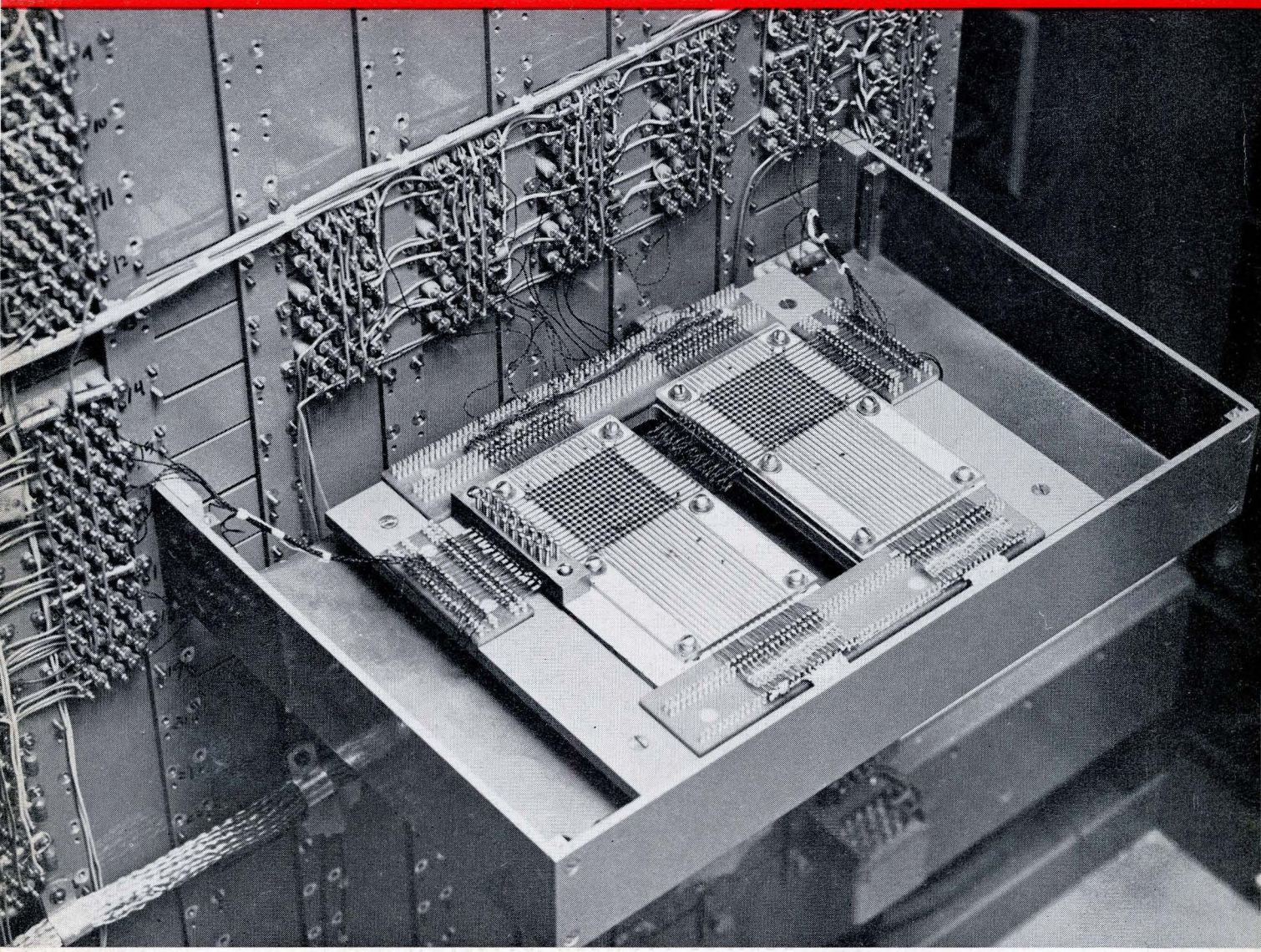
COMPUTERS
and AUTOMATION

DATA PROCESSING • CYBERNETICS • ROBOTS



Conversation With a Computer
Important Applications of Computers
Machine Translation From English to Russian
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OCTOBER
1959
•
VOL. 8 - NO. 10

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COMPUTERS *and* AUTOMATION

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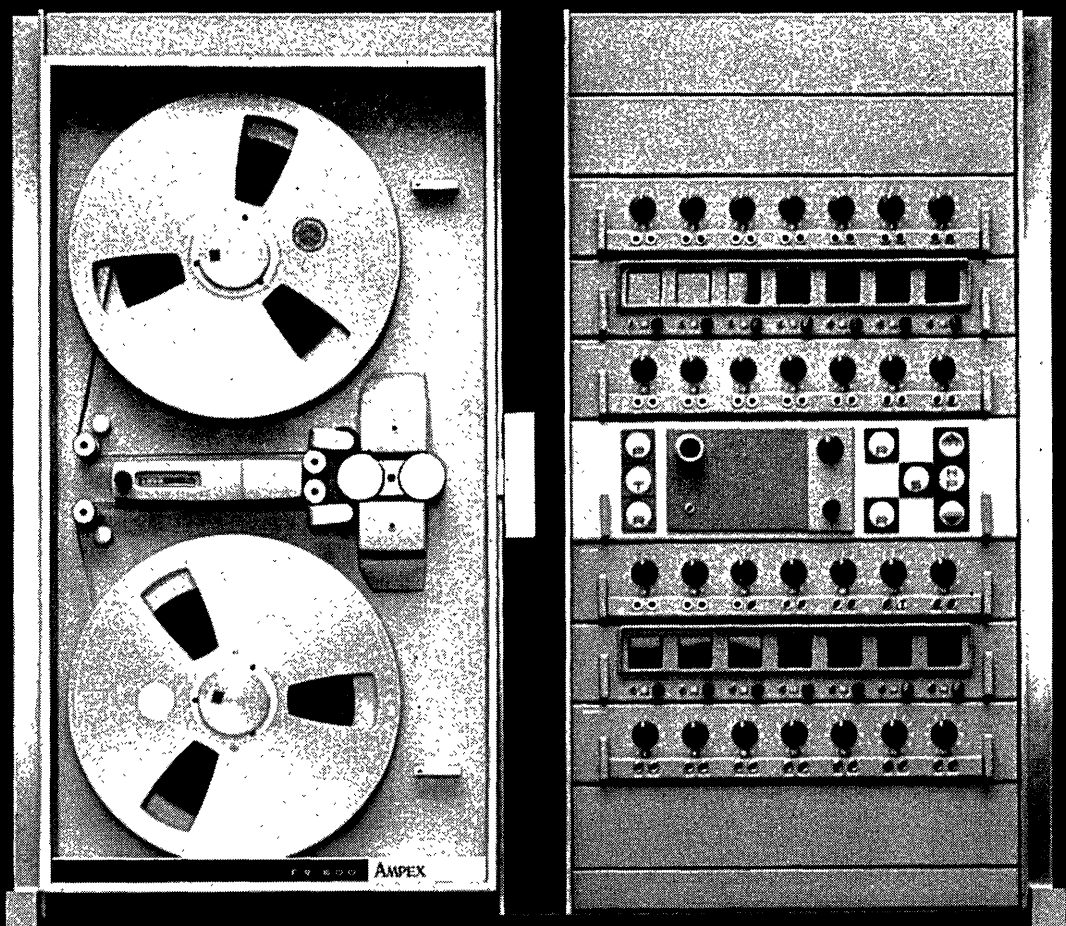


Readers' and Editor's Forum

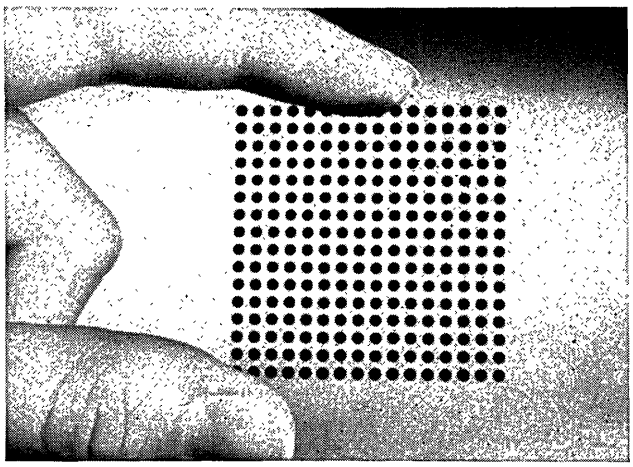
FRONT COVER: FIRST SUCCESSFUL OPERATION OF A PRACTICAL MAGNETIC FILM MEMORY

John A. Kessler
Mass. Inst. of Techn., Lincoln Lab.
Lexington 73, Mass.

The front cover shows a high-speed magnetic film memory now in operation as a part of the TX-2 digital computer at the MIT Lincoln Laboratory. It is believed to be the first in successful practical operation. Its performance has been entirely satisfactory since its installation in July 1959. It has a capacity of 32 ten-bit words, suitable for evaluation testing, and serves as an experimental prototype for larger units. This new memory, and the TX-2 computer of which it is a part, were developed by Lincoln Laboratory under Air Force contract, with the joint support of the Army, Navy, and Air Force.

The read-and-write cycle time of 0.8 microseconds is consistent with the speed of the computer itself, although bench tests demonstrated successful operation at a cycle time as short as 0.4 microseconds. Net driving current for writing is 150 milliamperes, and one-millivolt output signals are obtained from individual memory elements.

Each memory element is a circular spot of Permalloy film (82 percent nickel, 18 percent iron) 750 Angstroms thick, 1.6 millimeters in diameter, centered 2.5 millimeters apart. The spots are deposited by evaporation on a flat glass substrate, 0.1 millimeter thick, in 16 x 16 unit arrays. The complete memory unit as installed in TX-2 and one of the experimental arrays are shown in the two figures. The transistor drive and sense circuits can be seen surrounding the memory.



This is a magnetic film memory array of the type installed in the TX-2 computer at MIT Lincoln Laboratory. It is experimental. The memory elements are circular spots of film of Permalloy (82 percent nickel, 18 percent iron). The thickness is 750 Angstroms. It was deposited on a thin glass plate. Each memory element is 1.6 millimeters in diameter; the center-to-center spacing is 2.5 millimeters.

A thin film memory has several potential advantages over the familiar ferrite toroidal core memory: faster cycle time, lower power dissipation, greater compactness, and simpler fabrication. The unit now in operation confirms these expectations, although none of these factors has been fully exploited in this first developmental model.

CORRECTION OF TITLE — "A GENERAL PROBLEM-SOLVING PROGRAM FOR A COMPUTER"

In the July, 1959, issue of **Computers and Automation**, a paper "A Report on a General Problem-Solving Program for a Computer" by A. Newell, J. C. Shaw, and H. A. Simon was printed starting page 10 with the title omitting the words "A Report on," and thus implying, according to the authors, more finality to the report than the authors desire.

The title of this paper should be corrected to "A Report on a General Problem-Solving Program for a Computer."

WORKING GROUP ON SOCIALLY DESIRABLE APPLICATIONS OF COMPUTERS

At the Association for Computing Machinery Meeting in Cambridge, Mass., on Sept. 1, 1959, an afternoon session was held on "Social Aspects of Computing." After one paper was presented ("The Computing Machine — Slave Labor in a Free Society," by H. M. Elliott), a Panel Discussion on the Social Responsibilities of Computer People was begun by Arvid W. Jacobson, H. R. J. Grosch, and Louis Sutro, and continued by a great many members of the audience.

The discussion lasted vigorously for nearly 3 hours.

During the session, suggestions were made by Dr. Herbert R. J. Grosch, consultant, Evan Herbert, editor of **Data Control**, and E. C. Berkeley that we organize a "working group on socially desirable applications of computers," consisting of those persons who would sign up at the front of the room at the end of the session, and any other interested computer people. Twenty-nine persons signed up at the time as interested in working in this group, and the following questionnaire has been sent out to them.

Any interested reader of **Computers and Automation** is invited to complete this questionnaire, and send it in also.

The ACM Committee on the Social Responsibilities of Computer People of course still continues to exist and function, but with a difference in emphasis.

WGSDAC Questionnaire

(may be copied on any piece of paper; and any interested computer person that you know may fill in a copy also)

1. What do you suggest as the main purposes for this group? .....

[Please turn to page 30]

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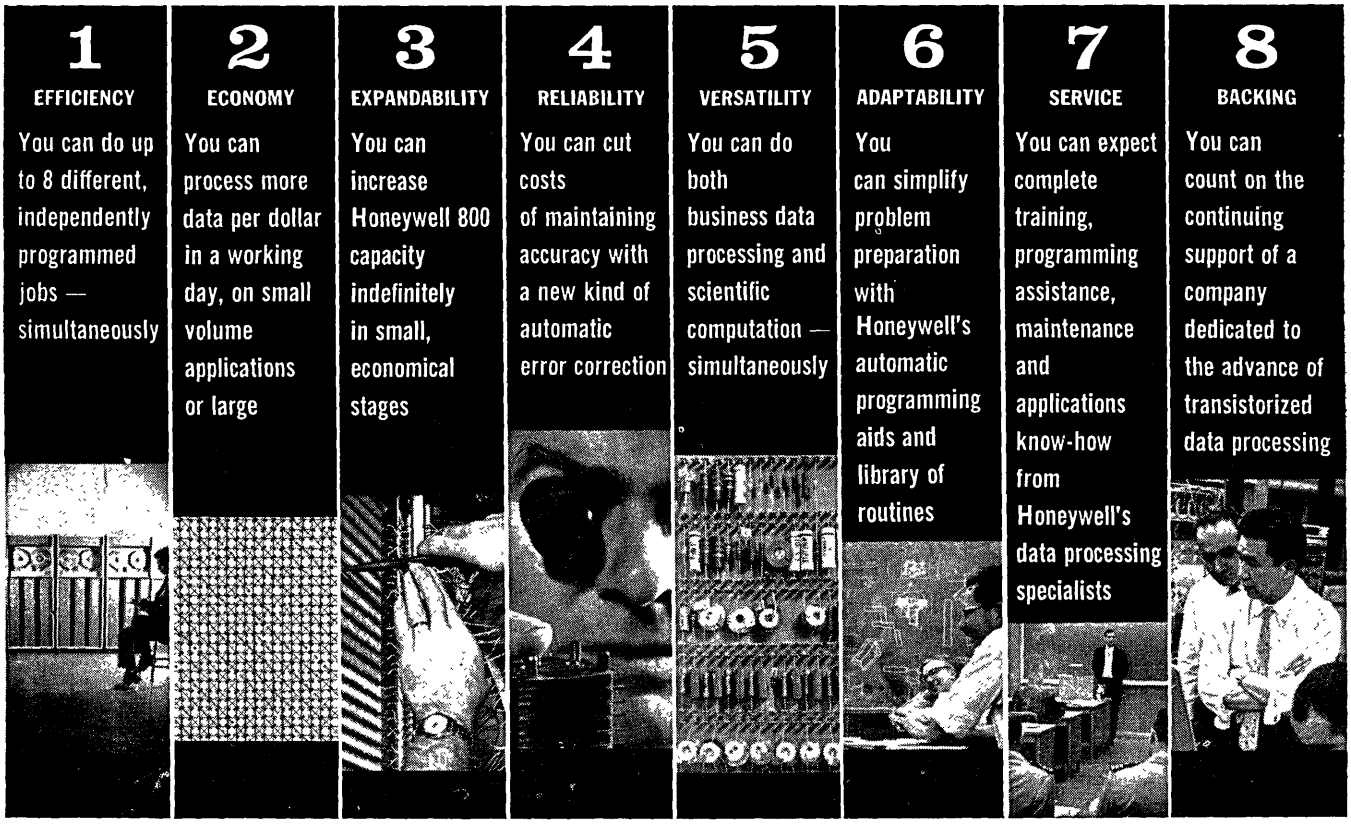


CONVERSATION WITH A COMPUTER

L. E. S. Green, KCS Limited, Toronto, Can.
E. C. Berkeley, Berkeley Enterprises, Inc.,
Newtonville 60, Mass.
and
C. C. Gotlieb, Computation Centre, Univ. of Toronto,
Toronto, Can.

Introduction

Can a computer carry on a conversation?

About 1938 the English mathematician Turing suggested that a machine could be said to be capable of thinking if it could carry on a conversation with a human being in another room, in such a way that the human being could not tell if he were conversing with a machine or with another human being. Since that time, this definition of a computer's thinking has stood as a challenge to computer people.

To make a beginning on the problem, it is clearly desirable to restrict it to some relatively simple and common subject such as the weather. About 1954 John W. Carr, III, now director of the computing center at the University of North Carolina in a course on computers for students at the University of Michigan, assigned as an optional problem for additional credit the problem of programming a machine to carry on a conversation about the weather.[1] But no student took up the challenge.

In December, 1958, the problem (as phrased and analyzed by E. C. Berkeley as a part of a study on language, ideas, and computers) was discussed with the Computation Centre of the University of Toronto. Dr. C. C. Gotlieb of the Centre classified it as a frontier problem having interest; and it was placed in the hands of L. E. S. Green, mathematician and programmer, to analyze, program, and code.

The first preliminary program ran in April, 1959, and showed a surprising degree of success, but also some "stupid" or "deaf" replies. The second preliminary program ran in August, 1959, and was a good deal more satisfactory; but at present writing, still contains some undesirable responses for such reasons as failure to recognize certain English idioms, and incompleteness of syntactical analysis.

This article is based on a paper by L. E. S. Green and E. C. Berkeley presented at the meeting of the Association for Computing Machinery at Mass. Inst. of Technology, Cambridge, on Sept. 2, 1959.

At the University of Toronto a preliminary program for a computer to converse about the weather has been written for the IBM Tape 650 in such fashion that a large proportion of the remarks made by the computer are sensible.

Assumptions

In this program, a number of assumptions have been made about the nature of the problem of conversation. These are as follows:

(1) Conversations consist of groups of words.

(2) In any conversation, a reply to a remark is generated by the meaning the remark has for the person spoken to or listener, the environment in which the remark is made, the knowledge and experience of the listener, or by the interactions among these three factors.

(3) In conversations about the weather, remarks are mainly stereotypes, and are made automatically with little cogitation on the part of the speaker. The comment "Some weather we're having, eh?" is such an example.

(4) A word, or combination thereof, has a meaning to a listener, only if it produces an association with an experience in the history of the listener. As a corollary then, words which give rise to no associations for the listener are meaningless to him.

(5) It is convenient here to classify words into three types, which we shall call ordinary words, time words, and operator words. Ordinary words are those which have meanings even when isolated from a context, such as "snow." Time words describe times of the year, such as "October," or a time relation to the present, such as "last week." Operator words, here, have no meaning when separated, but when taken in their context they alter the meaning of other words. Thus, they have a function rather than a meaning. For example the word "not" by itself is meaningless, but in the statement "The sun is not shining," its function is to change the meaning of its neighbours.

---

[1] Excerpt from *Problems For Students of Computers,* by John W. Carr, III, published in the February 1955 issue of Computers and Automation (Vol. 4, No. 2, pp. 6-8):

21. Limited Conversation

Devise a program that will make M I D A C perform what appears to be a reasonably lucid conversation about one particular subject (for example, the weather).

[So far no student has tried problem 21, which is a difficult problem indeed (an obvious challenge to approximate A. M. Turing's definition of a machine's "thinking"), but that problem has caused numerous comments and discussion among members of the class. Several tentative schemes have already been proposed.]

Inasmuch as these assumptions do not completely agree with the properties of conversations, the program at the present stage will occasionally generate replies which do not make sense.

Representation of Meaning of Words

In describing how these assumptions are used in the logic of the program I would like to discuss first the representation of meaning in the computer program. The meaning of an ordinary word is represented by a number pair (d, q).

The second number of the pair, q names the quality implicit in the meaning of the word, and the first number d, gives a quantitative description of the quality q; that is, d is the degree of the quality q. For example words describing wet weather are represented as:

dew	(1, 1)
drizzle	(3, 1)
rain	(6, 1)
cats and doge	(7, 1)
downpour	(9, 1)

A meaningless word is represented by the pair (0, 0).

The function of an operator word is also symbolized by a two-number pair, (d, f). Here f designates the function to be carried out, and d the degree to which the function f must be executed. Examples of operators which negate words preceding them in a context are:

change	(1, 13)
abate	(2, 13)
stop	(3, 13)

Similarly the sense of a time word is represented by the pair (d, t), where t gives the type of time, calendar or relative, and d again gives the degree.

For example:

yesterday	(1, 10)
to-day	(2, 10)
tomorrow	(3, 10)
December	(1, 9)
January	(2, 9)
February	(3, 9)

About 300 English words and their numerical representations are stored in the computer's memory during the program. This set of words constitutes the computer's recognition vocabulary—the computer finds these and only these words significant in its discourse with an observer. Hence we can say that a given word produces an association with the computer, if the computer is able to find this word in its recognition vocabulary.

Representation of Meaning of Remarks

Inasmuch as a remark consists of a group of words, a remark may have a meaning also. This meaning is determined by carrying out the functions of the operator words on the appropriate ordinary words in the remark. When this is completed all operators in the remark are replaced by the number pair (0, 0) which represents a meaningless word. Thus, the original remark, now consisting of ordinary and time words, is represented by a set of non-zero number pairs, and a set of zero number pairs. It is the set of non-zero number pairs that we call the meaning of the remark.

Generation of Replies

The second assumption was that a reply is generated by the interaction among the three factors, meaning, environment, and machine's experience.

The second factor is the environment in which the remark is made. This environment for the machine consists entirely of information about weather—the weather for the various months and seasons, and the weather for yesterday, to-day, and tomorrow. The latter type is told to the machine at the beginning of a run by a command to "remember such and such," whereas the former is stored internally, since the weather associated with the seasons is the same from year to year. In both cases, the weather information is stored as a set of number pairs.

The third factor, the machine's experience, is slightly more varied. In addition to the vocabulary, this experience consists of a set of weather parameters, such as sunny skies and warm breezes, which the machine likes, and another set which it dislikes, as determined by programmed statements to the machine. Since the ordinary words in its vocabulary describe only weather and emotion, the machine has a rather narrow outlook. Hence, the only aspects of the original remark and of the environment which the computer can recognize are phases of weather, which it usually associates with a time and a preference.

The third assumption was that conversation about the weather is stereotyped. Because of this the computer is able to reply by selecting a suitable reply frame from its memory, filling in a few ordinary weather words and time words generated by the interactions just considered and punching out the result. By making a quantitative evaluation of the degree of interaction the machine is able to select the particular reply frame most appropriate to the whole situation. In all, there are about 350 reply frames, each of which contains a number of blanks to be filled by the program when that particular frame is chosen as a reply.

An Example

Now let us work through a typical example. Let us suppose the remark is made to the computer

"I do not enjoy rain during July."

The computer substitutes the numerical representation for each of these words as the remark is read in. The resulting sentence then appears inside the computer as:

(0, 0) (0, 0) (3, 14) (3, 11) (6, 1) (0, 0) (8, 9)

Note that the word *not* is an operator word with the representation (3, 14). In this remark the word *enjoy,* (3, 11), is the operand. The function of (3, 14) is carried out on (3, 11) making it into the new word (3, 12), *dislike,* and changing the operator's word's representation to (0, 0):

(3, 14)	(3, 11)	→	(0, 0)	(3, 12)
not	enjoy		—	dislike

The meaning of the remark is now said to be the set of non-zero pairs:

(3, 12) (6, 1) (8, 9).

This combination of qualities in the original remark causes the program to compute the degree of interaction between the weather mentioned in the statement:

rain	(6, 1)

and the weather associated with the month of July:

heat	(7, 5)
blue skies	(6, 3)

It finds that the two sets of weather parameters are in:

essential disagreement.

Now the program must choose a reply frame. It notes

that the original remark is characterized by:

weather	(rain)
emotion	(dislike)
calendar time	(July)
statement	(period, not question-mark)

and that the interaction gave a result of:

disagreement

In the computer's memory there is a reply frame corresponding to this particular combination of qualities and interactions. The program then selects this frame, which happens to be this:

> "Well, we don't usually have ——— weather in ———, so you will probably not be disappointed."

This contains two blanks. The program then proceeds to fill in the blanks with words originating from the remark, environment, or machine's preferences. In this case the reply would then be:

> "Well, we don't usually have RAINY weather in JULY, so you will probably not be disappointed."

Some More Examples

First, we instruct the machine with its current preferences and current experience by the statement:

> Remember this month is August. Today we had rain and severe heat. Yesterday it was sunny and hot. Tomorrow will be cold and cloudy. That is all.

Then for various remarks by the observer O, the machine M replies as follows:

O: Did you enjoy the rain we had this afternoon?
M: Not really, what I like is sunny weather.
O: In hot weather one needs at least one bath every day.
M: Yes, I was just out and it was sweltering.
O: When Christmas comes we will have some colder weather.
M: Cold? Yes, it's usually pretty frosty during December.
O: Today is clear weather. Will it last?
M: Let me have no lying. It becomes none but tradesmen. Now how can overcast weather and the clear day you mention coexist?
O: Do you think atomic weapons testing affects the weather?
M: Your query is an interrogation of no consequence to me. However, how do you feel about today's rain?

An example of an error caused by the present model is:

O: Can you tell me what the weather is like?
M: Well I like sunny weather, not the rain we are having today.

Here the computer has incorrectly interpreted the word "like" to mean "prefer," and so the reply does not adequately correspond to the real meaning of the original remark.

Statistics on the Program

Some statistics on the second preliminary program, as it is at present, are as follows:

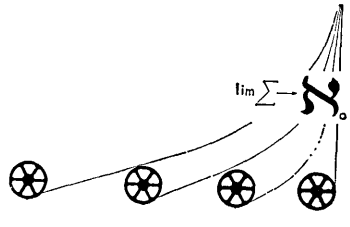
1. Number of instructions in the program: about 800
2. Number of decisions in the program: about 200
3. Number of words in the machine's recognition vocabulary: 319 but can be easily increased
4. Number of reply frames from which the machine can choose the form of an answer: about 350, but can be easily increased
5. Number of words (referring to weather, place, and time) that the machine uses to insert into blanks in the reply frames: about 75 but can be easily increased
6. Number of parameters of meaning about which the machine can react at least partially (such as temperature, humidity, precipitation, wind, month of year, relative time, place, emotional preference, etc.): 17
7. Time required to generate a reply: about 20 seconds

Limitations of the Present Program

The mathematical model on which the present program is based contains only very limited recognition of many parts of English syntax. For example, there is no recognition of subject and predicate; nor does it distinguish between nouns, adjectives, and verbs. In spite of this crudity, the results in passable conversation are surprisingly good, which in a way is a commentary on the shallowness of ordinary conversation about the weather. An unsettled problem is how little additional syntax one would have to include so that the program would plausibly imitate a man.

CALENDAR OF COMING EVENTS

Oct. 5-7, 1959: 5th National Communications Symposium, Hotel Utica, N.Y.
Oct. 12-14, 1959: International Systems Meeting, Royal York Hotel, Toronto.
Oct. 12-14, 1959: 15th National Electronics Conference, Hotel Sherman, Chicago, Ill.
Oct. 28-29, 1959: 6th Annual Computer Applications Symposium, Armour Research Foundation, Chicago, Ill.
Oct. 28-30, 1959: 2nd Annual Equipment Systems Conference and Exhibit, Conference Building, San Diego, Calif.
Nov. 4-6, 1959: National Automatic Control Conference, Sheraton Hotel, Dallas, Texas.
Nov. 11-13, 1959: 16th National Meeting, Operations Research Society of America, Huntington Sheraton Hotel, Pasadena, Calif.
Dec. 1-2, 1959: 4th Midwest Symposium on Circuit Theory, Marquette Univ., Milwaukee, Wisc.
Dec. 1-3, 1959: Eastern Joint Computer Conference, Statler Hotel, Boston, Mass.
March 21-24, 1960: IRE National Convention, Coliseum and Waldorf Astoria Hotel, New York, N.Y.
May 2-6, 1960: Western Joint Computer Conference, San Francisco, Calif.



SOME IMPORTANT APPLICATIONS OF COMPUTERS

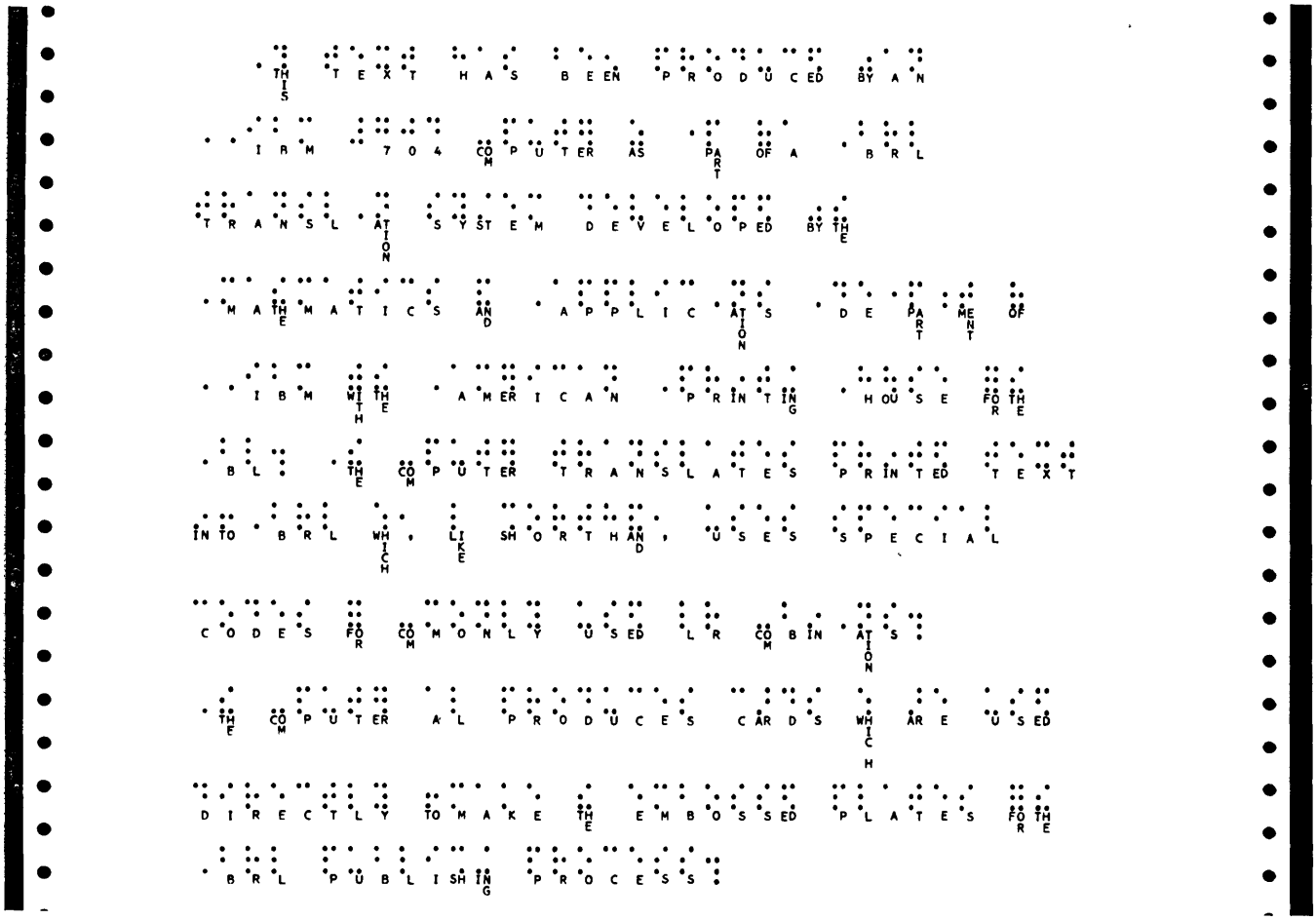
BRAILLE TRANSLATION

Translation of printed text into braille at electronic speeds is being accomplished with an International Business Machines Corp. electronic computer.

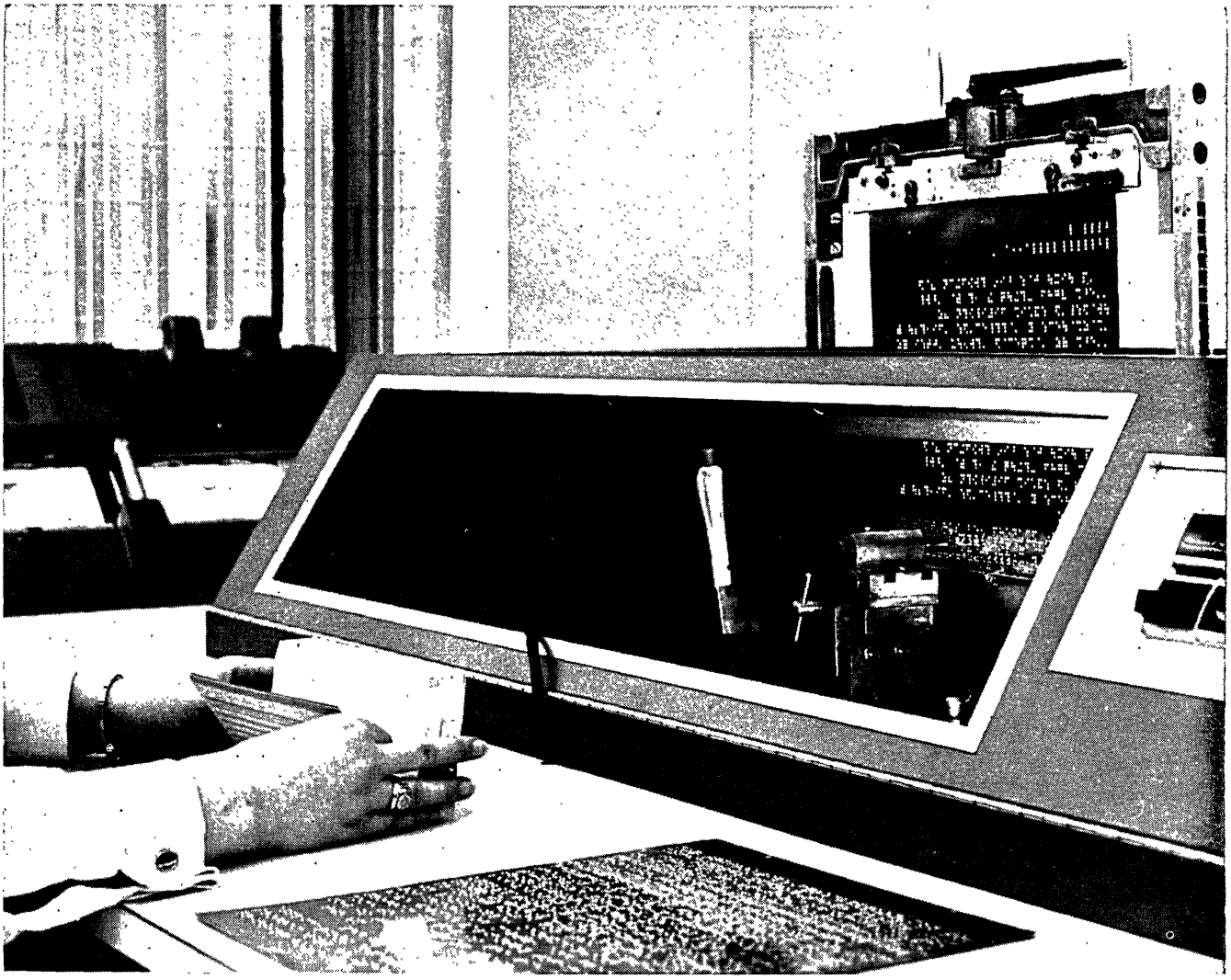
The procedure creates in minutes an embossed braille printing plate suitable for production of books for the nation's 350,000 sightless persons. It was developed by IBM mathematicians working in conjunction with the American Printing House for the Blind, leading braille book publisher.

The English-text-into-braille program will compensate for the serious shortage of qualified braille translators, whose training normally takes two years. A knowledge of braille by computer personnel is unnecessary.

The new method of creating braille was developed for a standard IBM 704 data processing system, a large-scale computer which has been installed in many industries to handle complex scientific and engineering problems. The 704 can translate a 300 page book into Braille in an hour — a job which would take more than six days for a skilled translator.



This sample page was produced by a computer translating English text into braille symbols. The braille equivalent appears directly above the English text; this makes it possible to edit the copy without having a special knowledge of braille.



This braille embossing machine is linked to a punched card reading device, and makes it possible to produce automatically the metal plates used to print braille books. The punched cards containing the braille language are prepared directly from the punched English text by an IBM 704 computer at high speeds.

Texts to be translated by the computer are first transferred to punched cards by means of a key punch with a conventional typewriter keyboard. The cards are then fed directly into the computer, which has had previously stored in its memory a program expressing the rules for conversion into braille. The machine executes as many as 600 instructions per word in less than the fortieth part of a second. The computer determines contractions and abbreviations by matching against an alphabetical table of braille equivalents.

The translated text emerges from the computer in coded symbols on punched cards, and these, in turn, are fed to a printer which reproduces the braille symbols above the English text for editing purposes. After editing, the corrected deck of punched cards is fed to an embossing machine, which creates metal plates for use in a rotary printing press.

SIXTY SECONDS FROM ENGINE TESTING TO FINAL EVALUATION

Roger E. Holmes
Consolidated Electrodynamics Corp.
Pasadena, Calif.

The only product of a cell for testing a jet or missile engine is data (raw information). Systems of equipment have been built to acquire a maximum of data from a test, to convert it into numerical values, and to record these values on magnetic tape for eventual input to a digital computer.

At this point, in many cases, engineers have been forced to stop; stop short of the goal in rapidly acquiring this data, which is to improve the performance of the engine being tested: they stop because of waiting for the computer's results.

In order to accelerate the flow of data, a new system called a "High-Speed Automatic Data Recording and Monitoring System" has been designed and built: it processes as well as acquires data from engine test cells. A small general-purpose computer is an integral part of the system. The system was built by Consolidated Systems Corp., a subsidiary of Consolidated Electrodynamics.

This new system is in use at Pratt and Whitney's Florida Research and Development Center, and the entire operation from acquisition of data from an engine test to final computed results takes only 60 seconds. As a result, research and development engineers can make immediate decisions from the final results even while the engine is still running. Accuracy and flexibility are other advantages of including the computer in the system.

MORE ADEQUATE SELECTION OF CANDIDATES FOR JOBS

An electronic data processing system has been installed in Randolph Air Force Base, Texas, for the Air Training Command, with its main assignment the more adequate selection of personnel. The computer has been programmed by the ATC Statistical Services group for this purpose. Screening of hundreds of records can now be accomplished in minutes.

For example, three people may need to be selected for assignment to a certain job. ATC personnel "asks" the computer for the 10 people in the command most qualified for such a position. The information necessary to answer this question, consisting of records for each officer, airman, and civilian in the command — are maintained on magnetic tapes which store assignment preferences, additional and potential skills, technical, flying, or professional training completed, and many other types of information. Each individual record is updated daily.

From this store of knowledge, the computer, a Burroughs Datatron 220, seeks 10 people eligible for the job ATC Personnel desires to fill. In a short time, 10 names are produced, together with their pertinent background. A selection board of human beings may then be designated to select three people out of the 10 for the assignment.

Much the same program may be used to fill promotions, quotas for overseas duty, assignments to schooling, etc. In addition to these personnel operations, the computer will soon be given other jobs, such as maintenance of records on aircraft, materiel, and vehicles.

The 220 at ATC is one of the largest of the Datatrons yet installed. It includes a 100,000-digit magnetic core memory, and eight magnetic tape auxiliary storage units, with a total storage capacity of approximately 112 million digits.

ALL DAILY WORK FOR BANK CHECK ACCOUNTING

All daily bookkeeping tasks for 220,000 checking accounts at 60 branches of the Bank of America in the Los Angeles, Calif., area have gone on to electronic data processing machinery, as of September, 1959. The system being used is the production model of ERMA, now called the GE 150 and GE 210 systems (ERMA is an abbreviation for Electronic Recording Method of Accounting). The system uses magnetic character reading. It is manufactured by the General Electric Computer Department, Phoenix, Arizona.

The system reads checks, sorts them, and posts 550 accounts per minute. By comparison, an efficient bookkeeper with a year's experience, can sort and post to about 4 accounts per minute.

The system processes and records all of today's checking transactions before tomorrow's banking begins. The Bank of America expects that at least 13 ERMA centers will be operating in California by the end of 1961, serving its 463 branches, and more than 2 million accounts.

ERMA comprises essentially a document-handler, an electronic computer which controls the entire system, a control console, tape units for storing information, a printer, and other input and output peripheral equipment. The printer, through directions from the computer, prepares customer and branch-bank statements at the rate of 900 lines per minute, or about 50 complete statements per minute.

The system is completely transistorized. The magnetic character reader can handle and read folded, mutilated, spindled, and overstamped checks and deposit slips.

The checks used by the Bank of America are similar to conventional checks, with one exception — stylized numbers are imprinted in magnetic ink across the lower edge. Numbers are in Arabic numerals, running from 0 through 9, and can be read both visually and by ERMA. They are imprinted in a special type font, developed by General Electric and standardized by the American Banking Association. Code numbers represent the issuing bank's number, routing symbol, and identifying data such as branch number and account number.

The system operates as follows:

1. The customer writes a check which has been preprinted in magnetic ink with ABA number and account number;
2. The check is presented to the bank, and the dollar amount is registered by a bank clerk in magnetic ink during the proofing operation;
3. The check is fed through the document handler, read by the magnetic character reader, and the information transmitted to the computer.
4. The computer performs some checking of the information, and sorts at a speed of 30,000 decimal digits per second, recording the information from the checks in account-number sequence;
5. The sorted information is compared with information in the customer's record, and the new account balance and the check amount are recorded in the customer's file;
6. While the customer account is being posted the check is sorted off-line on the document handler and goes to a customer file;
7. The high-speed printer produces a statement for the customer, showing all transactions and the current balance, either at the end of month or upon request;
8. As ERMA-sorted checks are filed, the signatures are compared with checks previously filed.
9. The cancelled checks and statements are sent to the customer, usually once a month.

SANTE FE RAILWAY RESERVATION SYSTEM

The process of obtaining a railroad reservation has long been an irritating and frustrating part of railroad travel. This problem has been a source of concern and the subject of study by many of the country's leading railroads, but relief is now at hand through the help of modern electronics.

In July the Atchison, Topeka and Santa Fe Railway put into service an automated electronic system for handling its passenger reservations. This combination data processing and communications system enables Santa Fe reservations personnel from Los Angeles to Chicago to make reservations for customers in a matter of seconds instead of hours or even days as has been the case in the past. The system is called the Magnetronic Reservisor and was designed, built, installed, and is maintained by The Teleregister Corporation of Stamford, Connecticut.

This "push-button" train reservation agent's set automatically clears and reserves Pullman space and chair car seats in a matter of seconds. It is in operation in five major cities served by the Santa Fe Railway: Chicago; Kansas City, Mo.; Fort Worth, Tex.; Los Angeles; and San Francisco. The agent's set can handle eleven separate types of transactions.

This equipment will process for Santa Fe Railway's sales agents all standard railroad accommodation transactions: (1) reserving the accommodation; (2) selling the accommodation and removing it from the inventory; and (3) cancelling previously made reservations when necessary. Agents perform these transactions through a piece of equipment not much larger than a typewriter, which produces a duplicate printed record of each transaction including a complete identification of the train space involved. This information includes the date, the train number, the car number, the particular seat, drawing room or bedroom number, and a customer's identification number.

Each of the Santa Fe agent sets is connected through specialized communications equipment and over a network of leased lines to the center of the Magnetronic Reservisor which is located at LaSalle Street Station, Chicago. This is the data processing center for all of Santa Fe's reservations information. It consists primarily of two magnetic memory drums and some forty-odd racks of computing and communications equipment. This is capable of keeping track of a total of 148,000 accommodations for any period up to 6 months prior to train departure date. This equipment is also capable of handling a reservations transaction originated in one of the agent sets in approximately a half second.

In addition to the standard accommodations transactions, the system provides the Santa Fe with the following services:

a. Cushion Control—provides advance warning when available space is critically low.

b. Priority Control — provides for systematic selling of available space, in response to random requests, at any time and in any sequence desired by management.

c. Wait-list Control — keeps a record of requests for which there is no space available so that the first cancellation can be given to the first person on the waiting list.

d. Expiration and Cancellation Control — When the agent reserves space, he informs the customer that the ticket must be picked up and paid for by a certain date and time. In the event that the customer fails to pick up the ticket before this expiration time, the Reservisor automatically cancels the reservation, making it available for another passenger.

e. Records Display — provides for printed records of any of the sales information or data stored in the machine to be quickly available to railroad management. This information is automatically arranged by the machine in the most convenient and useful manner, such as passenger lists for conductors (called consists), a count or list of transactions for each train car, a count of all the transactions by each agent, and many other important reports and statistics.

The Reservisor is in service seven days a week, 365 days a year, and is only taken off line for testing and maintenance routine during certain hours in the early morning when there is virtually no traffic. The data

processing equipment is designed for rapid and easy maintenance by the use of plug-in elements which, when they require replacement, may be removed and changed in a few seconds. Dual facilities are provided for critical functions so that one piece of equipment constantly double-checks the performance of its opposite number; also, if one rack has to be taken off line for maintenance, its dual counterpart carries on the functions by itself.

CASUALTY INSURANCE ACTUARIAL CALCULATIONS

An electronic computer in use in the National Bureau of Casualty Underwriters, New York City, is devoted almost entirely to actuarial calculations — the development of rate revisions, the development of actuarial tables, and research problems. The Bureau serves as a statistical and rate-determining agency for casualty insurance companies located throughout the country. The computer is the 300th LGP-30 put into operation since the equipment was first marketed in 1956 by Royal McBee Corp.

More than forty million punched cards are received annually in the Bureau from member and subscriber companies, reporting premium and loss data. The experience is checked, sorted, and summarized by statistical categories such as year of coverage, class, and territory, so that a meaningful analysis can be made. The electronic computer analyzes this summarized experience.

For example, in revising liability rates on private passenger automobiles, the computer determines trend factors, rate of level changes by territory, final rates by classification, and a comparison of present and proposed rates.

In the case of the trend factor calculations, the input data consists of the average claim costs for five years for each state, which represents five points on a trend line. A line of best fit is computed by the least squares method and projected to 18, 21, and 24 months in the future. Trend factors, equal to the projected figures divided by the latest year's least square value, are computed for each state and the country as a whole. The trend factors represent the estimated increase or decrease in average claim costs in the future months when new proposed rates will be in effect.

RAY TRACING IN A CASSEGRAINIAN OPTICAL SYSTEM

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A cassegrainian optical system consists of two reflectors arranged in such a way that the secondary or hyperbolic reflector intercepts the rays coming from the primary or parabolic reflector before they reach the focus. These rays are then sent through a hole in the primary reflector to the focal plane of the combination.

The problem is to determine the best geometry for such a system: the optimum sizes and focal lengths of the reflectors.

In a recent case of ours, the project manager for the development of this system placed limiting restrictions on the following items:

1) Aperture of the primary reflector;
2) Maximum overall size of the container;
3) Off-axis image size.

The method to be used was to trace extreme light rays through the double reflection to the focal plane, using systematically varied values for focal length, spacing and the diameter of the secondary reflector. The combination of paraboloid primary and hyperboloid secondary is exactly right for sharp focus on the axis, as a person who has studied conic sections knows. But the problem was to compute the total off-axis aberration as a function of the system geometry. This computation has been made in the literature of reflecting telescope design, with the results of suggesting some fourth-degree curves for the mirrors (Ritchey or Schwartzschild) which improve off-axis performance enormously at small cost in axial image blurring. But the number-juggling ability of a computer is such that the easiest approach to the design figures wanted here was to trace the rays to intersection with the secondary reflector, compute incidence (and therefore reflection) angles and then compute points of intersection with the focal plane, just as if the problem had never been considered before.

This was done by computing components of the direction vector v of a light ray striking an optical surface whose normal direction vector is n from an original direction vector u. Thus the machine did hundreds of calculations of the type $v = u - 2u \cdot (n\,n)$, where $n\,n$ is a dyadic which is a special type of tensor.

Location of reflection points was simply a matter of solid analytic geometry, which the IBM 650 handles with ease. If a ray starts at some point P_1 (x_1, y_1, z_1) and intersects the secondary reflector at P_2 (x_2, y_2, z_2) then the machine resolves compatibility between:

$$x^2/a^2 - (y^2 + z^2)/b^2 = 1$$

and $d = (x_2 - x_1)/x' = (y_2 - y_1)/y' = (z_2 - z_1)/z'$ where d is the distance from P_1 to P_2 and x′, y′, z′ are direction cosines of the ray direction. Similar computation locates the point of intersection with the focal plane. A sufficiently large number of points P_1 had to be used for each mirror geometry to be a good sample of primary coverage since it is not necessarily true that the extreme incident rays end up defining the boundaries of the focal spot.

Actually, many test cases were computed and by using the results obtained from one test, a new and better guess was made for the next test, until a result was obtained well within the limiting specifications.

The mathematical and physical principles involved in this problem were not difficult; however, the volume of computations necessary to define this system was very large and this method could not have been used if it had not been for the powers of the digital computer.

AUTOMATIC MACHINING OF PARTS WITH TWO-AND THREE-DIMENSIONAL CONTOURS

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A numerical-control tape-preparation system has been operating which automatically prepares control tapes for two- and three-dimensional contour machining of parts composed of straight lines, arcs, circles, and free form or point defined curves.

This system is a digital computer system designed especially for numerically controlled machining operations. It takes in dimensional and machining information from engineering drawings, and puts out a coded punched control tape for direct control of machine tools. This system has been used to prepare machine control tapes for machining intricate three dimensional parts containing pockets, flanges, tapers, contours, and grooves. Such parts include turbine blades, intricate cams, molds, forging and stamping dies, templates, integral panels, forged fittings, etc.

The equipment required in this system for producing a control tape includes: a prepared form, caled a process sheet; a flexo-writer with a tape punch; a Bendix G-15D general purpose digital computer; and a set of computer programs.

Computer Program for Automatic Control

Starting with a drawing of the part which has all dimensions given in the form of conventional rectangular coordinates referenced to a set of axes, or in some cases, a mathematical description, a process sheet is prepared.

The process sheet lists the coordinate dimensions of the part in the desired cutting sequence, along with such information as machine feed rates, cutter diameter, and tolerance. Coordinates at the end of each straight line section must be entered. For circles and acres of circles, only radii and end points of arcs need be specified. The computer will approximate the arcs by a series of straight lines (chords) to the accuracy specified in the tolerance entry.

The process sheet is then reproduced on a special typewriter (Flexowriter) which simultaneously prepares a punched process tape and condenses information from the process sheet into a form suitable for use as input to a computer. Verification of process tape accuracy is accomplished by inserting it in a tape reader unit attached to the typewriter. A second transcription of the process sheet is then made to produce a second process tape. If the two codes compare, the tape punch will operate and punch a verified second process tape. If the codes do not compare, the punch will not operate and the operator can then locate the error. Thus, the second tape is verified tape and will not contain any transcription errors. The verified process tape is then inserted into a reader that operates in conjunction with the computer.

The process tape is read by the computer which automatically produces the control tape in the form required for machine control.

The computer will: (1) calculate cutter center loci, (2) interpolate curve sections to provide intermediate points defining a continuous cutter path, (3) resolve specified feed rate into required speeds of the individual machine slides, (4) translate decimal input information into binary coded form, and (5) generate parity checking information. The interpolation function performed by the computer establishes the required spacing of intermediate points on curved sections in accordance with the tolerance specified on the process sheet.

Since the cutter path between the sequential points on the control tape will be along a straight line, the spacing of points will vary continuously so that the deviation from the desired curve will always be sufficiently small to satisfy the tolerance and surface finish requirements.

A tooling or process engineer can be trained to use this system in less than a week.

PREDICTING THE SOUNDNESS OF FOUNDRY CASTINGS

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Of continuous concern to foundrymen is their ability to make castings free of defects such as shrink cavities. In the past, sound castings have usually been obtained by application of empirical techniques. However, the use of this approach has become more difficult as the casting art has been asked to deal with more complex situations; for example, the casting of high-purity metals requires enclosure in a vacuum tank, and in this case it is difficult to use such techniques as "pour-out" in order to determine the location of the solidification front at various times — the movement of this front determine whether or not shrink cavities will form.

Now a solidifying casting changes its state from liquid to solid by losing heat. Therefore analysis of the movement of the solidification front is possible by determining the heat flow, and the resulting isothermal patterns in the casting at succeeding time intervals. Previous analysis of this problem has applied classical techniques. But these were necessarily restricted in scope because of the simplifications required in order to obtain a solution in closed form. Passive network analyzers have also been used, but the complexity of the problem requires the use of an undesirably great number of high-precision components in the experiment.

By representing a casting and the associated mold with a series of small cells, it has been found possible to use finite-difference techniques to describe the heat flow, and the resulting solidification patterns, in a casting. This technique represents an extension of previously used manual methods, which were however severely restrictd in application because of the length of time required to obtain a solution. By using an IBM 650 computer it has been found feasible to include many factors that were previously ignored and at the same time cut down the length of time required for a solution. This has made it possible to obtain solutions that have shown excellent correlation with experimental work conducted concurrently to check the validity of the mathematical model.

By using the model and the computer it is now possible to predict the effects of changes in casting procedures upon the soundness of the casting, and this analysis is being used to replace costly experiments.

The present model is regarded as a first step in the use of digital computers as an aid to foundrymen. It is expected that more sophisticated models will be developed for more complex studies of foundry castings.

COMPUTERS SIMULATING MEN

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Both men and aircraft have been simulated on digital and analog computers by Minneapolis-Honeywell in studies to determine human ability to control devices ranging from a single push-button to a complete space ship.

The computer technique may be termed "robot psychology"; the use of computers has speeded up exploratory research by eliminating the variability of real men.

The most important aspects of controls which men use appear to be those concerned with the dynamics of the control and of the control display combination rather than the particular location, shape and size.

Some of the study has been devoted to human abilities in the control of aircraft.

Although a great deal of prior research has been carried out in the study of human behaviour, many of the results are not in a form adapted to the design of actual systems and control devices. So a large part of the current study has been to examine, classify and evaluate data, and try to bring them into a coherent form leading to a general solution of the problem of human control.

Among the studies which have been carried out was an experiment on the behaviour of systems guided by "model" pilots. Both the man and the aircraft were simulated on a computer and the effect of variation in both human and machine parameters measured.

Although this particular kind of "psychology" deals with synthetic men rather than real men, it can produce results which apply to the control of aircraft by real men.

Experiments can be done rapidly and without the variability introduced by real subjects. After such "robot psychology" has been worked out, the limits are known within which it is likely to be profitable to study the behaviour of real men.

FLOOD CONTROL BY COMPUTER

The U. S. Army Corps of Engineers is now assessing rainfall electronically. By using a computer for one of the nation's flood-control areas, the Ohio River Basin, hydrologists can take in rainfall data, predict rising water levels, and calculate the re-routing of water from over filled tributaries.

The Corps of Engineers' Ohio River Division, based in Cincinnati, calculates a typical flood routing problem in five minutes with the E101 Burroughs computer, whereas prior methods would require 75 minutes.

Flood routing is the procedure used to advance a flood wave downstream from point to point, modifying it by the effects of the channel and addition of tributary inflow.

Computational methods for routing vary according to the basin. A process known as the Muskingum Method is employed in the Ohio River Basin. Using a simple mathematical formula, the computer determines when a flood, either known or predicted, can be routed to downstream points for maximum dissipation.

Other computations are used by hydrologists to convert rainfall over an area into flow in the stream draining that area. It is, in effect, a means of determining from the current season's rainfall, and from historic measurements, how high the waterflow will be.

For example, if through their computations hydraulic engineers find that the March rainfall may produce rivers swollen enough to produce flood conditions, the information is relayed to flood control experts who take preventive measures — re-routing, banking, etc.

AUTOMATICALLY SHAPING NONCIRCULAR GEARS

Cunningham Industries, Inc., Stamford, Connecticut has developed a program for the Royal Precision LGP-30, marketed by the Royal McBee Corporation, which makes possible automatic design and production of noncircular gears.

Input consists of coordinates of points describing a mathematical function. Output is a punched paper tape which can be used as direct input to a gear shaper to control automatically the shaping of a pair of gears.

No separate equipment for input data tape preparation is needed since a modified electric typewriter that produces punched paper tape is part of the LGP-30 computer.

On more limited computing equipment, the solution of the whole problem required four programs whereas with the LGP-30 it requires only one program.

RESERVOIR FILLING

An IBM 650 computer was used by the Colorado River Board of California to produce in 56 seconds a complicated water and power study over 36 years of observations that would have taken three engineers more than six months to compute with "paper and pencil" methods. The need for the computer's study of the river flows and other important data was created by the building of the gigantic Glen Canyon reservoir on the Colorado River. The 650 study was used by the Board in determining the best way to fill the 180-mile-long reservoir for the dam so that water and power supplies for Southern California, Arizona, and Nevada would not be adversely affected.

SEA RESCUE OPERATIONS

A dramatic application of a RAMAC 305 has been made by the U.S. Coast Guard. This machine is installed in the Eastern Area Command headquarters in New York City, and is being used to expedite search and rescue operations in the North Atlantic Maritime Region, which also includes the Caribbean Sea and the Gulf of Mexico. Each day the computer charts the course for all merchant vessels in this area, regardless of nationality. In case of emergency, the latitude and longitude of the ship in distress is entered in the computer. The IBM RAMAC 305 will then automatically determine which ships are in the immediately surrounding areas, so that the best situated ships can be contacted and requested to participate in rescue operations.

WEATHER FORECASTING

An IBM 705 in Asheville, N.C., makes available long-range climatological studies. Vast quantities of weather information are condensed on coded tapes and stored in the machine's memory. When a particular weather problem for some area comes up, a run on the 705 will quickly deliver a detailed analysis of the problem. The computer has been used to plan many long-distance military flights.

At Suitland, Maryland, the Weather Bureau in cooperation with the Air Force and the Navy has perfected a program for computing the weather on an IBM 704, based upon radio reports from around the world. In devising this program and checking its results, many long-held theories about the weather were found to have no real effect on the computer's predictions, and therefore have been dropped or changed. The present weather map, which is printed daily by the 704, is considered to be 15% more accurate than any map weather map made by human beings, and is now the only weather map used by the Air Force and Navy for weather forecasting.

THE HUMAN FACTOR in today's technology

Scientists have long been preoccupied with the technological problems of Man and the Machine. The increasingly complex nature of advanced systems has created an urgent need to enhance man's contribution to effective systems performance. The complicated nature of this relationship requires the skills of psychologists, social scientists, mathematicians, and engineers.

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Machine Translation Methods, And Their Application To Translation From English To Russian

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(Based on a portion of a paper given at the International Conference on Information Processing, Paris, France, June, 1959)

RESEARCH in methods of machine translation was started in the Soviet Union late in 1954 on the initiative of Academician A. S. Nesmejanov, President of the USSR Academy of Sciences. The first experiments in machine translation (MT) from English into Russian were carried out in December, 1955.

Since then considerable progress has been made towards adequate formulation of the method to be used. We can now say that a second stage of the research has recently been completed showing that the suggested methods are of general applicability. For demonstrating this, these methods have been extended to cover MT from languages differing greatly from English in structure, such as Japanese, Chinese and German.

In regard to the MT methods for translating from English to Russian, the research has reached a third stage in which: (1) complete grammatical analysis on a bilingual level takes place; (2) rearrangement of the most important types of English idiomatic constructions is accomplished; (3) grammatical modification of the Russian translation is performed by an independent set of routines, which have been termed Russian Synthesis.

In addition, in the field of applied mathematics, the volume of words now entered into the MT dictionary has considerably increased. More than 2000 words are stored in the English section of the multilingual MT dictionary; a still greater number of Russian equivalents is stored in its Russian section. The dictionary thus covers many different areas of applied mathematics.

To complete this stage of research a large-scale experiment on the Anglo-Russian MT methods has been carried out. One hundred samples (which amounted to 3000 sentences) of "unknown text" were selected at random from different English authors, and translated manually into Russian in strict accordance with the instructions provided by the MT dictionary and the translating routines. The ten persons chosen to carry out the experiment had no knowledge of English nor had they any previous experience with the task required.

This experiment showed that the scheme appears to be very effective at dealing with all sorts of texts so long as they are restricted, lexically, to applied mathematics. Grammatically no limitation as to type of the written text has been found necessary. One or two words per printed page is the average for "unknown" words with the present-size dictionary. This makes the translation quite adequate for understanding.

For this reason, as well as for reasons of preserving the proposed series of MT dictionaries strictly specialized as to field, we are not inclined to increase the volume of words in the present dictionary, but intend rather to proceed with compiling medium-sized (say, 2500-3000 words each) dictionaries for various fields. This indeed will be our occupation at the next stage of research.

Translating routines for Anglo-Russian MT being the final achievement of the recent research, it seems reasonable in the present report, to lay particular stress on a description of translating routines for vocabulary and grammatical analysis of the English sentence.

Applicability of MT Methods

The two most general MT questions are: is it possible to translate by machine? is it practical? The former question has already been answered, both theoretically and practically. The latter question still remains open for discussion. The objective of our present stage of research is to prove the applicability, the practicality of MT methods to any sphere of language.

To date, only within the limited sphere of scientific writing has the applicability of MT methods won general recognition. As to other uses of MT, most machine translators are inclined to feel very doubtful.

However, the majority of restrictions imposed on MT application, when analyzed, turn out to be due to a very strong inclination on the part of investigators to describe the translated language (source language) in terms of correspondence with some other system, say, another language, or a group of languages, or a science other than linguistics, especially particular logics or particular fields in mathematics. The possibilities of MT are discussed then as dependent on common elements in the compared systems. These elements may be more or less numerous, yet absence of complete correspondence between the systems, which is usually the case, inevitably brings about limitations of the scope of MT. Thus, application of machines to translating literary works of art has more than once been declared to be absolutely ruled out.

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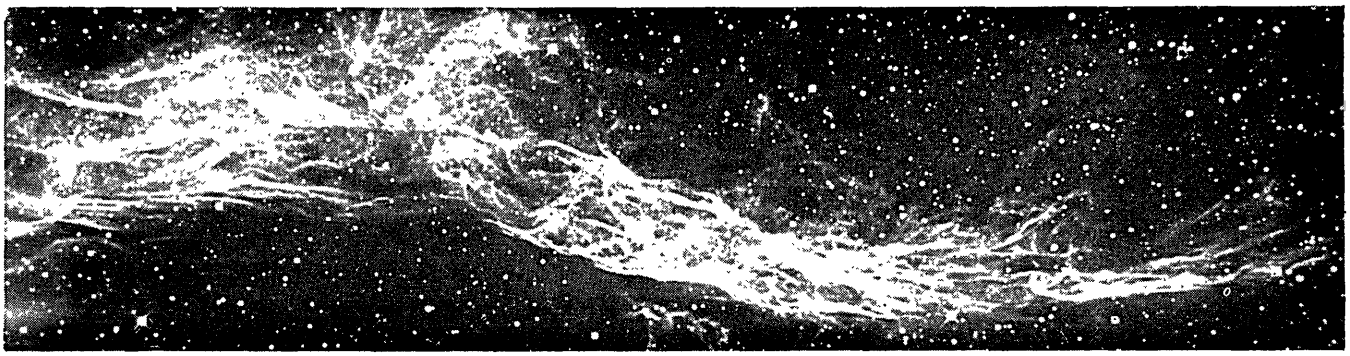

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[Continued from page 20]

In our opinion, it seems very reasonable to expect that these limitations can easily be eliminated, if the problem is formulated in a different way: namely, is it possible, within any existing language, to give formal description to any of its multiple spheres of use, individual as they may seem?

This is the same question as asking if the applicability of MT depends on whether it is possible to identify the implicit set of rules governing this or that particular sphere of language — perhaps as narrow a sphere as, say, Wordsworth's poetry, and, asking whether these rules can be formulated into a formal set.

It is our opinion that every piece of writing (insofar as written language is discussed) can be analyzed along these lines within the sphere where it belongs, and a set of rules for such analysis can be laid out. It is essential that these rules should be formal everywhere. Yet this is no obstacle either, since language is but a formal system of specific character developed by human beings to express and communicate their mental activities. If this is true, problems posed by stylistic peculiarities of literary works of art can be satisfactorily resolved, if treated along the lines suggested above, i.e., within the sphere where they belong.

In this light, the supposed "principal informalizability" of poetry should be rejected. On the contrary, poetry, as indeed any piece of literary art where formal elements are of no minor importance, would be particularly susceptible to machine translation in this sense.

Our opinion has been partly justified on empirical evidence, that is, by experimental translation of passages from Charles Dickens, J. Galsworthy, J. Aldridge, and Edgar A. Poe. It is our firm belief that further investigations will completely eliminate the restrictions now generally thought to cover MT application.

Finally, an adequate description of a language, or of any particular sphere of it, should aim at establishing within the language or sphere, a set of correlations of linguistic means with linguistic effects, i.e., of words and other linguistic devices with their meanings, their content, their denotation.

Taken in its most general sense, the translating problem is then the problem of equating these correlations in one language with those in another.

It seems to us that MT prerequisites do not rest upon the existence of common basic elements in languages, as is often pointed out, but rather include the following two factors:

(1) Language in itself is only a system of formal means by which communication of meaning is effected;

(2) All existing language systems are so developed as to express in their particular ways various shades of meaning as well as various emotional effects.

To refer again to our correlation, this is the same as asserting that the number of "effects" in any two languages is equal. This assertion makes the corresponding systems of "means" fully comparable, through their "effects."

Since language systems are formal, any application of them can be provided with a description programmable on a machine.

A Short Outline of the Translating Routines

The general procedure covered by the translating routines we have worked out can be classified into three independent steps, these being:

1. Vocabulary Analysis of the source language, for which purpose the MT dictionary and a set of **Dictionary routines** are used;
2. Grammatical Analysis of the source language, for which purpose **Analysis routines** are devised;
3. Grammatical Synthesis of the target language, for which purpose the same set of **Synthesis routines** is applied to the texts translated from different source languages.

To make the outline concrete, the translating routines will be further described in their Anglo-Russian realization.

Dictionary Analysis

Dictionary Analysis of the English sentence starts with searching in the MT dictionary for every word of the text. The first dictionary routine to be used here is that of transforming words of the text into the standard forms listed in the MT dictionary.

Thus "wanted" will be transformed into "want," "stopped" into "stop," "coming" into "come," "lying" into "lie," "copies" into "copy," "bigger" into "big," etc.

When the dictionary search is completed, another routine is applied which deals with the words that for various reasons have not been found in the dictionary. These are termed, "unknown words," because their lexical equivalents remain unknown throughout the translating procedure. Yet, for the "grammatical analysis" routine to be applied later, grammatical qualification of the "unknown words," must be obtained.

It is impossible to foresee every word in every text of a language or even in one of its particular spheres, since some of the words may be occurring for the first time in the language, not to mention quite a number of more trivial reasons.

However, the "unknown words" do not affect the translation greatly, if they have been classified grammatically. To meet the latter problem, a very important routine, that of classifying "unknown words" into "parts of speech" has been devised. In this routine extensive use is made of the morphology and syntax of these words.

Another category of sentence constituents which undergo preliminary grammatical analysis in accordance with a dictionary routine, are the so-called "formulas," by which we mean various symbols used in different sciences. The syntactical function of every "formula" in the sentence is defined in accordance with a special routine.

So much for the words and symbols not found in the MT dictionary.

In addition to lexical equivalents, words found in the dictionary are provided with information (termed "invariant characteristics") which is partly grammatical and partly semantic. The "invariant characteristics" obtained from the dictionary distinguish between final and preliminary information. Information is considered final for the dictionary routine when the lexical equivalent of the word is included. Information is preliminary when it is restricted to the indication "homonymous" or "polysemantic."

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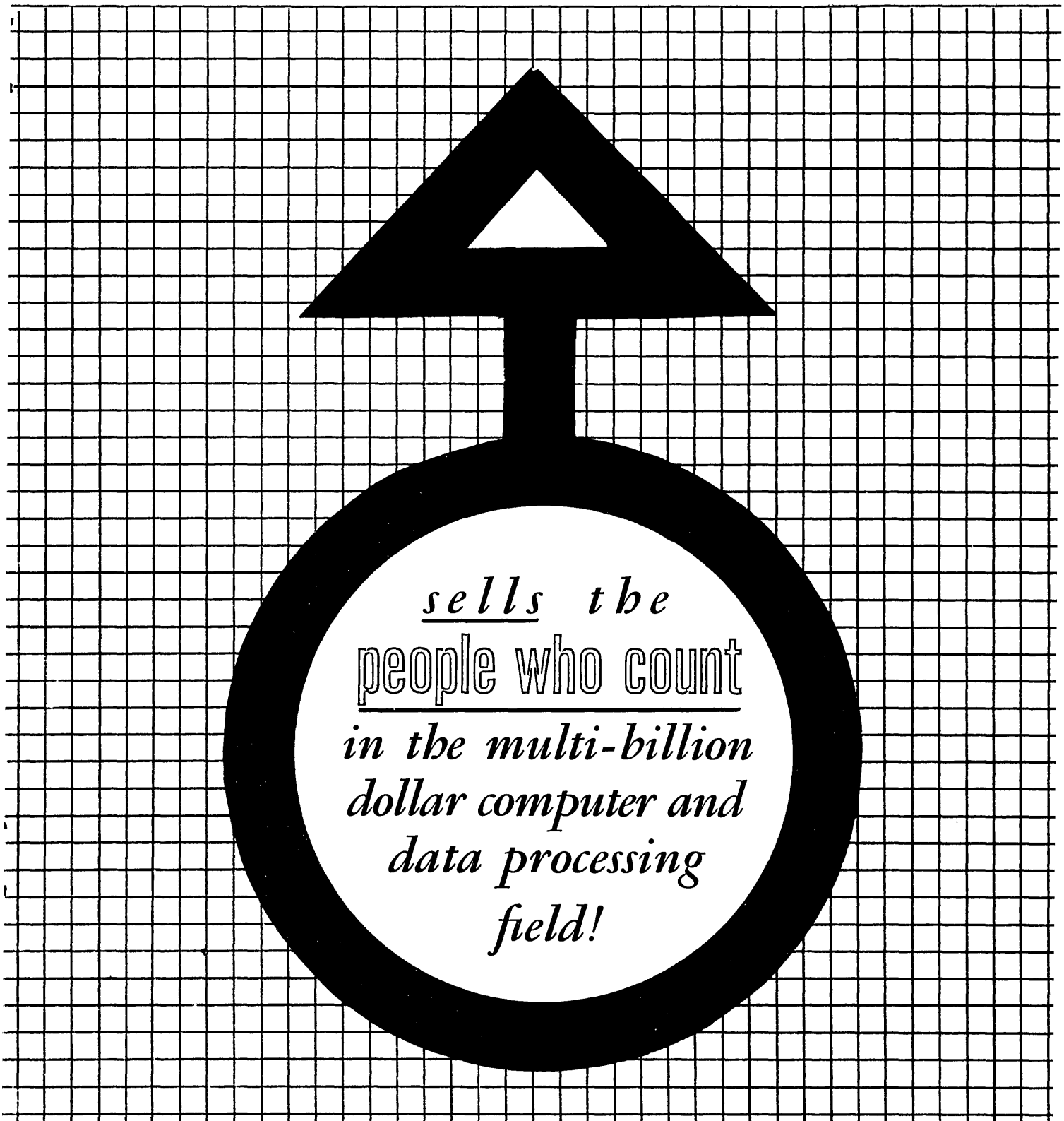

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- Author of "Giant Brains or Machines that Think", John Wiley and Sons, 1949
- Co-author of "Computers — Their Operation and Applications", Reinhold Publishing Co., 1956
- Author of "Symbolic Logic and Intelligent Machines", Reinhold Publishing Co., 1959
- Maker and Designer of small computing machines including the Brainiac® electric brain construction kits, Simon (miniature complete automatic digital computer), Relay Moe (tit-tat-toe playing machine pictured in Life Magazine, March 19, 1956), etc.
- Fellow of the Society of Actuaries; Harvard 1930 A.B., summa cum laude in mathematics; author of many articles and papers in New York Times Magazine, Scientific American, Record of the American Institute of Actuaries, Journal of Symbolic Logic, etc.
- Entered computer field in 1938.
- Founded "Computers and Automation" in 1951.

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General Electric	Tubes, Capacitors
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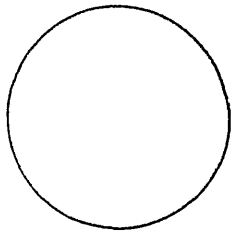

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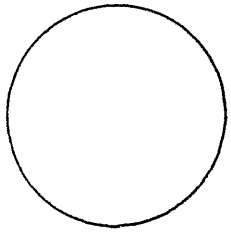
During 1959, we plan that the circulation of **COMPUTERS and AUTOMATION** will reach at least 5000 copies, as compared with 2600 subscribers in January 1957, 3700 in January 1958, and 4000 for the June 1959 Directory Issue. A continuing circulation campaign promises to add large numbers of new subscribers to our audience. All new subscriptions are regularly paid for at $5.50 a year, assuring a top-quality as well as a top-quantity computer-minded audience. In addition, about 1000 key decision-makers working at computer builders and at computer buyers have been added on a controlled basis in order to assure circulation in depth.



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Each issue of **COMPUTERS and AUTOMATION** includes new articles, new reference information, and new ideas, to make it as complete, informative, and stimulating to computer people as we can make it. Greater emphasis than ever before is being placed on news of computers and data automation . . . new surveys, new applications, new products, new devices, new ideas about computers and data processors . . . everything we can think of to help our readers do their jobs better, more quickly, and more profitably.

COMPUTERS AND AUTOMATION

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[Continued from page 22]

Special routines have been devised to deal with homonymous and polysemantic words; the analysis of the former words precedes that of the latter.

The four principal types of "Homonyms" analyzed by the routine are those of "adjective-noun" (Homonym 1), "noun-verb" (Homonym 2), "verb-adjective" (Homonym 3) and of "preposition-adverb" (Homonym 4). Also, a more complicated sub-type is distinguished, that of "adjective-noun-verb," as in "check," which may be an adjective, a noun, or a verb.

In specifying Homonyms 1, 2 and 3, a combination of a morphological and a syntactical analysis of the word is used. Thus, any inflection (except for ER or EST) identified in Homonyms 1 or 3 makes "adjective" an impossible alternative, just as ED or ING inflection in Homonym 2 deletes the "noun" possibility. These are morphological criteria, which do not, however, find as wide an application as syntactical analysis does in view of the scarcity of inflections in English.

The information "Homonym" acquired in the course of this analysis may or may not be final for the dictionary cycle, since some of the words in the MT dictionary are provided here with the indication "polysemantic" instead of a lexical equivalent.

The total number of polysemantic words stored in our dictionary amounts to 500 words.

The determination among multiple meanings of the single meaning of a word is accomplished by specifying typical contexts of polysemantic words in accordance with a special routine. This routine is the final one in the Dictionary Analysis of the English sentence.

Grammatical Synthesis

Grammatical processing of a sentence is broken up into two independent steps: Synthesis and Analysis. The former is the simpler.

Synthesis routines provide rules for grammatical modification of the translated text in accordance with grammatical information obtained in the course of the analysis of the English original.

The most important peculiarity of Synthesis routines is their "non-comparative nature." This means that rules of word-changing, as well as certain rules of word-building, are formulated strictly within a particular target language. Because of this, the same Synthesis routines can be applied to sentences translated from different languages.

However, the requirements of synthesis routines are inclined to increase when they serve multi-lingual MT purposes. In such case, with multi-lingual MT in view, Synthesis routines should be:

(1) EXHAUSTIVE, in describing the word-changing system in the target language, since grammatical rules with no application in MT from one language may become vitally important when the source language is changed;

(2) INFALLIBLE, so as to carry through any instruction obtained from the Analysis of the source language. This requires providing every "non-productive" category of the target language with a "productive" grammatical equivalent.

So far, the problem of grammatical equivalents within a language, theoretically, stands out as the most important for Synthesis.

(3) INDEPENDENT of the Analysis, since the latter may be very different for different languages.

Grammatical Analysis

Unlike Synthesis, independent Analysis cannot be recommended, for this would not help at all to make MT economical. Analysis problems are numerous, and are important scientifically. We shall discuss one of them at some length.

English Analysis is covered by six routines, of which we shall give a general outline of one, "Verb." It stands out as a routine playing a key part in the whole procedure of Analysis.

The "Verb Analysis" Routine

The 'Verb Analysis' routine is divided into five sections; the first section is compulsory for every verb of the sentence, whereas of the remaining four sections, only one is used for each type of the analyzed verbs.

In Section I, verb selection for further analysis is performed. Among words picked out for analysis in this routine are those possessing the indication "Verb," so far as they do not have any of the following indications: "to be Disregarded," "Not to be Changed," or (Russian) indications "Participle," "Verbal Adverb" or "Verbal Noun." The checking for absence of these indications is meant to exclude from further analysis those verbs that have been elsewhere provided with characteristics that satisfy the Synthesis routines.

In addition to verb selection, correction of certain verb indications is provided for in Section I.

Among verb indications liable to correction are those of tense with verb-predicates in if-clauses, and of case government with link-verbs, as well as some more particular indications. Analysis of homonymous forms, such as Past Indefinite and Subjunctive, and of irregular verbs also belongs here.

Checking for grammatical context, implying correction as a possibility, is also performed, both when one of the above-mentioned indications is ascribed to the analyzed verb in the dictionary and also when it is about to be developed in the course of further Analysis.

The preliminary checking of Section I is followed by verb analysis proper. For this purpose the analyzed verb is sent to one of the four different sections, differences in morphological structure of the verb being decisive in choosing the section. Thus, verbs with S-ending (affix S following the stem of the word) are sent to Section II; verbs with ED-ending, as well as certain forms of irregular verbs, enter Section III; and verbs with ING-ending are directed to Section IV; verbs not inflected are analyzed in Section V.

S-Verbs

Grammatical qualification of 'S-verbs' in Section II depends on whether S stands out as the only ending of the verb, or another ending (usually ING) is associated with it. In the latter case, the following indications are developed for the Russian equivalent verb: "Verbal Noun; Neuter; Plural," which implies further analysis by the "Noun" routine at the proper time.

When S is the only ending, English characteristics of the verb (Predicate in the Present Indefinite form) are transformed into Russian indications, but not without checking for correction conditions. Resultant characteristics are "Predicate," associated with either "Present" or

"Future tense," "Number" and "Person" (or gender for the Past tense in other cases). But some characteristics of the Russian predicate remain not defined until the subject of the Russian sentence is determined.

-ED-Verbs

The analysis of "ED-verbs," i.e., verbs with ED-ending and certain groups of irregular verbs, is performed **in Section III.** Here syntax definitely takes precedence, and four main patterns of grammatical verb context are here analyzed.

Noteworthy is the fact that context analysis of a word implies, in all cases, observation of "Rules of Word Selection." These rules are based on classifying all the words in a sentence into three categories, which are:

(1) words of third-degree structural significance; particles, adverbials, parentheses, and parts of a sentence combined by a coordinating conjunction, etc., are included;
(2) words of second-degree structural significance, where different words and word groups belong, so far as they are placed in the attributive position towards some word of a sentence;
(3) words of first-degree structural significance, which include words not identified as belonging to either of the two previous categories.

Through application of "Rules of Word Selection" in the course of the searching procedure all words of lesser category than the word searched are omitted; the chief constituents of the grammatical pattern required are thus singled out.

We cannot here give a detailed description of all the processes involved in the analysis of verb patterns in Section III, but we can comment on a few of the patterns that lead to interesting solutions.

For example, in transforming English construction of Modal Passive:

Modal Verb plus Selected Verb indicated, and "Auxiliary I" (BE) plus Analyzed Verb, into Russian Active Compound predicate:

Modal Verb; Impersonal plus Analyzed Verb, Infinitive, the transformation is associated with conversion of English subject into Russian Direct Object.

Also, another pattern is transformation of English Complex Object Construction into Russian subordinate clause.

Resultant characteristics developed for the verbs analyzed in Section III include both morphological and syntactical information. Of syntactical indications only "Predicate" and "Attribute" are fixed here. The former is associated with morphological indications of mood (Indicative, Subjunctive and Infinitive are developed here), of tense (Present or Past), and of voice (both Active and Passive).

The indication "Attribute" is accompanied by morphological indications of "Participle," tense (Present or Past), and voice (Active or Passive).

-ING-Verbs

ING-forms of verbs are defined in **Section IV.** Here the same verb patterns and others besides are analyzed, though important changes in their value affect the order in which they are searched here.

The resultant characteristics of the Russian equivalent verb include one of the following sets of indications: (1) "Verbal Noun, Neuter"; (2) "Participle, Present tense, Active voice; Attribute"; (3) "Verbal Adverb, Present (or Past) tense"; (4) "Not to be Translated," "to be Disregarded." In addition to these, "Infinitive," "Subjunctive" or "Indicative mood," with the corresponding set of indications, are examined here in case the analyzed verb takes its characteristics from some of the "selected helping words."

Verbs Not Inflected

Verbs not inflected are analyzed in **Section V,** with various verb patterns. One pattern which should be specially mentioned deals with transformation of the English constructions of Complex Subject and of attributive Infinitive into the Russian complex sentence or subordinate clause, accordingly.

The resultant information here includes the indication of Infinitive, Imperative, Subjunctive, or Indicative mood, with the indications of tense (Present, Past or Future) and voice (Active or Passive) attached in case of the Indicative mood. The only syntactical indication fixed here is "Predicate."

Another section of the verb analysis routine is based on a classification of verbs, devised to characterize English verbs both within the English system and with regard to Russian translating conventions.

Within the English language verbs are classified into MODAL and HALF-MODAL (help, dare), AUXILIARY and 7 sub-classes of HALF-AUXILIARIES, CAUSATIVE (cause, enable, make, order, command, etc.), DECLARATIVE (declare, call, label, report, etc.), Verbs Taking two Objects (give, offer, permit, etc.), etc.

To meet the requirements of the Russian translating conventions, verbs are divided into classes and semantic groups. To date, 53 groups of verbs have been established. These are summarized into three classes, the first two classes comprising verbs having translational peculiarities in Finite (class I) or Infinite (class II) forms; class III covers more complicated cases.

The "Verb Analysis" routine is applied until every verb of the sentence is provided with all the grammatical information required in the Synthesis routines, except for the indications of number, person (or gender), which are not defined until the subject of the Russian sentence is established.

Noteworthy is the fact that the information obtained in this routine is not restricted to the analyzed verb, but is extended to cover the information available at this stage of Analysis, concerning "selected" (helping) words (verb, nouns, adjectives, etc.) and punctuation marks.

Moreover, quite a number of transformations in sentence structure are introduced here. These include change of word-order, inserting necessary conjunctions and other words or punctuation marks, etc. There are transformations associated with the translation of Complex Subject and Complex Object, Attributive Infinitive and Gerundival Subject, as well as some other verb constructions.

And, of course, there is much more to be said besides. But perhaps enough has been said to show some of the main lines of our current research, thinking and aims in the subject of machine translation of languages.

[Continued from page 6]

2. What are your suggestions for the name of this group? .....
3. In what ways do you think computer people can be of particular help to the rest of society in influencing for good the applications and effects of computers? .....
4. In what ways would you like to work? .....
5. Any remarks? .....

Name .....

Address .....

When you have filled this in, please send it to E. C. Berkeley, Acting Secretary, WGSDAC, 815 Washington St., Newtonville 60, Mass.

ON FREEDOM TO PUBLISH

I. From: James A. Cook, The Rand Corporation, Santa Monica, Calif., to the Editor.

The RAND Corporation has always been interested in the widest possible dissemination of those research studies which are of value to the public. This purpose was being served, we felt, upon seeing your July issue with its report by Allen Newell and J. C. Shaw of RAND and H. A. Simon of Carnegie Tech, entitled "A General Problem-Solving Program for a Computer." All of us, including the authors, felt it was a genuine compliment that you had seen fit to include this paper among the three selected for publication. The authors expressed dismay, however, that the title used by **Computers and Automation** gave an appearance of finality to their work that they did not wish to imply, and they had selected a title commencing "A Report On . . ." because of the interim nature of their research.

A further discussion of the report revealed that it seemed to have been reproduced in your magazine without consultation or approval by the authors. We have not sought to restrict the report from the public domain. But, we do question the wisdom, both from the standpoint of reflecting up-to-date research and of business courtesy, for a commercial magazine to publish in toto a scientific paper without a prior inquiry or notification of the authors.

If you had an assent for publication from a source of which I'm unaware, my apologies for the assumption.

II. From the Editor to Mr. Cook:

Thank you for your letter of August 11. I am sorry for the misunderstanding about the paper by Newell, Shaw, and Simon. We shall of course publish a correction that deals with the meaning of "A Report On . . .", and we shall be glad to publish any other corrections that you and they feel should be made — may I please hear from you quickly as to any other changes?

In regard to your other point, I do sympathize with the feelings of authors who find themselves suddenly in print when they did not intend to be. But in the operation of a magazine a great deal of information flows across the desk of an editor; often, with pressure of deadlines upon him, he has to make quick decisions about what is the most interesting material that he has to print. Whenever a piece is marked "confidential" or "not to be printed" or "copyright", no reputable editor does print it, without securing permission. There is of course much other literature which the senders thereof are very eager to have printed.

In the case of the papers for the International Conference on Information Processing, there was nothing at any time in any of the literature that indicated the papers were not in the public domain. In fact, I do not believe that UNESCO would have consented to accept any paper for presentation that could not have been freely released to the press at the time of the conference. All of the 1700 people in Paris attending the conference were given an armful of preprints, and so were the press representatives; and I am positive that there will be printing or reprinting of parts or all of at least some of the papers, in many countries, Russia, France, England, etc.

I regret very much that apparently Mr. Newell, Mr. Shaw, and Mr. Simon did not realize the circumstances under which their paper was being released to the press.

If any similar occasion comes up in the future involving these authors, we shall now of course inquire to see if they mind being reprinted. However, this will place us at a disadvantage in regard to other organizations of the press, who in the absence of legal notice or some equivalent, will feel that they can freely quote or reprint. There is a legal implication that a person who does not take the trouble to put the word "copyright" on what he is writing or an equivalent notice, thereby does not restrict the copying of the information.

With best wishes . . .

III. Telegram from Mr. Cook to the Editor:

Appreciate your 17 August letter. The one correction you are publishing will suffice. Regards.

1960 WESTERN JOINT COMPUTER CONFERENCE — INVITATION FOR PAPERS

H. M. Zeidler
Technical Program Committee Chairman, 1960 WJCC
Stanford Research Inst.
Menlo Park, Calif.

"Computers — Challenge of the Next Decade" is the theme of the 1960 Western Joint Computer Conference scheduled for next May 3, 4, 5 in San Francisco, California.

Special emphasis will be placed on major areas where new planning, and new research and development programs are to be directed for the computer growth destined for 1960-70. For example, papers on concepts and techniques in newer areas such as language translation, data retrieval, and self-teaching systems would be of particular significance. It is of course intended that the conference shall also be a base for technical papers and discussions pertaining to the current state of the computer art — both analog and digital.

The Conference Proceedings incorporating the papers to be presented at the 1960 WJCC will be distributed at the registration desk. They will be of value to the conference attendee for his post-conference study, but also for his current comprehension of the technical sessions. Papers to be submitted to the Technical Program Committee should be prepared for thirty minutes delivery, extra time being available for discussion. Eval-

uation will be based on study of a first draft of the complete paper, three copies of which should be in the hands of the program committee as early as possible, and by 9 November, 1959, at the latest. No advance abstract of the paper will be required, but notification of intent to submit a paper should be provided as soon as possible to facilitate program planning. The papers will be reviewed, final selection made, and authors notified by 25 January, 1960. The papers must then be received in final form by the Technical Program Committee by 1 March for incorporation into the Conference Proceedings.

NOTICE FROM A COMMITTEE ON DATA SYSTEMS LANGUAGES

A. E. Smith
Chairman, Intermediate-Range Task Force
Committee on Data Systems Languages
Bureau of Ships, Department of the Navy,
Washington 25, D.C.

Would you please publish the attached notice in the next issue of **Computers and Automation**?

The Intermediate-Range Task Force of the Committee on Data Systems Languages would like to hear from people who wish to participate in the work of the Task Force as associate members. The purpose of associate membership is to provide the Task Force with the benefit of the experience and thinking of people engaged in all aspects of business data processing applications. The particular mission of the IRTF is to specify a common language for describing data processing systems. Associate members will not normally be asked to participate extensively in the working efforts of the Task Force or its task groups, but will be recipients of the publications of the Task Force and will, from time to time, be called upon to respond to surveys, give opinions, or otherwise guide the thinking of the working force.

Persons interested in becoming associate members are asked to write to Mr. A. E. (Gene) Smith, Chairman, Intermediate-Range Task Force, Code 280, Navy Department, Bureau of Ships, Washington 25, D.C., giving a statement of interest and experience.

EARLY ISSUES OF "COMPUTERS AND AUTOMATION"

I. From Dr. Herbert Rister

Bibliotheksrat
Westdeutsche Bibliothek
Marburg, Germany

The Editorial Staff of the "Gesamtverzeichnis der Ausländischen Zeitschriften und Serien," which has been processed at the Westdeutsche Bibliothek, Marburg/Lahn, Germany, would greatly appreciate your letting us know dates of change of title of **Computers and Automation** which formerly had the title "Computing Machinery Field." Please inform us, besides, about numbering of volumes and exact date of change of title (day, month, year).

II. From the Editor

The early issues of **Computers and Automation** were as follows:

Designation	Title	Date	No. of Pages	Manner of Publication
Vol. 1, no. 1	Organizations in the Field of Automatic Computing Machinery	Aug. 15, 1951	7	Purple Ditto
Vol. 1, no. 2	Roster of Organizations in the Field of Automatic Computing Machinery	March, 1952	8	Purple Ditto
Vol. 1, no. 3	Roster of Organizations in the Field of Automatic Computing Machinery	July 20, 1952	11	Purple Ditto
Vol. 1, no. 4	The Computing Machinery Field	Oct., 1952	36	Photo-Offset
Vol. 2, no. 1	The Computing Machinery Field	Jan., 1953	44	Photo-Offset
Vol. 2, no. 2	**Computers and Automation** (all later issues have had this title)	March, 1953	36	Photo-Offset

Beginning with 1953, all *volumes* of **Computers and Automation** coincide with the calendar year. Beginning with 1955, there were at least 12 monthly issues in each year. In some years there have been extra issues.

Air Traffic Control in the Year 1980

Vernon I. Weihe

Director of Air Traffic Control and Navigation Programs,
General Precision Equipment Corp.,
Washington 5, D.C.

(A talk given at The First World Congress of Flight, National Business Aircraft Association Symposium, Las Vegas, Nevada, April, 1959)

IT is now April 1980, and although I have reached the allotted span — three score years and ten — it gives me great pleasure to discuss the present air traffic control system with you. As you well know, this is the Twenty-First World Congress of Flight, and each year since that first meeting, way back in 1959, has been a milestone in the onward march of aviation.

Twenty years ago, many of us feared that a nuclear war might actually blot out the civilized world. If this had happened, the subject of this meeting might more appropriately concern the matter of "homesteading" the battered remnants of the world's population on some uncontaminated planet of the solar system.

Fortunately for all people the world over, the last two decades (since 1959) have been marked by a period of relative peace, and by an increasing awareness of the need for safer and more flexible use of aircraft. The Mach 3 transport airplane has become the basic medium for international person-to-person communication and, as such, is a major tool in the forging of better understanding among the nations and the peoples of the world.

Global Air Navigation and Traffic Control

Independent national and regional planning and installation programs in air navigation and traffic control have become largely outmoded; the renovated world organization has reached a more mature professional status. Local, or regional **faits accomplis** are no longer debated by "rigidly briefed" delegates. Planning now starts at the system engineering level, with global aspects well in mind. Experts from all interested nations meet in constructive conclave to pool their information and experience, and to jointly solve problems on a common and compatible basis. Because of the completeness and soundness of the plans, national legislative groups the world over now provide a new level of continuity in leadership and program support. Feast and famine financing, aborted programs, and the recurring dispersal of expert air navigation and traffic control systems personnel are no longer permitted by the top policy makers of the various administrations.

During the past twenty years, notable progress has been made in two very important "slum clearance" programs. The 1960-1970 period was marked by an effective clearance of airspace slums, followed by the construction of more satisfactory criteria and better methods of airspace use. The 1970-1980 decade was marked by a more complex, but no less important, "slum clearance" of the radio frequency spectrum.

Airspace Slum Clearance

The first program — that of "airspace slum clearance" — was made possible by the formation of the Federal Aviation Agency. Its programs in the application of electronic digital computers provide a workable airspace inventory and file system. No longer are large areas of airspace withdrawn from common user status (and thereby markedly reduced in overall value) to suit an infrequent, or intermittent special purpose. The electronic filing system contains an agreed priority system — when an airspace user completes his operation, the airspace automatically is made available to the next lower priority user who has filed a request or a flight plan.

The airspace inventory and reservation system now allows a substantial reduction in longitudinal separation over the old ten-minute rule of the 1960's. The "cocoon" of airspace around an aircraft is now related to the geographic locale and the amount of traffic involved. An aircraft no longer requires a billion times, or even a million times, its physical volume as an airspace "cocoon" for safe separation from other aircraft. Each aircraft is now more nearly able to fly the optimum path — safety, expeditiousness, and comfort are assured. Some aspects of this system will be described a bit later in this talk.

Radio Spectrum Slum Clearance

The second "slum clearance" program was completed during the last decade — 1970-1980. It concerns that basic resource which is the **sine qui non** of all subsystems which utilize transmitted radio energy. This resource — the radio frequency spectrum — is the real estate on which critically important aviation subsystems must be built. About thirty-five years ago, at the end of World War II, there was a short "land-rush" by many potential user groups. Allocations were made and defended on the basis of "I asked for it first!" Little fundamental knowledge was applied to the subject; in fact, in most cases fundamental system design information was lacking and, more importantly, the impact on practical economic

Mr. Weihe is an authority in the field of air traffic control; many of his predictions on air traffic control in the past have been remarkably borne out by developments. His experience before joining General Precision included service as chief engineer of the Communications and Navigation Laboratory, Wright Air Development Center; Air Traffic Control and navigation systems engineer for the Air Transport Association of America; and U.S. delegate to the International Civil Aviation Organization.

factors of service use were not understood. Wasteful systems were permitted to remain in operation, large areas were blocked off for uses which did not materialize, and selfish interests were allowed to hold deed to blocks of spectrum space which they were not occupying and stood little chance of requiring. This forced important systems to be located at awkward, compromise locations where system optimization was not feasible.

As recently as twenty years ago, there were no channel allocations, on a user basis, in the radar bands. Obsolete, or obsolescent, low stability systems were allowed to "wild cat" or deteriorate newer, high-performance, high-stability systems. Some groups argued for a particular spectrum allocation because it was free of weather obscuration and good for "seeing" aircraft, while others argued for the same spot in the spectrum for "seeing" weather and not aircraft. Likewise, in navigation, certain air/ground cooperating systems occupied bands too high for the service because obsolete or obsolescent systems of earlier vintage were still in limited use and no administrative machinery existed for clearing them out.

The radio spectrum "slum clearance" program in the United States was brought about in a manner quite similar to that of the airspace "Slum Clearance" program. The Federal Aviation Agency legislation which abolished the separate control of airspace by Civil and Military authorities, formed a model for the legislation which attacked the radio spectrum problem. The problem was quite a bit more difficult, however, since the radio spectrum problem was by no means confined to groups having a common interest, such as aeronautics. In any event, through executive and legislative leadership, in 1966, a single agency was formed to replace the two who formerly had cognizance. The new agency was called the Federal Radio-Emission and Communications Agency (FRACA), and was given "power of eminent domain." Funds were made available to buy up obsolete or obsolescent equipments and additional means were found to aid in the development, production, and implementation of new equipments and systems. Time schedules were set and they were met. Recalcitrant users of outmoded equipments were ordered "off the air."

Radars Where They Belong

The results we see today — weather radars are up where they belong, aircraft surveillance radars are down where they belong. Standard LORAN, and four-course ranges have been cleared out, and a new system having a nearly optimum radio frequency allocation has been implemented for both land and sea area coverage.

The single authority has brought new impetus to non-government programs. For ten years now, the single authority, working through its overseas counterparts, has left no doubt concerning the integrity of world-wide radio frequency service allocations. In the common carrier radio telephone service, because of the decreased risk, large amounts of development and implementation capital have been made available. We now—in 1980 — have an optimally located air/ground common carrier radio telephone service. Today, any occupant of an aircraft aloft on any of the world's airlanes, can dial to any other subscriber on land, sea, or aloft. The system is essentially world-wide. The high quality solid state trans-oceanic radio telephone cables and the wide-band, non-orbiting satellite communication relay stations vie

with each other to determine which can provide the most reliable and clearest point-to-point telephone service.

In the foregoing, I have alluded to changes in leadership, and to the two "slum clearance" programs which have been accomplished since the time when the First World Congress of Flight was held, back in 1959. I shall now summarize some of the operational and technical advances since that time.

Revolution in Electronic Computers

The fifteen-year period following World War II (1945 to 1960) was marked by a revolution in the electronic digital computer field. During the first portion, the computer engineer was adapting radio and radar components and circuits for computer uses, but toward the end of the period, under the impact of advances in solid state physics, unique components and circuits especially applicable to the computer art began to appear. At first, transistors and diodes replaced radio tubes, and printed circuit boards replaced wired component subassemblies. Then there was an attack on storage or memory subsystems. The subsystem became smaller, faster, and more flexible for any given size task. This was followed in the 1960-1980 period by advances in microminiaturization, based on breakthroughs in field emission and thin film techniques. These in turn led to development of the "intelligence amplifier." Many computers now approximate the human brain, both in appearance and in function. In 1960, we started to emerge from childhood in the computer field, and became "teen agers." Then useful standards started to appear, particularly in the field of computer to computer communications. Throughout most of the thirty-five year period noted above, emphasis was too heavily directed toward preferred solutions to problems, and too little effort was spent in defining the problems. "Crash" proposal writing and the professional proposal writer became outmoded. Complex systems, taking years to understand are now planned by specialists who have served the proper apprenticeship, know the "pitfalls," and how to avoid them.

Twenty years ago, computers were proudly made larger and faster, without proper consideration of the ability of the human operators to make use of their speed and size. Many functions were planned for computer action which should have been left out altogether. Some large-scale programs, using computers, were eventually phased out because the bandwidth-time product economics of the requisite communication nets rendered them economically unsound.

System Philosophy

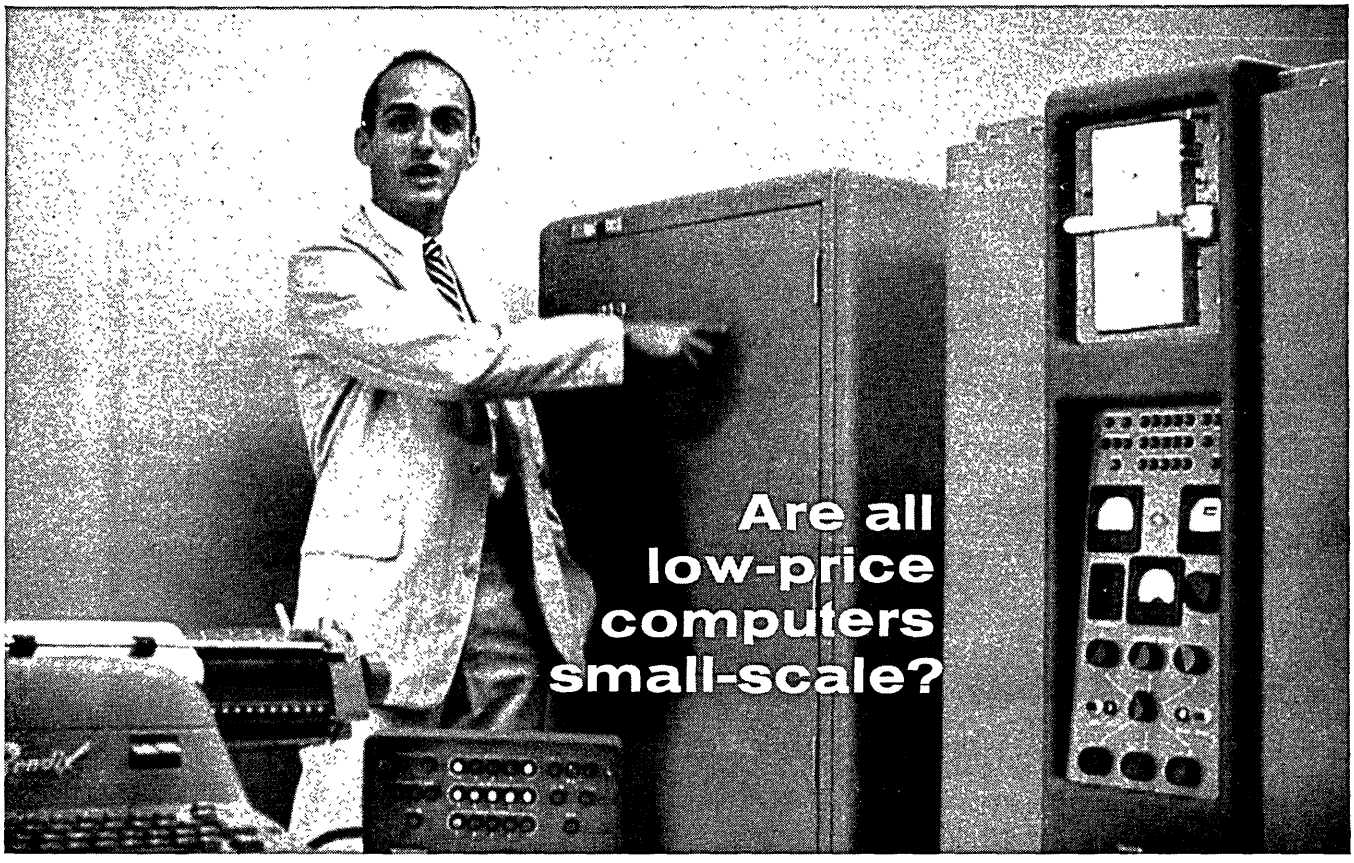
Early emphasis on component and subsystem reliability programs led to the growing realization that the system philosophy itself had to be sound. The modus operandi of the traffic engineer in the common carrier communication field was adopted by the value engineer (the V-E) in the netted computer field. This led to the adoption of signal and clocking standards, whereby computers in many locations performing many specialized tasks could talk to each other over common carrier networks. Computer reliability and economics were better served through the deletion of redundant functions and the elimination of the need for routine inputs to storage by human operators.

Present Air Traffic Control System

All of the above contributed to the present Air Traffic Control System, and to those aspects of it which I shall now describe.

In the overall system, a large number of computers now interchange data in coded form over a common carrier ground communication point-to-point network. This network is tied to the aircraft's central computer system through automatic selectively addressed ground-to-air and air-to-ground radio communication circuits. Many important functions are performed to the end that safety, expeditiousness, comfort, and economy of flight are vastly improved. In line with these improvements, the variables and contingencies of flight are brought under control. The repetitive human burden is reduced in relation to dispatching, flight following, meteorological forecasting, air traffic control, and pilot position reporting.

Back in the late 1950's, some airlines were using digital computers to determine the best weather and flight conditions for long haul flights, meteorological groups were starting to implement plans for regional and local forecasting, and for automatically distributing weather data over large continental areas. Vertical sensing of meteorological data predominated, and meteorological observations through the use of satellites were a dream. No real programs for the use of aircraft as automatic weather sensing stations had yet been implemented. In air traffic control, the Federal Aviation Agency, working with the General Precision Laboratory, Librascope, Incorporated, and Tasker Instruments Corporation, was



Answer: **All but this one.**

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making the first really serious effort to use computers to improve the air traffic controller's lot in life. First bold steps into automation were taking place on a number of other aeronautical fronts as well, such as Air Defense, Mission Control, Return to Base, Logistic Control, Aircraft Deployment, etc. Data on winds aloft, flight plans, and estimated times of arrival and departure, etc., were duplicated in a number of individual systems, and each group was trying to acquire data, and to send it to the others. But no comprehensive planning structure existed, no systems standards had been drafted, and each specialist group operated with a high degree of autonomy. About ten years later, in the late 1960's, each group realized that independent action led to overdesign, excessive cost, and below-par performance. It was then that plans were drafted for the comprehensive computer system which we now have. Each segment now confines major emphasis to its own field of interest and area of specialization, and draws heavily from other storage systems which contain data which he needs. Each sends high quality data to the other requiring or desiring it; each now makes the other's job easier.

Standard Air-Borne Digital Computer

Based upon an FAA development program, there is now a standard air-borne low cost minimal central digital computer available. It is required in all cross country aircraft. The low cost results from the fact that the design was accomplished at FAA cost and production is done in a computer-controlled automatic factory. The aircraft's air data, air navigation, and anti-collision sensors are used as airborne inputs. The selectively addressed coded communication system in the aircraft relays flight plans, weather data, air traffic control clearances, and mission control data automatically from the ground net. The central computer system corrects the heading reference sensors to obtain a uniform 95 percent value for heading accuracy of less than one degree. The computer output system supplies inputs for the pictorial situation display system, as well as for the conventional navigation and flight instruments. The pilot is supplied with the information which enables him to maintain the established flight schedule within the limits imposed by other traffic and by the confliction criteria established for the area of flight. After the automatic position report is processed by the ground net, the air traffic control computer, cooperating with the airborne computer, gives him the best route and speed to fly, and the necessary navigational display to optimize the flight.

Movement of Air Masses

Aeronautical operations on a global basis have now entered the age of aero-flight, where the fullest manifestations of the movement of air masses have become useful as a tool of flight. Air masses and jet streams are followed continually, and projections into future flight time are calculated at closely spaced intervals. Thus, the pilot of 1980 finds himself referenced to the motion of the medium in which he flies, taking maximum advantage in a manner which any sailing skipper of the 19th century would view with great envy.

Through self-contained navigational sensors, of the Doppler, Doppler-Inertial, and Inertial types, airborne computers are combined to reduce the requirement for continuous ground/air cooperating navigational systems. Applying the NAVATEC philosophy, they now serve primarily as zero-setting aids in the enroute service; uninterrupted service is now required of them primarily at departure and destination terminals. With automatic position reporting and ground-derived position determination integrated with the point-to-point and air/ground communication network and computer system, the pilot's and the controller's repetitive tasks in air traffic control are essentially eliminated. They can now devote full time and attention to decision making, thereby improving the safety and expeditiousness of flight.

In this 1980 system, maximum use is made of **a priori** data, and communication circuits are used for the transfer of new and meaningful data only. Because of this, the economics are favorable to world-wide deployment, and the system is not limited to a particular kind and type of land or sea area.

Surveillance functions have now gone 3-D. The common surveillance radar net now provides altitude information, along with the normal plan position information. The effective power density has been increased through the application of maser and parametric amplifier techniques, and the application of electronic scanning, so that all aircraft regardless of size are seen at the indicated range limit. Further improvements have been made in removing ground and precipitation clutter, and the overhead cones are now so small that full volumetric coverage with slant range correction is available wherever needed.

Air Space Reservations

When airborne, the aircraft has its airspace reservation cleared for it well in advance and no other aircraft may share it. Since the movement of the air mass is being carefully tracked for each regime of flight, there is a minimum of restraint imposed by the geographical characteristics of the land below, or by the characteristics of land-based electronic devices sited thereon. The airborne craft may go to Mach 3 or more within the atmosphere, leave the atmosphere and return and be guided to destination, or it may proceed at slow speed at low level without exceeding the limits of coverage or capability of the overall system.

Family Air Scooters

This is not the end of the air traffic control story — it is only a mid-chapter! The exotic fuels of twenty years ago are now superseded by equally high-performance fuels which are easy to handle. Aircraft now ascend and descend at high angles; long runways are required only for the obsolescent types still in use. With these new fuels, controllable jet thrust and turbofans have been combined to create all-weather cabin scooters, and family automobiles of the air. John Q. Citizen is now beginning to buy these instead of conventional wheeled automobiles. Detroit is near panic and will soon change over or lose its leadership to the West Coast. The next chapter in the air traffic control system engineering story — like the last — concerns new operating requirements, and the technical integration of the old with the new.

BOOKS and OTHER PUBLICATIONS

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Cambridge, Mass.

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.**

Gaynor, Frank / Concise Dictionary of Science / Philosophical Library, Inc., 15 East 40 St., New York 16, N.Y. / 1959, printed, 546 pp, $10.00

This dictionary provides concise, accurate, definitions of terms and concepts pertaining to many branches of "science." Included along with the basic sciences, physics, mathematics, astronomy, chemistry, are such new fields as virology, ensymology, cytogenetics, radio-chemistry, solid state physics, and nucleonics.

The author, editor of the Encyclopedia of Atomic Energy, includes all the standard terms, as well as many modern or newly created descriptive words and symbols.

Rosenblatt, Frank / The Perceptron: A Theory of Statistical Separability in Cognitive Systems / Cornell Aeronautical Laboratory, Inc., for Office of Naval Research, publn PB 151247, Office of Technical Servces, U. S. Dept. of Commerce, Washington 25, D.C. / 1958, printed, 272 pp $4.00

This book describes the author's initial work on the theory of the Perceptron, a "discriminating machine" which represents an advance in the design of an electronic brain. The author's research work on "Project PARA" (perceiving and recognizing automaton) under the Navy's sponsorship, is reported.

The book discusses principles and methods of electronic simulation of a human being's brain, and biological implications.

Rosenblatt, Frank / Two Theorems of Statistical Separability in the Perceptron / Cornell Aeronautical Laboratory, Inc., for Office of Naval Research, publn PB 151247-S, Office of Technical Services,

U. S. Dept. of Commerce, Washington 25, D.C. / 1958, printed, 46 pp, $1.25

This is a second report on the Perceptron; it concentrates on such matters as probabalistic mathematics versus symbolic logic, the importance of perceptual processes for automata, the continuous transducer neuron, and the organization of the Perceptron.

The theory on which the electronic brain model is based — the "theory of statistical separability" — is elaborated upon.

Perry, J. W., and A. Kent / Tools for Machine Literature Searching / Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N.Y. / 1958, printed, 992 pp, $27.50

This is the first volume in a series designed to provide information on contemporary achievements in library science and documentation. This volume is a guide to the understanding and effective use of modern automatic equipment in literature searching. The book covers: an introduction to machine literature searching systems; engineering of machine literature searching systems; applications and costs; programming for an IBM 650; procedures for analyzing, encoding and searching of recorded information; and a thesaurus of scientific and technical terms, which include the "Semantic Code Dictionary," a monumental compilation of word-term tabulations, with accompanying codes. The dictionary comprises more than one third of the book, and offers a practical means for adapting encoding as the definitive method of information retrieval.

Uttley, A. M. / The Design of Conditional Probability Computers / Department of Scientific and Industrial Research, National Physical Laboratory, Teddington, Middlesex, England / 1958, photo offset, 19 pp, cost?

"Learning in an animal is seen in its simplest form in the conditioned reflex." Computers which imitate such behaviour have been designed, and in this report a special purpose computer is described, which calculates conditioned probabilities. The computer can be extended to forecast the probability of future signals, and the past can be weighted in any desired manner.

Using the illogical principle of induction, the computer can specify conditional certainty, and compute conditional probability.

Dennis, J. B. / Mathematical Programming and Electrical Networks / John Wiley & Sons, Inc., (and The Technology Press, Mass. Inst. of Technology), 440 Fourth Ave., New York 16, N.Y. / 1959, printed, 186 pp, $4.50

This book offers a new approach to mathematical programming, based on an analogy with electrical networks. The author shows that any direct-current electrical network composed of current sources, voltage sources, ideal diodes and ideal transformers, is equivalent to a pair of dual linear programs. Extending this relation, certain consequences follow, and the procedures of the new approach are systematically explained.

Allendoerfer, C. B., and C. O. Oakley / Fundamentals of Freshman Mathematics / McGraw-Hill, 330 West 42 St., New York 36, N.Y. / 1959, printed, 475 pp, $6.50

It is the authors' contention that a large part of the standard undergraduate curriculum in mathematics is obsolete. With this conviction in mind, and from recommendations by groups of mathematicians, the authors have compiled a text which represents their ideas for a modern course of freshman mathematics. The text includes a review of Intermediate Algebra, a thorough discussion of the theory of sets, detailed treatment of simultaneous linear equations, vectors and matrices, and an intuitive approach to the concepts of limit and continuity. In organizing the text, the authors have kept in mind that the majority of those who take courses in mathematics are potential engineers and scientists. The material, therefore, can be used by a variety of groups, ranging from twelfth-grade high-school classes, to computer people who want a quick refresher on calculus and modern concepts.

McCracken, Daniel D., Harold Weiss, and Tsai-Hwa Lee / Programming Business Computers / John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y. / 1959, printed, 510 pp, $10.25

The reader who lacks an extensive background in mathematics but who wishes to study the applications of electronic computers to business problems, will find this an excellent "first book." The authors begin with fundamental topics, on the nature of the data-processing problem, the central concept of the file, flow charting, and the general characteristics of the computer. Subsequent chapters include information on coding, index registers, subroutines, input-output devices, programming, and economizing and estimating computer time.

The first appendix discusses a mythical stored-program computer, DATAC, to illustrate a number of techniques described in the text. The second appendix includes a description of the binary system, and demonstrates number base conversion. The last appendix is a "Data-Processing Diary" describing the programming of a file maintenance problem by people who had no previous experience with computers. The book includes a glossary, bibliography, and index.

Jeenel, Joachim / Programming for Digital Computers / McGraw-Hill, 330 West 42 St., New York 36, N.Y. / 1959, printed, 517 pp, $12.00

This book, expressly designed for readers with no previous experience in programming, guides the potential computer person to the preparation of problems for stored-program calculators. The approach, a general one, consists of establishing a framework upon which to build diverse programs.

The nine chapters include information on stored-program coding, the languages employed, a number of checking procedures, and techniques in storage and input-output. Nine appendices follow the text, with such topics as number systems, matrix inversion, alternative plans for a network problem. The 63 pages of the ap-

pendices are followed by a bibliography and glossary.

Sasieni, Maurice, Arthur Yaspan, and Lawrence Friedman / Operations Research — Methods and Problems / John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y. / 1959, printed, 316 pp, price ?

This book offers a clear treatment of formulating and solving mathematical models in operations research. It contains a great number of illustrative problems with their solutions, and exercises, some with answers. The chapters cover: some basic topics in probability and sampling; inventory; replacement; waiting lines; competitive strategies; allocation; linear programming; sequencing; and dynamic programming. The book features the mathematical approach to the study of operations research; the level of mathematics assumed is a working knowledge of differential and integral calculus. Three appendices cover finite differences, differentiation of integrals, and "row operations" (a rapid method for solving simultaneous linear equations.)

Horsey, Eleanor F., and Laurence D. Shergalis / Microminiaturization of Electronic Assemblies / Hayden Book Co., Inc., 830 Third Ave., New York 22, N.Y. / 1959, printed, 288 pp., $11.00.

The material in this book, most of which was presented at the Symposium on Microminiaturization of Electronic Assemblies, 1958, provides the first reference work covering new developments and techniques in this field. Detailed are the latest techniques in "two-dimensional" packaging and similar development.

Six sections cover techniques in fabricating miniature working circuits, semiconductors, components, circuits, missile systems, and micro electronics in industry.

Zeines, Ben / Servomechanism Fundamentals / McGraw-Hill Book Co., Inc., 330 West 42 St., New York 36, N.Y. / 1959, printed, 257 pp., $5.50.

Written especially for students and technicians, this clear, elementary treatment of servo systems is designed to explain the basic methods of servo systems and data transmission systems. Instead of examining any specific system in detail, the book stresses fundamentals.

The author, who is an instructor at RCA Institutes and Hofstra College, presents an introductory chapter on control systems and servomechanisms, then, chapters on servo systems, synchros, servo elements, electronic and magnetic amplifiers, direct-current and alternating-current servomotors, methods for servos and measurements, and, examples of servos and servo-systems. Twenty-two pages of appendices include magnetic amplifiers, direct-current motors, the theory of servomechanisms, and elements of mechanical, acoustic, and electrical systems. The book includes a bibliography and index.

Newman, Simon M. / Problems in Mechanizing the Search in Examining Patent Applications / Office of Research and Development, Patent Office, U. S. De-

partment of Commerce, Washington 25, D.C. / 1959, printed, 29 pp., 25c.

This paper describes some of the many details and compleities which occur in the searching process for patent applications, and outlines some of the interrelated problems that are being considered in research into methods for solving searching problems. Illustrative applications are given, describing the process for an ornamental beaded necklace, a Christmas tree decorative ball hanger, plastic products, and manufactured toys. In each case the preliminary examination and the search is described. According to the author, uniform coding systems will eventually be evolved, and the patents and publications in the search files will be encoded according to those systems. References and a bibliography follow the discussion.

Current Research and Development in Scientific Documentation, no. 4 / National Science Foundation, Supt. of Documents, U. S. Govt. Printing Office, Washington 25, D.C. / 1959, printed, 85 pp., 15c.

This volume contains about 75 brief descriptive progress reports on current research an development in scientific documentation in various places. The descriptive statements are classified under five subject headings: (1) information requirements and uses; (2) research on information storage and retrieval; (3) mechanical translation; (4) equipment development; (5) miscellaneous. The reports are compiled as a service to individuals and organizations interested in documentation, they include all pertinent activities in the U.S., as well as descriptions of foreign activities for which information can be secured.

Introducing the Univac 1105 Data-Processing Computing System / Remington Rand Univac, Div. of Sperry Rand Corp., 315 Fourth Ave., New York 10, N.Y. / 1959, printed, 55 pp., free.

This pamphlet describes a general purpose computing system which is capable of efficiently handling data processing applications, scientific applications, and synchronized automation. Among the features of the Univac 1105, are extremely high operating speeds, double buffers, flexible input-output facilities, large nonvolatile internal random access storage, internally stored programs that are capable of modification, and a double length accumulator.

These features are described, and the applicability of the system to business and science is discussed. Two sections are included to discuss programming and specifications.

Chestnut, Harold, and Robert W. Mayer / Servomechanisms and Regulating System Design, vol. 1, second edition / John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y. / 1959, printed, 680 pp., $11.75.

Keeping its objective similar to that of the first edition — to train design and application engineers in the basic principles of feedback control — this reports also on recent advances in the field. Major additions include a chapter on the application of the root-locus method to the analysis and synthesis of control system design, and a chapter on the use of an analog computer for the solution of control system problems. Other chapters are: the automatic control problem; manipulation of complex numbers; solution of linear differential equations; LaPlace transforms for the solution of linear differential equations; steady-state operation with sinusoidal driving functions; methods for determining system stability; types of servomechanism and control systems; design use of complex plane plot to improve system performance; and attenuation concepts for use in feedback control system design. In all, there are 16 chapters, followed by a bibliography, and a number of problems based on material in the text.

Thurston, P. H. / Systems and Procedures Responsibility / Harvard Business School, Div. of Research, Soldiers Field, Boston 63, Mass. / 1959, printed, 120 pp., $2.50.

The author, a lecturer on Business Administration at the Harvard Business School, presents an administrative view of the division of responsibility between operating people and specialists, for work in systems and procedures. Chapters cover: essential problems of planning and installing a wide variety of systems and procedures in several manufacturing companies: conclusions reached on the strengths and weaknesses of specialists and operators; selection of the most effective approaches to systems work; and general findings.

Symbolic Logic, Boolean Algebra and the Design of Digital Systems / Technical Staff, Computer Control Company, Inc. / Computer Control Co., Inc., 983 Concord St., Framingham, Mass. / 1959, printed, 32 pp., limited distribution.

This publication presents some fundamentals of symbolic logic as applied to the logical design of digital systems. After a brief history of the development of symbolic logic, number systems are discussed — decimal and binary.

A comparison of Boolean algebra and ordinary algebra is included, followed by certain theorems of symbolic logic. Some practical applications of the system of logic are demonstrated, and it is shown how a computer implements the principles described.

Handbook, Preferred Circuits, Navy Aeronautical Electric Equipment, NAVAER 16-1-519, Supplement no. 1 / National Bureau of Standards / Supt. of Documents, Washington 25, D.C. / 1959, printed, 106 pp., $.60.

This first supplement to "Preferred Circuits" includes schematics of a number of circuits, followed by explanations of design and uses. The circuits were derived after experimental work on a large number of examples taken from both commercial and military electronic equipment. The supplement includes five instrument servo-circuits, two regulators, two high-

voltage supplies, a pulse a.f.c., and a silicon transistor video amplifier, plus modifications of a number of circuits previously issued. The aim of the preferred circuits program is to reduce unnecessary circuit variations in military equipment.

Proceedings of the Eastern Joint Computer Conference, Dec. 3-5, 1958, Philadelphia / American Institute of Electrical Engineers, 33 West 39 St., N.Y. / 1959, printed, 184 pp., $4.00.

The theme of the conference was: Modern Computers: Objectives, Designs, Applications. The contents of this publication include thirty-eight papers, not all of which are related to this theme. The role of computers in various industries and in the military are discussed. The design of computer components are covered in some of the papers; "New Frontiers" are discussed in the first article by J. W. Forrester and in a number of other articles.

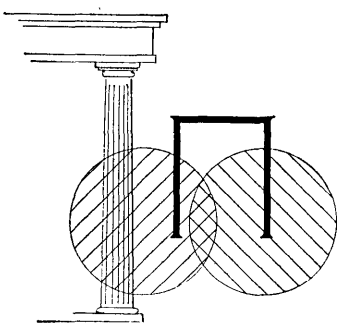
An Experiment in Auto-Abstracting; Auto-Abstracts of Area 5 Conference Papers / Information Retrieval Research Dept., IBM Research Center, Yorktown Heights, New York, N.Y. / 1958, photo offset, 18 pp, cost?

"Auto-abstracting" is a process of causing a computer to make automatically an abstract of a piece of literature using for this purpose a frequency count of the words occurring, and selecting for the abstract those sentences which contain the most frequently occurring words.

The samples of auto-abstracts contained in this collection are from machine-readable transcripts, and are presented in the format furnished by an IBM 704 Computer. In appendices there are two dictionaries of words occurring in the documents which are abstracted. Classification, translation, literature searching, and information retrieval problems, comprise some of the topics of the abstracted papers.

Luhn, H. P., and Peter James / Literature on Information Retrieval and Machine Translation / The Service Bureau Corp., 425 Park Ave., New York 22, N.Y. / 1958, printed, 42 pp, cost ?

The principle of auto-indexing by means of "key-words-in-context" is employed in this bibliography and index. The system is designed to facilitate the discovery of titles in a given subject area. It lists first the items by author. Then in a second part, there is an alphabetical listing of "key-words-in-context." A brief introduction gives some of the advantages of the system; and a bibliography and index are provided.



SURVEY OF RECENT ARTICLES

Moses M. Berlin
Cambridge, Mass.

We publish here a survey of articles related to computers and data processors, and their applications and implications, occurring in certain magazines. We seek to cover at least the following magazines:

Automatic Control
Automation
Automation and Automatic Equipment News (British)
Business Week
Control Engineering
Datamation
Electronic Design
Electronics
Harvard Business Review
Industrial Research
Instruments and Control Systems
ISA Journal
Proceedings of the IRE
Management Science
The Office
Scientific American

The purpose of this type of reference information is to help anybody interested in computers find articles of particular relation to this field in these magazines.

For each article, we shall publish: the title of the article / the name of the author(s) / the magazine and issue where it appears / the publisher's name and address / two or three sentences telling what the article is about.

Punched Tape Controls London Trains / R. Dell, Signal Engineer, London Transport / Control Engineering, vol. 6, no. 8, August, 1959, p. 82 / McGraw-Hill Pub. Co., Inc., 330 West 42 St., New York 36, N.Y.

The movements of 1300 trains a day are controlled by programs on punched tape. After destination and time of arrival of each train in the rapid transit system have been automatically checked against a recorded timetable, switches and signals are set to guide the trains. Diagrams accompany the article, illustrating how the system works.

An Ancient Greek Computer / Derek J. de Solla Price / Scientific American, vol. 200, no. 6, June '59, p 60 / Scientific American, Inc., 415 Madison Ave., New York 17, N.Y.

An ancient mechanism for astronomical calculation (2000 years old) in an Athens Museum is similar to a modern analog computer. It may bring further knowledge of Greek scientific technology and the evolution of modern science.

Dynamic Testing of Computer Building Blocks / R. W. Buchanan and B. Kautz, Staff Res. Engineers, Denver Res. Institute, U. of Denver, Denver, Colo. / Electronics, vol. 32, no. 30, August 14, 1959, p 66 / McGraw-Hill Pub. Co., 330 West 42 St., New York 36, N.Y.

This article discusses amega-pulse generator which expedites dynamic testing of multi-input and gates, by providing a pulse source for testing the design of high-speed adders and gating circuits of various types. These pulse sources must be variable in frequency to remain useful, as the search for higher operating speeds progresses.

Computer Switching with Semiconductors and Relays / G. L. LaPorte and R. A. Marcotte, Product Engineers, IBM Corp., Essex Jct., Vt. / Electronics, vol. 32, no. 33, August 14, 1959, p 64 / McGraw-Hill Pub. Co., Inc., 330 West 42 St., New York 36, N. Y.

The general considerations that influence computer designers in their choice of electromechanical or electronic types of switches are pointed out in this article. Two tables list normal applications of electronic and electro-mechanical switches, and desirable computer switch characteristics and characteristics of semiconductors and relays.

IRE Transactions on Electronic Computers / Professional group on Electronic Computers, Institute of Radio Engineers, Inc., 1 East 79 St., New York 21, N.Y. / vol. EC-8, no. 2, June, 1959, printed, 260 pp, $6.45 (non-members)

Published quarterly, this edition contains nineteen papers on computers and related topics, including four papers from the 1959 Solid-State Circuits Conference, and six papers from the 1958 National Simulation Conference. Five brief articles are included in the Correspondence section, and the publication furnishes abstracts of current computer literature, PGEC news and notices, and the Science Education Subcommittee Newsletter, SENEWS, vol. 2, no. 2, June, 1959.

Burroughs Puts Production Control on 205 / E. H. Goodman / Computing News, vol. 7, no. 15, Aug. 1, 1959, p 154 — 3 / C. N., P.O. Box 90424, Airport Station, Los Angeles 45, Calif.

A computer manufacturer has applied one of its computers to production control. The article describes the installation of, and some of the planned uses for, the computer.

Keeping your Maintenance Records with a Computer / F. H. Winterkamp, Instrument Div. Superintendent, E. I. duPont deNemours & Co., Inc. / ISA Journal, vol. 6, no. 8, August, 1959, p 44 / Instrument Society of America, 313 Sixth Ave., Pittsburgh 22, Pa.

Computer analysis and control enables a large industrial plant to keep track of hundreds of instruments with diverse calibrations, alarm settings, and preventive maintenance requirements. The punched-card records help improve preventive maintenance and provide lower service costs.

New Pad and Pencil for Electronic Offices / Modern Office Procedures, vol. 4, no. 8, August, 1959, p 12 / The Industrial Publishing Corp., 812 Huron Rd., Cleveland 15, Ohio.

This article provides a broad view of the computer and what it can do. It considers magnetic tape units as the pads and pencils, and describes them in terms a layman can understand.

Magnetic Core Circuits for Digital Applications / I. L. Auerbach, Auerbach Electronics Corp. / Automatic Control, vol. 11, no. 2, Aug., 1959, p 48 / Reinhold Pub. Corp., 430 Park Ave., New York 22, N.Y.

Bistable magnetic cores, one of the prime component types for digital applications, can perform most of the functions of digital data processing systems, including storage, delay, control and logical operations. This article discusses present applications of magnetic core circuits.

ADVERTISING INDEX

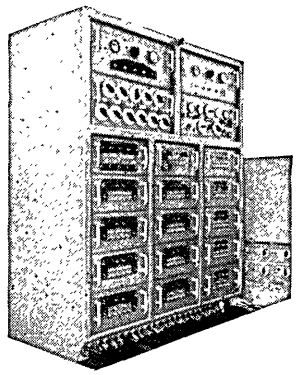
Following is the index of advertisements. Each item contains: Name and address of the advertiser / page number where the advertisement appears / name of agency if any.

Here's how General Electric solves typical DC power-supply problems

for computers and special applications

PROBLEM

"We need to devote our engineering time to designing our electronic circuitry . . . not the power components."



SOLUTION

This is a frequent problem facing computer manufacturers. General Electric's Rectifier Department has complete engineering and manufacturing capability not only to design and apply all types of power supplies, but also to incorporate power supplies into completely integrated systems.

These systems could include load distribution, supply sequencing, protection for power supply and load, and complete power distribution. Let General Electric tackle your DC power problems such as those associated with load IR drop, "cross talk," and other nuisance-type problems plaguing your engineers.

PROBLEM

"It's always a problem making sure transistorized equipment is safe from its power supply."

SOLUTION

To alleviate this problem, General Electric has developed several methods of making transistorized equipment safer in this respect. With G-E protective circuits, shorting a plus high-voltage bus to a plus or minus low-voltage bus would not cause the low-voltage bus to exceed a small percentage of nominal rated value.

General Electric power supplies protect completely transistorized pieces of equipment from large losses due to over-voltage failures.

PROBLEM

"My power supply requirements fluctuate so much . . . big jobs, little jobs, all in between."

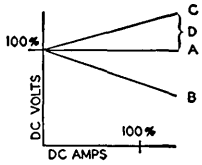
SOLUTION

G.E. has built individual power supplies and complete systems ranging from less than one watt up to 35,000 kilowatts. These power supplies span the complete range of DC power—regulated and unregulated—applying all types of components. G-E experience includes completely transistorized supplies, and supplies with the new controlled rectifier, magnetic amplifiers, voltage stabilizing transformers, and motor-alternator "brute force" systems.

PROBLEM

"We have a real low-voltage power distribution problem with our computer."

SOLUTION



Low-voltage distribution problems can be handled easily through load compensation. Curve "A" is net desired no-load to full-load regulation at load point. "B" is regulation at load without remote sensing or load compensation. "C" represents IR compensation in power supply itself. "D" is amount of IR or load compensation.

NO MATTER WHAT your computer and other special power-supply problems are, General Electric can help you economize—economize by helping you free your engineers of these problems. For more information on power-supply products and services, contact your nearest General Electric Apparatus Sales Office or write to Section G 535-2, General Electric Company, Schenectady, New York.

Progress Is Our Most Important Product

GENERAL ELECTRIC

"COMPUTER PROGRAMMING *at SDC is a fundamental discipline rather than a service. This approach to programming reflects the special nature of SDC's work—developing large-scale computer-centered systems.*

"Our computing facility is the largest in the world. Our work includes programming for real time systems, studies of automatic programming, machine translation, pattern recognition, information retrieval, simulation, and a variety of other data processing problems. SDC is one of the few organizations that carries on such broad research and development in programming.

"When we consider a complex system that involves a high speed computer, we look on the computer program as a system component—one requiring the same attention as the hardware, and designed to mesh with other components. We feel that the program must not simply be patched in later. This point of view means that SDC programmers are participants in the development of a system and that they influence the design of components such as computers and communication links, in much the same way as hardware design influences computer programs.

"Major expansion in our work has created a number of new positions for those who wish to accept new challenges in programming. Senior positions are open. I suggest you write directly to Mr. William Keefer at the address below. He is responsible for prompt response to your correspondence."

T. B. Steel

Senior Computer Systems Specialist

11-97

SDC

SYSTEM DEVELOPMENT CORPORATION

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