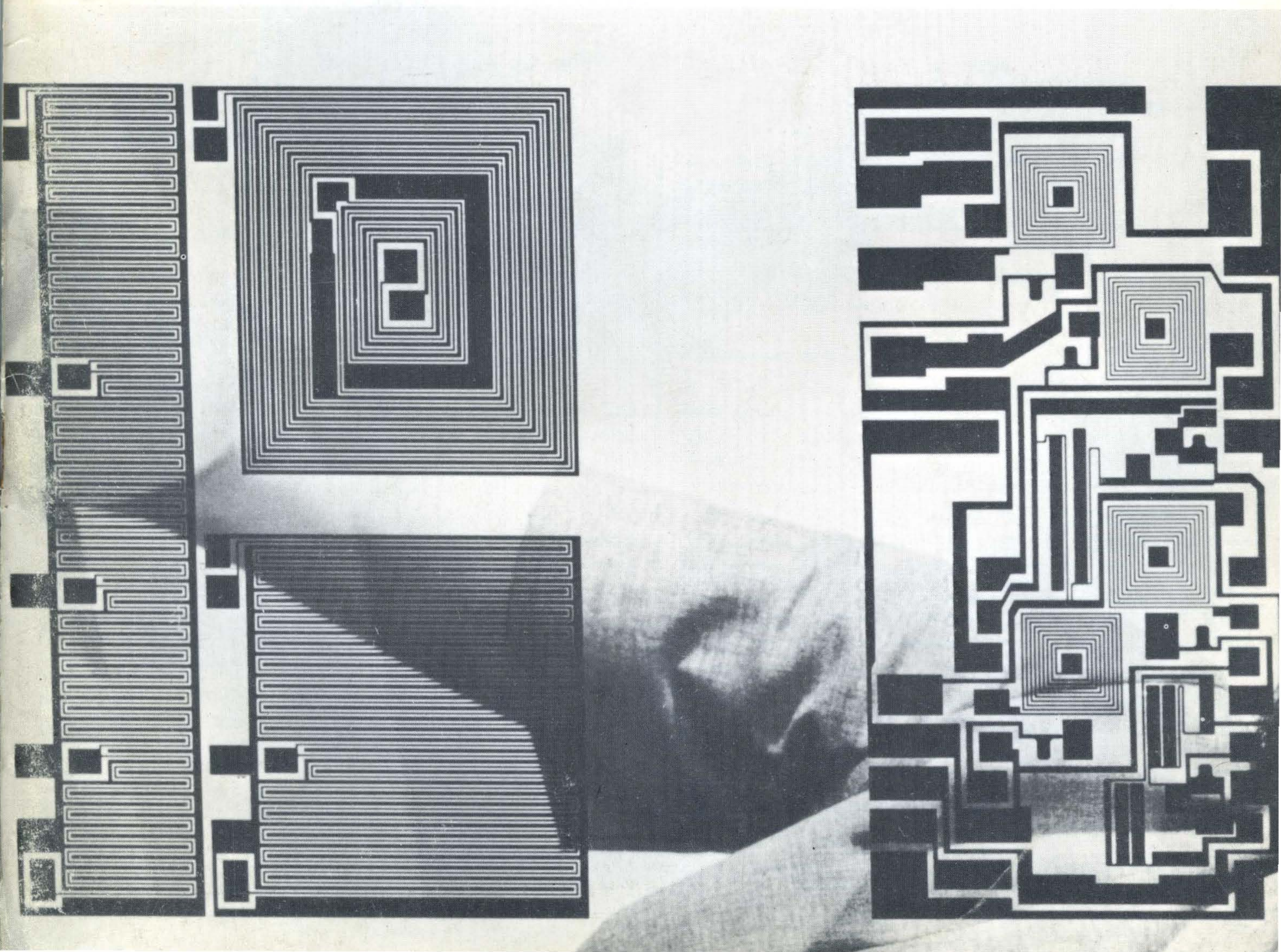
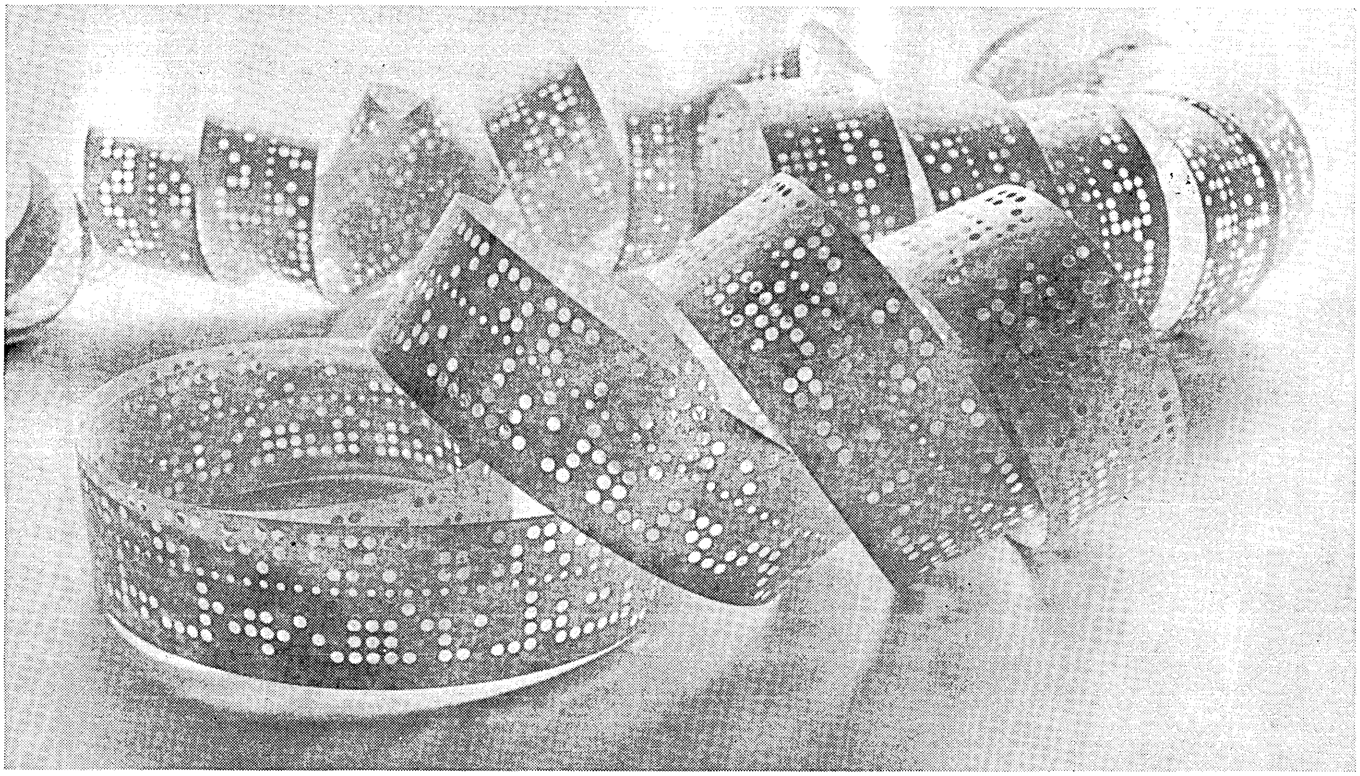
April, 1966

computers and automation

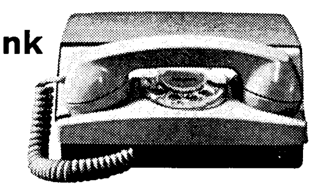
Glass master negative for producing printed circuit boards for computers





Clark Equipment Company gets data from 127 sales offices, 4 manufacturing plants, and a major warehouse as soon as it's recorded

Bell System communications is the vital link



Bell System data communications services link Clark's distant locations to a centralized computer center at Buchanan, Michigan. The result is better management control of all activities—sales, inventory, purchasing, production, payroll and accounting.

With current and accurate information, Clark management can quickly adjust to changing marketing conditions. Important orders get priority scheduling for production and shipment. And yet, purchasing, production and inventories stay at optimum levels.

An integrated information system of this size uses computer switching with store and forward capabilities. The fully automatic Clark system polls satellite stations, receives and transmits messages, assigns priorities, and converts different speed and code formats to one standard code. Other features of the switching unit provide the necessary supervisory control of the network.

Consider the economies a real-time, integrated information system can bring to your business with automatic data processing linked with fast, reliable communications.

Today's dynamic competition requires many companies to consider organizing for data processing in some phase of their operations. It's important to start organizing communications at the same time.

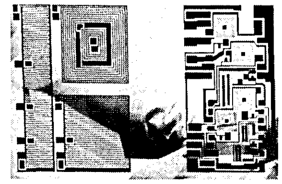
So when you think of data communications, think of the Bell System. Our Communications Consultant is ready and able to help you plan an integrated information system.

See the latest in data communications.
Visit the Bell System exhibit at the Spring Joint Computer Conference.

BELL SYSTEM

Bell System
American Telephone & Telegraph
and Associated Companies

The front cover shows a glass master negative used to produce circuit boards for the IBM System/360 For more information see page 51.



APRIL, 1966 Vol. 15, No. 4

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

In This Issue

Special Feature: Some Innovative Applications of Computers

In Every Issue

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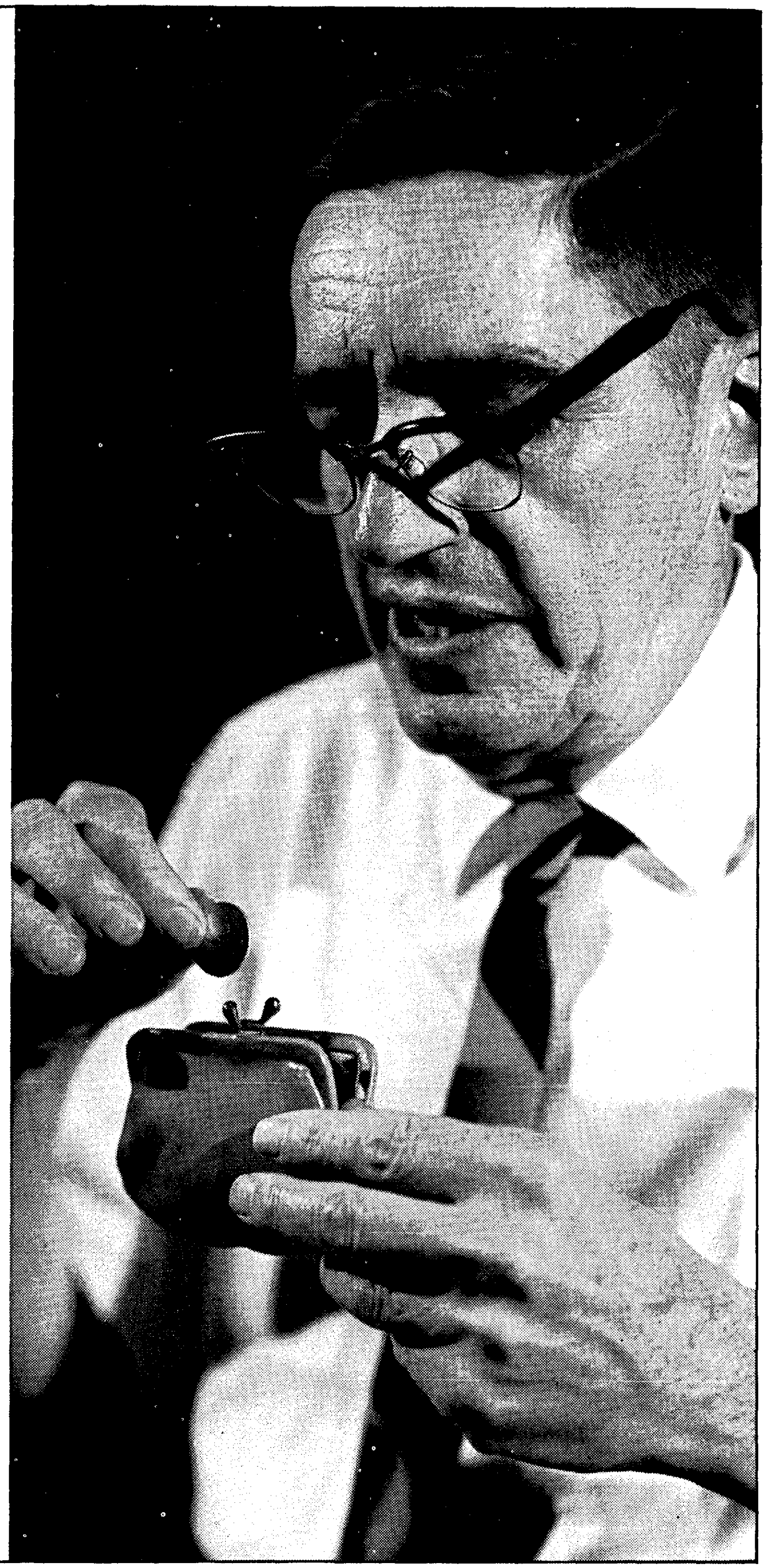
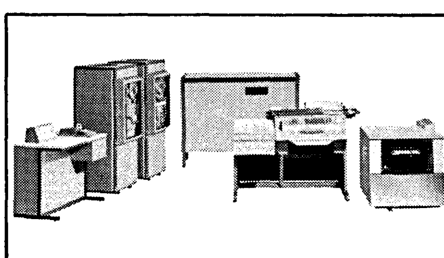




Perspective

In this issue we publish an off-the-trail article by Lord C. P. Snow. His article "Science and the Advanced Society" helps us see our world in better perspective. He talks of a number of important, sharp changes, revolutions, happening in our world. The reason we publish this article — although it talks about computers in only a few paragraphs — is that in general in our society:

Too much time, energy, and thought are devoted to less important problems and not enough to more important problems.

What is the evidence for this proposition? How do we measure the importance of problems? And if this proposition is true, what should we do about it?

In every society some problems are important, some problems are trivial. The importance of a problem in a society is measured by a number of factors. Among these are:

- The number of people whom the solution will affect and the degree to which they will benefit — the value of the solution;
- To what extent the solution of a problem enables other problems to be solved — its fruitfulness;
- The nature and quantity of work and resources required to solve the problem — the possibility of solution and the cost of solution;
- To what extent a new and better solution can bring improvements over prior solutions — the differential gain; etc.

In many cases nowadays, of course, the possibility of solutions, the cost of solutions, and the degree of improvement of a new solution over prior solutions, are greatly affected by the programmed computer.

In the segment of society called the computer field, a great deal of time, energy, and thought is nowadays going towards such problems as:

- The design of computers using integrated micro-circuits so that higher speeds and lower costs will be attained;
- The development of new and better computer programming languages so that more powerful methods for solving problems can be more easily used;
- The spreading of the use and application of computers into more and more organizations, so that the advantages of computers can be grasped in more and more organizations.

But in society there are much more important problems — and much harder to take hold of. One of these is the process for gathering data which the people of a society have for solving their problems. In other words, this is the problem of dealing with the stream of information and/or propaganda provided by newspapers, radio, television, etc. This problem is highlighted by such an example as the many flatly contradicting statements issued day by day by the government and the press in the U2 plane incident of May, 1960, and the Bay of Pigs incident of April, 1961.

Another of the great problems is that of food or starvation for tens of millions of human beings in the underdeveloped countries. This is highlighted by Snow's statement that a million inhabitants of India are expected to die of famine this spring.

Still another of the really important problems is the problem of the lack of control over nuclear weapons. These are now in the possession of at least five nations: the United States, the Soviet Union, Great Britain, France, and China. This problem is highlighted by the fact that the nuclear stockpiles of the United States and the Soviet Union are each sufficient to eliminate all human life in the Northern hemisphere.

Computer people, as we have said before, are essentially information engineers. They have hold of what Snow calls the most remarkable machine invented by man while on this earth. To gain the greatest value from our magical pearl of wisdom, we need to look at the engineering of information for human purposes in the broadest possible way. We need to see both big problems and small problems; we need to be able to tell the difference between them; and we need to devote solid work to the big problems — even if our only reward for a long time is abuse and punishment. We need perspective.

Edmund C. Berkeley
EDITOR

INTERNATIONAL COMPUTATION CENTRE — COMMENTS

C. Berge

The Director
International Computation Centre
Rome, E.U.R., Italy

I would like to thank you for your excellent and helpful editorial about ICC in "Computers and Automation." This was of great help to us and we have already received two letters and small donations from people who read your article.

I would also like to tell you that your book "The Computer Revolution" has been widely circulated among our students.

ANNUAL COMPUTER ART CONTEST

As in previous years, the front cover of the August issue of "Computers and Automation" will present the first prize in our annual computer art contest.

Any interesting and artistic drawing, design, or sketch made by a computer, analog or digital, is eligible. It should be provided if possible on white paper in black ink, so as to make a good reproduction; but this is not indispensable. The way in which the drawing was made by a computer should be explained. There are no formal entry requirements: any kind of letter submitting the design is acceptable.

Computer Art —
First Prize, August 1965

The deadline for receipt of entries to be considered in the contest is Friday, July 1, 1966.

THE JUNE ISSUE OF "COMPUTERS AND AUTOMATION": COMPUTER DIRECTORY AND BUYERS' GUIDE

The June issue of "Computers and Automation" is the annual Computer Directory and Buyers' Guide which we publish. This issue contains:

- Roster of Organizations in the Computer Field
- Roster of Products and Services: Buyers' Guide to the Computer Field
- A Special Roster of Electronic Computing and Data Processing Services
- A Special Roster of Consulting Services in the Electronic Computing and Data Processing Field
- A Special Roster of Software Suppliers
- Characteristics of General Purpose Digital Computers
- A Survey of General Purpose Analog Computers
- A Survey of Significant Special Purpose Computers
- A Roster of School, College and University Computer Centers
- A Roster of Computer Associations
- A Roster of Computer Users Groups
- A List of Over 1000 Applications of Electronic Computing and Data Processing Equipment

Subscribers of "Computers and Automation" are of two kinds: subscribers receiving the Directory, whose basic subscription rate is $15.00 a year; subscribers without the Directory, whose basic subscription rate is $7.50 a year. To tell which kind of a subscription our records show for you, look at your address label on the outside cover; if it has a *D, our records show that you receive the directory; if it has a *N, our records show that you do not receive the directory.

A nondirectory subscriber may become a directory subscriber by requesting the change and sending us $7.50 for the directory issue. The price of the directory issue to nonsubscribers is $12.00.

CORRECTION

In the February 1966 issue, on page 40, the story entitled "COMPUTERS BUILT INTO COMMUNITY HEALTH PROGRAM" was mistitled. It should have been entitled "COMPUTER SELECTS COLLEGES FOR HIGH SCHOOL STUDENTS."

Please correct your copy.

c & a
MARKET
REPORT

BURROUGHS ENTERS TWO IN THE THIRD...

Late last month Burroughs announced two new microcircuit computers as its latest offering in the third generation computer market. The two new processors, the B2500 and B3500, incorporate the key features of third generation computer equipment; i.e. (1) modularity, (2) compatibility, and (3) expansibility.

The new processors are described as first members of a B500 series, and it is expected that additional members of the new processor family may be announced soon.

The design philosophy of the B500 series seems similar to IBM System/360, but Burroughs President Ray W. McDonald insists that the new systems are "definitely not carbon copies" of systems being marketed by principal competitors. According to McDonald, "Our new systems provide a greater 'throughput' ratio and a higher degree of responsiveness than any competitive system series. We have proved this in our laboratories, and we will be proving it very clearly to customers when deliveries begin in about nine months."

The new processors are priced to compete in the small-to-medium-scale computer market, with workable configurations renting for $4500 to $20,000 a month.

The 2500 and 3500 offer a memory capacity ranging from 10,000 to 150,000 eight-bit bytes and a wide range of peripheral devices. The core-memory cycle time for the 2500 is 2 usecs. for each two bytes accessed. For the 3500 it is 1 usec. per two bytes. The overall performance of the 2500 is rated by Burroughs as between one to one and a half times that of the IBM 360/30 for a somewhat lower price. First delivery of the 2500 is scheduled for January, 1967, and for the 3500 in May, 1967.

Simultaneity All peripheral operations are independent of each other and of the central processor. Any combination of simultaneous input/output and processor operations is possible. Each peripheral device competes along with the processor for use of the core memory. Accesses are controlled by a priority system through a central controller. In the event of multiple access requests, the unit with the highest priority is granted access first. The hierarchy is established by simple field engineering adjustments.

Modularity Both the memory size and the number of input/output channels are expansible in small increments. For example, the memory of the B3500 is expansible from 10K to 150K characters; and the I/O channels can range from 1 to 20.

Address Memory A special "address memory" is used to increase the processing speed of the system. It is located within the central processor. It consists of an array of 24 words and is expansible in increments of 12 words to a maximum of 120 words. During execution, the processor addresses core memory with words from address memory, so that during the execution of an instruction, memory accesses are not required for information relative to the command itself. The time required to access a word from address memory is only 150 nanoseconds.

Peripheral Equipment A wide range of conventional peripheral equipment is offered with the B500. However, only the Burroughs disk file offers clear competitive advantage over currently available peripheral equipment from other manufacturers. The disk file provides online random access storage capacity of 10 million eight-bit characters and is expandable to up to 2.5 billion characters. With the one-head-per-track construction Burroughs has cut down average access time to only 20 milliseconds. This fast access time is coupled with a relatively high transfer rate of 275 thousand characters per second.

A new random access device called "system memory" is a single magnetic disk device capable of storing up to two million characters of information. The primary use of system memory is to house the software package and the user program library. Average access time is 17 msec.

Magnetic tape drives are provided with the system both for seven and nine channel tapes with transfer rates ranging from 36,000 to 144,000 characters per second and recording densitites up to 1600 bits per inch.

Software Successful sale of third-generation computer systems implies good software support. Because of the increasing shortage of competent personnel, computer users are becoming more heavily dependent on the software support provided by the manufacturers. Software has been traditionally one of the weak spots in the Burroughs product line; therefore it is with increased interest that one examines the software available with the B500 series.

The B500 offers both problem-oriented compiler languages and machine-oriented assembler languages. The problem-oriented languages include COBOL and FORTRAN. Two versions of the machine-oriented assembler languages are available, an Advanced Assembler and a Basic Assembler, both running under the control of a Master Control Program. (Burroughs has not announced any plans to develop a PL/I compiler for the new systems.) Thus, the software is heavily oriented toward the financial, banking and retail community.

Program Compatibility The two systems are fully program-compatible. The central processors also incorporate extremely fast read-only storage. This storage device is wired with interpretive routines which are executed at a 50 nanoseconds cycle time. These routines are called microprograms. The great advantage of microprograms is that various different routines may be wired in, allowing the "emulation" of other systems. This same technique is used by IBM in achieving compatibility between System/360 and 1400/7000 Series computers. Burroughs plans to use the emulation technique for both its own 200 and 300 Series systems and for the IBM 1401 Series machines. As such, they will have the only system offering a program conversion aid for the over 500 current users of their 200 and 300 series computers... thereby helping to insure customer loyalty.

Burroughs' Present Market Position During the last decade Burroughs has gained a foothold in selective computer markets, such as banking, the military and the government. Burroughs' current market position is the result of concentrated selling efforts in these markets. A breakdown by market category of the some $260 million worth of Burroughs commercial EDP systems currently installed is:

Finance, Insurance, Real Estate	33 %
Medical, Educational and Other Professional	16 %
Business and Other Non-Professional Service	13 %
Federal, State, City and Local Government	8 %
Other	30 %

The selective penetration and comparative success which Burroughs has achieved in these markets is due primarily to its line of peripheral equipment. The availability of special peripherals, such as MICR sorter readers and tape listers, are prerequisites for banking applications. Their two basic lines of central processors, the B-5000 line and the B-200 line have not been overly successful. However several times Burroughs has been able to revamp its line by repackaging returned machines and announcing them under new model numbers (e.g., returned B260/270/280's were introduced in 1964 under the model numbers B160/170/180). Also they have offered various price reductions to encourage the sale of their systems. These moves have effectively extended the revenue-producing life of their computer equipment.

Burroughs' Expected Market Position Burroughs expects its new systems to find wide use in on-line, real-time, and time-sharing operations such as automated inventory control and distribution systems, on-line bank systems, and management information systems.

Burroughs' President McDonald feels that while large corporations, research institutes, and some government agencies will continue to employ large scale systems, the greatest growth potential for computer usage in the next decade will be within the small to medium size businesses and financial institutions.

"Inexpensive, automated, data capturing-and-recording devices, that prepare computer input should make it possible for almost every business to afford the control that accurate, timely, and properly organized business data can provide." Despite this optimism, there does not seem much reason to expect that Burroughs will succeed in establishing a substantial market base outside of banking and service bureaus. Burroughs can continue to provide capable equipment for these special markets, offering good system know-how and competitive price/performance. By concentrating on these special markets Burroughs should be able to maintain its current overall market share of between 2.5-3.5 % in the years ahead.

We will be very surprised if the rest of the industry catches up with our new computer system in the next 5 years.

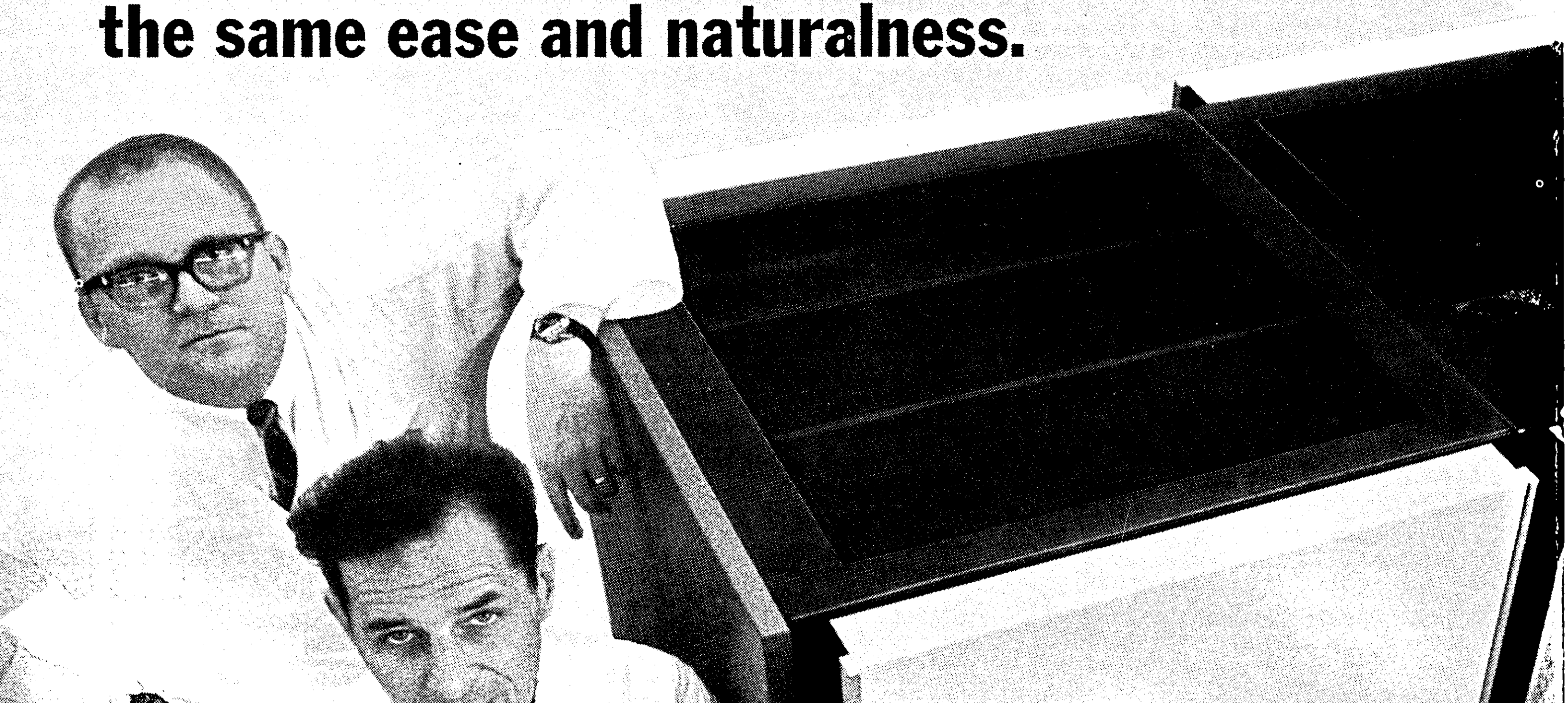
It is called Sigma 7.

It does time sharing in a real-time environment.

It is a totally integrated hardware and software package.

It was designed first of all to handle the heaviest demands of priority-interrupt processing—easily, simply, naturally.

Next it was designed to handle conversational time sharing, and all the tasks of science, engineering and business, concurrently, with the same ease and naturalness.

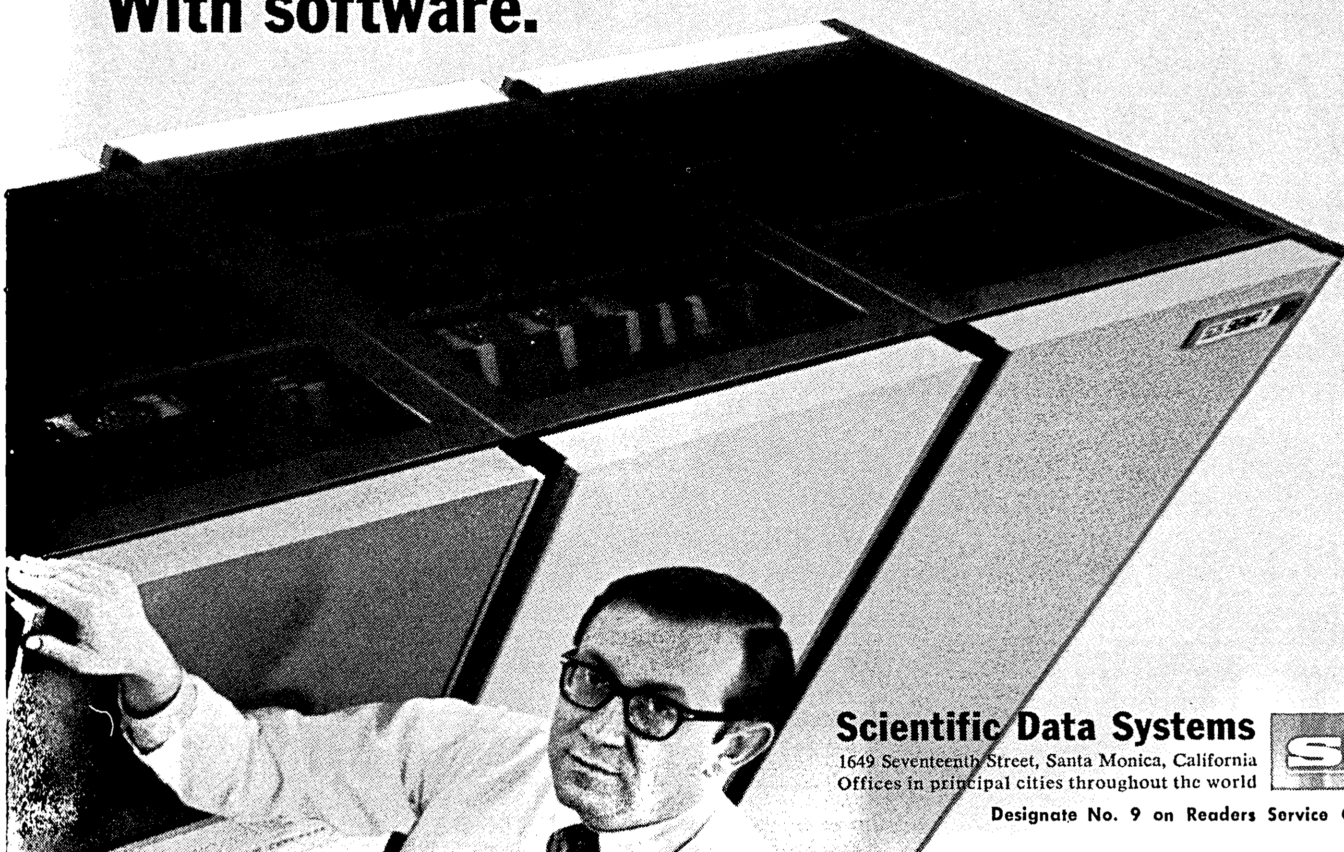


It can completely change its environment from one PL/I program to another in 6 microseconds, under the control of an operating system.

It can simultaneously perform real-time on-line control, time-shared conversation, batch processing, and high-speed input/output, with full protection for every user.

The only system on the market now that even tries to do what Sigma 7 does costs six times as much.

Deliveries will begin in six months. With software.



Scientific Data Systems
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SDS

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SCIENCE AND THE ADVANCED SOCIETY

C. P. Snow
Parliamentary Secretary
Ministry of Technology
British Government
London, England

"The computer is the most remarkable machine by far, yet made by man."

The subject of my talk tonight is "Science and the Advanced Society." By "science" I think everyone knows what I mean, and if you don't, I don't propose to define it now. "The Advanced Society" however, I think I should define. I mean by that, those parts of the world which have solved the purely brutal predicaments of our fellow human beings: societies which see that people get enough to eat, get somewhere to live, get some sort of medical attention, and can read. This, by our standard at the moment (and it's a poor standard) is what I mean by an advanced society.

At the moment, advanced societies exist only in just over one-third of the world: in the whole of North America; in nearly all of Europe (there are one or two pockets which I think one could not honestly say were advanced); in the Soviet Union; and in a few isolated enclaves in the rest of the world, like Australia, New Zealand, and so on. These are the advanced societies of our present world. They are doing pretty well, and the reason why they are doing well is perfectly simple. They are the countries which really did take on what for want of a better term we call the Industrial Revolution. They were the people who learned to make goods — through different histories, through different processes — but they all learned very much the same techniques in the end.

Food and Transformations

With different degrees of success they learned perhaps the most important trick of all, which is to grow enough food. Your country has been staggeringly successful in this last task. At the moment I think I am right in saying that 6% of Americans can grow more than enough for the whole of this gigantic country to eat and the real figure is probably nearer 3%.

This has transformed your society. It has meant you ceased to be an agricultural country long ago, because you can do this trick so easily.

You're soon going to cease to be a manufacturing country. The great industries in America are going to be services and education.

This has happened within a few years. To a lesser degree the same thing is true of all advanced societies. But it means that we are going to have our hands full of problems. I'm going to mention some of these in a moment or two, but I'd like to say that almost all that I'm going to say I've been discussing with my American colleagues like Harrison Brown, Lee DuBridge, Glenn Seaborg — all these excellent scientific administrators — and the astonishing thing is that we find ourselves completely in agreement. We can see at least what the problems are; and it seems to me, if we are in agreement, it is more than likely that there is something substantial in what we see.

The Industrial Revolution

The old Industrial Revolution was a messy affair. It started in my country, more or less by chance. You took it on very fast and fairly soon did it better. By about 1860 we who had thirty years start or more were, in fact, not producing as much as you were.

It worked. It worked in both countries. We also had certain advantages, both of us. It's a great advantage to have a commercial civilization preceding an industrial one. It teaches you to answer letters. It teaches you to do the rudimentary administrative work which all industrial societies require, although they can get by without it. So we were in fact very lucky. The Russians were rather less lucky because they had very little of this preliminary training in a commercial civilization.

I think the Chinese in due course will make a very good job of their Industrial Revolution simply because they have a tradition of high bureaucracy. There has been a very good Chinese civil service for about two thousand years, and two thousand years is a fair time. I would guess they'll do it extremely efficiently, but, of course, they're not there yet.

The Industrial Revolution had very little to do with science. It was mainly the work of ingenious craftsmen, people who could make things and didn't care much about the ideas upon which those things were made. Men like Henry Ford, who was not in any sense a scientist but had a very shrewd idea that you could make a motor car. There were many others, and almost the whole of at least the first phase of the Industrial Revolution was done by such persons.

The Scientific Revolution

But now, we are entering something extremely different.

(Based on a talk given at the Franklin Institute, Philadelphia, Pa., January 27, 1965)

We are entering a revolution, which in the view of myself and the friends I've just mentioned, is going to transcend anything which we have so far known. The rate of change, since about 1800, has been incomparably faster than anything men have known before. The rate of change between 1965 and 2000 will make the previous rate of change look like a tea party. Of this there is no doubt. We must be prepared for what this will do, both its desirable results, and its undesirable results.

Let me be perfectly clear. I have no doubt whatever that this revolution has to be done, and that by and large mankind will immensely benefit by what has to be done. I am not in the least pessimistic about the total social results of what we're walking into. But it's as well to clear one's head.

All great changes produce certain difficulties, and usually certain losses as well as great gains. I think we're all fairly sure, that the gains we're going to get are going to be accompanied by certain losses.

The Computer Revolution

The great instrument, which is immediately about to transform our lives, is the computer. The computer is not just a calculating machine. It's a source of information, of memory; an instrument which can collect information, settle it, keep it, store it, analyze it, and so on. It is by far the most remarkable kind of machine yet made by man.

I've heard, — this I don't believe, but I've heard it, — some ingenious physicists say that by the year 2000 we shall be able to make a computer which in *every* respect — in imagination, creative power, and so on — is better than any human brain yet existing. I don't believe this; but the fact that the claim can be made by sensible scientists, shows how remarkable these machines are, and, I think it's fair to say, how little we really know about them. We don't even understand yet their true nature.

We know that we can in theory make them so that they can reproduce themselves. This I find a slightly creepy thought. They're going to enter into the very texture of our lives, as no machines have ever done before. Within a short time none of you will ever write a check again.

Sometimes computers give rather surprising results, like the case of a simple housewife in England, whose income would be about $6,000 a year, who suddenly found from her bank that her credit balance was 2,300,000 pounds! At the moment computers can sometimes perform some rather nonsensical operations. But in fact computers are going to do all kinds of things which we can hardly envisage. All our payments, in and out, will be known. A great deal of the details of our personal lives will be open and at the service of a central government. They will make central government very much easier.

Submergence

This obviously has its disadvantages. The chief psychological disadvantage that I can see is that men may tend to feel that they're being submerged by the technological tide. We should be prepared for this. We should use every resource of social compassion to make sure that this doesn't happen.

In practical terms, a great many operations will be done by computers which are now being done by men. We've got to foresee this long before it happens. If we have the foresight and the technological skills, most of those practical effects — the non-psychological effects — can probably be at least mollified and, to some extent, wiped away.

Non-Work

But there is a long-term effect for which I see very little answer. It looks as though once you firmly establish a society advanced in this cybernetic way, then ten or perhaps twenty percent of the population will have to work extremely hard. Men of the whole managerial slice of society will have more tasks, more difficult and more complicated, than they've ever had before.

On the other hand, it seems to me inescapable that a large slice of the population, perhaps as much as 80%, will be underemployed, and will remain underemployed, so far as anyone can see, forever. I think they needn't be underemployed for the next hundred years or so; but in the long run, in a really advanced society, I can't see any easy way out from this. People will in fact cease to have an ethic based on work; they are bound to have an ethic based very largely on non-work.

This is worrying me, but it has great advantages. If I had to choose, I'd take it, because most men who ever lived, the overwhelming majority of our fellow human beings, have in fact lived lives which were short and hideous to contemplate; they worked from the cradle to the grave, with extraordinarily little compensation. This has been the ordinary lot of man from time immemorial. And so, therefore, to take that burden away is fine, and I'll settle for that.

Purpose

But I think, again, we have to be realistic. We have to remember that men and women want purpose in life. If you take purpose away, then you're likely to leave a state of boredom, ennui, a kind of feeling that society isn't theirs. This, I believe, is *ultimately* going to be the real problem for at least a certain part of the human race. They will feel, "fine, but what's it all for? What is the point?"

Here, again, I think we should be preparing now for this problem which is not immediate, but in this country it is not far away. If we get the rest of the world put to rights, the problem must ultimately come to the rest of the world also.

The absence of purpose is going to be one of the great psychological chores, a much greater psychological chore than anything that happened in the old Industrial Revolution which made the shape of the United States and of most of Europe.

The Biological Revolution

There is a second and probably a greater psychological burden. It has not yet been carefully thought out, though some of the problems of the cybernetic revolution have at least been sketched by a few of us. The biological revolution, so far as I know, has only been announced, and its consequences not yet imagined.

Recently, I heard Charles Price, of the University of Pennsylvania, say with his own authority, which is great, and with the authority of a great many of the chemists of the United States, that within a very short time we shall be making living cells, quite simple living cells, but, nevertheless,

Lord C. P. Snow, C.B.E., is the distinguished author of "The Two Cultures" and many other books. He is a scientist, educated at University College, Leicester, and Christ College, Cambridge, from which he received his Ph.D. He has held positions for many years in the government of Great Britain, often with particular concern for selecting and placing scientists.

life in the full sense. I find this more remarkable than anything which the physicists and engineers have done, it is something which is nearer the roots of our being, something which will be extremely hard for many persons to accommodate to, just that fact alone, without any practical applications.

There are practical applications also. As one of the two prongs of this extraordinary biological revolution, we now understand a good deal about the mechanism of heredity. It looks as if, not so immediately as the making of living cells, but within foreseeable time, we shall be able to control some of the mechanism of heredity. This, again, is something so dramatic that all the engineering triumphs of mankind will seem comparatively pale beside it.

This is not science fiction. This is the considered view of the best minds on this subject that I've been able to talk to. Once again I suspect that the total result will increase human good and not decrease it, although it is only fair to report that one of the best biologists in the world, an Australian called Macfarlane Burnet, said only a month ago, that this was something man ought not even to try to know. I can't agree with such a statement. I think that once you set that kind of limit, that our lives will become impossible. I think we have to try to know what we can know. But I am sure that that somber warning ought to be borne in mind by all of us, and ought to be borne in mind before the thing happens.

Warnings

A great many things have taken human beings unawares. There is no excuse whatever for these things to take us unawares. We've had heaps of warning. We've got, with the computers, two or three years before the full consequence is upon us. With the biological revolution we've got perhaps five to ten years before the secret is cracked. We ought to be thinking now with all the imagination of humane persons — sociologists, psychologists, anyone you like, any people of good will who wish well rather than ill to their fellowmen. This we've got to do; otherwise you'll get a great lack of belief that there is any worth in this life, among lots of persons in the community who have talent but aren't robust enough to face our life as it is going to develop.

There may be, as I say, an increasing lack of sense of purpose: what intellectuals of your country are fond of calling, alienation. I often think they call it alienation because they would like to have been country squires with large numbers of serfs, and they feel alienated from a society which doesn't make it easy for them to have that desirable result. They admire the peasant life having never seen a peasant in their lives. It would be very salutary for people who think of an 18th century society with happy, jocular peasants, actually to go and see happy, jocular peasants as they now exist in many places in this world.

Nevertheless, there may be an increase in the lack of human purpose, a lack of the purpose which gives salt to life. I suggest that for some time, for a hundred or two hundred years, there is no excuse for people to feel that they lack purpose. I've been talking exclusively for a while of advanced societies, of the rich countries, of countries that have had the historic luck.

The Poorer Countries

I want to draw your attention now to the rest of the world, the poorer countries, the countries which have not had historic luck; and so far as one can see, it is luck. There is very little else that can explain what has happened to us.

The world is divided into rich countries (the ones I've mentioned) and poor ones. The bitter fact is that the rich countries are getting richer and the poor countries are getting certainly relatively poorer and possibly absolutely poorer; and no one can see yet how this gap can be decreased. Curiously enough, to some extent within rich societies there is some sign of the same phenomenon; the gap in this country, I suspect, between the rich and the poor is not becoming any smaller. But that is a subsidiary problem which can be coped with by intelligent political management.

The other problem, the gap between the rich and the poor countries, seems to me by far the biggest social problem, not only of our generation, but of at least three or four generations to come.

It's extraordinarily hard for people born as lucky as you are, living in this immensely rich society, whatever its pockets, to understand even remotely what the life of two-thirds of your fellowmen is like. A friend of mine sitting next to me at an American dinner party in a very comfortable house said she had just been in an Asian town; she was active like most Americans, and she saw people lying absolutely still in the streets, not sleeping, not waking, waiting for heaven knows what. And she asked, in a good American way, "Why don't they move"? And her guide, who was himself Asian, said "The less they move, the less hungry they are."

Now this is so far from our experience, so far from anything we can even remotely come in contact with, that we don't speak the same emotional language as the majority of the human race.

If you want to hear this very sharply from someone of immense talent you should talk to one of the greatest of the world's mathematical physicists, Abdus Salam, who was born in a wretched Pakistani village as the son of a poor villager. He often says, even to people whom he'd regard to be of relatively good intentions, good heart, that: "Often when you speak to me, you chill the blood in my veins. You have no idea what our life is like and what the life of most people is like and will continue to be for as long as we can foresee."

I am thinking particularly of India, which is really the problem that is weighing heavily on us all. There seems to be no doubt that India is going to have a major famine within a few weeks and several million people will starve to death. Famine is a horrible thing.

I agree, of course, that there are certain exceptional societies. In the Fiji Islands, you've got a very jolly people who live comparatively simply, and live a fairly long time; they are well-fed, and extremely athletic. They do nothing but play games; I suppose this is fine. There are, of course, other intermediate societies.

But, when you're trying to produce a sort of shorthand account I think you've got to confine yourself to the gross and major aspects.

Medicine, including surgery, spreads much faster than food growing and incomparably faster than industry. Therefore, the actual length of life in countries like India, has gone up without any of the compensating things which we had when our Industrial Revolution was upon us, without being able to grow more food, make more goods, and so on.

Control of the population won't touch the situation during this extremely critical fifteen years. The children are already born, in fact. In all the poor countries of the world a fantastic proportion of the population, about 45%, is under age fifteen. This is because in fact medical science goes faster than either indusiry or food-growing. Therefore, we've got to cope with a giant immediate problem.

The world could support a very much larger population than it now has, probably three times as large or more. But there is clearly a limit Almost all societies in fact, even if not informed, do limit their population. I do not believe that overpopulation is as much a cardinal problem as some of the others. I fancy that once we get a relatively well-fed world, then you will find mysteriously that the population will level off.

One-Third Rich, Two-Thirds Poor

I cannot believe that the world can survive in peace, one-third rich and two-thirds poor. I simply do not believe it. I believe that this tension is the profound conflict of these days, and is being reflected in the events of this tumultuous century. People, once they get a little above the subsistence level, want much more; and it is right that they should want much more. I therefore believe, that all the rich countries (chiefly this one, but all of Europe) will have to get seriously to work if we want this world to be morally tolerable or even, in my view, practically viable at all.

As I said, this country can contrive to grow enough food for itself with probably the effort of two or three percent of the population. Some of the best calculations suggest that if we spend a few billion dollars, nothing like what we spend on space or on war, we could get the agriculture of these countries really going on their own terms. Then we might help them keep up, keep up only this subsistence level at which they are now existing. That is the best we can do by any contribution in terms of skilled agriculturalists and skilled equipment, and so on, for the poor of the world for fifteen years.

Then, if we're going to make them slightly better nourished, get them off the subsistence level, give them enough energy ultimately to cope with their own problems, it will need a contribution in actual kind, a contribution in terms of actual food. Again, the amounts involved don't seem to be out-of-question large. It would mean paying the farmers. It would mean some people working perhaps on the land who now don't work on the land. But it looks like a realistic prospect, that the 3% of your farmers who are now feeding the United States could in fact grow a bit more without much effort if they were paid for it. This, again, is not beyond question. And we have made the same calculations for Europe. It seems a perfectly feasible proposition.

If we do not cope with this task, then I'm afraid my view of the world will become very dark. I cannot see any conceivable solution for the world where we sit well-fed as though we were in a kind of fortress, heavily armed, trying to guard ourselves from the hordes outside. This is not tolerable, at least not tolerable to me, and I can't live like that. This is not a situation which a self-respecting human being should be placed in.

The Effects of Science

But I'm on the whole optimistic. We've been talking about science. Science is a future-directed activity. Optimism is in the very thread and cloth of science, because science has always had its eye on the future, has always progressed, and has always become better. Really, by and large, despite all the despairing half-intellectuals, its effect has been ultimately benevolent.

I believe we shall cope with this challenge. Challenge is a thing meant to be picked up and coped with. Despair is a vice and, hope, curiously enough, is a virtue. And we can do something.

The Solving of Problems

I sometimes ask myself, though, what will happen when we really have got some kind of social justice around the whole of this planet, when in fact everybody is living at a modest level, something like, say, North Italy today: not as well as you (that's very difficult), but something which is perfectly tolerable — North Italy or say Yugoslavia today. What happens then?

Now, will all men, having solved all the gross problems, all the problems we must solve if we're to think of ourselves as human at all — when people are no longer hungry, no longer short of medical attention, no longer seeing their children die, no longer illiterate — will they then succumb to boredom, ennui, all these things which in your literature are so strongly represented?

Well, it may be, but I would doubt it. I think in fact that men are much tougher than we think. The men of the future won't have our problems; that's clear. They'll have other problems. I believe in fact they will think our fears were slightly absurd, though they will probably have their own. There will be some of them who feel outside their society, because there have been some people in every age who feel outside their society. But the better spirits, the people who really know that man is a wild animal, that he is at his best when he is living in society — that he is a wild and beastly animal often, but has certain capacities for grace and certain aspirations — I believe they will say, "After all, we did it. We made these machines. We've solved these problems, and we're going to solve the others."

We came out of the caves, you know, about 12,000-13,000 years ago, perhaps. In the caves men painted pretty pictures. They were people like us, they looked rather like us, but life wasn't sweet. We've come a long way from the caves. We shall go a long way further. The thing to do is not to lose our nerve and to remember that we're all human.

THE AUTOMATED PROCESSING OF PEOPLE

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"The main train would never stop, thus solving a major acceleration-deceleration problem in people processing, nearly nonexistent with low-mass electrons in data processors."

Three years ago, a dozen of America's largest corporations entered into unintentional competition to design and build an automated people processor. Their prototypes — giant architectural mechanisms — were assembled at Flushing Meadows, New York and tested almost continuously over two years by the massive queuing of millions of people at their input terminals.

Not too curiously, one of the slowest automated processors of people was operated by the world's largest specialist in automated processors of data, while one of the fastest movers of people was built by the world's largest producer of human transport vehicles. But the most efficient and effective people processor of all was engineered by a concern experienced in using technology to "simulate" the movements of people in animated figures, images, and now, in full-scale robots: Walt Disney Enterprises. Even the impressive processor, GE's "Progressland," with its respectable input rate of a person per second, was unable to prevent peak period queues of thousands of people. But as sole survivor of the dismantling of the World's Fair, it is the undisputed winner of the competition, and will continue in operation at Disneyland.

The "Progressland" processor's pre-programmed instructions perform an entertainment operation upon the people being input, but its automated handling techniques are those of modern data processors: simultaneous, electronically synchronized routines, repeated upon "batches" of spectators in six adjacent sectors of a revolving people-storage disk. The I/O conversions between sequential and parallel handling of people (as individuals or as groups) is through input and output buffers — moving ramps, escalators, delay spirals and chambers, etc.

Automated Physical Transport of a Mass Population

Although uniquely spectacular, the moving "chairways," "people walls," "revolving auditoriums," and other World's Fair devices for controlling the movements of masses of people were simply surface indications of the inevitable application of automated process control to our basically necessary systems for the physical transport of a mass population: to rapid transit, air traffic, ocean and space-ship navigation, and even to our hundred million "personal" vehicles that currently criss-cross each others' paths in random abandon.

Just as the World's Fair's transportation exhibits were its largest, so is the automobile industry our nation's largest. The "motormania" of our auto-saturated populace (now approaching one motor vehicle per capita) is, of course, only our prevalent technology's implementation of a constant characteristic of civilized humanity. We must move about. We find it educational, essential, and entertaining. Only recently have we discovered that most low-level "intellectual" activities consist mainly of moving data rapidly and efficiently from one "address" to another. Complex data-processing routines are built upon this fact. But long ago we discovered, instinctively, that moving individuals into new physical relationships with one another and with their environment likewise initiates a wealth of higher-level operations.

A very random, slow "influx" of people builds a "neighborhood," with its back-fence chit-chat. Faster, loosely controlled, movement creates and disperses "crowds," with their simple emotional behavior. More selective transportation of individuals can convene an "audience" of similarly inclined minds. Highly deliberate manipulation of physical proximities within a large group will bring out either active "factions" or passive "cross-section" committees. "Teamwork" — actual bodily coordination of the movements of athletes or technicians — can produce results impossible for an individual alone. The forward movement of our society is probably quite literally related to our ability to move our society bodily — and will remain so until a future communications technology closes much of the practical gap between long-distance and face-to-face human interactions.

Merging Communication and Transportation

Such a "merger," in effect, of communications and transportation has captured the human imagination repeatedly. Instant "transmission" of people from place to place, bit by bit, was foretold in a "Lights Out" radio thriller in the B.C. era (Before Computers). Unfortunately, in that tale, a "programming" error reassembled the villain's mind in the hero's body. The wheel's invention set civilization slowly into motion, but we have since produced actual means of transportation approaching our dreams of genie-powered teleportation and Jules Verne trips around, into, and out of this world. Our astronauts make it around the world in

80-plus minutes (and a programming error displaces splash-down by 100 miles instead of scrambling their brains). Tomorrow's rapid-transit traveller is promised 400 mph trains and 2000 mph jets.

The probably pointless shuffling of people, twice a day, from here to there (and back again) is often attacked as modern society's most conspicuous down-to-earth "accomplishment," and our crash space program its most costly man-to-moon "lunacy." Unless more philosophic (and sedentary) minds can make us stop spinning our collective wheels — rather unlikely — we will no doubt push on toward the stars in multi-billion dollar spaceships that will, at last, let us travel unendingly, throughout a lifetime.

Manual Control

Until now, virtually all travel has been individual; the processing of people has been under the "manual control" of each person. Departure times, direction, speed, and path all have been largely uncoordinated. Full freedom of individual movement has been, in fact, so basic that detention from it is our traditional social punishment. Our sprawling network of highways alongside our withering passenger railroads paint only too clear a picture of obstinate determination of a hundred million individuals to preserve personal freedom of movement — even if it means our rolling 3000 pounds of steel and chrome everywhere each of us goes.

But, as in the automation of less "personal' technological systems, we must soon reluctantly relinquish manual control — even of our own bodies, at least in transit systems,[1] to the automated mode: first, because the computer now makes feasible automated passenger processing systems of unprecedented safety, speed, economy and efficiency, and second, because our existing transportation systems are simply collapsing, one by one, from age and overcapacity.

Street Traffic Bottlenecks

Street congestion pushed surface traffic onto "elevateds" and into subways even before mass production began clogging city intersections with cars. Automatic signal lights cleared these spot bottlenecks a bit, but created cross-town obstacle courses. Expressways did away with the signal light hurdles but produced blocks-wide jams at their flooded terminals, as downtown parking became impossible. Finally, within the last decade, our explosive dispersal to the suburbs has caused the familiar daily commuting crush that produces occasional 100-car collisions and regularly reduces several cities' "free"-ways to impromptu parking lots.[2] Their municipal traffic systems have, in effect, collapsed. A bit belatedly, Detroit and Chicago have set up experiments in expressway traffic flow control by electronic sensors and automated entrance ramp feeder displays (see Ref. 8). Toronto is placing its thousands of traffic signals under centralized computer control. And San Francisco has begun a massive automated rail transit development to offset peak-hour auto commuting (see Ref. 14).

Partial control systems had become, almost abruptly, too meager for air traffic even sooner than for surface systems. In the late 1950's, Washington's municipal airport had become so saturated under traditional coordination of flight patterns that circling for landing often took longer than the cross-country flight itself. Automated air-traffic control (ATC) has become a high priority research area. Its initial contributions, plus a switchover to high-capacity jets, automation of flight-reservation systems, and nationwide construction of huge new airports (some with moving walkways, mobile boarding lounges, and even automated departure displays) have relieved, at least temporarily, the main pressures upon this particular form of people processing. Long-range research has already produced completely automated take-off and landing devices (see Ref. 11) and concepts such as integrated flight-path control from space satellites.

Local emergencies in mass car and rail transit are now being compounded by related breakdowns in water and power supply systems strained by the same explosion of suburban populations. The early winter dusk demands of uncoordinated commuter traffic on elevators, subways, and street lights superimposed on normal lighting and heating have been prime factors in creating conditions vulnerable to "black-outs" in metropolitan London and the Northeast U.S. The millions of autos have also been charged with air pollution, of course, and the near annihilaton of municipal street transit and regional passenger rail systems.

Applied Research

Clearly, these crises now suggest serious applied research into the automated movement of people. Half-hearted preliminaries are past: the repainting of the same old public transit vehicles in bright colors, "shopper buses" and downtown "malls." Greyhound has pointedly ignored commuters in its offer to "Leave the Driving to Us," leaving Hertz to "Put *You* in the Driver's Seat" for urban driving. Desperation is now forcing the first steps, previously dismissed as radical or expensive, toward automated, integrated city-transportation control. Naturally, initial efforts have dealt with automobiles, from which neither the populace nor its politicians will be easily pried.

Flow Pattern

The bare beginning, if people in cars are to be processed like digital information in a computer, is to impose a basic pattern upon the flow of vehicles along common paths and through intersections. Such organization is introdued into computing by central timing pulses. Toronto has already centrally integrated the timing of a 1000-intersection signal network through a Univac 1107. Sperry is designing for Manhattan a $5.4 million electronic traffic "gating" system in which 11 Univac 413 computers will coordinate flow through 1200 intersections, and through an additional 1500 outlying points on key feeder arteries. Sixty intersections in San Jose, California are being placed under IBM 1710 control through feedback to its internal traffic model from 400 magnetic sensors buried at critical flow points.

Speed Control

A second step is to automate traffic flow rate — to equalize vehicle speeds. Besides increasing capacity, there is a safety bonus in elimination of passing and lane-switching maneuvers. On a 3.2 mile test section of Lodge

Dr. Packer's academic background is in human communications theory and mass education (B.A., Yale; M.A., S.M.U.; Ph.D., Univ. of Minn.). His experience includes television direction for both commercial and educational stations and training systems engineering for General Dynamics and Bunker-Ramo. The automation problems in mass transit are one facet of his current interest in the human/computer interface in systems designed for mass use.

[1]A briefly popular ballad of the 1950's related the plight of being lost in the complexities of the MTA, Boston's mass transit system: ". . . he never returned; his fate is still unlearned."

[2]On December 30, 1963, Boston experienced a total traffic standstill, city-wide, for five solid hours. (See "Getting to Work and Back," Ref. 6)

Expressway in Detroit, 21 overhead signs display speed "recommendations" for each of three outgoing traffic lanes. A human monitor of 14 closed-circuit TV cameras spaced along the roadway can input 55, 40, or 25 mph displays at a central switcher. He can close any lane involved in an accident by flashing a red "X" above it. Control Data Corporation is automating this system, as an element in the National Proving Ground for Freeway Surveillance Control, by programming computer direction of new traffic entry ramp displays.

Traffic Density Control

Control of traffic density, through input ramp closure is being tried on four miles of Eisenhower Expressway in Chicago, where automated density counts were begun in late 1962. Feedback signals, now installed on west-bound entry ramps, are metered to turn from green to yellow when expressway density climbs near congestion rates, and then to red when the ramp is closed to further traffic input. A human operator must still activate the ramp closure routine at a warning from the processor. This Chicago experimental hardware comes from General Signal, Automatic Signal, RCA, General Electric, and Honeywell. Three-fourths of the project's $1.5 million funding is Federal. With similar stimulus, automated traffic control is being attempted in Atlanta, Cincinnati, Syracuse, and Houston, and in England, Spain, Germany and Australia. Computers will shortly control the basic auto traffic pulsing of many cities.

Automation would next advance to the regulation of spacing between vehicles, to direct road tracking, and finally to programmed lane switching through vehicular requests for entrance or exit. This means automated acceleration, braking, steering and integrated entry/exit addressing. RCA and General Motors have been collaborating for several years, at David Sarnoff Research Center in Princeton, on an experimental electronic system to implement such an automated expressway concept within 10 to 15 years. At an added road-building cost of only 5% to 7% lane guidance cables and detection loops would be buried in the roadway and paired with electronic sensor/transmitter controls at 20-foot roadside intervals, dividing the road, in effect, into digital blocks. The input to a control unit in each car from the control units of successive blocks through which it passes would regulate the vehicle in relation to feedback from other automobiles in adjacent digital blocks. Roads to be engineered to this concept, GM calls "Autolines."

Automated Roadway

Westinghouse's early research took a different slant. Its "Roller Road," concept while accepting the near impossibility of separating people from their personal cars, circumvents the difficult interface between individually powered vehicles and the automated roadway by replacing the 20-foot electronic blocks with individually-powered rubber rollers every 20 feet. Over these, flat-bottomed carriers would ferry 10 cars each (packed sideways) along 3000-mile, computer-controlled roller-ways at 150 mph between major cities. Passengers would ride in a separate compartment and loading would be done hydraulically under computer control.

The compatibility of this trunkline concept with use of 100 million existing motor vehicles is foreshadowed in the success of modules for freight processing being piggy-backed on ships and rails. But the mass transport of bulky, empty private cars simply for the convenience of their owners is straining economics a bit, ignoring the universal availability of rental cars (at ever-falling rates) and dismissing human factors analysis. Human behavior is not that inflexible. The first season of B&O rail-ferrying of family cars from Chicago to Washington attracted only a few dozen drivers away from turnpike tolls and fatigue. The multi-passenger price of a rail ticket for their car deterred any mass switchover to passenger piggy-backing.

Commercial truckers would undoubtedly hand manual control of their vans over to an automated inter-city truckway or rollerway (if their salaries were unaffected). But the private driver will probably submit graciously in the long run, not to a usurping of his car's controls by automation,[3] but to the sensible alternative of leaving behind, for pleasure driving, his ego-boosting powerbuggy, and commuting or travelling "light" (i.e., his own compact body only) for economy and ease of movement into and out of congested civilization or over great distances. With this in mind, researchers have turned their full attention recently to the automation of mass transit systems.

San Francisco Automated Transit

The politics of public versus private transit funding are happily outside immediate discussion. San Francisco was the first area to somehow have the motorists of its major suburbs vote bonds for an automated comuter transit system, to be in full operation by 1971. BART (Bay Area Rapid Transit) construction will cost $1 billion. Additional R&D funds are from Washington, and operational revenue will come from fares and subsidy from the Bay Bridge's auto tolls. Details are impressive (See references 1, 12, 13 & 14), but the real significance is in the competition that will determine a practical overall system, already underway on the Diablo Test Track, 4.5 miles between Concord and Walnut Creek. Four computer-assisted systems are being tried: G.E., Westinghouse, General Railway Signal, and Westinghouse Air Brake. The concepts of the last two are advanced conventional track-circuit controls. G.E. has designed a decentralized "guided radar" system with small processors on each train. Westinghouse uses a central Prodac 500 computer, preprogrammed for scheduling all trains, with real-time inputs from a Prodac 50 computer that monitors actual positions, speeds and accelerations of each train via a "wiggly wire" along the tracks. A control unit at each station transmits digital information conforming to a stored speed-distance profile for that section of the track, to each train with the section. The requirements for the acceptable automatic control system are impressive: slowing, starting, door control and maintenance of train separations at 80 mph, and at 90 second service intervals. Trains must stop within six inches of a given spot.

In addition, automated fare collection is to be incorporated. Three teams have devised competitive hardware: FMC Corp/Control Data will soon test theirs at two Cleveland transit stations. G.E. will test at its meter department in New Hampshire; and Advanced Data Systems will further test, in Los Angeles, a system it has worked with in London. One concept is of a cash-purchased multi-trip ticket whose magnetically encoded value is decremented upon insertion in entry/exit pairs of gates. In the design of this important interface between passenger and system, small points are significant. Conveying the ticket, while being scanned, through the turnstile to allow passenger retrieval

[3]The usually sophisticated Cornell Aeronautical Labs recommended last spring that any transition to "automatic guidance" of autos be attempted first with mechanical devices — in deference to "a general lack of public confidence in the reliability of electronic devices." Past inadequacies of mechanical TV and data processing techniques should be enough warning against the futility and danger of mechanical shuffling of people about at high speeds.

without breaking stride has helped prevent rush hour queues in trials. Automated route displays are also being designed. Should San Francisco succeed, several similar water-blocked commuter areas are ready to follow: Philaelphia-Camden and Washington, D.C. bottlenecks, for example, maximize mass transit benefits. Los Angeles, nearing the end of its freeway spree, would also like to turn to mass transit.

Public Acceptance and Use

The unmanned Grand Central Shuttle has been run in New York since 1962, but neither it nor BART's advanced technology are sufficient alone for mass transit success. The sociology behind its public acceptance and *use* is crucial. The automobile has been declared "still in the ascendancy" in one official's opinion: "Every driver wants rapid transit — because he hopes it will remove the driver in front of him." Monorails, the early cure-all, lost favor because of switching awkwardness and high initial cost. But automation of traditional subways has begun in Stockholm where "automatic pilots" receive centrally integrated instructions. And Montreal announced, in the fall, a $1.1 million contract to Westinghouse Air Brake for automation of a 48-car "Expo Express" capable of handling 30,000 visitors per hour to its 1967 World Exhibition.

Westinghouse is aggressively promoting an interim "skybus" expressway for urban public transport in Pittsburgh-sized cities. Unlike the earlier "elevateds," the electric buses would roll quietly on pneumatic tires along relatively inexpensive concrete tracks. The system would ultimately be under complete computer control: track-mounted communications wires would alow computer direction to be continuous, with emergency stopping if a vehicle goes 100 milliseconds without computer information (See reference 17). M.I.T.'s exploratory study of "Northeast Corridor" transit problems is being used by the new Department of Urban Affairs to initiate major feasibility research on the 400 mph rapid transit system between Boston and Washington.

The developmental engineering of a turbine-driven train that "flies" through an underground tube (Ref. 7) is irresistible — as are exotic designs for VTOL and hover craft, a 700 passenger plane, an English Channel tunnel, a 2000 mph jet, etc. But each of these exotic engineering projects only adds to the dilemma of moving masses of people from front door to millions of different destinations conveniently. A 400 mph train is unlikely to make many local stops. Schemes are being devised for automated pick-up and drop-off of "pods" at the front and rear of high speed trains as they bypass parallel station strips. The main train would never stop, thus solving a major acceleration-deceleration problem in people processing, nearly non-existent with low-mass electrons in data processors.

Collection and Dispersal

There remains the problem of efficient collection and dispersal at these local interfaces with the exotic system (See ref. 16). Prediction is for greater use of small commuting/shopping vehicles; first, special rental cars and "minibuses," then credit-card actuated "slot-machine autos," and finally inexpensive electric "urbmobiles" rechargeable at parking meters and so universally available as to be treated, within a community, like shopping carts at present supermarket plazas. A monthly utility charge would cover their use, along with local power and water billings.

Increased attention to automating all transit facilities may bring radical departures in design of "accessory" systems: parking, elevators, escalators, walkways. Convenience to private autos has already changed hotels to motels, department stores to shopping malls, parking lots to high-rise automated garages.[4] Future elevator/escalator mergers may deliver a passenger, vertically and horizontally, to a specific skyscraper office, just as data is addressed in a core stack. Audiences may be guided to reserved seats by an analog driven overhead "automated usher" whose spotlight pinpoints the seat whose number it scanned on a magnetically-coded ticket stub. Moving walkways may funnel spectators into and out of jammed sports arenas and subway stations at centrally integrated rates responsive to the schedule of events or trains.

More "Usable" Lifetime

As the human passenger is relieved of constant attention to steering, spacing, switching, etc. — and as his trip becomes technologically smoother and less distracting, automation will hand us a bonus that sounds as remote to today's preoccupied participant in the commuter crush as jet travel would have sounded to a Wells Fargo stage driver: automated transportation will give us back a major fraction of our usable lifetime, now wasted in just "getting about."

Radio has survived TV mainly by salvaging, for millions of drivers chained to a steering wheel, some portion of a daily hour or so otherwise lost entirely. Ford now offers stereo tapedecks as optional equipment. Airlines serve meals and show movies. Philadelphia is flirting with offering its morning and evening rail commuters electric shavers and plastic-packaged cocktails (respectively). Only a near-millionaire can now afford five days of relaxation aboard a transatlantic liner in place of a jet flight which (with time zone losses) doesn't even allow shirking of an hour of one's work day. Automation, however, may provide each of us brief intervals of in-transit time for socializing, reading and recreation — and simultaneously eliminate the frenzied urge we now feel to "hurry up and get there."

Data, which is ironically indifferent to delays, can be processed in nanoseconds. But a shuttle service can never be a shift register. The key to successful people processing may, in fact, lie in tailoring the time for a trip to routine human activities, not in speed and more speed. By creating for each passenger a little world in which he can "accomplish," in transit, something personal and unrelated to the process of travelling, the actual transit time becomes of minor psychological importance. After all, when we come to the end of a day well satisfied, it is with the living we did in the preceding 24 hours, not with having traversed some 20,000 miles in a circle to arrive back at where we started.

Alice and the White Queen had to run just to stay in the same spot, but people would very much prefer the reverse — to sit comfortably still while moving rapidly forward. Computers are already dispatching subway trains, manipulating auto registrations, and routing trucks and buses across the country. It is not surprising that they will soon be chauffering us around: perhaps not in a big black limousine with telephone and TV, nor in the past grandeur of a private railway car, but at least in an efficient style that will make travel once again a pleasure.

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[4]Macy's has just built a circular multi-storied store in Queens where one can park adjacent to any desired department sector via a continuously enveloping ramp.

(Please turn to page 58)

THE HUMANITIES AND THE COMPUTER: SOME CURRENT RESEARCH PROBLEMS

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The reasons we are on a higher imaginative level than the Nineteenth Century is not because we have finer imagination, but because we have better instruments, which have put thought on a new level.
— Alfred North Whitehead

Within the past dozen years or so, the computer has made itself felt in every aspect of our society. One hundred years ago, it was the Industrial Revolution which wrought profound changes in the economic and social fabric of the western world. Today there is an upheaval of comparable force and significance in the so-called Computer Revolution. Putting the steam engine on wheels is analogous to making the computer accessible to a large number of people simultaneously at remote locations by means of typewriter consoles and visual devices.

Principal Advantages

Let us consider for a moment the principal advantages of the computer to humanistic scholarship in general.

Its incredible speed allows a scholar to accomplish in a short time what would otherwise take him a whole lifetime of drudgery to accomplish. The computer shortens what Ephraim Vogel has termed the "vision actuality interval" which exists in every field of intellectual endeavor; that is, the time-interval between a scholar's original idea or plan of action and its ultimate fulfillment in tangible terms. In the humanities, this time lag is distressingly long.

The computer's storage or memory constitutes an infinitely more reliable respository than the mind of the proverbial absent-minded professor. Indeed, once entries of any sort are reduced to machine-readable form, the computer can arrange this information in any number of ways, finding correlations that human brain-power would have missed.

The computer's great accuracy is completely dependable, even when untold mountains of statistical data require handling. Once the data has been checked for accuracy before being placed in storage, it will remain so with total recall.

And finally, the computer's automatic operation is not subject to the vagaries of human fatigue, interruption, or mood. Speed, memory and accuracy remain constant.

Saving of Time on Chores

To the humanist, I would suggest the most important of these advantages is the immense saving of time gained by the use of computers. It is useful to remind ourselves that the *Oxford English Dictionary* took some 80 years to complete with several generations of editors. Jakob and Wilhelm Grimms' monumental *Deutsches Wörterbuch* began to appear in 1854 and wasn't completed until 1960. Similarly, the manual indexing of the complete works of Thomas Aquinas (approximately 13 million words) would take 50 scholars 40 years to accomplish, but thanks to the computer, the total time required by a few scholars working mainly in Italy was less than one year. A concordance to the Revised Standard Version of the Bible was produced on a high-speed computer within a period of several months; this compares with the King James Version Concordance of the last century which took 54 scholars 10 years to accomplish. The deciphering of the Mayan hieroglyphic script by Russian mathematicians, we are told, took only 40 hours of computer time; human beings would have needed thousands of man-years to accomplish this. All this leads to the inevitable conclusion that there are a number of scholarly tasks — call them the more tedious clerical chores, if you will — that in this age demand the use of the computer. Certainly, one can no longer think of concordances, dictionaries, or projects involving masses of statistical data and numerous cross-correlations without bringing into play the tools of data processing. Thus, the computer's power can be harnessed to relieve scholars in the humanities of some of their most burdensome activity while at the same time providing their research with the benefits of greater speed and accuracy.

Unsuspected Meanings

A second major advantage is that the computer is frequently able to bring to light hitherto unsuspected relationships or meanings from the raw data on file. When descriptions of the orbits of 566 comets accurately tracked were fed into a computer in order to test the generally accepted theory that the orbits are randomly distributed, the results showed that the orbits were clustered around a single axis like the petals of an artichoke. Similarly, various puzzle canons composed by Johann Sebastian Bach were fed into a computer. In these usually two-voiced pieces, in which both voices must have the same melody, Bach wrote out only one voice, and the solver of the puzzle had to find the spot where the second voice enters, whether the time-value is different, whether the original melody must be inverted or retrograded, and whether it must start on the same note as the original. The computer came up with the previous solutions to the puzzle canons worked out 100 years ago — and some new ones as well!

Suspicion, Fear, and Ignorance

Unfortunately there is a great deal of suspicion, fear, and ignorance on the part of the humanist concerning the computer and its legitimate role in scholarship. This is no doubt part of the larger view that an overweening science and technology have conspired to form a monstrous ideology that threatens man's human existence. Some see the machine as eventually making decisions that man himself should make. Others find sinister implications in every technological advance, maintaining the attitude that science and the humanities don't mix. Finally, there are those who, ignorant of mathematics, fear they are totally and forever incapable of comprehending the computer and therefore dismiss it. Although no one would suggest burning at the stake the maker of a computerized concordance, as was almost the fate of the first person to make a complete concordance of the English Bible in 1544, the computer-oriented humanist does face some formidable opposition.

Ironically, while the impact of the computer may be compared to the influence of the Industrial Revolution one hundred years ago, there is also an analogous reaction among many highly-placed scholars to so-called computer-oriented humanistic research. Not that any misguided intellectual will physically attack "the dark Satanic mills," as did their Luddite ancestors. Nevertheless, there are those who, knowing little of the computer's advantages of limitations, damn the machine as not only useless but dangerous to the world of scholarship, as their ancestors inveighed against the railroads with their coal, iron and steam. One conservative scholar sent a computer-oriented friend a postcard with the message, "On an IBM machine you commit greater ironies than you discover!" Then there is the academician who places no value on the scholar's time, who dismisses data processing while pleading for more funds to allow for someone to be completely free for years in order to do the necessary clerical work. One professor said that, "If you have to use a computer to answer a question, it is not a question which I would care to put." Fortunately for the humanities, things are changing rapidly.

Let me now dismiss the negative position and turn to some representative computer applications within various humanistic disciplines which demonstrate beyond any doubt the role of this new device as an important and productive tool of scholarship.

Archeological Analysis

In the field of archeology, for example, the computer is becoming invaluable in studies of shards or fragments of artifacts found in the diggings of ruins. Two very basic problems are classifying shards as to their cultural provenance and reconstructing whole artifacts from broken fragments. Jesse D. Jennings, an archeologist from the University of Utah, has a collection of some 2,600 shards, each of which has 50 attributes each. Obviously, this represents an astronomical number of comparisons to make by hand, and yet for a computer it is a relatively simple task.

Similarly, Mr. Dee F. Green, Director of the University of Missouri Museum, no doubt following the maxim that pottery is "the alphabet of archeology," developed a code for reducing the individual attributes of some 4000-odd pottery vessels from burial lots in Arkansas to a numerical system for computer handling. Once the material was classified, the various attributes can be sorted into discrete categories and then statistical techniques applied to lump the attributes into statistically meaningful groups, or ceramic types.

As can readily be seen, such projects as these involving many thousands of artifacts, each with numerous attributes, as well as the dozens of correlations between them, really demand the use of computers to handle the sheer mass of information and to derive really meaningful results therefrom.

History

Historians have been facing a new impetus for the application of social science research techniques to the analysis of historical political data.

One of the earliest historical studies that used data processing was the study of Massachusetts shipping during the early Colonial period made by Professor Bernard Bailyn of Harvard University. Faced with the problem of sketching a realistic picture of the subject, he came upon a perfectly preserved shipping record for an eighteen-year period containing information not only about the vessels registered but about the owners as well; in other words, material of early American social and economic history. Bailyn not only summarized and tabulated this data in comprehensive fashion but used the opportunity to assess realistically the possibilities of applying machine techniques to historical material and to explore the problems of procedure.

The shipping register in question consisted of 1696 entries, each giving information about a vessel and the people who held shares in it. A total of 4725 punched cards were produced which contained all the information available in the register on the ships and their owners. Codes were developed not only for the purely quantitative data but for such qualitative information as names of people and places, vessel types, occupations, building sites, etc. Although numerous problems were encountered along the way, it is significant that Bailyn's book closes with the statement that only with these tools and techniques was the analysis of the register possible at all.

The American Historical Association has set up an ad hoc Committee on the Collection of Basic Quantitative Data of American Political History under the chairmanship of Professor Lee Benson. Election statistics on presidential campaigns from all counties in the United States from 1824 to the present, roll-call votes during each Congressional session since 1789, data on Federal court cases, and census and ecological information are all being computerized. Further material awaiting such attention exists in the fields of

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agriculture, business statistics, industry, religion, economic, social, and cultural data, foreign trade, employment, tax data, and housing. The amount of such unpublished information available is staggering. For but one year in American history, the U. S. Census Bureau Catalog includes over 5000 computer tape reels of data in the above-mentioned fields. One wonders, indeed, how many other fertile fields of information await the computer-oriented humanist scholar!

Content Analysis

Another research project involves content analysis by means of the computer. Professors Robert North and Ole Holsti of Stanford University are analyzing the origins of World War I by means of computer techniques for scanning and reporting the appearance of themes and relationships in a large body of historical material pertaining to decision-making during the 1914 crisis. "Communication is at the heart of civilization," but since students of international relations are considerably more restricted in access to data than most social scientists — direct access to foreign policy leaders is severely restricted — one method is to measure their attitudes, values, and assessments by means of a computer-produced content analysis of political documents at times of crisis. For carrying on further research, North and Holsti have constructed a dictionary of 3521 critical words and proper names, such as *abdicate, abolish, accept,* and *armaments,* and *Gromyko, Soviet Union* and *Communist.* These words are sought out in historical documents, and changes in style are noted as the historical crisis grows in severity in terms of verbal affectiveness, strength or weakness, and activity or passivity. By this means we can explore, for example, the relationship between the level of East-West antagonism and the degree of cohesion between the Soviet Union and China.

Word Indexes

Certainly the most well-known use of computers in the field of literature is the construction of word indexes. Briefly, there are two forms: first, a simple alphabetical listing of text showing the frequency or location of the words or both; and second, a textual concordance showing all the words of a given literary work not only alphabetically but in context as well. In this form, each word appears as many times as there are words within the parameter arbitrarily chosen for it along with the relevant passages of which it is a part. Such a concordance is not only of immense value to a literary scholar from the point of view of time saved, but is useful also to those in other disciplines employing literature as source material. For example, concordances to the poetry of American authors have been issued since 1959 by the Cornell University Press under the general editorship of Prof. Stephen Parrish. In the case of the poems of William Butler Yeats, an alphabetical index of all significant words was constructed, each word shown in the line or lines of verse in which it occurs. Opposite each line is given the line number, abbreviated title of the poem, and the page number on which the line occurs in the particular edition of Yeats. An appendix to the concordance lists all indexed words in order of frequency and gives their frequencies. So-called concordance-generator programs are widespread. Today, certainly, there is no justification for scholars spending years in manual indexing as was the fate of their Victorian predecessors.

Textual Analysis

However, it is in the area of textual analysis that computer-oriented research in literature shows exceptional and exciting promise for the future. The massive comparison of text where there are several or even dozens of sources presents an almost insurmountable problem for the scholar. To compare in complete detail as few as 40 manuscripts might take the better part of a lifetime. It is this type of activity that cries for the use of data processing techniques.

Perhaps the first such effort was the study by Professors Mosteller and Wallace at Harvard University, and actually continuing over a period of years, to solve the authorship question of 12 disputed Federalist Papers. Briefly, literary styles of Madison and Hamilton were identified, then matched with the style of each of the disputed papers. Having found such factors as sentence length, vocabulary and spelling to be of no help (the two authors were remarkably alike), it turned out that differences in the use of so-called key function words — particularly those of high frequency such as *from, to, by, upon, also,* and *because* — served to pin down authorship of the papers in question. From a number of computations, Mosteller and Wallace found that most of the disputed documents were written by James Madison.

Professor William Givson of New York University is directing "Project Occult," an acronym for Ordered Collation by Computer of Unprepared Literary Texts. He and his collaborators wrote a workable computer program for the collation of varying texts and the production of a readable print-out. Using the final section of Henry James' short novel, *Daisy Miller* in an early and late version (the latter heavily revised), Flexowriter paper tapes of the two texts were prepared. The computer program found and identified by number the sentences which were the same or similar in both versions. A print-out indicated either by code or actual words or punctuation the degree of identity, sentence-by-sentence.

Style Analysis

Mrs. Sally Sedelow of Saint Louis University has described the use of the computer for a rigorous description and analysis of pattern attributes of text. She makes the observation that while colleagues in linguistics have been making major contributions to such fields as machine translations and information retrieval — and in return, gaining important insights into the structure of language — those in literature have offered very little and gained very little. The aim of such studies is to discover the differences between writers' styles and to shed light on the changes of an individual author's style over a period of time. Known as "computational stylistics," these techniques deal with the parameters of literary style in terms of its constituent elements: rhythm, texture, and form.

Musical Structure

Musicologists, while perhaps overshadowed by their musician-colleagues who let the computer "compose" music or use it to fashion new sounds, have nevertheless been very active at the forefront of scholarly data processing. Over fifteen years ago, for example, Professor Bertram H. Bronson at Berkeley used computer techniques in an analysis of the structure of folk-songs. By means of punched cards, he coded the important elements of folk-tunes, including range, modal characteristcs, prevailing time-signature, number of phrases, the nature or pattern of refrains, final cadences, and so forth. By this means, an entire corpus of folk song material can be recorded both fully and accurately. The various elements can then be analyzed for statistical patterns, comparisons, or indeed subjected to any other query consistent with the data.

A computer can also serve to test hypotheses through simulation and models. Dr. Allen Forte of Yale University is applying machine analysis to help provide insights regarding the structure of the atonal music of Arnold Schonberg. The anatomy of a so-called pre-twelve-tone (or non-tonal) music is still somewhat of a mystery. Mr. Forte has found the traditional non-machine forms of analyses lacking and has stated that a structural description of this music would be virtually impossible without the aid of a computer. If I understand the outline of his program, first, he is formulating a basic working theoretical hypothesis based upon linguistic and mathematical models for musical structure; second, he is developing an analytical method to explore his ideas by means of the computer; and finally he will test the result. Harry B. Lincoln of Harpur College is using the techniques of information retrieval to compile a catalog of musical incipits (that is, brief melodic quotations of the first six to eight notes of a composition), of the entire body of 16th Century Italian *frottole,* a known body of some 600 polyphonic compositions. Since the possible permutations and combinations of the beginning notes of such pieces are almost infinite, both as to pitch and rhythm, such brief quotations represent unique identifications of the compositions from which they are taken. First the incipit is translated into alpha-numerical form by means of a code which can activate a photon printer. This is a device with a high-speed rotating disk containing about 1400 characters (in this case, musical), a light source, lens, and photographic film. This code consists of *even* numbers for the spaces, *odd* numbers for the lines of the musical stave, an *H* for a half note, a *W* for a quarter note, and so forth. One punched aperture card with a 35 mm photograph of the particular score set in the right-hand side holds information such as the composer, title, voice part, accession or serial number. The second card contains the proper sequence of notes representing the incipit coded for the photon device. When computerized, this code causes the printer to raise or lower its focus to the proper line or space and, when the correct note or other symbol is in place, shoot a beam of light through the proper aperture in the disk exposing the film at that time with the desired musical symbol. At the same time, a computer program extracts from this coded information the intervalic order or melodic profile of the particular incipit. This, then, can be compared to other musical sources for instances of borrowings by one composer from another, or from other works of the composer himself. All this suggests that new technologies, coupled with computer-oriented research, will open up an added dimension to humanistic scholarship.

Immediate Needs

What are the immediate needs?

- Courses in computers and programming tailored to the specific requirements of the humanities and using examples from these various disciplines;
- A manual or textbook explaining the achievements and potentialities of data processing in the humanities, presenting in non-technical language the fundamentals of computer science, and defining the scholarly tasks which can be greatly speeded up by computers;
- A professional society with its own journal devoted to computer-oriented research and to disseminating information about current projects and special computer programs;
- Creative computer-oriented professors on the faculty of every large humanities department and humanistically-oriented personnel in university computer centers; and finally,
- Fellowships and scholarships for dissertations and research involving the use of the computer as a tool.

The Information Explosion

One final problem: How can we handle the "information explosion" which is spreading rapidly from the sciences to the humanities? Knowledge is doubling every ten years, and scholarly journals are proliferating at the rate of over three per day. How can we integrate and disseminate this continually growing mass of information? Following the lead of the social sciences and their National Council on Social Science Data Archives, the humanities sorely needs a planning, policy-making and information-disseminating organization for establishing, maintaining and coordinating data archives in the several disciplines. Who is aware, as of this moment, of all the computer programs useful in humanistic research, or indeed where tapes are available containing masses of data or texts in machine-readable form? The Library of Congress, for example, set up a National Referral Center for Science and Technology which collects data on information sources and makes it available to scientists. In addition, the Smithsonian Institution has a Science Information Exchange which receives notices of current research projects from scholars. About 70,000 notices arrive each year and are stored on computer tapes for retrieval.

It is worth noting that 95 per cent of inquiring scientists knew nothing of investigators working elsewhere on the same problem.

The Computer and the Humanities

In a lecture at M.I.T., entitled, "The Computer in the University," the prediction was made that in a few years the computer will have settled immutably into our thought as an absolutely essential part of any university program in the physical, psychological, and economic sciences. On the basis of what I have said, I think the time has come to amend that statement to include the humanities. Furthermore, within a short time, I believe a knowledge of data processing will become part of the "common baggage" of research tools and techniques required of every graduate student in the liberal arts. I am even tempted to go a step further and state that with the increasing number of courses in programming being offered at our universities the time may come when some students in the humanities may be as fluent in programming as in writing English composition. Certainly, the computer is fast becoming an important and indispensable research tool for faculty and students alike.

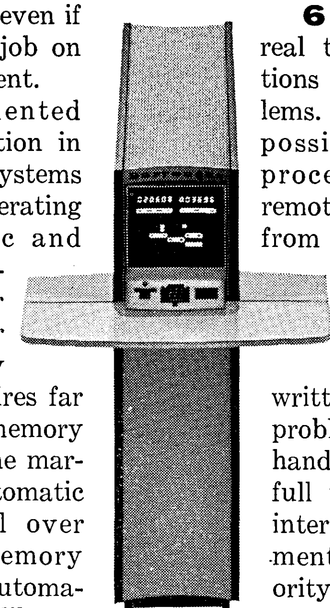
The value of such an acquaintanceship can be seen in the case of a professor of art history and archeology at an eastern college. Describing himself as probably the man on campus "least likely to benefit from a computer," he took a short summer course at the college computer center. Later, in reporting on the instruction, he said:

> "The course profoundly affected the thinking of all of us. This is the important thing — much more important than the machine itself. Of course, we know that it is the brains behind the machine that make these miracles possible. Nonetheless, it is a weapon of such power that all intelligent men and women everywhere should know the kind of things it can do. Once we know that, we can devise ways to make use of it.

Let us, therefore, see the computer as a means of liberation, freeing the humanist scholar from the time-consuming operations of the past, a tool rapidly providing him with proliferating resources in the form of statistics, collations, print-outs, cross-references, frequency-counts and hypothetical models upon which he may build a research of new dimensions and complexity. Viewed in this light, it is a device the potentialities and applications of which we cannot afford to ignore.

1 Extremely fast hardware speeds, with multimillion digit-per-second data transfers and control memories that operate in billionths of a second.

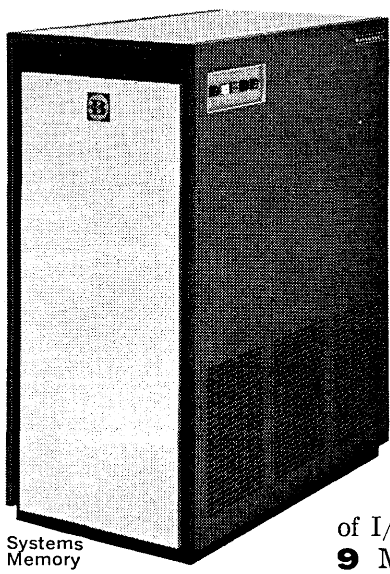
2 The ability to do many unrelated jobs at once (multiprocessing)—and to continue doing them without interruption even if you drop in a rush job on the spur of the moment.



Central Processor

3 An unprecedented degree of self-regulation in low-cost computer systems via a choice of two operating systems: the Basic and Master Control Programs. The Master Control Program, for example, not only does more, but requires far less resident core memory than any other on the market. It provides automatic scheduling, control over multiprocessing, memory and I/O allocation, automatic maintenance of a library of programs and data, program selection and initiation, error correction functions, interrupt handling, maintenance of the system log, and much more.

4 Programing that's so simple it can be started by one programmer and continued by another—or divided up and then integrated by the operating system. Since the housekeeping details are taken over by the operating system, the programmer is free to concentrate on the problem, not on the machine.



Systems Memory

5 Higher level programming languages (COBOL and Fortran) which save time and money. They improve supervision by facilitating review and control of programs and by demanding standardized documentation. They improve communication by removing the "machine language curtain" between those who understand the problem and those who understand the computer.

6 A special suitability to real time, data communications and time sharing problems. With the B 3500, it is possible, for example, to process order-entry from remote locations *and* compile from remote locations *and* execute major production runs at the computer site—all at once. Yet every program is written solely to solve the problem it was assigned to handle. Automatic interrupt, full memory protection, an interval timer, program segmentation, automatic priority scheduling and other features combine to provide quick response to a wide variety of simultaneous demands, with no interference between jobs.

7 The ability to accommodate the fastest random access disk file on the market. Operating speed of this already fast device may now be multiplied by simultaneous use through up to four I/O Channels.

8 From 4 to 20 I/O channels (all of which may be active simultaneously and still leave ample time free for computation) plus multiplexers and exchanges that allow great flexibility and simultaneity of I/O operations.

9 Monolithic integrated circuit design which produces greater speed and reliability and reduces size and costs. The B 2500 and B 3500 make use of two proven concepts in the very forefront of this development: complementary transistor logic and array monolithics.

10 Emulators which make it simple and quick to convert from our B 200/B 300 systems or from 1401, 1440, or 1460 systems. These conversion aids make your old programs immediately usable on the faster, more powerful B 2500 and B 3500.

11 A *responsiveness* to change in all aspects of computer use—from a change in the number of peripheral units to a change in program priorities. From a switch of card to tape or from random access to real time. And under MCP control, when you add new components,

Magnetic Tape Cluster

more memory, more I/O capacity, or upgrade from a B 2500 to a B 3500—anything short of changing the basic method of processing data—*absolutely no reprograming is necessary*. Change on these systems is economical, quick, and orderly.

The B 2500 and B 3500 share in one other important characteristic. They are both products of Burroughs acknowledged excellence in electronic data processing.

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The Tower of Babel Revisited

It is high time that data processing terminology and argot be refined, defined, and straightened out. It is somewhat frightening to notice the many terms and acronyms which are used today without uniformity and with confusion. In addition, the number of new terms which the industry sprouts appears to rival the number of new computer installations — some 6,000 per year.

If we try to categorize this confusion, we find it in three important areas:

1 — In basic terms, used in day-to-day communication among data processing personnel,
2 — In advanced terms, used among the elite few, who may be embarrassed to admit their lack of understanding,
3 — In acronyms, used to abbreviate both of the above, which replace confusion with lack of understanding.

Consider some of the basic terms. One of the most obvious examples is the name of the industry. "Data Processing" is generic, all-encompassing; "Automatic Data Processing" (ADP) survives mainly in Washington; "Electronic Data Processing" (EDP) may be used to describe an equipment manufacturer's representative (as in "EDP salesman"); "Information Processing" is more sophisticated; "Information Handling" is broader; "Automation" is not acceptable to organized labor.

More confusion is apparent among basic technical terms, where definition is more important. Consider the process which describes pictorially the flow of a system, or the flow of a program. For this, a profusion of terms exists, each almost completely interchangeable with the other:

block diagram		detailed
flow chart		semi-detailed
process chart		macro
flow diagram	Modified	micro
block chart	By	"big picture"
logic chart		program
logical flow chart		systems
program chart		overall
system chart		

The U. S. Government Glossary, published by the Bureau of the Budget, does not help, since all of these terms appear. (Since this Glossary spells programming and diagramming with a single 'm', it may not become the national authority.)

If a choice for a standard here is desired, the following is suggested:

block diagram	— to depict the logic of a *program*
flow chart	— to show the flow of a *system*
process chart	— to show the flow of a series of manual processes
macro	— to indicate the total program or total system
micro	— to indicate an *element* of the total

Confusion among the "advanced" terms is also obvious, and discouraging to persons newly in data processing. Consider the following terms, and try to define them, if you can:

real-time
on-line
multi-programming
multi-processing
time-sharing
software

These are popular terms; yet there is no uniform understanding of their meaning. If, for example, two programs are in memory simultaneously (presumably multi-programming, but often confused with multi-processing) and one is on-line on a real-time basis, and the other is a time-sharing system, what is the total system called? I suppose the answer is software.

Some acronyms which pun, confuse, or distract at the expense of meaning include:

BEST (NCR Business Equipment Systems Technique);
ARE (Advanced Real-Time Executive);
BASIC (Beginners' All-Purpose Symbolic Instruction Code);
TO (Trade-Off);
OF (Old-Fashioned);
MAD (Michigan Algorithmic Dialect);
THUGS (Two Hundred User Group, Southeast).

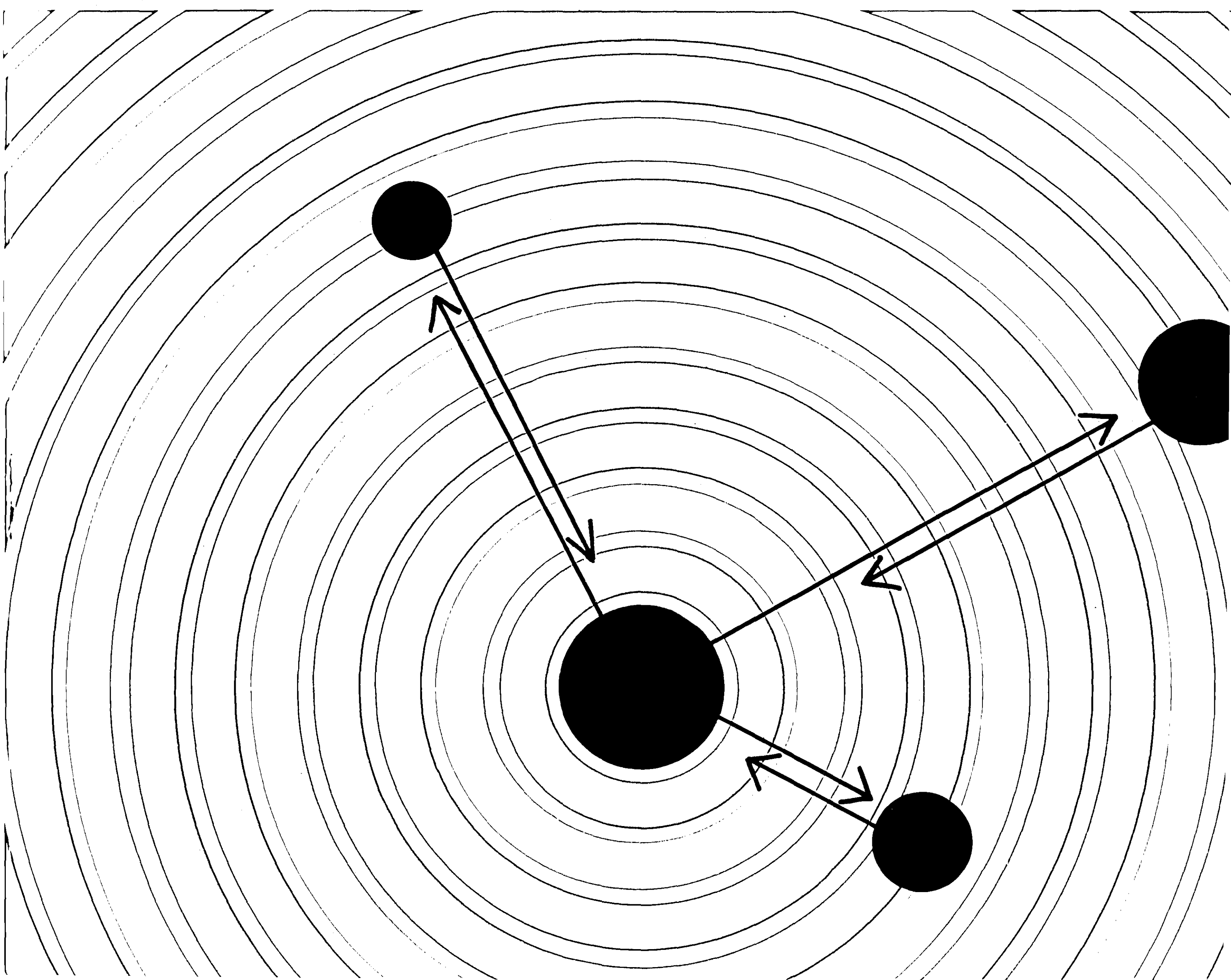
One of the tasks which joint computer conferences, data processing management meetings, and similar associations and councils could well take on, is cutting down the rank growth of these weeds. Well-selected terms clearly defined and some informal joint promotion of their use might make a big contribution to understanding and education.

Dick H. Brandon
Contributing Editor

One of a series on topics of importance to data processing management

Honeywell report on Data Communication

Managements across the country are combining the talents of the computer with modern communication techniques to achieve more efficient operations, improved use of corporate resources, tighter control and coordination of operating elements, and faster response to transactions. However, these benefits, and the potential cost savings associated with them, can come only to those managements that have carefully evaluated the response requirements of their data processing operations and have made these major considerations in the choice of a data communication system. This report indicates opportunities for effective and economical data communication, discusses requirements for an "on-time" system, and summarizes the equipment and services available to Honeywell Series 200 users.



DATA COMMUNICATION ADDS REACH TO YOUR COMPUTER

The ability of a data communication system to link computers, or to extend the power of a central computer to remote locations, has tremendous potential for business, industry and government. More specifically, some of the basic functions or activities that are benefitting from this capability are:

1. Customer Order Entry — where the nature of the product or the market necessitates immediate response as to order status.
2. Control of Irreversible Transactions — where complex analyses of information to support such actions as the granting of loans and credit are required for management decisions.
3. Data Collection — where volume, tendency for human error, and extent of processing require greater discipline in collection methods.
4. Control of Interdependent Operations — where involved and complex operations such as job scheduling and production control can benefit from faster exchange and processing of data.
5. File Interrogation — where dynamically changing information such as stock price quotations must be constantly available for quick decision.
6. Customer Service — where response to customer queries within limited waiting time is desired, as in a hospital admission or savings bank system.
7. Information Retrieval — where provision for high-speed insertion, deletion, and access to large volumes of textual material is a requirement.

Although each of these application areas is distinguished by its particular response requirements, there is an "on-time" attribute common to all. "On-time" in one instance may mean instantaneously, or in real time. In another case "on-time" might well be within an hour, a day, or even a week. Since the cost of a system increases rapidly as the response time of the system decreases, the "on-time" requirement of an application becomes an important economic consideration.

THE ON-TIME SYSTEM

A significant feature of the communication-based on-time system is that it places a heavy demand on the computer manufacturer to provide system elements which can function in a wide range of on-time situations. The following sampling of Honeywell data communication applications indicates the flexibility that can be achieved when a product line is geared to this design goal.

☐ A large distributor handles 3,000 orders per day on an inventory of 20,000 items by linking two Honeywell computers at the home office to several warehouses via teletypewriter. Upon receipt of a warehouse order, the computer runs a credit check, computes quantity, brand, size, and price, and transmits the totalled invoice back to the warehouse in only minutes.

☐ A large manufacturer uses a Honeywell computer to control message switching for a nation-wide network of 100 teletypewriter stations concurrently with data processing. The computer receives the message from the sending station, stores it, and forwards it to the receiving station upon availability of an outgoing line.

☐ A racing association system uses two Honeywell computers which, in conjunction with ticket-issuing machines, record all types of pari-mutuel bets and compute odds and payoffs instantaneously.

☐ A Honeywell system handles some 300,000 inquiries per day for a national credit bureau. All credit inquiries are answered within 24 hours.

☐ A trucking firm uses a Honeywell data communication system in which several freight terminals can be linked with the home office. Among other things, the computer calculates charges and transmits final freight bills to the destination terminal before the arrival of the trucks.

☐ A telephone company uses a matched pair of Honeywell computers to provide long-distance operators with split-second voice response to their queries on rate information. The system handles 5,000 inquiries per hour from operators throughout a five-state region. Formerly, it took operators using a rate book 45 seconds or longer to determine the rates.

HARNESSING TWO TECHNOLOGIES

The foregoing examples illustrate the diversity of applications and organizations now using data communication. This diversity will multiply in the near future as data communication developments continue to occur at a rapid pace. Already, central processors have made significant advances in their ability to control large-scale inquiry, data collection and message-switching systems. A greater range of more economical and sophisticated terminals is appearing in the marketplace. Systems design is maturing as evidenced, for example, by more efficient joint voice-data use of telephone services. Communications facilities, services and tariffs offer more flexibility than ever before.

Since the computer is the hub of the data communication system, it is up to the computer manufacturer to provide facilities that will fully exploit the systems design flexibility offered by proliferating developments in communications technology.

DIMENSIONAL DATA COMMUNICATION

Dimensional data communication is one facet of the "dimensional data processing" concept underlying the design of Honeywell Series 200 systems. Under this concept, Series 200 capabilities are available in small increments making it possible to tailor a Series 200 system to meet both the functional and capacity requirements of a user's job. He needn't be saddled with oversized and costly capabilities which he does not need. Furthermore as his workload increases, capabilities can be added or expanded, gradually and economically. Inasmuch as data communications involve both a computer and communications facilities, here's how the dimensional concept applies to both of these.

COMMUNICATION FACILITIES

Most of the elements in a communication system — such as terminals, data sets, and communication lines — are available in a wide variety of types and capabilities and thus offer ample flexibility for precisely tailored systems, initially and as the user grows. However, in order for a computer to communicate over a particular line and with a particular terminal, the computer manufacturer must provide a communication interface designed to handle that specific line-terminal combination. The interface is therefore the key to flexibility and the cornerstone to economical systems design. The greater the variety of communication facilities that the computer can handle, the greater the chances for a system of optimum design.

Honeywell Series 200 systems are available with a full range of communication interfaces providing an extremely broad selection of line-terminal combinations (see accompanying table). Furthermore, the number as well as the variety of lines and terminals that can be combined in a single system are sufficient to fill the requirements of any application.

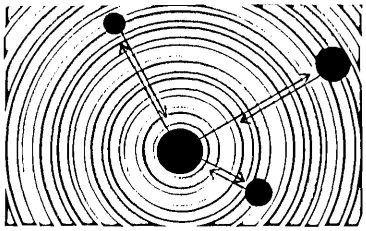
The Series 200 interface capability includes both single-line and multiline communication controls. Both controls are available with either character-by-character or message modes of operation. The single-line controls can send and receive data at the high speeds available through TELPAK, and still faster units can be provided on special order. The multiline controls can handle transmissions over as many as 63 lines simultaneously. It can accept varied combinations of remote terminals and can handle lines with speeds up to 300 characters per second and a total of 7,000 characters per second for all lines, a rate exceeding the requirements even of high-volume, 63-line message-switching systems.

In addition to the wide range of non-Honeywell devices that it can accommodate, Honeywell's Series 200 includes its own excellent terminals. These include CRT display devices and the Data Station, a multipurpose remote terminal. The Data Station features several optional capabilities including direct keyboarding, printing, card reading, paper tape reading and punching, and optical bar code reading — a unique capability for on-line or off-line handling of returnable documents such as insurance premiums and utility bills.

A Partial Listing of Communication Facilities That Can be Incorporated in a Honeywell Series 200 System

Terminal	Service & Line	Data Set	Transmission Speed
DATASPEED[1] 2	Voice-Grade Private Line DDD	202D 202C	105 cps
DATASPEED[1] 5 RECEIVERS	Voice-Grade Private Line DDD	402C	75 cps
DATASPEED[1] 5 SEND UNITS	Voice-Grade Private Line DDD	402D	75 cps
DIGITRONICS DIAL-O-VERTER[2]	Voice-Grade Private Line DDD	202D 202C	150 cps
DIGITRONICS TYPE 1 DIAL-O-VERTER[2]	Voice-Grade Private Line DDD	201B 201A	300 cps 250 cps
FRIDEN COLLECTADATA[3] 30	Voice-Grade Private Line DDD	103F 103A	30 cps
Honeywell Series 200 Computer[4]	Voice-Grade Private Line DDD	201B 201A	300 cps 250 cps
	Telpak A 48 KC Broad-Band Channel	301B	5100 cps
Honeywell Data Station	Voice-Grade Private Line DDD	202D 202C	120 cps
IBM 1050	W. U. 180 Baud Tel. Co. 150 Baud Voice-Grade Private Line	1181.1A 816 103F	14.8 cps
	Tel. Co. TWX-CE Tel. Co. DDD	103A 103A	14.8 cps
IBM Standard STR Series (7702, 1013, 1009, etc.)	Voice-Grade Private Line DDD	202D 202C	150 cps
	Voice-Grade Private Line DDD	201B 201A	300 cps 250 cps
TTY 15, 19, 28	5-Level TTY Circuit	— —	60, 66, 75, or 100 wpm
TTY 33, 35[5]	TWX TWX-CE Tel. Co. 150 Baud DDD	811B 103A 816 103A	100 wpm
TTY 33, 35, 37 Model 1	Voice-Grade Private Line W. U. 180 Baud	103F 1181.1A	100 wpm
UNIVAC 1004/DLT2	Voice-Grade Private Line DDD	201B 201A	300 cps 250 cps
UNIVAC 1004/DLT2B	Telpak A 48 KC Broad-Band Channel	301B	5100 cps
W.U. TELEX	W. U. Telex	W. U. Adapter	66 wpm

[1]Trademark of American Telephone and Telegraph Co.
[2]Trademark of Digitronics Corp.
[3]Trademark of Friden, Inc.
[4]This capability handled by single-line control only
[5]This capability handled by multiline control only



HONEYWELL REPORT ON DATA COMMUNICATION

THE COMPUTER

All Series 200 processors are program compatible. This and the fact that Series 200 encompasses a variety of input/output devices, all of which are available in many levels of capability, enable the user to tailor his system to the exact dimensions of his data communication job.

As an example of the Series 200's modularity, memory for the Model 200 starts at 4K characters and can be enlarged in 4K increments up to 32K and, from there, in increments of 8K up to 65K characters. Similarly, memory cycle times in the Series 200 start at 3 microseconds per character, then drop to 2, 1.5, 1, 188 nanoseconds, and 94 nanoseconds. Hence, the appropriate processor speed and memory size can be selected to meet both conventional and communication loads.

A unique input/output scheme and a hardware interrupt capability enable Series 200 systems to handle communications while *simultaneously* providing high production rates on conventional data processing applications. All Series 200 systems can handle multiple input/output data transfers simultaneously with computing; thus, they can send and receive messages over communication lines at the same time that input/output devices engaged in regular production runs are running at high speeds.

Series 200 also offers a wide range of peripheral capabilities for both real time and batched processing needs. There are 13 magnetic tape units ranging in data transfer rates from 7,200 characters per second to 96,000 characters per second. Honeywell's new Mass Memory File is available in three models, offering a range of on-line storage capacities up to 2.4 billion characters per control unit and random access times as low as 95 milliseconds. For faster access when storage requirements are less, a control/drum subsystem holding up to 20-million characters provides access to any record in an average time of 27.5 milliseconds.

A full complement of software is provided to handle communications for any type of application. This software includes those routines for interrupt handling, real-time input analysis, output stacking, random access storage, line utilization and determination of line availability, and data protection. All communication software may perform in conjunction with Series 200 Operating Systems.

MAKE YOUR OWN COMPARISON

The following table lists important characteristics in a data communication system. Honeywell's capabilities can be compared with those of any other system by filling in the appropriate data in the blank column provided.

Check List of Data Communication Features	Honeywell	Other
CENTRAL PROCESSOR		
Simultaneous production and communications?	Yes	
I/O interrupt?	Yes	
Memory protection features?	Yes	
Program compatibility for backup?	Yes	
Small-unit modularity?	Yes	
INTERFACE		
Single- and multiline interfaces?	Yes	
No. of lines per multiline interface?	Up to 63	
Character and message modes?	Yes	
Maximum line speeds: Single-line	5100 cps*	
Multiline	300/7,000 cps	
Gradually expandable line-handling capability?	Yes	
Automatic switching for backup?	Yes	
SOFTWARE		
Communication-handling routines for:		
Interrupt?	Yes	
Real-time input analysis?	Yes	
Output stacking and interfacing?	Yes	
Random access storage and retrieval?	Yes	
Line status?	Yes	
Data protection?	Yes	
Choice of operating system control?	Yes	

*Higher speeds on special order

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Honeywell

ELECTRONIC DATA PROCESSING

c & a

CAPITAL REPORT

A Special Report from C&A's Washington Correspondent

The management of computers in the Federal Government has taken a step up with the creation of a new ADP (automatic data processing) Management Branch in the Bureau of the Budget. Named to head the new Branch is Joseph F. Cunningham, former associate director of data automation at Air Force Headquarters in the Pentagon and a seasoned hand in Government computer circles.

The new ADP Management Branch, one of the first concrete results of passage of the Brooks Bill, has four specific duties:

1. To provide direction and guidance to Government agencies in their management of data processing, and to evaluate their efforts.
2. To construct a Government-wide information system on data processing equipment. This will be a big expansion of the old annual computer inventory.
3. To push standardization of data elements and codes among Federal agencies. Here Cunningham's extensive work with CODASYL, the Conferon Data Systems Languages, should be a definite asset.
4. To promote the advanced design of data processing systems, including the integration of systems on an intra-agency and inter-agency basis.

In addition to Cunningham, the staff of the ADP Branch includes J. P. Kingston, Clark R. Renninger, Fred J. Svec, and John L. Little. Its nucleus came from the former group of computer experts that functioned out of the limelight in the Budget Bureau for so many years. This group worked under William Gill, who retired from Government service at the end of 1965 and is now a consultant in Washington.

State governments generally lag behind the Federal Government in adopting some form of central management of data processing equipment and operation, according to a report issued jointly by the Council of State Governments and the Public Administration Service.

Of the 31 states taking part in a survey of computer operations, only 11 said they had legislative or executive directives dealing with the organization or role of a central data processing service. This is in contrast to the Federal Government's 1965 computer legislation, which gave the National Bureau of Standards responsibility for establishing computer centers and computer sharing, and with the many Budget Bureau directives issued since computers first entered Government service.

California leads all other states in the number of computers in use. Out of a total of 216 computers in all reporting states, it had 30. This figure does not include those on state university and college campuses. California has found 797 separate applications for its 30 computers. Looking at all states, the most popular areas for computer use are education, highway engineering, and administration.

Copies of the report can be obtained for $5.00 each from the Public Administration Service, 1313 East 60th St., Chicago, Ill.

Defense Secretary McNamara's "planning-programming-budgeting" system is being adopted by civilian agencies, and one of the long-range results should be the automation of some part of the budget process. A few years ago a study group concluded that the Library of Congress could not be automated completely, and this may be true of the budget; but even if it were proved conclusively that all of the budget could be automated, barriers would be raised in Washington to such an attempt, because the yearly review of the budget in appropriation hearings is the basic form of communication between Congress and the Executive agencies. It is not likely that Congress would want these conversations to cease.

On the other hand, the automation of an agency's budget before it is presented to Congress seems to be finding favor. In February, the Pentagon announced that Bunker-Ramo Corporation is automating part of the Army's $11 billion budget. Lt. Col. Richard Wormer, chief of the Army's Data Processing Systems Branch, said this automation will be arrived at by assigning an order of importance to the Army's various missions. Then funds will be allocated to the projects according to this order.

"The end result," Wormer said, "will be a more efficient, effective, responsive, economical system designed to free the various managers of details so that they can better exercise their imagination and creativity."

James Titus

JAMES TITUS

USING A COMPUTER TO DESIGN A COMPUTER

Kathe Jacoby and Armand R. Laliberté
Philco Corp.
Subsidiary of Ford Motor Co.
Willow Grove, Pa.

As the computer industry has become more competitive, design and production methods which reduce the lead time from functional specification to deliverable unit become increasingly important. Industry is more and more turning to the computers themselves as useful tools for automating the design of new computers. It is the purpose of this article to explain and give evidence supporting the use of computers to design computers, which we shall call "design automation."

Design Automation

Design automation is the use of computers in the design and production of new computers. When a computer is designed, the process is usually as follows: a functional specification, a type of circuitry, and a type of packaging are decided upon. The registers and their interconnecting gates are generally specified by a block diagram. The instructions may be described by flow charts describing the action of the elements of the block diagram. Alternatively, the instructions may be described by equations. While the block diagram is usually generated first, it is modified by feedback during the definition of the instructions. Once this system logic is complete, the detailed logic is defined always acccording to the rules required by the circuits and, in many cases, by the packaging. The form this design takes is a matter of preference but is most likely to be in the form of either equations or logical diagrams. It may be in the form of relationships between building blocks that are considerably larger than simple Boolean functions. Whatever the logic building blocks may be, they must next be translated into physical building blocks. This assignment is referred to as "placement". Design automation programs may perform some or all of the placement.

Once the logic building blocks have been assigned to physical blocks, the nodes (pins) that should be electrically common can be connected. Most current packaging techniques effect these connections via backboard wiring. A set of direct wire segments between nodes is selected by algorithms that depend upon circuit and packaging constraints and that try to achieve optimization according to criteria similar or identical to those for placement. If point-to-point wiring is used, the wiring net is completely defined. Otherwise, either a fixed path is computed for each segment, or a suitable path is routed if buildup of wire or crosstalk are problems. The documents required by production and test departments can be generated at this time. Also if production techniques include automatic or semi-automatic machines for wiring and/or testing*, the design automation system should include the programs for generating the appropriate input media for this equipment. After a design is complete, it is likely to be changed due either to design errors or to new features added to a design. At this time, all documents must be updated. Computers have proved themselves to be economically justified as an aid to many of these tasks.

Consistency

Design automation can enforce consistency in several ways. If the design programs derive placement and wiring from the logic, no inconsistencies can arise. Any inconsistencies among logic, placement, and wiring generated by manual methods will be detected by the checking of a design automation system.

* Examples of automatic tools at the present time are the Gardner Denver automatic wiring machine, continuity testers, and semi-automatic wiring machines such as the Philco Wiring Verifier.

Error Checking

Design automation permits error checking of various types. The main error checks are that no logic, circuit, or wiring rules be violated. While some transcription and keypunch errors can be found by the programs, there must be some checking by the designer that the logic, described by the input and returned to him in convenient forms, is the logic he intended. Simulation of the logic may be used to verify that the logic yields the expected results.

Design automation greatly reduces the lead time between the start of a design and the delivery of a computer product. The wiring of a unit is generally in progress within a day or two of completion of logic. Let us assume that keypunching requires a half day for a unit of about 700 logic elements, and that turnaround time at a computer service center is about four hours. An initial run to reveal errors requires about twenty minutes of computer time. The evaluation of a checking run may require from a couple of hours to a day, depending on the thoroughness with which the designer compares the computer output to his initial design. Then thirty to forty minutes are needed to run a complete initial series.

Why Design Automation?

Why use design automation? The most convincing answer to management is "it saves money". The advantage of lead time in getting a new product on the market quickly is difficult to estimate in either dollars or percentage of total cost. A contract may even require very short delivery time as a condition for award. There are three areas where time is saved: design, production, and debugging. The cost of the design time is reduced because design is supported for a shorter time. Because production can use automated or semi-automated techniques, the time and cost for production is reduced. Because the production documents are accurate and the production and debugging documents agree with the initial design, debugging proceeds more quickly and less expensively.

Even more significant than help in the development of the prototype are the savings when changes are made. Changes are implemented only after checking, and a complete and continuous history of the design may be retained.

Example of a Design Automation System

Typically, design automation systems take, as input, logic in terms of relationships of building blocks, as shown in Figure 1.

The representation of the relationships is a matter of convenience; design automation systems, therefore, accept as input whatever form is usual for the designers involved.

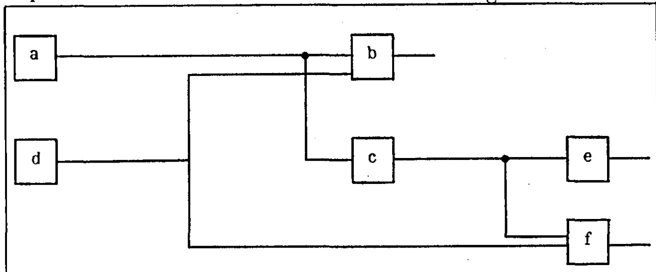


Figure 1 — Each of a to f is a building block, which might be an inverter, an and-gate, or some other circuit unit. The relationships may be described: (1) in terms of input, for example, f has inputs c and d; (2) in terms of driving, for example, c drives e and f; (3) in terms of logical relationships, for example, if c were an inverter and f an and-gate, then f equals d and not-a.

The building blocks can be represented by numbers or names, or both. Again this consideration depends on the convenience of the particular design group.

After the information that describes the relationships among the logical building blocks has been entered into a design automation system, information is checked by the computer programs for any violations of logic or basic circuit rules.

Output

The information can be returned to the designer in different forms. One form may be information describing both inputs to and loads from a logic element. Another form may be a set of input equations. Still another form may be equivalent to flow charts of instructions. There are other forms of logic presentation that are equally convenient.

If the correctness of the logic is to be checked by simulation, the simulation programs may be introduced at this point.

Criteria

The criteria for acceptability of a placement (i.e., correspondence between logical building blocks and location on a physical building block) are varied.

Typical criteria are:

1. Minimize total wire.
2. Maximize the wiring in a given physical direction.
3. Minimize the spread of source-to-load distances.
4. Orient special circuits near the external interface.
5. Have registers aligned.
6. See that no wiring rule is violated. Wiring rules depend on the circuit limitations specified by the circuit designer. Typical wiring rules are as follows: No wiring run may be longer than X inches. There may be no more than N wires of type Y (plain wire, twisted pair, for example) branching from a node as a function of the circuit at that node. If there are W loads on a wire run, the run may be no longer than X inches.
7. Minimize the number of twisted pair wires.
8. Minimize the longest wires.

In most applications more than one criterion applies. Some of the criteria involve reliability, some involve speed, some involve cost. For example, if a wiring rule is violated in the fabrication of a unit, this unit may not be adequately reliable; hence this criterion is always important. Speed may be increased when the spread of source-to-load distance is kept minimal. The spread of source-to-load distance is the difference between the maximum and the minimum source-to-load distance. The spread of the lengths of wire runs may be equally important. If delays through wire can be kept standard, then total delay per stage can be held to closer tolerances. The timing tolerances, which are considered in both worst case and statistical design, are then reduced. Cost is a reason for wanting to reduce the number of twisted pairs. Reliability is the consideration, for example, when special circuits involving connections that may generate noise, must be kept away from other wires. Cost is a factor when special production techniques favor the maximization of the number of wires in a particular physical direction. Cost is also a factor when maintenance and debugging operations are assisted by aligning registers when indicators are present on the physical package.

It is generally difficult to apply all the desired criteria directly and it is especially difficult for the human designer to maintain absolute "fairness" in multiple trade-off situations.

Figure 2	Arrangements of List		Computation
	Initial List	[a] b c d e f	$(2 + 3)/2 = 5/2 \cong 2$
		[b] a c d e f	$(2 + 3 + 4 + 6)/4 = 15/4 \cong 3$
		a [c] b d e f	$(1 + 3 + 5 + 6)/4 = 15/4 \cong 3$
		a b c [d] e f	$(2 + 6)/2 = 8/2 = 4$
		a b c d [e] f	$(3 + 6)/2 = 9/2 \cong 4$
		a b c e d [f]	$(2 + 3 + 4 + 5)/4 = 14/4 \cong 3$
	List after 1st iteration	a b f c e d	

Placement

After the logic has been checked, any placement information that the designer wants to specify may be introduced and verified for consistency and the remaining logic (which may be the whole or any portion of the design) can be left for placement by the program. For example, many of the placement programs used at Philco contain two parts. The first part depends exclusively on the logic building blocks and is independent of the nature of the building blocks or the type and organization of packaging techniques. The second part assumes that the packaging building blocks contain a number of logic building blocks that are generally not interconnected on the package. The specific program depends on the specific standard packaging techniques used.

The essence of the placement method is the reduction of the logic elements to a linear list. This list is then manipulated to form linear clusters of associated elements. The first phase examines the relationship of all of the logical elements and then lists each element as close as possible to its associated element(s).

Consider the logic sketch in the example shown earlier in Figure 1. We can make a list of building blocks:

Building Block List

a
b
c
d
e
f

We can also make an association list. Two elements are called associated if a wire path exists between them.

Association List

a	b	c	a	e	c
a	c	c	b	e	f
b	a	c	e	f	b
b	c	c	f	f	c
b	d	d	b	f	d
b	f	d	f	f	e

GATE WIRING REFERENCE			UNIT....TST		DATE..6-13-62		REV..B				PAGE 003	
SIGNAL IDENTITY	INPUTS GATE	INPUTS CONNECT	OUTPUT GATE	OUTPUT CONNECT	COLUMN TIE GATE	COLUMN TIE CONNECT	LOADS GATE	LOADS CONNECT	FROM	TO	TWIST	LENGTH
36	26	B20-14	35	B20*10			43	E31-12	B20*10	E31-12		13 3/4
36	66006	B21-02	36	B21*07			44	E32-05	B21*07	E32-05		13 1/4
. . . .												
. . . .												
44	32	E32-02	44	E32*04	54	B23-05	147	D31-02	B23-05	E32*04		13
	34	E32-03							D31-02	E32*04		4 1/4
	36	E32-05										
	40	E32-07										
	42	E32-06										
. . . .												

Figure 3 — Sample Of Typed Copy Of Machine Printout

The algorithm then considers each element on the logical building block list in turn. The subject element in each line of Figure 2 is indicated by enclosing it in a box.

Each subject element is considered in relation to all its associated elements. All the associated elements in Figure 2 are underlined. The sum of the positions in the list of the associated elements is divided by the number of associated elements. The quotient represents the center of gravity of the associated elements. The subject element is moved to this position and all the elements between its initial and final position are slid over one place.

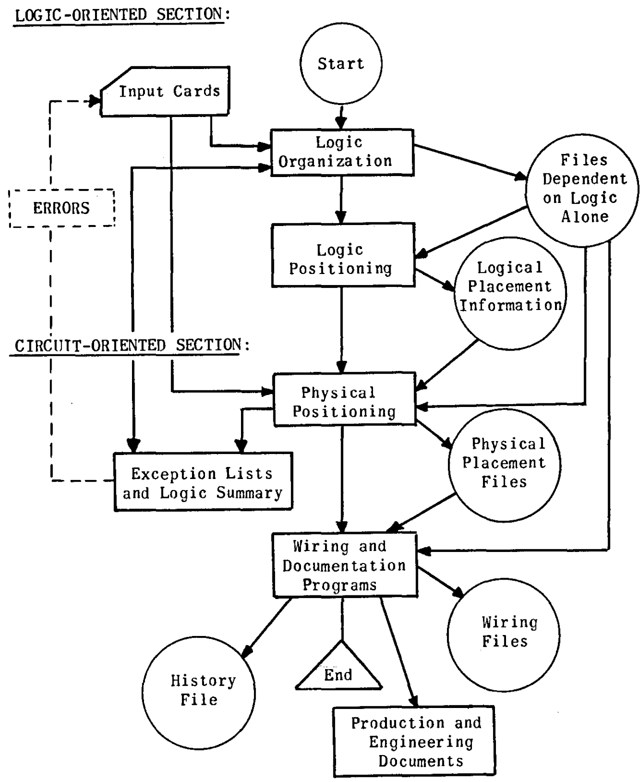


Figure 4 — Flow Chart Initial System

Iterations

When every element has been considered as a subject element, one iteration has been performed. For example, for a device with about 1500 logic elements, about eight or nine iterations are suitable. This example illustrates techniques, but is not sufficient to show the merit of this method.

The list of logic elements is then assigned to physical modules in such a manner that the order is disturbed as little as possible. The backboard positions are considered as one dimensional by ordering to left in one row and to the right in the next.

After placement of the logic, the design automation system determines the wiring and generates the documents required for fabrication and test. It also supplies information on the correct media for automatic or semiautomatic production or test equipment. Figure 3 shows a typical debugging document. Figure 4 illustrates the flow of a typical system for initial design. Figure 5 shows a typical system for changes to an existing design.

When a change is to be introduced, there are a number of basic investigations to be made. Is it reasonable? Is something being added that already exists in the file? Is the change consistent? Does the wiring change agree with

(Please turn to page 58)

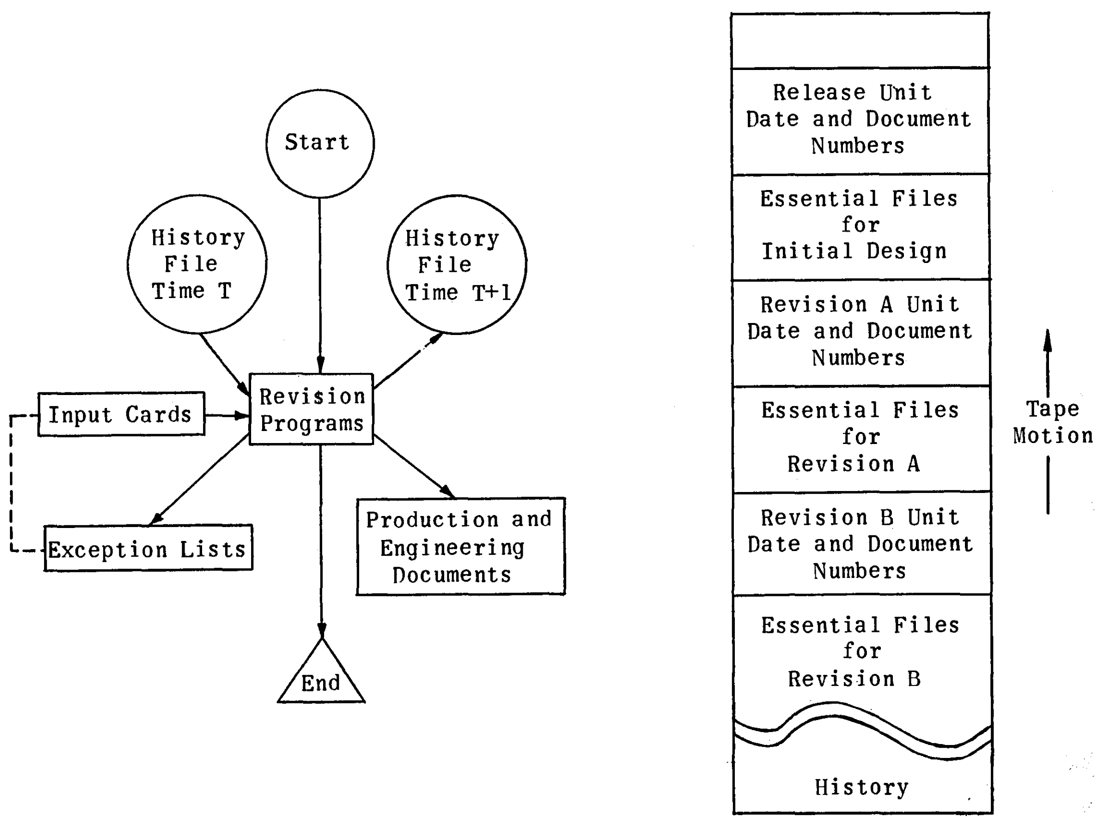
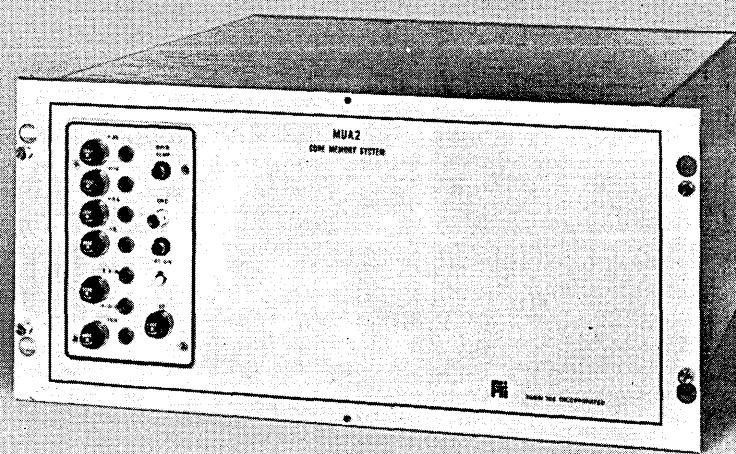


Figure 5 — Flow Chart Revisions and Revision Tape

A NEW integrated-circuit, core memory system from FABRI-TEK



Here is a compact, versatile memory system at a truly economical price which can perform any of the standard data storage functions with reliability. Full cycle time is 2 microseconds, half-cycle time is 1.25 microseconds. Access time is 850 nanoseconds. Four access modes are possible: Random; Sequential; Random/Sequential; and Sequential-interlaced. Capacities available are: 64, 128, 256, 512, 1024, 2048, and 4096 words, with 2 to 30 bits per word in increments of 2 bits. A choice of input and output interface circuits and optional address register is offered. Power supply and self-test exerciser are available options. Fabri-Tek's "standardized design" concept gives you a custom fit to your particular memory requirements with the economy of mass production.

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APPLICATIONS

MOLECULAR STRUCTURE "PICTURED" BY COMPUTER

Scientists at Argonne National Laboratory (operated by the University of Chicago under contract to the Atomic Energy Commission) have "taught" the Laboratory's sophisticated computers to display in pictorial form amounts of data so vast that they would be virtually unuseable in mathematical form. This accomplishment permits scientists who are studying molecular structure to compare various models of two-atom molecules by looking at "pictures" of their structure instead of trying to compare large numbers of complex tables.

Dr. Arnold C. Wahl, now an Assistant Professor in the Department of Chemistry and in the Theoretical Chemistry Institute at the University of Wisconsin, but formerly of the Argonne Chemistry Division staff, prepared computer programs which instructed a computer to construct and "draw" contour diagrams of molecular orbital and total electron densities for a number of molecules. He was assisted by members of Argonne's Applied Mathematics Division staff.

Physicists and chemists have been attempting to construct an adequate mathematical model of the structure of molecules for many years. However, the complex differential equations required to define such a mathematical model are extremely difficult to solve. In 1928, a significant advance occurred when R. S. Mulliken and F. Hund developed for molecules the orbital theory, or "shell model". Although this orbital concept simplified the problem greatly, calculating the orbitals still required a prohibitively large amount of algebra and arithmetic.

In recent years, the availability of high speed computers increased the usefulness of this orbital theory because it became practical to carry out this large amount of algebra and arithmetic and to calculate the exact properties of the Mulliken-Hund model for molecules consisting of two atoms. As a result of these calculations, the model is now well documented and its usefulness is being demonstrated.

Dr. Wahl points out, however, that if the advances and refinements of this model, which have been made possible by high-speed computers, are only to be described in complex mathematical language or in terms of vast, undigestible and often misleading numerical tables, they will have limited value.

In order to eliminate this obstacle to widespread use of the molecular model both in teaching and research, Dr. Wahl set out to prepare programs which would enable a computer to present a visual representation of the model — a picture which is correct, and is much more complete than anything which has thus far been available. The completely automatic programs developed by Dr. Wahl have made it easy to analyze visually a very large amount of calculated data. They are already being used in new studies of molecular structure. In one such investigation, a study of interatomic forces and the formation of the chemical bond, these computer programs are being used to display changes occurring in electronic charge density as a molecule forms.

Although the initial application of this new tool has been to studies of molecular structure, Dr. Wahl expects it to be useful in many areas where large-scale computational efforts result in such vast amounts of data that only a small fraction of it can be analyzed by conventional methods. Programming a computer to enable it to display such data visually and thus communicate directly with one of man's most sensitive and subtle senses can greatly increase the effectiveness of the interplay between man and computer, Dr. Wahl said.

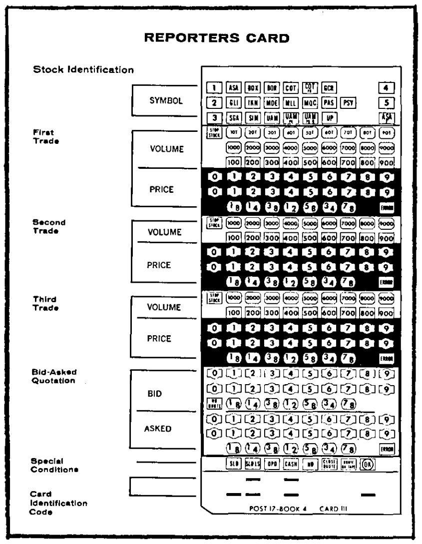
Dr. Wahl's work was reported in the February 25th issue of Science Magazine.

MARKET DATA SYSTEM USES OPTICAL MARK READING

A card dropped into a compact gray box on the floor of the New York Stock Exchange has set in motion a major technological breakthrough — the use of optical mark reading to capture continually changing information. The electronic first was scored as the Exchange prepared to place on-line its fully-automated Market Data

System. The system was specially developed by IBM Corporation as a major part of the Big Board's broad-scale automation program.

In the initial phase of the program, the specially-designed cards are being used to capture trading data at Post 17 on the Exchange floor, where 119 of the more than 1600 Big Board listed stocks are traded. As a trade takes place, the reporter, using an ordinary lead pencil, records the details by drawing lines through specially-coded boxes on the pre-printed card designating the stock symbol, number of shares, and price.



The card, which provides space for three trades and a bid-asked quotation, then is placed in the optical card reader located at the post. The optical reader scans the pencil marks and transmits the information in a fraction of a second to the computer center three stories above the trading floor. Here, the data is checked automatically for validity, processed, and recorded magnetically to provide information for the Exchange's Telephone Quotation Service. Within seconds, a computer-assembled announcement of prices is made via loudspeakers mounted at the post, and the transaction is reported at the post on a special printer.

As card readers are being installed at the 19 trading posts on the floor, the present manual reporting and ticker operation for each of the posts will be phased out. When fully operational later this year, the system will speed trading information out to the Exchange's international ticker network, usually within a fraction of a second after it has been reported on the floor.

COMPUTERIZED BOOK CATALOG

Stanford University's $5 million undergraduate library (Stanford, Calif.), scheduled for completion next fall, will have a computerized book catalog, Stanford Librarian Rutherford D. Rogers noted in his annual report. "This is the first major step toward computer application to library technology at Stanford," his report said.

"Stations" for instantaneous consultation of the list of books available in the library will be located in each major room of the new library and can be extended to the departmental offices of the University, Dr. Rogers said. This system will allow much quicker scanning of available holdings and will allow for quick copying of the list of books on a particular subject for distribution to students, faculty members and research scholars.

DIGITAL COMPUTER CONTROL APPLIED TO CEMENT MANUFACTURING

Cement manufacturing entered a new era with the recent announcement by Dundee Cement Company (Dundee, Mich.) that it has successfully applied a digital computer to the control of a giant rotary kiln. Roblee B. Martin, Dundee president, said the firm's 460 x 16 foot rotary kiln at its Dundee plant is now being controlled on a "closed-loop", or fully automatic, basis by an IBM 1710 process control system. This achievement culminated more than a year of research and development by Dundee and IBM Corporation.

"Our experience with closed-loop kiln control has clearly demonstrated the system's ability to maintain temperatures at pre-set levels throughout the 460-foot length of the kiln," said Werner Ostberg, Dundee vice president-operations. "Temperature control is the most critical aspect of the cement manufacturing process," he said. Significance of the achievement was explained by Mr. Ostberg, in terms of potential production gains, reduced maintenance costs and uniformity of product.

The computer, which can make thousands of calculations a second, instantaneously reacts to fractional degree temperature changes. To control the kiln operation, the computer gathers information — temperatures, speeds, pressure, etc. — from about 70 instruments located along the kiln. Based on predetermined standards of quality control, the computer calculates what simultaneous adjustments, if any, must be made. The computer then automatically positions the kiln actuators — valves, dampers, fans, etc. — to new settings which will maintain the process variables at pre-set levels.

Setting this system apart from other process control systems is its ability to consider the state of the entire kiln before making any adjustments.

BRITISH TOWN USING COMPUTER IN BRIDGE DESIGN

A computer is being used to help design a bridge over the River Aire. The bridge, to be constructed by cantilevering out from each bank, with the two sections finally joined by a pin, is the first of its type to be built in England, according to Col. S. M. Lovell, Yorkshire County engineer and surveyor. If conventional bridge design techniques were used, Lovell said, they would destroy the river's small navigable channel.

A Honeywell 400 computer installed at the county's headquarters several months ago is computing the profile of each of the 64 sections of the bridge to correct shrinkage, stress and creep problems that could prevent the bridge from meeting exactly at midpoint over the river. As many as 64,000 separate calculations are required to correct just one part of a section's profile, Lovell said. In addition, thousands of other calculations are needed to estimate stress and deflection in preformed concrete beams, determine distribution of loads between beams, and aid the design group in selecting quantities and shapes of steel and concrete reinforcements needed in the bridge.

Col. Lovell said the county plans to use the computer in constructing roads, by having it provide data on proper road curvature and camber. It also will aid in producing perspective drawings that permit road and bridge designs to be viewed from different angles — a technique used by engineers to correct misalignments and other design errors.

MESSAGES RELAYED TO AND FROM TIME-SHARING COMPUTER BY SATELLITE

A General Electric computer has received and answered messages relayed via satellite over a 200,000-mile round-trip route that touched on two continents. Simultaneously it handled unrelated problems fed into its multi-tracked "brain" from nearly 40 other scattered locations in the United States. The demonstration, recently held in Cleveland, Ohio, marked the first time messages have been relayed to and from a time-sharing computer by satellite.

The Early Bird satellite, stationed 22,300 miles above the mid-Atlantic, was used as the link between the United States and France. The Communications Satellite Corporation, in cooperation with its counterpart in France, made available the satellite circuits. Impulses traveled at the speed of light — 186,000 miles a second.

Two time-sharing computers were used to receive and reply to the messages from Cleveland — a GE-225 in Oklahoma City and a GE-265 in Phoenix, Ariz. Signals traveled to the two computers by telephone lines from Cleveland to the General Electric Computer Center in New York, then to ITT World Communications headquarters in New York, then to the Comsat-operated earth station at Andover, Maine. From the transmission center in Andover they were flashed by microwave to Early Bird, then to a receiving station in France, then back to Early Bird and back to Andover. From Andover the signals traveled by wire again to ITT in New York and then to General Electric's computer headquarters in Oklahoma City or Phoenix.

"This dramatic accomplishment," said Dr. Louis T. Rader, vice-president and general manager of G-E's Information Systems Division, "illustrates again the virtually unlimited potential of time-sharing computers." He predicted that, ultimately, time-sharing computers will be capable of becoming worldwide storehouses of information that can be tapped instantaneously from any point on earth.

NEW CONTRACTS

FROM	TO	FOR	AMOUNT
Western Union	SCM Corporation, New York, N.Y.	Electronic data communication sets for a new high-speed communications terminal for industry and government	$2 million
Puerto Rico Water Resources Authority, San Juan, Puerto Rico	The Foxboro Company, Foxboro, Mass.	Instrumentation for Units 9 and 10 of San Juan Steam Plant. The electronic control systems for Units 7 and 8 of the same station also were supplied by Foxboro	over $1 million
Alitalia Airlines, Rome, Italy	General Precision, Inc., Link Group	DC-9 digital flight simulator	over $1 million
Department of Defense, Air Force Rome Air Development Center, Griffiss Air Force, N.Y.	University of Illinois at Urbana	Designing and building world's fastest and most advanced computer. Device will be known as Illiac IV and is planned for upwards of 1 billion computations a second	$8 million
Sabena Belgian World Airlines, Brussels, Belgium	General Precision, Inc., Link Group	A Link 727 digital flight simulator	over $1 million
United States Air Force, Rome Air Development Center	General Electric Company	A large-scale GE-645 computer to help in its advanced electronics development work in computer technology — delivery scheduled for 1967	—
Aeronautical Systems Division, Air Force Systems Command	Sylvania Electric Products, Inc., a GT&E subsidiary	Manufacture of components and spare parts for advanced airborne data processing equipment	$3.2 million
General Services Administration	LMC Data, Inc., New York	Leasing data processing equipment and for service	—
Santa Barbara County, Calif.	Cubic Corporation, San Diego, Calif.	Delivery of 18 Votronics vote counters plus collateral equipment — "lease with option to purchase" contract extends for five years	over $490,000
Lower Colorado River Authority, Austin, Texas	General Electric Company, Instrument Dept., West Lynn, Mass.	A second GE/MAC (General Electric/Measurement and Control) system to be used in connection with a 125-mw turbine-generator set at the Authority's Sim Gideon plant, Bastrop, Texas	$187,000
Prince George's County, Upper Marlboro, Md.	Radio Corporation of America	Provision of a computer facility to eventually consolidate all County record keeping in one system — target time for operation of central computer system is mid-summer, 1967	—
Jet Propulsion Laboratories, Pasadena, Calif.	Scientific Data Systems, Santa Monica, Calif.	13 SDS 920 computers to be used by the NASA-JPL deep space network in forthcoming space exploration projects	$1,867,000
U. S. Navy, Bureau of Yards and Docks, Washington, D.C.	Honeywell EDP, Wellesley Hills, Mass.	Lease of one H-200 computer system at the Public Works Center, San Diego, Calif., to be followed by similar installations at 8 other Public Works Centers around the world — equipment valued at about $1.5 million	—

Newsletter

FROM	TO	FOR	AMOUNT
Western Geophysical, Los Angeles, Calif.	Redcor Corporation, Canoga Park, Calif.	Field digital seismic recording systems	over $2 million
Emery Air Freight, Wilton, Conn.	IBM Corporation	Real time computertized air cargo data network — system will include two IBM System/360 Model 40 computers	$3 million
Headquarters, Department of the Army	The Bunker-Ramo Corporation, Silver Spring, Md.	Automating a portion of their budget system — automation of Army budgetary processes is being done to institute economy into Army's budget by allocating funds to projects in their order of importance	$348,000
Iranian Oil Refining Company, Abadan, Iran	Bonner & Moore Associates, Inc., Houston, Texas	Development of an automated pipeline scheduling program which will facilitate scheduling of movements of products from the refinery to the Bandar Mashur terminal on the Persian Gulf and of the operation of the terminals	—

NEW INSTALLATIONS

AT	OF	FOR	FROM
R. J. Reynolds Tobacco, Co., Winston-Salem, N.C.	IBM System/360 Model 30 valued at $400,000	Increasing company's capabilities for computer processing; previously installed IBM 1401 and new equipment process accounting, keep track of warehouse inventories nation-wide, handle stockholder records, and calculate for industrial engineering studies	IBM Corporation
Heights Academic Computing Facility (HACF), New York University, New York, N.Y.	IBM System/360 Model 30	Student use by School of Engineering and Science and the University College of Arts and Science	IBM Corporation
Curtis Publishing Co., Philadelphia, Pa.	Two Control Data 8090 computer systems with Control Data 915 page readers	Processing firm's huge volume of subscriptions	Control Data Corp.
Gimbels-Pittsburgh, Pittsburgh, Pa.	H-200 system	Data processing activities involving all areas of merchandise analysis; other applications will include business accounting and sales analysis	Honeywell EDP
McDonnell Aircraft Corp., General Engineering Div., St. Louis, Mo.	Model SCS 670-2 computer	Inclusion in high speed digital data acquisition system	Scientific Control Systems, Inc.
Intinco Ltd., London, England	UNIVAC 418 computer	Operating hub of SCAN (Stockmarket Computer Answering Network)	Sperry Rand Corp.
C-E-I-R, Inc., Washington and New York service bureaus	Three IBM System/360 Model 30 computers having a total value of more than $1 million	Association, financial, business and government clients at Washington; two machines were added to firm's equipment complex in Manhattan	IBM Corporation
Stadtische Sparkasse Bochum, Bochum, Germany	NCR 315 system; a second system is on order	Bank's use initially in the automatic processing of customer "standing orders" (refers to customers' instructions to deduct certain amounts each month from a savings account and apply funds elsewhere — common in Europe)	National Cash Register Co., International Division
Space Flight Operations Facility, Pasadena, Calif.	Four S-C 3070 high speed printers	Operation from IBM 7044 and 7099 computers; will print information concerning JPL's unmanned planetary, interplanetary and lunar probes for NASA	Stromberg-Carlson Corp., Data Products Div.
Jersey-Kapwood Ltd., (manufacturer of fabrics, lace, lingerie), Nottingham, England	Honeywell 120 system	Initial use for cost estimating of pricing structures for firm's entire product line — other applications to be added later	Honeywell EDP
Bankers Data Corp., Chicago, Ill.	GE-415 system	Demand deposit accounting, savings, installment loan and other bank and commercial accounting operations	General Electric Co.
Dutch Statemines, Limburg, Netherlands	CAE 510 computer system	Control of new 100,000 tons per year ethylene plant	Compagnie européenne d'Automatisme Electronique
Bowring insurance group, London, England	Honeywell 400 computer system	Handling accounting and management statistics	Honeywell EDP
Duncan Electric Co., Lafayette, Ind.	Control Data 160 computer system	Calibrating watt-hour meters to new levels of accuracy and reliability	Control Data Corp.

AT	OF	FOR	FROM
DC Trucking Company, Inc., Denver, Colo.	GE-415 computer system	All business and management operations; will become hub of a computer-controlled communications network that will tie together all of company's operations in this country and Europe	General Electric Co.
U. S. Navy, Pacific Missile Range, Point Mugu, Calif.	Control Data 3100 system	Programming and operation by personnel of Geophysics Division of the Range Operations Dept. in areas of meteorology, oceanography, and climatology	Control Data Corp.
American Cyanamid Co., Stamford, Conn.	SDS 925 computer	Aid in research leading to new chemical products including textile fibers, plastics, refinery catalysts, and fuel cell electrodes	Scientific Data Systems
Mail Advertising Corporation of America, Lincoln, Nebr.	IBM System/360 Model 30	Increasing firm's data processing capabilities and opening new marketing areas in the direct mail advertising field	IBM Corporation
The Outlet Company, Providence, R.I.	NCR 315 system	Computerization of accounting procedures	National Cash Register Co.
Interstate Power Co., Dubuque, Iowa	Control Data 636 Industrial Computer System	Monitoring and data logging at the M. L. Kapp Station, Unit #2, Clinton, Iowa — as part of the SAL (Scanning, Alarming, Logging) system, the 636 will monitor the status of all major equipment in the power plant	Control Data Corp.
NASA's Marshall Space Flight Center, Huntsville, Ala.	IBM 1130 Computing System	Use in support of NASA's Saturn launch vehicle lunar program; a major application is assisting in Saturn antenna design	IBM Corporation
Crocker-Citizens National Bank, San Francisco, Calif.	Control Data 915 Optical Page Reader System	Translating bank and customer raw information from original source documents into useable 'computer language'	Control Data Corp.
Tridea Corp., a Subsidiary of Conductron Corp., South Pasadena, Calif.	Two DDP-116 computer systems	On-line machine tool programming in conjunction with a Tridea-developed automatic line tracer	Computer Control Co., Inc.

ORGANIZATION NEWS

HONEYWELL EDP TO MARKET BUNKER-RAMO DISPLAY DEVICES

Honeywell's electronic data processing division, Wellesley Hills, Mass., will market The Bunker-Ramo Corporation's new Series 200 and 400 information display and inquiry devices in commercial and government data processing markets here and abroad, it was announced jointly by Walter W. Finke, president of Honeywell EDP, and John E. Parker, chairman of Bunker-Ramo. Four basic models of the high-speed cathode ray tube displays will be offered by Honeywell in its product line, under this arrangement.

Bunker-Ramo will continue to manufacture and market these input/output display devices. The worldwide service organizations of both firms will coordinate field servicing of the devices.

The arrangement also provides Honeywell with rights for future manufacture of display units in the United Kingdom, Germany and Canada as well as in other selected countries. The agreement excludes Japan, where Bunker-Ramo display devices are marketed by the Nippon Electric Company. Nippon Electric also manufactures and markets Series 200 computer systems under a Honeywell license.

ISC ACQUIRES ASSETS OF CONSTRUCTION CONTROL, INC.

Information Systems Co., Los Angeles, Calif., has acquired the assets of Construction Control, Inc., Anaheim, Calif., supplier of management consulting services to the construction industry, according to M. O. Kappler, President of ISC. Terms of the transaction were not disclosed.

SIMULATORS, INC. ENTERS MARKETING AGREEMENT WITH TELEFUNKEN A.G., GERMANY

Simulators, Inc., Northbrook, Ill., has entered into an exclusive marketing agreement with Telefunken A.G., Ulm, Germany. Mr. Charles J. McVey, president of Simulators, Inc. announced that the company will have complete United States marketing responsibility for the Telefunken line of analog and hybrid computing equipment. Telefunken was represented by Dr. Lux and Dr. Zur.

Simulators, Inc. plans to use the Telefunken computing equipment with electronic mode control designed by the Automation Center of McDonnell Aircraft Corp. and produced by Simulators, Inc. under licensing agreement. A line of scientific computers is to be introduced at the Spring Joint Computer Conference this month. By joining the efforts of Telefunken, the McDonnell Automation Center and an internal development program Simulators, Inc. will enter the scientific computer market having the world's widest line of 10 volt reference analog computing equipment and have initially a system of field proven performance.

CSC COMPLETES ACQUISITION OF GEONAUTICS, INC.

Computer Sciences Corporation has completed the acquisition of Geonautics, Inc., of Washington, D.C. Fletcher Jones, president of CSC said holders of more than 97 per cent of the 116,555 Geonautics shares outstanding have tendered their stock to CSC. The offer was contingent upon the acceptance by holders of 90 per cent of the Geonautics shares outstanding. The transaction involved 9,017 shares of Computer Sciences' capital stock.

Geonautics provides professional and technical services in the fields of geodesy, oceanography, navigational systems and astronomy. The acquisition of Geonautics will further expand the capabilities of Computer Sciences and its subsidiaires in the field of the information sciences. Geonautics will be operated as a part of System Sciences Corporation, a wholly-owned subsidiary of CSC located in Falls Church, Va.

ITT AND ABC DIRECTORS APPROVE CONTRACT FOR FIRMS' MERGER

The boards of directors of International Telephone and Telegraph Corporation and American Broadcasting Companies, Inc., approved a contract in February covering the merger of the two communications firms. Before the merger becomes final, stockholders of both companies must approve. In addition, completion of the transaction is dependent on approval by the Federal Communications Commission and on a favorable tax ruling. It is expected that meetings of stockholders of the two companies will be held in the latter part of this month.

The formal contract, approved in February, stemmed from discussions between ITT and ABC for several months during 1965. One of the conditions of the merger will be the continued autonomous operation and management of ABC by its present management as a separate subsidiary of ITT.

CONTROL DATA ANNOUNCES $120 MILLION LOAN AGREEMENT

William C. Norris, President of Control Data Corporation, has announced that negotiations have been completed with ten major banks for a revolving credit agreement in the amount of $120 million. The term of the agreement is two years. Norris said that the funds will be used for increased working capital needs, and to finance the increasing leased equipment business which is present in Control Data's backlog and incoming orders.

LEASING OF COMPUTER SYSTEMS FOR EDUCATIONAL PURPOSES

Fabri-Tek, Inc., of Minneapolis has announced a leasing plan for its BI-TRAN SIX Computer Educational System. Under this plan the system can be leased for one, two or three months at a nominal cost. During this period if the leasee decides to buy the system any rental fees paid are applied to the purchase price. Arrangements for longer leases are also possible with purchase options.

This plan provides the means whereby educational institutions can actually use a computer system in classes to determine the desirability or applicability of using this type equipment in existing or proposed curriculum. Monthly leasing has been purposely established at a low rate to give all schools an opportunity to investigate computer training through actual use of the equipment. (For more information, designate #41 on the Readers Service Card.)

EDUCATION NEWS

STUDENTS LEARN MATH FROM COMPUTER 3000 MILES AWAY

Prof. Anthony Oettinger at Harvard opens his class by turning, not to a blackboard, but to the signalling device. On a keyboard, he types out a problem, thus programming a computer 3000 miles away in Santa Barbara, Calif. The computer, empolying a systems program worked out by Prof. Glenn Culler of the University of California, solves a problem in calculus or statistics, step by step, for the Harvard class. The mathematical process appears, almost instanteously, on a display device.

Three universities now are using the systems program developed by Professor Culler at Santa Barbara; UCSB, UCLA and Harvard. At Harvard, the computer is being used in a program of experiments in the process of teaching and learning. Research aspects are supported by the Advanced Research Projects Agency of the Department of Defense.

Professor Oettinger is using the system experimentally for instruction in a seminar on "Technological Aids to Creative Thought," as well as in other classes. The communication over the 3000 miles is made by telephone and microwave. Professor Oettinger foresees similar displays in many classrooms, all linked to the computing center.

"For the first time relatively inexpensive display devices can be installed in classrooms without regard to where a relatively more expensive computer is located. This means literally hundreds of schools and laboratories are now possible participants in a system of this kind." Essentially this method involves translating computer calculations into graphic terms which dramatically illustrate a problem and its successive steps to solution. "It's a case of a picture being worth a thousand words. Besides that, there are some problems you simply cannot describe in words," he said.

COMPUTER-TEACHER SYSTEM FOR FIRST-GRADERS NEXT FALL IN EAST PALO ALTO

First actual use of a computer-teacher system in an American elementary school will get under way next September at Brentwood School in East Palo Alto, Calif. At that time, 150 first graders will receive instruction in reading and mathematical skills a half hour per day, with the computer keeping track of their scores, feeding new materials as the students' abilities increase, and analyzing the data so that teachers and school officials can keep a day-to-day check on each student.

The system is an outgrowth of joint research and experiments over the past five years by Prof. Patrick Suppes, director of the Institute for Mathematical Studies in the Social Sciences at Stanford University and Prof. Richard C. Atkinson of the Psychology and Education Departments. A model installation was first demonstrated last March in laboratory form at the Stanford Computation Center.

For the new Brentwood first-grade program, a new model computer system and terminal, developed during the past year by IBM, will be installed. It permits the pupil to communicate with the computer by light pen which he can touch to a television-type screen, by typewriter keyboard, or by audible response to a tape-recorded voice from the computer. Problems in mathematics or sentences for reading are flashed on a screen about

8½ x 11 inches in size. The student responds by touching the light pen to the correct answer, typing it out, or answering verbally.

If the answer is wrong, the computer tells the student audibly and resubmits the question. The right answer brings up the next question, printed on an eight-millimeter film "chip" projected on the screen at the computer's command. The computer is programmed to increase the difficulty of the material as the pupil learns and improves. It also can be specially programmed for those with learning difficulties.

The project is supported by a $1 million grant from the U.S. Office of Education.

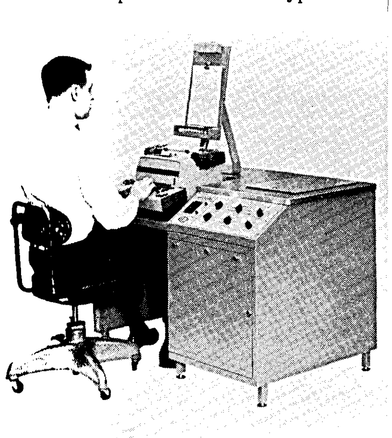
NEW PRODUCTS

Digital

DI/AN CONTROLS ANNOUNCES NEW COMPUTER TYPESETTING SYSTEM

DI/AN Controls, Inc., Boston, Mass., has announced the Model LC-3, a new development in their line of total composing room computer typesetting systems.

Built around a special-purpose computer, the new Computer Keyboard Model LC-3 has many improved operating features, in addition to being more compactly styled with fewer set-up controls. Hyphena-



tion, justification and error correction are all completed before the tape is punched. Idiot tape is eliminated. No rubouts are encountered because the operator produces hard copy and can quickly detect and rectify errors. Corrections are made simply by using one keystroke to erase either one letter, one word or an entire line at a time. The correct copy is then typed with none of these corrections ever appearing on the tape. The result is an error-free tape complete with linecasting instructions.
(For more information, designate #42 on the Readers Service Card.)

IBM SPACE COMPUTER "VOTES" ON SIGNALS

The most advanced space computer yet developed is slated to navigate the first 625-ton NASA Saturn IB launch vehicle. The 88-pound, suitcase-size device features triple sets of circuits that are tested by "voter" circuits to screen out erroneous signals, and duplicate memories that reset each other in case of error. The computer, developed by the IBM Corporation, and a companion device called the data adapter are located in the IBM-produced Instrument Unit (IU) stage, a three-foot "control center" placed just below the spacecraft and atop the propulsion stage.

The equipment is designed to take flight data from instruments aboard the IU and to calculate exact courses for the Saturns. To provide the highest reliability possible, certain modules in the units are triplicated. Sets of triplicated signals are sent through "voting" circuits which are designed to block a signal if it does not agree with the other two signals.

Another feature is a redundant memory system. Identical flight data is put into two memories before each flight. These memories constantly check themselves for incorrect data which might be caused by stray electrical signals. If an error appears in the memory being used by the computer, it is sensed and, in a split second, operation is switched over to the duplicate memory. After this switchover, the erroneous memory corrects itself using data from the second unit.

Memories

NANOMEMORY 650 — LARGE SCALE MEMORY SYSTEM BY ELECTRONIC MEMORIES INC.

A new, large scale memory system operating at a cycle time of only 650 nanoseconds will be demonstrated for the first time at the Spring Joint Computer Conference (see Meeting News) by Electronic Memories. The system, called the NANOMEMORY 650, has a capacity of 16,384 words of up to 84 bits and an access time of 300 nanoseconds. It is the fastest large core memory system in production, according to William Richmond, Director of Marketing for the firm.

The NANOMEMORY 650 has 2 ½-D selection techniques, a 20-mil core, and high speed silicon circuitry. The combination provides greater reliability, reduction of system noise, elimination of read-write time separation, and wider operating margins. Cost per bit is comparable with memories operating at a cycle time of 1.25 microseconds.

The device will be demonstrated in a standard 19-inch rack mounting configuration with a capacity of 16,384 words and a word length of 28 bits. There are two other standard configurations and custom configurations also are available.
(For more information, designate #44 on the Readers Service Card.)

AUXILIARY PROGRAM MEMORY EXPANDS CAPACITY OF MATHATRON

A new auxiliary program memory storage device, which greatly expands the computational capabilities of the Mathatron electronic calculator/computer, has been announced by Mathatronics, Inc. of Waltham, Mass. Called the APS (for Auxiliary Program Storage), new unit in conjunction with a Mathatron 8-48 desk top calculator/computer provides 48 to 88 individually addressable storage registers plus 480 steps of program memory.

Data, formulas, and programs are entered directly through a simple calculator type keyboard using ordinary algebraic language including parentheses. Up to 18 pre-wired programs, of 48 steps each, may be incorporated into the

device and entered automatically by the program or with a touch of a button. Decimal points are located automatically and all answers are printed out to 8 or 9 significant digit accuracy with a 2 digit power of 10 exponent. In addition to the storage registers and program memory, 5 separate registers are used for arithmetic manipulations. Number capacity is 100 columns.

Optional accessory devices include a paper tape punch and reader with page printer, remote location keyboard and direct entry punched paper tape reader.
(For more information, designate #43 on the Readers Service Card.)

MAGNETIC CARD MEMORY PROVIDES 100 MILLION BIT CAPACITY

Model MCM-1 Magnetic Card Memory, developed by Computer Accessories Corp., Santa Barbara, Calif., provides an on-line random access storage capacity of 100 million bits with a maximum access time of 50 milliseconds. The device uses long wearing flexible magnetic cards contained in interchangeable cartridges as the storage medium. Each cartridge holds 64 cards and can be loaded or unloaded on the MCM-1 in less than five seconds.

A single 32-track dual-gap magnetic head provides read-after-write capability and the maximum data rate is 10.4 megabits/second when 32 tracks are processed in parallel. There are 128 recorded tracks on each magnetic card divided into four groups of 32 tracks each. Moving the magnetic head from one group to another takes less than 20 milliseconds.

The equipment includes a transport mechanism, two electronics chassis and one power supply chassis all housed in a self-supporting metal cabinet 6.5' high by 25" wide by 30" deep. All cooling is incorporated so that in normal computer applications no special temperature control is required. Standard 115 volt, 60 cycle power is used. Many optional features are available.
(For more information, designate #45 on the Readers Service Card.)

Data Transmitters and A/D Converters

TALLY SYSTEM 311 FOR DATA TRANSMISSION

The new System 311 for data transmission, by Tally Corporation of Seattle, Wash., makes high-speed, error-free communication between a central computer and outlying points economical for the "data transmission mass market". At a recent press conference in New York City, Tally Corporation officials described the system as a development which "will help industry realize the full potential of computerization."

Each System 311 terminal incorporates a paper tape perforator, reader, and electronic logic. The Tally System 311 Send/Receive Terminal transmits or receives data at speeds of 1200 words per minute over ordinary dial telephone lines, will operate completely unattended, detects and deletes errors, and can be used for off-line tape duplication and editing in its spare time.

According to company spokesmen, net cost of the System 311 is lower than that of the leading competitive system which offers neither error detection nor tape duplication. The Tally system's transmission speed brings about lower phone line costs for a given amount of data. If used only one hour daily, the System 311 will send over a quarter-million more words in a month than will its chief competitor.
(For more information, designate #46 on the Readers Service Card.)

SYSTEM 600 DIAL-O-VERTER

A new "System 600" Dial-o-Verter, from Digitronics Corporation, Albertson, N.Y., will make it possible for intra-corporate communications to handle both message and data traffic at electronic speeds. It is capable of doubling a major corporation's communications capacity for handling administrative messages and data intended for computers. Yet, "System 600" Dial-o-Verter costs no more than the slower telegraphic network it replaces and affords the corporation the opportunity of eventually reducing operating costs.

The system accepts both data and messages on an interspersed basis. The two types of input are automatically separated. Major components of the new "System 600" at the switching center include: a 601 Central Control Station operating on private or toll wires; the 602 Tape Terminal consisting of two or more magnetic tape handlers; Model 603 Operator's Console which controls the entire network of the system; and Model 604 Printer Terminal is available to monitor all messages. At the remote locations the Model 605 Paper Tape Terminals send and receive automatically under direction of the Central Control Station. The basic system will handle up to 64 remote high-speed terminals. Additional capacity is available.

Richard W. Sonnenfeldt, President of Digitronics Corporation, pointed out that "System 600", although factory programmed for each user's system, is the first ever to eliminate do-it-yourself customer programming required even by the latest version of all computer controlled systems; it can be operated simply as soon as it is installed. Other important advantages were listed by Mr. Sonnenfeldt including provision for special handling of priority messages.
(For more information, designate # 47 on the Readers Service Card.)

SIXTEEN CHANNEL PAPER TAPE TO MAGNETIC TAPE CONVERTER

Digi-Data Corporation, Bladensburg, Md., has announced a new translation device from sixteen channel paper tape directly to IBM compatible computer magnetic tape. This portable, completely self-contained unit is capable of accepting standard sixteen hole paper tape generated by rain gauges, level gauges, temperature sensing devices, loggers, etc.

Front panel digital selector switches permit the insertion of twelve digits of fixed data to provide heading information for the computer. The conversion system operates at the rate of 17 readings (68 digits) per second.

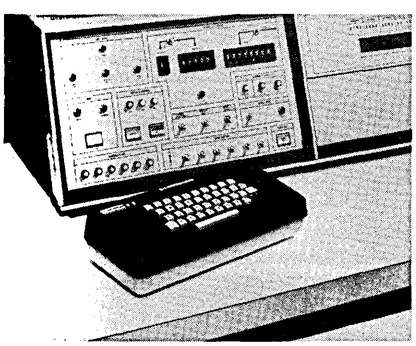
The model 1730 can prepare magnetic tape suitable for computer entry from standard rain gauge tapes. It is believed to be the only paper to magnetic tape translator commercially available which accepts complete paper tape spools (such as those made by Fisher & Porter Company instruments).
(For more information, designate #48 on the Readers Service Card.)

Input-Output

TELEMETRICS MODEL 8096 PHOTO-ELECTRIC KEYBOARD

Telemetrics Division of TMC, Santa Ana, Calif., recently introduced a new photo-electric keyboard. According to the manufacturer, this solid-state keyboard is a new approach to meeting the industry's requirements for a highly reliable, compact and versatile encoding device. For any key pressed, a corresponding code is presented at the output for entry into a computer, tape punch, information retrieval system, or other data handling or display equipment.

The keyboard uses long life lamps which stimulate an arrangement of photo-sensitive devices. When a key is depressed, a given arrangement of shutters, unique to that key, blocks the light path to a series of photoelectric sensors, and initiates a delayed clock pulse.



— Model 8096 Photo-electric Keyboard

Keys are in modular rows and each row can generate 8 bits plus a clock pulse. The keys are arranged on 3/4 inch centers in rows of 13 or less, to any customer arrangement. Quantity of keys per row and number of rows per keyboard are controlled by the customer's configuration. This button spacing feature and the modular row approach mean that a wide range of "special" keyboards can be implemented quickly and economically.

The keyboard is readily adaptable to new applications since changing of output codes is easily accomplished by untrained personnel in an hour or two. The simplicity of design provides a device that is lightweight, compact, easily assembled and tested, at a price competitive with similar electromechanical keyboards.
(For more information, designate #50 on the Readers Service Card.)

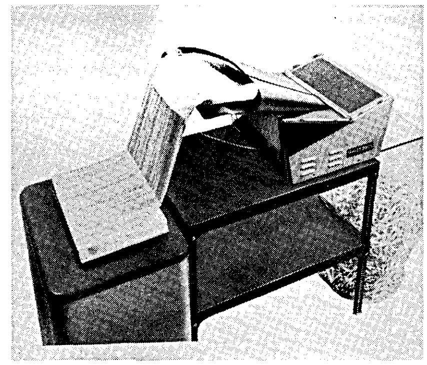
THE 'MINITYPER'

A new low cost, high speed printer, the "Minityper", has been developed by Shepard Laboratories, Inc., Summit, N.J., for use with analog-to-digital converter output (Voltage, Current, Frequency), BCD Counter Output, Telemetry Printout, Computer flip-flop printout and similar applications.

It has speeds of 20 lines per second alpha-numeric or 40 lines per second numeric, with 1 to 48 characters per line. The Shepard "minityper" will accept any input codes of up to 6 binary digits in accordance with customer specifications. Logic levels at any two voltages, plus or minus, with difference in levels of greater than 3 volts. The "Minityper" has all solid state electronics and a self-contained power supply. It is only 8 3/4" high, and is available as a table top cabinet or as a 19" rack mount.
(For more information, designate #51 on the Readers Service Card.)

CONTINUOUS FORMS FEED FUNNEL FOR PAPER SHREDDER

Computer print-outs, single and multiple continuous forms up to 18" wide now can be shredded easily with a new attachment, the Continuous Forms Feed Funnel, recently developed by Electric Wastebasket Corp. of New York for their Super Speed Destroyit Paper Shredder. The new attachment makes possible the security destruction of any type of continuous form, fan-fold or roll; it can accommodate multiple carbon copy forms without removing staples or clips.



Where limited space restrictions warrant an orderly method of forms disposal, the Super Speed Destroyit, with a capacity of up to 500 lbs. of shreds per hour, provides rapid on-the-spot destruction. The Super Speed shredder is available in several models, each differing only in its respective shred width of 3/16", 1/16" or 1/32", depending upon the degree of security required. All models are driven by a powerful dual drive 5/8 H.P. electric motor and run on standard 110 A/C current.
(For more information, designate #49 on the Readers Service Card.)

PORTABLE DIGITAL-RECORDER

The Ralph M. Parsons Company, Pasadena, Calif., now is producing a new digital tape recorder to be known as the DR 1200. This small, portable device reads and writes IBM computer compatible tapes at 200, 556, and 800 bits per inch, with tape speeds up to 120 inches per second. Recording format is 7 or 9 track data on IBM reels.

The DR 1200 weighs only 45 pounds and operates with only 100 watts of power. Overall dimensions are 19 in. x 14 in. x 7.5 in. Design is highly flexible and the recorder can be readily adapted to meet the requirements for field or fixed applications throughout a broad range of environments.
(For more information, designate #52 on the Readers Service Card.)

HIGH-SPEED DIGITAL PRINTER FOR DATA-LOGGING MARKET

DI/AN Controls Inc., Boston, Mass., has introduced the lowest priced high-speed digital data printer presently available for digital data-logging applications.

The Series "DL" Lister/Printer is capable of listing 40 lines of numeric data per second and printing 20 lines of alpha-numeric data per second.

The printer has a simplified design with only 4 major functional assemblies. An exclusive ink-roller exceeds the inking capcity of 10 standard ribbons and will imprint more than 10,000,000 lines before replacement is needed. The individual ballistic impact assembly for each column consists of only two moving parts. Paper feed is accomplished by a simple two-part capstan drive which provides paper motion. Paper input and output bins, which are located on the front panel, have a capacity of 1000 sheets of 2" x 8½" fan-fold paper.

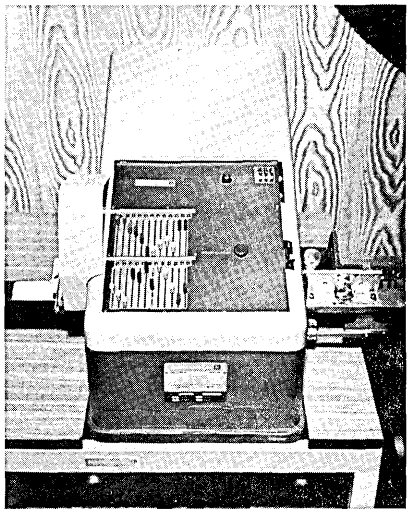
Through a variety of performance and interface options the Series "DL" can be economically and easily adapted to virtually any digital data source. The Series "DL" will accept any binary character code. It has four input data circuits to choose from, and optional line storage with 2 µsec transfer time is available. The machine operates asynchronously or synchronously.
(For more information, designate #53 on the Readers Service Card.)

NEW PRINT-PUNCH MARKING SYSTEM

A new print-punch marking system has been introduced by Litton Industries' Kimball Systems division, Belleville, N.J., The new system makes it possible to machine process a variety of hopper-fed tags with pre-punched "size" holes at the rate of 175 per minute without stopping to change size data.

The Kimball hopper feed system utilizes a Kimball PM 75 punch-marking machine to eliminate multiple set-ups of punch-mark tags. The combination of hopper feed and and pre-punched size information enables the user to select tags with pre-punched holes and run them through the Kimball PM 75 punch-marking machine without additional set-up or processing. This eliminates the possiblility of human error in punching size information into tags at each size change.

A special feature enables the user to punch-mark the exact quantity of tags required by setting automatic controls. The system



provides a fully automatic and versatile print-punch marking method for the retail industry. (For more information, designate #55 on the Readers Service Card.)

SERIES 300 PRINTERS BY DATAMARK, INC.

A new line of Terminal Printers has been announced by Carl I. Wassermann, President of Datamark, Inc., Westbury, L.I., N.Y. The printer system can be used to print data received over a telephone line at its maximum capacity using a Model 201 or similar Dataphone. The interface is easily tailored to operate with any computer. Any data coding can be accommodated. Standard horizontal spacing is 10 characters per inch; vertical spacing is 6 and 8 lines per inch. The paper slew is 3600 lines per minute.

Printers in the new 300 Series do not use hammer sharing or paper side-stepping techniques. Printer specifications are geared to Data Communications, low cost tape to printer and card to printer systems, and as small scale computer outputs. Worst case print speed is 300 lines per minute with full 64 character type font. Ninety-six character fonts are available on special order.

The printer uses nylon or silk ribbons and accommodates plain or pre-printed forms, single or multiple carbons, card stock, pressure sensitive, or transfer masters. Frame sizes are available for 80 and 132 columns.
(For more information, designate #54 on the Readers Service Card.)

Components

NEW PROCESS OPENS WAY TO GENERAL APPLICATION OF INTEGRATED CIRCUITS IN ALL OF COMMUNICATIONS INDUSTRY

An experimental process that opens the way for the first time to general application of integrated circuits throughout the communications industry, including radio, television, radar, microwave, and other systems, has been announced by the Radio Corporation of America. The new process, developed at RCA's David Sarnoff Research Center, Princeton, N.J., produces half-dollar-size mosaics made up of hundreds of tiny silicon tiles, each containing a microelectronic circuit element. The entire assembly is set in a ceramic matrix that insulates the elements electrically from one another.

The experimental process was conceived by Arthur I. Stoller in a long-range Process Research and Development program at RCA Laboratories under the direction of C. Price Smith. It now is undergoing evaluation by RCA's Electronic Components and Devices organization at Somerville, N.J. According to Mr. Smith, present integrated circuits are manufactured on wafers of silicon in the form of tiny rectangles which are insulated from one another by one of two techniques. Both of the techniques are suitable for the production of low voltage digital (computer) circuits and a few types of analog (communications) circuits, he said, but neither is applicable to the vast majority of communications circuits which require higher voltages.

The new process provides an insulating border around each tile that can withstand voltages 100 times greater than those which can be contained by the present techniques, Mr. Smith explained. He added that the new process requires no modification to long-established diffusion techniques for building microcircuits into tiles, or for depositing the circuit interconnections in the desired pattern. He said that the insulating material used in the new RCA process is a low-loss ceramic which is not only resistant to high voltages, but also is easy to use and produces a far more rugged circuit mosaic than can be achieved with the present processes.

ELECTRONIC SAFETY DEVICES MADE BY NEW COMPANY

A device made by Pacific Data and Controls, Portland, Ore., preserves signals transmitted down long lines or over radio circuits for hours in case lines go down or power fails. It also is used in digital computer control systems. Called a sample and hold amplifier, it operates on a new all-electronic principle which eliminates costly and bulky mechanical arrangements previously used.

Model 101 memorizes analog input values for hours after input is removed. This all electronic solid state amplifier holds values to better than 1% yet it uses no unwieldy and expensive electro-mechanical arrangements. When used with Model 4010 Digital-to-Analog Converter in a digital control system, it provides fail-safe operation when the digital processor fails or is taken off-line for a length of time. A unique capacitance-feedback amplifier performs the required memory function yet reduces cost substantially over the nearest competing device on the market.

The Model 101, may be used in a multitude of applications where information must be transmitted from one place to another and loss of this information would cause a dangerous condition or costly misoperation. Provision is made for either manual or automatic operation. Transfer from automatic to manual and vice versa may be performed without discontinuing service.
(For more information, designate #56 on the Readers Service Card.)

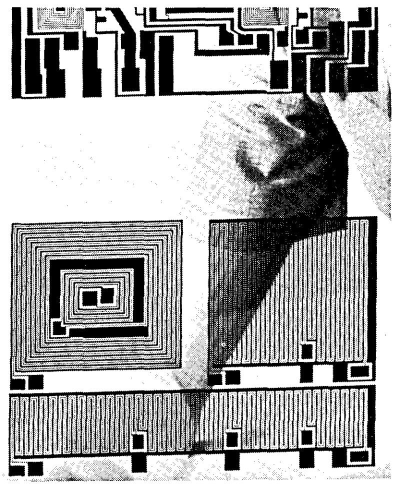
EASY-PEEL TAPE REEL LABELS

An extensive line of Able-Stik Easy-Peel Tape Reel Labels for identification of magnetic tape reels, disc packs and other data processing hardware is available from Allen Hollander Company, Inc., Bronx, N.Y.

Made of special latex-impregnated stock, Easy-Peel labels adhere firmly to spinning reels, yet can be cleanly removed in one piece when re-labeling is required. They come in a wide range of sizes and styles, multiple or individually cut. Custom copy may be imprinted. (For more information, designate #57 on the Readers Service Card.)

MASTER NEGATIVES OF GLASS PRODUCE CIRCUIT BOARDS

Photoplates made of chemically strengthened glass are being used as master negatives to produce circuit boards for IBM System/360 computers. Each master is used to produce many circuit boards and is remade to a new pattern as engineering changes are placed in production.



Glass plates were chosen for their transparency and dimensional stability. High strength is required to reduce loss of the costly circuit masters and to protect personnel and equipment.

Corning Glass Works, Corning, N.Y., developed the chemically strengthened glass plates with properties tailored to meet these needs. The plates have high impact resistance, but strength is controlled to prevent dicing. If broken, the plates remain in a few large pieces rather than dicing into small particles difficult to remove from precision machinery.

The finished plates are coated with an Eastman Kodak Orthochromatic Type 3 emulsion, and the circuit pattern is then produced by photographic techniques. The plates are approximately 9.5 x 14.5 inches, with a nominal thickness of 0.090-inch. The chemically strengthened plates are marketed by Corning's Optical Products Department.
(For more information, designate #59 on the Readers Service Card.)

NEW TEST JIG FROM COMPUTER TEST CORP.

The new Model 4031 Core Test Jig, by Computer Test Corporation, Cherry Hill, N.J., makes possible rapid and accurate analysis of fast switching ferrite memory cores of 30, 50 and 80 mil size. The advantage of the jig is that it provides identical test circuit conditions each time, assuring repeatability of test results and accurate analysis of core performance. Through the use of ground plane circuit design and special shielding techniques, common mode noise induced into the test circuit by the jig is negligible.
(For more information, designate #60 on the Readers Service Card.)

COMPU-PSI® LABELS BY COMPUTRON INC.

COMPU-PSI® (Pressure Sensitive Identification) labels, have been introduced by Computron Inc., Waltham, Mass., to provide instant visual identification of the firm's precision magnetic tape reels.

The new plastic-coated color-coding labels, die-cut in the shape of a ring approximately 4 3/4" in diameter and 1/2" wide, are provided with adhesive backing (protected by a temporary paper covering) which permits instant application to the reel hub. Once applied, they will remain permanently affixed unless deliberately peeled off. If desired, one label may be applied directly over another for a quick change of reel coding. The labels are available in six standard colors: grey, blue, yellow, red, white and green. They are expected to be of particular value to computer users who maintain large tape libraries.

According to a Computron Inc. spokesman, the new labels offer users additional convenience and all color-coded tape reels shipped by the firm will carry this new identification technique. The labels, which are available separately, may be applied on any Computron Inc. tape reels now in use.
(For more information, designate #58 on the Readers Service Card.)

MICRO-MINIATURE DPDT RELAYS

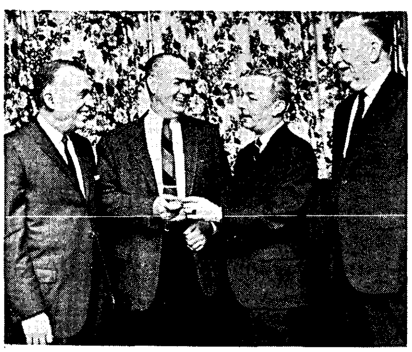
New micro-miniature DPDT relays, which will switch dry circuit to one amp loads with the same sensitivity as other DPDT relays many times their size, have been introduced by Babcock Relays, division of Babcock Electronics Corp., Costa Mesa, Calif. Designated the BR10, the units measure only .400 x .230 x .500, and are designed for low profile, printed circuit mounting. They meet the requirements of MIL-R-5757, and will withstand severe environmental conditions normally encountered in airborne applications; radiation hardened models are also available on special order.

The Model BR10 weights but 0.15 oz. and has a guaranteed life to 150,000 operations, minimum. Sensitivity is stated at 80 milliwatts; vibration performance, 30 g, 40-3000 cps.
(For more information, designate #61 on the Readers Service Card.)

PEOPLE OF NOTE

TEN-YEAR SERVICE AWARD FOR JAMES STEPHENS

James Stephens of Albany (shown in the picture below, second from left), who — despite total blindness — is chief programmer for the New York State Thruway Authority's electronic data processing system, receives a Ten-Year Service Award from Authority Chairman R. Burdell Bixby. Looking on are Joseph Mitchell, chief of the Thruway's Data Processing Bureau, and Daniel J. Langan, Authority Director of Finance and Accounts



Mr. Stephens, 53, who became blind in 1939, joined the Authority in 1956 and became a programmer the following year, when the Thruway acquired its first computer. (The records of the 559-mile Thruway, longest toll superhighway in the nation, are now maintained on two IBM 1401 systems.) When the Authority installs a third-generation computer in April, 1967, Mr. Stephens will develop and redesign all programs for it.

Mr. Stephens, a golf enthusiast, finished third in last year's regional tournament of the Middle Atlantic Blind Golf Association. He carded 126 for 18 holes. During the winter, he bowls weekly and he has a summer home on Cape Cod, where he swims and plays golf.

IBM ENGINEERS EARN PATENT FOR BASIC HIGH-SPEED COMPUTER CIRCUIT

A modification of a basic, high-speed electronic computer circuit — which allows computers to be built with fewer individual circuits — has earned a patent for two IBM Corporation engineers.

F. K. Buelow, of IBM's Corporate headquarters at Armonk, N.Y., and J. R. Turnbull, of the company's components development facility at East Fishkill, N.Y., discovered that the DC (direct current) characteristics of transistors can be used to achieve high operating speeds without the need for additional "adapter" circuits in a cascading chain of circuits. The circuit that has been patented (Patent No. 3,235,754) is a non-saturated, direct-coupled transistor logic circuit of the current-switching or current-steering type.

The basic principle of this circuit also is being used in the 1.5 nanosecond (billionths of a second) hybrid Advanced Solid Logic Technology (ASLT) circuits that will be built into IBM System/360 Model 90 series computers.

MEETING NEWS

1966 SJCC TO BE HELD THIS MONTH

Approximately 4000 persons are expected to attend the Spring Joint Computer Conference being held in Boston this month (April 26 to April 28) at one of the most modern convention sites in the world, the new Prudential Center. This 31.5-acre commercial, hotel and convention facility is located in the city's Back Bay section.

Headquarters hotel, the 29-story Sheraton-Boston, is the tallest in the city. It is overpowered only by the new 52-story Prudential Tower — tallest building in the United States outside of Manhattan.

The center's $12-million War Memorial Auditorium will house an estimated 85 SJCC exhibits and most of the 14 scheduled technical sessions. It contains a 5800-person auditorium, two large exhibit floors with 150,000 square feet of space, and two theatres.

The opening session at 10:00 a.m. Tuesday, April 26, will feature a keynote address by Walter W. Finke, president of Honeywell's electronic data processing division, on the subject "Information: Dilemma or Deliverance?"

Isaac Asimov, noted science-fiction writer and lecturer, will give a talk at the conference luncheon in the Sheraton-Boston's grand ballroom on Wednesday, April 27. Dr. Asimov will speak on "Four Steps To Salvation," or, "How We May Expect Computer Technicians To Save the World."

As part of the educational goals of the conference, lecture and tour programs for 500 top Massachusetts high school students and their teachers will be held on Thursday, April 28.

In addition to the scheduled sessions, a comprehensive SJCC tour program will permit conferees to visit most of the points of paramount interest to computer specialists. Two tours daily of major computing facilities in and around the Boston area include Adams Associates, Air Force Cambridge Research Laboratory, Computer Control Corp., Control Data Corp., Harvard University, Honeywell EDP, MIT's Project MAC and Lincoln Laboratories, Mitre Corporation, Raytheon, RCA and Sylvania.

Ladies programs will include tours of the famous Freedom Trail, wine-tasting programs and luncheon parties. And as a special attraction, the SJCC committee has obtained hundreds of tickets for opening night of the world-famed Boston Pops on April 28.

Registration for the conference opens Monday evening, April 25, from 7:00 p.m.-10:30 p.m. in the main entrance of the War Memorial Auditorium, and from 8:30 a.m.-5:30 p.m. on Tuesday and Wednesday. The registration fee for members of IFIPS organizations is $10, and for non-members, $20. Fees include a copy of the conference Proceedings.

The Spring Joint Computer Conference is one of two computer conferences sponsored annually by the

American Federation of Information Processing Societies for the purpose of providing an interchange of technical and general information on developments in the information sciences field for persons specializing in computers and related technologies.

BUSINESS NEWS

RCA SALES ACHIEVE RECORD — COMPUTER ORDERS UP 92%

Sales and earnings of RCA in 1965 set new records for the fourth consecutive year, the company reports.

Profits after taxes amounted to $101,161,000, an increase of 23 per cent over the previous high of $82,495,000 in 1964. Total sales rose 13 per cent to $2,057,117,000 from $1,812,459,000 a year earlier, surpassing the $2 billion level for the first time. Both earnings and sales for 1965 exceeded earlier year-end estimates.

In electronic data processing, RCA executives reported profitable operations for the second consecutive year. They said that the potential for future profits was enhanced by the booking in 1965 of orders for 92 per cent more RCA computer systems than in the preceding year. They added that, by 1970, "profits from the data processing business, including computers, communications equipment, electronic displays, licensing, and service, are expected to become a highly significant factor in RCA's total earnings."

EAI PROFITS DROP 39%

Electronic Associates, Inc., reports net sales for 1965 were $32,614,365, a slight decline from 1964 sales of $33,835,375.

Orders received for 1965 reached a record high of $39,192,000 as against $37,520,000 for the previous year.

Net income in 1965 was $1,130,013, compared with $1,863,601 in the previous year, a 39% decline.

"The decline in net income in 1965 was due in large part to the continuing expenses involved in bringing three major new products through development and into efficient production," EAI President, Lloyd F. Christianson said. "Our position in the analog market has been strengthened by the introduction of the EAI 8800 and EAI 680 systems, and the EAI 8400 is an important step in establishing us in the digital scientific computation field. The new record high in orders and backlog supports our belief in the value of these programs.

"With a good portion of the expenses related to these programs now absorbed, we expect improvements in 1966, particularly in the second half of the year. Orders, net sales and profits should advance as compared with 1965," Mr. Christianson concluded.

MAI INVESTS $61 MILLION IN DP EQUIPMENT

MAI reports gross revenues for the quarter ended December 31, 1965, amounted to $7,817,800, a gain of 334% over gross revenues of $1,803,400 for the quarter ended December 31, 1964. Net income after provision for taxes amounted to $641,800, an increase of 295% from $162,300.

Investment in data processing equipment, nearly all of which is being leased to customers, increased to $83,271,400, as compared with $59,427,200 and $22,002,200, respectively, at September 30, 1965, and December 31, 1964.

Rentals billed for the month of February, 1966, exceed $3 million for the first time, the company stated.

AMPEX SETS RECORDS

Record sales, incoming orders and earnings for any third quarter and nine months were achieved by Ampex Corporation in the periods ended January 29, 1966, William E. Roberts, president and chief executive officer, relates.

Sales for the first three quarters of fiscal 1966 were $115,221,000, up 7 percent from $107,338,000 in the first nine months of fiscal 1965. Net earnings after taxes were $5,664,000, up 8 percent from $5,234,000.

For the third quarter, sales were $41,768,000, up 9 percent from $38,356,000. Net earnings after taxes were $2,230,000, up 11 percent from $2,008,000.

"Of particular import is the marked gain in our incoming orders rate and subsequent increase in order backlog," Roberts Said.

"Exclusive of geophysical service contracts, incoming orders in the third quarter were $44,100,000, up 94 percent from $22,700,000. For the nine months, orders were $108,600,000, up 42 percent from $76,300,000. Our backlog of product orders is at an all time high of $54,600,000, up 71 percent from this time last year, and consists primarily of commercial, industrial and consumer product orders.

MONTHLY COMPUTER CENSUS

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

To aid our readers in keeping up with this mushrooming activity, the editors of COMPUTERS AND AUTOMATION present this monthly report on the number of general purpose electronic computers of American-based companies which are installed or on order as of the preceding month. These figures included installations and orders outside the United States. We update this computer census monthly, so that it will serve as a "box-score" of progress for readers interested in following the growth of the American computer industry, and of the computing power it builds.

In general, manufacturers in the computer field do not officially release installation and on order figures. The figures in this census are developed through a continuing market survey conducted by associates of our magazine. This market research program develops and maintains a data bank describing current computer installations in the United States. A similar program is conducted for overseas installations.

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

AS OF MARCH 10, 1966

NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS
Advanced Scientific Instruments	ASI 210	Y	$3850	4/62	24	0
	ASI 2100	Y	$4200	12/63	7	1
	ADVANCE 6020	Y	$4400	4/65	7	6
	ADVANCE 6040	Y	$5600	7/65	3	6
	ADVANCE 6050	Y	$9000	2/66	1	4
	ADVANCE 6070	Y	$15,000	10/65	1	6
	ADVANCE 6080	Y	$13,000	4/66	0	0
Autonetics	RECOMP II	Y	$2495	11/58	45	X
	RECOMP III	Y	$1495	6/61	10	X
Bunker-Ramo Corp.	BR-130	Y	$2000	10/61	159	5
	BR-133	Y	$2400	5/64	19	4
	BR-230	Y	$2680	8/63	15	X
	BR-300	Y	$3000	3/59	37	X
	BR-330	Y	$4000	12/60	34	X
	BR-340	Y	$7000	12/63	20	X
Burroughs	205	N	$4600	1/54	50	X
	220	N	$14,000	10/58	41	X
	E101-103	N	$875	1/56	145	X
	B100	Y	$2800	8/64	125	16
	B250	Y	$4200	11/61	95	4
	B260	Y	$3750	11/62	225	10
	B270	Y	$7000	7/62	148	12
	B280	Y	$6500	7/62	120	16
	B300	Y	$8400	7/65	68	90
	B5500	Y	$20,000	3/63	49	10
	B8500	Y	$200,000	2/67	0	1
Clary	DE-60/DE-60M	Y	$525	7/60	355	4
Computer Control Co.	DDP-24	Y	$2500	5/63	70	8
	DDP-116	Y	$900	4/65	45	48
	DDP-124	Y	$2050	3/66	2	12
	DDP-224	Y	$3300	3/65	20	22
Control Data Corporation	G-15	N	$1600	7/55	310	X
	G-20	Y	$15,500	4/61	23	X
	LGP-21	Y	$725	12/62	98	X
	LGP-30	semi	$1300	9/56	295	X
	RPC-4000	Y	$1875	1/61	50	X
	160*/160A/160G	Y	$1750/$3400/$12,000	5/60;7/61;3/64	450	1
	924/924A	Y	$11,000	8/61	30	X
	1604/1604A	Y	$45,000	1/60	58	X
	1700	Y	$2200	5/66	0	32
	3100	Y	$7350	12/64	63	32
	3200	Y	$12,000	5/64	97	10
	3300	Y	$15,000	9/65	4	35
	3400	Y	$25,000	11/64	19	6
	3500	Y	$30,000	9/66	0	4
	3600	Y	$58,000	6/63	50	10
	3800	Y	$60,000	2/66	1	16
	6400	Y	$40,000	3/66	0	11
	6600	Y	$110,000	8/64	9	5
	6800	Y	$140,000	4/67	0	2
Data Machines, Inc.	620	Y	$900	11/65	6	32
Digital Equipment Corp.	PDP-1	Y	$3400	11/60	60	X
	PDP-4	Y	$1700	8/62	55	2
	PDP-5	Y	$900	9/63	112	1
	PDP-6	Y	$10,000	10/64	14	7
	PDP-7	Y	$1300	11/64	54	48
	PDP-8	Y	$525	4/65	180	275
El-tronics, Inc.	ALWAC IIIE	N	$1820	2/54	21	X
Electronic Associates, Inc.	8400	Y	$7000	6/65	4	6
Friden	6010	Y	$600	6/63	540	85
General Electric	115	Y	$1375	12/65	30	420
	205	Y	$2900	6/64	44	8
	210	Y	$16,000	7/59	50	X
	215	Y	$6000	9/63	55	2
	225	Y	$8000	4/61	155	10
	235	Y	$10,900	4/64	60	8
	415	Y	$7300	5/64	100	65
	425	Y	$9600	6/64	54	40
	435	Y	$14,000	10/64	22	18
	625	Y	$14,000	12/64	12	26
	635/645	Y	$45,000	12/64	5	28
Honeywell Electronic Data Processing	H-120	Y	$2600	1/66	25	290
	H-200	Y	$5700	3/64	600	110
	H-400	Y	$8500	12/61	122	5
	H-800	Y	$22,000	12/60	86	3
	H-1200	Y	$6500	2/66	1	42

NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS
Honeywell (cont'd)	H-1400	Y	$14,000	1/64	12	1
	H-1800	Y	$30,000	1/64	17	6
	H-2200	Y	$11,000	1/66	2	44
	H-4200	Y	$16,800	3/66	0	8
	H-8200	Y	$35,000	3/67	0	3
	DATAmatic 1000	N	$40,000	12/57	4	X
IBM	305	N	$3600	12/57	165	X
	360/20	Y	$1800	12/65	45	4100
	360/30	Y	$7500	5/65	800	3200
	360/40	Y	$15,000	4/65	525	1000
	360/44	Y	$10,000	9/66	0	380
	360/50	Y	$26,000	8/65	25	360
	360/62	Y	$55,000	11/65	1	X
	360/65	Y	$50,000	11/65	2	110
	360/67	Y	$54,000	9/66	0	50
	360/75	Y	$78,000	2/66	1	55
	360/90 Series	Y	$140,000	6/67	0	8
	650	N	$4800	11/54	240	X
	1130	Y	$1000	11/65	50	2000
	1401	Y	$6000	9/60	6650	250
	1401-G	Y	$1900	5/64	1325	60
	1410	Y	$14,200	11/61	745	40
	1440	Y	$3300	4/63	2850	220
	1460	Y	$9000	10/63	2000	150
	1620 I, II	Y	$2500	9/60	1700	30
	1800	Y	$3700	1/66	1	150
	701	N	$5000	4/53	1	X
	7010	Y	$22,600	10/63	185	25
	702	N	$6900	2/55	8	X
	7030	Y	$160,000	5/61	7	X
	704	N	$32,000	12/55	37	X
	7040	Y	$18,000	6/63	118	8
	7044	Y	$35,200	6/63	122	20
	705	N	$30,000	11/55	60	X
	7070, 2, 4	Y	$27,000	3/60	335	5
	7080	Y	$55,000	8/61	80	X
	709	N	$40,000	8/58	11	X
	7090	Y	$63,500	11/59	45	1
	7094	Y	$72,500	9/62	130	5
	7094 II	Y	$78,500	4/64	115	15
ITT	7300 ADX	Y	$18,000	9/61	9	6
Monroe Calculating Machine Co.	Monrobot IX	N	Sold only - $5800	3/58	150	X
	Monrobot XI	Y	$700	12/60	580	100
National Cash Register Co.	NCR - 304	Y	$14,000	1/60	26	X
	NCR - 310	Y	$2000	5/61	20	X
	NCR - 315	Y	$8500	5/62	385	50
	NCR - 315-RMC	Y	$12,000	9/65	10	25
	NCR - 390	Y	$1850	5/61	1070	35
	NCR - 500	Y	$1500	10/65	180	800
Philco	1000	Y	$7010	6/63	20	0
	2000-210, 211	Y	$40,000	10/58	18	1
	2000-212	Y	$52,000	1/63	11	1
Radio Corporation of America	Bizmac	N	$100,000	-/56	3	X
	RCA 301	Y	$6000	2/61	645	5
	RCA 3301	Y	$11,500	7/64	47	16
	RCA 501	Y	$14,000	6/59	99	2
	RCA 601	Y	$35,000	11/62	5	X
	Spectra 70/15	Y	$2600	11/65	15	90
	Spectra 70/25	Y	$5000	11/65	7	55
	Spectra 70/35	Y	$7000	4/66	0	45
	Spectra 70/45	Y	$9000	11/65	3	125
	Spectra 70/55	Y	$14,000	5/66	0	12
Raytheon	250	Y	$1200	12/60	172	2
	440	Y	$3500	3/64	14	3
	520	Y	$3200	10/65	5	5
Scientific Control Systems	650	Y	$500	12/65	0	2
	660	Y	$2000	10/65	2	1
	670	Y	$2600	12/65	0	2
Scientific Data Systems Inc.	SDS-92	Y	$775	4/65	35	45
	SDS-910	Y	$2000	8/62	167	13
	SDS-920	Y	$2700	9/62	112	10
	SDS-925	Y	$2500	12/64	15	33
	SDS-930	Y	$4000	6/64	84	30
	SDS-9300	Y	$7000	11/64	20	9
Systems Engineering Labs	SEL-810	Y	$750	9/65	4	13
	SEL-840	Y	$4000	11/65	2	3
UNIVAC	I & II	N	$25,000	3/51 & 11/57	30	X
	III	Y	$20,000	8/62	84	1
	File Computers	N	$15,000	8/56	18	X
	Solid-State 80 I, II, 90 I, II & Step	Y	$8000	8/58	275	X
	418	Y	$11,000	6/63	62	28
	490 Series	Y	$35,000	12/61	88	60
	1004	Y	$1900	2/63	3300	160
	1005	Y	$2400	3/66	0	155
	1050	Y	$8000	9/63	285	80
	1100 Series (except 1107)	N	$35,000	12/50	12	X
	1107	Y	$60,000	10/62	30	2
	1108	Y	$65,000	9/65	5	16
	LARC	Y	$135,000	5/60	2	X
				TOTALS	32,504	16,325

X = no longer in production.

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


IBM
SYSTEM 360
RPG
COGO
SAP
AUTOCODER
FORTRAN
COBOL
PL/I

PACKER-PEOPLE PROCESSING

(Continued from page 23)

3. "Electronic Roads for Tomorrow's Traffic." *Business Week,* April 24, 1965, p. 160. Cornell Labs long-range plan for automated highways and standardized "Urbmobiles."
4. "Federal Group Pushes Plans for 400 mph Train for Northeast." *Wall Street Journal,* July 21, 1965, p. 1. M.I.T.'s long-range study for traffic through the "Northeast Corridor."
5. "Fifty Years of Rapid Transit: 1864-1917," Walker, J. B. New York City, 1918. An historical overview of municipal mass transit's development.
6. "Getting to Work and Back," Brecker, Ruth and Edward. *Consumers Union* series, Feb., March, April 1965.
7. "High-Speed Tube Transportation," Edwards, L. K. *Scientific American,* Aug. 1965. Feasibilities of a radical new system.
8. "Highways: Sharp Turn Ahead." *Forbes,* Oct. 1, 1965, pp. 24-29. A documentation of the economic inevitability of a trend from private to public transportation.
9. "How to Move 154,000,000 Children," Crenson, Gus A. *American Education,* July, Aug. 1965, pp. 10-12. The problem of safe, low-cost, speedy school bus transportation.
10. "In Chicago, the Rider is King." *Business Week,* March 20, 1965, p. 82. Successful and profitable commuter railways.
11. "Landing a Jet without Looking," Lader, L. *Sat. Evening Post,* 237:64-5, Feb. 15, 1964. Automation of air traffic all the way to landing operation itself.
12. "Moving People." *Railway Age,* Oct. 4, 1965, pp. 16-21. Facing the problem of integrated transportation systems which consider collection, movement, and dispersion of people conveniently.
13. "Toting Commuters by Computers." *Business Week,* April 10, 1965, p. 122. San Francisco's BARTD test track for electronically controlled mass transit.
14. "Transit: BART Opens a Golden Gate." *Railway Age,* Aug. 2, 1965, pp. 17-29. Complete technical summary of San Francisco's automated transit development to date.
15. "Transportation in Cities." Historical and operations research perspectives on urban transit problem.
16. "Transporting People," Herbert, Evan, Assoc. Ed. *Science & Technology,* Oct. 1965, pp. 30-38. Improving the "interface" between connecting modes of passenger transportation.
17. "Westinghouse Aims High with a Bus." *Business Week,* Sept. 18, 1965, p. 57. Total systems approach in Pittsburgh-size cities.

JACOBY and LALIBERTÉ

(Continued from page 39)

the building block change? Are any wiring or circuit rules being violated by the change? If a change will result in a serious violation of some one or several of such conditions, it is not processed and the exception is noted. Some violations are not too serious and the change is permitted but the violations are called to the attention of the designers by error printouts.

Cost of Design Automation

The development of a design automation program system is not cheap, but the gains to the user and the aggregate economies over former methods are considerable.

The cost of design automation falls into two categories: the cost to develop a system of programs; and the cost to use a system of programs. The total development cost is offset by the number of equipment development projects which are able to use the particular system. If the system is well designed, the running cost to a project is lower than the less effective manual methods.

The reduction of lead time between initial design and delivery is of great value to any user. This implies that a debugged running design automation system is available prior to the start of a design project which is to use it. A comprehensive system of programs takes time to develop. This development time must then precede all design projects which can use this system. The processing costs must be borne by each project using the system. Therefore, the system must be efficient with respect to its own use of computer time.

Requirements

For a system to use computer time efficiently, there are the following requirements:

1. Maximum checking for errors but minimum additional processing on trial runs to eliminate errors.
2. Effective utilization of tapes, files, and program linkage to minimize both normal running time and rerun time required in case of transient computer system malfunction.
3. Efficient algorithms.
4. Efficient coding.

Reduction of Cost of Design Automation

There are two principal ways to reduce the effective development cost of a design automation program. The first is for management to insist that standard packages and production techniques be used. The second is that the design automation program system be written so that the overall system, much of the files, and as many of the programs as possible be independent of the packaging and circuit techniques.

The first approach is very effective until the packaging technique must be changed because of technological advances. Changes in packaging affect only a minor portion of the programs. Some of these programs may only need parameter changes for such items as number of wires per pin, distance measurements, fan-in/fan-out rules, wire length rules, etc. Other programs that fit the logic to the required hardware package configuration usually need to be completely replaced.

Therefore a manufacturer can develop a general system of design automation programs. He can define a standard package for most of his equipment. The development cost to the individual project can be small if a project that requires deviations pays for the extra programs required. The cost for use chargeable to an individual project should not be greater than any other method of documentation and the overall saving to an individual project and to the manufacturer as a whole should be considerable.

Any company that uses standard building blocks in the design of its equipment, should seriously consider design automation.

Note

The first paper on design automation was given at the Western Joint Computer Conference in 1956 by S. R. Cray and R. N. Kisch. Their paper described a system that used mechanized methods for checking design logic, performing processes of detailed design such as planning component arrangement, determining wiring, and preparing manufacturing documents and maintenance aids. Since then numerous articles relating to design automation have been published. A bibliography has been collected by the Design Automation Subcommittee of the Computing Devices Committee of IEEE.

CALENDAR OF COMING EVENTS

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

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

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

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

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

April 25, 1966: 3C Users Group (CAP), Sheraton-Plaza Hotel, Boston, Mass.; contact Lorraine Heath, Computer Control Co., Old Connecticut Path, Framingham, Mass. 01702

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

April 28-30, 1966: SDS Users' Group, Sheraton Boston Hotel, Boston, Mass.; contact Hal Tuens, Scientific Data Systems, 1649 17th St., Santa Monica, Calif. 90404

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

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

May 4-6, 1966: The Honeywell 400/1400 Computer Users Association, King Edward Sheraton Hotel, Toronto, Canada; contact Gordon P. Brunow, Olin Mathieson Chemical Corp., New Haven, Conn.

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

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

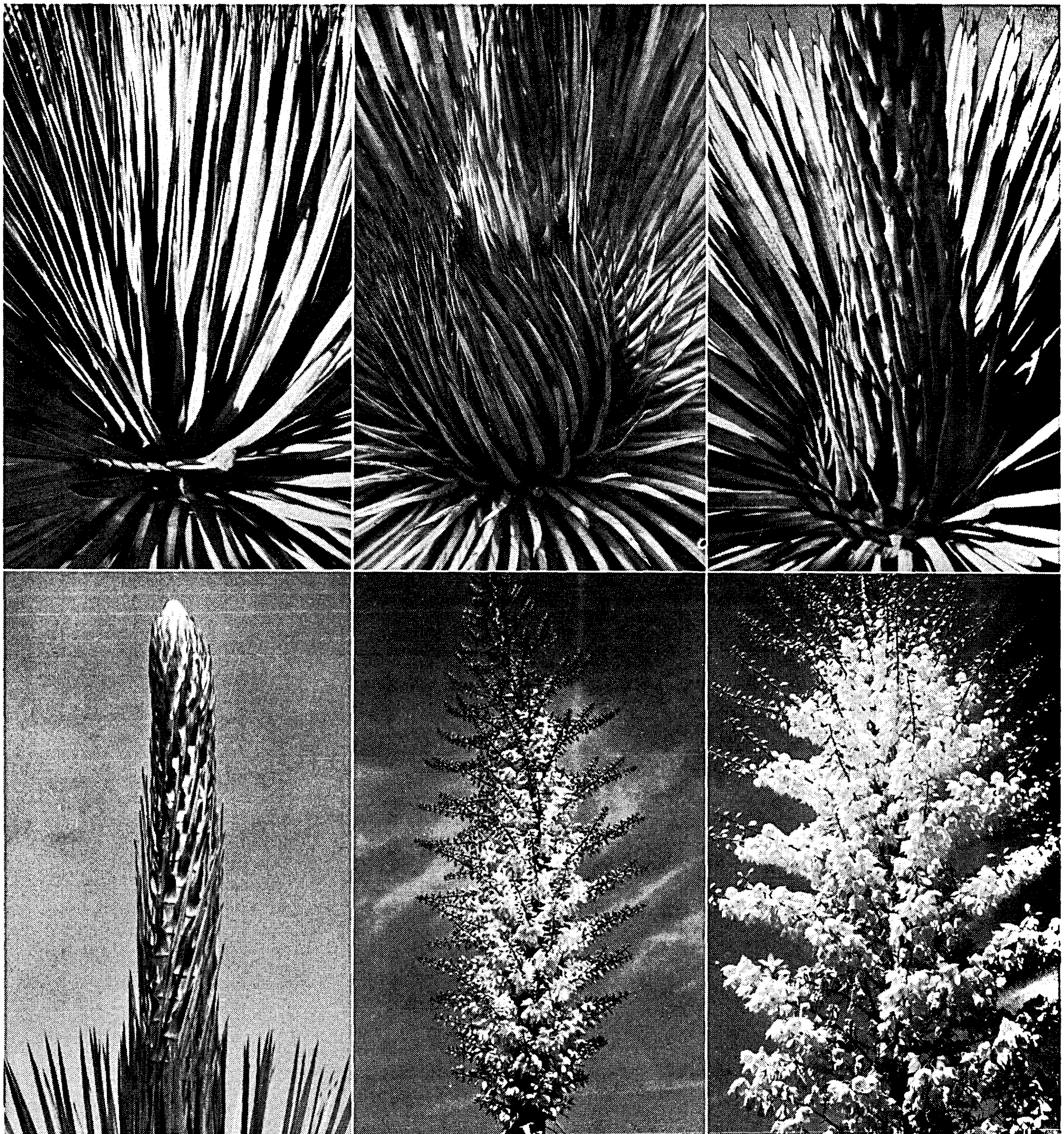
May 16-18, 1966: Annual SHARE Design Automation Committee Workshop, Jung Hotel, New Orleans, La.; contact Joseph Behar, Secretary, IBM, 425 Park Ave., New York, N.Y. 10022

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

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

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

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



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at NCR's expanding electronics division in los angeles

Your digital-systems career can blossom now at NCR. By early next year the fast-growing Electronics Division, already the largest commercial computer facility in Southern California, will more than double its present size. The reasons: rapid, worldwide acceptance of NCR systems and a record backlog. Incoming computer orders during 1965 climbed 85 per cent over the 1964 level and for the first time passed the $100,000,000.00 mark. Sales of NCR 315 systems in 1965 were more than twice those of the previous year. NCR means business—not someday, but now. How about putting your future in the present tense?

THIS IS GROWTH YEAR
AT NCR ELECTRONICS DIVISION

NEW PATENTS

RAYMOND R. SKOLNICK
Reg. Patent Agent
Ford Inst. Co., Div. of Sperry Rand Corp., Long Island City 1, New York

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.

September 14, 1965 (Continued)

3,206,735 / Edwin S. Lee III, Altadena, Calif. / Burroughs Corporation / Associative Memory And Circuits Therefor.

3,206,736 / Konstanty E. Krylow, and James T. Perry, Glen Ellyn, Ill. / Automatic Electric Laboratories Inc. / Self-Resetting Magnetic Memories.

September 21, 1965

3,207,912 / John C. Mallinson, Harrisburg, Pa. / AMP Inc. / Multi-Aperture Core Logic Circuit.

3,207,913 / Gerald B. Herzog, Princeton, N. J. / Radio Corporation of America / Logic Circuit Employing Transistors And Negative Resistance Diodes.

3,207,918 / Arden J. Wolterman, Apalachin, N. Y. / International Business Machines Corp. / Logic Circuits.

3,207,920 / Remo Galletti, Milan, Italy / Ing. C. Olivetti & C., S.p.A., Ivrea, Italy / Tunnel Diode Logic Circuit.

3,207,924 / Melvin M. Kaufman, Merchantville, N. J. / Radio Corporation of America / Logical And Circuit Utilizing A Tunnel Diode.

3,208,043 / Jack K. Shortle, Poughkeepsie, N. Y., and Russell A. Rowley, Saratoga, Calif. / International Business Machines Corp. / Magnetic Core Matrix Switch.

3,208,044 / Norbert G. Vogl, Jr., Wappingers Falls, N. Y. / International Business Machines Corp. / Magnetic Core Matrix Switch.

3,208,053 / Alexander Elovic, Elizabeth, N. J. / Indiana General Corp. / Split-Array Core Memory System.

3,208,054 / Conrad J. Kaiser, Dunellen, Marshall R. Boggio, Point Pleasant, and Robert J. Melnick, Woodbridge, N. J. / Lockheed Aircraft Corp. / Noise Cancellation Circuit For Magnetic Storage Systems.

3,208,055 / Alfred R. Lucas, Lakewood, Ohio / International Telephone and Telegraph Corp. / Magnetic Memory Device And System.

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.

BRANDON

APPLIED SYSTEMS, INC.

and

computers
and automation

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

TECHNICAL COURSES IN DATA PROCESSING

— conducted by Brandon Applied Systems, Inc.
— sponsored by Computers and Automation

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

New York, N.Y. — April 6, 7
London, England — May 17, 18

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

New York, N.Y. — April 5
London, England — April 25

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

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

"Management Audit of Data Processing"
a 1-day course for data processing management, senior management responsible for the data processing function, management analysts, and organizational specialists.

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

"Appreciation Course in Data Processing"
a 2-day course for top executive and departmental management covering the basic principles of data processing.

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

"Introduction to Data Communication and Time Sharing"
a 1-day course intended for data processing managers, departmental managers, and others using data communication equipment or time-sharing techniques.

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

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

London, England — May 16

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

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