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THE GEORGETOWN-IBM DEMONSTRATION,

7th JANUARY 1954

On the 8th January 1954, the New York Times carried a front-page report of the demonstration on the previous day at the IBM headquarters in New York of a system which translated some Russian sentences into English. It was the result of a joint project by IBM staff and members of the MT team recently gathered at Georgetown University under the leadership of Leon Dostert.

The impact of this demonstration was profound, possibly the most influential publicity that MT has ever received. Certainly, it is one of the few times that MT has been front-page news and for this reason it makes interesting reading forty years later, and the full text of the report is reproduced.

RUSSIAN IS TURNED INTO ENGLISH BY

A FAST ELECTRONIC TRANSLATOR

by Robert K.Plumb

A public demonstration of what is believed to be the first successful use of a machine to translate meaningful texts from one language to another took place here yesterday afternoon.

This may be the cumulation of centuries of search by scholars for "a mechanical translator." So far the system has a vocabulary of only 250 words. But there are no foreseeable limits to the number of words that the device can store or the number of languages it can be directed to translate.

Scholars and scientists who worked on it believe that within a few years the system may greatly increase communication, particularly in technical subjects, by making translation quick, accurate and easy.

The demonstration was at the headquarters of the International Business Machines Corporation, 590 Madison Avenue. It is the result of cooperative research by scientists of the corporation and scholars of the Georgetown University Institute of Languages and Linguistics in Washington.

The "mechanical" part of the translation system, which is mostly electronic, is a standard commercial model of the largest International Business Machines "stock" computer. This device, called the IBM Type 701 Electronic Data Processing Machine, was put on the market last April. Since then twelve of the machines have been sold to commercial, military and university computation laboratories.

The "literary" part of the system is a mechanical model of language devised at Georgetown by Prof. Leon Dostert and Dr. Paul Garvin. The corporation's share in the project was conducted by Dr. Cuthbert C. Hurd, director of its Division of Applied Science.

In the demonstration, a girl operator typed out on a keyboard the following Russian text in English characters: "Mi pyeryedayem mislyi posryedstvom ryechi" The machine printed a translation almost simultaneously: "We transmit thoughts by means of speech." The operator did not know Russian. Again she types out the meaningless (to her) Russian words: "Vyelyichyina ugla opryedelyayatsya otnoshenyiyem dlyini dugi k radiusu." And the machine translated it as: "Magnitude of angle is determined by the relation of length of arc to radius."

Several short messages, within the 250-word range of the device, were tried. Included were brief statements in Russian about politics, law, mathematics, chemistry, metallurgy, communications and military affairs. The sentences were turned into good English without human intervention.

The heart of the system is the mechanical model of language devised at Georgetown. There the scholars first assembled a 250-word vocabulary in Russian covering the seven broad fields. Then they determined the rules of syntax required for a meaningful statement and reduced them to six instructions for the data-processing calculator.

These instructions are introduced into the calculator's short-term electrostatic "memory" with punch cards. The cards tell the machine how to cope with syntax.

In translating, for instance, a word "A" which precedes a word "B" in Russian, may be reversed in some cases in English. Each of the 250 words is coded for this inversion. Sometimes words must be inserted in the English text, sometimes they must be omitted, following code instructions.

When there are several possible English meanings for a Russian word, the instructions tell the machine to pick out the meaning that best fits the context.

Foreign words are typed on a keyboard that punches I.B.M. cards. These are fed into the calculator, where they encounter the vocabulary, also punched on cards. On a standard printer meaningful English texts emerge.

According to Dr. Hurd, the calculator is a general-purpose data processing machine not designed specifically for translating. Nevertheless, it has a memory capable of storing

roughly 1,000,000 five-letter words. There are 600,000 entries in the latest Webster's unabridged New International Dictionary.

Dr.Hurd said that the corporation would 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, when the Georgetown scholars believe they can complete the "literary" end of the system.

Dr.Dostert and Dr.Garvin said they chose Russian for their first experiments because it was a difficult language and a system that could translate it could handle anything.

The machine will not accept incoherent statements, Dr.Dostert said. If they are introduced for "translation" the machine balks, and rings a bell. And it will ring a bell when it encounters a misprint. It now prints eighty letters in two seconds.

As soon as cards for Russian are completed, sets will be made for German and French. Then other Slavic, Germanic and Romance languages can be set up at will.

A further example of the impact of the demonstration can be found in the *Christian Science Monitor* a few days later (11 January 1954), a report which possibly reflects more accurately the exaggerated popular expectations of computers at the time.

ROBOT TRANSLATES NIMBLY

by Harry C.Kenny

Kachyestvo uglya opryedelyayetsya kaloryynostjyu, i.e. The quality of coal is determined by calory content. Thus, the Soviet language, has been translated into English by an electronic "brain" for the first time.

Yet so far as the now famous International Business Machines computer 701 is concerned, it doesn't blink an additional red light or add another whir to its purr if another language is inserted into the machine to come out in seconds in English. The Soviet language was chosen at the IBM demonstration here only because there is a relatively small number of students here of the Soviet language as it is so difficult to translate.

Significance pointed up.

The significance of the machine also is pointed up by the fact that there is a steadily growing accumulation of Soviet textual material whose true significance cannot even be estimated until its content can be converted into English. The girl who operated 701 did not understand a word of Soviet speech and yet more than 60 Soviet sentences were

given to the "brain" which translated smoothly at the rate of about 2 lines a second. And then just to give the electronics a real workout, brief statements about politics, law, mathematics, chemistry, metallurgy, communications, and military affairs were submitted in the Soviet language by linguists of the Georgetown University Institute of Languages and Linguistics.

Flicked out nonchalantly.

The "brain" didn't even strain its superlative versatility and flicked out its interpretation with a nonchalant attitude of assumed intellectual achievement.

It is expected by IBM and Georgetown University, which collaborated on this project, that within a few years there will be a number of "brains" translating all languages with equal aplomb and dispatch.

"The potential value of this experiment for the national interest in defense or in peace is readily seen," Prof. Leon Dostert, Georgetown language scholar, said. Professor Dostert originated the practical approach to the idea of electronic translation. Along with Dr. Paul Garvin, director of the translation project, he spoke to the group of natural scientists, United States Government specialists, and the press who witnessed the demonstration at IBM headquarters here on Madison Avenue.

Enormous Potential.

"Those in charge of this experiment," the professor continued, "now consider it to be definitely established that meaning conversion through electronic language translation is feasible." Although he emphasised it is not yet possible "to insert a Russian book at one end and come out with an English book at the other", the professor forecast 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."

Actually, this demonstration was rated only as a scientific sample, or, as Professor Dostert put it, "a Kitty Hawk of electronic translation." Nevertheless, the success of the project contains enormous implications for both linguistics and electronics. It is expected by IBM officials that the day will arrive when a simpler and cheaper machine will be available for less than the present \$500,000 supercalculator....

Two days later (13th January 1954), the *Christian Science Monitor* carried an editorial on the demonstration -- one of the very few editorial statements about MT ever -- which puts it into context. While the two reports of the demonstration emphasised the imminence of translation machines, the editorial gave a more sober (and, in hindsight, more realistic) assessment:

Such an accomplishment, of course, is far from encompassing the several hundred thousand words which constitute a language. And with all the preparations for coping with syntax, one wonders if the results will not sometimes suggest the stiffness of the

starch mentioned in one of the sentences as being produced by mechanical methods. Nevertheless, anything which gives promise of melting some of the difficulty which writers and speakers of different languages encounter in understanding each other - particularly as between English and Russian today - is certainly welcome.

A fascinating account of the technical problems which had to be surmounted was given by Peter Sheridan ('Research in language translation on the IBM type 701') in *the IBM Technical Newsletter* no.9, published in January 1955. Every aspect of the process sent the programmers into unknown territory: they had to decide about the coding of alphabetic characters, how the Russian letters were to be transliterated, how the Russian vocabulary was to be stored on the magnetic drum, how the 'syntactic' codes were to operate and how they were to be stored, how much information was to go on each punched card, etc. Detailed flow charts were drawn up for what today would be simple and straightforward operations, such as the identification of words and their matching against dictionary entries. The problems described by Sheridan are an illuminating illustration for younger MT researchers of the nature of the difficulties faced by the computer pioneers, who had to program with no 'assembly language' codes, let alone 'high-level' programming languages.

The linguistic aspects of the experiment were given in a contemporary account by Dostert himself ('The Georgetown-I.B.M. experiment' in Locke, W.N. and Booth, A.D. (eds.) *Machine translation of languages* (Cambridge, Mass.: M.I.T.Press, 1955), pp.124-135). Dostert had been a participant of the first MT conference two years earlier, held at MIT in June 1952 [see MTNI#2 (May 1992), 11-12]. He had come away convinced that "rather than attempt to resolve theoretically a rather vast segment of the problem, it would be more fruitful to make an actual experiment, limited in scope but significant in terms of broader implications". He identified "the primary problem [as] one of linguistic analysis, leading to the formulation in mechanical terms of the bilingual transfer operations, lexical or syntactic." The aim was a system requiring no pre-editing of the input, and producing "clear, complete statements in intelligible language at the output", although "certain stylistic revisions may...be required..., just as when the translation is done by human beings."

The corpus of 49 Russian sentences with a lexicon of just 250 words had been carefully selected. The lexical items were coded in a system of "digital diacritics" of three types. One series of 'diacritics' (Program Initiating Diacritics) indicated which of the six operational rules was to be applied. The second series (Choice Determining Diacritics) indicated what contextual information should be sought to determine selection of output. And the third (Address Diacritics) indicated the storage area of the English equivalents.

The six operational rules were (using the numbering of the researchers):

0. No problems of selection: there is one-to-one equivalence of source and target words, and the word order of the source is to be followed.
1. There is a change of order: the words are to be inverted.
2. The choice between target equivalents is determined by an indication ('diacritic') in the following word
3. The choice of target words is determined by an indication in the preceding word
4. The word in the source is omitted, and no word appears in the target sentence
5. A word is inserted in the target which has no correspondent in the source.

The limitations of the experiment were freely admitted in a later evaluation by Paul Garvin ('The Georgetown-IBM experiment of 1954: an evaluation in retrospect' *Papers in linguistics in honor of Dostert* (The Hague: Mouton, 1967), pp.46-56; reprinted in his *On machine translation* (The Hague: Mouton, 1972), pp.51-64). The limitations were the consequence of restricting the algorithm to "a few severely limited rules, each containing a simple recognition routine with one or two simple commands." Nevertheless, in Garvin's view, the experiment was "realistic because the rules dealt with genuine decision problems, based on the identification of the two fundamental types of translation decisions: selection decisions and arrangement decisions." The limitations were of two principal types: the restriction of the search span to immediately adjacent items, the restriction of target words to just two possibilities, and the restriction of rearrangements to two immediately adjacent items.

The choice of target language equivalents was restricted to those which were idiomatic for the 49 sentences only. The limitation of the procedure for Russian case endings was severe: either a case suffix was not translated at all or it was translated by one "arbitrarily assigned" English preposition. Further limitations were highlighted by Michael Zarechnak, a member of the Georgetown MT group, in his essay 'The history of machine translation' in: Bozena Henisz-Dostert, R. Ross Macdonald and Michael Zarechnak *Machine translation* (The Hague: Mouton, 1979), pp.20-28. None of the Russian sentences had negative particles; all were declaratives; there were no interrogatives or compound sentences (coordinate or subordinate clauses); the verbs were all in the third

person; and English articles were inserted arbitrarily to fit the particular words of the corpus.

Such limitations made it possible for the output to be impressively idiomatic, and suggested that continued experiments on the same lines would lead to systems with larger vocabularies and even better quality. The general public was impressed: MT was now seen as a feasible objective, and the translation quality was certainly acceptable. The demonstration undoubtedly encouraged US government agencies to support research on a large scale for the decade, and it stimulated the establishment of MT groups in other countries, notably in the USSR.

On the other hand, unrealistic expectations had been raised: the newspapers reported Dostert's optimism about working systems in the next three to five years, and with even better performance. They did not materialize. The disappointment led in the end to

the ALPAC report of 1966, which brought the large-scale funding of MT research in the United States to a virtual end. Indeed, the ALPAC report used the public achievements of the Georgetown-IBM experiment as a touchstone when assessing the output quality of subsequent systems. In doing so, it failed to acknowledge the artificiality of this small-scale demonstrator system.

In later years, MT researchers have been rather more circumspect when demonstrating experimental systems and have been less willing to indulge in speculations for journalists. The painful lessons of the Georgetown-IBM demonstration seem to have been learned.

Source : <http://ourworld.compuserve.com/homepages/WJHutchins/GU-IBM.htm>