[From: *Mechanical World*, December 1955, p. 534-535.]

Language Translation by Electronic Computer

This explanation of how an electronic computer is prepared for translating from one language to another is a good example of the way in which this kind of machine uses an artificial memory and selects stored data according to any number of set rules

By Dr. W. SCHWEISHEIMER

SEATED AT AN INTERNATIONAL BUSINESS MACHINES Corporation (IBM) electronic computer, a girl who did not understand a word of the language of the Soviets punched out the Russian messages on IBM cards: "Miyeryedayem mislyi posruedstvom ryechyi". In a few seconds the mechanical "brain", the 701 computer, produced a translation from Russian to English: "We transmit thought by means of speech." The operator again typed out the meaningless (to her) Russian words: "Myezhdunarodnoye ponyimanyiye yavlyayetsya vazhnim faktorom v ryeshyenyiyi polyityichyeskix voprosov", and the machine printed a translation almost simultaneously: "International understanding constitutes an important factor in decision of political questions."

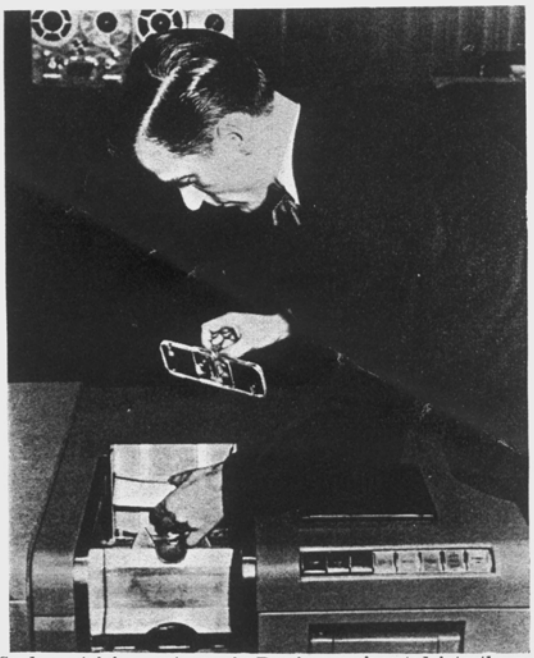
Brief statements about politics, law, mathematics, chemistry, metallurgy, communications and military affairs were submitted in Russian by linguists of the Georgetown University Institute of Languages and Linguistics to the computer and the machine immediately turned the sentences into easily readable English. With a vocabulary of only 250 words, the experiment was a success.

"Those in charge of this experiment now consider it to be definitely established that meaning conversion through electronic language translation is feasible", said Prof. Leon Dostert, Georgetown language scholar who originated the practical approach to the idea of electronic translation. It is not yet possible to insert a Russian book at one end of the machine and come out with an English book at the other, but Dr. Dostert predicted that "five, perhaps three years hence, interlingual meaning conversion by electronic process in important functional areas of several languages may well be an accomplished fact."

The minds of the Georgetown linguists (Dr. Dostert was assisted by Dr. Paul Garvin, while the work at IBM was done by mathematician Peter Sheridan and Dr. Cuthbert Hurd, Director of IBM's Applied Science Division) could not give the machine dependable instructions until they themselves had worked out foolproof means of telling in advance how to translate a word which had more than one meaning.

To translate clearly, the machine had to have simple translation rules (i.e., how to choose one of several meanings) impressed on its "memory" apparatus. Russian letters had to be converted to their English alphabet equivalents. The instructions are introduced into the calculator's short-term electrostatic "memory" with punched cards.

Sentences in Russian are punched into standard cards for feeding into the electronic data processing machine for translation into English



Cards containing sentences in Russian are inserted into the card reading unit. The reading device of the magnetic drum unit then "thumbs through" the dictionary record on it and comes up with the translation and pertinent syntax data

The cards tell the machine how to cope with syntax. Here is an example. The Russian "gyeneral mayor" must be reversed to arrive at the proper translation in English, "major general". The switch is assured in advance by attaching the rule-sign 21 to the Russian "gyeneral" in the bilingual glossary which is stored in the machine, and by attaching the rule-sign 110 to the Russian "mayor".

The stored instruction, along with the glossary, say "whenever you read a rule-sign 110 in the glossary, go back and look for a rule-sign 21. If you find a 21, print the two words that follow it, in reverse order." So the instant the "brain" is given "gyeneral mayor" to translate, it looks in the glossary, finds the two words there, reads the rule-sign 110, goes back and finds rule-sign 21, and automatically acts accordingly, all in a few seconds.

The six rules govern transposition of words where that is required in order to make sense, choice of meanings where a word has more than one interpretation, omission of words that are not required for correct translation, and insertion of words that are required to make sense.

The computer, though primarily controlled by an internally stored programme of instructions, is under the direct supervision of one operator

The Russian word "nauka" means "science" in English. The Russian word "o" can mean either "about" or "of". Proper English translation of "nauka o" is "science of", not "science about". How can the machine know that? It knows because, in its Russian-English glossary, "naukea" has affixed to it the rule-sign 242 and "o" carries the rule-sign 141. The instructions in the memory say, "whenever you read the rule-sign 141, go back and look for 241 or 242. If you find 241, select the first English translation and print both words in the order in which they appear in the Russian sentence.

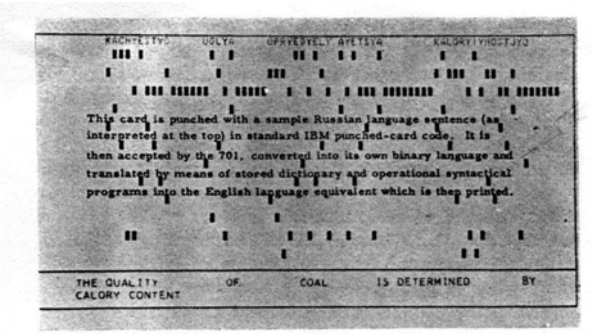
If you find 242, select the second English meaning. Consequently, when the computer is given "naukea o" to translate, it read the 141, looks for and finds the 242, chooses the second meaning given for "o" which is "of" and prints correctly "science of".

The first step in preparing the computer was to write electronically, in plus and minus charges on a magnetic drum surface, 250 Russian words and their equivalents in English. Wherever a Russian word had more than one meaning, each meaning was given a rule-sign. This set of electronic words constituted the dictionary to which the machine could refer.

A continuous sheet of English-worded sentences comes up on the printing unit seconds after sentences, in Russian, have been fed into the computer

The second step in preparing the machine to translate was to store the detailed instructions. They were written in electrical charges on the faces of cathode ray tubes in the electrostatic memory. All that remained to be done after that was to give the computer the Russian words to translate. The machine responded at the rate of one full sentence every six or seven seconds.

The present experimental demonstration can be rated only as a scientific sample. As Dr. Hurd pointed out, the calculator is a general-purpose data processing machine not designed specifically for translating. Still, it has a memory capable of storing roughly 1,000,000 five letter words. IBM will now design a machine particularly fit for translating rather than for general computing utility. Such a device should be ready within three to five years.



Above, a specimen punched card and below a strip with translation, printed within a few seconds

The machine will not accept incoherent statements, Dr. Dostert said. If they are introduced for "translation", the machine baulks and rings a bell. It will ring the bell also when it encounters a misprint. When cards for Russian are completed, sets will be made for German and French.

Students of language are now for the first time justified in undertaking serious study of language from a mechanical point of view. They have a practical reason now for trying to find out how language actually functions.