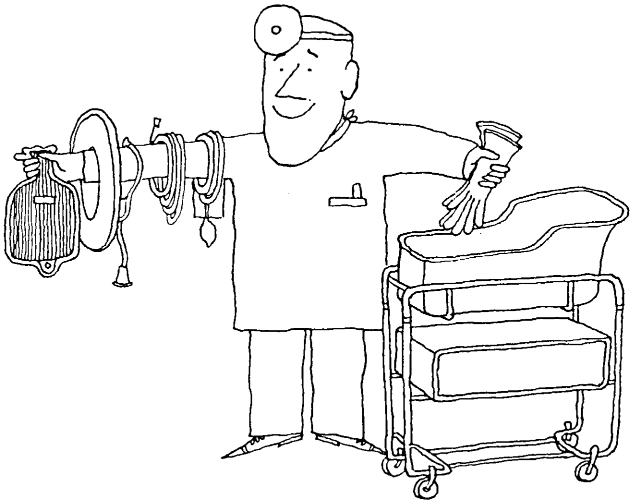
May, 1967

computers and automation

Kentucky Children Communicate with Computer in California



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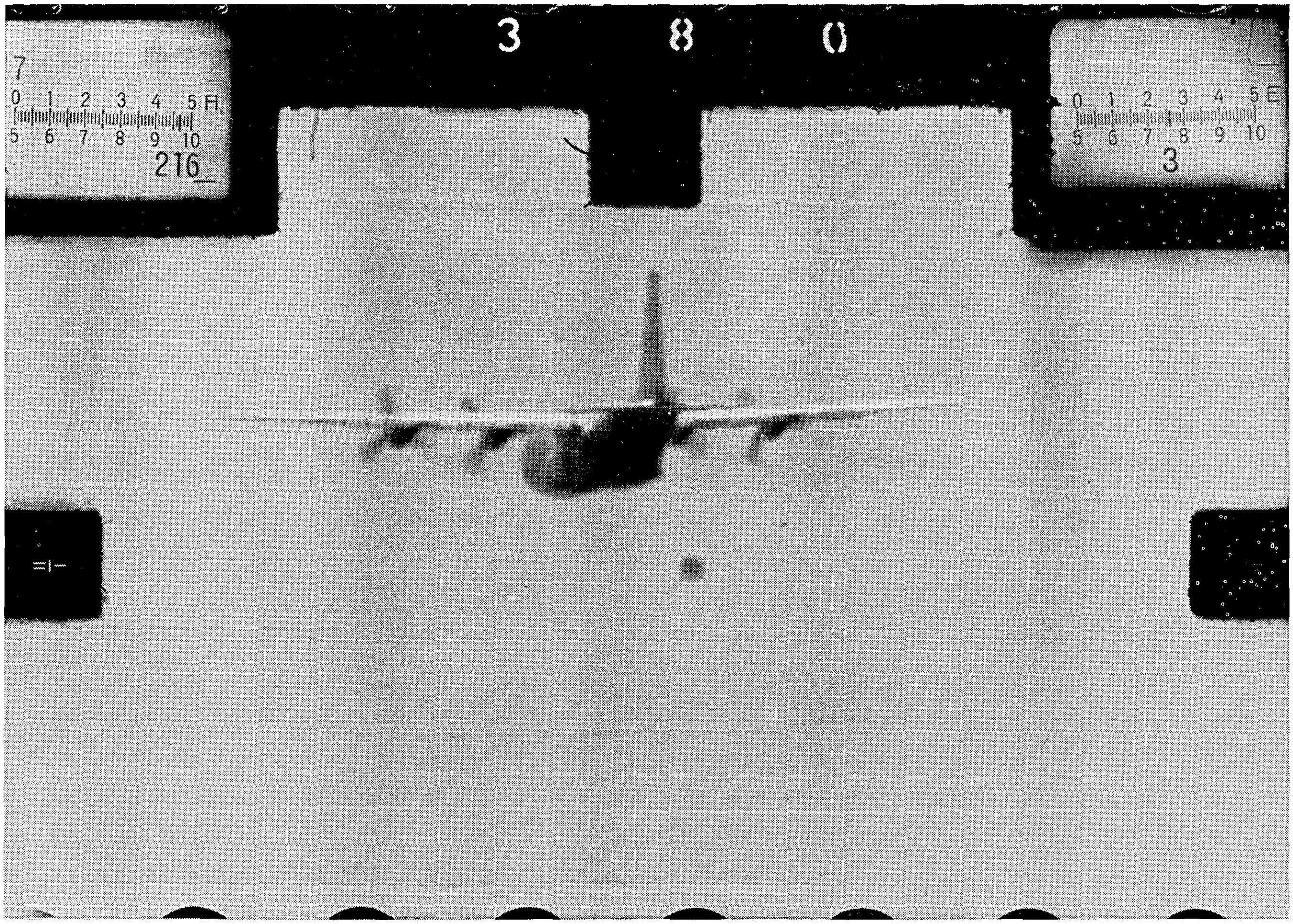

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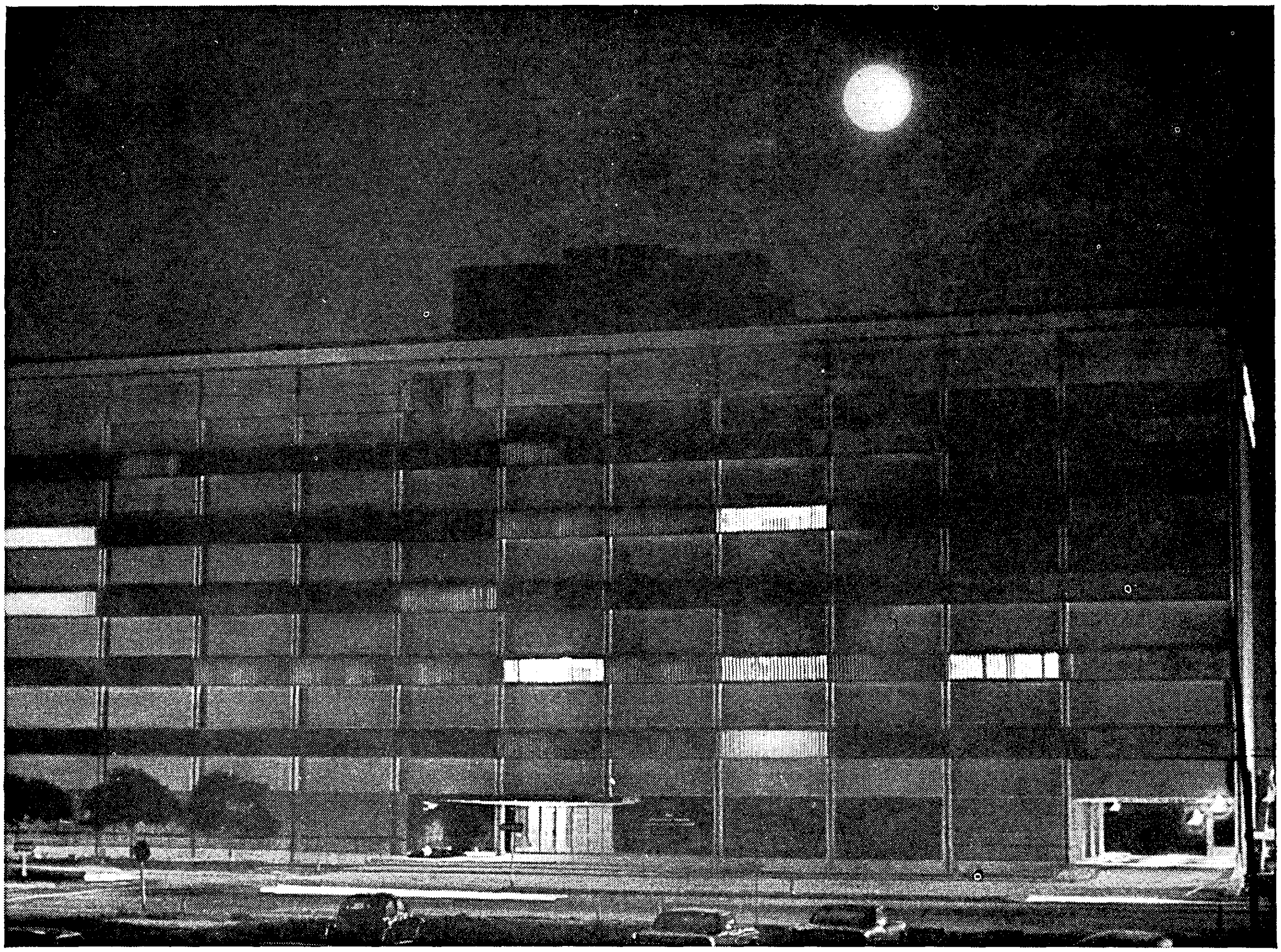

computers and automation

The front cover shows a second-grade student in Kentucky answering a problem presented by a computer in California while her classmates watch. For more information, see page 52.

MAY, 1967 Vol. 16, No. 5

Special Feature:

Data Communications

***D ON YOUR ADDRESS IMPRINT MEANS THAT YOUR SUBSCRIPTION INCLUDES THE COMPUTER DIRECTORY. *N MEANS THAT YOUR PRESENT SUBSCRIPTION DOES NOT INCLUDE THE COMPUTER DIRECTORY.**

ABC

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Computers and Scientific Models

An interesting and significant article appeared in "The Nation" for March 13, 1967, entitled "The Cybernetics of Blunder." It was written by Mordecai Roshwald, who teaches at the University of Minnesota, and is the author of "Level 7," a novel about one kind of future. He says, among other things (in substance):

> Contrary to popular belief, science is simpler, less complex, less sophisticated, than reality. It is true, of course, that scientific formulas may prove quite intricate: this, however, does not mean that the things they try to formulate, including situations produced by laymen, are less complex. The attempt to generalize makes for the intricacy of science, yet its intricacy is no guarantee of reliability: the particular, the unique, may well escape the net of the formula, however finely knotted it may seem. In the realm of political affairs, the net has had singularly big holes, while the situations retain an unusual degree of individuality. In other words: the generalizations are too broad to net the phenomena. No wonder that some peculiar situations slip through the net.
>
> Modern social scientists — in their attempt to be scientific, to grasp reality in general formulas — incline to think in models. When you ask a social scientist today why Nation A wages war on, or makes peace with, Nation B, do not expect an answer "because of economic interests," or "because of traditional hostility," or "because of man's insanity." Such answers are regarded as fit for a journalist or a philosopher. The scientist will tell you it is all bound up with the *decision-making process*. Only very few people seem to realize that this phrase means no more than that decisions in politics are made, and that there are agents who make them. Most laymen — and not a few nonlaymen — seem to believe that the answer is one of substance and that a formula exists which really explains *how* decisions are made. And if one finds it difficult to understand how a single formula can encompass decision making in such diverse countries as . . . , there is always the consolation that what is difficult for men is a mere child's game for electronic computers.
>
> It is hard to know to what extent computers have participated in making decisions in various decision-making situations concerning war . . . but it is a fair guess that the computer *mentality* has had a considerable impact. This mentality implies that one can rely on science and ignore common sense, that one should trust theory and forget about reality, that there are objective answers which dwarf the significance of subjective experiences. The domino theory, the game theory, the escalation model, are all expressions of this sophisticated credulity.

And more besides. In fact, disregarding the sarcasm here and there, the whole article is interesting and worth attention and reflection from computer people. But the main questions we want to discuss here are:

- Is it true that science is simpler and less sophisticated than reality?
- Do scientific concepts and models (including computer models) distort reality and make it harder to understand?
- Is there a "computer mentality" — an attitude of reliance on scientific models that give objective answers — when in truth common sense and subjective experience applied to reality would cause these answers to be thoroughly questioned?

It is probably demonstrable that science is simpler and less sophisticated than reality. Scientific models (and computer models) are essentially double-edged swords: they seem to enable some problems to be solved, at the expense of making other problems harder to solve. Models always have a tendency to distort reality, because they leave out some aspects in order to deal with others. For example, no measurement of a distance in the real world on Earth can be more accurate than 15 significant figures. Yet much of mathematics makes an "important" distinction between what are called "rational" numbers (numbers that can be expressed as the quotient of two whole numbers, like 3/7) and "irrational" numbers (numbers that cannot be so expressed, like the square root of two); yet in the real world of actual measurements, no such distinction can be observed.

Also, science cannot be "true" because it is continually changing, as the history of science shows. Good scientists studying the real world are continually modifying their theories, and issuing new ones. If new theory B contradicts old theory A, both cannot be true. For example, consider fashions in the science of medicine. In the real world, there are great individual variations in human beings; and nowadays many more doctors than a decade ago try a miracle drug much more carefully on a new patient, to see if it actually helps him, instead of harming him.

It is probably not true that scientific concepts and models make reality harder to understand. But with a fairly good theory we certainly tend to pay less attention to reality than we ought to.

Finally, it seems to me that the mentality or attitude that science, and what scientists say, is to be trusted with hardly any questioning is extremely dangerous. We notice the conspicuous evidence of successful predictions in fields like atomic physics, space ships, integrated circuits, modern computers, etc.; and we tend to accept this as evidence that what scientists may say in other fields, such as the domino theory, the game theory, and the escalation model, is also the basis of good predictions. We tend to forget that analogy is a poor argument. To believe what "the scientists say" is perhaps not quite as dangerous as to believe what "the computers say." But in any field the standard for believing "science" must be intimately tied to the record of successful predictions in that field. Predictions that don't come true are evidence of failure. Predictions that cannot be objectively proved or disproved are evidence of nonsense. The real world is more important, complicated, and sophisticated than most of our theories assume it to be.

Edmund C. Berkeley

Editor

MULTI-ACCESS FORUM

A NATIONAL DATA CENTER AND PERSONAL PRIVACY — RESOLUTION PROPOSED

Peter Warburton
Association for Computing Machinery
Washington Chapter
Washington, D.C.

The proposed National Data Center has inherent in it two areas of responsibility for people in the computer field: technical responsibilities, and social responsibilities. Unfortunately, the two cannot be measured in the same way. The economic benefits of a National Data Center can be measured tangibly in terms of dollars and hours and accessibility of information; the effects of such a system on the individual and the potential capacity for the infringement upon the privacy of the individual can only be measured intangibly. Yet the right of the individual must take precedence over any possible economic benefits. Consequently, safeguards and laws to protect the rights of the individual and to give him recourse against invasion of privacy resulting from such a system must be a part of any proposal for a National Data Center.

The Washington, D.C., Chapter of the Association for Computing Machinery has proposed a "Resolution on the National Data Center and Personal Privacy." Following is that resolution.

Recent proposals to consolidate the data activities of government agencies into a single national data center have generated both public and private investigations into the potential invasion of individual rights posed by such consolidation. The existence and operation of other public and private data centers pose the same hazard to individual citizens.

As members of the computing profession, we are concerned not only with technological progress, but also with the larger question of the role of the computer and the computing profession in the American society. Our professional duty requires that we point out the benefits of purely technological innovation and, with the same high level of competence and objectivity, call attention to actual or potential consequences of technological change which may be incompatible with the democratic society.

The question of a national data center is particularly difficult to adjudicate because while the chief potential benefits which motivated the proposal — economies in time and money — can be objectively assessed, the disadvantages that are potentially the most critical can be assessed only subjectively. These disadvantages include the invasion of privacy, the denial of constitutional protection against self-incrimination, and the adverse economic and social consequences of misuse of personal data which could result from the storage, manipulation, and transfer of personal dossiers. The real issue then is whether a possible loss of individual rights, however small, is justified in providing a probable gain, however large, in government efficiency and economy.

In putting the question this way, the conclusion is inescapable that in a democratic society individual rights take precedence and determine a practical upper bound on the efficiency attainable in government. Loss of individual rights can be justified only when a "greater good" for the people as a whole is provided. At this juncture, there does not appear to be a "greater good" derivable from a national data center or other public or private data centers that would justify the hazard to individual liberties posed by placing personal dossiers of a great number of Americans in the hands of a relatively few private or public employees.

Technical safeguards against intentional or inadvertent misuse of personal data by users, data center supervisors, programmers, operators, and maintenance men must provide for absolute accountability in the handling of personal data and must effectively restrict access and use to that which is consistent with constitutional rights. But technical safeguards are not sufficient. Strong laws must be passed and vigorously enforced to provide both an effective legal basis for accountability in the handling of personal data and procedures for redressing and compensating individual injury.

We urge that the need for such safeguards and laws be studied also in relation to the diverse agencies now dealing in personal data. In no case must promises and good intentions be substituted for technical safeguards and effective laws.

The burden of proof therefore rests with the proposers of a national data center to show that such a system is still economically attractive under the legal and technical constraints necessary to protect individual liberties in the American society.

COPYRIGHT REVISION BILL S. 597 — PROVISIONS THAT SEVERELY CRIPPLE TEACHING AND COMPUTER RESEARCH

I. J. D. Madden
Executive Secretary
Association for Computing Machinery
New York, N.Y. 10017

On April 4 in Washington, Dr. Anthony G. Oettinger, President of the Association for Computing Machinery, testified before the U.S. Senate Subcommittee on Patents, Trademarks, and Copyrights. Among other remarks, he stated:

"The proposed bill . . . threatens to cripple severely the very research and the very teaching necessary in order that the 'information storage and retrieval system or any similar device, machine, or process' materialize fully, be understood, and be controllable." His prepared statement follows in full.

II. Dr. Anthony G. Oettinger
Professor of Applied Linguistics and Applied Mathematics
Harvard University
Cambridge, Mass. 02138

Mr. Chairman, may I first thank you for the invitation to appear before your Subcommittee and for the opportunity to express my views on a matter which is of deep concern to me not only as a college teacher, as President of the Association for Computing Machinery (ACM) and as a member of the Board of Governors of the American Federation of Information Processing Societies (AFIPS), but also as a scientist and engineer directly involved in research on information processing and more specifically on technological aids to creative thought and on the impact of technology on education both in the school and in professional life. Like many of my colleagues, I am also an author drawing revenues from copyrighted works.

The Association for Computing Machinery is the professional society for individuals who apply, develop, design, and theorize about computers and computer programs; it currently numbers 20,000 members, the majority of whom are in the United States. Although I am speaking today as an individual, I have discussed my testimony with the other members of the ACM Executive Committee, Dr. Bernard Galler, Professor of Mathematics and Communication Science, University of Michigan, and Mr. Donn Parker, Staff Specialist, Control Data Corporation, Palo Alto. They are in substantial agreement with what I have to say.

My academic title reflects a traditional labeling of disciplines but I prefer to describe myself as a computer scientist and engineer concerned with both the theory and the practice of information processing by all the various means afforded to us by ancient and modern technology. The variance between my labels and my self-image reflects the one basic truth about the computing and information processing field today: it is growing and changing at a tremendous rate. This can scarcely be news to this committee since the report of the House Judiciary Committee[1] clearly pointed out that "recognizing the profound import that information storage and retrieval systems seem destined to have on authorship, communications, and human life itself, the committee is also aware of the dangers of legislating prematurely in this area of exploding technology."

Some of those who have preceded me have pointed out with great force and clarity the legal implications of the Copyright Revision Bill S 597 as presently drafted. I wish particularly to express my whole-hearted agreement with the perceptive analysis of the problem provided in the statement submitted by the Interuniversity Communications Council (EDUCOM). I do not wish to repeat arguments that have already been well made by others, particularly since I am not a lawyer. I should rather like to paint for you a picture of what the pertinent sections of this bill look like to someone who, like myself, would be directly affected by the consequences.

Experiments with Terminals 3000 Miles Apart

For a couple of years now, with the support of the Advanced Research Projects Agency of the Department of Defense, I have been experimenting with the classroom use of terminals linked up via 3,000 miles of New England Telephone, Western Union, and Pacific Telephone lines to a computer system devised by my friend and colleague, Professor Glen Culler, at the University of California at Santa Barbara. Students in several Harvard courses have used this terminal to solve problems in mathematics and statistics as well as to experiment on the design of the system itself with an eye toward producing a more advanced system.

Several facts immediately stand out: transmission is clearly over more than 100 miles! The time and content of the transmission very clearly and necessarily "depend on a choice by individual recipients in activating transmission." I have therefore already run afoul of two of the conditions by which exemption is limited under Section 110 (2) of the proposed bill. It would, moreover, be very difficult for me to know whether or not the system my colleague operates 3,000 miles away had or had not incorporated in it programs that were themselves copyrighted or data that were copyrighted and which, under the spirit of the bill, had in the first place been illegally introduced into the computer.

I am now planning additional experiments over the next three years in which I expect to combine our new computer system with a variety of films, videotapes, audiotapes and other technical devices as well as the more conventional devices such as chalk and blackboard, books, technical journals, etc. In the course of these experiments I expect to peruse, display, copy, and enter into computers or other files a great variety of materials in various media. I have as yet no idea how much of what I buy, rent, borrow or produce myself I will eventually keep and either use in my classroom, publish conventionally or disseminate by less conventional means now still in the experimental stage.

[1] Report No. 2237 89th Congress, 2nd Session, October 12, 1966.

Delays, Frustrations, and Chaos

Under the provisions of the bill as now conceived, I would have not only to acquire and evaluate materials but, in each instance, *before* experimenting with them, seek out the owner of a copyright, if any, make formal requests for permission to use the material, pay royalties if any are due, etc. All this before any material could actually be used and, in fact, before I could find out whether or not the material was useful! The delays, the frustrations and the chaos inherent in such a process now seem so formidable that if the bill were passed in its present form I would be tempted to return to the safer occupation of copying out manuscripts with a goose quill pen.

Labor-Saving Assistance of a Computer

I am interested in the free development of the science and the engineering of both computer hardware and computer software but, as an author, I am not unmindful of the protection afforded by copyright. Yet, the logic of permitting someone to cut up his legally purchased copy of a book I have written, paste pieces on file cards and sort these by hand while precluding him from doing the same job by machine escapes me. I *am* concerned if he makes illegal use of the *end-product,* but surely I have as little right to tell him not to use the labor-saving assistance of a computer as I have to forbid him to delegate work to a research assistant or a secretary.

The foregoing was all stated in the first person and with very specific reference to my own interests. Nevertheless I am familiar enough with the work of my colleagues in computing, libraries, and information retrieval to believe that I could quite safely have said "we", substituted innumerable variations on the general theme of educational technology or switched altogether to the broader problem of library modernization. What I have said would still remain true.

Infringement from Choice in Transmission

Beyond my immediate personal concerns, I can see other curious and perhaps earlier unforeseen consequences of the limitations of Section 110 (2). One could argue, for example, that programmed instruction of the linear kind where each student is presented with precisely the same sequence of questions as every other, could legitimately take place if time and content of transmissions were controlled by the transmitting organization. However, the use of branching instructional programs where the future course of instruction, the nature of questions and so on, depends on prior responses by the student might well constitute "a choice by individual recipients in activating transmission" and therefore an infringement! There is still considerable controversy among investigators of these modes of programmed instruction as to which is more effective and in what circumstances. It would be a rather curious precedent in our society and I need hardly say an unfortunate one, to have scientific questions decided *a priori* by legislation. However unintentional, this would surely be a return to the Dark Ages.

A look slightly ahead of us may further help in seeing the relevant provisions of the bill in some perspective. There now exist machines that can scan printed material of limited type fonts, and convert it into machine readable form. There also exist experimental means for taking words stored in a computer and converting these into the sounds that would be heard if a person were to pronounce the words. If such processes were perfected and extended even in limited form, one could visualize a prosthetic device which would enable a blind man to turn any book into a talking book without the delays and difficulties attendant on conversion into Braille or on recording by a volunteer reader.

A Blind Man Producing a Talking Book for His Own Use

We would then face the anomaly that a normal man who has purchased a book in a bookstore or borrowed it from a library would be within his full rights in reading this book anytime and anywhere he pleased; but, if I read the provisions of the bill correctly, that a blind man using his prosthetic machine might well be infringing a copyright:

a) by causing his prosthetic machine to translate print into machine readable form, whether or not transmission to a remote computer is required. If transmission was necessary, as is much more likely initially, then there might be further infringement;

b) by his exceeding the capricious 100-mile limit (Section 110 (2)B), which would be probable since the necessary computers most likely could be provided economically only at a limited number of regional centers.

c) through his exercising his choice as an individual recipient "in activating transmission from an information storage and retrieval system" or, as the bill goes on, *"any similar device, machine, or process"* (Section 110 (2)D — my underline).

Solutions to Great Information-Handling Problems

The problems which my colleagues and I are trying to solve range in their interest and applicability from the purest of theoretical investigations to the most immediately applicable design and engineering work. In nearly every case there is strong interest on the part of various branches of the federal government and of the public at large in the solution of the problems we are attacking.

The Library of Congress has studied various approaches to automation. The Department of Health, Education and Welfare is sponsoring, through its Office of Education, numerous studies of computer-aided teaching and other technological aids to instruction. The Congress itself, the Bureau of the Budget, the Vice-President of the United States, both now and as senator, the Committee on Scientific and Technical Information (COSATI) of the Federal Council on Science and Technology, various branches of the Department of Defense, and numerous other bodies have expressed deep concern over the information-handling problems of the federal government in every sphere of its activities, and they are seeking solutions through major programs now at varying stages from the operational through the experimental to the projected. I am sure that the computing profession and the computing industry share with the publishing industry a deep concern for the fruition of these efforts.

Serious Limitations of Existing Exemptions

In a sense, however, we are the victims of our own rosy predictions. The proposed bill drastically limits traditional exemptions although there is no clear and present danger of infringements, which are possible now only on the most limited and commercially uninteresting scale; in so doing, it threatens to cripple severely the very research and the very teaching necessary in order that the "information storage and retrieval system or any similar device, machine, or process" *materialize fully, be understood, and be controllable.*

Deliberate Introduction of Quantities of Minor Variations

In closing, may I address one remark to the question of copyright of programs, to cover a point which I think has been ignored in previous testimony. The statement by the Interuniversity Communications Council (EDUCOM), with which I am in agreement, objects to "the argument . . . in support of . . . copyright for computer programs covering the processes, that infringement could be avoided simply by changing in some degree the sequence of steps . . . of the program" and also rejects the corollary that "On this view, the presence of a copyright would merely compel an outsider to do some slight work of his own in order to stay out of trouble." The rejection of these views should include taking notice of the disastrous consequences that encouraging minor variations to "stay out of trouble" would have on standardization in electronic data processing, which is a subject of major interest to many members of both the Legislative and the Executive branches. Moreover, whatever one's views of the merits of standardization may be, the *deliberate* introduction of hosts of minor variations into a profession struggling to keep its head barely above a swarm of program "bugs" (or *accidental* and *unwanted* minor variations!) can only be viewed as a very grim practical joke on every taxpayer.

A THIRD-GENERATION DATA RECORDER?

H. Edward White
Data Processing Consultant
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Data recording and communications appears to be a growing field, yet one in which relatively few innovations have been presented recently. However, I attended a showing not long ago of a pair of "third generation" data recording machines designed by Wyoming Electrodata Corporation of Riverton, Wyoming, which could have a significant impact on the techniques used for entering data into computers.

These machines (the Model 353 Data Recorder and the Model 355 Data Recorder-Playback) enable the operator to enter alphanumeric data on a conventional typewriter keyboard. Data is recorded on ¼″ magnetic tape in a cartridge suitable for wire transmission or on-line entry into a computer.

This may not seem particularly startling or even totally new. Many data recording devices are being brought to market regularly in the rapidly growing data processing industry. Data recording from a typewriter keyboard is far from a new concept. However, the visitor to the first public display couldn't help noticing the similarity of the console to that of a computer. While it was much smaller, with fewer lights and buttons, it takes advantage of modern displays to guide the operator through the routine of accurate data recording. The consoles are of micro-circuit design — the modern electronics which differentiates third generation computers.

There are other features which make these recorders unique. Among these features is the recording medium. Data is recorded on ¼″ magnetic tape. Other recording devices make use of this technique, but this one makes use of cartridge-type tape insertion and removal. (If you have seen the Stereo systems in the new cars, the cartridges are of similar design, and insertion and removal of tapes is just as simple!) Each cartridge holds 400 feet of tape. That's about 40 minutes of music in your automobile or over 150,000 characters of data for your computer. If the same data were recorded on 80 column cards or paper tape the supplies cost for non-reusable cards and paper would be about $2.00. Tape cartridges cost less than $10.00 each and are reusable countless times. In effect, the supply costs of data recording are eliminated. Imagine the potential savings over the years!

How do we get data recorded on ¼″ tape into the computer? Wyoming Electrodata has successfully built and installed a tape cartridge on-line reader which can be interfaced to any second or third generation computer. One of these has been installed and has been in regular use by a service bureau in Denver, Colorado, for over two years. Input speeds are about twice those of 80 column cards or paper tape. The reader cost is less than most card or paper tape readers.

How about data communication? If you want to use the old-fashioned United States Mail route (it is still often difficult to justify the cost of wire communication for many applications), the tape cartridge can be sent by Air Mail for 48 cents (six ounces). The equivalent in punched cards would weigh about 11 pounds ($14.00 by first class air mail, but these are usually sent by somewhat slower air freight). The equivalent in paper tape would cost $2.00 to send by air mail.

Data can also be transmitted by telephone lines. A low-cost communications device is available for any of these data recorders. (The designer raised the console on the standard machine to allow room for a telephone on the desk top without interfering with working area.) It can transmit 100 or more characters per second over conventional telephone lines using the Dataphone. Similar speeds can only be achieved with paper tape or punched cards with equipment costing from two to five times as much. The lowest cost card transmission equipment, which is only about 20% as fast, is more costly than the ¼″ magnetic tape transmission equipment. The lowest cost paper tape equipment, while similar in cost, is only about one-half as fast. Speeds are very important when the cost of line time is considered.

The presentation of the new equipment brought to mind an experience of some fifteen years ago. At that time the metals industry was looking for a way to transmit order data from sales offices to plants. Teletype was the only transmission means then available, but a better means of recording data onto teletype tape was needed. A small, struggling equipment manufacturer in Rochester, New York, built an electric typewriter that would punch teletype tape and provide a "playback" before transmission by wire. Companies in the metals industry were among the first to use "Flexowriters" for writing orders and preparing paper tape for teletype transmission and data processing. The Flexowriter is still sold as a popular means of source document writing and data recording; the original users received a return on their investment in equipment which was undoubtedly many times that which is normally achieved.

Wyoming Electrodata Corporation has designed and packaged a data recording machine using "third generation" (micro-circuit) electronics which employs computer console control techniques. Furthermore, the data recording system offers faster recording and computer input speeds, elimination of supplies cost, and lower equipment costs than conventional data input techniques.

Is this product heralding a new generation in data recording?

COMPUTERS WILL AID VISITORS TO EXPO 67 — AND MAY HELP SAVE AN EXTRA $MILLION

(Based on reports in the March-April edition of Management Services, **published by the American Institute of Certified Public Accountants, and the** Globe and Mail, **published at 140 King St. W., Toronto 1, Ontario, Canada)**

If things work out as planned, one of the largest computer complexes ever assembled in Canada will help visitors considerably when attending Montreal's Exposition 67.

With the aid of computers, the Expo 67 management expects to find rooms for all visitors who need them — at the rates desired, in the specified neighborhood and with any needed particular services. It plans to do this through an elaborate reservation system, roughly analogous to the seat-reservation system used by most major airlines.

All transient lodging areas in an around Montreal have been charted and coded, with top rates frozen by the local governing authority. This information, along with additional data pertaining to rates, types of locations and special services available, has been stored in a new G.E. 225 computer. Computer files are supplemented by 40 telephone operators who serve in the same way that airline-reservation clerks do.

A prospective visitor will call the accommodations control center, state his preference in prices, location and other services, and wait while the operator feeds the requirements into the computer and comes up with a match. As reserved, these accommodations are removed from the availability list.

Snack bars and regular restaurants on the fair grounds will have prices predetermined by officials and the result will be economical prices for all types of meals with particulars clearly marked at all restaurants and snack places. Roving government inspectors will see that establishments adhere to fixed prices and not raise them for tourists.

Data processing machines will even be used to control one of the major headaches of a world's fair: excessive crowds and waits at more popular exhibits. Two systems will be used in an attempt to avoid confusion and delays suffered at New York's fair — they are preticketing, and Electronic Information Display (EID).

The first system will help people avoid long lines at displays. Space available at free shows will be logged into computers and flashed to the touring crowds at 11 well-located information displays. People then can reserve seats that day for a performance; groups visiting the fair can book bloc seating in advance. The computer will automatically keep track of the seats remaining open at each performance and update its files as requested by an information booth.

Data on crowd density at various sites on the fair grounds will appear on electronic display boards, controlled by computers supplied with up-to-the-minute information by walkie-talkie teams. Alternate routes to displays and exhibits which are not jammed will be indicated for smoother traffic flow. These display boards will also keep visitors posted on such items as the news, the weather, lost children, lost parents, and emergencies. They will be operating 12 hours a day throughout Expo — with 20% of their operating time devoted to advertisements.

Computers will help maintain security. Pass control will be administered by computers, and personnel files on the thousands of workers at Expo 67 will be maintained. Financial records and management information will also be computerized.

Estimates have been made that if the New York World's Fair had had this type of control, its officials could have easily made an extra $1 million in revenue. But fair managements in the past have had to wait for monthly reports in order to make decisions. With the computer, management data will be furnished immediately and quick action can be taken if abnormalities develop.

The $3-million computer system is being supplied by Canadian General Electric Co. Ltd. free for the duration of the fair. The system has been installed in Expo's 15,000-square-foot control center on St. Helen's Island. The equipment can store 800,000 pieces of information in its memory and its printer can provide information at the rate of 160,000 characters a minute. It is staffed by 80 persons, including operation controllers, programmers, and engineers. Both the computer equipment and the television monitoring devices used will be on public display during the exhibition.

COPYING THE TABLE OF CONTENTS OF "COMPUTERS AND AUTOMATION"

I. From Mrs. L. Vilentchuk
Deputy Director
Center of Scientific and Technical Information
Tel-Aviv, Israel

We have been publishing, on a trial basis, a monthly publication of contents pages of magazines in electronics and electricity. The publication consists of contents pages of the more important periodicals in these fields, which are available in the country.

Our trial publication has been wholeheartedly accepted by both industry and large organizations in Israel, specializing in these subjects, and has become a valuable guide to them.

We have found that this kind of publication ensures that the manager, scientist and engineer is kept abreast of new developments in his field of interest.

May we please have your co-operation in the following:

- Your permission to reproduce the contents page of your journal?
- Could you please arrange for us to receive the contents page by airmail, so that our publication may appear concurrently with the journal which is received by surface mail?

II. From the Editor

We are glad to give permission to you and to any technical or scientific magazine or review to reprint our table of contents.

We can in some cases arrange for sending by airmail our table of contents, and we will gladly do so in your case.

COMPUTER-COMPOSED MUSIC — COMPETITION FOR 1968

International Federation for Information Processing
IFIP Congress Office
23 Dorset Square
London, N.W. 1, England

The International Federation for Information Processing (IFIP) has organised a computer-composed music competition in connection with IFIP Congress 68. Entries submitted for the competition must be produced entirely by the agency of a computer and form an artistic whole. Entries will be judged on musical merit, and medals will be awarded for the best three pieces of music composed by computer. It is hoped that the prizewinning entries will be performed during IFIP Congress 68. The Congress is to be held in Edinburgh from August 5th to 10th, 1968.

Rules

1. Entries may be submitted either by individuals or jointly, by groups of people. Each entry must be accompanied by a statement signed by every member of the group (or by the individual) certifying that to their (his) knowledge all the computer programming — excluding general service routines — was executed by the group (or by the individual).
2. The performing time for an entry should be not less than three minutes and not more than 15 minutes.
3. Entries may be submitted in any of the following forms:
   a) a score for a string quartet.
   b) a recording accompanied by a score (where other instruments are involved)
   c) a recording without a score (if the sound is produced by machine, with no legible score involved)

   If a recording is submitted, it should be in a commonly accepted form (i.e. magnetic tape or gramophone (phonograph) record) and must be of a high quality, suitable for reproduction in a concert hall.
4. The music may be based upon a theme or themes explicitly presented to the computer, and dynamic markings by hand may be added to the composition produced by the computer. Apart from these two exceptions, the music composition must be determined entirely by the action of the computer. The computer program may, or may not, restrict the time signature and the overall structure of the work.
5. Each entry must be accompanied by a copy of the program (or programs) used, with a reference to the programming language in which it is written. The program should be well annotated so that it can be readily understood by a skilled programmer. A separate statement explaining briefly the principles on which the program is based must also be supplied. If the notes and statement are not written in English, an English translation should be attached. The input data and any printed computer output must also be supplied. Any further information about the program that may be requested by the judges must also be given.
6. Entries will be judged by a panel of expert musicians and computer programmers appointed by the President of IFIP, who will be the sole arbiter in any dispute that may arise.
7. IFIP reserves the right to withhold any of the prizes if the standard of entries is not sufficiently high.
8. The closing date for the submission of entries is 31st January, 1968. It is hoped to announce the results of the competition and the winning entries by 31st May, 1968.
9. Entries should be sent to the Administrative Secretary at the above address.

A "REGULAR" EX-SUBSCRIBER CONTINUES TO READ C&A

I. From C. R. Fox

Tax Consultant and Accountant
Long Beach, Calif. 90802

This letter is written to possibly help you in your market research. I subscribed to *Computers and Automation* to see if it could be helpful to my understanding of the computer revolution. But alas, I fear it is too technical to serve my purposes. I have passed several copies on to people who are in the data processing field locally. Perhaps they will become subscribers.

Since I am just starting my practice, I must limit my subscriptions to those which will have the greatest immediate value to me. However, I plan to continue to read your magazine in public libraries, hoping that, along with my other studies, the day will come when the light will dawn, and I will have a better understanding of the computer field.

Please send me the name of a public library in this area which subscribes to *Computers and Automation.*

II. From the Editor

Thank you for your letter. We are glad to inform you that the Long Beach Public Library, Ocean and Pacific Aves., Long Beach, Calif., receives two copies of *Computers and Automation* each month.

We are sending you a copy of our "Glossary of Terms in Computers and Data Processing" in the hope that it will be helpful to you in your study.

Good luck to you in starting your practice as a tax consultant and accountant.

SNOBOL BULLETIN ESTABLISHED — PAPERS SOUGHT

Professor W. M. Waite
Department of Electrical Engineering
University of Colorado
Boulder, Colorado 80302

The Special Interest Committee on Programming Languages of the Association for Computing Machinery will begin publication of an information bulletin on the string manipulation language SNOBOL. The bulletin will be distributed as a supplement to *SICPLAN Notices,* the Committee's informal monthly newsletter.

As editor of the bulletin, I invite contributions concerning SNOBOL which may be of interest to users and implementers of the language as well as to the computing community in general. Suggested topics include:

- Announcements of SNOBOL implementations for particular machines, outlining their relationship to the published descriptions of SNOBOL.
- Improvements or alterations in basic SNOBOL operations such as scanning, storage allocation and function calling.
- Interesting applications.

The bulletin will also be used as a forum for the discussion of problems associated with the language, and we would like to hear from anyone who is presently using or implementing SNOBOL.

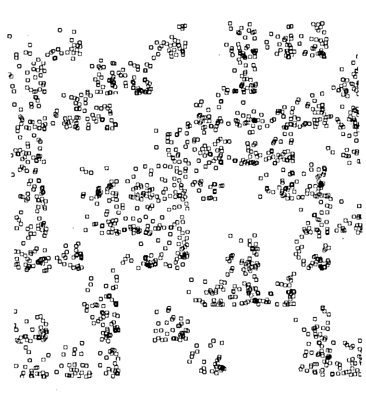
Please address all comments and contributions to me at the above address.

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 mandatory. 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.

The deadline for receipt of entries to be considered in the contest is Friday, June 30, 1967.



Computer Art -
First Prize, August 1966

A NEW CAREER IN COMPUTER PROGRAMMING

I. From B. G. Stickle
East Lansing, Mich.

Your editorial on "Computer-Assisted Explanation in Programming" in the February issue of *Computers and Automation* interested me.

Most of my business experience has been in industrial marketing. However, for the past few years I have considered changing to some field that would be more enjoyable and would bring more personal satisfaction to me. My attention has recently been drawn to computer programming as a career that I would find challenging and for which I have strong aptitude.

Frankly, I know very little about the subject. I have a limited background in mathematics and science, but have been told that my aptitude for these areas, my intelligence, and my wide range of interests are of equal importance.

I would like to ask for your advice. Do you think that a man of 50 with qualifications such as mine and no immediate need for income from a job should consider a career in programming? If so, are there any directories of schools, or are trainee programs available? Is aptitude testing advisable?

II. From the Editor

Thank you for your inquiry. You may also be interested in an editorial which appeared in the September, 1966, issue of *Computers and Automation* entitled "Bootstrapping a Career in the Computer Field," which I enclose.

You undoubtedly could easily become a good programmer. I suggest you talk to the director of a nearby computer center, and get his suggestions about local assistance, and nearby possibilities for instruction and training.

CORRECTION

In the article "Language Engineering", in the April 1967 issue of "Computers and Automation", on page 36 the last ten lines at the bottom of the second column should have been at the top of the column. Please mark this correction in your copy.

APOLOGY TO OUR READERS

After the printing of all 15,000 copies of the April issue, we found we had misinterpreted permission to publish the information which was printed on page 15, and did not have permission.

So for the first time in 15 years of publication of this magazine, it was necessary to cover up a page.

We regret the misunderstanding that occurred, and we apologize for the distressing appearance of the pasted-over page 15 in the April issue.

c&a

PROBLEM CORNER

Walter Penney, C.D.P.
Problem Editor,
Computers and Automation

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

Problem 675: Functions for a Checkerboard

When John Lawthorne entered the classroom there was only one student, and he was so absorbed in the sheet of paper on his desk that he didn't stop to look up. His class in Fortran had been dismissed for fifteen minutes, but this eager beaver was still plugging away. John peered over his shoulder and saw that he was putting 1's and 0's in the squares of what looked like a checkerboard, except that he noted it had only seven squares in each direction.

The student became aware of someone behind him and turned around. "This was part of today's assignment," he said, pointing to the square, "and I can't seem to get to first base with it. We're supposed to construct a function that will put 0's in all the cells of this square except for a cross of 1's in the center."

"How many 1's are there supposed to be?" John was beginning to get interested.

"Well, there's a line of 0's around all four sides so that the cross will consist of nine 1's, five horizontal and five vertical, with the center one doing double duty."

"Suppose you imagine two variables I and J, each taking on the values 1 to 7 inclusive, with the 49 results the contents of the corresponding cells."

The student looked a little skeptical. "That's the way I've tried to go about it, but for every function I've tried, if F (4,2) is 1, then F (3,3) turns out to be 1 also, and I don't want that."

What is F (I,J) that will put 1's and 0's in the proper cells?

Solution to last month's problem

The program represented by the Flow Chart would calculate

$$1 + 1/7^2 + 1/9^2 + 1/11^2 + \dots$$

i.e., the sum of the squares of the reciprocals of odd numbers (except 3 and 5) to ten decimal places. The sum of the squares of the reciprocals of the odd numbers is $\pi^2/8$, so that Z would be $\pi^2/8 - 1/9 - 1/25$, or 1.0825894390.

DATA COMMUNICATIONS

Robert E. Wallace
Auerbach Corporation
Philadelphia, Pa. 19107

"The early chapters of data communications are still being written, and succeeding chapters will bring devices and uses that can only be guessed at today. The data communications story will be a long one, and lively."

Norbert Wiener once said that the most fruitful areas of endeavor are often found in the "crack" between two fields. The discovery of this crack between communications and data processing has created a new and exciting area of application to which the manufacturers, the common carriers and the consultants are all giving considerable attention. This area has become a new technology called data communications, a technology dealing with data transmission between computers and the control of data transmission by computer.

Beginnings

The development of the data communication system in modern technology began in the mid 1950's when it was recognized that the paper tape used by teletype machines could also be used as an input medium for the digital computer. Thus, the teletype circuits and machines which had been used exclusively for transmitting messages became useful to transmit data to computers. In early applications the data was received at the computer installation on teletype tape which could be used directly as input into the computer. However, it took little time for manufacturers to replace the tape by electronic buffers between the computer and the teletype wire so that the data could be inserted "on-line" into the computer. Already the need to study the economic advantages of such systems had become evident. Teletype tape could be sent via mail, thus saving the cost of teletype wire, and trade-offs such as cost vs. speed of service had to be carefully examined.

Nevertheless, new developments in data transmission systems rapidly evolved. Telephone circuits turned out to be convenient media for the transmission of data, and transceivers providing access to these circuits via punched card became quite common in large computing installations. These systems were enhanced still further by the introduction of the dataphone, which replaced the transceiver as a buffer and provided direct dialing to connect the data source to the data destination. Switching to enable the routing of data was accomplished with the already available circuit-switching equipments in the telephone system.

While these systems were all publicly available and obtainable on a rate-per-hour basis or by rental, the need for leased wire systems in multi-divisioned corporate networks also developed rapidly and with this came the requirement for private data switching systems. It turned out that digital computers could be used effectively to control the switching, and because of this, it became necessary to consider together both the data transmission and data processing systems in the design of the total data communication system. Thus, it was that the computer manufacturers turned their attention to the development and marketing of the total system in conjunction with their computer business to participate in what was to become a rapidly increasing market.

The User's Viewpoint

From a user's point of view the computer-based data communication system consists of links to transmit the data, computer processing centers for the data transmission and/or applications processing, and terminals for the input and/or output of data. In relation to the overall system design, what is important for the user to consider for the links is the selection of an appropriate service from a common carrier. The principal design factors are the transmission rate, the availability (private wire, dial-up, party line), and the kind of link (one way at a time, two ways at once). In conjunction with these the quality of the service (error rate) and the interface requirements must be considered. Cost is an important criterion but it must be considered in respect to the overall system design rather than to any single portion of it. The terminals generally contain relatively simple equipment which directly serves the user such as card or tape readers and punches, document readers, printers and perhaps displays and magnetic tape storage. However, the user in his overall design considerations must also plan for some kind of communications control equipment and other equipment to interface with the transmission links.

The control equipment performs such functions as multiplexing, error detection, code conversions of various kinds, and signaling to other stations. What is actually needed depends on the design of the overall network and the way in which the processing centers communicate with the station. Equipment to match terminals to communications lines is generally a part of the service provided by the common carrier; it may be a standard item, or it may require modification to match the requirements of the terminal equipment.

Classes of Application

Current applications of data communications systems vary widely in their functions, their scope, and their equipment and programming requirements. New applications are being developed every day, and it would clearly be impossible to describe, or even list, all of the specific applications in which data communications equipment is being used. A more rational approach is to divide the total spectrum of data communications applications into a few fundamental application classes, each performing a certain general function and involving a certain type of data flow pattern. Most specific applications will then fall neatly into one application class or combine the functions of two or more classes.

Although coarser or finer breakdowns could be justified, it seems reasonable to consider six fundamental application classes. The function and data flow pattern of each of these classes are described in the paragraphs that follow.

1. **Data Collection**
   The function of this class of applications is the collection and transmission to a central processing point of information concerning the operations of geographically separated manufacturing plants, warehouses, branch and regional sales offices, and other outlying facilities. The basic data flow pattern is unidirectional, from multiple remote (and/or local) terminals to the central processing facility. This type of system can: (1) provide the complete, timely information about a firm's overall operations that is required for accurate cost control and informed management decisions, and (2) reduce the number of times and places at which data must be manually handled and transcribed, thereby cutting clerical costs and error rates.

2. **Data Distribution**
   In this class of applications, the principal function is the distribution of data generated and/or processed at a central facility to one or more outlying locations. Again the basic data flow pattern is unidirectional, from the central facility to the remote (and/or local) terminals. This function, of course, is the complement of the data collection function described in the preceding paragraph, and many data communications systems combine the collection and distribution functions.

   To appreciate the potential value of a data distribution system, it is necessary to realize that data has no real value until it has reached the actual point of application in a useful form. Significant financial benefits can frequently be realized through cutting down the elapsed time and improving the accuracy of the data dissemination process.

3. **Inquiry Processing**
   To meet the competitive demands of modern business, many firms are finding it desirable (and in some cases essential) to "go on-line" by establishing central data files that can be randomly accessed to provide prompt responses to inquiries from outlying locations. In this class of applications, the basic flow pattern is bidirectional; inquiry messages are transmitted from a network of remote terminals to the central processing facility, and appropriate response messages are generated and transmitted back to the inquiring terminals.

   The inquiry processing function is frequently combined with real-time file updating; the appropriate entries in the central data files are modified each time a transaction occurs so that the central files always reflect the true current status of the business. Although inquiry processing and real-time file updating systems promise great benefits for nearly every type of business organization, their advantages in terms of faster response and centralized control should be carefully weighed against their costs to ensure that the higher direct cost of a real-time system, as compared with that of a more conventional batch-type processing system, is worthwhile. Real-time inquiry systems are especially beneficial for organizations such as banks, brokerage firms, airlines, and hotels, where prompt servicing of customer inquiries is of critical importance.

4. **Computer Load-Balancing**
   Organizations that have two or more computers in geographically separated locations may find it advantageous to connect them by means of communications links. This permits more effective utilization of each of the interconnected computers because the slack time in one computer's schedule can be used to help smooth out the peaks in another's. Reliability is greatly enhanced because the communications links make it easy for one or more computers to take over another computer's workload when a breakdown occurs. The data flow pattern in this class of application is bidirectional; input data and results are transmitted between each pair of interconnected computers, and the volume of data flow depends upon their relative workloads at any given time.

5. **Computer Time-Sharing**
   In an effort to make the facilities of a computer system conveniently available to multiple users, extensive development work is in progress on "time-sharing" systems. The design objective of a time-sharing system is to furnish continuous computing service to many users simultaneously, while providing each user with virtually instantaneous responses. Multiple consoles, each equipped with appropriate input and output facilities, are employed, and each console is connected to the central computer facility by a communications link. (Some or all of the consoles are likely to be close enough to the central facility so that direct cable connections can be used.)

   The basic data flow pattern in a time-sharing system is bidirectional and similar to the pattern for the inquiry processing class of applications; input data and operating instructions are transmitted from the consoles to the central computer facility, and the results of computations are transmitted back to the appropriate consoles. The widely-discussed "public utility" computer concept, in which multiple subscribers would share the facilities of a giant centralized computer complex on a toll basis, is a logical extension of the computer time-sharing class of applications.

6. **Message Switching**
   The activities of a modern corporation tend to be spread out over a large number of widely separated locations, and an efficient system for handling communications among all these locations is vital. Where communications traffic is high, a computer-controlled message switching system is likely to be the best overall choice. In this type of application the data flow pattern involves two-way message traffic between a number of terminals and a central switching center. The sending terminal transmits each message to the center, which stores it temporarily, performs any processing or code conversion functions that may be required, and then transmits the message to one or more designated receiving terminals. Large networks may utilize two or more switching centers which are interconnected by high-speed communications links.

System Design

Designing a data communication system from the point of view of methodology is in some respects similar to designing a data processing system. However, there are many problem areas which are significantly different because they embrace both communications and data processing technology. Furthermore, a large number of the design parameters are interrelated, and compromises and trade-offs are necessary.

First, a number of basic factors must be determined. These can generally be described as the information flow requirements and include the following:

1. The kind of information to be transmitted through the network, and the types of messages.
2. The number of data sources and points of distribution to be encompassed by the network, and their locations.
3. The volume of information (in terms of messages and lengths of messages) which must flow between the various locations.
4. How soon the information must arrive to be useful. At what intervals is the information to be transmitted, and when. How much delay is permissible and what is the penalty for delay.
5. The reliability requirements in respect to the accuracy of the transmitted data, or system failure. What is the penalty for failure.

In addition, there are management policies to be determined, with respect to the use of existing equipment, security of messages, economic guidelines, and centralization of facilities.

The overall design depends on this information. It involves many problem areas. Some of these are:

1. Estimating the volume of information which may develop and the associated traffic statistics. (This may be quite different than the stated requirements.)
2. Providing for traffic overloads.
3. Distributing the storage and computer capabilities at the various processing centers to best fulfill the processing requirements, and balancing these capabilities with the capacities and speeds of the transmission links to minimize the cost.
4. Locating the processing centers, switching centers, and line concentrators to minimize network costs, and of course, selecting the appropriate network.
5. Optimizing the system configuration in fulfilling reliability and backup requirements and in maintaining continuous and efficient operation.
6. Selecting economical error detection and correction techniques.
7. Establishing the programming requirements in each of the processing centers and specifying the necessary storage and computer capabilities.

A design problem of slightly different character but deserving considerable emphasis is the development of a system which is "open-ended." That is, it must be capable of expansion to provide for new plants, higher volumes of traffic, new applications, and other developments. The design and implementation of a data communication system is a major investment. Proper planning at design time to provide for future growth will safeguard this investment.

These problems cannot be treated separately; they are interlocked through the various system parameters which are determined by their solutions. Trade-offs become necessary between the equipment, the programming systems, the services, and the operating requirements. Thus, the design techniques embrace both communication and data processing, and the system team having responsibility for the development of a data communication system must be knowledgeable in both.

Data Communications Devices

The earliest data communications devices were general-purpose machines. In the same way that a telephone is not concerned with the *content* of the telephone message, a teletype machine transmits a wide range of alphanumeric characters, paying no attention to the content of the message.

The devices which are gaining prominence today, however, are much more specialized, according to the requirements of the job they are to perform. Excluding military systems, the earliest of these was probably the specialized agent set used to communicate information concerning requests for and confirmation of the sale of airline seats; more recently, special-purpose devices have come into use in the factory in the form of labor- and work-status reporting systems, in stock brokers' offices, and as specialized teller machines in savings banks.

These specialized devices, in addition to helping speed up the flow of information, have several other important characteristics. They usually force the operator to format the information properly or they refuse to transmit. They simplify transmission of certain information by allowing a single key depression to represent words or phrases; they frequently store information and transmit over wire lines at a rate higher than the operator could transmit from a keyboard — in certain applications this provides a great saving in wire costs by allowing connection of such devices on a "party-line"; they frequently reduce the amount of information that must be transmitted to achieve a particular level of accuracy, because they contain built-in error-detection and correction means.

Helping the Operator

Sometimes, the incorporation of operator checks in these devices is referred to as "idiot-proofing." This is in no sense a derogatory term. It is used by designers to keep reminding themselves that the operators of these devices are usually not highly skilled in the operation of the device, as was the telegrapher or teletype operator of an earlier day. Basically, they are machine operators in a factory, stock brokers, ticket agents, or bank tellers. The operation of the data communications device is not their principal task. Their principal task is operating a machine, selling stocks, selling airline seats, or handling money and answering depositor queries.

The importance of the ease with which a data communications device can be accurately and efficiently operated by a person not specializing in its operation is hard to overrate. In selecting such a device, every opportunity to test the way the people who must use it will react to it should be carefully explored before making any final decisions. On the other hand, initial reactions must be evaluated carefully to determine whether problems uncovered are fundamental or merely transient emotional ones. In some cases, professional psychologists have had to be used to determine the answer to this question.

The Many Uses of Data Communications Devices

A wide variety of applications for both general- and special-purpose devices have been found. These applications utilize general-purpose equipment which transmits punched cards at 5-120 characters/second, paper tape at 10-300 characters/second, magnetic tape, and direct communication between computers at speeds of 200 to many thousands of characters/second.

There are now coming into being applications for more specialized devices. Savings-bank window machines provide tellers with automatic communication to a central computer. Access to file information about an account is made through these special-purpose devices, and the files are automatically posted at the time of transaction. Specialized cash-register devices permit automatic take off of data from retail transactions. Thousands of aircraft plant workers report time worked and job number through specialized input devices. The costs of these devices vary widely, from less than $100 per month to several hundreds, depending upon specific requirements.

CRT Display Terminals

Cathode ray tube (CRT) display terminals are now being widely used as "electronic blackboards" to provide rapid, easy access to data stored in computer systems and to their computational facilities.

An alphanumeric CRT display terminal is typically a compact unit that looks — and actually is — much like a small television set equipped with a keyboard. Data entered from the keyboard or received from a computer is displayed on the face of the cathode ray tube. Displayed data can include alphabetic letters, numeric digits, punctuation marks, and specialized symbols. Some units can display only a subset of this character set, such as numeric digits. In this article, any display symbol is referred to as a character.

The distinguishing features of CRT display units are: the actual size of the display area, the display arrangement (i.e., the number of characters per line and the number of lines per display), the total number of characters per display, the number of different characters or symbols that can be displayed, and the technique for character generation. Readability of the display is influenced by character size and by the colors and relative brightness of the characters and the display background.

The three common techniques for generating the characters to be displayed are: dot matrix, stroke, and monoscope.

With the dot matrix technique, points within a specified point matrix (usually 5 points wide by 7 points high) are intensified to form the displayed symbol. The characters so formed are actually composed of small, overlapping circles.

The stroke system is used to form symbols by drawing short straight lines between specified points. Different display units may use different combinations of lines, which lead to differences in the appearance of the symbols on the screen.

The monoscope technique utilizes a separate scanning tube which contains a plate with all of the displayable characters etched into it. The scan generates signals that control the movement of the electron beam in the display tube. Any symbol shape or type can be generated with this technique.

Most commercially available alphanumeric display terminals can either be connected directly to a computer input/output channel or connected remotely, via a communications line and appropriate controller or adapter at the computer site.

Display Terminal Applications

Two broad types of applications for which alphanumeric display terminals are well suited are:

- Obtaining quick responses to inquiries about a particular account or subject, such as credit, bank balance, inventory, and airline seating availability. Data files maintained at the central computer site serve as the source of information. These files can be updated immediately to reflect each event or transaction.

- Providing convenient man-machine "conversations" which permit users at remote display stations to base their inquiries upon prior results calculated by a computer and displayed on the screen. This type of application allows programmers, engineers, and designers to create and execute programs in step-by-step fashion while being informed of programming errors and intermediate results at each step.

These applications can be — and have been — implemented with communications terminals other than display units. The principal advantages of the display terminals are their speed, ease, and convenience of operation.

Editing Facilities

The editing facilities provided for the operator's use govern the ease and flexibility of entering data and modifying or correcting previously displayed data. All current commercial display units use a visible cursor or entry marker to indicate to the operator the position where the next character will be displayed when entered. Control keys are usually included within the keyboard layout to allow the operator to position the cursor for data entry at specified locations on the screen.

Editing facilities that are provided in some display units include the following:

- Horizontal tabulation — allows the operator to set specified "stops" within a display and later skip to these stops in the same manner as on a typewriter.

- Line erase — allows the operator to erase a whole line or selected portion of a line with a single key depression.

- Line insertion — allows the operator to insert data within a line, with the previously displayed data being automatically shifted to the right.

- Transmission of partial display — allows transmission of a selected portion of the total display, in contrast to having to transmit the full display each time.

- Split screen — allows retention of previously displayed data while new data is being entered or received. In practice, this may take the form of filling in a displayed format or of displaying a series of operator inquiries and computer responses. With some units the operator can be prevented from modifying the previous data.

Control Units

Depending on the particular equipment, multiple display units may be connected to a central controller, or each display unit may be independent and contain its own control logic. In the former configuration, the individual display units can usually be located up to 1000 to 2000 feet from the controller.

The types of phosphors used in current alphanumeric display terminals are of relatively low persistence. To present a display that is suitable for viewing and free from annoying flickering, the display must be continually regenerated. Buffer storage is provided within the central controller or within each display unit to store data entered locally or received from the remote computer. Logic circuitry within the controller or display unit utilizes the buffer storage to regenerate the display, usually 30 to 40 times per second.

The amount of buffer storage determines the maximum amount of data that can be displayed at any one time. The capacity of the buffer is of concern primarily in multi-unit display systems where the buffer storage is contained in a central controller. The total buffer size is one factor that limits the number of display units that can be accommodated and the maximum amount of data that can be displayed by each unit.

In some cases more than one display controller can be connected to a single communications line. This "multidrop" capability requires that control logic be provided for controller address recognition to enable selective transmission to individual display units. This capability can be used to expand the number of display units at a single location or to permit units located at geographically separate locations to share the same line. The object of either arrangement is to reduce line costs. Careful analysis must be made to ensure that a single line will provide adequate transmission capacity.

Equipment Costs

The total equipment costs of individual display systems will vary widely depending on the number and type of display units in the system, the number of special features incorporated, and the number and type of auxiliary units.

Monthly rentals for each display unit connected to a central controller range from about $40 to $135. The rental for the corresponding central controller can range from about $200 to more than $1,000. The costs of the controller generally increases with the number of display units connected to it because of the need for increased buffer storage and control logic.

Independent display units that contain integral control logic range from under $100 to almost $400 in monthly rentals.

Facilities

While microwave and other radio facilities are doing an excellent job in many special applications, wire is still by far the most important electrical communication medium.

Except for strictly local connections within a building or location, the bulk of available wire is supplied by the communications common-carriers, the telephone companies, and the Western Union Telegraph Company.

The wire circuits they supply are of essentially two types. Those originally designed for transmission of teletype signals handle speeds up to about 10 characters per second. Speeds up to about 300 characters per second are carried over telephone-grade circuits; speeds above this are usually carried over several telephone-grade channels leased as a group.

The cost of these facilities ranges from about $.75 per month per mile of circuit for the lowest-grade teletype circuits to $3 per month per mile of circuit for telephone-grade circuits. The resultant cost per character of information transmitted varies over a very wide range, depending upon the geographic area covered by the system, its location, the volumes of data to be transmitted, speed and frequency of transmission, and the accuracy and reliability required. The basic principle which underlies the economics of wire transmission is simply to utilize the facility as completely as possible during the period you have paid to use it.

Equipment referred to as MODEMS, communications subsets and buffers have been developed to adapt the modern data communications devices to wire transmission over long distances. These are usually furnished by the communication carrier and, except for paying for them, are not a concern of the user.

The Names for Wire Types

Some of the ways in which wire is made available to users have strange names with which users should become familiar.

Leased lines are teletype or telephone lines made available to the user, usually on a full-time basis, between specific points.

TELPAK is the name given to the service in which several telephone-grade lines are leased as a group between two points. The rates for service are substantially lower than those for an equivalent number of single telephone channels.

Toll services are those which allow a subscriber to call many points and to pay for service only when it is actually being used. The telephone in your home is an example of telephone toll service.

TWX and TELEX are the names applied to the toll teletypewriter services of the Bell System and Western Union, respectively.

WATS (for Wide-Area-Telephone Service) is the name given to a telephone-grade service in which an unlimited number of calls may be made for a flat monthly charge from a single point to any other subscriber within a very large area — the entire United States if desired.

Most of these strange names, then, refer to different methods of pricing the availability of wire, rather than to basically different facilities.

In most cases, the telephone-grade services can be employed for the transmission of voice, of data, or both, alternately, through the use of Dataphone subsets supplied by the telephone company. Frequently, this ability permits considerable savings by combining telephone and data needs.

Having these devices and facilities available, the principal questions for the user, of course, are:

- Will they improve operations?
- What do I need to know to design a system and *use* these techniques?

Will They Improve Operations?

This, of course, is largely a matter of money — money saved through a reduction in operating expense or money made through attracting income sources and utilizing assets more efficiently. The answer is that data communications, particularly as an adjunct to a modern, on-line real-time computer system, *can* achieve operational improvements in all these ways. It cannot do so in every case, but only a careful analysis will show the facts of your particular situation. It is a fact, however, that many millions of dollars of increased income are being produced yearly by the users of data communications equipment integrated into modern information-processing systems.

What Do I Need to Know to Design a System and to Use the Techniques?

Although no unusual skill requirements are ordinarily imposed on operating personnel by the introduction of a data communications system, it is well to remember that the new system will always require modifications in procedures and retraining of some personnel. The over-looking of this fundamental point has inserted needless delays in the implementation of many of the early modern integrated data communications computer systems.

The system design job presents larger problems. A data communications system is utilized because it is an extremely rapid means of transmitting data accurately. While it is usually designed to correct its own mistakes, it will rapidly and accurately transmit erroneous data generated elsewhere in the system; and it will usually transmit this error directly to some machine which may have difficulty in coping with it. In addition, a greater-than-usual amount of attention must be paid to overall systems design and testing to guard against the possibility that the system does not properly respond to abnormal demands. In the case of one early major data communications system in the $100-million class it took nearly four times as long to thoroughly debug responses to these abnormal demands as it did to ensure reliable handling of normal demands. These days, however, utilization of some of the more advanced system design techniques of operations research, including simulation and the application of queuing theory, will reduce the impact of this problem, allowing a smooth transition to the new system.

A Final Note

Factual accounts, such as this one, tend to lack commentary on the dramatic possibilities that lie ahead in data communications. As with other areas of EDP, it is hazardous for any of us to make predictions, not because the future may expose our exaggerations, but because it may instead reveal our over-cautiousness and shallow imaginations.

It is enough, at this point, to say that the early chapters of data communications are still being written, and that succeeding pages will bring devices and uses (mostly beneficent ones, we hope) that can only be guessed at today. The data communications story will be a long one, and lively.

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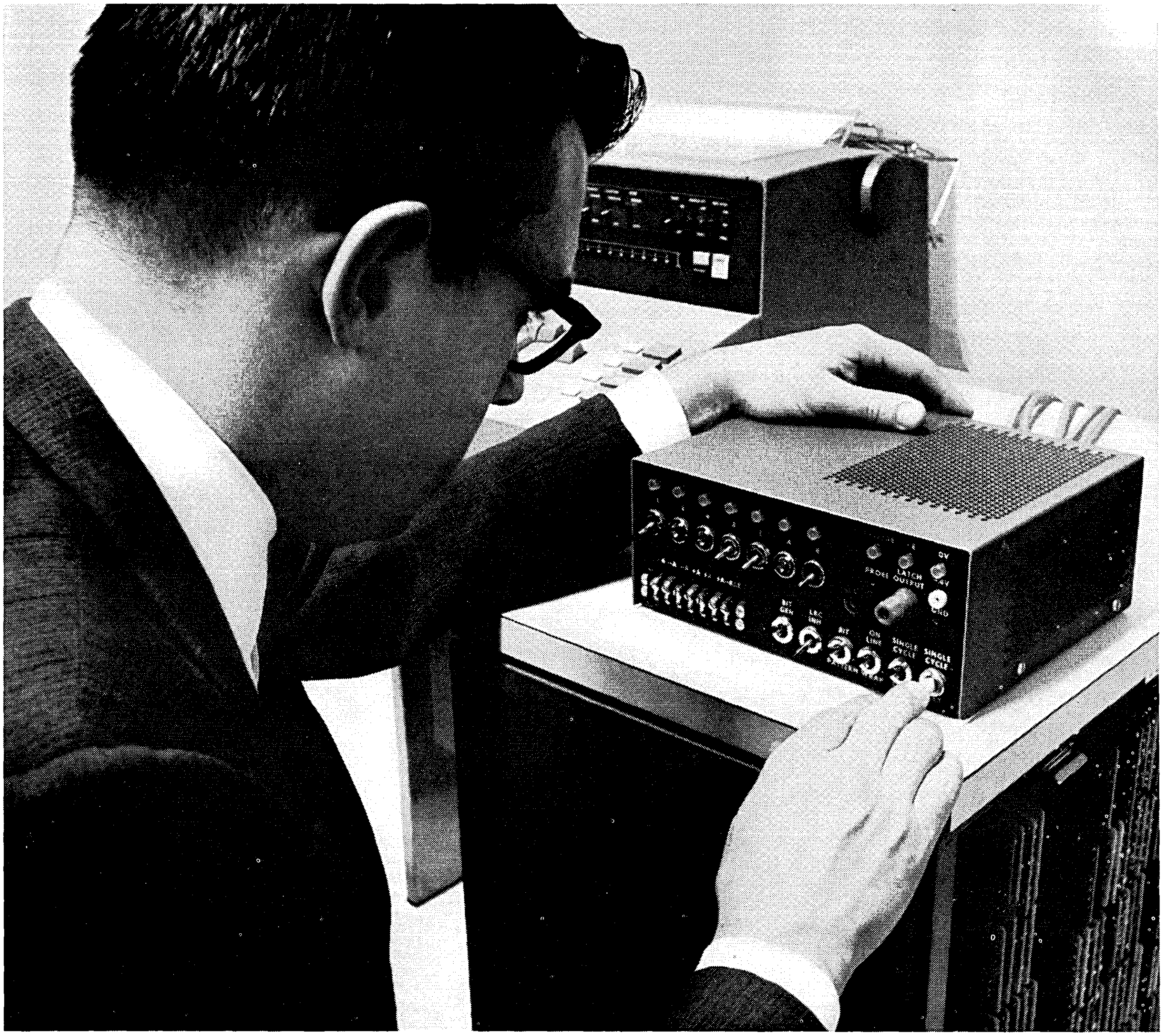

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CAPITAL REPORT

Effect of Computer Prediction on Elections To Be Studied

Senator Vance Hartke (D-Ind.) has pushed back his planned hearings on the effect of computer-based projections on elections. He recently voiced the opinion that the use of computer projection models and the televising of predictions based on early vote counts may have serious effect on our whole democratic election process. As a member of the Subcommittee on Communications of the Commerce Committee, he had hoped to spearhead the investigation of the effect of computer prediction on both national and local elections.

Senator John O. Pastore (D-R.I.), Chairman of the Communications Subcommittee, has had to put the hearings on the reservation of educational TV and radio channels first, and Hartke now hopes to look into election predictions later in this session. No specific dates have yet been set for the hearings.

Gerald A. Waindel, Special Assistant to Senator Hartke told *Computers and Automation* that the Senator's position has not changed. He feels that there may be a serious effect on the action of voters who sit in front of their sets and see either a local or national election going in a certain direction. The prediction that one candidate may have a lead which the models say is unbeatable could cause the lethargic voter to simply sit there and refrain from voting. "It's all over now, anyway . . . the computers say that Candidate X is going to be elected. What's the use of voting now. . . ." Such an attitude could cause voter apathy, and possibly lead to serious lag of opposition when, in fact, the models might be wrong if all of the possible voters went to the polls and expressed their opinions with the ballot.

The crux of the matter is that the country is divided up into time zones. Polls close in one zone, the computers spin out a prediction, and the polls have not closed in another part of the country. If voters do decide to stay home and give up when they think the results are already decided, the effect on local elections could be great. Local races are often decided by slim margins and the stay-home voter swayed by his TV set, might be the crucial slim edge which a candidate needed to win in a local race at the county or city level.

Waindel admits that the dangers are still hypothetical, and that no one has been able to prove effect as yet. But a critical look at the possibilities is sorely needed. The backbone of local government races determines representation in Congress, and the subtle effect of national TV predictions is probably more significant than is currently realized.

South Dakota, for example, is cut by a time zone. A state law is on the books which makes it unlawful to announce the probable results in one part of the state while the other, in a different zone, is still voting. The possibility of preventing a national TV network from broadcasting projections is rather remote, however, in spite of the fact that it might be violating state law.

Federal Computer Utilization

The National Bureau of Standards (NBS) is still looking for someone to head the Center for Computer Sciences and Technology, according to John Eberhard, acting Director of the Center. Eberhard, Director of the NBS Institute for Applied Technology, has been filling in since Norman Ream left sometime ago, and is heading the hunt for Ream's replacement. By the time this appears, a selection may have been made from among the industry and government candidates under consideration. Eberhard indicated that some of the delay in picking the new Director has been caused by the fact that the Civil Service Commission (CSC) must pass on the qualifications of the individual selected, and this may take somewhat longer than expected. The panel is leaning toward a possible selection from industry, and CSC must be sure that all candidates are fairly considered.

A change in the Bureau's philosophy in the government ADP field is also indicated. Eberhard told *Computers and Automation* that the Bureau would like the NBS facility to "become an experimental facility within the government. We would like to explore the use of remote consoles, time-sharing, and interagency use of the new remote time-sharing technology now in existence. Our position as a standard, time-selling computer service center has now ended, and we hope to get independent funding directly from Congress to carry on new experimental work." NBS has signed with Univac for an 1108 to be installed in June, and they hope to use this as the base for experimental work. Published reports that the 1108 was obtained to replace the NBS Pilot System were erroneous, according to Eberhard. The 1108 will replace an IBM 7094, a CDC 3100, and a Honeywell 1200 now at the Center. Most of the replaced hardware will not go out the door, he indicates. The 7094, for example, is now under the Harry Diamond Laboratories who will have full control of it when the 1108 is installed. "We will simply get off their hardware," said Eberhard.

NBS also planned to be a prime witness at hearings early this month on Management of ADP in the Federal Government. Congressman Jack Brooks (D-Tex.) is spearheading this look into Federal computer utilization.

Effects on U.S. Economy Simulated by Computer

The Brookings Institution in Washington is continuing to refine and improve its Econometric Model of the United States, which it runs on a 32K IBM 7040 in its capital headquarters. The model is believed to be the largest in the world, and simulates interactive forces of the US economy with approximately 180 nonlinear coupled partial difference equations.

George Sadowsky, Director of the Computer Center at Brookings, described the model as one which, for the first time, can disaggregate many of the lumped economic factors used in previous economic models. The large number of equations, some of which are distinct identities, allow more accurate predictions of economic effect than previously possible. Subsectors of the economy are input at levels formerly infeasible. The rediscount rate, prime lending rate for banks, time deposit savings and loan rates, government bill and bond rates, and the level of unborrowed reserves, are only a few discrete elements used in the monetary subsector. The industrial subsector of eight groups will shortly be expanded to thirty-three to give an even more accurate picture of industrial interrelationships.

(Please turn to page 45)

PRODUCTION AND INVENTORY CONTROL BY COMPUTER – A UNIVERSAL MODEL

Karl E. Korn and James H. Lamb
Western Electric Company, Inc.
195 Broadway
New York, N.Y. 10007

"Including problem definition, system design, file information, programming, coding, debugging, and cutover, the total expended technical effort since 1964 has been about twenty man years."

The production-control function of a 175-man part shop making metal pieces, at the Kansas City Works of the Western Electric Company has been fully computerized. The system of computer programs corresponds precisely to a shop together with its finished-parts storeroom. The system controls the inventory of finished goods through automatic generation of replenishment orders. Determination of stock-on-hand status is not included in the model, but rather is independently provided by a workswide stock-status system.

On a weekly basis, the computerized model of production and inventory control issues the following information:

1. The start date and size of each new lot to be produced and assembled.
2. All paperwork necessary to initiate movement of raw material and components to the proper shop area in order to start a lot.
3. A forecast by time periods of raw material quantities required.

On a daily basis, the system issues a work list for each of the five shop sections. Operations to be performed on the lots are listed in priority sequence.

The production control system is a product of the Engineering Research Center and is currently operated and maintained by personnel at a pilot installation in the Kansas City Works. The computer configuration is an IBM 1410 with an 80,000-character memory, six magnetic tape-drives and a disk file.

Based on an article in *The Western Electric Engineer* for July, 1966.

Environment

The Works is divided into a hierarchy of assembly shops and associated storerooms, as shown in Figure 1. The levels are arranged so that the demand on any module (shop and storeroom combined) must come from a higher level. Generally speaking, demand flows in a direction opposite to the flow of product.

Demand on each module is determined on a plant-wide basis in a level-by-level explosion. Note that the demand on any storeroom in a module can come from all higher levels. The arrows in Figure 1 show the path of demand explosion through the plant hierarchy.

Karl E. Korn received a B.S. degree in mechanical engineering from the Cooper Union School of Engineering in 1943. His background is in design, development and research projects. He became active in computer applications in 1957 and in 1959 served as a consultant in that field. He joined the Western Electric Engineering Research Center in 1961, where he is presently a Senior Research Engineer.

James H. Lamb received a B.S. degree in industrial engineering from Fairleigh Dickinson University in 1957. He then joined Western Electric. In 1962, after a year of study at New York University's Courant Institute, he rejoined Western Electric at their Engineering Research Center to help develop the computerized production control system described in this article.

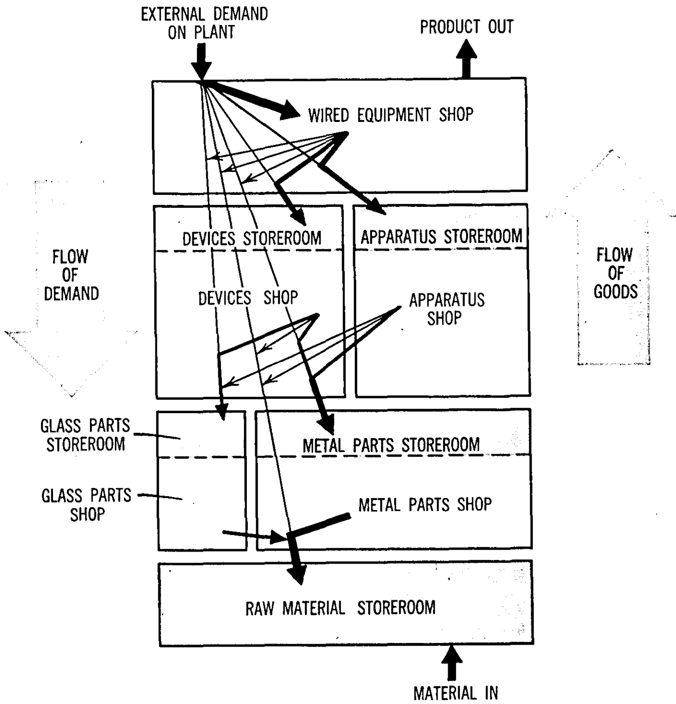

Figure 1. The plant is divided into a hierarchy of assembly shops and associated storerooms. Demand on a shop-storeroom module can come from external demand on the plant or from any higher-level module.

Requirements File

Demand for the entire works is stored on a single magnetic tape file, called the requirements file. Requirements consist of weekly quantities, varying from twenty weeks into the future for piece-parts and up to forty weeks into the future for wired equipment and raw material. For shops producing non-stocked items, requirements constitute demand on the shop; for shops producing stocked items, requirements constitute demand on the storeroom.

There is an important reason why each storeroom is grouped with the shop which feeds it. Such a grouping permits fast response to unexpected demand. In this model, demand for any finished item is considered inviolable. Thus, each such module has the responsibility of satisfying all requirements for its finished products, and also has the responsibility of providing its suppliers (at lower levels within the hierarchy) with a stable demand.

A module, which has various internal assembly levels, receives external demand for its finished goods at all internal assembly levels. These levels are identified by a numerical "lowest-level code." Demand from within the shop, internal demand, is distinct from external demand and must be calculated separately by the system model. Internal demand is the demand for lower internal assembly-level items which are manufactured in, and re-enter the same shop for use in higher-level assemblies. A typical shop module is shown in Figure 2.

Scheduling By Feedback

Considering the constant changes in demand for product, any detailed production schedule deteriorates as time passes. A schedule made to a lesser degree of detail but remade at relatively frequent intervals can be adjusted to the variations and thus can be more realistic. The degree of detail for a schedule may be selected as a function of the time range, the frequency at which the schedule will be remade, and the expected variation between predicted and actual operation times. The more detailed schedules generally have shorter horizons and a higher frequency of rescheduling.

As shown in Figure 3, the system realizes feedback on two levels — daily and weekly.

Approximations

Every week the system produces a twenty-week schedule for the shop by disregarding machine-capacity limitations and calculating a start and due date for each operation of each lot.

This first approximation schedule is improved by the machine-loading function of the system. Although at this time machine loading is not used at the Kansas City Works, the model is designed to adjust the schedule to meet manpower and machine capacity constraints. Each operation for each lot is loaded into a matrix of machine-time periods, as shown in Figure 4. If insufficient manpower or machine time is encountered, earlier dates are specified for the operation, the schedule of the lot is expanded, and an earlier lot start date is established.

Since the scheduling is repeated once a week, only those lots[1] which have a start date within a specified short-range limit (normally two weeks) are released to the shop. The remaining lots are used for predicting future raw-material demand and estimating future shop and storeroom inventories. Many of these lots will never really exist, since the work will be scheduled again the following week.

Adjusting Shop Status Record

The daily feedback occurs through shop-generated messages which indicate the progress of each lot during its manufacturing operations. Special telephone dialers for message input are conveniently located within the shop premises. The input messages are punched into a paper tape that becomes the input to the daily portion of the system.

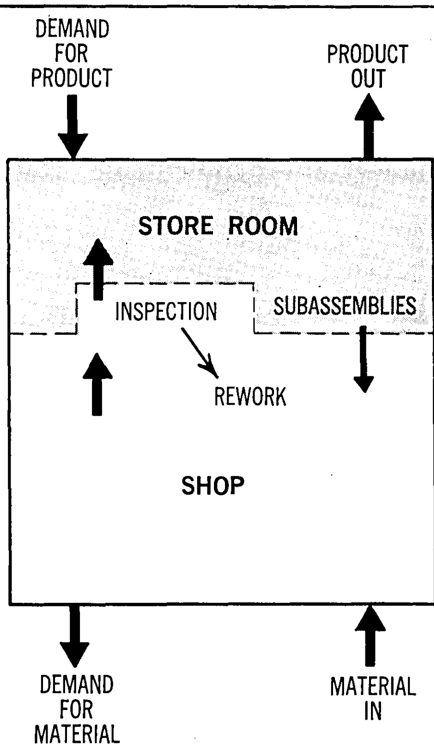

Figure 2. A typical shop-storeroom module.

[1] There are three categories of lots: planned lots, lots to be started this week, and lots in the shop. The planned lots are completely recalculated each week based on the new demand pattern, the existing shop lots and the existing stock position. A planned lot becomes an actual lot when it is released to the shop.

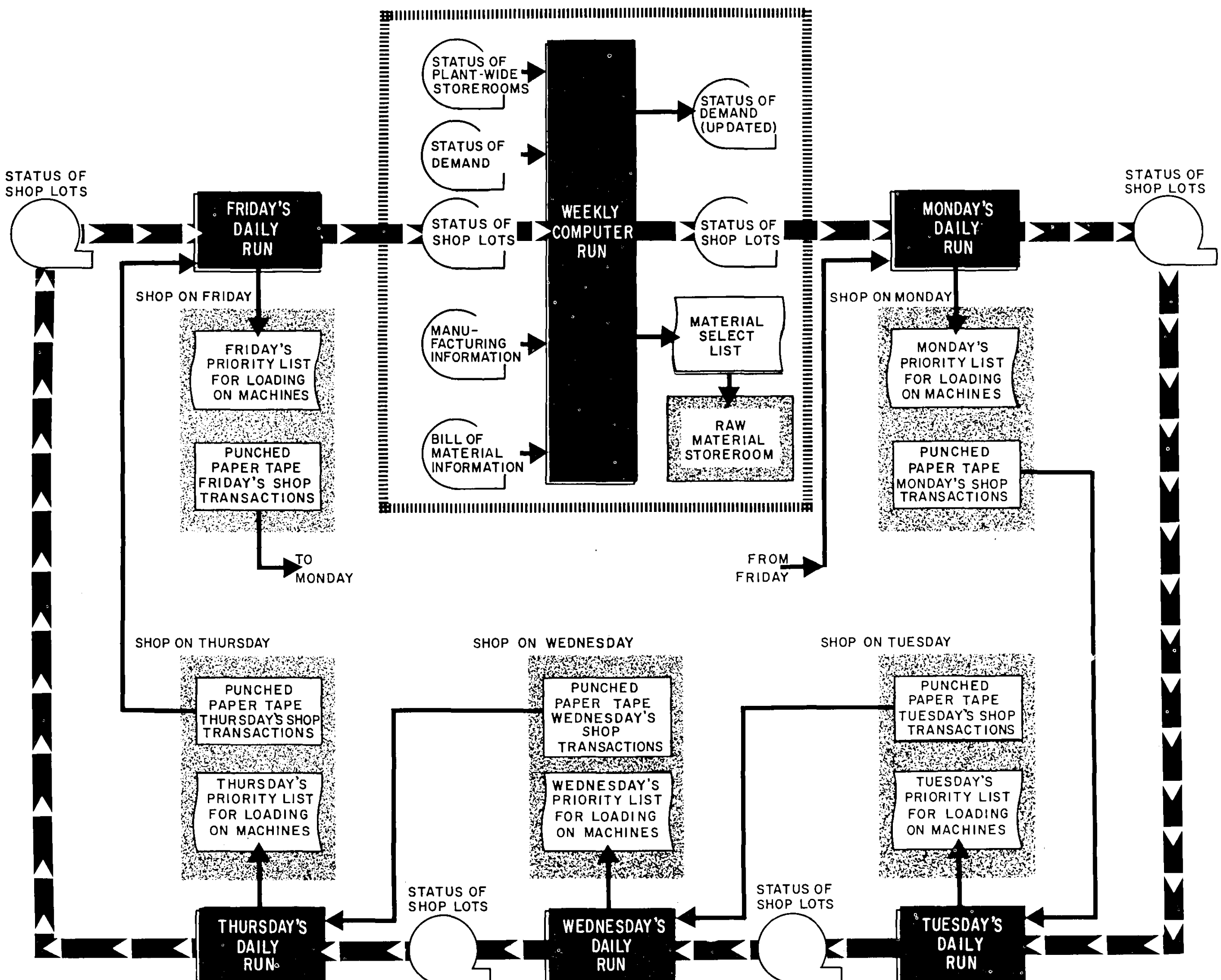

Figure 3. Feedback to the system occurs on a weekly and a daily basis. Once each week, a new schedule is determined from current demand and storeroom data, and the lot-status tape is updated. Each day, the shop transactions for the previous day are used to update the lot-status tape, and a new priority loading list is generated.

Once a day, the daily portion of the system, using the punched paper tape, adjusts the record of shop status. An updated priority list for the next day is then prepared and printed. A lot increases its priorities whenever an operation falls behind its scheduled date.

As shown in Figure 5, the transaction messages to the system are of three types: information pertaining to operations, information pertaining to lots, and inspection information. A priority loading list, showing the dispatching priority for each lot, is calculated from the computer-scheduled date for the next unfinished operation. For flexibility, short-interval (rush) orders may be introduced daily, if desired.

The Shop Status File Tape contains the status of all lots and is used and updated by both the daily and weekly portions of the system and thus forms the link between them.

System Design Policies

Major policies that affected the design of the system and thus produced significant system characteristics are as follows:

1. The model must be universal (repetitively applicable to all stocked shops in a manufacturing complex.)
2. Finished goods storeroom demand must be satisfied.
3. Uncompleted parts may not leave shop control, i.e., any part which has not been completed may not be stocked.
4. Investment in labor and raw material is to be made as late as possible.
5. Outside supplier lots (on parts which are also made in house) must be ordered by the model.
6. The use of historical data is avoided. The decisions made during the current computer run are maximally independent of last week's computer run. The latest status information is used in calculating the current week's decisions. Demand on the storeroom is considered deterministically dependent upon a high-level forecast.
7. The arrival of raw material to the shop floor is determined by the model. *Initiating a lot is not a manual decision.*
8. The size of the lot on the shop floor may only decrease. Messages describing increases in lot sizes from the shop floor (through a data collection device) are not accepted.
9. Rush jobs may be introduced manually.
10. Shop made subassembly (lower-generation) parts must be considered as and stored as finished goods.

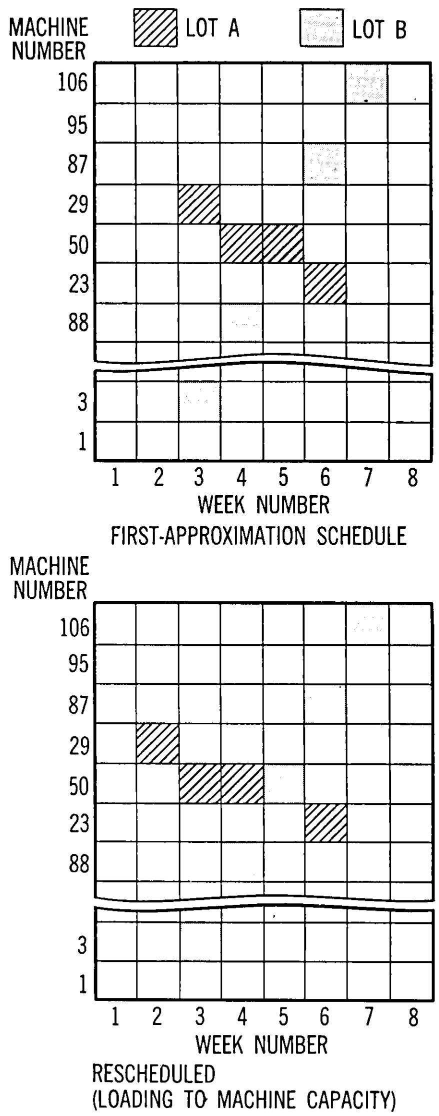

Figure 4. After all lots have been scheduled, each operation is loaded into a machine-week matrix, and conflicting lots are rescheduled. In this example, lot A is rescheduled a week earlier to avoid the conflict on machine 50 in week 5.

The Computerized Model

The production control model consists of six major functions:

1. Netting the demand.
2. Forming economic size lots.
3. Scheduling machine operations (calculating start and due dates.)
4. Calculating lower generation demand.
5. Rescheduling to capacity constraints.
6. Producing outputs for accounting, storeroom and shop.

The structure of the system is such that each major function is a separate program. In this way program maintenance is simpler, and new or improved functions can be easily added to the system. A general flow diagram of the weekly portion of the system is given in Figure 6. A description of each section follows.

Housekeeping

The first program formats the disk file tracks. The second establishes the date of the computer run and accepts values of significant system constants.

Constructing the Master File

The primary purpose of this loader program is to bring together, each week, current information on an individual part number, for the convenience of subsequent computer programs in the weekly system. Data for one part usually occupies a single disk track of 2,800 characters. Only those parts which are subject to manufacture in the piece-part shop and which may be required by subsequent programs, are loaded onto the disk file. (Manufactured parts which are exclusively purchased are handled the same as raw material.) The loader program also performs certain miscellaneous functions. It data-protects the system by examining critical values for reasonableness. It issues a discrepancy report of missing records and certain unreasonable data values and counts the quantity of different part numbers actually loaded, the corresponding number of disk tracks utilized, the number of unfinished lots in the shop, the monetary value of completed lots, and the like.

Netting the Demand

The primary purpose of the netting program is the conversion of estimated demand (by part, by week), called "gross requirements on storeroom," into the corresponding estimated net demand on the shop facilities. This conversion takes into account the gross storeroom demand values for twenty weeks into the future, the total quantity already committed (but not withdrawn), the amount on hand, the predetermined safety stock, and lots in the shop which have not yet been received into the storeroom. A numerical example illustrating a simplified netting algorithm is given in Figure 7.

A refinement to the estimate, called soft netting, permits the use of planned safety stock to meet sudden short-range

MESSAGES FROM
THE SHOP FLOOR

Operation Information
1. Setup started
2. Setup completed
3. Run started
4. Run completed
5. Work stopped
6. Work resumed
7. Rework started
8. Rework completed

Lot Information
1. Renumber the lot
2. Split the lot quantity
3. Merge two lots
4. Change lot quantity

Inspection Information
1. Accept the completed lot
2. Voided (previously accepted) completed lot message

Figure 5. Transaction messages inform the system of the daily progress of production lots.

increases in the demand on the shop. This refinement, not shown in the example, reduces the number of new lots that would otherwise be released on a rush basis.

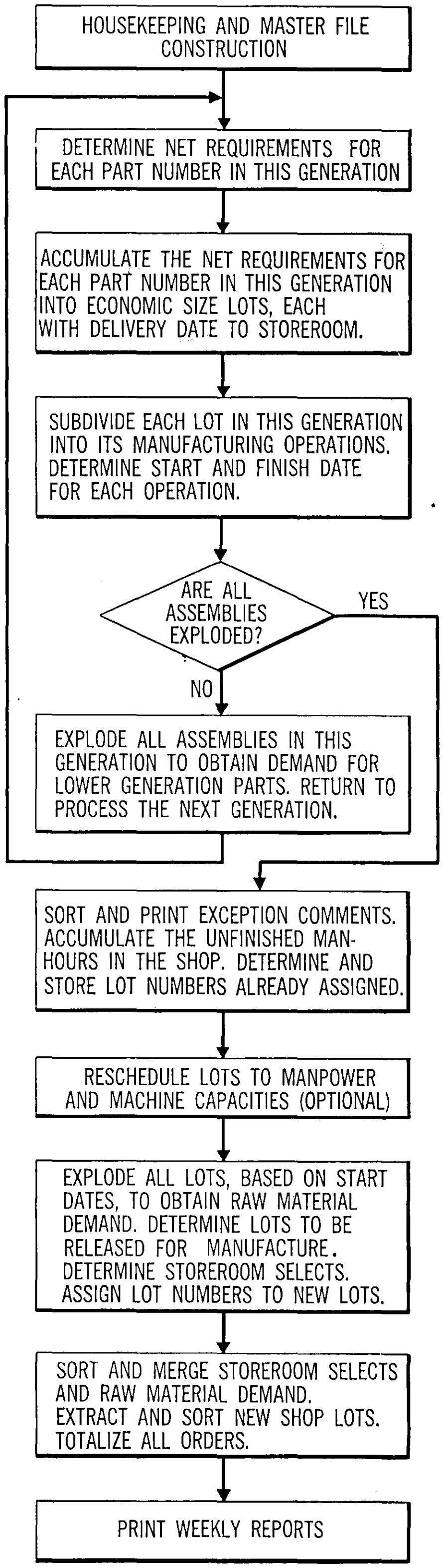

Figure 6. A simplified flow diagram of the weekly portion of the system. Each block represents one or more programs and contains a brief description of the major functions of that section of the system.

All parts in the reference files have a numerical code corresponding to the lowest subassembly level in which the parts appear. It is important to note that the gross requirements for a multiple-use subassembly cannot be considered complete as long as any lots of the higher-level assemblies (in the list of parts) have yet to be scheduled and exploded. Therefore, netting, forming lots, and scheduling are delayed until the gross requirements for the sub-items are complete. The computer program utilizes the random access feature of the disk file while processing lower-generation parts, in preference to passing the entire file of parts sequentially.

Deciding the Lot Size

The Wagner and Whitin[2] dynamic programming model is one of the two methods utilized to determine the lot sizes and their delivery dates into the storeroom. With the policy that the storeroom demand on the shop must be satisfied, the shop may deliver the net requirements earlier, but not later, than the times specified. Consequently, some of the net requirements are combined into one lot, provided the saving in setup cost exceeds the penalty of the earlier investment. When the relative setup cost is sufficiently high, a single lot is produced to cover an economical time period exceeding the twenty-week horizon of demand, but limited to a year's supply as a maximum.

Scheduling Machine Operations

After a lot quantity and its delivery date into the storeroom have been specified, the individual operations required for manufacturing this lot are assigned due dates and start dates (calendar day numbers). This is done by using the required delivery date into the storeroom and providing sufficient time for the last operation, previous operation, etc., until the start date for the first operation is calculated. For each manufacturing operation, the queue time and setup time are added to the calculated make time to produce the total scheduled time for the operation. (Inspection is treated in a manner similar to a manufacturing operation.) This produces a first approximation schedule for the manufacturing operations and also results in a tentative lot start-date. Holidays, weekends, and vacation shut-downs are avoided.

Calculating Lower-Generation Demand

The primary purpose of the lower-generation explosion program is to produce the total demand (quantities by weeks, twenty weeks into the future) on all lower-generation parts. These total requirements represent the total expected stores withdrawals resulting from external demand by other users and internal demand by the make shop itself for use in higher-level assemblies.

In the first pass through the list of parts, the demand for the second-generation parts is produced. The complete demand for these parts is not known until the pass is completed. The demand for the third (and subsequent) generation parts is unavailable because the second-generation lots have not yet been established at this point, their gross demand having just become available. After the first pass through this program, the total demand for all second-generation parts is known and has been up-dated on the disk file.

The computer then returns to the netting program, which converts gross demand on the storeroom into demand on the shop for the second-generation parts. For each such generation, lots are then formed, operations scheduled and, except

[2] Wagner and Whitin, "Dynamic Version of the Economic Lot Size Model." *Management Science* (October, 1958).

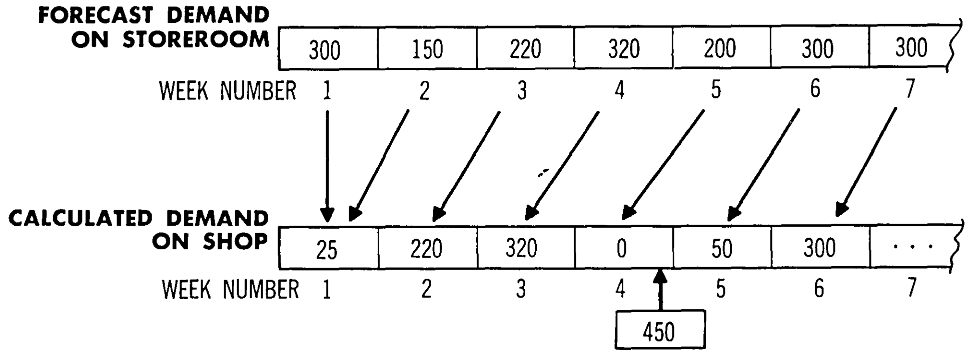

Figure 7. For this example of netting, 1,000 units are on hand in the storeroom, a safety stock of 450 units is required, and 125 units are committed but not yet withdrawn from the storeroom. A lot of 450 units is in shop and due in the storeroom on Friday, week 4

for the lowest generation, demand for the next lower-generation components is determined.

To automatically maintain the lowest-level code assignments, the system issues a correction card to the reference files in the event that an error in the lowest-level code assignment is detected.

Reporting Inventory Exceptions

This program prepares and prints reports of abnormal inventory or scheduling situations, for example, those parts that have an excessive quantity on hand in the storeroom and in lots in the shop. Following this, the program totals and lists the planned man-hours scheduled for the shop over the twenty-week period. In addition, the program determines reassignable lot numbers presently in use, permitting subsequent number assignments to the new lots by computer.

Rescheduling to Capacity Constraints

A linear programming solution provides a forecast of smoothed manpower as an optional addition to the existing system. Input consists of weekly man-hour requirements for the planned lots and the unfinished portion of the shop lots. Output consists of the total shop smoothed manpower, a forecast by weeks, and the value of allowable overtime work. The program cost constraints include such costs as hiring, layoff, overtime, straight-time, and inventory. The machine loading program loads to weekly manpower and machine limitations and computes new operation dates when capacity for the week has been reached.

Producing Outputs

For each lot to be released (within a specified short range limit), a lot number is assigned, and a storeroom material-select list specifying delivery of sub-assemblies and raw materials is produced. Also, the raw material demand information for all lot start dates outside the specified short-range release limit (usually two weeks) is provided as an input to the plant-wide material ordering system. This demand is obtained by exploding shop lots to required lower generation quantities, and planned lots to required lower generation and raw material quantities. The raw material forecast, storeroom select, and lots to be released are determined after any possible change in lot start dates (caused, for example, by insufficient man or machine power capacities).

System Performance

With minor exceptions, the system functions as designed and is trouble-free for extended periods. The system itself is a product of the Engineering Research Center; the pilot installation is operated and maintained by the Kansas City Works operating personnel. The daily portion of the system, including the data collection hardware system, was installed in October 1963. The weekly portion of the system was installed in September 1964. The weekly portion operates the 175-man shop with no manual inputs.

The net savings of the system have been calculated to be $300,000 per year in the pilot installation obtained from reductions in inventories and manpower requirements. The scope of the pilot installation is indicated by the shop statistics given in Figure 8. Including problem definition, system design, file formation, programming, coding, "debugging," and cutover, the total expended technical effort was about 20 man years.

The designers of the system have made a concerted effort to maximize both the structural nature of the system and the ease of revision. The bulk of the computer coding (in Fortran II language) was done by the designers. Autocode subroutines for character manipulation, tape records up to 2800 characters in length, and revisions to IBM software providing forward-alpha characters within words were provided by Autocoder specialists. The daily portion of the system was written in Autocoder.

Due to system complexity, multiple applications have not yet been widespread. Although the system is large and complex, almost all revisions are additive in terms of both size and complexity.

Future Work

Work is continuing on improvements to the system. The Loading Preference Factor (LPF)[3] for the machine-loading scheme is being investigated. A method for applying it is also under study. The LPF work should improve scheduling by determining priority equations for loading each lot into the machine matrix.

As shown by the backlog syndrome,[4] the amount of backlog interacts with the productive efforts of an individual. Specifically, the individual works best when a backlog of jobs exists, and he tends to create a backlog if one does not exist. Such shop conditions need to be considered in future improvements.

In addition, the system could be used to handle storeroom receipt of finished goods, eventually obviating the need for reporting storeroom inputs through the plant-wide stock status system.

Currently, revisions are made to the system by engineers

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[3] The LPF is a priority number assigned to each lot to denote its relative sequence in the loading process.

[4] Gomersall, E. R. "The Backlog Syndrome," *Harvard Business Review*. (September-October 1964), pp. 105-115.

at the Works and frequently include contact with the designers of the system. A formal revision procedure is being considered for future use.

SHOP STATISTICS	
Number of Employees	175
Number of Machines	233
Number of Homogeneous Machine Groups	100
Number of 8-Hour Shifts	3
Number of New Lots Per Week	300
Average Number of Operations Per Lot	6
Average Time Per Operation (approx. hrs.)	4
Number of Lots in Shop	1,600
Number of Parts on File	1,800
Average Number of Active Parts	1,200
Routing Through Shop	Random

Figure 8. Shop statistics show the scope of the pilot installation.

Conclusions

In summary, a large manufacturing complex containing a hierarchy of manufacturing shops and intermediate storerooms can be subdivided in such a manner as to allow production control by a universal model, which is incorporated into a system of computer programs. The corresponding physical module is a shop together with its stored finished goods. It is dissociated from its raw material storeroom, provided shop-made sub-assembly parts are considered as finished goods. The boundaries of the system of computer programs should be as described herein and limited to correspond to the boundaries of one shop and its storeroom, in order that the system of programs remain repetitively applicable to each shop-storeroom combination.

Progress of the lots within the shop (down to the specific machine operation on each lot) is continuously recorded on paper tape and batched daily by computer in the pilot application described. However the system of computer programs which operates weekly and establishes the flow of goods produced within the module can be designed omitting per-operation control.

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SYSTEMS AND DATA PROCESSING DEPARTMENTS NEED LONG-RANGE PLANNING

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"The typical system should be designed to operate effectively under the conditions that will exist five to ten years after the system is first proposed."

Data processing and systems departments need long-range planning. Why?

Most of the departments of a corporation, both those performing relatively new functions and those that are well established, seldom engage in long-range planning for themselves. The personnel department may make long-range forecasts of personnel requirements for the company, but it places very little emphasis on long-range plans for the personnel department. Likewise, the accounting department may collect and consolidate budgets from other departments of the company that extend five or more years into the future, but the accounting department seldom has a formal process for planning its own direction and development. Why then should a systems department make long-range plans for itself? What makes the systems departments different from most other corporate departments?

There are perhaps seven reasons that make long-range planning particularly important to systems and data processing departments:

1. Long lead time
2. Rapid technological changes
3. Spectacular growth
4. Large investment
5. Lack of clear authority and responsibility
6. Need to set a good example
7. Self protection

Let's consider each of these reasons in more detail.

Long Lead Time

The typical large systems project takes two to four years from the first investigation and proposal until it is programmed and ready for implementation. If many people or many different locations are involved, a year or two more may be required for full implementation. It may then take three to four years thereafter for the system to show an adequate return on the effort invested; that is, the pay-back period may be three to four years after full installation. Thus the typical system should be designed to operate effectively under the conditions that will exist five to ten years after the system is first proposed. This means that forecasts of that environment, of technological changes, and of changes in the nature of the business, must be made five to ten years into the future.

Long lead times also exist for acquiring or developing the systems department's resources. Orders for some types of computing equipment must be placed 18 months to two years in advance. Three to five years may be required to train and develop a head programmer or systems analyst.

A long lead time is also required to economically meet the company's requirements for office space. Both the systems department personnel and its computing equipment require floor space and special facilities. Of even greater impact is the effect that systems improvements can have on the office space required by other departments. Because buildings require time to plan and construct, because it is difficult to expand the

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size of most buildings, and because the depreciation must be spread over many years, floor space and facilities planning usually requires a forecast over five to ten years.

Rapid Technological Change

Everyone in systems work knows how rapid technological changes have been. Of course, the more extensive and profound the changes, the more effort is required to produce accurate forecasts, and the more necessary these forecasts become. In other words, the planning process requires more emphasis and care whenever it is more difficult to produce reliable plans — which is the case in our rapidly changing environment.

Spectacular Growth

The systems departments of ten to fifteen years ago, B.C. (that's Before Computers), not only performed grossly different functions than now, but they were staffed by very few people and no equipment. Now systems departments of fifty or more people are commonplace, and the typical systems department is growing at a rate of 10 to 20% per year. In addition, there is a trend for systems departments to take over functions once performed by independent departments. First was equipment programming, which was originally done by the tabulating departments. Then systems took over tabulating and computer operations. Then systems took over wire communications. This rapid growth has created the widespread feeling that more formal plans are needed for adequate evaluation and control.

The rapid growth and change in functions has also led to a widespread lack of understanding about the functions, purposes and goals of the systems departments. Other department managers and executives sometimes have a fear and distrust of the systems department, while still others feel that automated systems are the answers to all of the company's problems. With these wide differences of opinion, it is necessary for the Systems and Data Processing Department to clarify its position and to justify and explain its purposes and plans, much more frequently and thoroughly than is required of other departments.

Rapid growth has also led to internal problems. The accumulation of personnel from other departments, and from outside of the company, has created internal differences of opinion, and conflicting viewpoints. One of the best ways to indoctrinate these people, to integrate their different viewpoints so that everyone works toward the same goals, is through a process of formal, explicit, participative, long-range planning.

Large Investment

The fourth condition that distinguishes systems departments from other staff departments is the large investments that are required. The cost of the systems and data processing departments in some of the larger companies runs between five and ten million dollars every year. Even in companies of moderate size the total investment in the design and programming of systems may run into hundreds of thousands of dollars. With these large expenses, the cost of not knowing where one is going (in terms of the costs of re-design and re-programming) can be very large. Even if long-range planning can effect only a slight improvement, it would be worth many times its cost.

Lack of Clear Authority and Responsibility

The systems and data processing departments have recently been added to the organization charts of companies which previously operated effectively for many years without them. As a result of this newness, it is still not quite clear who is responsible for what, or who has the real authority to order the implementation of systems changes. The controller, or a financial committee, often controls the amount of money to be invested in systems equipment and the total amount of money to be spent on systems development. The operating departments, however, can do much to speed up or delay systems work in their areas. Who has the real authority for the selection of systems projects to be implemented? or for determining the priorities of resources to be devoted to these projects?

The chairman of the board, the president, or an executive committee may have the final authority, but these top people usually do not have the understanding, the interest, or the time to either exercise their authority or to develop policies to be used as guidelines. By default, these decisions are often made at lower levels, first on one basis, then on another. When the responsibility for implementation is not stated, who is to be held accountable when the system is delayed? or when it does not operate effectively? Because the authority and responsibility are actually spread over many executives, councils, and departments, some method of clarifying and coordinating these decisions and actions is required. One method of doing this is for the systems department to create what it feels is an acceptable long-range plan, and then to circulate this formal plan to all interested and affected departments. Any substantial differences of opinion between the various authorities can then be brought out for discussion and clarification by the top executives of the company. The lack of clear authority and responsibility for systems work, therefore, is a prime reason why long-range planning is particularly important.

Need to Set a Good Example

Systems departments usually try to offer advice to other departments on management science techniques and modern management methods. Usually this requires that they practice what they preach! If systems departments want to help other areas of the company in making long-range plans, they must first show that they can apply these planning techniques to their own departments. Setting a good example in order to earn the confidence of other people, therefore, is another reason why a systems department needs to make long-range plans.

Self Protection

For many different reasons, the systems departments are particularly vulnerable to the hind-sight kind of criticism. They must frequently answer the question: "Why did you spend so much effort in that area?" or "Why was this done that way?" Excuses can always be offered, but the best way for the systems departments to answer these questions, and to protect itself from irresponsible second guessing, is to obtain prior approval and commitment to a recorded, widely published, long-range plan. These plans should not be looked upon solely as alibi paper. An effective long-range planning process helps to develop the important factors that must be considered to create *better* plans and more *useful results.*

These seven reasons point out why long-range planning is particularly important to a systems and data processing department. Many of these same reasons, of course, apply to other corporate departments. The fact that these other departments do not make long-range plans does not mean that they should not.

Benefits

Let's look at the need for long-range planning from another viewpoint: at the benefits that could be gained by a systems department if it did make long-range plans. These advantages can be described as reducing management problems in the following five ways:

1. Recognizing future needs in time to meet them.
2. Promoting better current decisions.
3. Promoting better organizational structure.
4. Promoting better internal communication, teamwork, and morale.
5. Saving management's time.

Recognizing Future Needs

Long-range planning recognizes future needs, opportunities, or problems in time to prepare for them, as, for example, by:

a. Detecting a future shortage of computer capacity in time to obtain, in an economical way, the delivery and types of equipment required.

b. Detecting the need for trained personnel. Sometimes this involves detecting the need for new kinds of computer capability, such as time sharing, message switching, direct access inquiry devices, etc. in time to train programming personnel in the use of these techniques. This category also includes recognizing new application areas before the managers of these areas see the need, so that knowledgeable personnel can be acquired or be trained.

c. Preventing costly changes in direction. One example would be centralizing all systems and data processing operations on the basis of today's economics only to learn that new techniques and future equipment developments make decentralized operations more practical. Another costly type of change in direction is that caused by the changes of heart by a user. After designing, programming, and testing a new system you find out that it is not what the user really wants. Long-range planning, by pointing out the costs and problems beforehand, and by clearly communicating what is planned to all of the people concerned, tends to reduce the *unnecessary* changes.

Current Decisions of Better Quality

Long-range planning promotes higher quality current decisions:

a. By creating better forecasts on which to base these decisions. An example would be making a current computer lease-or-purchase decision on the basis of a good forecast of our future needs for this type of equipment, and with a better estimate of the final sale or trade-in value that will apply at the end of the lease or depreciation period.

b. By discovering inconsistencies through insuring more comprehensive plans that are reviewed by more people. An internal example would be discovering that the data-processing-operations-department plans to do away with the type of computer that someone in the systems development area intends to use for a new system.

c. By considering more alternatives. It does this by increasing the opportunity for more people, at all levels, to contribute suggestions and criticisms to the plans, and by bringing attention to the opportunities offered by technical advances. It also brings attention to those areas that are outside the responsibility of any one existing department or division.

d. By de-emphasizing the immediate return through stressing improvement over longer time-periods. It does this by forcing plans to be made further and further into the future.

e. By pre-determining fast reactions. It does this by developing, beforehand, alternate courses of action to be followed in emergencies. Long-range planning thus provides the ability to react quickly and in concert by investigating and developing contingency plans that might not otherwise be created.

More Effective Organization

Long-range planning allows more effective organization. After long-range planning has clearly defined the purpose of the organization, uncovered its weaknesses, and developed its long-range strategies, it becomes more obvious how the organization must be structured to carry out the strategies and to obtain its purposes. Furthermore, the key men are more likely to yield a part of their empire when they are doing it to achieve defined and agreed-upon objectives, or when they can see clearly how they will fit into the future organization.

Good Internal Communication

Long-range planning promotes good internal communication, teamwork, and morale.

Unless the direction of growth for the systems departments has been clearly defined, different employees may be unknowingly working at cross purposes. The written plan provides an important channel of communication upward, downward, and cross-wise. This helps eliminate confusion, frustration, and misunderstandings. The participative planning process promotes cooperation and coordination of plans. Agreed-upon goals generate enthusiasm and inspire employees to work more effectively.

Saving the Time of Management

Long-range planning saves management's time. It does this by:

a. Allowing MANAGEMENT BY EXCEPTION. Formal planning allows control through comparison, which is impossible if the goals are not predetermined. It is an old saying that no one can ascertain whether he is on the correct path unless he has determined where he wishes to go. Long-range forecasts identify problems that need managerial attention, and eliminate the need to spend time on matters that are going as expected.

b. Allowing DELEGATION OF AUTHORITY. Subordinates are more able and more willing to take on responsibility when they can rely on an accepted plan or goal as justification of their actions.

c. Providing STANDING ORDERS. Long-range planning develops strategies and policies that need not be redeveloped for every application. This saves executive time by reducing the number of meetings, memos, orders, etc., that would otherwise be required.

Higher Level of Systems Department Achievement

We have mentioned seven important reasons why systems departments need long-range planning. We have also pointed out five important benefits and advantages of long-range planning. There is one last reason why everyone in the systems and computer departments should want long-range planning: Long-range planning moves the department to a higher level of worthwhile achievement. This means that individual goals for growth, recognition, promotion, higher salaries, etc. are more likely to be obtained, as is the personal satisfaction that goes hand-in-hand with a high level of accomplishment.

Excuses

Most of the reasons and benefits that I have mentioned are widely known. There is no secret about them, they have been mentioned in many general articles and books about long-range planning. Why it is, then, that so many systems departments spend so little time on long-range plans? Could it be that most systems managers enjoy handling current problems, working with the here-and-now, and that they will cling to almost any excuse to avoid dealing with the future? Let's look at some of the excuses that have been offered, and at some of the answers:

"I Don't Have Time To Plan"

This is probably the excuse that the professional planner hears most frequently. Some of the common varieties are as follows:

a. "Putting out fires, solving current problems, is more important *now* than planning."

b. "If you're about to be fired, you're not likely to have much interest in long-range planning."

c. "I'm too new in this position. I'll be able to plan better after I get the department running smoothly."

d. "We're going to start planning as soon as we get through with this big project that's taking up all of our time."

These excuses are all the *result* of poor planning. The answer is to quit procrastinating; steal a little time every week; organize your department now so that the work is properly delegated and allocated, so that you *do* have time for long-range planning.

"I Have Plans But I Can't Tell Anyone About Them"

This excuse overlooks the fact that there is more to planning than creating secret strategies. One can't organize effectively, for instance, without at least telling the people who are to make up that organization the functions they are expected to perform. The details in one's mind that are not written down are probably still a little hazy and perhaps even unsound! The advantages of participative planning are being overlooked by the people who use this excuse. Some variations of this excuse are as follows:

a. "If I write my plans down, someone may use the information against me." (But look at all your subordinates who can use the information to *help* you!)
b. "I don't want to limit my flexibility." (Is flexibility more valuable than achievement?)
c. "I don't want to commit myself to something I may not be able to deliver." (But psychologists tell us that one's lack of commitment will probably lower one's achievement, and the lack of achievement may hurt more than missing a few goals, especially if the long-range plans allow for some reasonable slippage.)
d. "Some of my people might be discouraged if they knew the truth about what was in store for them." (If there's bad news ahead, they probably already know it. Besides, good planning recognizes everyone's needs and goals and can often change a gloomy future into a bright one.)

"For Me, Planning Would Be a Waste of Time"

This excuse is probably the most common among managers who feel they need a convincing reason for not planning. It has many facets:

a. "Important events that affect my operations are too unpredictable to make planning worthwhile. All that is needed is a flexible organization that is quick on its feet, so that it can adjust to the changes." (Systems technology is *not* unpredictable. Agreed-upon plans reduce the unpredictable behavior of the other people in your company who can affect your operations. And it is worth remembering we're talking about long-range plans that need not be changed to fit every emergency or adjusted to show every change in the operational plans.)
b. "Planning around here would be worthless because our plans have to be coordinated with the plans of other departments — and these other departments won't make any plans or pay any attention to our plans." (Have you pointed out the need for long-range planning and the benefits? How about suggesting some changes in the corporate structure for planning? Have you considered a top-level systems planning committee that includes the executives to which these other departments report?)
c. "I don't see any problems, so why do I need any plans?" (These are famous last words. Without long-range planning one probably can't see the changes and problems that are in store.) A very similar, but different attitude can be expressed this way: "My plans are to keep things the way they are — I don't want any changes and therefore I don't need any plans." (Does anyone with that attitude belong in systems work? But more directly, lack of planning usually leads to someone else forcing changes upon you. You can't avoid progress by ignoring it.)
d. "I won't be around here much longer (I'll be transferred, promoted, retired, die, etc.); so why should I plan ahead?" (You may be judged by the quality of your plans and by the condition in which you leave the department. If you create plans, you can later get the satisfaction of seeing how your plans have been carried out, how they have benefited those you left behind.)

"Top Management Doesn't Want Me to Plan"

a. "Planning must start at the top, but my management doesn't tell me their plans or ask me to spend any time on planning. (Planning can also start from the bottom. By developing plans and getting your management to approve them, you will indirectly get them to tell you those parts of their plans that affect you.)
b. "If I made plans, no one would look at them or approve them. I can't get anyone to commit themselves around here." (Have you actually submitted a comprehensive, well thought out long-range plan? It may not be practical for anyone to approve pieces of a plan before seeing the whole picture. See 3b for more suggestions.)
c. "I do what I'm told, and no one has told me to make any plans." (Can't you do anything on your own? This is just a variation of 4a.)
d. "The company has no formal plans — so how can I plan?" (Another variation of 4a.)
e. "My boss doesn't allow me any time for planning." (Another variation combined with 1a — "I don't have time to plan").

"We're Too Small to Plan"

(Not true! The planning job for a small department is

(Please turn to page 45)

600 Grand Mercedes, courtesy Mercedes-Benz of North America.
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WORLD REPORT – GREAT BRITAIN

An extremely interesting situation is developing in the British banking world. Under the threat of sharp competition from the Post Office GIRO — the poor man's bank — the Big FIVE, who have some 5,000 branches all over the U.K., are formulating automation and interconnection plans which are more far-reaching and ambitious than anything elsewhere, including the United States.

The Midland Bank with its 1,500 branches all over Britain was the first to disclose its plans. These provide for the installation of three, possibly four, centres in Britain to which groups of branches will be connected over Post Office lines. The centres will themselves be interconnected, probably over high capacity coaxial cables.

The aim is that by 1970-71, a bank customer shall be able to transact business at any branch, however remote from his home bank, without the need for extra documents or special identification. Automated teller's sets linked directly to the nearest computer center will ultimately supersede the standard accounting equipment, reducing manual clerical labor to almost vanishing.

For its central data units, Midland has specified $17 million worth of Burroughs units, and the whole integrated system may cost as much as $32 million. The bank terminals are to be engineered by Olivetti of Great Britain (which has been fiercely independent of General Electric since the latter captured so many of the Olivetti family in Italy).

National Provincial Bank with some 1,200 branches was the next to announce its plans. However, this bank already has two IBM 360/30's, three 40's, a 50, and another 50 to come. It claims — but there are many DP experts who shrug off this claim — that it will be able to handle all its branches from *one* centre in London with the IBM equipment it already has, amounting to something over $15 million worth.

The next to go 360 may be Westminster, which also has well over 1000 branches and is already operating a very ambitious central computing unit based on 1410's and 1401's. Other manufacturers have been trying hard to challenge IBM, but only English Electric has the machine and the experience. IBM's performance to date on the Barclay credit card scheme and at Lloyds — the other two banks in the Big Five group — has been uninspiring, to say the least.

Indeed, the smaller Martin's Bank with its 700 branches went so far as to throw out $1.6 m. worth of 360's last year to which it was firmly committed and buy NCR 315's, including an RMC type, instead.

It is certain that had English Electric come on the scene with System-4 six months or a year earlier, the banking story would have been vastly different. And if the Westminster Bank plans depend on the performance of the multi-access software for the IBM 67, then the whole contract will be in the lap of the gods for the next twelve months.

It is no laughing matter for the major banks. The Post Office bank will mean a serious threat with its immediate cash payment and withdrawal facilities in every village and hamlet of the British Isles where there may be just one branch of one of the majors. This means that before 1969, when the Post Office bank will gear up to full operation, the banks will have to agree on some measure of cooperation or lose valuable business.

The immediate and intriguing consideration is that of the massive software problem facing whoever supplies the data networks for the five big banks.

As far as is possible for any manufacturer with this size of headache, English Electric is sitting pretty, for it is supplying the machines (70's) and the software for Post Office GIRO It has also concluded a contract on Britain's Project MAC at Edinburgh University for joint development with the government of the software for 200 simultaneous on-line terminals, again based on a 70, or an enhancement thereof. These three tasks are mentioned here in reverse chronological order. If everything goes smoothly it will be a miracle, and the bank DP staff from all over the world will break a trail to English Electric's doorstep.

A rapid backwash from IBM's decision to kill the 90 series has come from English Electric which, with characteristic check from a company whose computer turnover is a hundredth that of IBM, has announced a "tentative and problematical" System 4-90 to cost $3 million per machine.

A computer venture about which very little is heard is the Digital Systems Department of the Ferranti Company at Bracknell. They are responsible for a massive integrated environmental control, attack and defense system costing roughly $6 million and based on three Poseidon computers installed on HMS *Eagle*, a medium-sized flat-top. The Department has an annual turnover around the $15 million level, doubling every five years, and is military in flavour. But it thinks increasingly of venturing into civil fields (such as radar trainers and simulators) and anywhere the highest reliability is essential, including air traffic control.

It is carrying out some very interesting R & D, particularly in the area of interconnection on eight and more layer circuit boards. One idea is to suppress the tiny "washers" which mark the interconnection points between layers and nevertheless achieve continuity with the through-hole plating.

Ted Schoeters

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THE QUEST AND THE COVENANT:

How to Translate Ideas into Government Research Contracts

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"You are a brilliant, impractical, unworldly scientist with a couple of ideas for nice bite-sized research projects, neither trivial nor insoluble — how can you turn these personal 'noncontracts' into Federal contracts?"

According to "Federal Funds for Research, Development and Other Scientific Activities"[1]:

- Federal obligations for basic research, applied research, and development are expected to total $15.9 billion in each of fiscal years 1966 and 1967;
- Obligations for basic research have risen to an estimated $2.1 billion in 1967;
- Applied research obligations have risen to just under $3.5 billion; and
- Development obligations are expected to drop to a mere $10.4 billion.

It has also been estimated:

- That in fiscal year 1966, computers and/or automatic data processing in the Federal government alone used 63,000 man-years of personnel and cost $1.1 billion for acquisition and operation[2];
- That the National Science Foundation alone spends over $10 million per year in the support of computer centers at universities;
- That over 12,000 military computers have been delivered; and
- That some 1,800 computers are used by contractors on Federal contracts.

Changing "Noncontracts" into Contracts

This article is concerned with the problem of changing "noncontracts" into contracts — or in other words, how to take that first big step towards getting Federal support for research ideas in the field of computers and data processing out of the foregoing budgeted activities. Although I emphasize "preparing" research proposals, it should be stressed that this is almost the last step in a complicated process, *not* the first.

A research proposal differs from most other forms of nonfiction (we hope) in that:

- The writer is assured that at least one person will read what he has written;
- There is an operational test of effectiveness: the proposal is accepted or rejected.

If the proposal is accepted, the technical writer is entitled to as much credit as he can steal. If it is rejected, the blame can be shared equally between the scientists who gave them lousy material to work with, and the inverse Micawberism of those bureaucrats in Washington who keep waiting for something to turn down.

In fairness to the reader, a writer should tell when he knows what he is talking about, and when he is talking through his hat. I know, reasonably well, the problems involved in preparing and submitting an unsolicited basic research proposal to the Air Force Office of Scientific Research. Specific details may differ, but I think that my general statements will apply equally well to unsolicited proposals to the Office of Naval Research and the National Science Foundation. To a lesser extent they should also apply to unsolicited proposals submitted to the Army Research Office, the National Aeronautics and Space Administration, and the National Institutes of Health.

Unsolicited Proposals

The operational word in the preceding paragraph is "solicited"; its antonym is "unsolicited." "Unsolicited" is a term of the art, like "ethical" in relation to pharmaceutical

[1] Surveys of Science Resources Series, National Science Foundation, NSF 66-25. Available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for $1.25. (See especially Volume XV, setting forth the funds spent or planned to be spent during fiscal years, 1965, 1966 and 1967.)

[2] See "Inventory of Automatic Data Processing Equipment in the Federal Government 1965," published by the Bureau of the Budget.

houses which I assume lack the antonym. An "ethical" house, regardless of its scientific or business ethics, is one that nominally advertises only to the medical profession.

An "unsolicited" proposal is, according to the Armed Services Procurement Regulations:

> A research proposal which is made to the government without prior formal or informal solicitation from a purchasing activity.

An unsolicited proposal, at least in our Command, is treated as proprietary. It is evaluated, accepted or rejected on its own merits. To be sure, it is in competition for our budget with all other proposals that we receive. We will haggle on the price, but we will not take your idea and put it out for competitive bidding.

Solicited Proposals

A solicited proposal, on the other hand, is one prepared in response to direct solicitation. In an unsolicited proposal you propose both the problem and its solution. In a solicited proposal *we* propose the problem and *you* propose the solution. Your proposal will then be evaluated, usually by an evaluation team, in direct comparison with your competitors.

As you might expect in this non-Aristotelian world, there is a third category which might be called the "quasi-solicited" proposal. Procurement shops live in a binary world of contracts or grants, sole source *or* competitive bidding, but there are all sorts of grey areas before the proposal reaches procurement.

For example, there is the *procurement synopsis* program. We are required by law to place our programs — not only our contract and grant awards but also our research interests *(not,* in our case, *needs)* — in the *Commerce Daily,* which is published in Chicago by the Department of Commerce. You have an opportunity there to review what we are doing and, if you see an announcement of a proposed procurement and if you think you can hack it, you are invited to contact the Air Force laboratory which is conducting the program and ask to be included in the competitive bid process. If you demonstrate by your response an interest and technical capability in the Air Force Program, you will have an opportunity to be placed on bidders' lists.

Bidders' Lists

It is particularly important, if you are interested in getting RFP's (Requests for Proposals) from the Air Force that your company's capabilities be entered in the Air Force Systems Command Research and Development Capability File. This file maintains a Random Access Source Selection system, showing in the file the interests of contractors. Some of the areas of interest to the readers of *Computers and Automation* are listed in Table 1.

A similar system, called QDRI, is run by the United States Army. For the first step of this, the prospective bidder fills out a Policy Agreement, in which he agrees not to disclose any classified information revealed to him and, more or less in return, is allowed access to the services of the Defense Documentation Center. The Army then sends him various documents showing their research interests; if any of them seem interesting he fills out a Field-of-Interest-Register. This, in turn, does two things for him. It provides him with the names of interested research managers in the Army and puts him on bidders' lists to receive Requests for Proposals.

A brochure describing this program can be obtained, either by writing to:

Commanding General
Army Materiel Command
Washington, D.C. 20315
ATTN: AMCRD-SS-P

Or, if more convenient, getting in touch with one of the various Army Commodity Commands. These are:

U.S. Army Electronics Command
Ft. Monmouth, N.J. 07703

U.S. Army Missile Command
Redstone Arsenal, Ala. 35809

U.S. Army Munitions Command
Dover, N.J. 07801

TABLE 1

A PARTIAL LISTING OF AREAS INCLUDED IN THE AIR FORCE SYSTEMS COMMAND RESEARCH AND DEVELOPMENT CAPABILITY FILE

Aircraft instruments	Bionics
Combat information centers	Bioinstrumentation
Anti-jam techniques and equipment	Biomedical data processing
Mathematical theory of communications	Cybernetics
Crytography	Intelligence data handling and display (storage and retrieval, presentation, dissemination and reproduction, conversion, image interpretation)
Data links	Intelligence systems studies
Radar and radio	Documentation
Image display and interpretation equipment	Technical writing
Electronics and electronic equipment	Computers (including analog, digital, data reduction, data processing, theoretical studies, information storage, data presentation, simulation and programming)
Electronic tube devices	Documentation and library science
Countermeasures	
Modulation studies	
Electronic theory	
Electromagnetic compatibility	
Guidance and control	
Mathematics (pure and applied)	

Further information on how to be entered into this file, and copies of the Air Force Systems Command Form 220 needed may be obtained from:

Air Force Systems Command
Attn: SCKAE-2
Andrews Air Force Base
Washington, D.C. 20331

U.S. Army Weapons Command
Rock Island, Illinois 61201

U.S. Army Mobility Equipment Command
St. Louis, Mo. 63166

U.S. Army Tank-Automotive Command
Warren, Michigan 48090

U.S. Army Aviation Materiel Command
St. Louis, Mo. 63166

In all cases, letters should be addressed "ATTN: QDRI."

As far as I have been able to find out, the Department of the Navy does not have a centralized bidders' list; various individual lists however are maintained by the separate Navy Bureaus, such as the Bureau of Naval Weapons and the Bureau of Ships. The Office of Naval Research, which perhaps supports the greatest number of research efforts in the computer field, deals almost entirely with unsolicited proposals, q.v.

The problems of the bidder seeking solicited proposals do not end with putting his qualifications in a central file. It is equally important to scan *Commerce Business Daily*, for notices of impending procurements, which are usually of the form:

> Office of Director, Defense Research and Engineering, The Pentagon, Room 3E112, Washington, D.C. 20301. Telephone 202-697-74789
> A-RESEARCH AND DEVELOPMENT SOURCES SOUGHT
> Firms having a capability to undertake a study to . . . are invited to submit complete information to the activity listed above. Info furnished should include total number of employees, qualification of professional personnel; a description of facilities, and an outline of previous and current projects. This is not a request for proposal. Respondents will not be notified of the results of evaluation of source info received. Responses to this proposal should be received in this office no later than . . .

Responses to such requests can be almost boiler-plate; it is probably worth the effort to keep answering them. The next step would be a formal request to attend a bidders' conference in which the impending procurement would be discussed and then, if you think it worth the gamble, to prepare a research proposal.

Obtaining Funds for Unsolicited Proposals

Obtaining funds for unsolicited proposals presents a somewhat more difficult problem. Your company has on its payroll, or you are, a brilliant, impractical, unworldly scientist, Theoprastus Bombastus von Hohenheim, whom we will call Dr. Paracelsus for short. Doc has all his union cards — PhD from a respectable school, several sound articles in reasonably respectable journals, a hi-fi set, a Volkswagen and a crew cut. He has a couple of ideas for nice bite-sized research projects, neither trivial nor insoluble. The only thing he doesn't have is Federal Support.

The campaign falls into four stages:

Reconnaissance and target identification
Contact
Proposal writing
Patient waiting

Reconnaissance and Target Identification

This job is essentially a problem in technical intelligence; much of it can be done without leaving your desk. The basic reference is the "U.S. Government Organization Manual" which you buy from the Superintendent of Documents, Government Printing Office (hereafter abbreviated, SupDoc) for $1.75. This gives you the set of all Federal organizations; your job is to find the sub-set which is interested in supporting Dr. Paracelsus' research and then within those organizations find the lowest level of administrator who can say "Yes" with a reasonable probability of making it stick.

What Agencies Would Like to Support

There are two ways of finding out an agency's research interests. One is to listen to what it says about what it would like to support; the other is to find out what it actually *does* support. Dr. P's proposed research is, of course and by definition, unique, but it isn't all *that* unique, and the odds are a little better that it will find a home among similar efforts in an on-going program than that it will break virgin territory and open up a new research area for an agency.

Finding out what we say we'd like to support is not difficult. Five dollars worth of stamps will get you at least 100 agency brochures. Agencies love to put them out and get rid of them so that they can print new ones to take care of their latest reorganizations.

What Agencies Do Support

Finding out what research we are actually supporting is a little more difficult. One outfit in New York spends something like $1 million a year, and makes a tidy profit on it, in running an intelligence operation on DOD contract awards. They'd be delighted to sell you their services.

The Public Health Service list of grants and awards is available from SupDoc. In 1966 the National Science Foundation published their annual report in two parts. The second part is a grant listing; you can buy it from SupDoc for $1.00.

Neither of these publications, I regret to say (with tongue in cheek), has either a subject index or a list of abstracts of their research efforts. The Air Force is the only one of the three military services and, with the possible exception of NASA whom we taught how to do it, the only Federal Agency to publish a properly subject-indexed set of abstracts describing all their basic research efforts. This is called *Air Force Research Resumes* and can be purchased from the Federal Clearinghouse for Scientific and Technical Information — the former office of Technical Services — for, I believe, $5.00.

Dr. Paracelsus can be a big help here. For our own legitimate bibliographic reasons we do our damnedest to encourage journals to print credit lines as footnotes to their articles — "The research reported herein was supported in whole or in part by the Directorate of Information Sciences of the Air Force Office of Scientific Research." I assume that these credit lines can also be used for other, less legitimate purposes. Dr. P should certainly be encouraged to root through the footnotes in his piles of reprints and come up with clues for you.

Collect organization charts. The largest single bargain you can find is the Department of Defense phone book. We got so tired of having these swiped out of our offices that we finally made them available through SupDoc for $1.25. Trade magazines love to print organization charts — you'll find them in everything from *Aviation Week* to *Electronic News* — and usually more complete than the official ones.

I know of no easily obtainable compilation of agency research programs in the field of "computers and automation." Some indications of agency interest in an overlapping field, that of "scientific documentation" in the broadest sense, may be obtained from the National Science Foundation publication, "Current R & D in Scientific Documentation." A current issue is number 14 (NSF-66-17) which you can buy from

SupDoc for $2.00. Table 2 was compiled from this publication.

As you can see, research likely to be of interest to the readers of *Computers and Automation* is most likely to be supported by some twelve agencies. Their addresses follow:

- National Science Foundation, 1800 K Street, Washington, D.C. 20550
- Army Research Office, 3045 Columbia Pike, Arlington, Virginia
- U.S. Army Electronics Laboratory, Fort Monmouth, N.J. 07703
- Office of Naval Research, Main Navy Building, Washington, D.C. 20360
- Air Force Cambridge Research Laboratory, L. G. Hanscom Field, Bedford, Massachusetts
- Air Force Office of Scientific Research, 1400 Wilson Boulevard, Arlington, Virginia 22209
- Rome Air Force Development Center, Electronic Systems Division, Griffiths AFB, N.Y. 13440
- Hq, Electronic Systems Division, L. G. Hanscom Field, Bedford, Mass.
- Advanced Research Projects Agency, Room 3D169, Pentagon, Washington, D.C. 20301
- Division of Research Grants, National Institutes of Health, Bethesda 14, Maryland
- Division of Research, U.S. Atomic Energy Commission, Washington, D.C. 20545
- Office of Advanced Research and Technology, National Aeronautics and Space Administration, Washington, D.C. 20546

There is a temptation to stop at this stage of the game — say with your discovery that Dr. P's research might be of interest to the National Institutes of Health, the Atomic Energy Commission and the Space Agency — write a simple

TABLE 2

FEDERAL SUPPORT OF SCIENTIFIC RESEARCH PROJECTS REPORTED IN "CURRENT R & D IN SCIENTIFIC DOCUMENTATION" (14th Edition)

Area	Nat'l Sci. Foundation	Army	Navy	Air Force	Defense Dept. (Other)	Nat'l Inst.of Health	Dept.of Health, Edu.&Welfare (Other)	Atomic Energy Comm.	NASA	Total
1. Information Needs & Uses	14	0	1	3	1	7	4	1	3	34
2. Document Creation, Copying	4	2	1	2	2	2	1	--	3	17
3. Language Analysis	13	3	5	25	4	6	3	--	--	59
4. Translation	3	--	1	8	--	--	--	--	--	12
5. Abstracting, Classification,etc.	18	2	5	11	2	7	--	1	2	48
6. Systems Design	10	7	6	10	2	8	9	3	2	57
7. Analysis and Evaluation	11	--	1	13	--	4	2	1	1	33
8. Pattern Recognition	3	6	5	22	--	4	1	--	1	42
9. Adaptive Systems	4	2	5	14	1	5	--	--	--	31
	80	22	30	108	12	43	20	6	12	333

1. Information Needs & Uses. Information needs of scientists and uses made of scientific literature. Coverage of indexing and abstracting services; improved efficiency of library services.
2. Document Creation and Copying. Mechanized processes for document composition and conceptual studies on document creation: photocomposition, mechanical methods of composing chemical structures and mechanized editing systems. Improvement of technical writing, graphic design and publication design.
3. Language Analysis. Pure and applicable linguistics; lexicography and related areas, automatic dictionaries and thesauri; automatic abstracting, indexing, content analysis, information storage and retrieval, document characterization, concept-oriented syntactic analysis, etc.
4. Translation. Application of computers to automatic translation and linguistic analysis.
5. Abstracting, Classification, Indexing and Coding. Theoretical and pragmatic studies on the intellectual aspects of organizing documents for subsequent retrieval; vocabularies, thesaurus construction, classification systems; conventional and machine-aided indexing.
6. Systems Design. New information retrieval systems; library operations and library mechanization; real time systems for library networks; information centers.
7. Analysis and Evaluations. Evaluation of indexing vocabularies, coding, abstracting, indexing methods; relevance studies, surveys and content analyses; convertibility studies for vocabularies and indexes; comparisons of specific systems or methods.
8. Pattern Recognition. Use of computers in optical pattern recognition; character recognition, coding of geometric configurations in patterns; pictorial image recognition and interpretation; graphs (medical and biological data); speech analysis, recognition, synthesis.
9. Adaptive Systems. Related psychological studies pertaining to artificial intelligence; simulating complex information processing activities involved in human cognition and underlying neurophysiological mechanisms; self-organizing systems.

jim-dandy general purpose proposal, load it into a blunderbuss and fire it off in the general direction of a dozen different agencies. Don't. Keep on working until you have the specific names of individuals in these agencies at the lowest level in the organization that can say "Yes" and make it stick.

Contact

The next step is to come out of the overcast and make contact with us. There are two possible strategies, depending upon whether you or Dr. P has more spare time — but someone has to find out whether we're interested.

Civil servants are easy to talk to, but they're hard to catch in the office. Keep trying. Phone ahead to find out whether we're interested. If not, we can usually suggest someone, either in our own organization or elsewhere who might be. This is not always a run-around, but even if it should be, it's better to wear out Ma Bell's electrons than your shoeleather.

But suppose someone does nibble at your bait. I had over 100 formal office visitors last year, so it's not impossible. From here on out, you can handle things by mail. If Paracelsus were teaching in a small college in Oregon it would be ridiculous to suggest that he come to Washington to discuss a $5,000 grant. Eventually though we are going to want to meet the scientist who's going to do the work — if not in our offices, in his lab or at a scientific meeting.

Some companies seem to like to use their Washington representatives or traveling vice-presidents to do the preliminary screening; some send teams of three — the scientist, the salesman, and someone who sits in the corner and says nothing but silently weeps when we mention that the purpose of an AFOSR contract is not to make money; a few are actually brave enough to send the scientist down without someone to hold his hand. Suit yourself, but if you're going to have to write the proposal you might as well come along.

Prepare for Work, Not Play

Make a definite appointment. Phone the day before to confirm it. Life in Washington is hectic, and even with the best of intentions the executive flu, a Pentagon panic or even a purely local head-shed flap or brush fire can leap upon us.

Come prepared. Not with your key to the Playboy Club -- the nearest one is in Baltimore, and that's too far to go for lunch — nor with credit cards in anticipation of a big night on the town. Most of us belong to car pools and have wives, homes and children in the suburbs we see all too rarely as it is.

Don't prepare an elaborate formal briefing. We're reasonably good at that racket, and we're more likely to try to pick up a few new techniques than pay attention to what you're saying. I deliberately don't have an easel in my office; flip charts look silly spread on the floor; 35 mm slides look even sillier projected on my wall. Any charts needed should be briefcase size — you're visiting a private office, not a theater.

Do come prepared for about an hour's conversation. If Dr. P is like most of my scientist visitors, he needs to be turned off, not on. But remind him to bring along spare copies of any relevant publications, and some sort of summary he can leave with us.

False Assumptions

One common mistake visitors make is to assume that I'm smarter than I am. A large desk only conveys the appearance of omniscience — I haven't yet been able to build Memex into mine. Dr. P is all too likely to come in and start talking immediately about the latest advances in a field of which I have only general knowledge. I have a standard defense — "What do *you* mean by Bayesian statistics?" — but I'd rather not be made to use it. This may be a chance for you to justify your trip by playing Dr. Watson when my eyes start to glaze.

On the other hand, you can't absolutely count upon my being stupid. Make sure that Dr. P does his homework. He is presumably in my office because he knows more about his field than I do — and if I find out that he doesn't know about what has already been done or about similar work that is going on elsewhere I'm likely to take a dim view of his competence.

Let's assume that you have found the right office. The conversation is going famously, but you've been there for almost an hour. Get out while you're ahead, but remember to ask two questions before you go:

- Should (or may) I send in a proposal?
- When should I send it in?

Fiscal Cycle

The second question is actually the more delicate of the two, since it involves the oestrus cycle of the agency. Some come into heat twice a year; others are more or less in heat all year round. The fundamental biological rhythm is that of the Federal fiscal year, which starts officially on the first of July. Congress does not usually get around to appropriating funds until some time in August, and we can't spend the money until we get it.

Most agencies are under some pressure to have their funds committed well before the start of the next Fiscal Year. We, for instance, are usually told to have all of our funds initiated by the end of January each year. We also do not like to keep proposals around for more than six months (our General doesn't like it either, and that's important).

When to Send Proposals

In practice then, although proposals can be sent in at any time of the year, for us at least those sent in from February through August tend to lie fallow. We will be busily writing purchase requests from September through January. I suspect, although I haven't bothered to keep the statistics, that the best time to send in proposals to us is from May or June through November. I suspect also that each agency has its own peculiar rhythm. As far as I can tell from the notices in *Science* the National Science Foundation has two deadlines a year for submitting proposals, but find out!

Agencies differ in the way they answer the question, "Shall I send in a proposal?" The proper, safe, dull, bureaucratic procedure is to say, "Oh yes, by all means. I have to see it in writing before I can possibly make a decision." This is fine as far as it goes, but it can go too far. For gross improbables I prefer to use the sword in my office rather than the Judas kiss *in absentia*. It's work for us to log in, acknowledge, evaluate and reject proposals; it's even more work for you folks to write them. I prefer not to let people leave my office without giving them some idea of the probability of our being able to fund their proposal, although I am always careful to point out that if they don't send in a proposal at all the probability is 0.

Let's say that I have suggested — not asked or solicited, mind you, but suggested — that you might want to send in a proposal.

Writing the Proposal

There are two sorts of proposals — formal and informal. The formal proposal is a legal document, bearing the signature of a responsible officer of the would-be contractor. The informal proposal has no legal status. On the other hand, it can bypass your administrative chain which, at the very least, saves time. An informal proposal can be converted into a formal proposal by the addition of a firmer cost estimate and a legal signature. In practice we prefer, and most of the people we do business with seem to prefer, to use informal proposals as a first step. I gather that some agencies can deal only with formal proposals.

Before you leave the office find out what the local ground rules for proposals are. Find out also if there are any peculiar pieces of paper to be used. We're perfectly happy with plain white bond, although I will admit that paper 8½ inches wide gives me a terrible feeling of margin envy (The General Services Administration saves vast sums of money, and gives me a permanent inferiority complex, by standardizing on paper 8″ x 10½″) but apparently some other agencies use Multilith mats or fan folds with their own peculiar forms. Make them give you some. It serves them right.

What a Proposal Includes

Our own suggestions for preparing research proposals are set forth below as an example. Other agencies may have different suggestions. Find out what they are. It would be a shame to blow it when you're this close to home.

I will skim lightly over the more obvious points. You should include:

1. The legal name and address of the organization requesting support, as well as the name of the individual submitting the proposal.

2. Desired starting period of the research, remembering that it takes time to translate a proposal into a contract — allow at least three months — and the time period for which support is requested. This should probably not be for less than a year. We can occasionally fund for multiple years, but it's best to break the effort down into year-sized chunks.

3. We assume that the principal investigator will be responsible for direct supervision of the work, and in most instances will participate in the conduct of the research regardless of whether or not he is to receive any compensation from the contract funds. We need his *curriculum vita* with a list of his principal publications (I, at least, deduct one point for every proposal listed as a publication — and don't think that people don't do it); we will need similar information for other senior professional people who will be associated with the project.

4. Cost estimates are important, but I could derive more sheer lyric beauty from reading a page of the Philadelphia telephone directory to you. Besides, this is one place where we don't want creative writing. Get the local rules before you leave.

Submit Proposals to Several Agencies

Please feel free to submit the same proposal to several different agencies, but tell us if you do. It makes our job simpler. There is coordination among the different agencies, but it's not foolproof. There have been times in the past when we did not discover that another agency was planning to fund the same proposal until it was almost too late to straighten things out. It's a lot better for all concerned for you to tell us, rather than have us find it out. This is one of the things that makes civil servants uncivil.

If the proposal is to be treated as a formal proposal, one copy must be signed by the principal investigator and by an official authorized to sign for the organization. All copies of the proposal should indicate the persons, with their titles, who have signed the proposal.

Send in at least six copies of your proposal. Your office copying machines don't cost any more than ours, and probably work better.

So far, much of what I have discussed is *biblia abiblia,* literature devoid of humanistic interest. There are other things that the proposal must have:

- A *title*
- An *abstract,* in 200 words or less, set forth on a separate page.
- A *detailed description* of the work to be undertaken, the experimental and theoretical methods to be used, the work objectives and their relation to the state of knowledge in the field and to comparable work in progress elsewhere.

A bibliography of pertinent literature citations should be included. Since May of 1957 there has been an oft-repeated, and amplified, bit of nonsense to the effect that if a proposed piece of research costs less than $100,000 it is cheaper to do the research than the literature search. We don't, needless to say, agree with this. A scientist stands on the shoulders of other scientists as, in part, revealed by the published literature[3] and his ability to search the literature, or have it done for him for somewhat less than $100,000, is part of his professional competence. We don't mind, although we usually don't support, people who feel that they must invent the wheel; we have no immediate need for stoneboats, travois or sled runners.

Importance of the Title

Sometimes I think that the title of the proposed research is the most important part. It will be the first, and may be the only contact others have with the research. It behooves us to pick titles which are bland to the Bad Guys and informative to the Good Guys.

A Bad Guy, in this context, is one who reads a list of project titles, spots one on, say, "The Mating Habits of the South African Flea," and proceeds to sound off on the waste of the taxpayers' money involved without bothering to find out what it's all about. Bad Guys, by this definition, occur in all walks of life, from newspaper columns to, I am told, the halls of Congress; lists of project titles circulate almost as freely. As I am also told, Virtue usually Triumphs, but it's easier on all concerned not to give the Bad Guys a handle.

Things to avoid, if at all possible, are:

- Words or phrases with possible sexual or scatological connotations — single, double, and triple entendres.
- Familiar names of mammals, birds, fish and even, insects.
- Words with a vulgar meaning at variance with the scientific meaning.

A good title will contain the most important specific keywords needed to index a project, arranged into a phrase that has more meaning than a random assortment of these selfsame words. Two things are important, then: the selection of the right words, and the ordering and connection of these into a meaningful phrase.

Description of the Research

The description of the proposed research is, to the scientists who will evaluate the proposal, the single most important

[3] The reader interested in the history of this phrase is referred to the delightful exercise in scholarship, "On the Shoulders of Giants" by Robert K. Merton, Collier-Macmillan, N.Y. 1966. Turns out Newton didn't coin it at all; it can be and is traced back to the 12th century Bernard of Chartres.

part. Dr. Paracelsus must write at least the first draft of this himself — if he isn't interested enough to write it we don't want him for a principal investigator. There are things you can do to help him, after he's got it down on paper.

Make sure that Paracelsus has answered, if at all possible, the following questions:

What is he going to do?

Why does he want to do it? Professor Popper of the University of London suggests that every scientific investigation is undertaken to yield an answer to a question. This question should be statable before the research starts.

How is he going to do it? Is his approach theoretical, descriptive, analytical, experimental?

What new or old techniques or apparatus will be used or improved?

Will, *deo volente,* the investigations hopefully yield new techniques, new apparatus, new theories or hypotheses, new interpretations, new evaluations, new understanding?

Neither you nor he should work too hard to:

- Justify the support of basic research by the Air Force.
- Write a high school textbook (undergraduate, maybe, but not high school) on the state-of-the-art in this research area.
- Provide detailed specific Air Force applications of the possible results of the proposed research.
- Bias the Nobel Prize Awards Committee.
- Win the Westinghouse Award for Science writing.

If you can:

- Be precise. Avoid vague and inexact usage. Avoid idle words. Make every word pull its own weight.
- Spell things out. Avoid acronums and peculiar abbreviations. Say extreme low frequency," rather than ELF.
- Be clear. Consider the beauty and efficiency of the simple declarative sentence and its siblings as a medium for communication.

Vocabulary

You have two tools for your job; words and the arrangement of these words into sentences. Choose your vocabulary carefully before you begin to write. This isn't easy. A powerful English vocabulary comes only from much reading — as little of it as possible in manuals on technical writing — writing, and dictionary using. The most effective stimulants for Bad Guys and confusants for Good Guys are everyday dictionary words used with specialist meanings without warning. Use a dictionary. Not as an authority — Dr. Paracelsus has words in his vocabulary too new to be found in any dictionary — but to warn him what the word means to most readers.

Particularly dangerous are everyday words that have been compressed into specialist meanings, and then decompressed again as the specialty widens. Thus the word ends by having a vague specialist meaning, or meanings, quite different from its vague everyday meaning, as well as having specific specialist meanings at variance with each other and with any specific everyday meaning. *Exempla horribilis* — INFORMATION!!!

Good writing depends not only upon syntax and grammar, but also upon vocabulary. In English, particularly, proper choice of words can dominate and sometimes correct grammar and syntax. The reader benefits if vocabulary, grammar and syntax all pull the same way. If they pull in different directions, see to it that the vocabulary pulls in the right one. Neither misleading nor diffuse words can do this, for the latter either run in circles or don't pull at all. The sentence becomes an algebraic expression with unknowns to be supplied out of the reader's technical and social experience.

When choosing words, near enough is not good enough.

Waiting

The proposal is typed, proof-read, assembled, bound, signed, proof-read again. Six copies are mailed in. Your job is done, Eventually, if all goes well, after various subterranean heavings and mutterings, you will get a letter of technical approval, which is *not* a commitment of funds *nor* an authorization to start work, and, eventually, a contract or grant. Relax, get lots of sleep, eat a light, nourishing diet. Because someday you are going to have to start worrying about technical reports and journal articles, and how to fill out DD Form 1473.

But that's a topic for another paper.

Acknowledgement

Anything of literary merit in the preceding section stems, as does much of documentation today, from the advice of Robert Arthur Fairthorne, Mentor of Arisia and sometimes, I fear, Boskone. (The reader who is not familiar with this allusion is referred to the canonical writings of the late Edward E. Smith, Ph.D.)

c&a

COURSE ANNOUNCEMENTS

With this issue "Computers and Automation" starts a new department, "Course Announcements." Listings of courses (subject to editing, and a reasonable maximum of number of words) will be printed at a charge of $8 apiece, but the first half dozen listings received in the mail in each calendar month will be printed at no charge.

It seems to us that this may be a reasonable compromise between not printing any listings for courses for which other than nominal charges are made, and printing all those and only those course announcements which are paid for.

However, to start off the department in this issue, all the courses for which we found information on hand in our file were listed at no charge.

EDP Management Seminar: Top Management Control of EDP / Brandon Applied Systems, Inc. / May 11-12, 1967; St. Moritz Hotel, New York, N.Y. / Contact David F. Alison, Brandon Systems Institute, 1130 17th St. N.W., Washington, D.C. / $?

EDP Management Seminar: Computer Operations Management and Control; Project Control Systems for Data Processing; Computer Systems Analysis Techniques / Brandon Applied Systems, Inc. / May 15-19, 1967; Biltmore Hotel, New York, N.Y. / Contact David F. Alison, Brandon Systems Institute, 1130 17th St. N.W., Washington, D.C. / $?

EDP Executive Seminar: Executives' Guide to Data Processing; Measuring EDP Performance; Management Standards for Data Processing / Brandon Applied Systems, Inc. / May 22-26, 1967; Hotel Mayflower, Washington, D.C. / Contact David F. Alison, Brandon Systems Institute, 1130 17th St. N.W., Washington, D.C. / $?

The Role of Computer Assisted Instruction in Business, Industry, and Government / Computer Assisted Instruction, Inc. / May 10, St. Louis, Mo.; May 16, San Francisco, Calif.; May 17, Los Angeles, Calif. / Contact, Dr. Robert C. Kyle, Computer Assisted Instruction, Inc., 111 West Monroe Street, Chicago, Ill. 60603

The Heuristic Programming Approach to Artificial Intelligence / Univ. of Calif. Extension, Los Angeles /Dr. James Slagle / June 19-23, 1967; Univ. of Calif. at Los Angeles Campus / $225

A heuristic program is defined as a computer program that uses "educated guessing" to discover solutions to intellectually difficult problems. Covers principles underlying the heuristic programming approach, with a view toward future applications.

Top Management Control of EDP / Automation Training Center / May 11-12, 1967; St. Moritz Hotel, New York, N.Y. / Contact Director, Automation Training Center, Box 3085, Scottsdale, Ariz. 85257 / $?

Data Processing Risk Management / Automation Training Center / May 5, 1967; Statler Hilton Hotel, Los Angeles, Calif. / Contact Director, Automation Training Center, Box 3085, Scottsdale, Ariz. 85257 / $?

EDP Audit and Control / Automation Training Center / May 14-19, 1967; Jack Tar Hotel, San Francisco, Calif. / Contact Director, Automation Training Center, Box 3085, Scottsdale, Ariz. 85257 / $?

Computer Graphics for Designers / The Univ. of Mich. College of Engineering / June 5-16, 1967; Univ. of Mich. Campus, Ann Arbor, Mich. / $300

An introduction for designers in engineering, architecture, and related fields to elementary computer programming, principles of graphic manipulation and applications of computer graphics as aids in improved design methods.

Programming Concepts, Automata, and Adaptive Systems / The Univ. of Mich. College of Engineering / June 19-30, 1967; Univ. of Mich. Campus at Ann Arbor / $300

To acquaint practicing scientists, engineers and university faculty with current results in the fields of formal and programming languages, adaptive systems, artificial intelligence, cellular and parallel computers, and the theory of automata and computation.

Elements of Simulation / State University of New York at Buffalo / June 5-9, 1967; State University of New York at Buffalo, N.Y. / $175

Covers: the role of simulation; an appreciation of when it should not be used; constructing, executing, evaluating and experimenting with mathematical models.

Documentation in the Social Sciences / American University / Mass. & Nebraska Aves. N.W., Washington, D.C. / Dr. Lowell H. Hattery / May 8-11, 1967, Marriott Motor Hotel, Washington, D.C. / $?

Covers problems, needs, methodology, centers and networks, international programs, user relations, and research and development in the social sciences.

Introduction to Digital Computer Engineering / Univ. of Mich. College of Engineering / June 19-30, 1967; Univ. of Mich. Campus at Ann Arbor / $300

Introduction to the engineering aspects of digital computers, fundamentals of computer organization and design.

Foundations of Information Systems Engineering / Univ. of Mich. College of Engineering / June 19-30, 1967; Univ. of Mich. Campus at Ann Arbor / $300

Covers: basic mathematical concepts in graph theory, algebra, and probability theory; development of information theory, automata theory, queueing theory, decision theory, optimization theory, network flow analysis, and discrete time system analysis.

Numerical Analysis / The Univ. of Mich. College of Engineering / June 19-30, 1967; Univ. of Mich. Campus at Ann Arbor / $300

Covers important methods in contemporary numerical analysis.

Computer and Program Organization — Fundamentals / The Univ. of Mich. College of Engineering / June 19-30, 1967; Univ. of Mich. Campus at Ann Arbor / $300

Computer and Program Organization — Advanced Topics / The Univ. of Mich. College of Engineering / June 19-30, 1967; Univ. of Mich. Campus at Ann Arbor / $300

Computer Languages and Their Philosophies / Univ. of Calif. Extension, Los Angeles / Dr. Lionello A. Lombardi / July

31-Aug. 4, 1967; Univ. of Calif. at Los Angeles Campus / $225

For managers, technical staff members, and others interested in programming languages. Covers: fundamental concepts of programming languages, their classifications and characteristics — functional, technical, non-technical, and future potential.

Interactive Time-Sharing Systems: Hardware and Software / Univ. of Calif. Extension, Los Angeles / Dr. Harry D. Huskey / June 19-30, 1967; Univ. of Calif. at Los Angeles Campus / $300

This course is intended for managers of time-sharing installations, system programmers, system users, and covers: Characteristics of time-sharing systems, hardware requirements, monitor characteristics, subsystems.

Management Information Systems: A Critical Appraisal / Univ. of Calif. Extension, Los Angeles / Drs. Lionello A. Lombardi and James C. Emery / Aug. 21-25, 1967; Univ. of Calif. at Los Angeles Campus / $225

For upper executive and staff level managers concerned with application of information and technology to planning and control systems. Covers: computer-based information systems for planning and control, judging system effectiveness, and exploitation of future technical advances.

Introduction to Symbolic Control / Ill. Institute of Tech. Research Institute / July 27-28, 1967; Oct. 19-20, 1967; IIT Research Institute, 10 West 35 St., Chicago, Ill. 60616 / $70

Covers basic elements of computer-aided, numerical control manufacturing; computers, APT, post-processors, and APT research and development.

Basic Numerical Control / Ill. Institute of Tech. Research Institute / June 5-7, and Sept. 18-20, 1967; IIT Research Institute, 10 West 35 St., Chicago, Ill. 60616 / $100

Covers the components in a typical numerically-controlled machine tool installation; point-to-point and continuous path equipment; tape formats; manual programming; computer-assisted programming systems; and postprocessors.

Basic APT Part Programming / Ill. Institute of Tech. Research Institute / May 15-19, Aug. 28-Sept. 1, and Nov. 6-10, 1967; IIT Research Institute, 10 West 35 St., Chicago, Ill. 60616 / $200

Covers fundamental techniques of APT part programming; tool and workpiece geometry; process planning; two-dimensional and point-to-point pattern programming applications.

Advanced APT Part Programming / Ill. Institute of Tech. Research Institute / July 10-21, and Oct. 16-27, 1967; IIT Research Institute, 10 West 35 St., Chicago, Ill. 60616 / $400

Workshop covers realistic experience in all phases of part planning, programming, processing, and fabricating. Work may be done on class problems or on parts brought in for economic analysis or actual production. Computer and machine tool time will be charged at standard rates.

SYSTEMS DEPARTMENTS — Young

(Continued from page 33)

easier — many of the organization and communication problems are much simpler in a small organization. Often there are fewer projects, less alternatives and less functions. When a planning specialist or consultant can not be employed, the systems manager should provide the planning know-how and inspiration for planning).

"I Don't Know How to Plan"

(For some strange reason I very rarely get this as an excuse for not planning. I usually hear it only from people who *are* planning.). Here are two variations of this complaint:

a. "We don't have any historical data on which to base a forecast, and how can you plan without a forecast?" (Collecting data for forecasts is part of the planning process — start now and get out of this vicious circle. Perhaps data from other installations could be used as a rough guide. Have you tried to exchange such information?)
b. "I have not written any plans because I don't know what a written plan should contain." (Why not sign up for a systems planning course, or read some books on the subject?)

The value of long-range planning, and the rewards that come to those who do it and do it reasonably well, are great. And systems departments, which now logically include data processing, equipment programming, tabulating and computer operations, and wire communications, will include more and more functions that are important, as they become masters of long-range planning.

CAPITAL REPORT

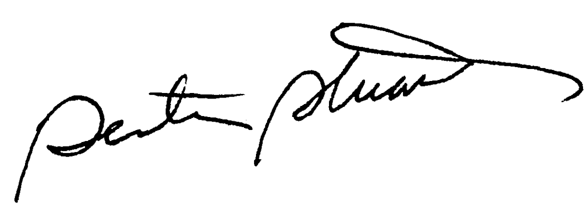
(Continued from page 22)

IBM has provided substantial support for the project; the American Bankers Association has funded refinement of the monetary subsector; and the National Science Foundation has contributed heavily to improving the model. Gary Fromm heads the model project at Brookings. James Duesenberry of the Council of Economic Advisors, Ed Kuh of the Massachusetts Institute of Technology, Lawrence Klein of the University of Pennsylvania, and Fromm have contributed most heavily to the several man-years of econometric analysis necessary to get the model operative.

What Brookings hopes to have five or ten years from now is a model accurate enough to predict the effect of fiscal and monetary policy changes contemplated by the government. In its present state, according to Sadowsky, the model is still considered experimental, although runs made to predict changes already announced by government officials have been verified by actual effect on the economy.

Brookings also spurred the Internal Revenue Service (IRS) into taking a 100,000 record sample of United States tax returns in 1962. This sample is currently being used to predict effect of tax law changes, and plans are drawn to make added refinements in the way in which it analyzes the tax structure and measures its effect during periods of economic expansion and recession. Brookings' 1964 hypothetical prediction proved accurate with respect to the tax law's economic effect in sustaining United States economic growth.

Brookings is non-profit and staffed by economists and econometricians who advise the United States government at the highest level. Its head, Kermit Gordon, was formerly Director of the Bureau of the Budget. Most of its top personnel are consultants to other government agencies, and have close ties to IRS, the Department of the Treasury, the President's Council of Economic Advisors, and similar organizations.



Senter Stuart

ACROSS THE EDITOR'S DESK

Computing and Data Processing Newsletter

TABLE OF CONTENTS

APPLICATIONS

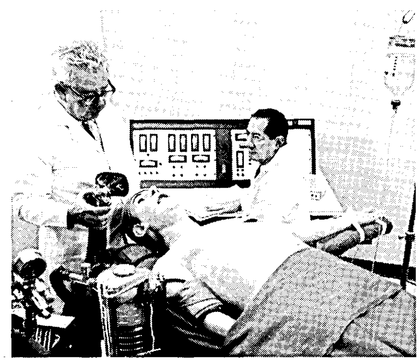
COMPUTER-CONTROLLED ANESTHESIOLOGY PATIENT SIMULATOR

A revolutionary application of engineering technology to medical education became known recently when a manikin — computer-controlled as a patient-simulator for training resident physicians in anesthesiology — was shown and demonstrated for the first time at a professional meeting by the University of Southern California's School of Medicine. This most complex medical teaching tool, to be known as Sim One, was developed by USC medical researchers in Los Angeles working with engineers of Aerojet-General Corporation's Von Karman Center in Azusa, Calif., under a grant of $272,130 from the Co-operative Research Project of the U. S. Office of Education. Co-directors of the manikin project are USC's Dr. J. S. Denson and Dr. Stephen Abrahamson.

Sim One is sufficiently lifelike to be truly representative of a human patient on an operating table awaiting surgery. Skin-colored, skin-textured plastic covers its frame. The manikin's jaw is hinged to permit the mouth to open and close in normal human fashion. Inside the mouth are all the structures found in the human patient; the manikin even has bronchial tubes. Sim One has a heartbeat, carotid and temporal pulse beats, blood pressure; movements of the diaphragm and chest simulate the action of breathing; the eyes open and close and the pupils of the eyes dilate and constrict. Computer programmed, electronic systems drive these mechanical actions of the manikin to simulate the symptoms and physiological responses an anesthesiologist may encounter during an actual operation.

Further, Sim One is programmed to provide appropriate responses to the injection of four different drugs, administered in varying dosages, as well as to the administration of both nitrous-oxide and oxygen. The manikin's human-like reactions and responses were programmed by Aerojet-General Corporation into an Electronic Associates, Inc. hybrid 2400 computer, composed of an EAI 231-R analog and DDP-24 digital computer made by Computer Control Company (now a Honeywell division). The manikin itself was fabricated by Sierra Engineering Co., Sierra Madre, Calif., to the specifications of Aerojet-General, under a subcontract.

While a resident is learning on the simulator, his instructor will be at the instructor's control console where he can monitor each step of the performance. If he wishes to talk with the student, he may stop the procedure at any point and for as long as desired, and then resume from that point or start all over again. Not only is the system designed to allow the procedure to be halted at any time, but also the computer may be called upon for a print-out of precisely what has taken place up to that point — or after the procedure has been completed, one may review a time-sequence read-out of everything that happened to the manikin. In addition to the computer print-out, a pen recorder also charts the action of all vital signs as they occur.



— Computer-controlled anesthesiology patient simulator is checked out prior to demonstration by Dr. J. S. Denson (left) and Dr. Stephen Abrahamson.

Dr. Denson explained that Sim One will be used in training resident anesthesiologists in the particular skill necessary in endotracheal intubation. "This is the name given to a procedure which involves passing a semi-rigid tube into the trachea, or windpipe. Through this tube anesthesia gases are administered directly to the lungs while controlled artificial breathing is maintained. This technique is used frequently for major surgery and it demands a high degree of skill on the part of the anesthesiologist," Dr. Denson said.

Drs. Denson and Abrahamson feel that perhaps the greatest training values afforded by Sim One lie in the abilities of the simulator to demonstrate and repeat as often as desired, the emergencies which are irregular occurances during actual surgery. USC's researchers in medical education believe that Sim One could be the first of a whole generation of medical simulators.

PROPERTY DEEDS TO BE VERIFIED BY COMPUTER

Historical records of more than 2.4 million land parcels — many dating back to 17th century Spanish land grants — will be stored by an RCA computer for virtually instant retrieval at the Security Title Insurance Company in Los Angeles, Calif. Security Title's EDP manager, Ernest F. Woodward said, the information, used by the company to verify property deeds in Los Angeles County, now is contained on some 30 million punched cards. This data will be transferred to the memory storage device of an RCA Spectra 70/45 computer this summer. Mr. Woodward noted that the cards, which contain abstracts of every legal document affecting land transfers in Los Angeles for the past 300 years, represent the country's largest file of its type, and the first to be computerized.

In order to insure clear title to a property, its ownership must be traced as far back as possible. With the computerized file, it will be possible to retrieve in seconds the complete history of any parcel of land in the County, saving as much as a full day of research. Information from an RCA Random Access Memory Unit may be displayed visually on TV-tape screens of four Video Data Terminals, or may be produced as hard copy on a high-speed printer.

The Spectra 70/45 also will write title policies tailored to the specific needs of clients, which vary in each case depending upon unique characteristics of the land involved. Terms of a policy for a property with Municipal or County access rights attached to it will differ, for example, from those of one for property without such rights. Literally thousands of individual policy clauses covering similar contingencies will be stored in the computer's memory. Those meeting requirements of a particular situation will be selected automatically by the computer and the policy will be written accordingly.

TEXTILE INDUSTRY USING DIGITAL COMPUTER TO MATCH COLORS

American & Efird Mills, Mount Holly, N.C., and IBM Corporation have announced that a small digital computer now is being used successfully to match hundreds of different textile colors. It is the first time a textile firm has matched colors this way, on a production basis, for a wide variety of yarns — cottons, wools and a growing number of synthetics. A&E annually produces as many as 9000 different colors.

— Yarn on its way to the dye vats. A&E's Research and Development Director Gordon Broome (left) and Supt. of Dyeing and Finishing Neal Sellers check two new colors against the computer printout from the color-matching IBM 1130.

The color matching and color formulation are done on a desk-sized IBM 1130 computer in A&E's color laboratory. Contrasted to the long, painstaking process of matching thousands of colors by hand, A&E's computer: matches the color automatically with a variety of formulas; computes the different costs for the different formulas — some running 15¢ a lb. less than normal; and indicates how the color match will appear under different lighting (fluorescent as compared to daylight, for example). It takes the computer only minutes to match a color, contrasted to days and weeks by hand. The entire process hinges on A&E's punched card library of standard dyes, developed over a 15-month period. Each card is a dossier on how one of A&E's 200 standard dyes reacts with different fibres at different concentration levels.

Basically, the computer matches colors not unlike an artist on his palette, except that it uses numbers to represent colors and can mix the numerical symbols in millionths of a second. Since the computer isn't color-sensitive, A&E's standard dyes and the samples to be matched, have to be analyzed first by a spectrophotometer. Once the computer has the numerical color profile of the sample, it begins to blend matching formulas from A&E's standard dyes, using combinations of three or four at a time. Once the color match is struck and tested in the laboratory, the computer can then calculate and document the king-sized formulas needed for A&E's production package dye machines, which process as much as a ton of yarn at a time.

COMPUTERS TO EXPEDITE TELEGRAPHIC TRAFFIC IN AUSTRALIA

Two UNIVAC 418 Computers, supplied by Sperry Rand Corporation's UNIVAC Division, are being installed by Overseas Telecommunications Commission (Australia) to expedite the transmission and distribution of international telegrams.

With the new system, which replaces conventional teleprinter equipment, a message received by an operator for transmission will appear on a screen as he types it, enabling him to detect errors and correct them. When the message is completed, the contents are stored in the computer's memory. The computer automatically finds the destination, seeks a vacant channel and transmits the message. One of the main benefits of the system will be a speedup in the transmission of telegraphic traffic sent across the Pacific for routing through Australia to South East Asia. This routing time will be reduced to a few minutes.

Among other advantages the system automatically will ensure that traffic is transmitted in accordance with priority rating and time of receipt, eliminating the need for manual checking lists. Additionally, the system will be programmed to convert semi-automatically Australian Post Office messages to international format. The routing information will be supplied by an operator at a format conversion position equipped with CRT keyboard display unit. The computer will keep records of messages and their serial numbers.

The new message-switching system, costing over $1 million for the basic computer equipment, will be installed in OTC's Overseas Telecommunications Terminal at Paddington, a suburb of Sydney, Australia's largest city. It is expected to be fully operational by late 1967.

BULLOCK'S APPROVES CREDIT IN SECONDS WITH AUTOMATED FLOOR AUTHORIZATION SYSTEM

Bullock's Department Store, Los Angeles, Calif., now can approve purchases in ten seconds, the time it takes to check the credit standing of their charge customers, via an automated floor authorization system that joins a Bunker-Ramo cathode ray (CRT) device with a central computer. The electronic data processing device is reputed to be the first of its kind in use in a department store. Dave Blair, Bullock's credit manager, and Darryl Hoffman, Bullock's director of data processing worked for almost a year along with technicians of The Bunker-Ramo Corporation to develop the system.

Some 750,000 Bullock's accounts were programmed, based on diverse criteria such as the occupation and residence of the account, the age, and how frequently and how much a customer had been buying. Bullock's downtown Los Angeles store, and their seven Southern California branches are linked directly with this system which employs ten Bunker-Ramo Model 212 Display Stations hooked up to an NCR 315 computer in an area referred to as the Central Credit Inquiry.

When a customer makes a charge purchase, the clerk calls the Central Credit Inquiry by special phone where the customer's account number and name are punched in on the alphanumeric keyboard by the credit operator. The computer responds in seconds with an answer on the CRT screen. If the computer has a referral, the charge is referred to a supervisor who makes a decision as to whether or not the charge can be processed. The supervisor is helped in his decision with further facts the computer can spell out on the CRT screen related to the account.

Even if all ten Bunker-Ramo CRT machines were punched simultaneously, with inquiries from ten sales clerks made at the same time, the last one would have a wait of only ten seconds for an answer, Mr. Blair said. He added that in three months the system has resulted in faster customer service, better control of bad debt losses, some cost cutting, and more consistent credit authorization judgements.

COMPUTER NOTES WHAT MAKES PEOPLE TICK

Researchers at Carnegie Institute of Technology's computer controlled psychology laboratory in Pittsburgh, Pa., are studying human behavior using a Honeywell computer to explore the way people learn and solve problems. Because of the speed of response and ease of storing experimental data in the computer, psychologists are able to record vast amounts of information from a subject in a short span of time. This data is the basis for psychological models describing the way people think. By applying the information gained from the experiments to a model in a computer program, psychologists hope to determine how people cope with their environment.

Display screens connected to the computer enable psychologists to test memory and reaction times. In a typical experiment, the subject is asked to recall a several-digit number flashed on the screen for only hundredths of a second. The accuracy and speed of the subject's response are recorded by the computer for later analysis.

Carnegie psychologists are working toward computer programs that will allow them to outline their requirements to the computer which will develop the experiment for them. If they are successful, the computer will serve as a research assistant, setting up experiments, taking voluminous notes an evaluating test data.

CBS TV NETWORK SALESMEN USE CRT DISPLAY SYSTEM TO QUERY COMPUTER

An on-line data processing system that instantly displays the availability status of commercial time and other management reports is in operation at CBS headquarters in New York City. It has been designed to speed up the handling of inquiries relative to CBS Television Network programming and consists of several Bunker-Ramo Series 200 cathode ray tube (CRT) input/output terminals, linked to a Univac 1050-III computer. It is said to be the first CRT display system in the United States used exclusively by a TV network for computer interrogation.

The CRT devices are used by CBS Television Network salesmen and executives to obtain instantaneous answers to questions pertaining to station clearances, sponsors, advertising agency purchases, salesman's records, and much other information relative to the purchase of commercial time on any CBS Television Network program. The system eliminates paperwork and delay. By pushing a few buttons on the Bunker-Ramo device the salesman can have the answer in seconds without having the customer wait for a printout. When available commercial time is sold, the computer record is updated instantaneously by entering the sale information on a teletype input/output. No punched cards, punched tape, or magnetic tape are used in the updating function.

— After entering a request to the computer, the answer appears on the screen for CBS employee, Suzanne Franzel

The system also can check out: which network stations are carrying competing network shows or local shows; the market potential of any network show; the salesman's records as to what he is selling and to whom; and all sponsors and their records, as well as ad agencies and their records.

NEW CONTRACTS

FROM	TO	FOR	AMOUNT
Barclays Bank Ltd., London, England	Burroughs Corporation, Detroit, Mich.	Burroughs B8500 electronic information processing system for what will be the largest on-line, real-time banking system in the world	$32 million
Federal Aviation Agency	Burroughs Corporation, Detroit, Mich.	177 radar digitizers which convert radar signals into computer messages — another step toward automating the air traffic system	$22,403,010
U. S. Army Missile Command, Redstone Arsenal, Ala.	Philco-Ford Corp., Aeronutronic Division, Newport Beach, Calif.	Continued research and development of the U. S. Army's Chaparral Air Defense guided missile system	$4,559,200
Kuwait National Petroleum Co.	Bonner & Moore Associates, Inc., Houston, Texas	Design and responsibility for implementation of a totally integrated computerized information system for use by operating management at its Shuaiba Refinery located south of the capital city of Kuwait	—
Department of Health and Hospitals, St. Louis, Mo.	McDonnell Automation Center	Consulting services and systems analysis and planning studies on an "as required" basis	—
American Airlines, Inc., and Continental Air Lines, Inc.	General Precision's Link Group, Binghamton, N.Y.	Two Boeing 727 simulators and two visual systems for American; a new 727 (the third) for Continental	over $3.5 million
Aeronautical Systems Division, U. S. Air Force	Whittaker Corp., Los Angeles, Calif.	Design, development, and initial production of advanced air traffic control (ATC) equipment	$2.4 million
Electric Boat Division, General Dynamics Corp.	C-E-I-R, Inc.	PERT programming services relating to an on-going modification of Polaris submarines	—
British General Post Office	Recognition Equipment Ltd., (British subsidiary of Recognition Equipment Inc., Dallas, Texas)	Optical character recognition and high-speed sorting equipment that will read information from and sort more than one million banking documents per day	about $2.3 million
General Electric Co., Defense Electronics Div., Special Information Products Dept., Syracuse, N.Y.	Data Products Corp., Culver City, Calif.	A follow-on order calling for DISCfILE random access memory storage systems to be used in conjunction with GE's 605 computer line	over $2 million
Karstadt Company (West Germany's largest chain of department stores) Essen, West Germany	Sperry Rand Corp., UNIVAC Div., New York, N.Y.	UNIVAC 494 Real-Time Computer System to be used for information processing on all phases of its operations with 54 branch stores	about $1,700,000
U. S. Army Materiel Command	Computer Sciences Corp., El Segundo, Calif.	Formulating and implementing a computer-based management information system	$1.6 million
New York Central Railroad	General Railway Signal Company, a unit of General Signal Corp., Rochester, N.Y.	Equipment and automation of the 70-track Alfred E. Perlman freight car classification yard	—
Lockheed Space and Missile Co., Sunnyvale, Calif.	Scientific Data Systems	A Sigma 7 computer system which will be used to help accelerate development of the Poseidon missile	$1.6 million
Bayerische Hypotheken und Wechsel (Bavarian Mortgage and Loan) Bank of Munich, West Germany	Sperry Rand Corp., UNIVAC Div., New York, N.Y.	A UNIVAC 491 Real-Time Computer System	over $1,300,000
Conductron-Missouri, Division of Conductron Corp.	Systems Engineering Laboratories, Inc., Fort Lauderdale, Fla.	Four computer systems, each consisting of one SEL 840A and one SEL 840 Multiprocessor; systems will be used as elements of C-5A Mission Flight Simulator Complex for Lockheed and The United States Air Force	over $1 million
Eastman Kodak Co., Rochester, N.Y.	Cubic Corp., San Diego, Calif.	Development and production of a new product in the field of computer output microfilmers	about $750,000
British Overseas Airways Corp.	Collins Radio Co., Dallas, Texas	A large quantity of TE-216A data modems, for the airline's intercontinental reservation system (BOADICEA)	$500,000
Honeywell Incorporated	Computer Applications Inc., New York, N.Y.	Extension of previous contract which will incorporate mass memory capabilities in Honeywell H-200 series software	about $¼ million
Tidewater Oil Company	ITT Data Services, a division of ITT Corporation	Responsibility for all data processing requirements of oil company's world headquarters and western division in Los Angeles	—
Sylvania Electronics, Inc	Systems Engineering Laboratories, Inc., Fort Lauderdale, Fla.	An SEL 810A computer system for use in acquiring and processing data from satellite tracking antennas; installation will be in Australia	over $190,000
Naval Research Laboratory	Systems Engineering Laboratories, Inc.	An SEL 810A computer system; project use is classified	over $150,000

NEW INSTALLATIONS

AT	OF	FOR
Georgia Institute of Technology, Atlanta, Ga.	UNIVAC 1108-II computer valued at $2.6 million	Use by Lockheed, UNIVAC, all academic departments of the school, all divisions of the experiment station, and government and industry
Colorado State University, Fort Collins, Colo.	Control Data 6400 computer system valued at $1.2 million	Variety of scientific research projects concentrated in area of the atmospheric sciences, engineering and biological sciences; also will be used for educational purposes as well as certain administrative programs
Hennepin County, Minneapolis, Minn.	IBM System/360 Model 30	Centralizing county's record keeping program; providing better service to taxpayers of Minnesota's largest county
Midwest Federal Savings and Loan Association, Minneapolis, Minn.	UNIVAC 491 computer system	On-line processing of savings accounts, to be followed by on-line mortgage account processing
Service Bureau Corporation (SBC), Scientific Computer Center, Washington, D.C.	IBM System/360 Model 40	Expansion of data processing capabilities
U. S. Railroad Retirement Board, Chicago, Ill.	IBM System/360 Model 50	Aid in administering the Railroad Retirement and Railroad Unemployment Insurance Acts
The Von Hoffman Companies, St. Louis, Mo.	Honeywell Series 200 computer system	Accounting and job estimating functions, and management control for inventory and production scheduling
University of Hawaii, Honolulu, Hawaii	IBM System/360 Model 50	A campus-wide computing network used by faculty, researchers, and students; supports over 600 research projects ranging from studies of tidal waves to linguistics; also used for administrative and accounting functions
Bankers Investment Co., Hutchinson, Kans.	IBM System/360, Model 20	Protection against unscrupulous persons' obtaining large amounts of insurance on a multitude of small loans — alerts management by means of exception reports to incorrect rates, refunds and charges
Los Alamos Scientific Laboratory	Model 933 computer system valued at $198,000; system contains a SEL 810A computer	Acquiring and processing data and controlling a linear accelerator installation
Jewel Companies, Inc., Chicago, Ill.	Two IBM System/360 Model 30 computers	Helping provide customized grocery selections to housewives in each of its 260 Jewel Food Stores in the Chicago metropolitan area
Batelle Memorial Institute, Pacific Northwest Laboratory, Washington	An SEL 840A computer, disc file, and control unit valued at $89,000	Research purposes
Kansas State Teachers College, Emporia, Kans.	IBM 1130 computer and 1230 mark scoring reader	Scoring and analysis of a variety of tests administered by public schools and the college
Ted Bates & Co., New York, N.Y.	Honeywell 2200 system	Providing immediate service and support to all areas of the advertising agency's processing tasks
Utah State University, Logan, Utah	Honeywell 1200 system	Administrative and scientific research applications initially; later conversational Fortran and graphic display research projects
Maison Blanche, New Orleans, La.	NCR 135 computer system	Assisting with accounts receivable processing for Maison Blanche, a division of City Stores Company, and handling ledger listings and statement printings for two other outlets in the City Stores chain
Percy Wilson Mortgage and Finance Corp., Chicago, Ill.	IBM System/360 Model 20	Servicing its $230 million portfolio of mortgage loans; this includes recording of payments and calculation of loan balance, interest, taxes and insurance premiums; also used for escrow analysis, generating two reports annually
Commercial National Bank, Peoria, Ill.	IBM System/360 Model 30	Handling the accounting functions of savings, checking and trust accounts
Elgin Electronics Inc., Waterford, Pa.	NCR 315 computer system	Inventory control and production scheduling
Edwards Air Force Base Rocket Propulsion Laboratory, Calif.	SEL 810A computer system valued at $200,000	Measuring, controlling, displaying and recording test data from liquid propellant evaluation tests
AMFAC, Inc., Hawaii	Honeywell 200 system	Handling of accounting and inventory control work of firm's six operating divisions
Goodyear Tire and Rubber Co., Goodyear Research Center, Akron, Ohio	Control Data 1700 computer system	Automatic control of 20 on-line gas chromatographs
General Precision, Inc., Aerospace Group, Wayne, N.J.	UNIVAC 1108 computer	Scientific applications involving wide variety of calculations and tests, including model simulation, and commercial applications including a nation-wide payroll with remote check printing via communications
The Chrysler Boat Corp., Dallas, Texas	NCR 315 computer	A system which will provide a complete "computer picture" of planning and inventory operations
Atlantic Richfield Co., Dallas, Texas	IBM System/360 Model 50	Scientific (exploration, engineering and research) applications

ORGANIZATION NEWS

RCA ENTERS FIELD OF COMPUTER-BASED INSTRUCTION

RCA's full-scale entry into the field of computer-based instruction, representing the first major joint undertaking of its kind by industry and education, has been announced by Robert W. Sarnoff, President of Radio Corporation of America. He also announced the formation of a new activity, RCA Instructional Systems, which will spearhead the development of computer-based techniques designed to overcome some of the nation's most pressing educational problems.

Mr. Sarnoff said the new technology will combine computers, communications channels and display terminals into a system capable of teaching the student as an individual, rather than an arbitrary norm. He reported that Alan B. Corderman has been appointed Director of RCA Instructional Systems, with headquarters in Palo Alto, and will work closely with a group of nationally-known Stanford University educators, headed by Dr. Patrick Suppes, a pioneer in computer-based instruction (CBI).

RCA Instructional Systems has been given a "broad mandate" to study, create and test instructional systems designed to facilitate many facets of the educational process, Mr. Sarnoff said. He also noted that Random House and its educational subsidiary, the L. W. Singer Company, will play an important role in the new project.

COMPUTER SCIENCES INTERNATIONAL, S.A. INCORPORATED IN BELGIUM

On March 29th, Computer Sciences International, S.A., was incorporated in Brussels, Belgium, to offer a broad range of computer services throughout Western Europe. The new company, which began operations in April, will provide a complete range of computer-based services, from problem analysis through system concept and design, programming, and system implementation.

Computer Sciences International is owned jointly by Computer Sciences Corporation, one of the leading U.S. computer services firms, and N. V. Phipils' Gloeilampenfabrieken of Eidnhoven, The Netherlands, one of the world's largest electronics concerns. CSC, majority owner of the new company, has been active in Europe for more than a year. Computer Sciences International was formed to provide expanded capability in response to the strong and growing demand for computer-based services throughout Europe.

Arthur E. Speckhard is president and general manager of Computer Sciences International.

AFFILIATION AGREEMENT LINKS AMERICAN AND AUSTRALIAN TECHNICAL CONSULTANTS

The first affiliation and licensing agreement linking American and Australian technical consultants has been announced by Brandon Applied Systems, Inc., of New York City, and W. D. Scott & Pty. Ltd., of Sydney, Australia. Scott is Australia's largest management consulting firm.

In a joint announcement, Dick H. Brandon and Sir Walter Scott, chief executives of the two firms, said that under terms of the agreement their companies will exchange technical expertise and research information regularly. Personnel will be exchanged for specific joint projects and training of Australian personnel in U.S. computer techniques. The agreement also includes cooperative ventures throughout Australia, New Zealand and all of Asia.

Brandon Applied Systems is furnishing training courses to the Australian firm through its training division, Brandon Systems Institute of Washington, D.C., which specializes in electronic data processing courses for management personnel, systems analysis, and programmers. Such courses in Australia, the world's fastest growing computer market, have not been readily available. Brandon Applied Systems, Inc. has licensed the use of its name to W. D. Scott & Co.

In addition to its Institute, Brandon Applied Systems, Inc. maintains offices in Washington, D.C. and in London. Scott has 15 offices in Australia, New Zealand, Hong Kong, Malaysia, the Philippines and the United Kingdom.

EDUCATION NEWS

EDUCATIONAL SYSTEM OF FUTURE RECOMMENDED FOR THE SCHOOL DISTRICT OF PHILADELPHIA

An educational system of the future, the design for district-wide electronic data processing support of administrative and instructional functions, has been recommended for the School District of Philadelphia in a study done by Santa Barbara's Brooks Foundation in collaboration with Technomics, Inc. of Santa Monica (Calif.) This modern instructional system, the culmination of a year-long study by Brooks Foundation, was outlined before the Philadelphia School Board last March by Don D. Bushnell, Foundation Vice President. The ten-year evolutionary development plan, executed under a $93,000 contract from the School District of Philadelphia, calls for the phased introduction of forty computer consoles and ten thousand computer stations into the School District's 250 schools by 1975.

The Brooks Foundation Plan, designed to serve educational needs of over a quarter of a million youngsters, calls for the application of automated electronic information processing to such diverse school functions as: scheduling of classes, teacher assignments and busses; counseling and testing; staff training; business and plant management; all phases of information retrieval and storage, including student records; research; and even architectural projections. Such educational innovations as automated library systems, computer-based games and the use of the time-shared computer as a problem-solving tool are part of the plan.

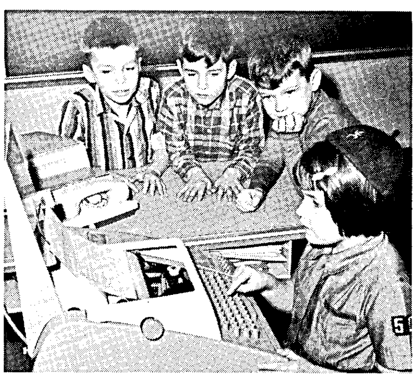
Mr. Bushnell emphasized that the most important contribution of computer application to education will lie in the area of individualized instruction. "Despite the inestimable gains in system efficiency that will be achieved through computer application to education," he said, "the most dramatic benefit will be realized by the individual learner. The computer, acting as an aid but not a substitute for the teacher, can provide each student with an individually tailored study program. A machine tutor, with infinite patience and absolute memory, will be able to feed the student an instructional program that is continually revised and guided by the performance of the student himself. Self-directed progress and problem-solving will be possible to a much greater degree than ever before."

A report of this EDP design will be published soon by McGraw Hill Book Co.

CALIFORNIA COMPUTER TEACHES ARITHMETIC TO SCHOOLCHILDREN IN KENTUCKY

A computer center in California recently began instructing and testing elementary schoolchildren of Morehead, Ky., in arithmetic over long-distance data communications facilities provided by General Telephone Company of Kentucky, a GT&E subsidiary. Transmission of educational data over conventional telephone lines to teletypewriters at the Breckenridge School in the Kentucky community enabled second and sixth grade students to use a highly advanced teaching program in mathematics prepared at Stanford University, Palo Alto, Calif., for its computation center.

Each of the more than 50 students in the two classes sat in turn at one of three teletypewriter units which printed the arithmetic lesson for each individual and graded their responses. A second-grade student is pictured below



answering a problem presented by the Stanford computer while three of her classmates look on. The number of problems for each student was determined on the basis of the child's scholastic progress, requiring an average of about five minutes at the teletypewriter. When the lesson was completed, the teletypewriter printed a record of the day's work for the student. Following the message, the machine typed "goodbye Susan (or Jane or Jim), tear off here..." It then turned the paper up to the "cutter bar", permitting the student to tear the paper off and keep the printed record of the day's work.

The Breckenridge School is operated as part of Morehead State University, located approximately 70 miles east of Lexington. Dr. Adron Doran, President of Morehead State, said, "This long-distance teaching technique represents a totally new concept of education for the Appalachian region. It is one of many educational programs of a similar advanced nature which we hope to bring to the area." Dr. Doran is a member of the advisory committee on education to the Appalachian Regional Commission established by Congress.

COMPUTING CENTERS

TRAFFIC COUNSEL OF AMERICA LINKED TO SHIPPERS VIA MODERN TELETYPEWRITERS

In the transportation of goods, determining the correct rates, routes, commodity classifications and inter-line charges, to prepare what is supposed to be an optimum bill of lading, traditionally has been a hit-or-miss effort subject to much human error. Now, companies employing any type of teletypewriter service can be linked to an unique data processing center in Canton, Ohio, to quickly obtain accurate, complete bills of lading and freight bills. The center, operated by Traffic Counsel of America, Inc., is equipped to receive shipment information via regular telephone lines, digest it within a random-access computer system, and transmit back the data required to print out multi-copy shipping documents. The entire cycle takes less than one minute — less than the time it takes the trucker to come around to the back of his truck to close the doors after loading!

The heart of the operation is a real-time computer with random-access equipment capable of storing 5½ billion characters. Data from a customer's teletypewriter can be transmitted directly into the computer — regardless of the type of Bell System transmission service the customer may be utilizing within his overall data communications network. The same network is employed to send data back to the customer, where a second teletypewriter, at the shipping dock, for example, types out required documents.

TCA, which was organized in 1962, provides a broad range of traffic services to replace the repetitive and time-consuming paperwork that surrounds the transportation of goods. Managed by Stephen Kovach, president, the firm has within its steadily growing roster of customers many of the country's well-known industrial giants.

TCA's services also extend to the transmission of computer-generated messages concerning shipments to teletypewriters at banks, consignees and carriers' destination

— Teletypewriter in terminal prints out shipment messages generated by Traffic Counsel of America's computer

terminals. Banks use the data to debit shippers' accounts and credit the carriers'. Messages to consignees and carriers serve to alert them of shipments on the way. (For more information, designate #41 on the Readers Service Card.)

SEVEN MARYLAND COLLEGES LINKED IN COMPUTER NET

Seven state colleges in Maryland will share a single computer complex in a unique educational data processing program being initiated in Towson, Md. The program has as its goal: to reduce administrative paper work; increase the speed and accuracy of information to faculty; and provide a tool for student and institutional research for the seven participating colleges.

The computer, a Honeywell 1200 system, will be located on the Towson State College campus. A transmission station at each of the other six schools — Morgan, Bowie, Coppin, Frostburgh, St. Mary's and Salisbury state colleges — will send and receive information over private telephone lines connected to the central system. The campus terminals will consist of a card-reading device, a keyboard printer and a high-speed printing device that can produce data from the computer at a rate of up to 400 lines a minute.

Initially the system (which will go into operation at the start of the fall semester this year) will process admissions and registration data, scheduling, and grade reporting for 14,600 pupils at the seven schools. (The number of students is expected to increase to nearly 23,000 by 1970, according to school officials.) Other financial accounting and library record-keeping tasks also will be handled by the system. Later the computer will be used for student training and computer-aided education, in which students will be able to code problems, transmit them along with test data to the computer site, and have them processed and sent back to their campus terminals.

COMPUTER RELATED SERVICES

AIRCON, A COMPUTER SERVICE FOR THE INTERNATIONAL BUSINESS COMMUNITY

Radio Corporation of America has activated a new common access computer service that provides the international business community with a central clearing house for a wide range of data. AIRCON, which stands for Automated Information and Reservations Computer Oriented Network, is a high-speed computerized reservations information and message switching system for industrial customers, explained Howard R. Hawkins, President, RCA Communications.

At present, RCA's AIRCON system will handle primarily administrative and reservations message traffic and perform certain data processing for subscribers. The system is designed to serve the needs of a wide range of industries, particularly those with similar reservations and information switching requirements, for example, hotels, airlines, railroads, travel, and shipping. In the airline industry, both domestic and international carriers will be able to obtain information on seat availability of subscribing airlines and arrange through-bookings. In future phases, the system is expected to handle data on air cargo space reservations, flight planning, crew scheduling, passenger and freight information and a wide variety of other administrative data services.

The AIRCON system, installed at RCA Communications' international telecommunications center in New York City, has two Model 4104 computers built by RCA's research and development center in Van Nuys, Calif. The dual computers, each capable of handling over 250,000 messages a day, will provide the system with complete redundancy and assure virtually uninterrupted service.

Charges for the new AIRCON service are based on a minimum of $350 per month for each cable, radio, satellite or wireline connected to the AIRCON center in New York. This monthly minimum also covers the computer processing of 35,000 average length messages. (For more information, designate #42 on the Readers Service Card.)

COMPUTICKET

Computer Sciences Corporation of El Segundo, Calif., has announced the development of a computer-based instant ticketing system that will bring the sports or theater box office to the neighborhood bank or shopping center. The system has been under development for two years and is expected to be operational by 1968.

The new system is called Computicket. Fletcher Jones, president of Computer Sciences, explained that in each metropolitan area in which the system is established, there will be two large-scale computers linked to terminal devices installed in several hundred banks, markets, and other commercial retail concerns. These terminal devices, to be operated by bank or store employees, will be used not only to query the computer on seat availability but to print the admission tickets as well. Litton Industries is designing the terminal units under an exclusive contract, Jones said.

In addition to increasing the number of places where tickets can be bought during convenient hours, the new service will provide a greater number of seats to choose from. The box office and all Computicket service desks will sell tickets from the same inventory simultaneously. "This means the public can make its choice from all the unsold seats at every event served by Computicket, not just from the allotment held by one agency", Jones said. And there will be no surcharge to the public for all the benefits of the Computicket service, he added.

Computicket also will provide the management of organizations that subscribe to the computer-based service with far better sales information than they can obtain at present. Computicket provides the sports and entertainment industries with their first total distribution and control system.

Computer Sciences has formed a subsidiary, Computicket Corporation, to market and operate the Computicket system. The initial Computicket network, scheduled for installation in Los Angeles, will employ a duplexed IBM System/360 Model 40 computer. This equipment will be cap-

able of storing information on the price and location of up to 10 million seats for as many as 800 different entertainment events. Computicket Corporation is negotiating with the principal sports and entertainment organizations in Los Angeles, and also is marketing the system in other principal U. S. cities.
(For more information, designate #43 on the Readers Service Card.)

NEW PRODUCTS

Digital

CONTROL DATA 6500 SYSTEM

Control Data Corporation, Minneapolis, Minn., now is marketing a new super scale computer system known as the Control Data 6500. This dual processor system, latest addition to the firm's 6000 Series Computers, utilizes two Control Data 6400-type processors. The "central processor overhead" inherent in other "dual processor" systems, where the processors must handle both processing and input/output chores, is completely eliminated.

— At the console of the new Control Data® 6500 computer system

Since the 6500 Dual Processors are free for processing only, they may be used simultaneously for processing two of the several jobs which can reside in the central memory at any given time. Thus, the 6500 achieves multi-programming and multi-processing by one central computer. The 6500 Dual Processors also can be used interchangeably during the calculation of a single problem, providing up to twice the computing power of the single-processor 6400 with only a nominal increase in the system price.

The 6500 uses either a 65K or 131K word (60-bit) core memory. Storage is in 4K word banks. Each central processor has its own 24 operating registers for a total of 48 registers.

All of the desirable features in other Control Data 6000 Series Computers have been incorporated in the 6500, including the entire repertoire of field-tested and proven 6000 Series programs. Programmers can start working immediately. Perhaps of primary importance is the 6400/6400/6600 SCOPE Operating System. It was designed especially to handle monitor and executive functions in a dual processor system. This means that no programs need be redesigned, and no special training or relearning will be required on the part of the 6500 users.
(For more information, designate #44 on the Readers Service Card.)

Memories

FOUR NEW CORE MEMORY SYSTEMS FROM LITTON INDUSTRIES

Four new core memory systems, specifically designed to meet high reliability requirements of military and aerospace computers, are being offered by the Guidance and Control Systems division of Litton Industries, Beverly Hills, Calif. The four memories consist of: LCM 710, random access, DRP; LCM 210, serial access, DRO; LCM 410, random access, DRO/NDRO, and LCM 220, random access, NDRO.

LCM 710, through its use of switch core word selection, provides a unique combination of coincident current addressing and linear select operation. These memories are available as complete systems or with modified electronics for specific applications. Standard expandable memory capacity is 256 or 4096 words with up to 32 bits per word. Larger word and bit sizes can be provided.

The LCM 210 systems are actually nonvolatile digital delay lines that have already found application in the X and R register memories of a specific aerospace computer. The LCM 210 permits the convenient plugging-in of additional sections of computer core storage to effectively change the delay line length.

LCM 410 systems offer the ability of storing both electrically alterable and fixed data in the same array. Standard expandable memory capacity is 512 to 8192 words with up to 32 bits per word; larger word and bit sizes are available.

The LCM 220 is a hard-wired read-only memory, utilizing very few semiconductor components. Unlike conventional hard-wired units of the past, the LCM 220 system can be readily filled without difficulty and easily modified with external fill equipment. LCM 220's expandable memory capcity is 256 to 4096 words with up to 60 bits per word.
(For more information, designate #47 on the Readers Service Card.)

HONEYWELL MEMORY CYCLE TIME REDUCED TO 670 NANOSECONDS

Faster cycle and access times and a wider operating temperature range have been announced by Honeywell's Computer Control Division (Framingham, Mass.) for its ICM-47 core memory system. Full cycle time for the integrated circuit memory has been reduced from 750 to 670 nanoseconds, and access time has been cut from 400 to 350 nanoseconds. The systems operating temperature range has been expanded from 0^{o} - 40^{o}C to 0^{o} - 50^{o}C.

The new capabilities widen the applications for the system especially where operating temperatures and faster cycle times are important factors. The changes make the ICM-47 fully interchangeable with the division's one microsecond memory, the ICM-40.
(For more information, designate #46 on the Readers Service Card.)

GE ANNOUNCES FOUR-FOLD MEMORY CAPACITY INCREASE FOR MEDIUM-SCALE COMPUTERS

A four-fold increase in the memory capacity of General Electric's medium-scale computers has been announced by Louis E. Wengert, deputy division general manager for GE's Information Systems Division, in a move which expands significantly the performance capabilites of the GE-425 and GE-435 systems.

The central memory banks of the computers have been boosted to store up to 131,000 words (524,000 characters). Previously the maximum meqry capacity was 32,000 words (128,000 characters). The boosted capacity makes it possible for the systems to handle much larger and more complex communications, business and scientific problems. The expanded memories also enlarge the abilities of the computers to work on several programs at once.

In addition, users now have the opportunity to "grow" their GE-425 or GE-435 installation and extend its life, thus amortizing data processing costs over a longer period of time, Mr. Wengert noted. Users can obtain added memory capacity in 16,000-word increments as their work loads require it. The extended memory modules will be available for first deliveries starting in the first quarter of 1968. (For more information, designate #45 on the Readers Service Card.)

Software

READY-TO-USE SYSTEMS FOR BANKS

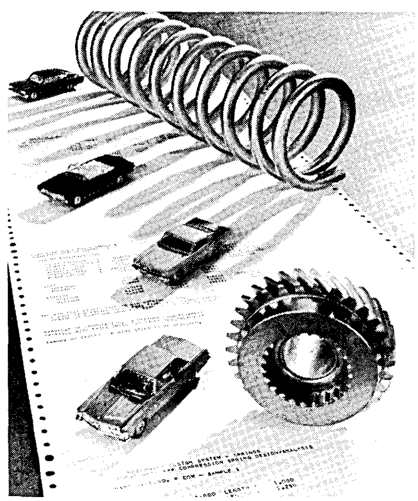
The first of a series of ready-to-use systems, designed to enable banks to reduce the cost and time needed to automate various customer services, has been developed by Information Sciences Associates, Cherry Hill, N.J. The initial system, which is named the Bankserv Credit Card System 1401, is for processing credit card accounting in an IBM 1401. The system covers both merchant and cardholder accounting. (A second credit card system for use on the IBM System/360, Model 30, will be available in the near future.)

The first Bankserv system for credit card accounting consists of everything needed for immediate implementation. This includes a detailed system design, computer programs on card decks or magnetic tapes, layouts of data formats and forms, and comprehensive documentation of all system elemtns.

The computer programs of the system are written in Autocoder for an IBM 1401 processor, with 16,000 characters of core storage and the Advanced Programming and Multiply-Divide features. Besides the central processor, the system calls for four magnetic tape drives, a card reader punch, and a printer. The programs are highly modular and can be adapted easily to an IBM 1460 or 360, Model 30, equipped with 1401 Compatibility Mode. Program modularity also makes it easy to modify the programs to meet individual bank requirements.
(For more information, designate #48 on the Readers Service Card.)

'INSTANT' AUTO PART DESIGN

During the 1967 Automotive Engineering Exposition (held in January), an IBM 1130 computing system was used to calculate automatically the specifications for auto springs and gears. (Such devices are shown on the computer's printed results in the photo.) In the demonstra-



tion, it was shown how a designer, using familiar engineering terms, can type a description of the part directly into the 1130 system. Almost instantly, the computer prints all of the information needed to produce and test the part. A new IBM program enables the designer to use the system himself, eliminating the need to call on a computer specialist to translate engineering terms into computer language.

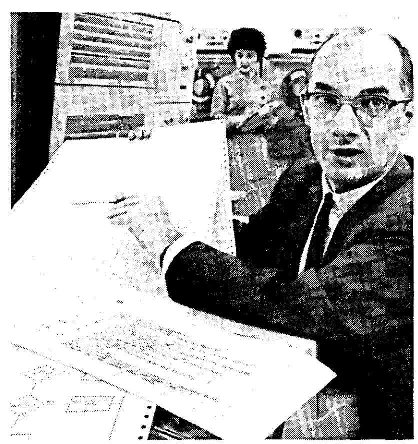
The program — the 1130 Mechanism Design System - Gears and Springs — produces specifications for helical and spur gears and for extension, compression and torsion springs. These parts are common not only to automobiles but to a variety of other mechanical devices, ranging from household appliances to jet aircraft. The program is scheduled to be available to IBM 1130 users during the second quarter of this year. (For more information, designate #49 on the Readers Service Card.)

FACILITY LOCATION PACKAGE

A computer-oriented Facility Location Package (FLP-1) has been announced jointly by Fisher-Stevens, Inc., data processing firm of Clifton, N.J., and R. Shriver Associates, an operations research consulting firm in Denville, N.J. FLP-1 is an advanced approach for top management when considering where to locate plant and warehouse facilities. The new system will indicate to the executive whether he should utilize present facilities; cut back or increase facilities; where to locate new facilities; and what customers should be handled from each facility. The system, programmed in FORTRAN, can be adapted to most large technical computers. (For more information, designate #51 on the Readers Service Card.)

AUTOMATIC FLOWCHARTING FOR IBM SYSTEM/360

Programmers who write instructions for the IBM System/360 now can call on the same computer to help them do their job. With System/360 Flowchart, a new program now available from IBM Corporation, a computer can produce — in minutes — detailed diagrams like those shown in the picture. Drawing such



flowcharts by hand may take days or weeks. These diagrams, essential programming tools, enable the user to plan and organize his work by mapping out each logical step in the program.

System/360 Flowchart is the most easily used technique for automatic flowcharting yet developed by IBM. The programmer need only list the steps of his program in simple, English-like statements. Entered into the computer by punched cards, the list is transformed into diagrams. Even persons with little or no programming experience can use System/360 Flowchart to produce and update the diagrams for the programmer.

Flowchart programs for earlier systems either required more complex instructions or produced less detailed charts. The new program contains more automatic features for labeling and linking elements of the flowchart. It also enables programmers to include footnotes in the charts for the first time. (For more information, designate #54 on the Readers Service Card.)

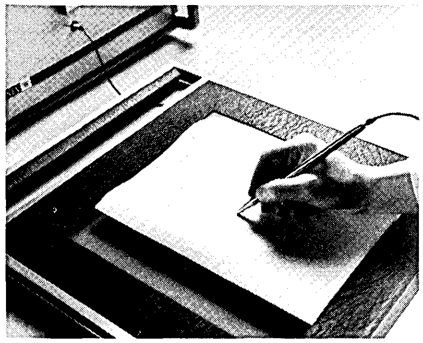
Data Transmitters and A/D Converters

SYLVANIA DATA TABLET

An electronic ballpoint pen which translates graphic material to computer language as it writes and simultaneously transmits data to computer for storage or analysis has been developed at the Applied Research Laboratory of Sylvania Electronic Systems, a division of Sylvania Electric Products, Inc., Waltham, Mass. The pen and its electronic "note pad", known as the Sylvania Data Tablet, enable scientists to communicate with computers through written symbols and diagrams rather than by formal mathematical terminology. The system converts written symbols to digital and analog signals for transmittal to computers or over telephone lines for display at remote locations.

The writing area is a conductive surface on which electric waves travel in "x" (horizontal) and "y" (vertical) directions. As the pen passes over the writing surface it records its position by measuring the phase of these "x" and "y" signals at a rate of 200 per second. It can measure movements as small as three one-thousandths of an inch. Dr. James E. Storer, Laboratory Director, said that in addition to "x" and "y" measurements, the Sylvania Data Tablet has a third axis capability. Varying the height of the pen above the tablet can assign electronically an increased number of characteristics to graphic elements.

"Because the tablet is transparent, an operator can place it over a cathode ray tube display to change data already stored in a computer", Dr. Storer said. Also, he noted, the operator can put paper or film on the tablet to produce a permanent copy of the graphics as he works. This versatility enables the operator to feed graphics to a computer, ask questions about it, and make revisions merely by drawing symbols or schematics rather than writing new programs. "The system can benefit almost anyone wishing to convert graphics to digital form," Dr. Storer stated. (For more information, designate #55 on the Readers Service Card.)



POTTER ANNOUNCES CONTROL UNIT FOR FIRM'S RAM®

Potter Instrument Company, Plainview, N.Y., has announced a newly-designed Control Unit for the RAM (random access memory). The Control Unit, designated the CTM-4550, provides the logic and electronics necessary to adapt the RAM to a standard computer interface and is available either 6-bit character oriented or 8-bit byte oriented. A complete logic package with error detection and address location are features of the new equipment.

With CTM, a data processing system can conveniently cause any of the three operations of read, write or sectorize to be performed.

Two-mode sectorization control is offered as an optional accessory. This relieves the data processing system from programming the addresses used for the sectorization operation. Another option is: Multiple-RAM unit, which enables a group of RAMs to be treated as a single data storage unit.
(For more information, designate #56 on the Readers Service Card.)

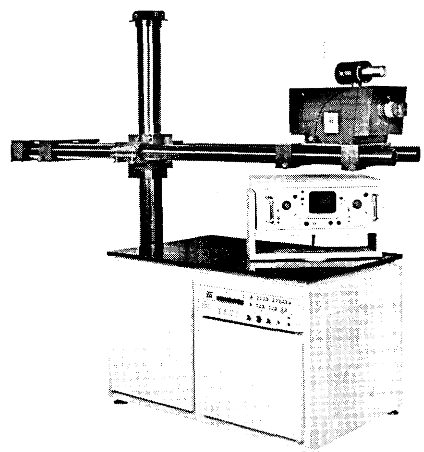
Input-Output

A COMPUTER EYE — IT "LOOKS AND SEES"

What would a "computer eye" be? It would be a device that could be attached to a computer, which would:

- optically sense (or "see") the surrounding environment;
- select and examine ("look at") points or areas in its field of view;
- recognize patterns; and
- call for appropriate responses.

Such a machine exists. The first such machine was delivered recently to Project MAC at Mass. Institute of Technology, Cambridge, Mass. Three more Computer Eyes have been ordered, and are being built by the maker, Information International Inc., West Los Angeles, Calif.; they are for use in educational and industrial environments. Demonstrations of the Computer Eye can be arranged in Los Angeles on request. The accompanying picture shows one of many ways in which the Computer Eye can be mounted and used.



The Computer Eye is an outgrowth of the Programmable Film Readers previously built by Information International, Inc., but the Computer Eye is based on responding to reflected light (reflected from the environment) rather than to transmitted light (transmitted through a previously made film).

In technical language, the Computer Eye is an optical information sensor and processor which is able to recognize, measure, and interpret scenes in the real world. The sensor of the Eye is like a TV camera but differs because it is under control of a computer program for processing images. Thus the Eye can select points or areas in its field of view, seek out a significant part of the image, pay attention to that, and then transfer attention to other areas, all under the guidance of a computer program that recognizes and deals with patterns.

Among the possible applications of the Computer Eye are: measuring and classifying biological samples as "seen" through a microscope; interpreting and digitizing maps, x-rays, photographs, or engineering drawings; detecting and classifying physical flaws in objects; comparing and measuring precisely the dimensions, shapes, finishes, etc., of parts fabricated in a production process; etc.

The sensor element is an image dissector phototube which can resolve the field of view into approximately 1200 lines. The image is processed by a general purpose computer with a stored program, which includes corrections for any geometric distortion that may be introduced by the optical system. (For more information, designate #57 on the Readers Service Card.)

PHOTOTYPESETTERS PRODUCE 70 LINES-PER-MINUTE

Photon, Inc., Wilmington, Mass., has developed two new electronic phototypesetters that are more than three times as fast as the best competitive machines and that break the age-old $1000 per line equipment cost barrier in typesetting. The new models, Textmaster 713-30 and 713-40 produce 70 newspaper lines a minute for an investment cost as low as $700 per line per minute.

By comparison, the most efficient tape-driven, hot metal line-casters produce up to 15 lines a minute at a cost of about $2500 a line. The closest competing phototypesetter claims a top speed of 20 lines a minute, at about $1500 a line.

Although Photon's new machines are related to two other Textmasters introduced earlier, there are important differences. The two newest versions are more than 50% faster but cost only about 20% more. The new 713-30 and 40 have less type font mixing power — they use 8 sizes of each of 4 different type faces for a total of 32 type fonts, compared with 8 sizes of 8 faces for 64 fonts in the two earlier models.

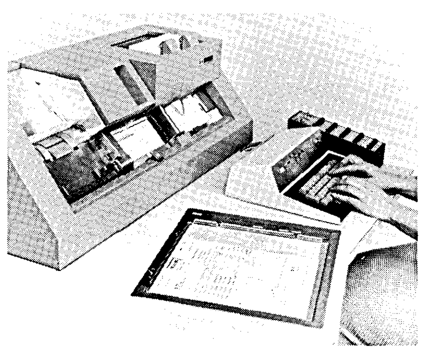
All four Textmasters are driven by 6, 7, or 8 channel paper tapes. An auxiliary reader-drive unit enables use of computer magnetic tapes. When used in conjunction with a computer, all four Textmasters can produce completely made-up pages, so that customary manual stripping steps are eliminated and the making of printing plates can follow directly from the phototypesetting.

The new Models 713-30 and 713-40 Phototypesetters are suited for broad use by newspapers as well as commercial printers and typesetters. Shipments are scheduled to begin in the second quarter of 1967.
(For more information, designate #59 on the Readers Service Card.)

DATAFINDER CARD PUNCH "INSTRUCTOR"

Datafinder — an electrically-activated instruction device for card punch operators — now is being introduced to the data processing market by Tab Products Company, San Francisco. Datafinder is readily attached to any standard IBM card punch or verifier and provides operators with continuous automatic instruction while substantially increasing their punching speed and accuracy to achieve optimum thru-put.

Datafinder utilizes an electrically controlled light beam, positioned beneath an 11" x 11" document viewing panel. This fine



line of light acts as a moving ruler, underscoring each field on the document in punching sequence. When punching of a field is completed, the light line instantly moves to indicate the next information to be punched. Lighted lenses on the adjacent instruction panel concurrently give the operator standard and special punching and coding instructions, and indicate the size of the card field to be punched.

Warren Higgins, Marketing Director for Tab Products Machine Division, said that a unique feature of Datafinder is its ability to substitute its own "memory" for that of the operator with respect to card field sequence and data location on the source document. Also, by the movement or non-movement of the light-ruler, along with the instrument panel lights, the operator instinctively senses when a punching mistake has been made.

Datafinder utilizes solid-state circuitry and, under actual operating conditions in a variety of applications, reduces training time by some two-thirds while increasing thru-put by an average of 25%. In addition, error reduction of some 70% has been accomplished through Datafinder's automatic guide system.
(For more information, designate #58 on the Readers Service Card.)

Components

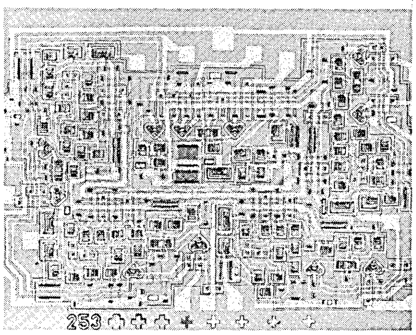
CARD PATCHER

To correct punched card errors, the BARC Hole Filler, introduced by Berkeley Applied Research Corp., Alamo, Calif., applies an opaque liquid plastic which dries in less than a minute and is compatible with all data processing machines.

This patented product makes it possible to "erase" errors with a single stroke. A patched hole may be repunched without fouling the punch. Each bottle of BARC Hole Filler will correct approximately 5000 cards. Introductory kits, with six fillers and a drying rack, are available.
(For more information, designate #65 on the Readers Service Card.)

4-BIT SHIFT REGISTER CONTAINS EQUIVALENT OF 175 COMPONENTS

Sylvania Electric Products Inc. (a subsidiary of General Telephone & Electronics Corporation) has announced a major development in large scale integrated circuit arrays — a universal 4-bit shift register containing the equivalent of 175 components. The unit is the most complex single chip — 60 x 85 mils — ever produced by Sylvania,



according to Dr. Richard Sirrine, Manager of Engineering - Integrated Circuits for Sylvania's Semiconductor Division.

The 4-bit shift register is capable of performing parallel and serial storage and data shifting in every type of digital system. It also lends itself to parallel and serial or serial to parallel conversion, storage, delay and shifting operations in all parts of digital computers or control systems and can perform key arithmetic operations, such as multiplication and division.

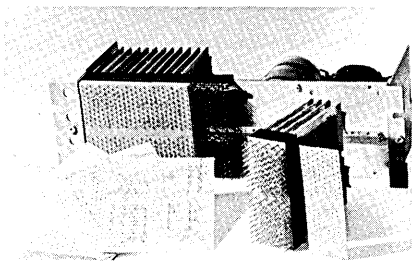
The new register can shift left or right from parallel units and contains the equivalent of eight SUHL (Sylvania Universal High Level Logic) packages. These are: two dual J-K flip flops; two dual AND-NOR gates; one quad inverter; one dual inverter; one AND-OR gate, and one pulse shaper. It will shift at speeds in excess of 25 megacycles.

The SM100 is a complete 4-bit storage and parallel and/or serial shift register for digital systems. Additional packages can be connected together to form larger word lengths in multiples of four bits. All of the inputs and outputs are completely compatible with Sylvania's families of TTL, SUHL I and SUHL II.

The new 4-bit register is a true universal logic element, not just a storage element, and is designed to simplify digital systems design in all speed ranges. Incorporated in a computer, each of the new units would replace eight devices formerly required. In addition, Dr. Sirrine said, it provides the user with lower power requirements, substantially less wiring, less board space and less clock loading than individual packages. (For more information, designate #64 on the Readers Service Card.)

DIGITAL'S NEW PANELAID AND OCTAID KITS

Digital Equipment Corporation, Maynard, Mass., has introduced two series of digital module kits which provide the digital logic user with an easy-to-assemble, time-saving method of building common logic functions such as up-down counting, decoding, digital to analog and analog to digital conversions, and computer interfaces. The new kits include an Octaid® series containing up to eight standard FLIP CHIP® modules and a Panelaid® series containing up to 64 modules.



— A complete Panelaid and Octaid kit together with their printed circuit boards

Each kit contains the necessary modules, connectors, and specially designed printed circuit back panel wiring which requires only a simple soldering operation to achieve connection. Hand wiring and trouble shooting are eliminated, resulting in a significant reduction in manufacturing time.

Input/Output Buffer kits are designed to interface between Digital's PDP-8 or PDP-8/S computers and other Octaid kits or specially designed systems. Panelaid kits in general can be interfaced directly to the PDP-8 or PDP-8/S. Delivery of both the Octaid and Panelaid series is off-the-shelf. (For more information, designate #66 on the Readers Service Card.)

RESEARCH FRONTIER

WIDE USE SEEN FOR NEW BENDIX INFRARED SYSTEM

The beginnings of plant and tree disease epidemics, smoldering forest fires and water pollution in streams and lakes are some of the things that it will be possible to detect with a new Bendix airborne thermal mapping and infrared imaging system. The infrared detection system is believed to be the first commercially available device of its kind, said officials of Bendix Aerospace Systems Division at Ann Arbor, Mich., where it was developed.

In many cases it will be possible to detect plant and tree diseases before major damage has occurred by using the infrared system which records the differences in heat radiation between diseased and healthy plants. Early forest fire detection is another indicated use, as the system will be able to pinpoint "hot spots" caused by incipient fires before they can be detected visually. Mapping of temperature variations in water currents can prove useful in not only determining currents, but also in locating water pollution sources, Bendix officials said.

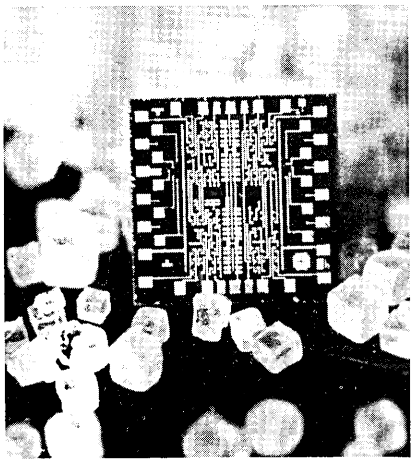
The system consists of four basic modules — a scan head, control console, vertical reference, and power supply. It can be installed and serviced in a wide range of light aircraft. The system is said to be simple to operate. It uses readily available 70-millimeter Tri-X film. Only moving parts are the scanning shaft and film drive. The power consumption is low, as the system operates on 10-amperes, 28-volts direct current. Cooling is by liquid nitrogen contained in the detector dewar located in the scan head.

The scan head can be installed either externally or internally on the aircraft and has a scanning angle of 120 degrees, instantaneous resolution of 3 milliradians and maximum temperature sensitivity of 0.5 degrees centigrade. Spectral coverage for the standard mapper is 0.7 to 5.5 microns. Various modifications and accessories such as roll compensation, 8 to 14 micron coverage and a tape recording output also are available.

IBM MAKES MASKS FOR INTEGRATED CIRCUITS AUTOMATICALLY

Researchers at IBM Corporation have overcome a major difficulty in making complex arrangements of integrated circuits. They have largely automated the design and fabrication of the circuit masks, cutting the time of these operations by more than a factor of ten.

The photograph shows an integrated circuit chip of 55 NOR circuits, which was fabricated from masks generated in the experimental automated process. The circuit



chip, containing 207 field-effect devices, is compared in size to crystals of common table salt.

In the new process, the design and fabrication of masks consists of five basic steps. First the designer draws a rough pencil sketch of the circuit layout. Then he translates this into digital form by describing the circuitry in a symbolic notation — a specially developed high-level language for th mask designer. In step three, this symbolic language is fed to a computer and processed. In processing, the circuit structures are automatically assigned to their appropriate masks. The computer then generates a set of commands which can be used to drive a "light table" to draw the patterns for each layer of the mask set. In the fourth step, the actual patterns are drawn on high-resolution photographic plates by the light table at 10 to 20 times final size. The plates are mounted on an x-y platform, which is driven by stepping motors. As the table is moved, under computer command, a light beam from a xenon flash lamp draws the mask pattern on the plate. The flashing of the lamp also is controlled by commands from the computer. Four patterns of an insulated-gate field-effect transistor chip of 122 circuits were written in about 1 hour; over 100 hours would be required to cut artwork by commercial techniques. In the final step, the exposed and developed plates are placed in a step-and-repeat camera to form a complete array of chip patterns at final size on photographic plates which, in turn, are used to expose the array of chip patterns on the semiconductor wafer.

Details of the newly developed technique were described by Dr. Dale L. Critchlow at the Institute of Electrical and Electronics Engineers International Convention held in New York.

BUSINESS NEWS

THE FOXBORO COMPANY SALES, NET INCOME SET RECORDS IN 1966

President R. A. Bristol reports sales and net income of The Foxboro Company (Foxboro, Mass.) set records in 1966, the eighth successive year of record sales. Sales, up 16% over 1965, totalled $111,255,167. Net income was $10,118,159, a 21% increase from $8,343,958 in 1965.

In 1966, new orders booked were approximately $125 million, up nearly 25% from the 1965 record. The company entered 1967 with a backlog of nearly $40 million in open orders on the books.

MEMOREX REPORTS 1966 EARNINGS

Memorex Corporation net earnings for the year ended December 31, 1966 were $2,724,000 compared to $1,331,000 for 1965, Laurence L. Spitters, President has disclosed. Net sales of Memorex, a leading developer and manufacturer of precision magnetic tapes, were $24,417,000 in 1966, compared with $13,099,000 in 1965, an 86% increase.

Also evidence of the growth and maturation of Memorex's business during 1966 were doubled production capacity, new product introductions, and stronger selling capability with 18 branch offices in the United States and five new sales subsidiaries in Europe.

Mr. Spitters also said that Memorex doubled the size of its Research facilities and launched a new subsidiary, Disc Pack Corporation, which will constitute a diversification for Memorex.

ALL-TIME HIGH SALES AND EARNINGS REPORTED BY CUBIC CORP. FOR 1966

Earnings surpassed $1 million for the first time and sales reached an all-time high in 1966 for Cubic Corp., Walter J. Zable, president, has announced. After-tax profits for 1966 rose 43% to $1,003,413, from $702,194 in 1965. Sales increased 10%, from $13,850,674 in 1965 to $15,289,077 in 1966.

Backlog at year end was slightly less than $12 million, a new record, versus $11 million at the close of 1965, the previous record year. Mr. Zable said, "Success of products like the Votronics vote counter and our line of electronic surveying instruments has meant a rising percentage of industrial/commercial sales versus military systems work."

IDC REPORT ON INTERNATIONAL MARKET

The international market for American-made computers is growing considerably faster than the domestic market, according to a study just completed by the International Data Corp., Newtonville, Mass., a market research firm for the information processing industry. Patrick J. McGovern, president of IDC, notes that by 1973 the international market for U.S.-made computers will equal the U.S. market in annual shipments.

Computer shipments increased dramatically during 1966, by 52.5% over the previous year, to a record $3.66 billion. For the current year, computer shipments are predicted to be $4.3 billion. In 1966, McGovern said, almost 74% of American-made computers were installed in the U.S. These were worth $10 billion of the $13.5 billion total. By 1977, when there will be approximately $100 billion of American-made computers installed, about half (in value) will be located outside the U.S.

A summary of the report is contained in the current issue of EDP Industry and Market Report, IDC's newsletter for executives concerned with electronic data processing. The newsletter contains 20-year estimates and projections for each of the five principal sectors of the computer industry, a worldwide analysis of general-purpose computers manufactured by U.S.-owned companies, and a discussion of industry trends through 1975. Copies are available. (For more information, designate #68 on the Readers Service Card.)

MONTHLY COMPUTER CENSUS

The number of electronic computers installed or on order at any one time has been increasing rapidly during the past several years. New models have been offered in the computer market, and familiar machines have gone out-of-production and subsequently been retired from active use and dismantled. Some new computers have been received with open arms by users — others have been given the cold shoulder.

To aid our readers in keeping up with this rapidly changing profile of computer use, COMPUTERS AND AUTOMATION presents this monthly report on the number of general purpose electronic digital computers made by U.S.-based companies which are installed or on order as of the preceding month. These census figures include installations and orders outside the United States. The figures are compiled and updated each month by the International Data Corporation, Newton, Mass. 02160, a market research firm specializing in the computer industry. We hope they will serve as a useful "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 the International Data Corporation. This market research program compiles and maintains a worldwide computer installation locator file which identifies, by customer, the installation sites of electronic computers. The resulting census counts are submitted to the individual computer manufacturers for their review and voluntary confirmation.

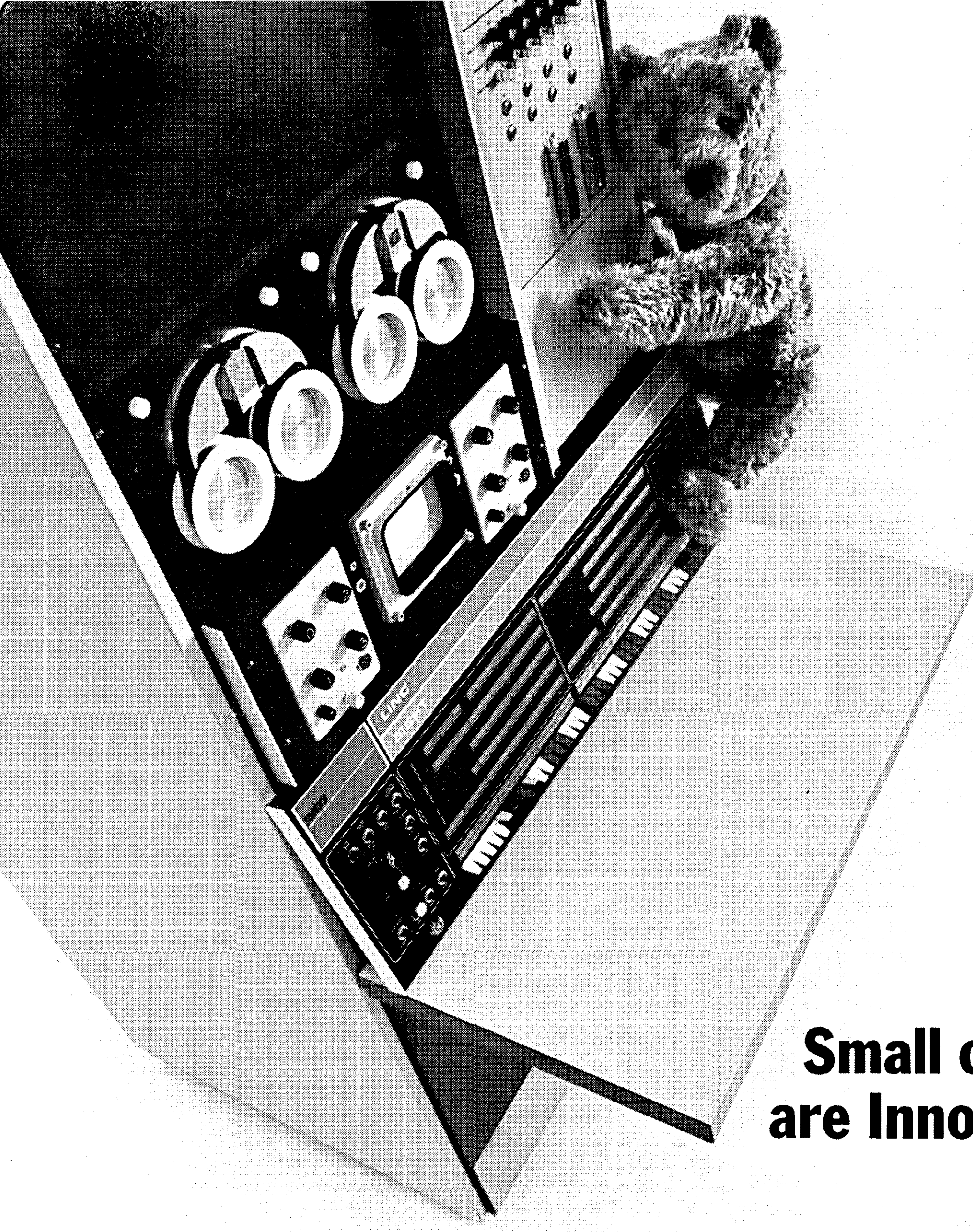
AS OF APRIL 10, 1967

NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS
ASI Computer	ASI 210	Y	$3850	4/62	26	X
	ASI 2100	Y	$4200	12/63	7	X
	ADVANCE 6020	Y	$4400	4/65	14	13
	ADVANCE 6040	Y	$5600	7/65	8	12
	ADVANCE 6050	Y	$9000	2/66	7	9
	ADVANCE 6070	Y	$15,000	10/65	5	6
	ADVANCE 6130	Y	$1000	2/67	8	22
Autonetics	RECOMP II	Y	$2495	11/58	33	X
	RECOMP III	Y	$1495	6/61	7	X
Bunker-Ramo Corp.	BR-130	Y	$2000	10/61	160	X
	BR-133	Y	$2400	5/64	36	32
	BR-230	Y	$2680	8/63	15	X
	BR-300	Y	$3000	3/59	33	X
	BR-330	Y	$4000	12/60	29	X
	BR-340	Y	$7000	12/63	20	X
Burroughs	205	N	$4600	1/54	40	X
	220	N	$14,000	10/58	32	X
	B100	Y	$2800	8/64	180	9
	B200 Series	Y	$5400	11/61	600	8
	B300 Series	Y	$10,000	7/65	148	73
	B2500	Y	$5000	2/67	3	55
	B3500	Y	$14,000	5/67	0	52
	B5500	Y	$22,000	3/63	67	9
	B6500	Y	$33,000	2/68	0	14
	B8500	Y	$200,000	2/67	0	4
Control Data Corporation	G-15	N	$1600	7/55	280	X
	G-20	Y	$15,500	4/61	25	X
	LGP-21	Y	$725	12/62	160	X
	LGP-30	semi	$1300	9/56	133	X
	RPC-4000	Y	$1875	1/61	64	X
	160*/160A/160G	Y	$2100/$5000/$12,000	5/60;7/61;3/64	462	X
	924/924A	Y	$11,000	8/61	28	X
	1604/1604A	Y	$45,000	1/60	59	X
	1700	Y	$3500	5/66	60	178
	3100	Y	$10,000	12/64	98	25
	3200	Y	$14,000	5/64	66	X
	3300	Y	$19,500	9/65	60	50
	3400	Y	$18,000	11/64	19	X
	3500	Y	$30,000	9/67	0	10
	3600	Y	$48,000	6/63	45	X
	3800	Y	$49,300	2/66	18	13
	6400	Y	$52,000	5/66	13	22
	6600	Y	$117,000	8/64	24	17
	6800	Y	$130,000	4/67	0	2
Data Machines, Inc.	620	Y	$900	11/65	54	12
	620 I	Y	$500	6/67	0	38
Digital Equipment Corp.	PDP-1	Y	$3400	11/60	59	X
	PDP-4	Y	$1700	8/62	55	X
	PDP-5	Y	$900	9/63	115	X
	PDP-6	Y	$10,000	10/64	24	1
	PDP-7	Y	$1300	11/64	128	26
	PDP-8	Y	$525	4/65	700	170
	PDP-9	Y	$1000	12/66	6	64
	PDP-10	Y	$7500	7/67	0	14
Electronic Associates, Inc.	8400	Y	$12,000	6/65	16	9
General Electric	115	Y	$1800	12/65	310	600
	205	Y	$2900	6/64	42	X
	210	Y	$16,000	7/59	47	X
	215	Y	$6000	9/63	54	X
	225	Y	$8000	4/61	202	X
	235	Y	$10,900	4/64	73	5
	415	Y	$9600	5/64	215	55
	425	Y	$18,000	6/64	82	42
	435	Y	$25,000	9/65	25	15
	625	Y	$50,000	4/65	22	16
	635	Y	$56,000	5/65	21	17
	645	Y	$90,000	7/66	2	9
Honeywell	DDP-24	Y	$2500	5/63	87	X
	DDP-116	Y	$900	4/65	180	44
	DDP-124	Y	$2050	3/66	36	34
	DDP-224	Y	$3300	3/65	56	8
	DDP-516	Y	$700	9/66	45	160
	H-120	Y	$3900	1/66	430	300
	H-200	Y	$8400	3/64	1060	140
	H-400	Y	$8500	12/61	101	X
	H-800	Y	$28,000	12/60	90	1
	H-1200	Y	$8000	2/66	92	100

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	X
	H-1800	Y	$42,000	1/64	20	1
	H-2200	Y	$12,000	1/66	36	62
	H-4200	Y	$20,500	4/67	0	9
	H-8200	Y	$35,000	4/68	0	5
IBM	305	N	$3600	12/57	125	X
	360/20	Y	$2000	12/65	2550	6800
	360/30	Y	$7500	5/65	3900	4400
	360/40	Y	$15,000	4/65	2000	1800
	360/44	Y	$10,000	7/66	50	200
	360/50	Y	$26,000	8/65	300	700
	360/65	Y	$50,000	11/65	60	260
	360/67	Y	$75,000	10/66	7	50
	360/75	Y	$78,000	2/66	20	38
	360/90 Series	Y	$140,000	6/67	0	10
	650	N	$4800	11/54	152	X
	1130	Y	$1200	2/66	1400	4600
	1401	Y	$6600	9/60	7650	X
	1401-G	Y	$2300	5/64	1610	X
	1410	Y	$14,200	11/61	815	50
	1440	Y	$4800	4/63	3500	190
	1460	Y	$11,500	10/63	1700	X
	1620 I, II	Y	$4000	9/60	1660	90
	1800	Y	$7600	1/66	160	350
	701	N	$5000	4/53	1	X
	7010	Y	$22,600	10/63	216	5
	702	N	$6900	2/55	7	X
	7030	Y	$160,000	5/61	6	X
	704	N	$32,000	12/55	27	X
	7040	Y	$22,000	6/63	120	6
	7044	Y	$32,000	6/63	130	8
	705	N	$38,000	11/55	48	X
	7070, 2, 4	Y	$27,000	3/60	315	X
	7080	Y	$55,000	8/61	85	X
	709	N	$40,000	8/58	8	X
	7090	Y	$63,500	11/59	44	X
	7094	Y	$72,500	9/62	105	1
	7094 II	Y	$78,500	4/64	138	4
National Cash Register Co.	NCR - 304	Y	$14,000	1/60	24	X
	NCR - 310	Y	$2500	5/61	15	X
	NCR - 315	Y	$8500	5/62	435	122
	NCR - 315-RMC	Y	$12,000	9/65	63	44
	NCR - 390	Y	$1850	5/61	500	25
	NCR - 500	Y	$1500	10/65	1200	850
Philco	1000	Y	$7010	6/63	16	X
	2000-210, 211	Y	$40,000	10/58	16	X
	2000-212	Y	$52,000	1/63	12	X
Radio Corporation of America	RCA 301	Y	$7000	2/61	642	1
	RCA 3301	Y	$17,000	7/64	73	3
	RCA 501	Y	$14,000	6/59	96	X
	RCA 601	Y	$35,000	11/62	5	X
	Spectra 70/15	Y	$4100	9/65	100	130
	Spectra 70/25	Y	$6700	9/65	62	54
	Spectra 70/35	Y	$10,400	1/67	22	140
	Spectra 70/45	Y	$17,400	11/65	64	110
	Spectra 70/55	Y	$40,500	11/66	3	15
Raytheon	250	Y	$1200	12/60	175	X
	440	Y	$3500	3/64	17	1
	520	Y	$3200	10/65	23	5
Scientific Control Corporation	650	Y	$500	5/66	11	7
	655	Y	$1800	10/66	1	2
	660	Y	$2000	10/65	2	1
	670	Y	$2600	5/66	1	2
	6700	Y	$30,000	10/67	0	1
Scientific Data Systems Inc.	SDS-92	Y	$1500	4/65	95	65
	SDS-910	Y	$2000	8/62	210	50
	SDS-920	Y	$2900	9/62	155	40
	SDS-925	Y	$3000	12/64	40	35
	SDS-930	Y	$3400	6/64	210	50
	SDS-940	Y	$10,000	4/66	13	28
	SDS-9300	Y	$7000	11/64	32	13
	Sigma 2	Y	$1000	12/66	12	200
	Sigma 5	Y	$6000	8/67	0	22
	Sigma 7	Y	$12,000	12/66	7	27
Systems Engineering Labs	810	Y	$1000	9/65	24	X
	810A	Y	$900	8/66	22	14
	840	Y	$1400	11/65	4	X
	840A	Y	$1400	8/66	6	34
UNIVAC	I & II	N	$25,000	3/51 & 11/57	24	X
	III	Y	$20,000	8/62	69	X
	File Computers	N	$15,000	8/56	14	X
	Solid-State 80 I, II, 90 I, II & Step	Y	$8000	8/58	228	X
	418	Y	$11,000	6/63	114	36
	490 Series	Y	$35,000	12/61	150	56
	1004	Y	$1900	2/63	3200	50
	1005	Y	$2400	4/66	650	200
	1050	Y	$8000	9/63	285	20
	1100 Series (except 1107)	N	$35,000	12/50	9	X
	1107	Y	$55,000	10/62	35	X
	1108	Y	$65,000	9/65	48	74
	9200	Y	$1500	6/67	0	950
	9300	Y	$3400	6/67	0	550
	LARC	Y	$135,000	5/60	2	X
				TOTALS	45,734	26,181

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, customers ordering a new computer model intended to replace a computer model in the same product line may continue to use much of their current peripheral equipment, which can account for 30-70% of the value of the total computer system.



Small computers are Innovation machines

The power under the direct control of the scientific investigator with small computers is enormous. Not just the power to calculate. Not just the power to analyze. But the power to innovate.

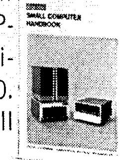
Small computers — and by that we mean laboratory size or smaller general purpose machines — are most frequently used on-line, in real time, intimately hooked up to the experiment. Inputs to the computer are direct from the experiment. Outputs are instantaneous detail, or instantaneous sampling, or instantaneous averaged results, all provided while the experiment proceeds.

Two things can now happen. First, the investigator can change the method of data taking, or the sequence of data taking, based on the results he sees emerging. He can sample more frequently than he thought necessary, or can look in detail, at an unexpected result.

Second, he can influence the experiment, either by himself or automatically by the computer, based on the results he sees emerging.

If he waited to complete the experiment and analyze the results at the computation center, the opportunity to innovate would be gone.

Small, real-time, on-line, general purpose computers are intensely personal, highly approachable, responsive scientific innovation machines. It will be the rare laboratory that will not have one in the next few years.



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CALENDAR OF COMING EVENTS

May 3-4, 1967: Annual National Colloquium on Information Retrieval, Philadelphia, Pa.; contact R. M. Hildreth, Publicity Chairman, Auerbach Corp., 121 N. Broad St., Philadelphia, Pa. 19107

May 3-5, 1967: Electronic Components Technical Conference, Marriott Twin Bridges Motor Hotel, Washington, D.C.; contact C. K. Morehouse, Globe Union Inc., Box 591, Milwaukee, Wisc. 53201

May 4-5, 1967: The Montreal Chapter of the Computer Society of Canada EXPO '67 Seminar, Windsor Hotel, Montreal, Quebec, Canada; contact Raymond A. Beaudoin, Programme Committee, Computer Society of Canada, P.O. Box 1772, Station B, Montreal, Quebec, Canada

May 8-10, 1967: National Rural Electric Cooperative Association's Third Annual Data Processing and Automation Conference, Executive House, Chicago, Ill.; contact Tracy E. Spencer, Management Services, N.R.E.C.A., 2000 Florida Ave., N.W., Washington, D.C. 20009

May 18, 1967: Association for Computing Machinery Technical Symposium, San Fernando Valley Chapter, Century Plaza Hotel, Century City, Los Angeles, Calif.; contact B. G. Dexter, Jr. TRW Systems, One Space Park, Redondo Beach, Calif. 90278

May 18-19, 1967: 10th Midwest Symposium on Circuit Theory, Purdue University, Lafayette, Ind.

May 23-26, 1967: GUIDE International, Americana Hotel, New York, N.Y.; contact Lois E. Mecham, Secretary, GUIDE International, c/o United Services Automobile Assoc., 4119 Broadway, San Antonio, Texas 78215

May 31-June 2, 1967: A Symposium on Automatic Photointerpretation, Washington Hilton Hotel, 1919 Connecticut Ave., N.W., Washington, D.C.; contact George C. Cheng, Symposium Coordinator, Pattern Recognition Society, P.O. Box 692, Silver Spring, Md. 20901

June 8, 1967: International Conference for Network Planning Users, Royal Festival Hall, London, England; contact Graham R. Bunting, Press Officer, I.C.T. House, Putney, S.W.15, England.

June 9, 1967: Third Annual Stony Brook Conference on "Advances in Computing," Stony Brook, L.I., N.Y.; contact Sol Droder, SUNYC Stony Brook, L.I., N.Y. 11790

June 12-14, 1967: International Communications Conference, Leamington Hotel, Minneapolis, Minn.; contact R. J. Collins, Dept. of Electrical Engineering, Univ. of Minn., Minneapolis, Minn. 55455

June 14-17, 1967: Annual Meeting of Council of Social Science Data Archives, University of California, Los Angeles, Calif.; contact William A. Glaser, Bureau of Applied Social Research, 605 West 115 St., New York, N.Y. 10025, or Ralph Bisco, Institute for Social Research, P.O. Box 1248, Ann Arbor, Mich. 48106

June 19-21, 1967: Conference of ADP Managers on Public Welfare (By Invitation Only), Airlie House, Warrenton, Virginia; contact Saya S. Schwartz, Bureau of Family Services, Dept. of Health, Education and Welfare, Washington, D.C. 20201

June 19-21, 1967: Third Annual Conference on Automatic Data Processing (ADP) Systems in Local Government, Hotel Barbizon-Plaza, New York City, N.Y.; contact Henry Sellin, School of Continuing Education, New York University, New York, N.Y. 10003

June 20-23, 1967: DPMA International Data Processing Conference and Business Exposition, Sheraton-Boston Hotel, Boston, Mass.; contact William J. Horne, Conference Director, United Shoe Machinery Corp., 140 Federal St., Boston, Mass.

June 26-27, 1967: Computer Personnel Research Group Fifth Annual Conference, University of Maryland, College Park, Md. (near Washington, D.C.); contact Dr. Charles D. Lothridge, General Electric Co., 570 Lexington Ave., New York, N.Y. 10022

June 26-30, 1967: 8th Annual Joint Automatic Control Conference (JACC), University of Pennsylvania, Philadelphia, Pa.; contact G. K. L. Chien, IBM Corporation, Monterey & Cottle Roads, San Jose, Calif. 95114

June 28-30, 1967: 1967 Joint Automatic Control Conference, University of Pennsylvania, Philadelphia, Pa.; contact Lewis Winner, 152 W. 42nd St., New York, N.Y. 10036

July 31-August 4, 1967: MEDAC '67 Symposium and Exhibition, San Francisco Hilton Hotel, San Francisco, Calif.; contact John J. Post, Executive Secretary, AAMI, P. O. Box 314, Harvard Square, Cambridge, Mass. 02138

August 7-11, 1967: 12th Annual Technical Symposium of the Society of Photo-optical Instrumentation Engineers, International Hotel, Los Angeles, Calif.; contact Dr. John H. Atkinson, Technical Program Chairman, S.P.I.E. Symposium, P.O. Box 288, Redondo Beach, Calif. 90277.

August 22-25, 1967: WESCON (Western Electronic Show and Convention), Cow Palace, San Francisco, Calif.; contact Don Larson, 3600 Wilshire Blvd., Los Angeles, Calif. 90005

August 23-25, 1967: International Conference on Computational Linguistics, Grenoble University Campus, St. Martin-D'Heres, France; contact Professor Bernard Vauquois, C.E.T.A., B.P. No. 8, 38- St. Martin-D'Heres, France.

Aug. 28-Sept. 2, 1967: AICA (International Association for Analogue Computation) Fifth Congress, Lausanne, Switzerland; contact secretary of the Swiss Federation of Automatic Control, Wasserwerkstrasse 53, Zurich, Switzerland

Aug. 29-31, 1967: 1967 ACM (Association for Computing Machinery) National Conference, Twentieth Anniversary, Sheraton Park Hotel, Washington, D.C.; contact Thomas Willette, P.O. Box 6, Annandale, Va. 22003

Sept. 6-8, 1967: First Annual IEEE Computer Conference, Edgewater Beach Hotel, Chicago, Ill.; contact Professor S. S. Yau, Dept. of Electrical Engineering, The Technological Institute, Northwestern University, Evanston, Ill. 60201

Sept. 11-15, 1967: Fifth International Cybernetics Congress, Palais des Expositions, Place André Rijckmans, Namur, Belgium; contact J. Lemaire, Managing Director, same address.

Sept. 11-15, 1967: 1967 International Symposium on Information Theory, Athens, Greece; contact A. V. Balakrishnan, Dept. of Engineering, U.C.L.A., Los Angeles, Calif. 90024

Sept. 25-28, 1967: International Symposium on Automation of Population Register Systems, Jerusalem, Israel; contact D. Chevion, Chairman of Council, Information Processing Association of Israel, P.O.B. 3009, Jerusalem, Israel

October 1-4, 1967: 1967 International Systems Meeting, Cobo Hall, Detroit, Mich.; contact Richard L. Irwin, Systems and Procedures Association, 24587 Bagley Rd., Cleveland, Ohio 44138

Oct. 18-20, 1967: Eighth Annual Symposium on Switching and Automata Theory, University of Texas, Austin, Tex.; contact Prof. C. L. Coates, Room 520, Engineering Sci. Bldg., Univ. of Tex., Austin, Tex. 78712

Nov. 14-16, 1967: Fall Joint Computer Conference, Anaheim Convention Center, Anaheim, Calif.; contact AFIPS Headquarters, 211 E. 43rd St., New York, N.Y. 10017

May 21-23, 1968: Spring Joint Computer Conference, Sheraton Park/Shoreham Hotel, Washington, D.C.; contact AFIPS Headquarters, 211 E. 43rd St., New York, N.Y. 10017

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

BOOKS AND OTHER PUBLICATIONS

Neil Macdonald
Assistant Editor
Computers and Automation

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

Reviews

American Documentation Institute, ed., and 108 authors / Proceedings of the American Documentation Institute, Vol. I, Parameters of Information Science Annual Meeting / Spartan Books, 1250 Conn. Ave. N.W., Washington, D.C. / 1964, hardbound, 519 pp., $?

This volume contains papers from the October, 1964 annual meeting of the American Documentation Institute. It contains some computer preprinted papers and program-produced indexes which cover a broad range of subjects.

Apter, Michael J. / Cybernetics and Development / Pergamon Press, 44-01 21st St., Long Island City, N.Y. 11101 / 1966, hardbound, 188 pp., $8.00

This book is a "preliminary attempt" to apply some of the insights and techniques of cybernetics to the problem of understanding the development and control of biological systems. Chapters include: "Cybernetics and Development," "Information Theory and Development," "Development on the Computer," and "Growing Automata Nets."

Bellman, R. E., R. E. Kalaba and J. Lockett / Numerical Inversion of the Laplace Transform: Applications to Biology, Economics, Engineering, and Physics / American Elsevier Publishing Co., Inc., 52 Vanderbilt Ave., New York, N.Y. 10017 / 1966, hardbound, 249 pp., $?

This is the fourth volume in a series "Modern Analytic and Computational Methods in Science and Mathematics." The purpose of the series is to reformulate classical processes of mathematical physics in terms suitable for computational study. This volume covers applications of the Laplace transform in such fields as heat conduction, system identification, non-linear control, and time-dependent transport processes. It includes appendices and an index.

Cherry, Colin / On Human Communication: A Review, A Survey, and A Criticism, 2nd ed., / The M.I.T. Press, 50 Ames St., Cambridge, Mass. 02142 / 1966, hardbound, 337 pp., $10.00

This is a collection of essays by the author, who is a Professor of Tele-communication, Imperial College, University of London; the book surveys the newly-evolved, combined field of cybernetics and information theory (linguistics, mathematics, phonetics, psychology, and semantics). This second edition is a revised and updated version of the first. It includes bibliographies, over 400 footnoted references, an appendix of terms, and an index.

Computer Consultants Limited / A Report on Computers in Russia / Computer Consultants Limited, G.P.O. Box 22, Enfield, Middlesex, England / 1966, looseleaf, duplicated, 200 pp., $30.00?

This report is based on observations made and information obtained in the U.S.S.R. by representatives of Computer Consultants Limited, and is mainly a report on machines and their features. The analysis of Soviet computers is preceded by a short section giving general information on the social and state systems of the U.S.S.R.

The authors predict that, while computer activity in Russia is at present well behind Great Britain, Russia will outdistance the rest of the world during the next five years.

Dimitry, Donald L., and Thomas H. Mott, Jr. / Introduction to Fortran IV Programming / Holt, Rinehart and Winston, Inc., 383 Madison Ave., New York, N.Y. 10017 / 1966, hardbound, 334 pp., $6.95

The purpose of this text is to present Fortran at an elementary, but comprehensive level. The authors have stressed the governing rules of Fortran IV as defined for the IBM 7040-7044 computer. The first three chapters are devoted to a discussion of computer operations and adapting programming languages to machine languages. The remaining 15 chapters are devoted to Fortran programming. Problems are included at the end of each chapter. All examples presented have been computer tested. The final chapter consists of 25 problems chosen to demonstrate programming techniques. Flow charts and programs are presented for ten of the problems.

This book is a good basic reference on Fortran.

Flores, Ivan / The Logic of Computer Arithmetic / Prentice Hall, Inc., Englewood Cliffs, N.J. / 1963, hardbound, 493 pp. $?

This book is an exhaustive study of highspeed, binary digital computer arithmetic hardware, and its rationale. It is intended for practicing engineers or logical designers in the computer field. There are 18 chapters, a bibliography and index. This book is highly technical.

Forney, G. David, Jr. / Concatenated Codes / The M.I.T. Press, 50 Ames St., Cambridge, Mass. 02142 / 1966, hardbound, 147 pp., $8.50

This book is a revision of the Sc.D. thesis of the author. It discusses the general structure of communication systems and previously known results rather than on details of proofs. Chapters include: "Reed-Solomon and BCH Codes," "Generalized Minimum Distance Decoding," "Theoretical Performance of Concatenated Codes," and "Computed Performance of Concatenated Codes."

Gardner, Martin / New Mathematical Diversions from *Scientific American* / Simon and Schuster, Inc., 630 5th Ave., New York, N.Y. 10020 / 1966, hardbound, 253 pp. $5.95

This book is the third collection of the author's column in the *Scientific American*. It contains twenty new mathematical games ranging from confirming the Pythagorean Theorem with scissors to solving problems of packing spheres with rubber cement and ping-pong balls. A fascinating book to challenge the mathematical imagination.

Kent, Allen / Specialized Information Centers / Spartan Books, Washington, D.C. / 1965, hardbound, 296 pp., $9.00

This book provides detailed information on specialized information centers, the unit operations performed and the factors influencing their success or failure during operation. It also offers a comparative presentation of case histories. Chapters include: "Acquisition of Materials," "Terminology Control," "Storage of Source Materials," "Delivery of Search Results," and "Costs and Evaluation." The author is the Director of the Knowledge Availability Systems Center at the University of Pittsburgh.

Although the sources of excerpts from materials supplied are not identified, this book presents a good first analysis of the field.

Manheim, Marvin L. / Hierarchical Structure: A Model of Design and Planning Processes / The M.I.T. Press, 50 Ames St., Cambridge, Mass. 02142 / 1966, paper bound, 226+ pp., $8.50

This is the author's Ph.D. dissertation, submitted to the Dept. of Civil Engineering at M.I.T. under the title "Highway Route Location as a Hierarchically Structured Sequential Decision Process: An experiment in the use of Bayesian decision theory for guiding an engineering process."

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.

NEW PATENTS

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

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

February 7, 1967

3,303,351 / Shintaro Oshima, Musashino-shi, Tokyo-to, Hajime Enomoto, Sugano-machi, Ichikawa-shi, Chiba-ken, Seiichi Inoue, Musashino-shi, Tokyo-to, and Yasuo Koseki, Chofu-shi, Tokyo-to, Japan / assignors to Kokusai Denshin Denwa Kabushiki Kaisha, Tokyo-to, Japan / Logical Circuit Using Magnetic Cores.

3,303,464 / Edwin R. Kolb, University Heights, Ohio / assignor to Harris-Intertype Corp. / Ring-Sum Logic Circuit.

3,303,473 / Genung L. Clapper, Vestal, N.Y. / assignor to International Business Machines Corp. / Adaptive Logic Circuits.

3,303,474 / Clarence J. Moore, Philadelphia, and Stephen W. Leibholz, Hatboro, Pa. / assignors to Radio Corporation of America / Duplexing System For Controlling On-Line And Standby Conditions Of Two Computers.

3,303,479 / Milton Rosenberg, Santa Monica, Calif. / assignor to Ampex Corporation / Multiaperture Magnetic Memory System.

3,303,480 / David R. Bennion and William K. English, Menlo Park, and David Nitzan, Palo Alto, Calif. / assignors to AMP Inc. / Dummy Load For Magnetic Core Logic Circuits.

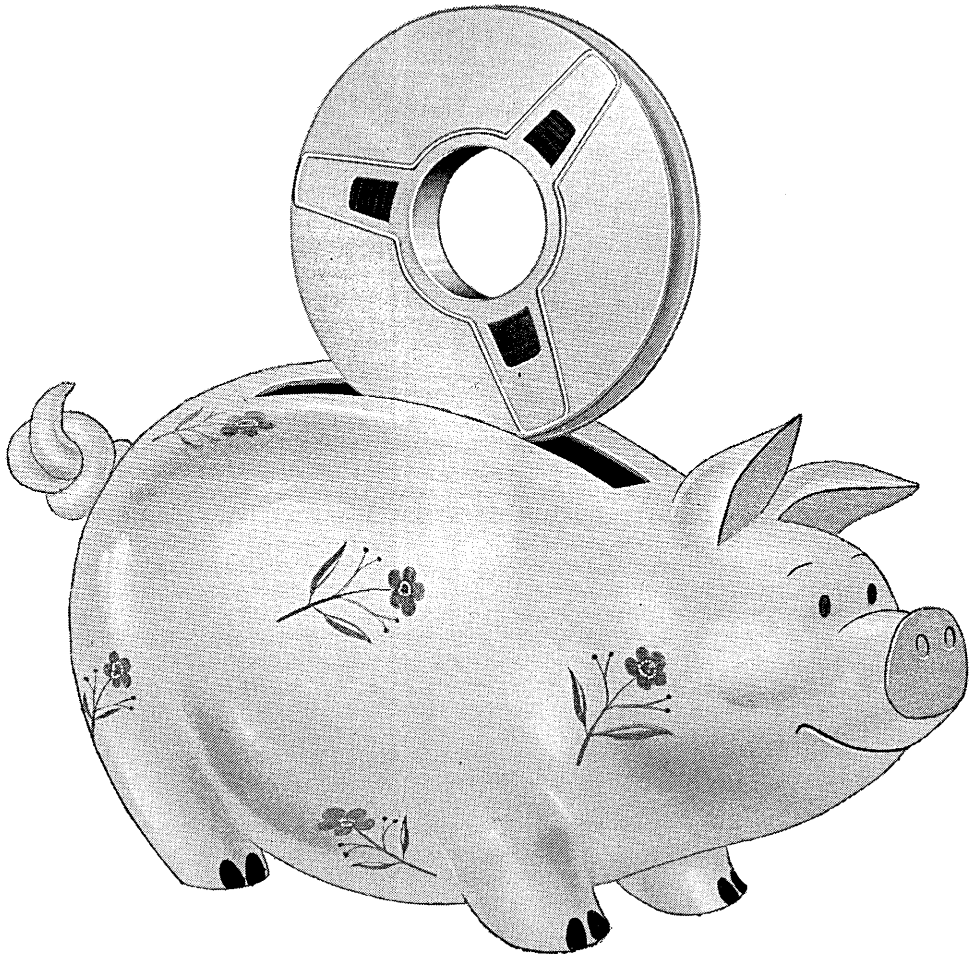
3,303,481 / Barry I. Kessler, Cherry Hill, N.J. / assignor to Radio Corporation of America / Memory With Noise Cancellation.

February 14, 1967

3,304,410 / Edwin O. Blodgett, Rochester, N.Y. / assignor, by mesne assignments, to Friden, Inc. / Tabulating Card Reader.

3,304,411 / Edwin O. Blodgett, Rochester, N.Y. / assignor, by mesne assignments, to Friden, Inc. / Punched-Card Reader.

3,304,436 / James J. Klinikowski, Somerville, N.J. / assignor to Burroughs Corp. / Semiconductor Counting Circuits.



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CEC's DR-3000 Digital Magnetic Tape System is a minor phenomenon in an age of high cost instrumentation.

Not only does the DR-3000 cost less than any other digital tape handler, but it offers a combination of versatility and reliability unmatched by the majority of today's most expensive systems.

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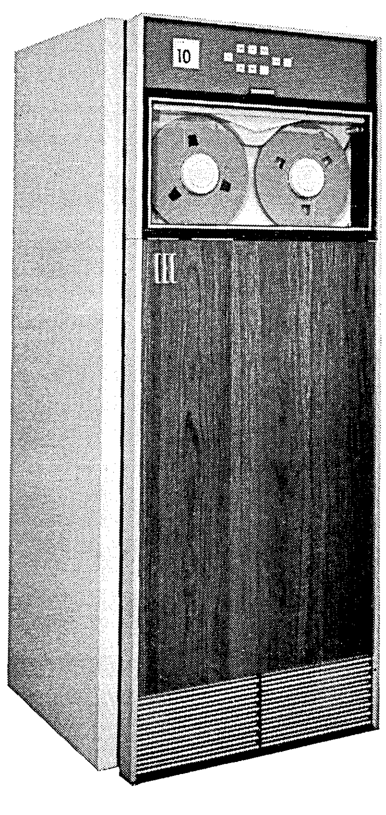

- Simplified parts provisioning and service with complete interchangeability of parts, regardless of speed requirements.
- There is one basic model with tape speeds from 37½ to 112½ ips—and a choice of cabinet configurations: horizontal for computer applications; vertical for data acquisition systems. And, due to its rugged compact construction, the DR-3000 is also ideally suited for mobile assignments.
- Each system is supported by prompt local service and assistance available through CEC's nationwide resident field force.

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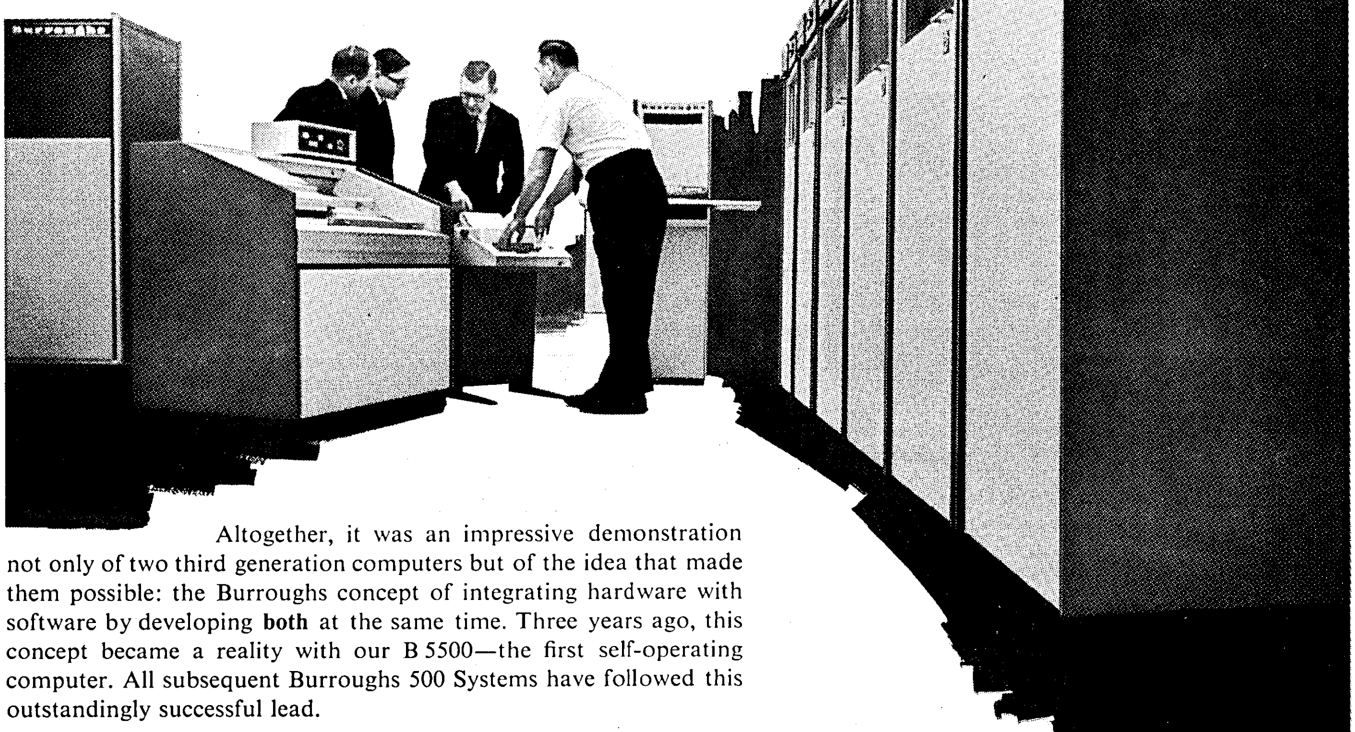
They demonstrated highly efficient operation in COBOL, the widely accepted higher level language for business data processing.



Altogether, it was an impressive demonstration not only of two third generation computers but of the idea that made them possible: the Burroughs concept of integrating hardware with software by developing **both** at the same time. Three years ago, this concept became a reality with our B 5500—the first self-operating computer. All subsequent Burroughs 500 Systems have followed this outstandingly successful lead.

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