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MACHINE TRANSLATION:
THE CONTRIBUTIONS OF ALEKSANDĀR LJUDSKANOV

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This paper is dedicated to the life and work of AleksandĀr Konstantinov Ljudskanov, the pioneer of machine translation in Bulgaria and author of a comprehensive semiotic theory in translation studies.

Our initial idea was to interview his student and a longtime collaborator Dr. Elena Paskaleva who, between 1965 and 1972, was the only linguist in his Machine Translation Group and the author of the most easily accessible and probably the only comprehensive account of Ljudskanov's scientific career. It was published in *Early years of Machine Translation*, edited by W. John Hutchins.¹ She readily agreed to talk to us, but, unfortunately, passed away in January 2014 before we could meet.

Ljudskanov was born in 1926 to parents of different nationalities. His father was the scion of a Bulgarian family with a long history of involvement in the country's political life. Before 1919, he was an officer in the Russian army and later served as the first secretary at the Bulgarian embassy in Belgrade. His mother was a Russian from the Ermolov family. They spoke three languages at home – Bulgarian, Russian, and French.

When in 1944 the Communists came to power, Ljudskanov was a law student at the University of Sofia and later an assistant to Professor Ceko Torbov, the Bulgarian translator of Kant's works and a Herder Prize winner. Naturally, Ljudskanov's parents hoped that their son, who had all the necessary qualities, such as ambition, intelligence, and communication skills, would enter politics.

This did not happen however, and, during the political purges immediately after 1944, he was fired from Sofia University because of his family background. A few years later, the cultural shift that followed the political

¹ E. Paskaleva, AleksandĀr Ljudskanov, in *Early Years In Machine Translation. Memoirs and Biographies of Pioneers*, ed. by W. J. Hutchins, Amsterdam-Philadelphia, John Benjamins Publishing Company, 2000, pp. 361-376.

change brought a significantly increased demand for competent translators from Russian and he was able to find a job at the “Bulgarian-Soviet friendship” journal. His proficiency in Russian which was being taught in schools as a ‘second mother tongue’ was a particularly valuable asset. Thus, in the early 1950s Ljudskanov began to teach Russian, and later gave a course in Russian grammar at the newly established Department of the Faculty of Slavic Studies at the University of Sofia.

By the time of his untimely death in 1976 at the age of 50, Aleksandăr Ljudskanov had been leading the first and only group dedicated to machine translation in Bulgaria at that moment.

He was a member of the executive bodies of several international organizations, among which the International Committee on Computational Linguistics (ICCL), the International Association for Applied Linguistics, the International Association of Semiotics and the Committee for Applied Computational Linguistics.

Ten months before he died, in 1975, he succeeded in organizing an international conference “Application of Mathematical Models and Computers in Linguistics” where 170 scientists from both sides of the Iron Curtain met.² According to Paskaleva, the ratio West-East for foreign participants was 36:24 and among the ‘westerners’ there were Bernard Vauquois, Antonio Zampolli, Hans Karlgren, David Hays, Guy Rondeau, Robert Kittredge, Brian Harris and Martin Kay, to name a few.³

The success of the conference was due largely to the fact that Ljudskanov had a personal contact with most of the people involved. In the words of Vauquois, “all who knew him will remember our private talks, where Ljudskanov, a scientist with erudition and a perceptive mind, an inquisitive and wonderful listener, shone with incomparable charm”.⁴

Ljudskanov’s first articles published in the late 50s were directly related to his work as a translator and a teacher. At that time, he studied some of the new concepts in the science of translation like a *functional equivalent*, the *accuracy of translation*, and *the sign nature of language*.

In 1959, a *Slavic phrasebook* appeared that was co-authored by Ljudskanov. It went through a number of editions. Additionally, he was one of the

² P. Burnev, *Deloto i prinosät na bälgarski učeni informatici: Aleksandăr K. Ljudskanov, Dimităr M. Dobrev, Valentin T. Tomov, Petăr M. Todorov, Dimităr P. Šiškov*, Sofia, Institut po Matematika i Informatika, 2005, p. 10.

³ E. Paskaleva, *Aleksandăr Ljudskanov*, cit., p. 374.

⁴ B. Vauquois, *In memoriam*, in *A. Ljudskanov, Preveždat čovekät i mašinata (izbrani trudove)*, Sofia, Narodna kultura, 1980, p. 9.

three editors of the two-volume *Russian-Bulgarian dictionary* published in 1960.

In the early 60s Ljudskanov became interested in machine translation (MT) which remained his main research area for the rest of his life and in which he worked guided by the principle that there should be “a general theory of translation regardless of the genre of the translated message, the source and the target language, and whether it is performed by a human translator or a machine”. This quote is from his *magnum opus*, the monograph *Man and Machine translate*⁵ in which he further developed the ideas outlined in his PhD thesis (*On the subject and the methodology of the general theory of translation*, 1964). The monograph consists of four parts; the first is dedicated to a historical overview of “the practice and theory of translation” as they were seen in 1960s; in the second, we find the main postulates of Ljudskanov’s semiotic theory of translation; the third part is devoted to the peculiarities of the human translation and the last one presents a snapshot of the achievements of several scientific teams working in machine translation, followed by an outline of the basic concepts, approaches and issues, and ending with an example of an algorithm that can be used to translate a single sentence from Russian to Bulgarian.

Man and Machine translate is a book that presents Ljudskanov’s ideas and his thorough knowledge of both the Soviet and the European and American literature on translation. The monograph was translated into several languages. A French translation done by the author himself was published in 1969.⁶ In 1972, a revised and extended version of the Bulgarian original appeared in German,⁷ and a year later, in Polish.⁸

Ljudskanov was awarded the degree of Doctor of Sciences by the University of Leipzig for this work. It was later used as a textbook at the Institute for Applied Linguistics and Translation Studies of the same university. It is worth pointing out that one of the leading figures of the Leipzig School in translation studies, the professor of Slavic studies, Gert Jäger, was involved in the German translation.

⁵ A. Ljudskanov, *Preveždat čovekät i mašinata*, Sofia, Nauka i izkustvo, 1968.

⁶ Id., *Traduction humaine et traduction mécanique*, Paris, Centre de Linguistique Quantitative de la Faculté des Sciences de l’Université de Paris, 1969.

⁷ Id., *Mensch und Maschine als Übersetzer*, transl. G. Jäger and H. Walter (U. Dresden), Halle (Saale), VEB M. Neimeyer Verlag, 1972 [repr. 1975].

⁸ Id., *Tłumaczy człowiek i maszyna cyfrowa*, transl. A. Naumow and K. Leski, Warszawa, Wydawnictwo Naukowo-Techniczne, 1973.

After Ljudskanov's death his monograph went through another two editions: a Bulgarian one that appeared in 1980 and was edited by Elena Paskaleva.⁹ It was based on the German and the Polish versions, and on a part of Ljudskanov's unpublished notes. The partial Italian translation of the French edition carried out under the supervision of Bruno Osimo appeared in 2008.¹⁰ In it, the chapters devoted to machine translation and some other more technical parts were shortened. This editing in fact echoes Ljudskanov's own opinion which he had shared earlier in private communication with Brian Harris, the author of the natural translation hypothesis. He knew that these aspects of the book would grow old quickly and future translators would have to update them accordingly.¹¹

To say that the monograph had a great impact will be an overstatement. It was never published in English or Russian. Nevertheless, despite the fact that most of Ljudskanov's publications were in Bulgarian, he achieved international recognition, especially in Eastern and Central Europe. This would not have been possible without his personal contact and continuous dialogue with the central figures of the field from Moscow, Prague, Leipzig, Grenoble, Ottawa and so on.

The Bulgarian academic system rejected and suppressed people like him. He was born of the 'wrong parentage' and his ideas were opposite to the official dogma. That was why he was never able to advance his career. However, thanks to his erudition and intelligence, Ljudskanov managed to get the support of influential people, among them the president of the Bulgarian Academy of Sciences, the linguist Vladimir Georgiev, and the director of the Institute of Mathematics, Ljubomir Iliev. Without their patronage, Ljudskanov would not have had the opportunity to travel abroad, to organize scientific meetings, to have his own team of specialists implementing his ideas, or even to appear in "Bălgarski ezik", the most renowned linguistic Bulgarian journal which was edited for many years by Vladimir Georgiev.

Perhaps it is worth asking why Ljudskanov decided to work in the field of machine translation. One possible answer is that, arguably, for a practicing translator, the most important question is "how is translation possible, and what is the nature of the translation process?"

Possibly, when he discovered the Russian translation of Locke and Booth's

⁹ A. Ljudskanov, *Preveždat čovekāt i mašinata*, cit.

¹⁰ A. Ludskanov, *Un approccio semiotico alla traduzione. Dalla prospettiva informatica alla scienza traduttiva*, ed. B. Osimo, Milano, Hoepli, 2008.

¹¹ B. Harris, *Ludskanov in Italian*, Retrieved from: <http://unprofessionaltranslation.blogspot.it/2009/12/ludskanov-in-italian.html>.

Machine translation in 1957, he thought that this might be the path to the answer. This explanation is somewhat supported by the epigraph to the first edition of *Human and Machine translate* that begins with a quote from Claude Shannon, the father of information theory: “Humankind has always faced two big questions. The analytical ‘how one thinks?’ and the synthetic ‘can you reproduce human thought?’ (C. Shannon). Machine translation can provide us with a partial answer to the latter”.¹²

The idea to gather a team of like-minded mathematicians and linguists came naturally after the inspirational meetings with some of the most prominent figures in the field of semiotics and formal linguistics like Andrej Zaliznjak, Igor’ Mel’čuk, and Roman Jakobson at the 5th International Congress of Slavists (1963).

All of the team members were fascinated with the new and exciting science of cybernetics. Political leaders on both sides of the Iron Curtain were aware that the winner of the Cold War would be the one who had better technology. Technology means not only military power, but also economic, social and ideological superiority.

Dismissed initially as a decadent bourgeois pseudoscience in the Soviet Union, during the Chruščev-era, cybernetics became the main intellectual and ideological trend and a highly esteemed scientific discipline.¹³ In the words of the mathematician Vladimir Uspenskij, “the years from 1956 to 1976 were the ‘Silver age’ of structural, applied and mathematical linguistics in the USSR. All of those, machine translation included, were considered branches of cybernetics”.¹⁴

One of the main metaphors of cybernetics was that of the human brain computer. Man is nothing but the most sophisticated cyber machine. To understand human thinking means to model it by mathematical means. The human brain is a machine that performs a complex program. This is one of the basic postulates of the theory used by Ljudskanov in his quest to find an answer to the question ‘how is translation possible?’ According to him, the activity of a human translator can be formulated in two fundamentally different ways.

Based on the model at hand, we may want to obtain a machine output that is similar to the result of the corresponding process performed by the

¹² A. Ljudskanov, *Preveždat čovekāt i mašinata*, cit., p. 4.

¹³ S. Gerovitch, *From Newspeak to Cyberspeak: A History of Soviet Cybernetics*, Cambridge MA, MIT Press, 2002.

¹⁴ V. Uspenskij, *Trudy po Nematematike s priloženiem semiotičeskich poslanij A. N. Kolmogorova k avtoru i ego druž’jam*, Moskva, OGI, 2002, p. 925.

person. Alternatively, we may want to obtain a procedure that gives us not only the outcome of a given human activity, but also the process occurring in our heads.

It is generally agreed that the idea of the feasibility of machine translation was first formulated by Warren Weaver in a memorandum to the Rockefeller Foundation in 1949: "I have a text in front of me which is written in Russian but I am going to pretend that it is really written in English and that it has been coded in some strange symbols. All I need to do is strip off the code in order to receive information contained in the text".

Seven years later Paul Garvin and Peter Sheridan publicly demonstrated machine translation of 30 sentences from Russian to English, the so-called Georgetown experiment. This event was described in a paper published in the journal "Computers and Automation" which was translated into Russian and half a year later, the team led by professor Ljapunov tested an algorithm for translation from French to Russian.¹⁵

The end of the 'Silver age' for Machine Translation in Western Europe and the U.S. came with the infamous ALPAC Report, commissioned by the US National Academy of Sciences). In it, it was claimed that machine translation offered no commercial advantages.¹⁶ The fact that, by that time, computers had already been used to speed up the translation process significantly went unnoticed. The conclusion was due in part to the unrealistic initial expectations that "fully automatic, high quality machine translation"¹⁷ was just around the corner.

Governmental funding was reduced significantly on both sides of the Iron Curtain but the negative effect was more pronounced in the US. In the USSR, work on machine translation, which was labeled 'formal linguistics', remained relatively unaffected. Scientists who were fired for political reasons found shelter in the Scientific Research Institute for Information and Economic Studies in Electrical Engineering (the so-called InformElektro).¹⁸ Work on machine translation continued in several centers in Canada (Montreal, for example), France (the GETA group in Grenoble, led by Vauquois), Germany (the SUSY group in Saarbrücken).

¹⁵ I. Mel'čuk, *Machine Translation and Formal Linguistics in Early Years in Machine Translation. Memoirs and Biographies of Pioneers*. ed. by W. J. Hutchins, Amsterdam-Philadelphia, John Benjamins Publishing Company, 2000, pp. 206.

¹⁶ D. J. Arnold et al., *Translation: an Introductory Guide*, London, Blackwells-NCC, 1994, p. 13.

¹⁷ Y. Bar-Hillel, *The present state of research on mechanical translation*, "American Documentation", 2 (1951) 4, pp. 229-237.

¹⁸ I. Mel'čuk, *Machine Translation and Formal Linguistics*, cit., p. 221.

The ALPAC Report did not have any effect on Ljudskanov and his team. Until the end of his life, he was in constant contact with the other groups and worked on various dictionary-based models and their modules for Russian to Bulgarian machine translation.

After Ljudskanov's death, long before the heyday of statistic-based MT in the 90s, the Bulgarian Machine Translation group ceased to exist. Indeed, the group started working again a year and a half later under the name "Linguistic Modeling Department (LMD)" and many of Ljudskanov's co-workers became its members, but the focus was now not on machine translation but on mathematical linguistics.

As predicted by Ljudskanov himself, his algorithms for translation from Russian to Bulgarian rapidly became outdated. The same is true about the idea that successful MT systems should imitate the behaviour of human translators and produce similar results. However, Ljudskanov's ideas about the semiotic nature of translation remain relevant even today.

Ljudskanov sympathized with the proponents of the so-called linguistic approach to translation. He rejected as biased and unscientific the ideas of the other major trend at the time, namely the literary approach to translation. His arguments were as follows: 1. the literary approach posits that literary translation is a form of art and, therefore, it requires a literary rather than a linguistic treatment; 2. when translating a literary work, the translator must take into consideration a whole series of extra-linguistic facts like 'world-view', 'style', 'emotional and historical context', and so on; 3. To consider these factors is to apply the literary approach – but Ljudskanov noted that the need for such extra-linguistic analysis is a consequence of the specificity of the natural language.

On the other hand, Ljudskanov pointed out that the opposing, so called linguistic approach, was unsatisfactory, too, for several reasons, among which he listed: 1. lack of a sufficient degree of abstraction: although the need for genre-independent analysis of the translation process is acknowledged, the linguistic approach has as its object of study mainly the translation of written texts; 2. the focus is shifted to the outcome of the translation process and not on the process itself; 3. there are no accurate methods of research and analysis and no formal model of the translation process.

Ljudskanov tried to overcome these weaknesses in his semiotic theory of translation. He posited that translation is any *inter* or *cross-semiotic transformation* where the output information is obtained from the input information by applying the relevant rules. Since it is a tool for communication "in the plane of two languages", translation must agree with its main purpose, namely, to provide *invariant information*. The notion of invariant information

Ljudskanov renders equivalent to another concept which plays a central role in his theory – *functional equivalent*, introduced as early as 1958.¹⁹ The process of translation itself must be seen through the prism of functional equivalents.

Ljudskanov was strongly influenced by the ideas of V. Rozencvejk and I. Revzin. They suggested that the translation process must be objectively modeled and studied and that machine translation can be used as a means of testing the hypotheses of the various theories of translation. One of their most original contributions is the separation of the two types of translation: *translation proper*, in which the translator generates the output code based only on the pre-established “correlation” between the two languages (that is, linguistic information), and *interpretation*, during which, on the basis of the input text, the translator describes extra-linguistic situation and then creates a new message.²⁰

Ljudskanov agreed with the implicit assumption in the above dichotomy that both machine and human translation should not be differentiated based on the genre of the translated text. He compared the process of translation from/to a natural language with the process of translation from/to a formal or artificial language. According to him, there is no creative work involved in the process of semiotic transformation between artificial languages.

The prerequisites to a successful mechanical transformation in this case come down to the availability of a complete description of the source language, the output language and the transformation rules between the two. It is this type of semiotic transformation that corresponds to translation proper.

In fact, the notion of *necessary information* was introduced in order to be used for the analysis of the dynamics of the translation from or to a natural language. It embraces a variety of data, such as information about the signified, contextual analysis, essential understanding on the level of the signifier, deep structure analysis (in this respect Ljudskanov follows the contemporary structuralist understandings), and extra-linguistic analysis.

The formalization and the study of these types of information is considered not only difficult but an impossible task: “As far as the so-called free-

¹⁹ “Functional equivalents are those constructional units of translation, those linguistic means that perform the same functions in the system of the context as the means of the original text in the system taken as a whole, and in their entirety provide the same conceptual, semantic, aesthetic and emotional functionality as the original text” (A. Ljudskanov, *Principāt na funkcionalnite ekvivalenti – osnova na prevodačesjoto izkustvo*, “Ezik i literatura”, 6 (1958), p. 359).

²⁰ A. Ljudskanov, *Preveždat čovekāt i mašinata*, cit., pp. 52-54.

dom of the translator is concerned, we should note that this freedom is actually the result of an insufficiently precise description of the linguistic facts”²¹

Another key concept in this semiotic theory is the *interlingua*, the intermediary language that each translation (human or machine) considered functional and operational, must go through. It is the indispensable correlation system used for the mapping of the signs belonging to two different languages, artificial or natural. For the members of a given language-group, the interlingua coincides with the natural language shared among the members of the collective. However, every translator has (at least) one other interlingua that can be used for facilitating the mapping of the linguistic-signs of two languages.

Unlike other authors, Ljudskanov did not think that the interlingua should be universal and/or unique. On the contrary, he argued that different systems could be used as such. Of course, he was familiar with the ideas of the universal interlingua and the semantic components. As far as the latter are concerned, he did not think that their use should be compulsory.

We could safely claim that Ljudskanov’s ideas about the nature of the translation process were implemented in the architecture of the translation systems developed by his team. These systems used the most basic direct machine translation strategy, based on glossaries and morphological analysis without conversion to interlingua, but with added syntactic modules for word-sense disambiguation which was one step further on the path to building a higher generation rule-based MT system (Fig. 1).

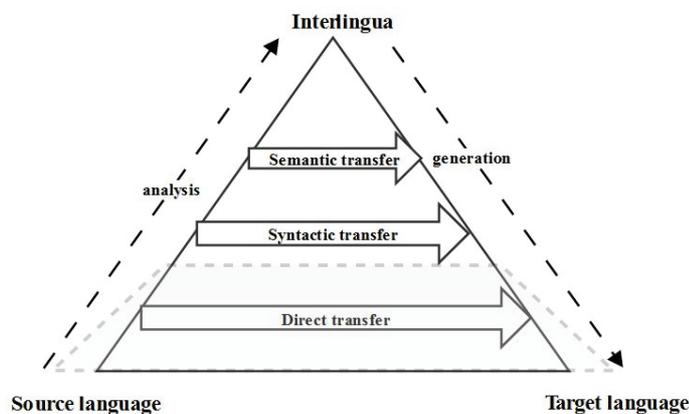


Fig. 1. The Vauquous triangle.

²¹ A. Ljudskanov, *Preveždat čovekāt i mašinata*, cit., p. 136.

Whatever the value of Ljudskanov scientific contributions is, as a practicing translator he strived to grasp and decode the essence of translation as a process, and thus, to build matching algorithms. Many of his ideas have been surpassed; some were rejected as naive or controversial. Nevertheless, he will be remembered as a hardworking enthusiast who embodied the ‘romantic spirit’ of Machine Translation in Bulgaria.