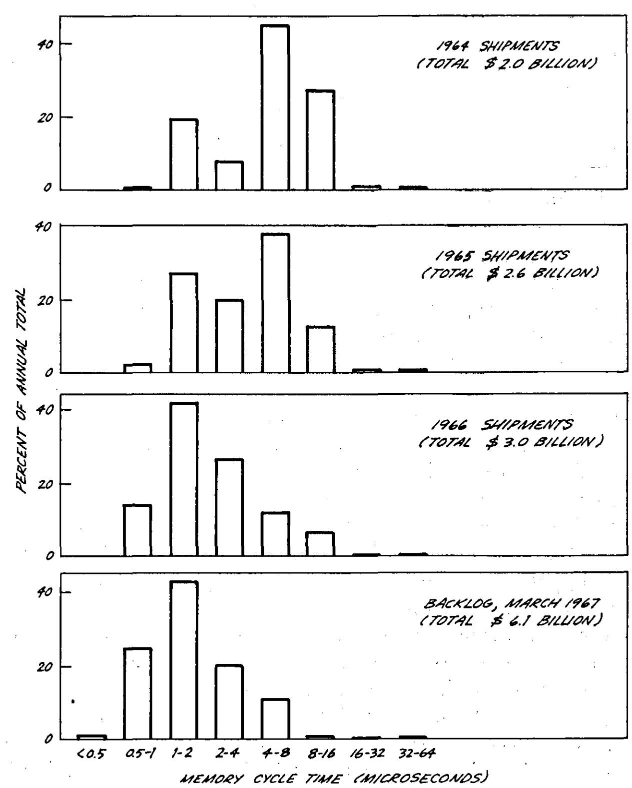
Note that cost per bit increases very sharply for short cycle times: in fact, as the cycle time goes from 1 microsecond to 500 nanoseconds, the cost per bit doubles.

Some hard physical facts underlie this simple-looking curve. Every core memory system has an electronic section and a magnetic section. The electronic section includes a switching system which puts each bit of information into the proper place in the memory and then retrieves it again when wanted, an amplifying section which makes the memory's read-out signal strong enough to be used elsewhere in the computer, a "clock", and a power supply. The magnetic section consists of thousands of little ferrite doughnuts, strung on wires which carry the signals in and out of storage. Basically, the speed-limiting factor in the memory has always been the magnetic section. Engineers have discovered that they can make the ferrite cores respond more quickly by making them smaller, and over the years the diameters of these tiny doughnuts have shrunk, bit by bit, from more than .050″ down to as little as .012″. Nevertheless, these miniature doughnuts still have to be fabricated, tested, and mounted on frames, each with two or three carefully strung wires passing through its center. Over the years, the cost of making the magnetic section of the memory has actually increased. The overall reductions in memory cost have come about through drastic decreases in the cost of the surrounding electronics. In our interviews it became clear that more and more engineers were doubtful that these trends could be extended much further. It appeared then, that the sharp rise in the left-hand side of the curve in Exhibit 7 constituted a cost umbrella under which other technologies might take root and develop. If memories using thin film technology would operate effectively at cycle times of around 500 nanoseconds, and if there were indeed a need for memories operating that fast or faster, it seemed quite likely that they could be sold competitively at a price per bit of around 10 cents, even though quite possibly they could not be built to sell for a price as low as 5 cents per bit. This, then, was the thesis which it appeared we must investigate.

The Memory Needs of Future Computers

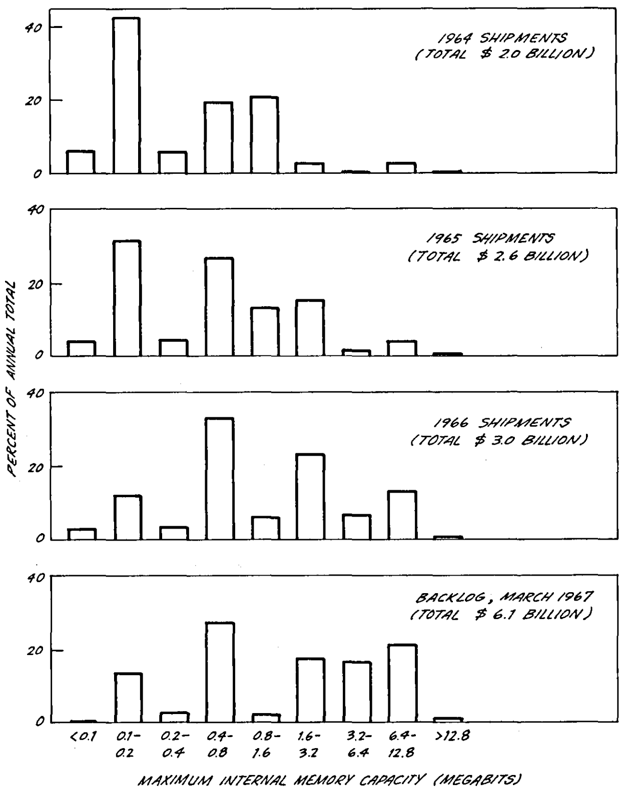
We now set about to test this thesis in the environment of the computer market of the future. Bearing in mind that our client was at least two years away from commercial sale of memory components, it appeared reasonable to try to forecast the market over a span of about 5 years. This, we felt, would define the competitive climate into which his new products would have to be launched.

We began by attempting to define the performance specifications of computers of the future. There was already no doubt that computer memories were becoming larger and faster. In Exhibit 8, for example, we can see the trend in memory cycle time of computers shipped over a period of three years. Simple observation indicates that average cycle



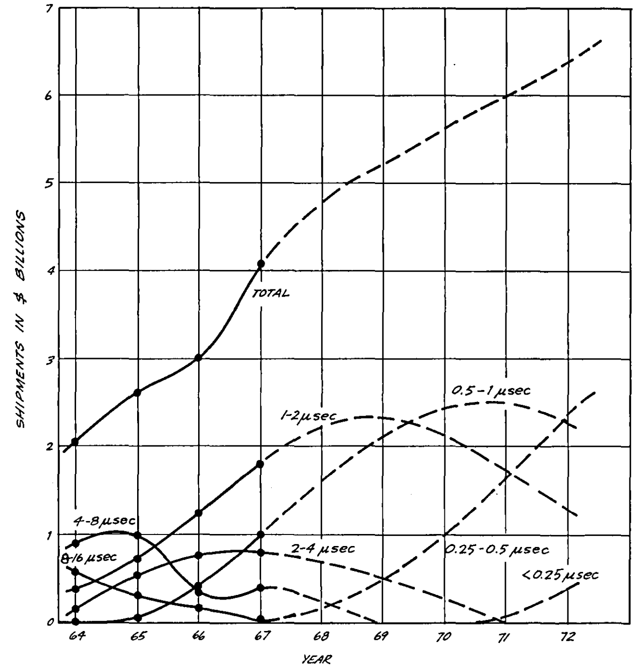
DIGITAL COMPUTERS — ANNUAL SHIPMENTS BY SELECTED U.S. MANUFACTURERS — CLASSIFIED BY INTERNAL MEMORY CYCLE TIME

Exhibit 8



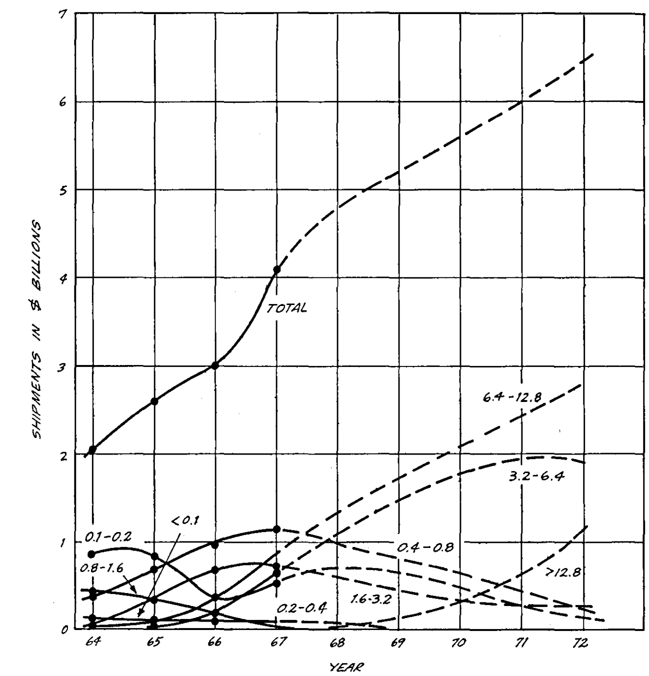
DIGITAL COMPUTERS — ANNUAL SHIPMENTS BY SELECTED U.S. MANUFACTURERS— CLASSIFIED BY MAXIMUM INTERNAL MEMORY CAPACITY

Exhibit 9



ESTIMATED ANNUAL DOLLAR VALUE OF SHIPMENTS OF GENERAL-PURPOSE DIGITAL COMPUTER MAIN FRAMES BY SELECTED U.S. MANUFACTURERS AS A FUNCTION OF MEMORY CYCLE TIME

Exhibit 10



ESTIMATED ANNUAL DOLLAR VALUE OF SHIPMENTS OF GENERAL-PURPOSE DIGITAL COMPUTER MAIN FRAMES BY SELECTED U.S. MANUFACTURERS AS A FUNCTION OF MAXIMUM MEMORY CAPACITY

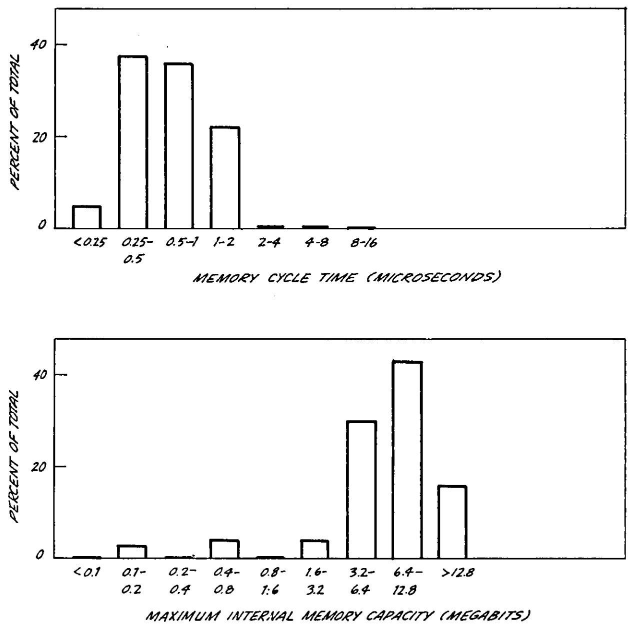
Exhibit 11

time has decreased considerably. In Exhibit 9 we may make a similar comparison for maximum internal memory capacity, in which it can be seen that capacity is growing larger. We next undertook to extend these trends out to the year 1972.

It is a common observation that any product has a life cycle. The product is introduced, sales increase as it "catches on" in the market place, sales finally reach a peak, and then, as it loses favor to other more advanced products, sales diminish until finally it disappears from the market altogether. Although computers are still so new that we do not have very much life history on them, sales statistics suggest that computer models undergo life histories of this type, and that a particular model will survive on the market place from five to ten years, depending upon its popularity. We would suggest that the same kind of behavior characterizes whole classes of computers, if they are categorized with respect to memory size and memory speed. For example, computers with memories of a given cycle time first appear in a given year, increase in usage as they outsell slower competitors, finally reach a peak in sales, and then are themselves superseded by even faster computers until, seven to ten years after their introduction, having become obsolete, they pass from the picture.

With this thought in mind, we prepared Exhibits 10 and 11. The upper curve in each exhibit is a repetition of our previous forecast of total shipments of computer main frames. The lower curves represent the past and predicted division of the main frame business on the basis of memory cycle time. Thus, the sum of the ordinates of the lower curves always equals the upper curve. We may see, for example, that computers with 8-16 microsecond memories were already obsolescent in 1964 and that they disappeared in 1967. Computers with 2-4 microsecond memories appear to have reached their peak in the year 1967 and are expected to decline in popularity, dying out completely in 1971. Computers with 0.5-1 microsecond memories have been increasing in popularity since their introduction in 1964, and are not expected to reach their peak until around 1971. If we take a "slice" through this chart in any given year, we can obtain an approximation of the value of the computers shipped, broken down by memory cycle time. Exhibit 11 would permit us to perform the same exercise with respect to maximum internal memory capacity.

By this means, we performed such a breakdown for the year 1972, and the results are displayed in Exhibit 12, using the same type of presentation that was used in Exhibits 8



PREDICTED DISTRIBUTION OF 1972 DIGITAL COMPUTER SALES BY MEMORY CYCLE TIME AND MAXIMUM MEMORY CAPACITY

Exhibit 12

and 9. In effect, what we did here was to forecast that the bulk of the computer memory market in 1972 would call for cycle times in the range of 0.25-1 microsecond and for memory capacities in the range of 3-12 megabits. This forecast, plus our previous forecast concerning memory costs, served to define the requirements which the memory designer of 1972 would be expected to meet.

Competing Technologies

It then became our task to estimate the extent to which the various memory technologies would be used to fill these requirements. In our report to the client, we disposed briefly of several memory technologies which we felt would not be of commercial significance during the period from 1967 to 1972, and concentrated our attention on the four technologies which we felt would be important: ferrite core memories, plated wire memories, thin planar film memories, and integrated circuit memories. It was obvious at the time of our study that each of these technologies had vigorous adherents, and that each was receiving a wealth of R and D support. In fact, to say that one technology would outstrip all the others was to say that more than one major U.S. corporation had placed sizeable wagers on the wrong horse. For example, General Electric and Digital Equipment Corporation appeared to be confident that ferrite cores would be the most practical computer memory system for some time to come. Univac and National Cash Register had already committed themselves to the production of plated wire memories. Burroughs and Control Data Corporation indicated that they had bet on thin planar films. RCA appeared to be leaning toward integrated circuit memories. Only a few companies, such as Honeywell, appeared hesitant to place final bets.

Major Memory Technologies

This much, however, appeared to be certain: in 1972 each of these four major memory technologies would have some significant part to play in the computer industry. In Exhibit 13 TMA attempted to summarize what each of these parts was likely to be.

Ferrite Cores. Despite ten years of advances in speed and cost, the barriers which stood in the way of continued development of ferrite core memories appeared to be hard and fundamental. Further improvements in speed through the use of smaller cores would require cores smaller than .012″ diameter, which seemed to be prohibitively expensive to string. Labor cost reductions would require that plants be located in areas where skilled labor is even cheaper than that in Hong Kong or Taiwan, and it is doubtful that such a place exists. Hence, we concluded that ferrite core memory technology in 1972 would be little improved over that which we found in 1967.

Nevertheless, TMA also concluded that the majority of memories made in 1972 would still use ferrite cores. The most significant factor working to perpetuate ferrite core memories was inertia. With only a few exceptions, ferrite core memories are today's standard throughout the industry. Engineers understand them. Components, or whole systems,

Exhibit 13

PRESENT EVALUATION OF PRINCIPAL COMPETITIVE MEMORY TECHNOLOGIES

Performance	Ferrite Cores	Integrated Circuits	Plated Wire	Planar Film
Minimum cycle time	About 350 ns.	Below 50 ns.	About 100 ns.	About 100 ns.
Capable of NDRO	Generally not	Yes	Yes	Yes, but difficult
Physical size	Relatively large	Small, but needs cooling	Intermediate	Small
Volatility problems	None	Inherent	None	None
Aging effects	None	None	Appreciable	None
Shock resistance	Fair	Excellent	Poor	Excellent
Signal/noise problems	Negligible	Negligible	Moderate	Relatively severe
Manufacturing Cost				
Typical '67 cost/bit	$.06	$.50	$.06	$.15
Effect of increasing size	Cost/bit declines up to 10 MM bits	Cost/bit remains flat at all sizes	Cost/bit may tend to increase above 1 MM bits	Cost/bit may tend to increase above 500 K bits
Effect of increasing speed	Cost increases sharply below 1 μs. cycle time	Cost relatively independent of speed	Little increase down to 200 ns.	Little increase down to 200 ns.
Manufacturing yield	High	Low	Fairly high	Low
Cost of related electronics	Relatively low	Minimum	Intermediate	Relatively high
Investment Required				
Manufacturing facilities	Not needed	Very high	Lowest	High
Engineering and Development	Not needed	Very high	Moderate	High
Adapt data processing system	Not needed	Very high	Moderate	Moderate
Capacity for Further Improvement				
Performance	Improvement in speed doubtful	Simplification and reduction in heating are likely	Size reduction likely	Increase in signal possible
Reliability	Already acceptable	No change likely	Reduction in aging effects likely	Little change likely
Manufacturing cost	Cost expected to remain about constant because of higher labor content, balanced against decreasing circuit costs.	Considerable reductions likely in all types.	Improvements likely in overall cost, through higher yield in wire mfg. and lower cost of supporting electronics.	Considerable cost reduction possible, through simplified electronics and one-process mfg. of film and electronics.

using them are available at competitive prices. Replacement parts and field service for them are readily obtained. Virtually all current software programs are written around core memory logic. It appeared safe to say that even if every company in the industry began at once a program to replace ferrite core memories with some other type, it would not be economically possible to get all the core memory computers out of production by 1972.

Integrated Circuits. Although memories built around monolithic integrated circuits and MOS arrays can potentially out-perform all other types, it was not expected that they would have a major share in the memory market by 1972. Cost was the principal problem. In 1967, such memory systems carried a typical price of about 50 cents per bit. Industry observers predicted that this figure might be reduced to 10 cents per bit by 1972. A look at Exhibit 7 shows, however, that such a price would not be competitive with core memories even in 1967, except for cycle times faster than 500 nanoseconds. Since, by 1972, lower-cost memories of other types were expected in the 100-500 nanosecond speed range, it appeared that integrated circuit memories would continue to be restricted to special purpose applications.

What sorts of applications? Two types were found:

(1) Even with 1967 technology, integrated circuit memories could easily achieve cycle times of 100 nanoseconds or less. For the relatively small fraction of the computer market which would demand memory speed as high as this, the integrated circuit memory would be a strong competitor.

(2) The price per bit of the integrated circuit memory remains relatively constant in all sizes, whereas for all types of magnetic memories, the cost per bit increases sharply as the size becomes smaller. Thus, somewhere there should always be a bit capacity below which the integrated circuit memory will become desirable simply because it costs less. TMA's informants predicted that in 1972 this capacity would fall somewhere well below 250,000 bits; the most likely figure was taken as 100,000 bits.

Clearly, however, if integrated circuit memories were to be limited to cycle times under 100 nanoseconds and capacities under 100,000 bits, they could claim only a very small share of the market in 1972.

Planar Film. Planar film in 1967 was an "almost but not quite" technology. Adherents of planar film claimed that potentially it would do anything that plated wire would do, and do it better and cheaper. Skeptics pointed out that this had yet to be demonstrated in practice. Nevertheless, the technical promise of planar film was so great that it was expected to have earned an important place in the memory market of 1972 for several reasons.

(1) Planar film memories would offer outstanding performance, with cycle speed as low as 100 nanoseconds, combined with non-destructive readout. The memories would be unusually small, consume little power, and have no inherent limitations in capacity. Because of their inherent mechanical rigidity, and resistance to temperature changes, planar film memories would be favored for military use, and for severe industrial requirements. On the negative side, techniques would have to be found to limit the effects of non-uniform magnetics and of interference from stray fields, and these precautionary measures would have an adverse effect on cost.

(2) It was not performance but inability to achieve competitive manufacturing costs which had, up through 1967, kept planar films "out of the big time". Over the next five years, considerable refinement was expected in the methods for producing the magnetic film itself. By 1972, in fact, the present vacuum deposition processes might well be supplemented by other techniques which would promise a much higher yield of acceptable film planes. Present planar film memories, however, suffer a cost disadvantage in electronics as well as magnetics. The amount of circuitry needed to achieve satisfactory high-speed operation is greater than for a plated wire memory, and much greater than for a conventional core memory. Although the cost of electronics was expected to fall rapidly, it was not yet certain that the overall cost disadvantage of planar film technology could be fully overcome by 1972.

(3) Because of the elaborate facilities needed to evaporate film planes, and the painfully long programs involved in their development, the price of admission into the planar film memory business is relatively high. This was the principal factor which was expected to lead most computer makers to prefer the development of memories using plated wire techniques.

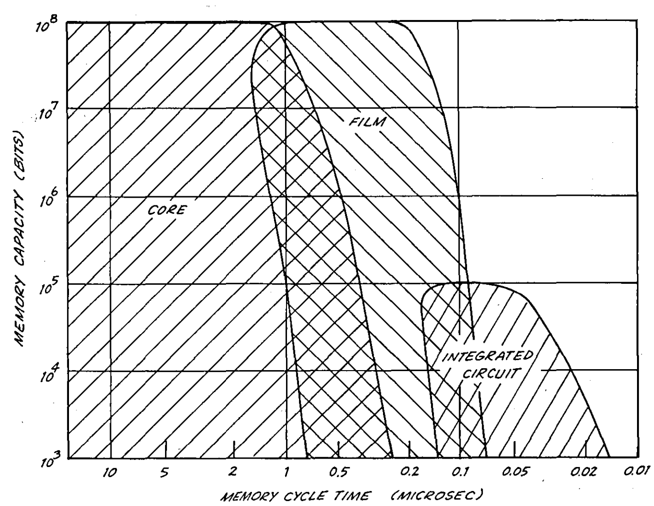
Plated Wire. No new technology could lay a stronger claim to an improved place in the memory market of 1972 than plated wire. The supporting evidence, while not wholly favorable, was convincing.

(1) Two computer manufacturers had already committed themselves to the use of plated wire in 1967; the plans of at least one more (Honeywell) were in an advanced stage; and one supplier of cores and stacks (Indiana General) was expected to supplement his product line with plated wire.

(2) Plated wire performance blanketed the expected needs of the computer market in 1972. Cycle times of 200 to 600 nanoseconds were practical and economical for plated wire, and this speed range covered about half of the market depicted in Exhibit 12. Plated wire memories could be built in any capacity, were fairly compact, and introduced no heating problems.

(3) The reliability of plated wire memories had been demonstrated through years of experimental testing. Although they did not withstand the "shake, rattle and roll" requirements of military specifications as sturdily as planar films, plated wire memories were generally dependable and reasonably rugged. Performance was currently limited by a tendency to lose signal strength with increasing age, but it appeared probable that new materials and refined construction techniques would have overcome this weakness by 1972.

(4) Plated wire memories seemed to offer significant potential savings in manufacturing costs. The companies which already used them claimed in 1967 that plated wire memories cost less than ferrite core memories when both were operated



NOTE: THE SHADED AREAS INDICATE OPERATING REGIONS IN WHICH THE THREE MEMORY TYPES ARE EXPECTED TO PREDOMINATE BECAUSE OF PERFORMANCE CAPABILITIES AND / OR ECONOMIC ADVANTAGES.

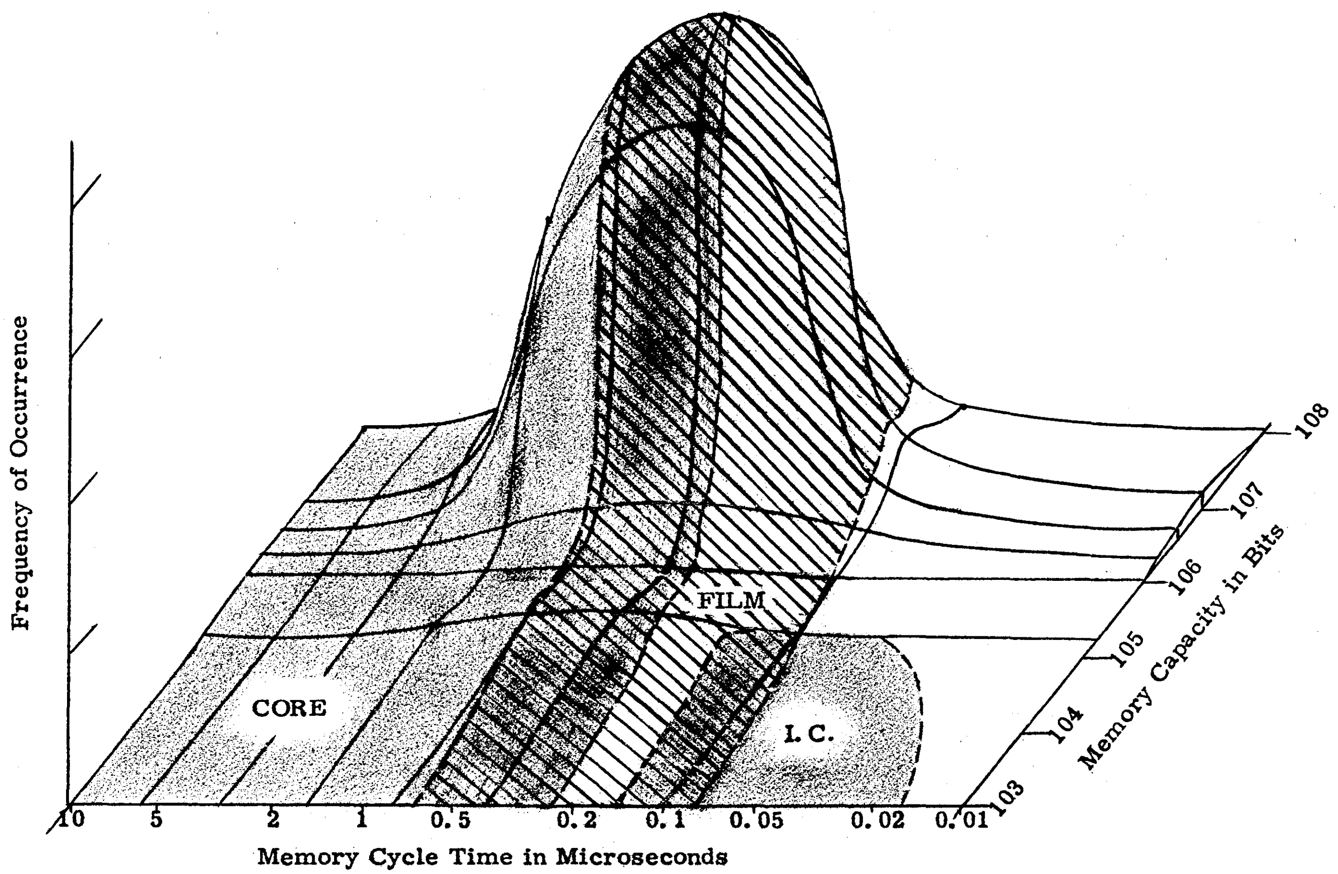
PREDICTED PERFORMANCE CHART FOR MEMORY SYSTEMS IN 1972

Exhibit 14

Exhibit 15

FORECASTS COMBINED IN AN ISOMETRIC PRESENTATION:

FREQUENCY OF OCCURRENCE OF MEMORY SPECIFICATIONS AND AREAS OF APPLICATION FOR SELECTED TECHNOLOGIES FOR THE YEAR 1972



at cycle times of around 500 nanoseconds. As further development takes place, this cost advantage was almost certain to increase. Honeywell indicated that it would change from core memories to plated wire memories only if it was assured that the use of plated wire would cut its memory cost per bit in half, but the company seemed convinced this is likely, since it was proceeding with detailed plans to build a plant to manufacture complete plated wire memories.

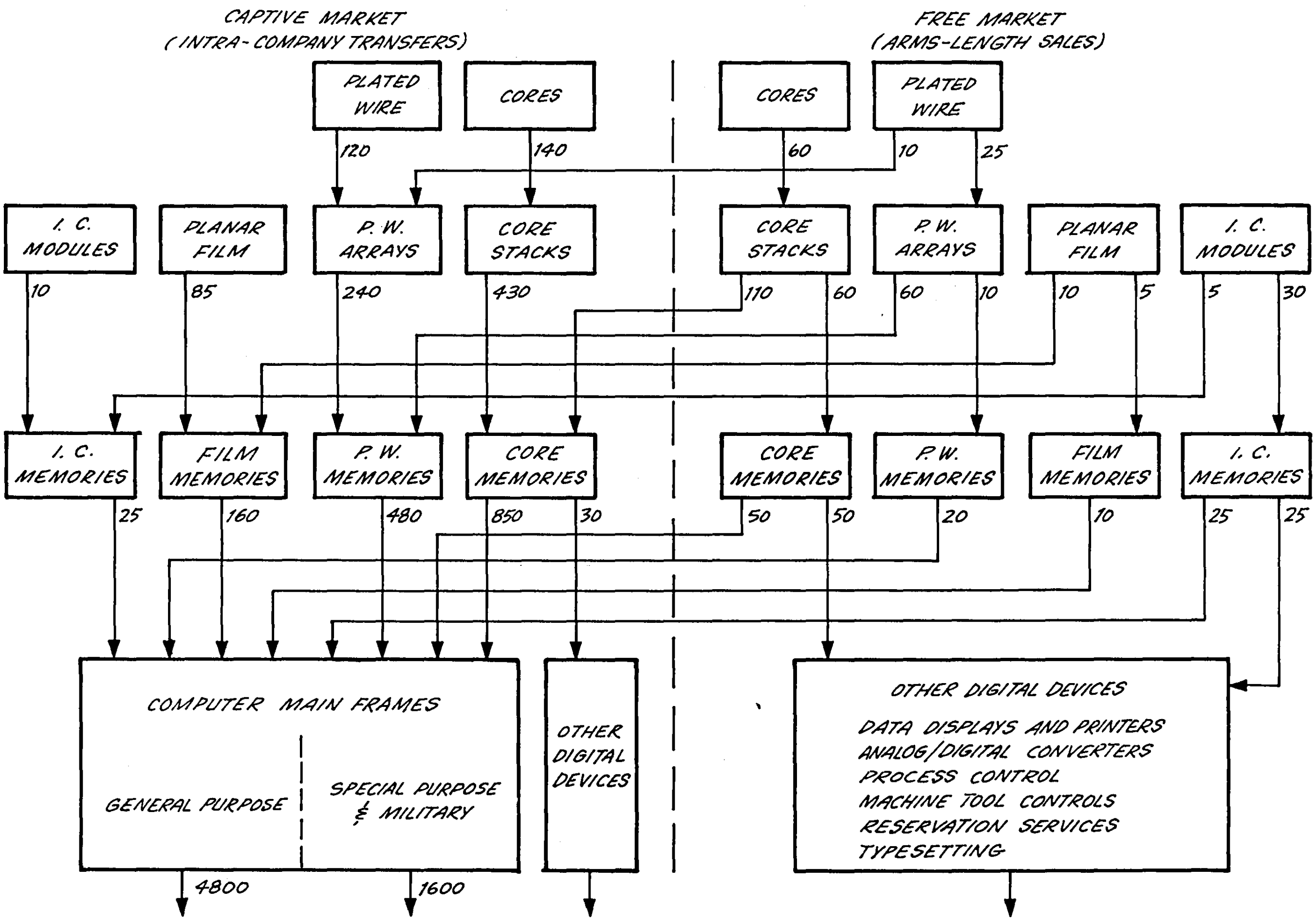
(5) TMA's interviewees seemed to agree that the investment needed to establish a facility for manufacturing plated wire was considerably less than that for any of the other new techniques discussed here. Furthermore, the engineering and development costs to adopt a plated wire system, with respect to both hardware and software, were said to be modest.

The foregoing set of opinions, derived from more than 50 lengthy interviews with engineering leaders of the computer industry, does not lend itself to precise analysis. Instead, like a typical business decision, it requires the weighing and evaluation of a large number of interrelated variables. Nevertheless, using the facts at hand, a limited amount of quantitative analysis is possible. The interviews did seem to make it clear that the various memory technologies have certain practical limits of application so far as memory size and memory speed are concerned. In Exhibit 14 these limitations were approximated. Core memories are seen to be dominant for most applications with cycle times over 500 nanoseconds. Integrated circuits dominate applications under 150 nanoseconds, provided that the capacity of the memory is less than 100,000 bits. Thin films dominate the region between cycle times of 150 and 500 nanoseconds. No distinction is made between planar film and plated wire, there being little to choose between them on a performance basis.

The plane on which Exhibit 14 is drawn, however, is not a plane of uniform economic opportunity. We had already forecasted in Exhibit 12 that memories of certain sizes and speeds would be much in demand in 1972, whereas other specifications would be little used. Consequently, we could now combine the predictions made in Exhibits 12 and 14 to arrive at a simulated three-dimensional picture of comparative opportunities in memory technology for 1972. In Exhibit 15 the vertical scale measures frequency of usage, while the total volume under the curved surface represents the total value of the memory market.

The Forecasted Memory Market for 1972

Having gained some technical insight into the memory market of 1972, we were now in a position to predict the economic structure of that market. This was done in Exhibit 16 using the same format which was used to describe the market of 1967 in Exhibit 3. The client's interest focused on the predicted value of the free market for thin film components: i.e., plain plated wire, plated wire arrays, and planar film arrays. It can be seen that the total value of these market segments, which was about $700,000 in 1967, was expected to grow to $120-million in 1972! Such a startling increase is, of course, the result of the concurrence of several favorable factors: the rapid growth of the computer industry itself, the



INPUT-OUTPUT ANALYSIS OF THE COMPUTER MEMORY MARKET
FORECASTED 1972 SALES AND TRANSFERS IN MILLIONS OF DOLLARS

Exhibit 16

fact that memories will make up an ever-increasing portion of the value of these computers, and the fact that thin film technology will, as we have seen, have come "out of nowhere" to occupy a significant place in the memory market. Certainly, then, it would appear that our client had been putting his money on the right horse after all.

At this point, it may be appropriate to pause and ask, in retrospect, how accurate we feel these forecasts were. Certainly they were based on painstaking research; it is doubtful whether the doubling of our budget would have provided any significant amount of additional useful information. At the same time, it is equally obvious that we were obliged to make many assumptions, approximations, and oversimplifications in order to arrive at any conclusions at all. Also we observed, as noted above, that some large corporations have invested very substantial sums of money based on conclusions different from our own. Nevertheless, we believe that the relationships forecast for the client are, in their general outlines, correct, and that the dollar values indicated on Exhibit 16 will probably prove to be accurate within a factor of approximately 2.

If this proves to be so, then we believe that our forecast will have served its purpose. What our client wanted to know, after all, was whether or not to continue his development program and, if he continued it, toward what end. It would take a very substantial alteration of the specific forecasted numbers to distort the general picture which the study presented.

Business Implications

This brings us to the point of the study: what action should the client take? It turned out that our recommendation to the client was not what might be expected. Although our picture of the future market for thin film memory components was certainly very attractive, our recomendation of thin film components as a new product venture for the client was very heavily qualified. Our reservations were based largely on factors not directly involved in the market forecast. It seemed to us that the client was technically far behind the competition, and that at his going rate of development he was falling farther behind all the time. Only a major acquisition appeared likely to make him competitive from the technical standpoint and to give him the kind of marketing organization necessary to handle products of this complexity. In essence, we felt that the computer memory industry was like a high-stakes poker game. To be sure, the pots were expected to be large. On the other hand, the chips were expected to be very expensive, the other players had all the experience, and we were by no means sure that the client could, or should, ante up enough money to see the game through at that kind of a table.

Fortunately, the client seems to have decided to shift his attention to another aspect of memory technology to which his entire organization appears to be much better suited. Although this new approach is currently under study, it appears to us that his competitive prospects here may be more favorable. ■

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 691

Find one proofreading error.

After the appeal, I gave a talk at the University of California in Berkeley. I chose as my theme the recent committee hearings on fallout dangers, and concentrated on "What the Report Did Not Say." And I had plenty of material, which even in outline takes up a lot of space. Briefly, the report did *not* say:

1. What the effects of testing by *other* nations would be. It assumed that no other nations would begin a testing program — which is nonsense.
2. What the effects of continued and future testing would be.
3. What the effects of limited — not to mention total — war would be, in terms of fallout hazards.
4. What the known biologic effects are.
5. What the known genetic effects are.
6. What the opinions of independent investigators — whose conclusions are quite at variance with AEC — are.
7. What the effects of variation are. Particularly, the vital information that radiation does not spread evenly throughout the body, but tends to concentrate in "hot spots," which are centers for the appearance of cancer, was not mentioned. This evidence was available to the committee, through an excellent report by Caster, in *The Minnesota Chemist,* copies of which were sent to them.
8. What the effects are of *short-lived* radioactive poisons, such as radioactive iodine (Wolff, U.S.P.H.S.).
9. What the effects are of other isotopes, such as carbon 14, and especially of the *combined* effects of all the radioactive poisons (Terrill, U.S.P.H.S.).
10. What the conditions are in other countries — conditions for which we are partly responsible. Japanese scientists, for instance, under date of May 7, warned that Japan is being endangered by steadily increasing radioactive fallout from nuclear weapons tests. The report said that in 26 of 179 areas surveyed, the rain water was found to be unfit for human consumption.

ANNOUNCEMENT

Beginning January 1, 1969, Computers and Automation will be published 13 times a year instead of 12 times. The new June issue will have the same kind of editorial content as the other monthly issues; and "The Annual Computer Directory and Buyers' Guide" issue will become a special 13th issue published additionally in June.

Effective February 1, 1969, the annual subscription rate for Computers and Automation WITH the "Computer Directory and Buyers' Guide" will become $18. 50, and WITHOUT the Directory issue the annual rate will become $9. 50, for United States subscriptions.

ALL OUR SUBSCRIBERS ARE INVITED TO RENEW THEIR PRESENT SUBSCRIPTIONS ON OR BEFORE JANUARY 31, 1969, and thereby receive the additional issue at the old rates. This same invitation is extended to all readers who are not yet subscribers.

Since 1960 our subscription rates have been unchanged. But because of the additional issue we will publish, and because of continually increasing costs of producing and publishing the magazine, this price increase has become necessary.

These are some of the points I brought up at the California talk. This makes hard going for a lay audience to grasp, but I was impressed by the attention shown and the concern manifested in the question period that followed my talk. That evening, at a local church, I again spoke on the problem and also made several radio talks.

It is fascinating and challenging to try to describe, to a lay group, a fairly complicated concept, such as this matter of individual variability. For instance, it doesn't make much impression to say that the AEC describes fallout in terms of *averages,* when it should deal in variability, in how much can be concentrated in a single individual, or within that individual, in a certain spot on the bone. However, anyone can understand the problem when put in these terms: suppose a man was killed by a falling sandbag, and a report on the death is made by a committee that does not wish to admit that the death was caused by this. One day of making the report is to say that the *average* impact, per square inch of body surface of the dead man, was only a small amount. Therefore, such an event *could not* have killed the man. By spreading the effect of a single impact at a single spot on the body, to a description of the sand falling on the body as a whole, they give a report that is entirely misleading. This is what happens when fallout is described in *average* worldwide terms. It has no significance in terms of danger to the individual.

— From *The Forbidden Voyage (of the Phoenix into the A. E. C. Prohibited Zone),* pp. 195-197, by Earle Reynolds, David McKay Co., Inc., New York, N. Y., 1961, 281 pp.

Solution to Proof Goof 6812:

Paragraph 3, line 1: Replace "non-mass mouns" by "non-mass nouns."

Paragraph 3, line 5: "Give me—" should read "Give me a—".

TIME SHARING IN THE NEAR FUTURE

Richard T. Bueschel
Time Share Corp.
Lyme Rd.
Hanover, N.H. 03755

"If the potentials of time sharing are realized, it will change the way man learns and works. It will open up the possibility of continuous learning, and it will make possible a far broader range of managerial control."

"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."[1] Time-sharing is passing from potential to actuality at an increasing rate.

No matter how we view it, 1968 will stand as the "breakthrough" year for the time-sharing industry. The services are burgeoning (see Exhibit 1 and Table 1). Connected terminals are skyrocketing (see Exhibit 2). And in the present year the developmental emphasis is rapidly shifting from the academic to the practical world. Certain trends are now apparent in the industry. We will follow those trends into the future and try to discern the coming impact of time-sharing.

Richard T. Bueschel is President of Time Share Corporation and Chairman of Computer Environments Corporation. He started in the computer field in 1956 on the Whirlwind computer, worked on SAGE at Mitre and held various management and technical positions at Honeywell before forming Time Share Corporation two and a half years ago. He is the author of over 25 articles in the data processing field. He received his A.B. at Dartmouth and M.B.A. at Northeastern University.

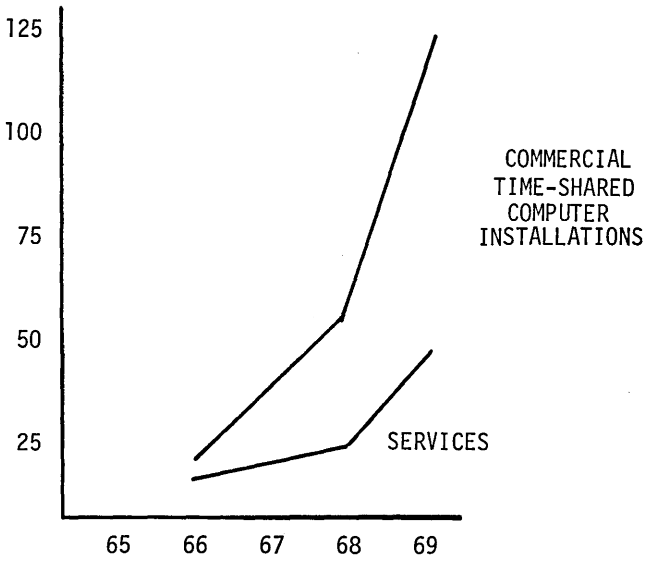
Business Applications

We can best begin to extrapolate the future evolution of commercial time-sharing by isolating its present impact on industry.

Today the typical user is no longer buying just raw computer power alone. He is beginning to buy both applications and computing power. And the applications are increasingly being found in the business area. Time-sharing is being recognized as a powerful aid to business decisions. The once-remote computer has been replaced by the familiar teletypewriter or electric typewriter at the manager's point of contact. Conversational languages are becoming less obscure under the push for expanding time-sharing resources. Strong foundations in time-sharing are now an integral part of management education being provided by the nation's top graduate business schools. Numerous time-sharing articles have appeared in the leading business periodicals. The concept is enjoying growing exposure in the commercial world. And this trend is being accentuated as large commercial data files are becoming available on a more economical basis.

The application of time-sharing was initially oriented toward engineering and scientific problem solution but is now shifting toward business uses such as financial analysis. This direction is exemplified by White, Weld's subsidiary, Interactive Data Services, which operates a system based on its First Financial Language (FFL). The Boston Company and Dial Data have jointly undertaken a similar venture. Goodbody's financial analysis is offered through ITT's Reactive Terminal Service (RTS). First National City Bank and other large financial institutions are moving quickly in this area.

EXHIBIT 1



Management

Although time-sharing in business is most heavily used in financial applications, its suitability to other business areas is increasingly apparent. Management consultants are now pioneering its use in a wide variety of simulation studies, but also top corporate management in such firms as Pillsbury and McKesson & Robbins have recognized the advantages of accessible computer power as a management aid. Time-sharing is appearing in such diverse enterprises as advertising agencies (media models) and wholesale houses (real-time inventory models).

Hospital Administration

Another fertile field for time-sharing appears to be hospital administration. With skyrocketing costs and their comparative lack of administrative talent, the hospitals badly need the additional capabilities that time-sharing can bring. A pioneering effort is now underway at the Monmouth Medical Center under Mr. James Fahey. This first completely integrated Hospital Management Information System should help set the standard for future hospital administration. Other efforts such as Medinet are also attempting to pioneer in this area.

The most important development in time-sharing, however, is not as visible as the various application packages being used today. Following the Dartmouth Tuck School example, Harvard and other leading graduate business schools are making time-sharing an integral part of their curricula. The new M.B.A.'s are bringing a special expertise into business. They will be a catalyst in the development of new management patterns. They will be the facilitators and initiators of the increasing importance of time-sharing.

The impact of time-sharing on commercial enterprise is beginning to be significant today. "To thousands of sophisticated businessmen, the time-sharing terminal is a helpful partner who makes life a lot more productive."[2] Tomorrow's impact will be profound!

Educational Impact

While we expect time-sharing's impact on commerce to be profound, its significance for educational practices will be even more dramatic. It will change the face of education in America.

The present effort in computer-assisted instruction (CAI) is well known, but the more generalized "education utility"

EXHIBIT 2

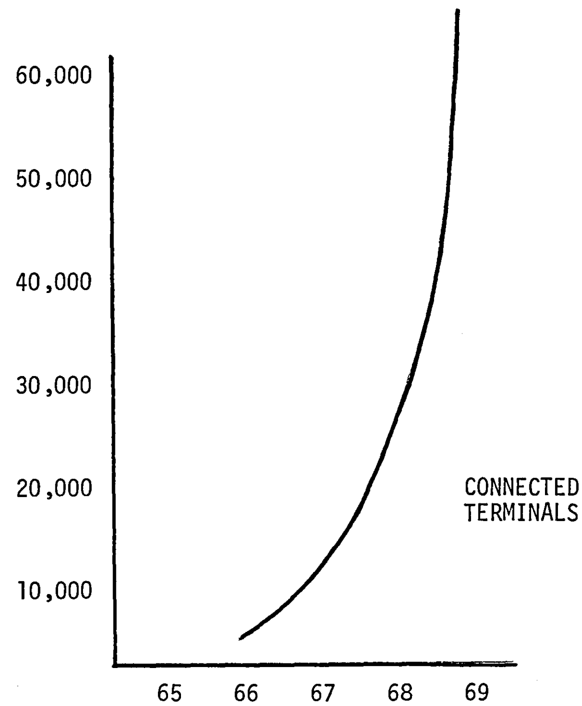


TABLE 1

FIRMS OFFERING TIME-SHARING SERVICES

Allen-Babcock Computing Los Angeles, Cal.	IBM Quicktran New York, N. Y.
Applied Logic Corp. Princeton, N. J.	ITT Data Services Paramus, N. J.
Automatic Data Processing, Inc. Clifton, N. J.	Information Network Corp. Phoenix, Ariz.
Bolt, Beranek & Newman Cambridge, Mass.	Interactive Computing Corp. Los Angeles, Cal.
Call-A-Computer Raleigh, N. C.	Interactive Data Services New York, N. Y.
C-E-I-R, Inc. Bethesda, Md.	Keydata and Adams Associates Cambridge, Mass.
Computel Systems, Ltd. Ottawa, Canada	Management Information Columbus, Ohio
Computer Network Corp. Washington, D. C.	Marquadt Corp. Phoenix, Ariz.
Computer Sciences Corp. El Segundo, Cal.	McDonnell Automation St. Louis, Mo.
Computer Sharing, Inc. Bala-Cynwyd, Pa.	Multi-Access Computing, Inc. Waltham, Mass.
Computer Time Sharing Minneapolis, Minn.	On-Line Systems, Inc. Pittsburgh, Pa.
Computrol Systems, Inc. Atlanta, Ga.	Philco-Ford Corp. Willow Grove, Pa.
Com-Share, Inc. Ann Arbor, Mich.	Rapidata New York, N. Y.
Control Data Corp. Minneapolis, Minn.	Remote Computing Corp. Los Angeles, Cal.
Data Network Corp. New York, N. Y.	System Development Corp. Santa Monica, Cal.
Dial-Data, Inc. Newton, Mass.	Technical Advisors, Inc. Wayne, Mich.
Direct Access Computer Corp. Detroit, Mich.	Tel-A-Data No. Miami Beach, Fla.
Eli Time Sharing, Inc. E. Paterson, N. J.	Time Share Corp. Hanover, N. H.
GE Information Systems Bethesda, Md.	Time Sharing Systems, Inc. Milwaukee, Wis.
Graphic Controls Corp. Buffalo, N. Y.	Tymshare, Inc. Palo Alto, Cal.
Greyhound Computing New York, N.Y.	U. S. Time-Sharing, Inc. Washington, D. C.
IBM Call/360 Basic New York, N. Y.	United Computing Systems Kansas City, Mo.
IBM Call/360 Datatext New York, N. Y.	University Computing Dallas, Tex.
IBM Datatext New York, N. Y.	VIP Systems Washington, D. C.

will carry more significance in the future. The learn-by-rote, canned-learning approach of CAI does not really constitute a pedagogical innovation. It simply is old practice automated. The new interactive programming languages, however, will open up entirely new learning resources in the coming age of information explosion.

For the first time man faces the certainty of skill obsolescence. The technician's present skills will not match tomorrow's needs. And the once-comfortable businessman can no longer afford the luxury of operation by "experience". To succeed will increasingly become synonymous with keeping abreast. And the act of keeping abreast will call new educational forms into existence. Time-shared computer systems are now evolving which will permit continuing professional education to become a reality. It is possible that the generalized time-shared systems can be tailored for educational uses.

A "Skill Updating Device"

To appreciate the value of a time-shared education utility as a skill updating device, let's look ahead and try to discern the outline of such a system. Because engineers are particularly susceptible to skill obsolescence, we'll consider the "engineering education utility". There will be no single utility computer center. Rather, a series of interconnected regional facilities will be scattered across the nation. Input into each facility will be a shared effort of both the engineering schools and firms. Likewise, the output of the system will be equally available to both academic and practical users. Because the facility will be primarily used as an updating resource, the focus of the input will be on the most current and developing engineering applications. The universities will retain their traditional role of providing the base for the profession, but the utility will be dedicated to updating it.

Specific input into the utility might be in the form of professional articles to be microfilmed for graphic display, new computational routines and applications, and verbal descriptions of new engineering techniques. Also implicit in the notion of a dedicated engineering education utility will be the continued development of engineering programming languages. The utility computer will index various inputs and store them by the various classifications of the engineering profession. The system user will be provided with an index guide at the outset which will enable him to retrieve the most current developments in his own field, or to scan the most recent developments in others.

The education utility will provide a powerful tool to hedge against the pressures of the information explosion. It will also establish a long-life pedagogical relationship between the individual and the education system. In a very real sense it will establish a man-machine symbiosis.

Hardware Developments

This view of the evolving future would be speculation without an appreciation of the current developments in the hardware sector. Two major trends are discernible. In the first place, super systems (e.g., CDC 6600, S360/85, B8500) are well along in development. These large systems allow us to predict the coming of education utilities, intra-industry information banks, and large-scale general purpose utilities.

A second characteristic of the industry lies in the development of many new, small, general-purpose, time-sharing systems (e.g., DEC TSS-8, HP 2000A, the soon-to-be-announced Varian time-sharing system, etc.). We should expect these smaller systems to form the basis for internal management information systems, inventory control systems, and self-sufficient institutional systems for use within industries and institutions.

While, at first glance the two hardware tendencies appear divergent, this apparent divergence may be illusory. The new DEC TSS-8 will have a direct interface to the DEC PDP-10 permitting the smaller time-shared system to call upon the capabilities of the large system when required. In this same direction, the Advanced Research Projects Agency of the Pentagon, long the angel of time-sharing, is now embarked on a project to connect together various university time-sharing centers. The resulting system is to be based on a series of yet-to-be-designed special-purpose communications computers. A.R.P.A. plans to closely monitor the effectiveness and properties of such a network.

The "Firmware" Concept

Complementing the hardware development is a significant new development — the "firmware" concept. This concept consists in building a function or an entire compiler into hardware. This is not really a new concept: Allen-Babcock Computing used it to implement PL-1 on its 360/50; and IBM uses ROS (Read-Only Store) in the 360/25 and /85. What is new, however, is the broad use of ROM's (Read-Only Memory) now being made and planned for new time-shared systems such as Standard Computer's IC 7000. Here entire compilers and executive routines will be built into the memory hardware. The use of ROM's or ROS's should improve compile and execution times considerably in a time-sharing environment. Other systems recently introducing ROM's include Interdata and Datacraft.

Perhaps the most significant developments taking place in time-sharing today are the growing ability to handle large volumes of data. This capability unlocks the commercial potential of time-sharing. The evolution of large file-handling systems is well along; it is itself spawning new file-handling languages as well as file systems. Most of the people developing large file-handling techniques are not talking; this has become one of the big areas of trade secrets. Much of the pioneering work is being done by commercial firms, such as Applied Logic's 1.15 billion character file system based on the Bryant drum and disks. The reason that the commercial vendors are leading the way is the potential payoff in rental storage for the large commercial time-sharing system. The universities also are still working heavily in these areas. This is also an area of prime focus for the Univ. of Calif. at Berkeley, Dartmouth, and others at this time.

Supplementing the developing file-management systems is an indication that mass storage costs will begin to drop rapidly in the next 15 months. Disk prices are coming down. New techniques of mass storage are being explored. Foto-Mem, a new firm in magnetic-film-optic storage, is projecting a new storage system, now in prototype, to store over 100 billion characters at a price well under $1.00 per million characters. Large low-cost files, and appropriate file management systems, coupled with the increasing capabilities of firmware will significantly change time-sharing in the next two years.

Conclusion

This has been a conservative look into the future. Time-sharing will change the way man learns and works. It will open up the possibility of continuous learning, and it will make possible a far broader range of managerial control. If the potentials in these opportunities are actualized, time-sharing will have a profound impact on our way of living in the coming decade.

---

1. J. Stanford Smith quoted in "Share and Share Alike" by Bohdan O. Szuprowicz and J. Richard Elliott, Jr., *Barron's*, September 23, 1968, p. 3.

2. *Ibid.*

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ANNUAL INDEX

for Volume 17, 1968 of

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CALENDAR OF COMING EVENTS

Jan. 15-17, 1969: Second Annual Simulation Symposium, Tampa, Fla.; contact Annual Simulation Symposium, P.O. Box 1155, Tampa, Fla. 33601

Jan. 24-26, 1969: 75th Annual American Mathematical Society (AMS) Meeting, The Jung Hotel, 1500 Canal St., New Orleans, La. 70141; contact American Mathematical Society, P.O. Box 6248, Providence, R.I. 02904

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

Jan. 30-31, 1969: Third Annual Computer Science and Statistics Symposium of the Los Angeles Chapter of the Association for Computing Machinery (ACM), International Hotel, Los Angeles, Calif.; contact Business Admn. Extension Seminars, Room 2381, GBA, Univ. of Calif., Los Angeles, Calif. 90024.

Feb. 13-14, 1969: Assoc. of Data Processing Service Organizations Management Conference, Hotel Frontier, Las Vegas, Nev.; contact Jerome L. Dreyer, Assoc. of Data Processing Service Organizations, Inc., 420 Lexington Ave., New York, N.Y. 10017.

March 21-22, 1969: 7th Annual Atlantic Systems Conference, Americana Hotel, New York, N.Y.; contact Atlantic Systems Conference, P.O. Box 461, Pleasantville, N.Y. 10470

March 24-26, 1969: 10th VIM meeting, (users group of Control Data 6000 computer series), Florida State University Union, Tallahassee, Fla.; contact Carol J. Richardson, Control Data Corp., 8100 34th Ave. So., Minneapolis, Minn. 55440

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 1-3, 1969: Numerical Control Society's Sixth Annual Meeting & Technical Conference, Stouffer's Cincinnati Inn, Cincinnati, Ohio; contact Peter Senkiw, Advanced Computer Systems, Inc., 2185 South Dixie Ave., Dayton, Ohio 45409

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

April 23-25, 1969: 21st Annual Southwestern IEEE Conference and Exhibition, San Antonio Convention and Exhibition Center, San Antonio, Texas; contact William E. Cory, Southwest Research Institute, Box 2296, San Antonio, Texas 78206

May 5-6, 1969: Association For Computing Machinery (ACM) Symposium on Theory of Computing, Marina del Rey Hotel, Marina del Rey, Calif.; contact Prof. Michael A. Harrison, Dept. of Computer Science, Univ. of California, Berkeley, Calif. 94720

May 6-9, 1969: The Association of Educational Data Systems (AEDS) Annual Convention, Portland Hilton Hotel, Portland, Ore.; contact Wayne J. Smith, Convention Contractor, 201 Massachusetts Ave., N.E., Washington, D.C. 20002

May 7-9, 1969: International Joint Conference on Artificial Intelligence, Statler-Hilton Hotel, Washington, D.C.; contact Dr. Donald E. Walker, IJCAI Program Chairman, The MITRE Corp., Bedford, Mass. 01730

May 14-16, 1969: Spring Joint Computer Conference, War Memorial Auditorium, Boston, Mass.; contact American Federation for Information Processing (AFIPS), 210 Summit Ave., Montvale, N.J. 07645

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 8-12, 1969: Sixth Annual Design Automation Workshop, Hotel Carillon, Miami Beach, Fla.; contact Dr. H. Freitag, IBM Watson Research Ctre., P.O. Box 218, Yorktown Heights, N.Y. 10598

June 9-11, 1969: IEEE International Communications Conference, University of Colorado, Boulder, Colo.; Dr. Martin Nesenbergs, Environmental Science Services Administration, Institute for Telecommunication Sciences, R614, Boulder, Colo. 80302

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.

June 17-19, 1969: IEEE Computer Group Conference, Leamington Hotel, Minneapolis, Minn.; contact Scott Foster, The Sheffield Group, Inc., 1104 Currie Ave., Minneapolis, Minn. 55403

June 19-20, 1969: Assoc. of Data Processing Service Organizations Management Conference, Sheraton Ritz Hotel, Minneapolis, Minn.; contact Jerome L. Dreyer, Assoc. of Data Processing Service Organizations, Inc., 420 Lexington Ave., New York, N.Y. 10017.

June 19-20, 1969: Seventh Annual Conference of the Special Interest Group, Computer Personnel Research of the Association of Computing Machinery, Univ. of Chicago, Chicago, Ill.; contact Dr. Charles D. Lothridge, General Electric Co., 570 Lexington Ave., New York, N.Y. 10022

June 21-28, 1969: Second Conference on Management Science for Transportation, Transportation Center at Northwestern University, 1818 Hinman Ave., Evanston, Ill. 60204; contact Page Townsley, Asst. Dir., Management Programs, 1818 Hinman Ave., Evanston, Ill.

June 30-July 3, 1969: Institution of Electrical Engineers Conference on Computer Science and Technology, Univ. of Manchester Institute of Science and Technology, Manchester, England; contact Conference Secretariat, Institution of Electrical Engineers, Savoy Place, London, W.C.2, England.

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

c.a

IDEAS: SPOTLIGHT

The Ultraintelligent Machine

. . . . . The fact that today's computers are very obviously not "intellectually superior" [to human beings] has given us a false sense of security — like that felt by the 1900 buggy-whip manufacturer every time he saw a broken-down automobile by the wayside. This comfortable illusion is fostered by the endless stories . . . . about stupid computers that have had to be replaced by good old-fashioned human beings, after they had insisted on . . . . threatening legal action if outstanding debts of $0.00 were not settled immediately. The fact that these *gaffes* are almost invariably due to human programmers is seldom mentioned.

Though we have to live and work with (and against) today's mechanical morons, their deficiencies should not blind us to the future. In particular, it should be realized that as soon as the borders of electronic intelligence are passed, there will be a kind of chain reaction, because the machines will rapidly improve themselves . . . . the merely intelligent machine will give away to the *ultra*intelligent machine.

One scientist who has given much thought to this matter is Dr. Irving John Good, of Trinity College, Oxford. . . . . Dr. Good has written "If we build an ultraintelligent machine, we will be playing with fire. We have played with fire before, and it helped keep the other animals at bay."

Well, yes — but when the ultraintelligent machine arrives, we may be the "other animals"; and look what's happened to them.

It is Dr. Good's belief that the very survival of our civilization may depend upon the building of such instrumentalities; because if they are, indeed, more intelligent than we are, they can answer all our questions and solve all our problems. As he puts it one elegiac phrase: "The first ultraintelligent machine is the last invention that man need make."

. . . . It may be the greatest virtue of the ultraintelligent machine that it will force us to think about the purpose and meaning of human existence. It will compel us to make some far-reaching and perhaps painful decisions, just as thermonuclear weapons have made us face the realities of war and aggression after 5000 years of pious jabber. . . . .

From "The Mind of the Machine" by Arthur C. Clarke, astrophysicist and author, in Playboy *for December 1968, p. 116. . . .*

WHO'S WHO IN THE COMPUTER FIELD, 1968-1969 — 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

In Retrospect:

The FIRST Business Feasibility Study in the Computer Field

Henry W. Schrimpf, Jr., Supervising Actuarial Clerk
Clyde W. Compton, Methods Analyst
Prudential Insurance Co. of America
Newark, N.J. — July, 1947

"The main purpose of this report was to convince many unconvinced persons that an 'automatic large-scale sequence-controlled calculator' could actually perform the required business work. The report was successful; it produced the conviction."

INTRODUCTION, 1968

Edmund C. Berkeley, Chief Research Consultant
Prudential Insurance Co. of America
Newark, N.J. — July, 1947;
Editor, Computers and Automation — *December, 1968*

Twenty-one years ago, in the Methods Division of the Prudential Insurance Company of America, Newark, N.J., a group of analysts, of which I was one of the supervisors, had just finished a feasibility study.

This was the *first* feasibility study that ever occurred in business, in regard to the application of computers (then called "large scale calculating machines") to business problems. As I write this introduction, I am holding in my hands the bound report of this feasibility study:

> *Ordinary Insurance Premium Billing Trial on Harvard's Sequence Controlled Calculator — Mark I — in June 1947.*

That report, of which many excerpts are given here, consists of 78 pages, many of them photostatic reproductions of original typewritten or handwritten memoranda and records. Some of these photostats are of the raw input, consisting of actual life insurance company records of payment of premiums on ordinary insurance policies (called "renewal cards"). Some more of the photostats show the actual "premium notices" produced by the Harvard IBM Sequence Controlled Calculator, as a result of the actual test made.

The main purpose of the report was to convince many unconvinced persons in the Prudential at that time that an "automatic large-scale sequence-controlled calculator" could actually perform the required business work. The report was successful; it produced the conviction. It led, along with other studies, over the next few months to the first contract made by any business for a large-scale electronic calculating machine; this contract was however subsequently canceled, basically for reasons of nondelivery.

This report survived over the years, escaping the fate of many other reports (which is to be thrown away when no longer needed), because Professor Howard H. Aiken, in charge of the Harvard Computation Laboratory then, graciously refused to accept any payment from the Prudential for the assistance of his Laboratory to the investigating group. And so we bound some copies of the report, and gave him a copy for his archives, with our warm thanks.

There is no question that this is the first business feasibility study, because the first general-purpose automatic computer that operated, was the Harvard IBM Automatic Sequence Controlled Calculator — Mark I, which began operating in 1944; and in 1947 only 5 or 6 general-purpose computers were in operation, and no other machine up to that time had been assigned any business applications.

The Mark I handled numbers of 23 decimal digits with fixed decimal point; it performed 3 additions per second, or one multiplication in 4 seconds, or one division in 6 seconds; it could store 72 numbers at one time.

This bound report is still an excellent example of a good feasibility study. It was carried out by good systems analysts (then called "methods analysts") at the Prudential. This report contains: a flow chart; a program; full documentation; and many other features of modern reports. And it is a very thorough document worth examination and thought, even after 21 years.

Note: Because of the length, this article will be published in two parts.

Memorandum for Mr. E. C. Berkeley, July 11, 1947

ORDINARY INSURANCE PREMIUM BILLING — TRIAL ON HARVARD'S SEQUENCE CONTROLLED CALCULATOR (MARK I)

1. *Trial of Premium Billing on a Sequence Controlled Calculator.* The Company has been investigating the use of an electronic sequence controlled calculator for premium billing. Among many questions that must be answered are these two:

(1) Will such a calculator actually do premium billing?

(2) What is the kind of programming needed?

As a result of the cooperation of Professor Howard H. Aiken and the Harvard Computation Laboratory, both these questions have now been answered. The Prudential made an actual trial with Harvard's sequence controlled calculator (Mark I) of the preparation of premium bills for ordinary insurance.

In our office beforehand, the renewal cards of the Manchester, N.H., district were scanned; 46 very different types were chosen, and photographed. These were the raw material for the trial. To test the machine for many kinds of rejections, 17 of these cases required no premium bill in July, the assumed month of billing. 5 duplicate premium notices were required out of a possible 8.

At the Laboratory about a week was spent learning procedures and coding for the machine, and preparing tapes, punch cards, etc., for input. The trial run took place successfully on June 9, lasting about 40 minutes.

This trial proved completely that premium bills could be produced by a sequence controlled calculator. This trial also proved that a machine must be able to carry out hundreds of routine instructions and dozens of choices in order to cover all the cases.

This memorandum is a summary of the experiment; the attached exhibits describe the experiment in detail.

2. *Sequence Controlled Calculator Used.* The sequence controlled calculator used was the Harvard-IBM Mark I, finished in 1944. This calculator is not electronic, but is electromechanical and relay. It is described fully in a *Manual of Operation,* published by the Harvard University Press, in 1946.

This calculator was designed to solve mathematical problems; it was never designed to do office routine. Therefore, it is the more remarkable that a fair proportion of the premium billing work was done on Mark I.

2a. *Main Sequence of Instructions.* The calculator has a punched paper tape for the main sequence of instructions. The main sequence tape may easily hold more than 10,000 instructions.

For the premium billing problem, we used the main tape only for 11 instructions, to start off the calculation, and to cause the final total printing.

2b. *Subsequences of Instructions.* The machine has attached to it by a cable a new unit called the Subsidiary Sequence Unit. This unit provides for 10 subsidiary sequences of 22 instructions each. Thus the machine can change from one short series of instructions to another or to the main tape and back again in many different ways. The subsequence instructions are specified by wiring a plugboard.

For the premium billing problem, we used almost all the subsequence capacity of 220 instructions. Lack of more subsequence capacity limited our trial to a portion only of all the choices of routines needed. Because of this limitation, the problems of loan interest calculation and file maintenance could not be investigated.

2c. *Value Tape Mechanisms.* The machine has three mechanisms for reading a table of numbers punched on paper tape. These mechanisms are called "value tape" mechanisms. Any desired numerical values stored on these tapes may be obtained automatically.

We used two out of the three value tape mechanisms. One held "old premium rates" dividends per $1000; the other held "new premium rates" dividends per $1000. The machine automatically consulted the dividend rate tables, selected the right dividend for the policy being considered, and computed the policy dividend.

An ordinary dividend rate is actually determined as a function of five variables: year of issue, premium rate basis, plan. age at issue, and rate basis duration. Juvenile policies have a sixth variable; place of issue. However, to save subsequence instructions, we had to code the dividend rates and make them functions of three variables only: age at issue, premium rate basis, and a code designating the other variables. A calculator with more subsequence capacity could have handled all the variables.

2d. *Card Feeds.* The machine has two regular IBM punch card feeds. Here numerical information can be put into the machine if it is only to be referred to once.

For each of the 54 possible premium notices we prepared four punch cards containing the necessary billing data. Due to pressing computing schedules, Professor Aiken requested us to start our experiment two days earlier than planned. As a result the coded equivalents of the addresses in some of the punched cards were not completely checked.

The cards were fed into the machine in Card Feed 1. We also prepared as a check 34 cards containing the policy numbers of those cases in the trial for which premium notices were to be made. These cards were fed into Card Feed 2. Of course, in practice we would not know which cases these were; but for the trial, this seemed to be a good check on the machine.

The policy and premium data could have been punched in less than four cards; but operating instructions were greatly simplified by using all four.

2e. *Constant Switches.* Constant values in the formulas used to perform premium billing were stored in the hand set switches of the computer.

2f. *Printing.* Mark I has some limitations in electric typewriter printing. The machine has no way of designating alphabetic information. Therefore we used numeric symbols to fill up the space of alphabetic information. In our code, "1" was any letter of the first name, "2" any letter of the second name, etc. "0" indicated separation: between first, middle, and last name; between numbers and street; between city and state.

In order to drop out extraneous 0's in the top line of information which included the premium, it was necessary to drop out the 0's to the right of the 8th digit position in the name and address field.

Two new circuits, carriage return control and typewriter tabulating control, were required by us for printing. These were rapidly put into the Mark I calculator for us by the Laboratory. To save time, we did not seek to make the new tabulating circuits work perfectly; consequently, in our trial run, the dividend and the net cost are not always typewritten in the same vertical column as the premium.

The machine printed the premium bills on Typewriter 1. On Typewriter 2 it printed (1) the dividend if due and if not used to reduce the premium, and (2) the totals of premiums, and reduction dividends — figures we have no way of getting now.

3. *Operating Procedure.* The procedure followed by the calculator in handling the data for each policy is carefully shown in Exhibit 12.

4. *Results.* The Mark I calculator did an excellent job. 46 premium renewal cases were processed, giving 34 premium bills and 17 cases for which premium bills were not required. Mark I made no errors in selection or computation. The entire run took about 44 minutes.

This machine designed primarily for mathematical computation can also do premium billing; and that is very impressive. The Harvard Laboratory men and we who worked on this experiment concluded that a computer designed for insurance company work could do premium billing at least 200 times as fast. This means that we could reasonably expect a computer to prepare and print the bills for 10,000 policies in an hour.

We have been discussing for some months a certain type of electronic sequence controlled calculator for premium billing and other insurance company work. Our experience in this trial convinces us that such a calculator will work.

5. *Characteristics of a Sequence Controlled Calculator for Insurance Company Work.* Some of the characteristics of such a calculator will be very important.

5a. *Input.* The medium for putting all information into the machine should be more flexible than hand set switches, punched paper tape, plugwiring, or punch cards. Probably it should be magnetic tape.

There should be a key device like a typewriter for preparing the magnetic tape.

5b. *Computer.* The computer should be able to handle data quickly in the following ways: sort, verify, collate, select, alter, insert, delete, print, add, subtract, multiply, divide, refer to stored data, refer to previously computed results, check its own computed and printed results.

5c. *Output.* The machine should be able to print its output, or enter its output on magnetic tape.

5d. *Servicing.* The machine should be very reliable. Units should be of the plug-in type, and should be easily accessible for service.

6. *Exhibits.* The exhibits attached to this report are listed herewith.

Henry W. Schrimpf, Jr.
Methods Division

Exhibit 1

PREMIUM BILLING FOR REGULAR ORDINARY INSURANCE, REDUCTION DIVIDENDS, AND LOAN INTEREST NOTICES — PRESENT PROCEDURE

1. *Premium Renewal — Notices and Receipts.* The Company has in force on the premium paying basis, approximately 4.3 million policies of ordinary insurance; 60,000 of these policies have monthly premiums, and premiums for the remaining policies are payable annually, semi-annually, or quarterly.

Bills (notices of premium due) for all except monthly premiums must be prepared and mailed. Receipts for all premiums must be prepared and furnished to the field offices to give to the insured when he pays his premium.

If a dividend under a policy is due, and is being used by request of the insured to reduce the premium, then the premium notice shows: the premium; the dividend; and the net cost, which is the difference.

List of Exhibits, July 11, 1947

ORDINARY INSURANCE PREMIUM BILLING — TRIAL ON HARVARD'S IBM AUTOMATIC SEQUENCE CONTROLLED CALCULATOR (MARK I)

Exhibit Number	*Exhibit*
1	Premium Billing — Present Procedure (Report 5/23/47)
2	Policy Sample — Original Information for Billing
3	Policy Sample — Scheme for Translating into Machine Language
4	Policy Sample — Equivalent Numeric Information Punched in Cards for Machine Input
5	Policy Sample — Rules for Billing Premiums (Report 6/3/47)
6	Policy Sample — List of Rules that Applied to Each Policy (Report 6/3/47)
7	Instructions to Machine — Setting of Constant Switches
8	Instructions to Machine — Assignment of Storage Counters
9	Instructions to Machine — Main Sequence Programming
10	Instructions to Machine — Subsequence Programming
11	Instructions to Machine — Board Plugging
12	Scheme of Programming Followed by Machine
13	Output from Machine — Dividends not Deducted from Premiums and Totals of Dividends and Premiums
14	Output from Machine — Bills
15	Comparison — Bills as Typed in Company

If there is a loan under the policy, notice of loan interest, if due, is included in the envelope containing the premium notice.

About 25% of premium notices are sent to persons other than insureds. These persons are largely applicants for policies insuring children; some are assignees, and other holders of rights. Applicants for policies insuring children receive the only premium notice. Assignees and other holders of rights receive a duplicate notice. About 2% of all notices are duplicate notices.

If the insured at time of issue resides in or subsequently moves to an "affidavit" state, proof that any premium notice was mailed to him must be retained. The "affidavit" states are:

Illinois
Kansas
Louisiana
New York
North Carolina
Ohio

Approximately 10 million sets of premium receipts and notices are completed annually.

1a. *Time Started.* About 2½ months before the first of the month in which the premiums fall due, the Typing Sections start to type the required premium notices and receipts.

1b. *Block of Renewal Cards Selected.* The renewal cards are filed by geographical district or agency. Each district or agency is in order by "notch." A notch (so-called because the cards are notched on the top edge correspondingly) consists of policies requiring premium notices in one of four months as follows:

Notch 1: Policies that may require a notice in any of January, April, July, October

Notch 2: Policies that may require a notice in any of February, May, August, November

Notch 3: Policies that may require a notice in any of March, June, September, December

A block of cards from a notch is picked out of the file by a typist. She takes them to her desk and pages through them, without disturbing their order, looking for cases requiring premium notices. In order for the typist to determine which cases require premium notices, she must consider the mode of premium payment and the anniversary premium date. If an irregular premium has been paid on a policy, the premium anniversary date is the month and day when the first premium after the irregular premium is due. Between 2 and 3% of our policies have at one time or another had an irregular premium.

Thus, for example, if a typist is preparing premium notices for policies having a premium due in August, she selects notch 2 and looks for: all quarterly premium cases; all semi-annual premium cases having an anniversary premium date in February or August; and all annual premium cases having an anniversary premium date in August.

1c. *Form Used.* The present form used for premium billing is a two part form interleaved with carbon. The original is the premium receipt. The carbon copy is the premium notice. Recently, the Methods Division has been experimenting with a new system. At the same time as the notice and receipt are typed, 2 accounting stubs are typed in addition as carbon copies. The 2 accounting stubs are also sent to the field office. One of the accounting stubs is returned to the home office stamped with the date when the premium is paid and is used to post the renewal card with the date of payment. The other is retained in the field office as their record of premiums paid and deposited. The apparent success of the experiment indicates that a 4 part form at each billing may be used.

1d. *Typing.* The typist, as each policy requiring a notice and receipt is determined, types a set of forms showing the following items which are contained on the renewal card:

Item	*Number of alphabetic or numeric characters*
1. Policy Number	8
2. Day of the month the premium is due	2
3. Mode of premium payment	1
4. Amount of premium	6
5. Dividend if any and if deducted	5
6. Net amount due (if dividend is shown)	6
7. Name of insured	17
8. Name of person if other than insured to whom notice is to be sent	17
9. Address of person to whom notice is to be sent	41

Other information on the renewal card required for control, etc., is:

Item	*Number of Alphabetic or Numeric Characters*
1. Information from which the date of premium change can be determined	6
2. Amount of premium after each change	12
3. Kind of policy	10
4. Date of issue	8
5. Age of insured	2
6. Amount of insurance	6
7. Branch office	6
8. Rate group	1
9. Dividend option	1
10. State of residence	2
11. Designation of irregular premium	2
12. Whether duplicate notice is required	1
13. Date to which premiums are paid	8

1e. *Comparing.* Comparers check the work of the typist. They make sure no required notices and receipts are omitted. They make sure the typed notices and receipts are correct. We might mention that a comparer's job is an extremely monotonous one.

1f. *Printing and Cutting.* Some of the receipts and notices now being prepared are in continuous strips and are cut to proper size and burst apart on a bursting machine. This machine at the same time prints two items which are unchanged for large blocks of receipts and notices at a time:

1. Month and year premium is due
2. District agency and its address

1g. *Mailing.* The receipts are sent in packages to the district offices.

Premium notices are placed in groups according to premium due date. They are mailed about 22 days before the premium falls due. Before mailing premium notices for affidavit states, they are microfilmed.

1h. *Returns Used to Pay Premiums.* Sometimes money is due the insured for a return of an excess amount paid. If the insured requests it, payment is made by deducting the return from the next premium due. The amount of the return is entered on the renewal card. When the receipts and notices are typed, a special typing procedure providing for the extra entry is used. About 5000 of these special premium notices are sent out each year.

1i. *Notices to Convert and Congratulatory Cards.* The comparer, in addition to checking the work of the typist, selects those policies that must be converted on the next premium due date and pastes on each premium notice, a reminder to convert.

When a premium if paid will cause a policy to become paid up, a card congratulating the insured for having a paid-up policy is attached by the comparer to the premium receipt.

2. *Reduction Dividends.* At the time the premium notices and receipts are typed, reduction dividend information is already on the renewal card. About 25% of the forms typed have a dividend deducted. An explanation of the method of obtaining these figures is in order.

Dividend card files are maintained for each of the four dividend options. The Reduction Dividend File is about 62% of the total dividend cards. For the purpose of mechanizing premium billing, we will confine ourselves to the discussion of the calculation of dividends used for premium reduction only.

2a. *Calculation.* If a dividend is payable, the amount of dividend per unit of insurance, i.e. the dividend rate, is determined by:

1. Year of issue
2. Gross premium rate basis of policy
3. Kind of policy
4. Age at issue
5. Year of policy anniversary

and reference to the Dividend Rate Book. The amount of dividend per unit amount of insurance is found from the Dividend Rate Book, and is then multiplied by the number of unit amounts of insurance provided by the policy.

2b. *Recording.* The amount of the policy dividend is entered on the dividend card in order to have a permanent record of dividends paid.

Subsequently the amount of the dividend is transcribed to the renewal card. It is entered in two different spots on the renewal card, once in ink and once in pencil. The difference between the premium and the dividend is obtained and entered in pencil. When the premium due is paid, these pencil entries are erased. This procedure has been accepted as the most economical method of providing the net cost for the typist, the comparer, and the clerk checking and recording the payment by the insured when made.

2c. *Dividends on Irregular Premium Cases.* For irregular premium cases, the dividend is also calculated as of the policy anniversary. Thus some dividends payable say in 1946 and calculated by the 1946 dividend rates may be used to reduce a premium due in 1947.

3. *Loan Interest Notices.* A loan record card file is maintained showing for each policy having a loan charged against it:

Item	*Number of Characters*
1. Initial date of the loan	8
2. The premium payment anniversary date immediately following the initial date of the loan	8
3. Policy number	8
4. District	6
5. Kind of policy	6
6. Name of insured	17
7. Name of any assignee	17
8. Amount of loan	8
9. Interest rate charged	1
10. History of loan and interest payments	*40
11. Address of person to whom notice is sent if no premium notice is sent	41

*This figure assumes that four amounts of principal and four interest payments will be sufficient.

There are about 600,000 loan interest cards in the file. Loan cards are filed by the month of the premium anniversary due date. Each month is filed in policy number order.

3a. *Interest Tables.* Policy loans are granted at one of three rates of interest, 5% and 6% payable at the end of the contract year, and 5% payable at the beginning of the contract year. The policy terms state which rate of interest is to be charged if a loan is granted.

The five interest tables used, showing the interest factors to be used according to the number of days of interest involved, are based on:

1. 6% effective
2. 6% simple
3. 5% effective
4. 5% simple
5. 5¼% simple (used for 5% discount)

3b. *Calculation of Interest.* To calculate loan interest, the clerk determines from the loan cards the amount of indebted-

Table 1

VOLUME OF WORK AND NUMBER OF CLERKS AT PRESENT

Item of Work	Basis	Number of Cases in Year (Millions)	Clerks Required
1. Premium Billing			
a. Maintaining files*	35% changes a year on 4.3 million policies	1.5	180
b. Typing notices	230% of 4.3 million policies	10.0	82
c. Comparing	"	10.0	52
d. Imprinting and bursting	"	10.0	3
2. Reduction Dividends			
a. Maintaining Files	About 15% changes a year on 4.3 million policies	.7	43
b. Calculating reduction dividends	62% reduction dividends on 4.3 million policies	2.6	18
c. Transcribing	"	2.6	18
3. Loan Interest			
a. Maintaining files	About 100% of 600,000 loans	.6	15
b. Calculating loan interest	"	.6	2
c. Typing notices	"	.6	4
d. Comparing	"	.6	2
		Total	419

*Excluding posting premium payments on premium renewal cards ness and the number of days involved as of the policy anniversary date. He then multiplies the amount of indebtedness by the correct interest factor. If the loan has been initiated during the year, effective interest is charged for the fraction of the year to the annivesary date of the policy. If the amount of loan has changed during the contract year, the loan is considered to be a combination of loans of different amounts for different periods of time such that if considered together they would result in the actual loan history. The amount of interest due is posted on the loan card. About 80% of the calculations are cases where the amount of loan outstanding at the beginning of a policy year was not reduced during the year.

3c. *Form Used.* The present form used for interest notices is a two part form interleaved with carbon. The original is the interest notice. The carbon is a record used to give the field office loan interest data.

3d. *Typing.* The typists usually take the file of a month of loan cards at a time and type a two part form (and any duplicate required) showing the following items contained on the loan card:

Item	*Number of Characters*
1. District	6
2. Date interest is due	8
3. Policy number	8
4. Loan principal	6
5. Interest due	4
6. Name of insured	17
7. Name of person if other than insured to whom notice is to be sent	17
8. Address of person to whom notice is to be sent provided no premium notice is sent	41

3e. *Notices Sent to Persons Other than Insureds.* As in premium billing, it is estimated that 25% of the interest notices are to be sent to persons other than insureds.

3f. *Checking.* The interest notices are checked to determine if any required notices are omitted and if the data typed on the notices is correct.

3g. *Mailing.* The premium notice comparers match the loan interest notices with the premium notices in order that a matched pair may be mailed in the same envelope. If there is no premium notice, the interest notice is mailed alone.

4. *Volume of Work and Number of Clerks.* The volume of work and the number of clerks employed on this work at present are approximately as shown in Table 1. These clerks work a 35 hour week.

5. *Other Problems.* The problem of accounting for premiums and loan interest paid, and posting premium payments on premium renewal cards is one which vitally concerns the billing operation. This problem has so many complications that it will be covered in a later memorandum.

Another problem is the remaining 38% of policy dividend calculations. This will be discussed later.

Under any new mechanical system for the work described in this report, of course not all the clerks reported will be released, for clerks will still be needed to:

1. Prepare input information
2. Operate the machinery
3. Take care of exceptional cases and discrepancies

H. W. Schrimpf, Jr.
Supervising Actuarial Clerk

C. W. Compton
Methods Analyst

(Part 2 of this article will appear in the next issue.)

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 691:

```
          T A L K
        x M U C H
        ---------
        I E E T T
      M I H L N
    L C M T I          M = N
  I U I H C
  ---------------
= H N H I T K E T
```

The Numble above is a little more difficult than some of the previous ones. For a booklet on solving numbles, write for "Numbles — Number Puzzles for Nimble Minds," available from *Computers and Automation,* 815 Washington St., Newtonville, Mass. 02160. Price is $1.00, postpaid, returnable in 7 days for full refund (if in saleable condition) if not satisfactory.

Solution to Numble 6812

In Numble 6812 in our December issue, the digits 0 through 9 are represented by letters as follows:

M,N = 0	R = 5
H = 1	F,T = 6
O = 2	U,W = 7
D = 3	S = 8
A,E = 4	G = 9

The full message is: Use soft words and hard arguments.

WORLDWIDE

REPORT FROM GREAT BRITAIN

So many events of international significance have taken place in the past several weeks that it is hard to rank them. But if a strict dollar-order is observed, then the official inauguration of the $100m seat reservation and data processing complex of Britain's intercontinental airline, BOAC, must take pride of place.

BOAC's $100m Network

Massive, even by present American standards, the network is built up from three IBM 360/65's — one on real-time, one on stand-by and one on batch processing — served by two world-wide information networks. The first is a real-time network which has no parallel elsewhere. It consists of voice-grade links from the Boadicea centre at London Airport to — at present — 11 strategic centres of major air transportation demand in North America and 4 in Europe. From each of these there is or will be a further fan-out of lines to booking offices.

Novel is the use at each node of an extremely fast micro-miniature computer operating as a traffic controller between up to 36 display and communication sets working on seat reservations across the Atlantic to the real-time 65 in London. Both the displays and the controllers have been ordered from Britain's Ferranti company — which has always disputed Univac's claim to have built the first "commercial computer" — and while the present run of equipment provides for about $6m worth of displays and Argus "400" computers (850 and 50 respectively) Ferranti expects to supply a total of $12m worth of equipment to complete the system by the early 70's. (This means, of course, that the British component in the hardware of the system will considerably outweight the value of the three 360/65's, imported from the U.S.)

The second information network which operates at a somewhat slower pace than the real-time one, whose worst case London to Los Angeles enquiry takes no more than three seconds, is the world's biggest privately owned telegraph system. This is automatically switched by two Collins computers in London and serves Africa, the Middle East and Australia.

How It Was Achieved

There is food for a good deal of reflection in the system and the way in which it was achieved. IBM and BOAC spent 300 man-years on the real-time package and it is probable that lesser organisations would have given up, though it is almost certain that they would not have attempted this type of frontal attack and would have taken the less perilous stepwise approach.

Again, people in Britain take comfort from the fact that the imported component (the 360's and their big discs) is only a fraction of the whole cost. It is true that the sophistication of the Ferranti Argus for the control and monitoring by software of the traffic between the displays and the 65 is unique. But no "big brutes" would have been available from a British source to meet BOAC's time scale. This is essentially due to the abject failure of the right-wing political crew in power in Britain during the crucial years 1954/64 to grasp the significance of the electronic data processing explosion in the United States. Their failure to appreciate this and so many other facets of post-war technological advances is the root cause of most of this country's troubles today. Laissez-faire and keen U.S. marketing brought the inevitable result.

One final point on Boadicea. Peter Hermon, the dedicated BOAC chief of information handling, told me that the "Sabre" system in the U.S. had been a salutary lesson to all in that it had demonstrated just how big the airline problem was. When I met him, just before inauguration of the BOAC system, he was rubbing his hands over a first windfall from the Miami reservation centre, which had already been cut in. Apparently a big block booking of well over $10,000 for six months ahead had been presented to other airlines' offices with no takers; that is with most imprecise replies. Submitted to the Boadicea system 4,000 miles away, the transaction was concluded in around five seconds flat.

The London Market

Market observers are wondering who will be the next to raise capital on the London market now that National Cash Register and Burroughs have taken the plunge. It seems almost inevitable that Honeywell should, if only to add a London quote to the aura of being the "other British computer company" that it has cultivated with no little success.

I.B.M. has often considered the move but has so much money in hand that fresh capital might be embarrassing. Univac will make no move in Britain till it is clear that the Common Market countries are going to lower the drawbridge and let us knot "Fortress Europe."

National Cash was the first to move. It is raising $28.2m or £12m in London. Of this £6m is being offered as a straight 8½ percent guaranteed loan stock. The remaining £6m is a 4 percent sterling/dollar convertible guaranteed loan stock. Conversion rights can be exercised during 1973/80 on the basis of one NCR/U.S. share of common stock for every £59 nominal of loan stock. The dollar premium to be paid will be only related to the nominal $141 value and not to the actual value at the time.

Operations of NCR's Scottish plants are to be transferred from U.S. control of NCR(UK), a group whose profit before taxation for the year to November 1967 was close to $12m on a gross turnover of over $85m, of which close on $70m represented export business.

Similarly Burroughs is raising £6m worth of 3¾ percent 1972/82 stock to be issued at par. The stock is convertible into common shares of the U.S. parent company Burroughs Corporation at a rate equivalent to a conversion price of $28.0 per share against a current level around $241.

The money will be used to build the company's new £4m Glenrothes factory and pay off short and medium term loans contracted by the company for the expansion of its Strathleven and Cumbernauld factories.

Government Pressure on U. S.-Controlled Companies

Now, where is all this leading to? I think it is a legitimate assumption that Government pressure on U.S.-controlled companies is a leading factor. As I have reported on previous occasions, all computer companies tendering for contracts on which the Government — through the Ministry of Technology — has any influence, are equal. But International Computers, the British company in which the State has a major financial stake, is more equal than most.

Looked at another way, that is through the eyes of the Ministry, the U.S. companies established in the U.K. have settled here because it is a particularly advantageous trading base. They have, particularly in the Scottish development areas, enjoyed concessions of every kind including cheap factories, tax remissions and the like, to encourage them to settle. To be treated on an equal footing with a domestic industry that the Government is desperately trying to foster, however, they must take the further step of identifying themselves much more closely with the economic life of the country. Ministry of Technology men say they cannot understand why Burroughs, Honeywell, Univac and IBM should feel aggrieved if more costly or less sophisticated ICL equipment is selected in preference to theirs, since one criterion laid down for consideration in Government contracts is the experience ICL will derive from the contract if it is a novel application of the art.

This viewpoint is hard to reconcile with the export claims of NCR, Burroughs and Honeywell. Both can be argued at great length.

Olivetti's New Campaign

Highly significant in this line of thought is the new advertising campaign of the Olivetti company which presents its UK organisation as "a British industry, a world-wide group." Olivetti is soon expected to announce the biggest terminal contract so far secured outside a major clearing bank. It would be worth nearly $3¼m for terminal sets alone, excluding the computers to come from ICL, for installation in the branches of the Trustee Savings Banks of the Manchester and West Midlands consortia.

Similar Olivetti terminals were ordered for working to ICL computers in the British Giro, and at one time there was a rumour of a closer than commercial link between the two. But the break with General Electric, which took place in Italy some months ago, was due, I am assured, entirely to the fact that Olivetti saw its future in the supply of a mass of sophisticated devices to other equipment manufacturers. Being tied to GE did nothing to help its sales efforts, however.

Ted Schoetery

Ted Schoeters
Stanmore, Middlesex
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C.a PROBLEM CORNER

Walter Penney, CDP
Problem Editor
Computers and Automation

PROBLEM 691: WHO IS MISSING?

"Working overtime?" Joe asked, seeing Pete still at his desk long after quitting time.

"Yes," Pete said, "there's one entry missing in this payroll and if someone doesn't get his pay on time tomorrow you know what the union will do to us."

"Why don't you run it against last month's. There haven't been any changes since then and that ought to tell you who's missing."

"It would take too long to get the tapes out and running. I thought I could figure it out sooner from these totals I built into the program. I've added up the numbers corresponding to the first five letters of the names; if these totals check I figure everything is O.K."

"Numbers corresponding to letters?" Joe sounded a little puzzled.

"I convert A into 1, B into 2, and so on, and add up each column mod ten."

"You mean keeping track of only the last digit in each column?"

"Yes, since the names are left justified and there are no carries from column to column this should give us a check on the first five letters of each employee's last name." Pete's voice seemed to underline the *should*.

"And your sums don't agree?"

"Right. The total count is off by only one. Now I have to figure out who that is. Then I'll be able to get the card from last month and add it."

"What are the totals you get?"

"Well, they should be 7 9 0 6 3. Instead I get 1 6 5 7 6. Who is missing?"

Solution to Problem 6812: An Arabic Gray Code

If any digit of a number is preceded by an even digit it will remain unchanged; if preceded by an odd digit it will be replaced by its 9's complement. (The leading digit can be assumed to be preceded by 0.) Hence a number will be unchanged only if all the digits from the ten's place leftward are even. There are 100,000 ÷ 16 or 6250 such numbers. The required number is therefore 6249 since we begin with 1, not 0.

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.

ACROSS THE EDITOR'S DESK

Computing and Data Processing Newsletter

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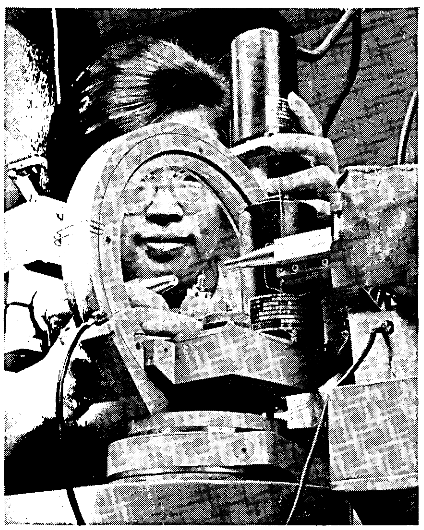
APPLICATIONS

AGRICULTURAL SCIENTISTS USE COMPUTER IN DEVELOPMENT OF BETTER FOOD PRODUCTS

At the U.S. Department of Agriculture's Western Utilization Research and Development Division, Albany, Calif., tiny food crystals are being analyzed by a variety of scientific instruments coupled with an IBM computer to develop better foods for consumers and more economical agricultural products for Western farmers. The research is seeking answers to such questions as what gives fresh bread its aroma, and what produces the strawberry's distinctive taste? The highly organized but tiny crystals extracted from food products for analysis help provide the answers.



A U.S. Dept. of Agriculture laboratory technician positions a crystal for analysis on an X-ray diffractometer.

The scientist's task is to isolate and identify each component contributing to a product's particular flavor and aroma. Then the organic chemist can apply this information in new ways to help preserve or increase a product's flavor and aroma, thereby improving its appeal to the customer.

The computer, an IBM 1800 data acquisition and control system, is connected to an X-ray diffractometer and other instruments which bombard compounds with X-rays, laser and infra-red light, and measure radio waves produced by compounds when subjected to strong magnetic fields. Measurements of how components react to these kinds of energy can be as distinctive as human fingerprints.

Typical of the complex nature of these studies are those using the X-ray diffractometer for analysis of crystals. Analysis of an average crystal may require measurements taking up to three minutes each at as many as 3,000 different angle settings. The entire experiment, running six days or more, is controlled by the computer.

In 1938, X-ray diffractometer measurements of simple crystals took three years. Today, with standard equipment, they can be completed in a month. Using the computer and analytical instruments as a laboratory automation system, the Agriculture Department has cut the time to 12 hours.

A NEW WAY TO DISPLAY AND RESEARCH HUMAN DEVELOPMENT

A graphic, detailed approach to the study of human motor development is being developed by Prof. Richard E. Garrett, an engineer in the School of Mechanical Engineering at Purdue University.

Prof. Garrett uses an electronic system consisting of a cathode ray tube display device linked to a computer to study the human body and how it develops, ages, and functions. The computer's memory is used to store data on how psychological, sociological, physiological and intellectual factors affect a child's physical movements. Through the use of the CRT display device, Garrett can ask for a display of a 2-year-old in motion, then superimpose another of the same child at age 3 to highlight general development. In addition, the system allows him to call for any of the dynamic characteristics of motion, such as velocity, acceleration and energy expenditure.

The system promises to eliminate much of the statistical tedium which confronts physiologists, psychologists, child development specialists, etc., and will allow them to function without need for being mathematicians or statisticians.

For example, a psychologist interested in the correlation between motor development and learning development in children would not have to be an expert in the study of motion. Instead he could call for a display of how a normal 2-year-old jumps and how legs and arms move while he does so; how a normal 5-year-old does the same; and how motor development correlates with, and is influenced by, factors other than age.

Currently Prof. Garrett is developing a means of using the electronic system to display body forms in computer-simulated motion. He is also working on a command language for the system that would be simple enough for a professional untrained in computer technology to use readily.

CANCER SURGERY STUDIES AT HOUSTON HOSPITAL USE SDS SIGMA 5 SYSTEM

The University of Texas M.D. Anderson Hospital and Tumor Institute at Houston (Texas) is studying and developing improved methods to treat and cure cancer patients. An SDS Sigma 5 computer system, integrated with an analog computer, is permitting hospital personnel to perform a variety of cancer research and study programs focused on improved surgical, patient monitoring, and analytical procedures.

In addition to being linked to intensive care units and research facilities, the system is also used on-line to monitor patients undergoing surgery. During an operation, the patient's brain waves, respiration, blood pressure, and other bodily functions are sensed by the computer and instantaneously displayed in the operating room to help surgeons and anesthesiologists determine the patient's condition.

Research applications of the computer include calculating the radioactivity levels needed to kill cancer cells, predicting cancer cell growth, and simulating the functions of the human organs and systems.

HISTORICAL RESEARCH TO BE AIDED BY COMPUTER AT HISTORICAL DATA CENTER AT PRINCETON UNIV.

The groundwork is being laid at Princeton Univ. for an Historical Data Center with the long-range goal of assembling a vast computer-readable storehouse of facts about the people — both well-known and little known — who have helped to make history.

Now in its formative stages, the Center will concentrate on collecting computer tapes of multiple biographies of important historical groups — congressmen, for example, or scientists, bureaucrats, or maybe even pirates. With these resources readily available, scholars around the world would be able to make more precise statements about historical behavior than ever before.

Dr. Theodore K. Rabb, Associate

Professor of History at Princeton and director of the fledgling Center, said it is hoped that within 5 to 10 years the Center will be able to provide historians with both specific information, such as a list of every musician active in 16th centruy Italy, and general information, such as the average marriage age of nobles in 18th century Spain.

He added that the eventual usefulness of the Center will depend on the amount of biographical data it is able to assemble.

The American Council of Learned Societies, which has granted the Center $10,000, has joined with the American Historical Association in sponsoring the project.

COMPUTER-CONTROLLED SYSTEM MONITORS AIR POLLUTION IN NEW YORK CITY

An automated system to monitor the quality of the air was recently put into operation in New York City. The system includes a computer-controlled central recording station, 10 automatic remote data acquisition facilities located at strategic sites throughout the city, and peripheral equipment for manual control, printout and data analysis of critical air pollution parameters.

The 10 automatic stations continuously identify and monitor the three major elements which contribute to the pollution of city air — sulphur dioxide, carbon monoxide, and small airborne particles. Temperature, wind speed, and wind direction are also measured. In addition, one of the stations in Central Park measures radiation as part of a U.S. government study.

The automatic stations are interrogated by a computer as often as every five minutes. This information is used as the basis for a daily air pollution index which is issued to the public, and will enable the city "to predict serious pollution episodes in time to take effective corrective action," according to New York's Air Resources Commissioner, Austin N. Heller.

The city also operates 28 other stations where data are read manually by operators who move to different field sites during the working day.

Control, telemetry, and data acquisition segments of the system were designed and built by the Environmental Sciences Group of Packard Bell Electronics, a Teledyne company, of Newbury Park, Calif.

COMPUTERIZED INFORMATION CENTER IN HARTFORD, CONN. IS DESIGNED FOR USE BY THE GENERAL PUBLIC

The first of a planned network of National Information Storage and Retrieval Centers (NISARC), located in Hartford, Conn. was visited by more than 1,000 persons on its opening day recently.

The Center is designed specifically for use by the general public to help them make important decisions about buying a house, selecting a college, or locating a job more efficiently.

The woman in the picture below is shown "house hunting". She is punching out house specifications on an IBM coded card in one of NISARC's audio-visual screening rooms. Details of location, architectural style, price, number of bedrooms, etc. are all included in the card, which upon completion is sent via computer to the NISARC memory bank to find homes which match her specifications. She pays only for printouts which actually meet her coded requirements.

Similar searches can be made to find the right college to apply to or to locate employment opportunities. The entire operation requires a little more than 15 minutes for a complete search. Real estate searches cost $5; college searches cost $10. NISARC has no vested interest in the decisions people make so that the service it provides can be impartial and objective.

Joel Tenzer, president of NISARC, described the first-day visitors at Hartford as being "overwhelmed". The centers, he said, "will eliminate the tremendous amount of time, money and frustration involved in making these important decisions. It is the first time giant computers and other modern equipment have been placed at the disposal of the public for their specific use."

This same approach will soon be available to people in other areas as NISARC opens centers elsewhere in the nation.

NEW PRODUCTS

Digital

NEW COMPUTER ANNOUNCED BY DECADE COMPUTER CORP.

The DECADE 70 is the latest addition to the line of low-cost high-speed digital computers being marketed by Decade Computer Corp., Huntington Beach, Calif.

The DECADE 70 is an 860-nanosecond digital computer, rack-mounted and designed for applications in the original equipment manufacturers' systems market. Among the features of the DECADE 70 are a 16-bit memory word, a standard 4K memory field expandable to 16K, memory parity, and a memory-protect function, as well as direct memory access.

Previously identified as the 70/2, the new computer will be marketed as the DECADE 70. Hardware delivery is "off-the-shelf". Software is presently operational and includes a single-pass assembler, FORTRAN IV, CHAT, mathematical subroutines, and a utility package. (For more information, designate #42 on the Reader Service Card.)

VICTOR COMPTOMETER CORP. ENTERS COMPUTER MARKET

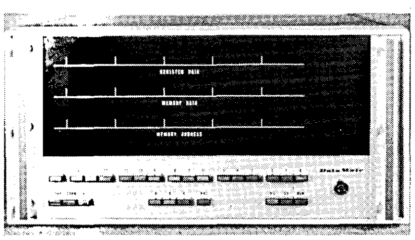
Basic billing computers which can be expanded into an electronic data communications network of general purpose computers and peripherals has been introduced by Victor Comptometer Corp. of Chicago.

The heart of the basic system is an internally programmed, desk-size computer, the 820/20 (shown below), which includes arithmetic and logic control, input/output control, and three memories. Its memory can be expanded from 256 digits up to 81,920 digits. Peripheral components which can be used with the system include: electronic alphanumeric keyboard, serial printer, companion printer, punched tape and edge punched cards, magnetic tape, and conventional ledger cards. Each communications control unit can handle up to 32 terminal computers. From seven to nine channels are available with a packing density of 200 to 800 bits per inch.

The Series 800 line can be programmed for billing, sales analysis, accounts receivable, payroll, inventory control, general ledger, stock control, accounts payable, data collection, message switching, on-line banking, and on-line commercial applications.
(For more information, designate #41 on the Reader Service Card.)

DATAMATE COMPUTER SYSTEMS INTRODUCES DATAMATE 16

DataMate Computer Systems, Big Spring, Texas, has announced their new DataMate 16 digital computer. The DataMate 16 features a two's complement, 16 bit arithmetic fully parallel processor, and has a 4096 word 1.0 microsecond memory modularly expandable to 32,724 words. The computer has byte, word, and double word processing capability with multi-level indirect addressing.



Built-in features include hardware multiply and divide; 8 I/O channels with priority interrupts; hardware index register; and power failure protection. A flexible I/O bus accommodates up to 64 peripheral devices.

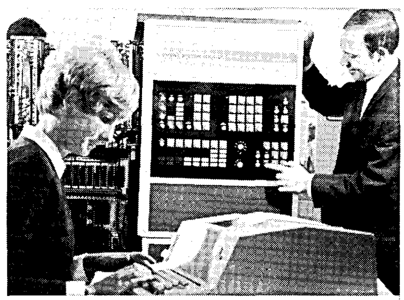
Standard peripherals include a teletype; paper tape reader and punch; incremental magnetic tape; CRT display; digital plotter, and rotating mass storage. A simple plug-in card is used to interface DataMate 16 with these peripherals.

The high volume data thruput rate of 1,000,000 sixteen bit words per second makes the computer particularly applicable to data acquisition, data manipulation, data logging, data analysis, and processor instrument control systems.
(For more information, designate #43 on the Reader Service Card.)

SIEMENS ROUNDS OFF 4004 SERIES WITH TWO NEW COMPUTERS

Two new models — the 4004/16 and the 4004/26 — have been added to its 4004 family of computers by Siemens of Munich, Germany.

The Siemens System 4004 is a hierarchically graded series of computers with a high degree of program and data compatibility from model to model. The models 16 and 26 have been designed with integrated circuitry, as have the larger models of the series.



The model 26 distinguishes itself from the model 16 by peripheral simultaneity and by a larger instruction complement. Model 4004/16 has a main memory capacity of 8,192 or 16,384 bytes; model 4004/26 has a main memory capacity of up to 65,536 bytes. Both processors are capable of handling "byte"-organized data as words of variable lengths. Peripheral devices are connected via an I/O interface which is standarized for all 4004 series computers.

By means of a data communications control, both processors can communicate directly with any other processor in the system, enabling the new models to stand alone as data processors, to function as satellite support for larger systems, or to operate as remote communication terminals in real-time systems.

To utilize the capabilities of these new processors, a number of powerful peripheral units equipped with integrated circuits especially developed by Siemens are being offered.
(For more information, designate #44 on the Reader Service Card.)

Special Purpose Systems

FRIDEN DEVELOPS DATA TRANSACTION SYSTEM FOR RETAILERS

Development of a point-of-sale data transaction system for retailers has been announced by Friden of San Leandro, Calif., the business machines division of The Singer Company.

The basic unit of the Modular Data Transaction System (MDTS) is a terminal which actually performs as a compact electronic computer having its own core memory and processor, plus a common interface for input/output devices.

The terminal is designed to handle every type of point-of-sale transaction — both credit and debit. Computer logic enables it to perform calculations and extensions, equipping it for such functions as check digit verification, calculation of sales taxes, discounts and quantity multiplication of unit costs.

The Friden unit is designed as a "free-standing terminal" that can operate either off or on-line. It produces hard totals, prepares audit tapes, computes change, provides cash sale receipts and processes charge sale slips in multiple copies. It can communicate with a computer — instantly or at periodic intervals — to update credit and inventory records or provide input for accounts receivable, sales audit and reporting, and other purposes.
(For more information, designate #46 on the Reader Service Card.)

SECRETARIES GET A COMPUTER OF THEIR OWN TO AUTOMATE TYPING

The Automatic Office Div. of Information Control Systems, Inc., Ann Arbor, Mich. recently introduced their new Astrotype system — a small desk drawer computer linked to a group of typewriters to give each of the typewriters automatic, error-editing capability.

The typewriters can produce perfect, error-corrected letters as a result of the link-up. Corrections in a letter are made automatically when the typist strikes over the wrong character while typing, or when she gives the computer a special footnote to the letter. The computer follows up by driving the typewriter through an automatic, high speed re-type of the letter which has been refined to

100% perfection.

A whole network of typewriters can simultaneously share the control capability of the tiny computer, meaning that every typist in an office can be using her machine for perfect typing at once. Since letters are filed in the computer's memory and can be recalled at any time, the office's physical correspondence file can be eliminated.

David Carlson, president of the Automatic Office Div. of I.C.S., said the controller is "a true programmable computer which has most of the same capabilities found in larger systems." The computer is, however, "dedicated" to the automatic, error-editing typing function by its special software.

The low cost of the system derives from two points: the software makes ingenious use of the computer's small (4K) core memory; and the new computer utilizes space and cost saving integrated circuits. The desk drawer control unit measures only 16 x 20 x 9 inches.

The Astrotype system accepts all editing requests via the standard typewriter keyboard, and can be operated by any typist with only an hour's instruction.
(For more information, designate #45 on the Reader Service Card.)

COMPUTER-CONTROLLED TEST SYSTEM OFF THE SHELF

Hewlett-Packard, Palo Alto, Calif., has combined compatible, off-the-shelf instruments to provide a new computer-controlled stimulus/response test system, the HP Model 9500A. The system offers a rapid and economical means of testing electronic components, modules, or assemblies at the laboratory, production, incoming inspection, or field maintenance level.

A basic 9500A system consists of the computer (HP Model 2116B), a teleprinter input/output unit on which instructions are typed in and output information recorded, a punched tape reader to take in programming data at 300 characters per second, a programmable dc power source, an integrating digital volt-meter for precise dc measurements, and a distribution switch to connect the system to any of 16 test points.

The system is programmed in BASIC, an English-like language that can be learned easily.

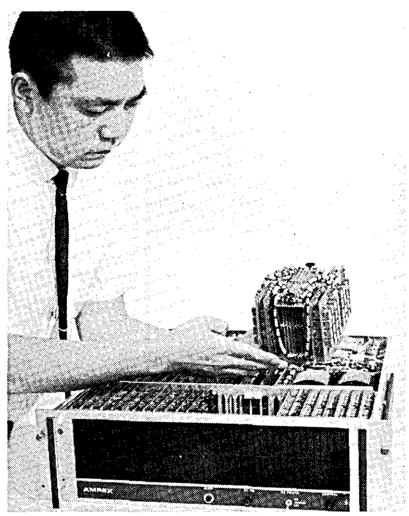
Advantages claimed are: (1) one-supplier responsibility for system performance; (2) easy modification of specific tasks (by reprogramming in BASIC); (3) easy expansion of test capability; (4) availability of system elements as bench instruments too, since all are standard instruments; (5) low comparative cost; and (6) prompt availability.
(For more information, designate #47 on the Reader Service Card.)

Memories

RGX: A NEW COMPACT CORE MEMORY FROM AMPEX CORP.

A compact new core memory occupying one-third the space of previous memories with comparable speed capacity characteristics has been placed on the market by Ampex Corp., Redwood City, Calif.

The new Model RGX core memory is a complete memory system contained in a drawer-module $5\frac{1}{4}$ inches high. It is available in capacities of up to 4,096 words by 48 bits, or 8,192 words by 24 bits. The new memory offers a cycle time of 900 nanoseconds and a data access time of 350 nanoseconds.



An engineer demonstrates how the core stack can be removed easily from the Model RGX core memory.

The compact design incorporates memory, power supply and an optional self-testing unit. Other optional items include address register outputs, data parity generation and check, zone control and sequential/sequential-interface operation.
(For more information, designate #51 on the Reader Service Card.)

UNIVAC OFFERS IMPROVED VERSION OF FASTRAND MASS STORAGE SUBSYSTEM

A new and improved version of the FASTRAND Mass Storage Subsystem — the FASTRAND III — has been announced by Sperry Rand Corp.'s UNIVAC Div. The additional storage capacity (one and one-half times that offered by FASTRAND II) is attained by increasing the sector density from the 64 sectors per track available with FASTRAND II to 96 sectors per track. Increasing the sector density while maintaining the rotational speed also results in a 50 percent increase in transfer rates over FASTRAND II.

The new FASTRAND III Subsystem can store almost 200-million characters of information on each of up to eight drum units. The average access time is the same as that for FASTRAND II — 92 milliseconds.

FASTRAND III has immediate applications with the UNIVAC 1108, 494, and 418-III Systems. Deliveries are scheduled to begin during the summer of 1969.
(For more information, designate #50 on the Reader Service Card.)

FERROXCUBE INTRODUCES FOUR MEMORY PRODUCTS

Ferroxcube Corp. introduced four new memory products at the Fall Joint Computer Conference in San Francisco last month. Their new plated wire memory stacks are designed for use in memories with speeds of less than 500 nanoseconds. These stacks have typical Read cycle times of 150 nanoseconds, with a 400 nanosecond Write cycle. The basic stack size is 8,192 words of 18 bits. Other stack sizes, such as 16K x 9, 4K x 36 and 2K x 72, can be derived from the basic stack. The stack is designed to operate in a Non-Destructive Read-Out mode with equal Read and Write word currents.

A new 500 nanosecond core memory stack with 18 mil ferrite cores was also introduced. Designated the Series 500, this stack features a $2\frac{1}{2}$D 3 wire organization in a capacity of 8K x 18. Stack sizes from 8K x 9 to 16K x 18 are also offered with 500 nanosecond speed.

A new buffer memory exhibited was a self-contained plug-in unit with a 4 microsecond speed. This memory is organized 3D - 3 wire with a 256 x 18 capacity.

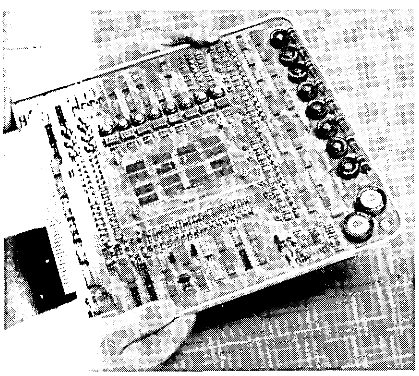
A buffer memory card set, complete with all electronics, was featured consisting of four plug-in cards. Operating at a speed of

40 microseconds, the card set memory capacity is 160 x 16 organized in a 3D - 3 wire configuration.

Ferroxcube Corp. is a subsidiary of Consolidated Electronics Industries Corp., and has manufacturing facilities in Saugerties, N.Y. and Englewood, Calif.
(For more information, designate #49 on the Reader Service Card.)

NEW MEMORY FROM SANDERS ASSOCIATES CONTAINED ENTIRELY ON A SINGLE PRINTED CIRCUIT BOARD

A low cost, high-speed memory system contained entirely on a single, flat circuit board has been developed by Sanders Associates, Inc., Nashua, N.H. Designated the MEMCARD® system, the memory includes address registers, power on/off, core memory, and associated electronics — all on one 12 by 12 inch board, ½ inch thick.



The MEMCARD system features cycle times of 1.5 microseconds. It is designed to operate in commercial environments of 0 to 50 degrees centigrade, and features temperature compensation within the memory itself, and plug-in convenience for easy maintenance or replacement. The 3-wire, 3D memory, contained on a plane in the center of the printed circuit card, is comprised of eight mats, each containing 1024 cores.
(For more information, designate #48 on the Reader Service Card.)

Software

AMPS (Assembly Manufacturing Payroll System) / Delta Data Systems Inc., College Park, Md. / Provides manufacturers with a flexible method of reporting an employee's earnings without elaborate sorting and card handling. Designed to operate on piece work or assembly shop payrolls, the system provides for two types of bonuses based upon employee production, and handles seven deductions in addition to the normal tax and exemption deductions. Written in COBOL for an IBM 360 computer.
(For more information, designate #52 on the Reader Service Card.)

ARIS (Audio Response Interface System) / Datametrics Corp., Van Nuys, Calif. / A computer interface system for coupling the IBM 7770 Model 3 Audio Response Unit with the Univac 1108 computer. Provides audio communication of unlimited message length and features a basic pre-recorded vocabulary of 128 most frequently used words associated with a specific industry. System accommodates up to 48 individual telephone lines simultaneously by direct dial service. Application areas include computer-aided education, machinery monitoring and control, process control, and reservation control.
(For more information, designate #53 on the Reader Service Card.)

DATA PROJECT MANAGEMENT SYSTEM / Lutter and Helstrom, Inc., Chicago, Ill. / A new software system designed for measuring the performance of EDP systems analysts and computer programmers, and improving administrative control of computer centers. Measures the weekly work performance for each systems analyst and programmer against pre-determined time standards for each task in a project designed for computer application. Each project is assigned a control number, then broken down into elemental tasks which are assigned to specific individuals. Time estimates for each task are developed in consultations with the systems supervisors and used as a check on project progress.
(For more information, designate #54 on the Reader Service Card.)

DISPLAYALL / Informatics Inc., Sherman Oaks, Calif. / Designed to reduce the time required to develop on-line application programs for IBM 2250/2260 display terminals. Consists of a display generation and checking program; multi-console executive routine; higher order display programming statements; and application interfacing utilities. Operates under OS/360 and may be used with Assembler Language and FORTRAN IV.
(For more information, designate #55 on the Reader Service Card.)

EASYPLOT / Tymshare, Inc., Los Altos, Calif. / Allows Tymshare subscribers to call out prestored plotting routines and specify appropriate visual formats, annotation, scaling factors, and labelling to graphically present the results of computation. Data and instructions are sent to the Tymshare computer via teletypewriter from any location with standard phone connections. Plotting is produced on a CalComp 500 Series Plotter.
(For more information, designate #56 on the Reader Service Card.)

GIS (Generalized Information System) / IBM Corp., White Plains, N.Y. / A management information system that will enable executives at remote terminals to ask for data stored in a central computer. Allows users to access information stored in a System/360 Model 50 or larger by means of IBM 1050 or 2741 communication terminals, or a 2260 display station. Will process English-like commands and produce answers in the format specified and at the desired level of detail. Differs from GIS (Basic) announced earlier in that it has tele-processing capabilities and provides for concurrent retrieval from 16 different files of computer-stored data instead of three. Scheduled to be available in the third quarter of 1969.
(For more information, designate #57 on the Reader Service Card.)

PI SORT / Programmatics Inc., Los Angeles, Calif. / External package is identical to DOS Sort for the IBM 360, and includes all of the options of DOS Sort. But PI SORT sorts files up to twice the size of the largest file which can be sorted by DOS Sort, while maintaining a ratio of two to four reduction in time. Introduction of PI SORT is considered an important step in the controversy over separate pricing for software.
(For more information, designate #59 on the Reader Service Card.)

NLO (NonLinear Optimizer) / Information General Corp., Woodland Hills, Calif. / Designed to optimize process performance and provide feasible solutions without matrix inversion. Written in FORTRAN. Application areas include the design and operation of continuous flow processes in the chemical, petroleum, food, metals and related industries.
(For more information, designate #58 on the Reader Service Card.)

SL-1 / Scientific Data Systems, El Segundo, Calif. / Designed primarily to simplify the work of scientists and engineers who lack special training in programming, but who must program a digital or hybrid computer to simulate par-

allel systems. A superset of CSSL (Continuous System Simulation Language), the standard specified by Simulation Councils, Inc., SL-1 provides hybrid and real-time features, a powerful set of conditional translation features, and an extensive macro set, augmented by the ability to accept user-specified macros.
(For more information, designate #60 on the Reader Service Card.)

THOT (Transportation Horoscope of Trade goods) / Economatics Inc., Pasadena, Calif. / Offers a fast comparison of shipping alternatives (truck, plane, train) along the same route, or between alternatives using other routes which arrive at the same destination. Can be applied to selected territories or worldwide. Input information on the costs and statistics can be easily varied so the program can simulate projected transportation systems. Can be used on any third generation computer. Written in FORTRAN.
(For more information, designate #61 on the Reader Service Card.)

Peripheral Equipment

DATA READER CAMERA SYSTEM CONVERTS VISUAL IMAGE TO DIGITAL SIGNALS

An electronic camera that converts optical images to precise digital electrical signals has been developed by the Westinghouse Astroelectronics Laboratory, Newbury Park, Calif. When this unit, the data reader camera, is focused on any scene, display, image or graphical representation, it produces a corresponding series of electrical impulses which represent the data in digital form.

The data reader camera is designed to follow any desired pattern in scanning an image. Scanning commands can be supplied by any digital computer or by a small specially programmed computer available for this purpose from the Westinghouse laboratory.

This optional unit, termed the image conversion control unit, is used to direct the camera's scan and deliver the output from the camera for storage or processing by other data reduction equipment. The data reader camera and image conversion control unit together form a complete optical image digitizing system.

Some areas of application include medical electronics, natural resource exploration, topographic imagery, and automated reduction of photographic data and chart records of all types.
(For more information, designate #63 on the Reader Service Card.)

HONEYWELL ADDS NEW FAMILY OF DATA DISPLAY TERMINALS

A new family of advanced desktop terminals for remote on-line entry, retrieval and display of computer information — the 2300 — will be marketed by Honeywell's Electronic Data Processing Div., Wellesley Hills, Mass.

The six Visual Information Projection (VIP) terminals include a low-cost single-station unit for display of up to twelve 80-character-wide lines of information (equal to one punched card) and five multiple-station terminals that provide information display areas ranging from 960 character to 222 characters on 9, 18 or 36 separate terminals attached to a single control unit.

The Series 2300 VIPs may be used in such diverse applications as manufacturing production control, marketing data retrieval, library indexing, hospital patient records, airliner passenger or freight information, and other similar management information systems.
(For more information, designate #65 on the Reader Service Card.)

IMAGES GENERATED BY COMPUTER CAN BE COPIED ON PAPER WITH IBM 2285 DISPLAY COPIER

Photo copies of images generated by a computer on a TV-like screen can be produced by a new display copier — the 2285 — announced recently by IBM Corp., White Plains, N.Y.

The 2285, shown at the left, can produce a photo copy in 15 to 38 seconds, depending on the complexity of the image. When the "copy" button on the 2285 is pushed, the signals that produce the display on the large screen are transferred to a small cathode-ray tube (CRT) in the copier. The CRT's image is projected onto 8½" by 11" photo-sensitive paper.

The machine is designed to operate with the IBM 2250 display unit. The paper handling and developing mechanism is being built for IBM by the 3M Company.
(For more information, designate #62 on the Reader Service Card.)

CAPACITY OF PHONE LINES IS DOUBLED WITH NEW DATA SETS

International Communications Corp., a subsidiary of Milgo Electronic Corp., has developed a pair of data sets which can significantly reduce the cost of computer communication. The new data sets — Modem 4400/20H and Modem 4400/20L — transmit two separate high-speed 2000 bit-per-second messages at the same time over a single telephone line. Each message stream is transmitted independently, as if two individual phone lines were being used.

The Modem 4400 data sets are based on a narrow-band technique of transmission developed by Milgo.
(For more information, designate #64 on the Reader Service Card.)

NEW CALCOMP PLOTTING SYSTEM IS DESIGNED TO RELIEVE MAINFRAME COMPUTER AND PROGRAMMING TIME

A CRT microfilm plotting system designed to relieve mainframe computer and programming time by incorporating a small, general purpose computer was introduced by California Computer Products, Inc., Anaheim, Calif., at the Fall Joint Computer Conference in San Francisco last month.

The new Model 840 Stored-Program system operates on-line with a Honeywell 516 computer. Plotting instructions are introduced into the 516 from compacted magnetic tape data generated by a central computer and by executive routines entered via keyboard. The Model 8350 CRT monitor, which provides real time display of plotter output, is available as an optional feature.

The 840 system provides automatic microfilm recording in either 35mm or 16mm format. Basic software allows use of computer tapes formatted for a line printer. Used as a high-speed line printer, the 840 prints at an average rate of 1200 lines per minute, each line

consisting of 132 characters.
(For more information, designate #66 on the Reader Service Card.)

DISPLAY RECORDER PERMITS VISUAL VERIFICATION OF DATA BEING ENTERED ON COMPUTER TAPES

A high speed, data entry system that enables untrained personnel to see the data they are entering onto magnetic computer tapes is now available from Sanders Associates, Inc., Nashua, N.H.

The Sanders System 6000® permits operators to display computer formats at the touch of a button. Using the electronic keyboard, they can fill in the data in the same manner as filling in a printed page by typewriter. Unlike conventional keypunch or keyboard-to-tape operations where the operator enters the data without being able to see it, the Sanders system displays the typed data on a screen for verification and editing before it is recorded on tape.

The System consists of a control unit, up to 12 operator display stations, and a rack of four tape recorders. A unique feature of the System 6000 is the automatic merging of data batches from all operators onto a single tape at very high speeds. In conventional systems, a special tape machine, or "pooler" is required to merge all the data on short "operator" tapes onto one reel prior to input into the computer.

The System provides 2700 locations for displaying characters on a 32-line screen, with up to 84 characters per line.
(For more information, designate #67 on the Reader Service Card.)

LOW-COST PERIPHERAL FAMILY FROM SCIENTIFIC DATA SYSTEMS

Three new low-cost peripheral devices for use with SDS Sigma computers have been announced by Scientific Data Systems, El Segundo, Calif. The three new units — a line printer, card punch, and card reader, are designed for applications not requiring the higher input/output speeds provided by the existing peripheral product line.

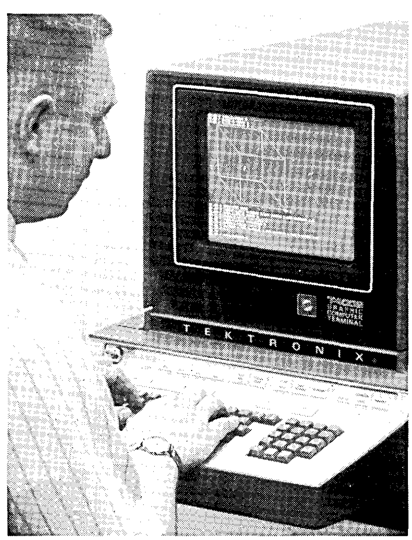
The Model 7450 Line Printer utilizes 64 graphics in a 128-column format, and has a print speed of 225 lines per minute.

The Model 7165 Card Punch is capable of punching full 80-column cards at a 100-card-per-minute rate.

The Model 7121 Card Reader reads 80-column punched cards in either a binary or EBCDIC mode at 200 cards per minute.
(For more information, designate #68 on the Reader Service Card.)

TEKTRONIX INC. ANNOUNCES GRAPHIC COMPUTER TERMINAL

Tektronix, Inc., Beaverton, Ore., has announced a completely self-contained, desk-top information display system, the T4002. Complete communication interaction is achieved by the system through the use of a solid-state data entry keyboard and visual displays. System components are: display unit, terminal control, character generator, keyboard and input/output interface. A unique 11 inch, direct-view, storage display tube developed by Tektronix is used as the display media.



The 6 1/2 inch by 8 3/4 inch screen will accommodate up to 35 lines of alphanumeric characters, with 80 symbols per line. Manual entry of data is through a solid-state keyboard with full USASCII capability (128 codes). Two sizes of characters are under program control, with others available.

Initially two types of interfaces are available for direct coupling to computers or data communication systems. Type 4801 Interface couples the T4002 to Digital Equipment Corp.'s PDP-8 series of computers; type 4802 Interface couples the T4002 to data communication systems such as the Bell System Type 201 and Type 202 Data Sets.
(For more information, designate #69 on the Reader Service Card.)

DIGITAL DATA LOGGER FROM CONTROL EQUIPMENT CORP.

The 120 Series of Digital Data Loggers scan, digitize, and record analog data for later computer entry or manual study. Available from Control Equipment Corp. of Framingham Center, Mass., the new portable Data Loggers are suitable for aircraft and shipboard use, as well as for field and laboratory applications.

Each Data Logger contains the scanner, A/D converter, digital clock, digital data entry, and output buffer, and can output to eight types of recording devices.
(For more information, designate #70 on the Reader Service Card.)

Data Processing Accessories

CURRENCY DISPENSER WILL MAKE CASH AVAILABLE TO BANK CUSTOMERS AROUND-THE-CLOCK

The Docuteller Currency Dispenser is the first in a series of products that ultimately will lead to the unmanned teller station for the banking industry. By using the dispenser, banks can offer their patrons faster service and shorter teller lines, plus the convenience of getting cash on an around-the-clock basis seven days a week, even in remote locations. Benefits to banks using the dispenser are savings in personnel and floor space requirements, and the ability of offering patrons an added banking service.

A bank customer is issued a personal identification number plus a plastic card similar to those used by many U.S. banks and credit card organizations. When the card holder needs cash, he inserts the card in the Docuteller Currency Dispenser, keys in his personal identification number, chooses one of two predetermined cash amounts and, if all is in order, receives his money. The equipment records the withdrawal on a debit voucher, one copy of which is issued to the customer along with the currency. The other copy is retained in the dispenser for later automatic data processing by the bank.

A number of safeguards are built into the dispenser, to preclude misuse.

The Dispenser was developed by the Docutel Corp. of Dallas, Tex., a subsidiary of Recognition Equipment Corp. Chemical Bank New York Trust Co. has placed the first order for a Docuteller Currency Dispenser to be installed in May 1969. (For more information, designate #73 on the Reader Service Card.)

JERSEY TAB CARD CORP. TO MARKET OWN MAGNETIC TAPE

A special polyester film backing that provides unique strength and flexibility is one of the important features of a new computer tape being marketed by Jersey Tab Corp., Union, N.J. The tape is available with nine different colored adhesive-backed rings for identification purposes, and is packaged in a thin, sturdy plastic case which may be stacked interchangeable with present libraries. (For more information designate #72 on the Reader Service Card.)

3M OFFERS DISK PACK COMPATIBLE WITH CDC DISK STORAGE DRIVES

A new magnetic computer disk pack, compatible with the Control Data Corp. (CDC) 853 and 854 disk storage drives, has been announced by 3M. The new disk pack, Scotch brank 904, has a sector disk with 33 slots (32 sectors). It is the second disk pack being offered by 3M's Magnetic Products Div. in St. Paul, Minn. The first, the 906, is compatible with IBM 1311 and 2311 drives. (For more information, designate #71 on the Reader Service Card.)

COMPUTER RELATED SERVICES

COMPUTERIZED MANAGEMENT SYSTEM FOR LEGAL OFFICES

A data processing system which will handle all adminstrative details in the management of a professional legal office has been announced by Associometrics Inc. of Dallas, Tex. The new system, called PLOMS (Professional Legal Office Management System), provides complete client statements for law offices and also gives current information for management guidance in the planning of lawyers' time and profitability. The system is designed to allow lawyers to concentrate on profitable areas of practice; know accurately where to renegotiate fixed or retainer fees; gauge value of each client, case and type of case; and take exact steps to correct unprofitable situations.

Under the system, law offices are not required to purchase data processing equipment nor to hire data processing personnel. All original documents remain in the lawyer's office and data for processing is provided to Associometrics by the lawyer's current clerical staff on input sheets computer-printed for that purpose. (For more information designate #74 on the Reader Service Card.)

DIGITAX, AN AUTOMATIC INCOME TAX PROCESSING SERVICE

The utilization of the computer is regarded by many accountants as a breakthrough in the field of tax return preparation. During his highly seasonal work load period, the tax professional has had to resort to all sorts of aids, from the carbonized snap-out forms to copying devices. Digitax, a new automatic income tax processing service, is designed to save much of this repetitive labor.

The procedure as reported by Digitax requires but 4 input sheets into which is incorporated a consistent format of 4 working columns. They contain all the information necessary for the filing of federal, state or city resident taxes. When the tax practitioner completes these sheets, they are forwarded to the computer service where the computer processes the information and prints, in triplicate, the federal or regional returns, including such schedules as wages, dividends, interest, itemized deductions, income averaging, etc. Processing, once requiring up to 9 days, now is accomplished in 48 hours and costs for the service have been reduced as well. (For more information, designate #75 on the Reader Service Card.)

TIME-SHARING SERVICES

INTERNATIONAL TELECOMPUTER NETWORK HAS ENTERED TIME-SHARING FIELD

International Telecomputer Network (ITN) Corp. has been formed to provide time-sharing, remote-access and batch-processing computer services in major population centers throughout the United States and Canada.

ITN will utilize a GE 635 computer — a $3.2 million system which can be programmed to simultaneously service 200 customers. The system allows users to perform time-sharing and batch processing from standard teletypes or other terminal devices. One feature of the system, believed to be an industry first, enables ITN customers to build data files at their terminals and to access these files during either time-sharing or batch operation. Similarly, files stored directly into the system at the Telecomputer Center during batch operations may subsequently be accessed from remote terminal devices.

In addition to providing time-sharing and remote access services, the firm will develop and market proprietary computer application packages for its clients; and later plans to design, manufacture and lease remote computer peripheral devices.

The company, which was organized

by five former General Electric employees, is headquartered in Bethesda Md. It will initially offer its services in the Washington, New York, and Philadelphia metropolitan areas.
(For more information, designate #76 on the Reader Service Card.)

TRANS-PACIFIC COMMUNICATION FROM TERMINAL IN HAWAII TO COMPUTER IN OKLAHOMA IS COMMERCIALLY SUCCESSFUL

Data Research Corp., Tulsa, Okla. recently announced that on Nov. 22, 1968, they completed the world's first commercial trans-Pacific terminal to computer communication via cable and satellite. Control Data Corp.'s Honolulu office began broadcasting from their 200 User Terminal at 2:30 a.m. on Nov. 22 to Data Research's CDC 6400 computer in Tulsa, Okla. All types of experimental test programs were tried and successfully completed. Data Research had to make only one card change in their regular program, due to the fraction of a second time lag due to the distance between computers.

According to Leo McIntire, president of the company, the success of their trans-Pacific communication will mean "that computers such as the CDC 6400 will soon be available for time sharing through remote stations anywhere in the world." Data Research Corp. currently provides specialized time sharing services for research needs in the southwest and midwest.

SWEDEN'S FIRST TIME-SHARING CENTER OPENS IN STOCKHOLM

His Royal Highness, Prince Bertil of Sweden, recently presided at the inauguration ceremonies of Sweden's first full-scale, commercial time-sharing center in Stockholm. The opening of the Stockholm center marked the eleventh time-sharing system installed in Europe in the past 14 months by General Electric's European computer affiliate, Bull General Electric, and other firms in the Company's worldwide Information Systems Group.

GE computer time-sharing is now within reach of most of Western Europe's major metropolitan areas. The new Stockholm center, besides providing computer power to scientific, business, industrial and educational customers in Sweden, also will serve users in Norway and Finland. More than 50 General Electric time-sharing systems are now in operation worldwide, serving more than 50,000 individual users.

STANDARDS NEWS

AMERICAN STANDARDS INSTITUTE COMMITTEE TO INVESTIGATE STANDARD LANGUAGE FOR CONTROL OF COMPUTER OPERATING SYSTEMS

Under the auspices of the United States of America Standards Institute (USASI), an ad hoc committee is being formed to investigate the need for and feasibility of a standard computer-operating-system control language. A wide range of interests will be represented on the committee, including producers and users of computing equipment, terminal equipment, and computing software; trade associations; user organizations; and professional societies.

Millard H. Perstein of System Development Corporation (SDC) has been appointed chairman of the committee (USASI X3.4.2F), which becomes a part of the committee structure concerned with data processing in general, and programming language in particular.

A two-day committee organizational meeting will be held at SDC at 10 a.m. on Tuesday, February 4, 1969. The meeting will be devoted to establishing committee rules, assigning tasks and reviewing work already accomplished in developing a standard.

All interested persons are invited to attend the initial meeting, and are urged to write: Millard H. Perstein, chairman X3.4.2F, System Development Corp., 2500 Colorado Ave., Santa Monica, Calif. 90406.

NEW LITERATURE

INSTITUTE FOR SCIENTIFIC INFORMATION STARTS NEW PUBLICATION FOR BEHAVIORAL, SOCIAL AND MANAGEMENT SCIENTISTS

One of the newer methods of disseminating information to scientists to enable them to keep up-to-date in their fields is through the publication of "current awareness" journals, which contain the tables of contents pages of selected primary journals. The Institute for Scientific Information, Philadelphia, Pa., has introduced such a publication to cover the social sciences.

The new publication, Current Contents®, Behavioral, Social and Management Sciences, is a weekly pocket-size guide containing the contents pages of approximately 700 journals from all over the world. An alphabetical index and author address directory is provided to permit subscribers to request reprints of the articles listed.

The Institute, also publishes "current awareness" journals in the physical, life and chemical sciences, and in education.

SYSTEMS AND PROCEDURES HOME-STUDY COURSE NOW AVAILABLE

A new home-study course in Systems and Procedures is available from the North American Institute of Systems and Procedures of Newport Beach, Calif. The course can be used both as a refresher course, and to teach new systems people.

The course is sponsored and copyrighted by the Systems and Procedures Association. The 50-lesson course covers a wide range of topics including: Organization, Responsibilities and Functions of a Systems Department; Charting, Procedure and Report Writing; Forms Design; Office Layout; Work Simplification; Automatic Data Processing; Electronic Data Processing; and Information Retrieval.
(For more information, designate #77 on the Reader Service Card.)

ORGANIZATION NEWS

NEW FINANCING PLAN FROM SCIENTIFIC RESOURCES CORP. INCLUDES ASSURED COMPUTER PERFORMANCE

A new computer marketing/financing plan that includes committed performance as an end product has been announced by Scientific Resources Corp., Philadelphia, Pa. The new plan, called Computer Resources Financing, offers all of the elements of a computer installation — hardware, software development, systems implementation, etc. — in a total systems performance package for a monthly fee.

According to Thomas T. Fleming, president of Scientific Resources Corp., the objective of the plan is to eliminate the cost and inefficiency which computer users often meet in having many different people responsible for the implementation of their various computer programs.

Under Computer Resources Financing, Scientific Resources Corp. will sell or lease computer hardware, design and implement application software, ensure effective operation, assist in developing a customer's own EDP staff, and retain total responsibility for the entire system until defined performance objectives are met.

GENERAL ELECTRIC AND SYSTEMS CAPITAL CORP. ANNOUNCE PROCESS CONTROL COMPUTER LEASING PLAN

A new rental plan for process control computers, believed to be unique in the industry, has been jointly announced by General Electric Co. and Systems Capital Corp. (SCC) of Philadelphia. The plan is designed to provide substantial advantages over conventional leasing arrangements, including lower monthly rates, additional savings in monthly rental of new equipment where the user qualifies for an investment tax credit, and an ascending payment schedule to help equalize expenses when startup costs are high and production is not yet maximized. Renewal options at decreasing monthly rental rates and purchase options are also available.

NATIONAL CASH REGISTER WILL MARKET PROPRIETARY PROGRAM FROM NATIONAL COMPUTER ANALYSTS

Recently the National Cash Register Co. of Dayton, Ohio entered into an agreement with National Computer Analysts, Inc., Princeton, N.J., giving NCR exclusive rights to market NCA's proprietary system, QUICK-DRAW, through Sept. 1, 1970. The agreement is believed to represent the first time a computer manufacturing company has agreed to market proprietary programs developed by a software company.

NCR may retain exclusive rights to QUICK-DRAW, provided that a minimum payment of $450,000 accrues to NCA every six months, with the first six-month period beginning Sept. 1, 1968.

NEW COMPANIES

CURRAN COMPUTER SERVICE / Hackensack, N.J. / Leases digital plotters and drive systems to business, industry, colleges, state and municipal governments.

DATA SCIENCE VENTURES, INC. / Princeton, N.J. / Provides venture capital funds and management assistance to new and growing companies in the data processing industry.

TY-CORE INC. / Chelmsford, Mass. / Design and manufacture of Data Tape Systems and other peripheral computer equipment.

VANGUARD DATA SYSTEMS, INC. / Newport Beach, Calif. / New products to be introduced into the computer peripheral market.

ACQUISITIONS

ASPEN SYSTEMS CORP., Pittsburgh, Pa., a developer of full text computer storage and retrieval techniques applicable to the law, has acquired COMPUTYPE, INC., St. Paul, Minn., a computerized photocomposition service.

COMPUTER APPLICATIONS INC., New York, N.Y., a computer consulting and programming firm, has acquired MERCEDES BOOK DISTRIBUTORS CORP., Brooklyn, N.Y., a book distributing and data processing firm.

COMPUTER PLANNING CORP., Torrance, Calif., a computer service organization, has acquired ON-LINE SCIENCES, Los Angeles, Calif.

STRATEGIC SYSTEMS INC., New York, a software company, has acquired CREATED SPACE, INC., New York, a computer room design and construction firm.

PEOPLE

BLIND COMPUTER PROGRAMMER AUTOMATES LIBRARY AT THE UNIV. OF NORTH DAKOTA

North Dakota's largest library is being automated by a computer programmer who cannot read any of the 210,000 books on its shelves. Elmer Morlock, who is in charge of the project, is totally blind, and the Chester Fritz Library at the Univ. of North Dakota has no books written in braille.

Morlock, totally blind since age nine, has begun the first phase of the project, computerizing the ordering and purchasing of books. Several computer programs are necessary for the undertaking, but for Morlock another program was necessary before he could begin — converting the characters used in the program into braille.

The braille conversion program that Morlock wrote utilizes the same characters for the alphabet and single digit numbers as does standard braille. Because computer braille characters consist of only one cell composed of six dots, Morlock had to create many of his own characters. The computer is adapted to print braille by means of an elastic band which causes the paper, when hit by the periods, to indent slightly. In order to read braille normally (left to right), it must be written from right to left, due to the indentation factor.

For his current project, Morlock has recorded all of the planning sessions with library personnel. When he begins writing a program, he refers to the tapes. He also employs a reader, who reads articles from periodicals and other research to the recorder which Morlock refers to when necessary. The reader also carries out other tasks, such as filling out forms used in programming and reading directly to Morlock.

After graduation from the Univ. of N. Dakota in 1961, Morlock attended a private computer training school in Pittsburgh, Pa. Before undertaking his present job, he worked as a data processor for the state of Minnesota.

Conrad Dietz, Director of the Univ. of N. Dakota Computer Center, called Morlock "a very capable programmer" and "an inspiration to his fellow workers."

PRISON INMATES REPAYING DEBT BY WRITING COMPUTER PROGRAMS

Seven inmates at the Massachusetts Correctional Institution at Walpole, Mass. are repaying their debt to society in a dollar-and-cents way by writing programs for a computer at the Mass. Dept. of Education.

Assistant Education Commissioner James F. Baker estimates the inmates have provided the Commonwealth with more than $22,000 worth of service since the project began in February, 1968. "These men provide a high level of technical service to the state," Baker said. "But just as important, we feel this project is a major contribution to their rehabilitation. It is clear evidence that a valid work experience can be provided men in the restricted institutional setting of a prison."

The inmates learned programming at a course conducted at the maximum security prison by Honeywell's EDP Div. They write their programs and keypunch them at the prison.

NEW CONTRACTS

TO	FROM	FOR	AMOUNT
Data Products Corp., Culver City, Calif.	Transamerica Computer Co., Inc., Los Angeles, Calif.	A computer peripheral equipment purchase agreement over a two year period	$25 million (minimum)
Burroughs' Defense, Space and Special Systems Group, Paoli, Pa.	Army Electronics Command, Fort Monmouth, N.J.	Development of a Tactical Automatic Digital Switching System (TADSS). TADSS will receive incoming tactical field data and redistribute it on a real-time priority basis to various field commanders	$11 million (potential)
Scientific Data Systems, El Segundo, Calif.	Scientific Resources Corp., Philadelphia, Pa.	An SDS Model 940 time-sharing system to provide time-sharing services to Scientific Resources customers and affiliates, and several SDS Sigma computers for use in PASS I, PASS II and PASS III seismic data processing systems for oil, natural gas, and mineral exploration	$8 million (approximate)
Liberascope Group of Singer-General Precision, Inc., Glendale, Calif.	U.S. Naval Ordnance Systems Command	An antisubmarine warfare (ASW) weapon control system; contract was won in advertised-bid competition	$5,212,999
Marshall Laboratories, Torrance, Calif.	Transamerica Computer Co., Inc., Los Angeles, Calif.	Purchase of Marshall M2500 disc storage drive equipment as it is leased to end users, over a two-year period	$5 million (potential)
Sylvania Electric Products Inc. (a GT&E subsidiary), Needham, Mass.	U.S. Air Force	Contract addition for engineering support of ground electronics system which controls targeting and firing of the Minuteman II intercontinental ballistic missile (ICBM)	$3.5 million
General Electric Co., Schenectady, N.Y.	U.S. Army Corps of Engineers	Purchase of a network of previously installed GE-200 computer systems, and lease of a GE-420 time-sharing system	$3 million (approximate)
Bunker-Ramo Corp., Stamford, Conn.	Honeywell Inc.	Desk top visual data display equipment for use in computer systems produced by Honeywell's EDP Division	$3 million (minimum)
Federal Electric Corporation (FEC), ITT's worldwide service associate	U.S. Army Electronics Command	Design and installation of a communications system in the Federal Republic of Germany	$2 million (approximate)
Lear Siegler, Inc., Santa Monica, Calif.	Lockheed-California Co.	Development of an advanced automatic flight control system for the U.S. Navy's P-3C Orion antisubmarine patrol aircraft	$1 million (approximate)
Recognition Equipment Ltd., UK subsidiary of Recognition Equipment Inc., Dallas	The Dutch Bank Giro, Amsterdam, The Netherlands	An Electronic Retina® Computing Reader for use in automatically processing over 150,000 daily banking transactions for 73 Dutch banks	$800,000 (approximate)
Communications & Systems Inc., (a division of Computers Sciences Corp.), Falls Church, Va.	U.S. Navy, Naval Ship Systems Command	Technical assistance and support to the Navy's Fleet Maintenance Data Collection System	$800,000 (approximate)
Boeing Company, Seattle, Wash.	U.S. Air Force	Initial Airborne Warning and Control System (AWACS) radar support; AWACS is foreseen as an "eye in the sky" dual-purpose air defense and tactical flying command post. (Boeing also is competing for the AWACS prime contract)	$800,000
Computer Sciences Corp., Los Angeles, Calif.	U.S. Army, SENTINEL System Command	Assistance in development of a computer-based information system to aid in deployment of the SENTINEL Ballistic Missile Defense System	$723,000
Computing and Software, Inc., Panorama City, Calif.	National Aeronautics and Space Administration	Operation of the Biodata Analysis Labora- for the Biomedical Program Office at NASA's Flight Research Center, Edwards, Calif.	$450,000+
Ampex Corporation, Redwood City, Calif.	Stanford University	Core memories for use in a nation-wide computerized learning program	$350,000 (approximate)
PRC Technical Applications, Inc., Alhambra, Calif.	U.S. Army Missile Command, Huntsville, Ala.	Design, development and programming of a system to write specifications automatically	$345,000
Computer Sciences Corp., Los Angeles, Calif.	NASA's Ames Research Center, Mountain View, Calif.	Continued operation and expansion of the telemetry processing system used in the Pioneer space program	$338,000
Decca Radar Canada (1967) Ltd., Toronto, Ontario, Canada	Govt. of Can. Dept. of Transport, Marine Traffic Control Branch	A computer-assisted traffic control system to operate on the St. Lawrence River	$200,000 (approximate)
System Development Corp. (SDC), Santa Monica, Calif.	U.S. Air Force, Electronic Systems Division	Development of a computer-based training program for the Air Force Phase II Base Level Data Automation System	$169,000
Electronic Associates, Inc., West Long Branch, N.J.	U.S. Department of the Interior, Office of Saline Water	Hybrid computer simulation of a desalination plant located in San Diego, Calif.; the simulation will provide an economic way to help OSW understand dynamic plant behavior, and will be used as an important tool in flash plant design, operation and control analysis	$64,000
Systems Dimensions Ltd., Ottawa	IBM Co. Ltd., Toronto, Ontario	An IBM System/360 Model 85 valued at $13 million; the new center will offer batch processing and time-sharing services	—
Frontier Airlines, Denver, Colo.	GATX/Boothe Corp. (a subsidiary of General American Transportation Corp.)	An 8-year lease of a $5,750,000 passenger reservation system which is built around two IBM System/360 Model 65 computers	—

NEW INSTALLATIONS

OF	AT	FOR
Burroughs B340 system	First National Bank of Oelwein, Iowa	Processing demand deposits, installment loans, proof and transit, savings, and payroll (system valued at $220,000)
Burroughs B2500 system	Ivanhoe Division of Reliance Electric Company, Cleveland, Ohio	Sales and order processing, inventory control, payroll, cost accounting, various engineering calculations (system valued at $440,000)
Control Data 3300 system	Benefit Trust Life Insurance Co., Chicago, Ill.	Automating claim service and issuance of policies, and of new policy applications; instantaneous policy-holder status reports and retrieval of other pertinent data
Control Data 6400 system	French Institute of Petroleum (IFP), France	Simulation of data on oil reservoirs, refinery processing and geophysical research; engineering studies and general scientific applications
Digital Equipment PDP-8/L	A. O. Smith Corp., Electronic Systems Division, Milwaukee, Wis.	Use in a bulk terminal gasoline distribution system
	General Radio Corp., West Concord, Mass.	Use in a system for checking communication cables
	Houdaille Industries' Electronics Division, Clarence, N.Y.	Integration into systems for preparing tapes for the control of industrial machinery
GE-435 system	Field Enterprises Educational Corp., Chicago, Ill.	Order processing and accounting tasks
NCR Century-100 system	Cal Metal Corp., Torrance, Calif.	Payroll, sales analysis, and data processing for associated plants
	Glick's Furniture Co., Dayton, Ohio	A central credit system; also sales analysis and stock record statistics among initial applications
	W. H. Kiefaber Co., Dayton, Ohio	Development of hardware wholesaler inventory control program
	Mercy Hospital, Baltimore, Md.	In-patient/out-patient accounting, general ledger and payroll
	Quality Markets, Jamestown, N.Y.	Prime function is preparing invoices (in label form) from (32) store merchandise orders
	Ter Bush & Powell, Inc., Schenectady, N.Y.	Accounts receivable/payable, payroll, salesmen's commissions, and installment finance agreements
NCR Century-200 system	Cincinnati Province of the Sisters of Mercy, Cincinnati, Ohio	Shared computer facility will serve 12 hospitals, almost 100 schools, and various other institutions
NCR 315 system	Green Shield Trading Stamp Company Ltd., London, England	Maintaining information on all merchandise stocks and stock movements at firm's gift houses, warehouses and suppliers
RCA Spectra 70/45 system	City of New York, Department of Social Services, New York	On-line budget computation for all of the city's welfare cases (system valued at over $1 million)
	Commonwealth of Massachusetts, Comptroller's Division, Boston, Mass.	On-line handling of legislative bill status, State Budget, and personnel records
UNIVAC 1107 system	French National Institute of Health and Medical Research (INSERM), Villejuif, France	Applications embracing the entire medical field including hospital control, appointments and scheduling medical treatments, laboratory analysis, etc.
UNIVAC 1108 system	U.S. Navy, Underwater Sound Laboratory, New London, Conn.	Sonar and electromagnetic system design and analysis, scientific data processing and design review, other technical applications; some business applications
UNIVAC 9200 system	Chittenden & Eastman Co., Burlington, Iowa	Billing, invoicing, and sales analysis; replaces tabulating equipment
	Del Mar Pacific, Petaluma, Calif.	Billing and inventory control; replaces tabulating equipment
	Denby's, Troy, N.Y.	Sales reports, accounts payable/receivable, and summaries for buyers
	Forgflo Corp., Sunbury, Pa.	Production control, payroll processing, and general accounting
	Howard Community Hospital, Kokomo, Ind.	A wide variety of business operations including medical and insurance billing and payroll processing
	Lyman Printing & Finishing Co., Lyman, S.C.	Handling inventory control; replaces tabulating equipment
	Marin Municipal Water District, Corte Madera, Calif.	Consumer billing, inventory control and general accounting; replaces punched card equipment
	Town of Huntington, Huntington, L.I., N.Y.	Follow-up on parking violation notices, tax billing, payroll processing, and various licensing procedures
UNIVAC 9300 system	Blue Ridge Grocery Co., Waynesboro, Va.	Billing, inventory control, payroll processing, accounts payable/receivable and fixed assets accounting
	Computer Retrieval Systems, Inc., Bethesda, Md.	Operation of a legal reference system by the information service firm
	Northwestern Life Insurance Company, Seattle, Wash.	All phases of insurance accounting including processing ordinary and special risk insurance, statistical reporting and calculation of commissions, etc.
	Commonwealth of Pennsylvania, Department of Property and Supplies	Issuance of all Professional Licenses; also for payroll, timber sales and purchasing
	Record Club of America (RCOA), York, Pa.	Up-dating membership records, informing members of new records, order processing, inventory control, etc.
Varian Data 520/i	Analog Technology Corporation, Pasadena, Calif.	Nerve center for a pulse-height analyzer system (PHA); PHA system measures and analyzes a variety of electromagnetic and charged-particle radiations from space

MONTHLY COMPUTER CENSUS

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

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

The following abbreviations apply:

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

AS OF DECEMBER 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-$14,000	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
Datacraft Corp. Ft. Lauderdale, Fla.	DC6024	$1300	1/69	0	0	3	3
Data General Corp. Hudson, Mass.	NOVA	$7950 (S)	1/68	0	0	0	0
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	48		X	
Maynard, Mass.	PDP-4	$1700	8/62	32		X	
	PDP-5	$900	9/63	100		X	
	PDP-6	$10,000	10/64	21		X	
	PDP-7	$1300	11/64	99		X	
	PDP-8	$525	4/65	1381		C	
	PDP-8/S	$300	9/66	880		C	
	PDP-8/I	$425	3/68	541		C	
	PDP-8/L	?	11/68	39		C	
	PDP-9	$1000	12/66	309		C	
	PDP-9/L	?	-	3		C	
	PDP-10	$7500	12/67	36		C	
	LINC-8	?	9/66	136	3616	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, Ariz.	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	

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
General Electric (cont'd)	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
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	7/68	3		1	
Oceanport, N.J.	Model 3	$300-$500	3/67	105		35	
	Model 4	$400-$800	8/68	6	114	22	58
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	
	200-212	$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	70	292	20	20
Scientific Control Corp. (R)	650	$500	5/66	23		0	
Dallas, Tex.	655	$1800	10/66	63		15	

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
Scientific Control Corp. (cont'd)	660	$2000	10/65	9		6	
	670	$2600	5/66	1		0	
	6700	$30,000	10/67	0		1	
	4700	$500	2/69	0		14	
	6700	$30,000	10/67	0	96	2	32
Scientific Data Syst., Inc. (N) Santa Monica, Calif.	SDS-92	$1500	4/65	120 E		10 E	
	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) Los Angeles, Calif.	IC 4000	$9000	7/68	0		2 E	
	IC 6000	$10,000-$22,000	5/67	7	7	12 E	14 E
Systems Engineering Labs (R) Ft. Lauderdale, Fla.	SEL 810	$1000	9/65	24		X	
	SEL 810A	$900	8/66	91		34	
	SEL 810B	$1200	9/68	4		18	
	SEL 840	$1400	11/65	4		X	
	SEL 840A	$1400	8/66	33		X	
	SEL 840 MP	$2000	1/68	7	163	20	72
UNIVAC, Div. of Sperry Rand (R) New York, N.Y.	I & II	$25,000	3/51 & 11/57	23		X	
	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	
	1044	$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) Newport Beach, Calif.	620	$900	11/65	75		0	
	620i	$500	6/67	255		430	
	520i	-	10/68	8	338	-	430
		I. U.S. Manufacturers, TOTAL —			67,200 E		23,300 E

II. Non-United States Manufacturers

NAME OF MANUFACTURER	NAME OF COMPUTER	AVERAGE OR RANGE OF MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTAL-LATIONS	MFR'S TOTAL INSTAL-LATIONS	NUMBER OF UNFILLED ORDERS	MFR'S TOTAL UNFILLED ORDERS
A/S Norsk Data-Elektronikk Oslo, Norway	NORD 1	$1000	8/68	5		3	
	NORD 2	$200	8/69	0	5	0	3
A/S Regnecentralen (R) Copenhagen, Denmark	GIER	$2300-$7500	12/60	37		1	
	RC 4000	$3000-$20,000	6/67	1	38	1	2
Elbit Computers Ltd. (R) Haifa, Israel	Elbit-100	$4900 (S)	10/67	35	35	15	15
English Electric Computers Ltd. (R) London, England	LEO I	-	-/53	3		X	
	LEO II	-	6/57	11		X	
	LEO III	$9600-$24,000	4/62	39		X	
	LEO 360	$9600-$28,800	2/65	8		X	
	LEO 326	$14,400-$36,000	5/65	11		X	
	DEUCE	-	4/55	32		X	
	KDF 6	-	12/63	17		X	
	KDF 8-10	-	9/61	12		X	
	KDF 9	$9600-$36,000	4/63	28		X	
	KDN 2	-	4/63	8		X	
	KDF 7	$1920-$12,000	5/66	8		X	
	SYSTEM 4-30	$3600-$14,400	10/67	3		C	
	SYSTEM 4-40	$7200-$24,000	5/69	-		C	
	SYSTEM 4-50	$8400-$28,800	5/67	9		C	
	SYSTEM 4-70	$9600-$36,000	1/68	2		C	
	SYSTEM 4-75	$9600-$40,800	9/68	-		C	
	ELLIOTT 903	$640-$1570	1/66	52		C	
	ELLIOTT 4120	$1600-$4400	10/65	82		C	
	ELLIOTT 4130	$2200-$9000	6/66	23	348	C	110
GEC-AEI Automation Ltd. (R) New Parks, Leicester, England	Series 90-2/10/20/25/30/40/300	-	1/66	13		X	
	S-Two	-	3/68	1		X	
	130	-	12/64	2		X	
	330	-	3/64	9		X	
	959	-	-/65	1		X	
	1010	-	12/61	8		X	
	1040	-	7/63	1		X	
	CON/PAC 4020	-	-	0		C	
	CON/PAC 4040	-	5/66	9		C	
	CON/PAC 4060	-	12/66	5	49	C	8
International Computers Limited (R) London, England	1200/1/2	$900	-/55	62		X	
	1300	$3000	-/63	79		X	
	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	

AS WE GO TO PRESS

CONTROL DATA CORP. HAS FILED A SUIT AGAINST INTERNATIONAL BUSINESS MACHINES CORP., CHARGING ANTI-TRUST VIOLATIONS AND MONOPOLISTIC PRACTICES. IBM has called the charges "unfounded", and said it will "vigorously defend itself against this action".

The 30-page complaint contends that IBM has sold or leased some equipment at a loss for the purpose of hindering competition, has discouraged customers from replacing IBM computers with competitor products by offering discriminatory prices and other concessions, and has misrepresented the status of their computers by issuing premature announcements of computers in order to deprive competitors of sales. The complaint is based on orders for Control Data computers, particularly the CDC 6600. The company seeks treble damages, and an injunction against IBM.

IBM said that the suit, which requests a jury trial of "all the issues", came as a "complete surprise".

THE COURT OF PATENT APPEALS HAS OVERRULED A DENIAL OF A PATENT FOR A COMPUTER PROGRAM, and in so doing, may have taken a big step toward opening the way for the patenting of computer programs. The disputed patent was granted for a computer program in the case of Prater and Wei.

The Patent Office has upheld the so-called "Rule of Abrams", which claims that functions that can be handled mentally are not proper subject matter for patenting. The Court of Appeals reviewed this rule, and felt that it was based on questionable precedents, and that it had never been properly adopted. The Court also pointed out that the rule did not differentiate between processes that could be handled only mentally (as had been true in the Abrams case), and processes that could be handled mentally, but could alternatively be handled without human intervention. Computer programs appear to fall in the second category.

The Patent Office said that if the ruling is upheld, computer programs would be patentable, providing they meet other qualifications. But the Patent Office is asking the Court to reconsider its decision.

AT&T'S PROPOSED TARIFF SCHEDULE COULD RESULT IN "LESS SERVICE AVAILABLE TO THE PUBLIC FOR MORE MONEY TO THE TELEPHONE COMPANY", according to a petition filed with the Federal Communications Commis-

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)	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	
	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	8	34	10	29
N.V.Philips' Computer Industrie Apeldoorn, Netherlands	P1000	?	6/68	0	0	5 E	5 E
Saab Aktiebolag (R) Linkoping, Sweden	DATASAAB D21	$5000-$14,000	12/62	32		2	
	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		1	
	4004/15/16	19,000 "	10/65	70		15	
	4004/25/26	32,000 "	1/66	31		8	
	4004/35	46,000 "	2/67	69		61	
	4004/45	75,000 "	7/66	59		40	
	4004/55	103,000 "	12/66	4		2	
	301	2000 "	-	1		14	
	302	4000 "	9/67	13		8	
	303	10,000 "	4/65	67		8	
	304	12,000 "	-	14		20	
	305	14,000 "	11/67	21	425	26	203
Union of Soviet Socialist Republics	BESM 4	-	-	C		C	
	BESM 6	-	-	C		C	
	MINSK 2	-	-	C		C	
	MINSK 22	-	-	C		C	
	MIR	-	-	C		C	
	NAIRI	-	-	C		C	
	ONEGA 1	-	-	C		C	
	ONEGA 2	-	-	C		C	
	URAL 11/14/16	-	-	C		C	
	and others				2500 E		700 E
		II. Non-U.S. Manufacturers, TOTAL —			6800 E		2000 E
		Combined, TOTAL —			74,000 E		25,300 E

sion by Photo Magnetic Systems, Inc., the manufacturer of the patented "Comput-A-Phone" Touch-Tone telephone time-sharing system.

The petitioners said that the proposed revised tariff to retain the same or even stronger controls over so-called foreign attachments (customer-provided equipment) was in direct contradiction to the FCC's Carterfone decision handed down last Sept. In that decision, the FCC held that AT&T must allow users to connect any device to their lines that will be beneficial to the user, providing it does not interfere with the telephone network itself or another user's activity within the system.

Under AT&T's proposal, the customer would have a choice of using his own data terminal equipment on telephone lines, or using the Data-Phone data sets provided by the company. If he chooses to use his own equipment, AT&T would connect it to the terminals with a protective device which would limit signal levels — and for which he would pay a monthly charge of about $2.00.

The petition filed by Photo Magnetic Systems claims that this protecting device could be easily built into the independent manufacturer's equipment "at little cost and with no installation charge or recurrent rental required".

IBM CORP. HAS ANNOUNCED THAT NO LATER THAN JULY 1, 1969, IT EXPECTS TO "MAKE CHANGES IN THE WAY IT CHARGES FOR AND SUPPORTS ITS DATA PROCESSING EQUIPMENT". The company has been "re-examining its methods of doing business in the United States to determine what support services should be separately offered and priced to better meet the future requirements of all users of IBM equipment".

The study is reportedly being made as the result of the need for increasingly complex and comprehensive systems support, and new support requirements coming from leasing companies and other owners of IBM equipment as they relocate and reapply their systems. Speculation is that the company will probably begin charging separately for certain types of software, instead of including software as part of the purchase agreement for a computer.

IBM said that until the study is completed and results are announced, it will continue to do business in the same manner it has in the past.

THE DEPT. OF DEFENSE HAS ADOPTED THE NEW USA STANDARD COBOL, and all Cobol compilers delivered to the department after Jan. 1, 1970 must either provide for the full standard or one of the new standard subsets. The USA Standard Cobol was adopted by the USASI (United States of America Standards Institute) last August, and copies are expected to be available early this year. The Dept. of Defense is the largest user of computers in the government.

THE 1969 ACM NATIONAL CONFERENCE HAS ISSUED A CALL FOR PAPERS TO BE SUBMITTED BY FEB. 17, 1968. Areas of interest are: Organization of Large Files / Online Automatic Indexing and Classification / Simulation of Continuous, Discrete Systems / New Applications of Simulation Techniques / Selection and Training of Computer Personnel / Administrative Applications in the University / Computational Techniques in Civil Engineering / Data Management for Urban Planning / Techniques for Symbolic and Algebraic Manipulation / Computer Graphics / Computer-Assisted Instruction / Design Automation / Language Implementation Tables and Techniques / Artificial Intelligence / Data Transmission for Online Terminals / Certification of Numerical Routines / Interactive Numerical Analysis / General-Purpose Mathematical Programming Systems / Online Programming Languages: Alternative Approaches / General-Purpose Languages / Development and Operation of Remote Access Utilities / Pricing Strategies for Computing Centers / Realtime Systems — Operations and Applications / Testing and Conversion of Realtime Systems / Systems Acceptance Criteria / Evaluation of Computer Installations / Numerical Analysis / Automatic Numerical Analysis / Time Sharing Networks / Resource Allocation and Scheduling / Automata Theory — Computability / Biomedical Data Processing.

Those planning to submit a paper should send a postcard giving a short description, working title, name, affiliation, business address, and telephone immediately to Ward Sangren, ACM 69 Technical Program Chairman, P.O. Box 2867, San Francisco, Calif. 94126. Five copies of the entire paper are due no later than Feb. 17.

The 1969 ACM National Conference is scheduled for August 26-28 at the San Francisco Civic Center.

GAEL BURNS, ART DIRECTOR AT HONEYWELL'S ELECTRONIC DATA PROCESSING DIV., HAS WON A PLACE IN THE "GRAPHIS ANNUAL". "Graphis", published in Zurich, Switzerland, receives more than 17,000 entries from art directors in 40 nations each year. Judges select about 1000 for publication. Burns' winning entry was a brochure he designed for a computer programming package called FACILE.

THE POSSIBILITY OF FORMING A TRADE ASSOCIATION FOR MANUFACTURERS OF COMPUTER PERIPHERAL EQUIPMENT was discussed by such manufacturers and a few mainframe manufacturers at the Fall Joint Computer Conference in San Francisco last month.

The four general purposes of the organization which were agreed upon are: (1) To create a center that will gather, process, and disseminate information on what types of computer equipment are currently available from the group's members; (2) To establish a liaison committee to work in the area of government business; (3) To explore the possibility of developing some form of standardization in computer peripheral interfacing; and (4) To study the feasibility of creating a nationwide service-maintenance organization.

The organization structure and charter is expected to be presented for approval during the 1969 Spring Joint Computer Conference. Manufacturers who will work out the organizational structure include representatives from Hewlett-Packard, Palo Alto, Calif.; Houston Instrument, Houston, Tex.; and Bryant Computer Products, Walled Lake, Mich.

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NEW PATENTS

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

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

November 5, 1968

3,409,877 / Michael E. Alterman, Matawan Township, Monmouth County, Donald W. Huffman, Shrewsbury, and Frank S. Vigliante, Piscataway Township, Middlesex County, N. J. / Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York / Automatic maintenance arrangement for data processing systems.

3,409,880 / Gerald M. Galler, Washington, D. C., and Ernest J. Porcelli and Laszlo L. Rakoczi, Phoenix, Ariz. / General Electric Company, a corporation of New York / Apparatus for processing data records in a computer system.

3,409,881 / Mitchell P. Marcus, Binghamton, and Cyril J. Tunis, Endwell, N. Y. / International Business Machines Corporation, Armonk, N. Y., a corporation of New York / Nondestructive read-out storage device with threshold logic units.

3,409,882 / James R. Sweet and Louis D. Stevens, Saratoga, and Jack O. Hildebrand, San Jose, Calif. / International Business Machines Corporation, Armonk, N. Y., a corporation of New York / Digital concept coordination information retrieval system.

November 12, 1968

3,411,022 / Lucien Budts, Paris, France / Thomson Automatismes, Chatou, France, a corporation of France / Logical circuits.

3,411,137 / George Aneurin Howells and Geoffrey Allen Hunt, Aldwych, London, England / International Standard Electric Corporation, New York, N. Y., a corporation of Delaware / Data processing equipment.

3,411,146 / Richard E. Knutson, Albuquerque, N. Mex. / The United States of America as represented by the United States Atomic Energy Commission / Digital data sorting logic system.

3,411,149 / Rabah Shahbender, Princeton, N. J. / Radio Corporation of America, a corporation of Delaware / Magnetic memory employing stress wave.

November 19, 1968

3,412,255 / Edward L. Krieger, St. Paul, Minn. / Sperry Rand Corporation, New York, N. Y., a corporation of Delaware / Character recognition system using selectively positioned light conducting rods and including conversion to excess three binary code.

3,412,261 / Charles W. R. Hickin and Richard P. Quinlivan, Binghamton, N. Y. / General Electric Company, a corporation of New York / Analog voter.

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.

Supersonic air travel, rapid transit monorails and rockets to the moon get all the publicity.

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That's why passenger and freight volume are forever on the rise and have to be run on incredibly tight schedules.

This isn't easy when you're handling 16.5 million people and 563,000 tons of freight every day.

But the JNR does it. And with the help of the UNIVAC 490 manages to provide some of the fastest and safest train rides in the world. And some of the most comfortable and punctual.

The UNIVAC 490 serves as a nucleus for integrated work in cost accounting, settlements, assets, payroll, purchase and stores, workshop control, and statistics on personnel and health programs.

Univac is working for a number of railroad systems—from the newly formed Penn Central; the French National; C&O/B&O; Great Northern—to the Boston and Maine; Spokane, Portland and Seattle; Bessemer and Lake Erie.

Univac systems are working around the clock and around the world for industry, education and government, to help people go where they want to go faster.

UNIVAC

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

SPERRY RAND

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This isn't exactly the Chattanooga Choo-Choo.

The Bullet Train is the world's fastest. It speeds by Mount Fuji every day at 125 mph.