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SCIENTIFIC TRANSLATION AS AN EVOLVING SUBDISCIPLINE OF TRANSLATION STUDIES

This review paper analyses the essential conditions for defining scientific translation as one of the distinct subfields of the Translation Studies that is currently given growing research attention. The main objective is to highlight the development of scientific translation studies as a subtype of specialised non-literary translation. Our research revises the views of the leading scientific translation theorists concerning the necessity and possibility of formation of a special theory of scientific translation, with criteria and research principles analysed. The article summarizes the translation relevant features of the language of science that play a significant role in defining major problems of translating scientific texts (lexical, grammatical, stylistic and genre, textual problems). Selected difficulties are illustrated by an example of the Ukrainian physics text rendered into English, with the analysis of translator's solutions that helped bridge these difficulties and bring the translated text in conformity with the target language norms, with regard to the scientific English regulations. The paper outlines the scope and perspectives of scientific translation as a separate research area within the translation science that is highly likely to evolve with time into a special theory of scientific translation.

Keywords: science, scientific translation, Translation Studies, theory of scientific translation, translation relevant features of scientific texts, research methods and principles.

In spite of its significant role in the profession, the activity of translating science has been a rather underresearched area of Translation Studies. Translation scholars have devoted great research effort to literary translation, even though most professional translations deal with texts from scientific, technical, legal, commercial and other non-literary domains. What is more, it is

undeniable that translation has played a vital role in disseminating scientific knowledge across cultures and times. In this sense, it is important to investigate the present-day position of scientific translation, with regard to its high research potential, hypothesizing on the issue of establishing a special theory of scientific translation within the general theory of translation.

As viewed by K. Károly (Károly, 2022, p. 340), in a broad sense, the translation of academic texts has been paid less research attention than other areas of non-literary translation (news translation, legal or business translation, etc.) despite the crucial role of translation in the evolution of scientific thinking and international scholarly communication (Károly, 2022, p. 340). As the author importantly states, within a large number of contrastive studies on academic genres, only a few can be further applied in Translation Studies. But, fortunately, the mid-1990s have seen the growth of research interest in the translation of academic texts in general and scientific texts in particular, largely due to the development of research methods within Translation Studies and the increased use of English as the *lingua franca* of international scholarly communication (Károly, 2022, p. 340).

A shift in research focus – from prevailing literary translation works to the study of non-literary translation – can be witnessed in the Routledge Encyclopaedia of Translation Studies, the first substantial reference work for Translation Studies. Its first edition (Baker, 1998) contains no mention of special translation theories, while its second edition (Baker, & Saldanha, 2009) presents the entries on specialised translation – commercial translation, institutional translation, scientific and technical translation, the latter being discussed undividedly. In the third edition (Baker, 2019), one can trace the evolution of specialised translation, with separate subfields branched out, such as legal translation, scientific translation, with technical translation in perspective. And there appear more and more related research articles in academic journals.

We totally agree with M. Olohan (Olohan, 2007, p. 133) that it is practical at this point to investigate the distinction between technical translation and scientific translation, which used to be referred to as the binomial phrase "science and technology". The current research has proved that science and technology are quite

distinguishable from one another – we can take as generally accepted that technology is the application of scientific knowledge for practical purposes (Olohan, 2007, p. 133). Technical translation can thus be interpreted as the translation of texts about how scientific knowledge is put to use (Byrne, 2006, p. 3). Our further remarks in this paper will be on the translation of scientific texts as a research area that has all grounds to develop into a separate subfield of Translation Studies.

Following M. Olohan (Olohan, 2019, p. 510), we can state that approaching the research questions and issues applicable to scientific translation, one needs to consider two fundamental concepts – science and translation. The concept of translation is under strict investigation by translation theorists who try to better understand the place of translation in the world. The concept of science, the same complex, is critically examined by a different body of scholarship. Here we can observe the intersecting fields of science studies, science and technology studies (STS), and science, technology and society (also STS) in their attempt to better figure out the place of science in the world. Both science studies and translation studies are interdisciplinary in their nature, they make use of a great number of theoretical and empirical approaches to consider historical, philosophical, social, cultural and political issues. The author concludes that the understanding of the place of scientific translation in the world may thus benefit greatly from scholarship at the confluence of these two disciplines (Olohan, 2019, p. 510).

With regard to scholarly contributions, it should be noted that most of publications on scientific translation before the 2000s were written as textbooks for translators and translation students. Earlier scientific works developed a fundamental conception of science as knowledge and a notion of scientific discourse as "communication of invariant referential meaning" (Olohan, 2019, p. 511). Following the growing demand for rules and regulations, translation theorists, being experienced translators themselves, produced in the 1960s–1980s such manuals for those engaged in translation of scientific and technical texts. Primarily most of such works were used as textbooks teaching what translation techniques are instrumental in striving for terminological accuracy and precision of expression. A few works reflected the

translator's development of conceptual scientific knowledge and understanding. Since the 2000s, guides to scientific translation have demonstrated a deeper understanding of the social and cultural importance of scientific translation, providing a much more contextualized consideration of scientific communication, with a more detailed description of professional scientific and technical communication and focus on specific scientific genres (Olohan, 2019, p. 511).

However, many of the earlier works on scientific translation that focused more on textual analysis understood scientific texts as fulfilling just informative or referential functions. This led to a popular belief that scientific translation is easier than translation of literary texts, in part because of the universal nature of the language of science. But one cannot help mentioning the significant expressive and operative functions of scientific discourse that enable authors "to construct meanings, make claims, challenge others, enrol allies and preempt contestation, seek to build consensus within a scientific community, exclude or include non-members of that and other communities and establish and drive research agendas" (Olohan, 2019, p. 511). Lack of understanding of the role of these social and rhetorical functions of scientific discourse can result in concentrating on precision of terminology and accuracy of description. This view of science may account for a certain lack of research interest to social and textual practices of scientific translation while those of literary translation were broadly investigated (Olohan, 2019, p. 511).

Despite the fact that science has been a rather neglected area of translation studies, scholars of translation have much to offer the researchers of science – sociologists and historians of science, as they perfectly understand the role that translation can play in "hampering or propagating established discursive practices" (Károly, 2022, p. 341). Sociologists and historians of science carefully examine agents (and they are not often translators) and the power relations which impact on them in their production of knowledge. The significant role of translation in the performance of science becomes better understood and translation practices start to be studied as integral components of scientific practices, especially "in relation to tools, technologies and sociotechnical developments in translation" (Károly, 2022, p. 341).

Translation has had a powerful influence on the construction of science, too. As S. Montgomery demonstrates, "translation has been instrumental in the creation of astronomy in both the West and the East, in the formation of Arabic science, in the establishment of Latin as the *lingua franca* of science in the medieval world, in the evolution of modern science in the non-Western world and in making English the "new Latin" (Montgomery, 2000, as cited in Károly, p. 341).

Translation has a considerable impact on the creation and standardization of scientific terminology. Translators coin new words, create new linguistic metaphors which often become recognized scientific terms. What is more, "translation into or from the *lingua franca* has influenced patterns of thinking and shifts in the style of persuasion and in the establishment of new ways of organizing ideas, presenting arguments and ultimately a change of logic" (Montgomery, 2000, as cited in Károly, p. 342).

As viewed by K. Károly who outlined the disciplinary perspectives of academic translation in general and scientific translation in particular, the Translation Studies, when investigating the complex nature of this subfield of translation, collaborates with other disciplines: science and technology studies, cognitive linguistics, terminology studies, text linguistics and discourse analysis. Within the science of text, relevant subfields include languages for specific purposes (LSP), English for academic purposes (EAP), genre analysis, contrastive rhetoric, corpus linguistics, critical discourse analysis, English as a *lingua franca* and international English (Károly, 2022, p. 343).

Another important issue in the research into scientific translation is the methodology problem which concerns the research methods that can be potentially used in the study of translating academic texts. As K. Károly mentions (Károly, 2022, p. 343), the study of translating academic texts has been boosted by globalization and the quick spread of English as the *lingua franca* of communication. Since the 1990s, significant contributions to academic translation have been made, for example, by target-oriented contrastive research aimed at identifying features of translated language by comparing it with non-translated language produced in a target culture. Scientists in the field have applied a corpus-based methodology and corpus linguistic tools to test hypotheses about universal features

of translation, the translation of lexical elements or jargon, textual features or theme–rheme relations. Other research techniques involve manual text analyses (based on discourse analysis), computer-based text analyses (with large corpora and computerized search techniques to provide quantitative evidence for or against hypotheses), translators' interviews, focus groups (to probe the findings of product-oriented analyses), surveys, experimental designs, combined corpus and experimental study designs, etc.

Later research, as K. Károly describes, included contrastive, empirical studies to observe translators working in different communicative situations. Comparisons, thoroughly planned, usually involve source and target texts, translated and non-translated texts (i.e. originals in the target language). For instance, there has been developed a model for target-oriented corpus-based contrastive analysis (CA) which included three steps: (1) linguistic data collection; (2) establishing criteria for comparison, defining linguistic variables and testing these statistically to obtain baseline data; and (3) contextual analysis. The target-oriented quantitative CA applied to a fairly large corpus was found to be efficient since it ensures valid empirical data and understanding of the translation process that may be later beneficial in translator training and practice. In multilingual research, corpora can be parallel (consisting of original texts and their translations) or comparable (containing texts in two or more languages, collected according to identical criteria). Later on three corpora were used – a translation corpus (original texts and their translations), a comparable corpus (source and target non-translated texts from the same genres with comparable topics, serving as a reference corpus) and a validation corpus. The purpose of the last one was to validate the results of the text analyses from the translation corpus and the comparable corpus. It consists of translations from the same genres into the opposite direction (Károly, 2022, p. 345).

As one can see, the research on translating texts for academic purposes is plentiful and multi-focused, it requires not only practical but also theoretical investigation, facilitated by constantly emerging modern translation tools and the dynamically evolving methodological base of Translation Studies. In our review, we will concentrate on texts from the domain of science – a perspective underresearched

area, with rich empirical material accumulated that awaits its comprehensive theoretical study.

As M. Olohan rightly notes (Olohan, 2013, p. 433), the translation of science has a vast scope to be studied both more broadly and more deeply. "Alongside the traditional sources of inspiration for Translation Studies, disciplines like history of science, sociology of science and rhetoric of science offer tools and a considerable body of research which can inform studies of translations and translators of science". There is no shortage of research material in the field. Perhaps, the main challenge for translation theorists is to formulate and frame research questions about the translation of science in a way that can interest specialists of those other disciplines, providing for perspective collaborations and enabling multidimensional research projects "to address many of the complexities of the role played by translations and translators in the production and circulation of scientific knowledge" (Olohan, 2013, p. 433).

As for research questions, data and methods for translation scholars, bearing in mind the scarcity of research on scientific translation until now, it is quite possible to find aspects of scientific translation which need thorough theoretical attention, with a number of research questions to be formulated. As viewed by the prominent scientific translation scholar M. Olohan (Olohan, 2007, p. 139), these questions might cover the following issues: 1) norms of scientific translation dominant at a certain period of time in a certain culture concerning a certain language or language pair; 2) language features frequently occurring in scientific translations; 3) networks in which translations are produced; 4) profile, motivation, status, etc. of translators of scientific texts; 5) reception of scientific translations, with the view of how the availability of translations impacts on the spread of scientific ideas and methods, what not.

As analysed by M. Olohan (Olohan, 2007, p. 140), studies aimed at investigating these aspects of scientific translations need corpus-based methods, those used in relation to literary or journalistic texts to study translation strategies, linguistic patterning in translations, creative or conventional use of language by translators, simplification or explicitation in translation, translator's style, etc. An example of such a corpus is the Translational English Corpus at the University

of Manchester which was developed specifically to study the nature of translated language, but its texts are mostly literary. Scientific translation as an evolving subdiscipline requires similar systematic collections of scientific texts and their translations. Very much needed is the research with parallel corpora (science texts and their translations) and comparable corpora (e.g. scientific translations and comparable scientific texts in the same language), and combinations of both of these corpus configurations. And here the scientific translation can borrow the successful practices from corpus linguistics, corpus-based translation studies, descriptive translation studies, studies of rhetoric and style, discourse analysis, etc. However, not all the scientific texts and their translations are part of such corpora – left out are source texts that could be brilliant examples of language and style and their best translations, which makes them a valuable research material that enables to formulate solid theoretical grounds for a perspective special theory of scientific translation (Olohan, 2007, p. 140).

In complement with the studies of translations and paratexts, other data sources are needed to investigate the broader aspects of the translation of scientific texts, to determine what is translated and why, by whom, as well as to trace the impact and importance of the translation activity. Among such well-known resources that provide starting points for research in contemporary scientific translation is the UNESCO's Index Translationum which rests upon bibliographical data provided by member state publishers. It is a cumulative index of book translations (around 1.5 million translations, computerised since 1979) in various fields: philosophy, religion, social sciences, law, economics, natural sciences, medicine, science and technology, agriculture, management, architecture, art, history, sport, biography and literature. The collection, upgraded each year, represents over 500 languages and a quarter of a million authors. Though instrumental, the Index cannot be considered to give a complete account of all translations published – it contains books translations only. Despite this, the collection may be used to mark current trends in translation activity and single out domains of research interest (Olohan, 2007, p. 141).

Concluding her research, M. Olohan highlights the fact that the study of scientific translation can take on diverse forms and

directions. Research on scientific communication gives some frameworks and insights which scientific translation scholars can use along with approaches and methods that have already been applied in the investigation of other genres in Translation Studies. "Through cross-fertilisation and the application of a range of research methods, it should be possible for us to produce more theoretically and empirically grounded studies of scientific translation than has hitherto been the case" (Olohan, 2007, p. 142).

All things considered, the research on translating scientific texts is multifaceted and prospective and it has all grounds to develop into a special theory of scientific translation, provided that major recent theoretical works in the field are systematised.

As V. Karaban states (Karaban, 2012, p. 26), special translation theories deal with translation of specialised texts meaning texts of a certain subject area. A special translation theory is designed to determine, describe and explain the principles, regulations and problems in translating specialised texts. It should not only explain specific features of rendering particular styles and genres but also interpret the process of specialised translation and generally predict the result of such translation (Karaban, 2012, p. 26).

The researcher asks a further question – which is the best developed special translation theory in Ukraine and which is the worst developed one. The literary translation theory is an actively evolving field, what cannot be said about special translation theories (Karaban, 2012, p. 27). Important and yet unsolved is the issue of how many special translation theories can be and should be developed practically. Is it possible to create special translation theories for texts from each of the numerous subject fields? Which special theories deserve priority development?

Further in his paper, V. Karaban (Karaban, 2012, p. 27) formulates the main criteria for establishing the necessity of creating a special translation theory, of which the most relevant for scientific translation theory are the following: 1) a large number of lexical, grammatical, textual and pragmatic translation features; 2) a special status of translated texts; 3) specific lexical units that may not be present in the target language; 4) numerous clichés and fixed phrases with no direct translation equivalents. Accordingly, special translation

theories that are likely to appear are legal translation theory, military translation theory, economic translation theory, medical translation theory, technical translation theory, publicist translation theory and others. One of the main preconditions for this, as V. Karaban states, is the accumulated translation material sufficient for such a theory.

Similarly to the general translation theory, one can specify the following central principles of construction for special translation theories: 1) the principle of identifying and accounting for peculiar features of a certain type of special translation; 2) the principle of scientific description of the process of special translation as a set and order of translator's actions on converting a source text into a target one; 3) the principle of identifying the type of adequacy for a particular type of special translation; 4) the principle of classifying this special translation into types, depending on styles, genres and kinds of special texts; 5) the principle of description completeness rate for this type of special translation; 6) the principle of establishing the general objective regularities of special translation; 7) the principle of identifying specific language regularities of special translation (Karaban, 2012, p. 28).

Following the pattern of the legal translation theory, as exemplified by V. Karaban (Karaban, 2012, p. 28), let us consider the perspectives of formation for a special theory of scientific translation, viewed separately from the technical translation, which is also an object of extensive research. Translation of scientific texts has always been of great demand in the market of translation services, both in Ukraine and in the world. Scientific translation practices are widely discussed in academic publications, while theoretical translation issues are somehow left aside, possibly due to supposed difficulties in studying the translation of texts for academic and research purposes.

Historically, "translation of science is as old as science itself" (Montgomery, 2010, p. 299), taking into account its role in collecting and spreading knowledge. Scientific knowledge has proven to be a mobile form of culture. And it is translation that has made this knowledge mobile. As S. Montgomery notes (Montgomery, 2010, p. 304), the growing demand for translation of scientific texts is substantiated by the spread of English and its influence on changing social practices in science itself. Such practices are closely connected to the internet

as a new core medium in science. Of great importance is the growth of international research into the translation of scientific materials, contributed by multinational teams of scholars.

Scientific translation has over time accumulated a large amount of research material, and it is gradually evolving into a special research field. It has applied various translation methods, what is proved by a close study of methods during the major historical episodes of translation (Montgomery, 2010, p. 301). Sometimes translators worked alone, in other cases with mediators using both oral and written methods. Sometimes a third language was used, in which both mediator and translator were fluent.

Modern professional scientific translators work one-on-one with a text, but mediators and advisors are still used, for example if a translator's knowledge of the target language or discipline is imperfect (Montgomery, 2010, p. 302). A growing number of translators now have scientific training. Translators of scientific texts use specialised dictionaries, tending to work in specific fields. Since the turn of the millennium, translator's work has been facilitated by digital tools, which "has inevitably increased in depth and sophistication" (Montgomery, 2010, p. 302). Such tools have little decreased the need for human translation, as high demands in scientific translation cannot be met without a human expert.

Another supporting argument for human translation is that science terminology requires for precision. Before the 20th century, scientific language shared many elements with learned discourse in general, thus making translation methods and approaches intersect with literature and other areas (Montgomery, 2010, p. 302). At present, science is strongly based on highly specialised and continuously developing technical vocabularies, which can be quite demanding for the scientific translator. Incorrect translation of scientific terms can seriously damage the quality of such translation. What is more, a science translator can coin new terms, which is viewed "as a measure of scientific advance, involving new discoveries and development of new subdisciplines" (Montgomery, 2010, p.302), what presents new demands upon translators. Scientific terminology has been mostly coined in English, since at least the 1980s, and today the process is on.

It is commonly understood that to provide for high quality translation of scientific materials, so various nowadays, it is strongly required for a translator to have a solid theoretical basis. Generally accepted is the fact that translating science is a linguistically unsophisticated process, based on word-for-word rendering, though it is definitely false as scientific language is not universal; there is no one-to-one correspondence among different languages when they express scientific information (Montgomery, 2010, p. 302). And the translator needs to be really creative and competent, having in his arsenal a wide range of translation strategies and specific techniques to be able to adequately reproduce the given scientific message. Scientific translators produce cultural products that qualify as originals in the target language, and they are mighty actors in the globalization of knowledge (Montgomery, 2010, p. 302).

It should be briefly mentioned that scientific translation comprises specific forms that are "diverse and expanding" (Montgomery, 2010, p. 303). Some forms of translation activity include translation of a complete published text (article, report, etc.) from one language to another; translation of sections of a published text for personal, professional, or classroom use; translation of portions of a website for either professional or classroom use; translation of one's own writing (draft of an article, conference presentation) into English, either by oneself or a paid individual, or translation agency; partial translation of one's own writing, which is then sent to a colleague or editorial consultant for completion; translation of lab notes or experimental data or other infra-research material (likely into English) to be shared with co-authors or outside parties; reading and writing of emails and other correspondence in English, requiring mental translation or sometimes written translations; scripting or writing notes for a talk in one's mother tongue, which must then be translated into English for an international conference, what not (Montgomery, 2010, p. 303). All things considered, the practice of translating scientific texts provides rich material for establishing a special theory of scientific translation.

Scientific translation is thought by many translators and translation theorists as one of the most intricate types of written translation demonstrating the growing demand for experts able to

professionally render science materials. At the same time, scientific translation as an evolving subfield of Translation Studies needs solid theoretical grounds – it is essential to collect and review major published papers investigating scientific translation, unify its terminology, outline its specific principles and approaches, thus forming the methodology of this important subdiscipline.

In our view, as exemplified by V. Karaban (Karaban, 2012, p. 29) who described the formation of the legal translation theory, a special theory of scientific translation can be grounded on the following sections: lexical problems, grammatical problems, stylistic and genre problems as well as textual problems.

Investigating scientific texts, the general translation theory has been influenced by the studies of languages for special purposes (LSP) as a branch of applied linguistics that traditionally focused on terminology, but later on shifted to analysing the phraseology and syntax of specialised discourse and reaching the level of the text. LSP researchers have recently focused more on the communicative activity itself, referring to cognitive studies and communication theory (Olohan, 2013, p. 426).

And here one needs to consider some of the characteristics of languages for special purposes, in particular the translation relevant features of the language of science, as described by M. A. K. Halliday (2004, as cited in Olohan, 2022, p. 328) Outlining the difficulties of scientific writing in English, M. A. K. Halliday believes that terms themselves are not difficult to master, but more challenging are the relations between terms. Writing about "interlocking definitions", he analyses how groups of related concepts are referred to in texts and how terms are used to define other concepts, in order to enable the reader to understand all of them at the same time. Referring to "technical grammar", M. A. K. Halliday highlights that special expressions may be used in technical texts where grammatical structures are different from those of general language. Another feature of scientific writing is high lexical density which can be understood as packing lexical items tightly into grammatical structures, usually into noun phrases. The use of such nominal groups can be syntactically ambiguous because of possibly unclear relations between the different elements.

This selection of features is not exhaustive but rather indicative of how technical content may be analysed textually, particularly in relation to communicative purpose. As exemplified in M. Olohan (2016) and F. Scarpa (2020), these and other textual or syntactic features can require particular attention when translating various professional scientific and technical genres.

Let us now specify some major problems that may arise in translating scientific texts. As outlined by V. Karaban in his seminal manual (Karaban, 2004, p. 15), they are lexical problems, grammatical problems, genre and stylistic problems as well as textual problems. The scholar mentions that the division of complex translation cases into grammatical or lexical problems is rather tentative – in every language, grammar phenomena are closely connected with lexical phenomena and the ways grammatical forms and structures are rendered in translation often depend on their vocabulary load. The same grammar phenomenon can be translated differently depending on its lexical expression. However, there are certain general regularities of correspondence of grammatical forms and structures in source and target texts the translator must be knowledgeable about, to assess the opportunities he/she has to be able to adequately render the original grammar phenomena (Karaban, 2004, p. 15).

It is known that completeness and accuracy in translating scientific texts greatly depends on the translator's correct identifying and understanding grammatical forms, syntactic constructions and sentence structure. In brief, one can say that in translation, the knowledge of grammar and techniques needed for rendering grammar phenomena is much more important than the knowledge of terminology – term equivalents can be easily found in specialised translation dictionaries, while the process of searching for an equivalent of a grammatical form or a syntactic structure can be quite long if the translator does not know the translation match for a certain grammatical element (Karaban, 2004, p. 11).

As summarised by V. Karaban, the language of science differs from colloquial language or the language of literature in certain lexical, grammatical and stylistic features. If lexical dissimilarities are noticeable even to a non-scientist (these are mostly special lexis and terms), grammatical differences are less distinguished but the

same diverse. They are not inventory differences in the composition of syntactic structures or morphological forms, but differences in the functioning of grammatical elements. One of the most distinguished grammar peculiarities of scientific texts is a large number of composite sentences (mostly complex sentences) that are used to render logical relations between objects, actions, events and facts typical of the language of science. Scientific texts written in various languages also have significant grammatical differences due to divergent grammar structures of languages, norms and traditions of scientific writing. For instance, English language specialised texts, if compared to the Ukrainian ones, more often use passive voice, participle, infinitive, gerund constructions and other special structures (Karaban, 2004, p. 15).

As V. Karaban rightly concludes, obligatory for achieving faithful translation of scientific texts is the translator's ability to correctly analyse the grammar structure of an original sentence, to identify grammar challenges and build a translated sentence according to the norms of the target language and genre of the translated text. For this, the translator needs to be knowledgeable about grammar peculiarities of source and target languages, the basic concepts of general translation theory and scientific translation in particular, as well as translation techniques for rendering various language phenomena. Especially important for a science translator is to know the subject area of the text to be translated, to understand the meaning of the sentence, semantic relations between sentence parts and meanings of metatext elements that are part of text organization. Naturally, most of the grammar translation problems deal with understanding of the syntactic structure and morphological composition of sentences as language elements that are direct carriers of subject information (Karaban, 2004, p. 16).

In translation, all original text aspects are interrelated and the translator needs to process simultaneously grammatical, lexical, stylistic, general textual and communicative information. In particular, grammar depends on lexis – for instance, the grammatical meaning of a syntactic model can change depending on the words in a word group. Vocabulary also relies on grammar – a change in typical word combinability can bring about a new lexical and semantic variant

of a word thus coining a new word. Similarly, grammar and vocabulary are closely related to genre and style problems, as stylistic features of the text include the frequency of certain words, the use of certain grammar forms and structures. It is therefore untenable to study separately lexical, grammatical, terminological, genre and style translation problems – they should be analysed as a whole (Karaban, 2004, p. 273).

Lexical difficulties of scientific translation include polysemy of words (terms) and the choice of a proper dictionary equivalent of a word (term), the use of common words in scientific texts, application of proper vocabulary translation techniques, defining the boundaries of lexical transformations in translation, rendering neologic terms, abbreviations, pseudointernational words, homonymic terms, ethno-specific lexis, ethno-national term variation, foreign words and terms in English language science texts, proper names, etc. (Karaban, 2004, p. 273).

Genre and style difficulties may arise in rendering metaphorical phraseology terms, idiomatic and non-idiomatic phrases, clichés, colloquial elements used in scientific texts, as well as genre specific features of scientific texts such as instruction manuals, technical specifications, patents, etc. To address these problems, it is first of all important to be able to identify them, then to decide on translation techniques for rendering lexical elements, phrases and phraseological units, developing stable habits of handling various lexical, terminological and stylistic translation difficulties, with regard to target language genre and style norms (Karaban, 2004, p. 274).

Let us now consider some of the scientific translation problems that demonstrate its specific nature. For such analysis in terms of this paper, we suggest parallel Ukrainian-to-English translated texts from the research domain of physics recently published in the Ukrainian Journal of Physics. On its base, we will try to highlight the problems that contemporary translators face and the ways of their handling. We can preliminarily conclude that the translation difficulties, analysed in the context of sentence, mostly come from the differences in grammar structures of the Ukrainian and English languages as well as from different norms and traditions of scientific writing in these languages. The translator more often referred to

passive voice, infinitive and gerund constructions, other special structures, changed the word order (with regard to theme/rheme distinctions between the languages), used compact noun clusters, made other syntactic and lexical changes to bring the source text in conformity with the target language norms.

In most cases, the translator's solutions served the purpose of language compression, as wordiness is quite a serious problem in Ukrainian scientific writing. The following fragment is an example of a passive construction used to reduce the number of language elements in the sentence – a simple verb replaces a noun-verb phrase:

1. **Сублімацію** вихідної суміші C_{60}/C_{70} **проводили** з нагрітого керамічного тигля шляхом пропускання електричного струму через ніхромову спіраль (Gorishny, 2023a, p. 319). – *The initial C_{60}/C_{70} mixture **was sublimated** from a ceramic crucible heated up by passing an electric current through a nichrome spiral* (Gorishny, 2023b, p. 319).

Generally, passive constructions were quite frequent in the analysed translation, if compared with the Ukrainian original:

2. Плівки суміші C_{60}/C_{70} **наносили** на різні підкладки методом термічної сублімації у вакуумі 6,5 мПа (Gorishny, 2023a, p. 318). – *Films of the C_{60}/C_{70} mixture **are deposited** onto various substrates in a vacuum of 6.5 mPa using the thermal sublimation method* (Gorishny, 2023b, p. 318).

3. Далі в нашій роботі **ми позначаємо** цю суміш як C_{60}/C_{70} відповідно до її основних компонентів (Gorishny, 2023a, p. 319). – ***Hereafter**, this mixture **will be denoted** by C_{60}/C_{70} according to its main components* (Gorishny, 2023b, p. 319).

As to vocabulary, the translated text demonstrated high degree of equivalence – the translator carefully selected terminological matches both for special physics (**mixture**) and general science (**hereafter**) terms, in conformity with the norms of English scientific writing.

Nevertheless, sometimes Ukrainian passive structures were replaced with English active constructions:

4. У колонці 4 цієї таблиці **наведено** дані для спектра плівки C_{70} товщиною 20 нм (рис. 3) (Gorishny, 2023a, p. 320). – *Column 4 of this table **contains** data for the spectrum of the 20-nm C_{70} film* (Fig. 3) (Gorishny, 2023b, p. 320).

Another translation challenge in rendering Ukrainian scientific texts into English is typically long sentences that need to be divided – such is the rule of most English language guides on scientific writing (See Example 5). However, it is sometimes quite reasonable to unite in translation two or more sentences related to the same idea (See Example 6):

5. У [10] C_{60} і C_{70} були отримані методом Крачмера (Krätschmer) та ін. [11] з наступною їх екстракцією з бензольного розчину вихідної графітової сажі та очищенням колонковою хроматографією (Gorishny, 2023a, p. 318). – In work [10], C_{60} and C_{70} were obtained using the method of Krätschmer et al. [11]. **Then** they were extracted from the benzene solution of initial graphite soot and purified using the column chromatography method (Gorishny, 2023b, p. 318).

6. Енергії переходів гексанових розчинів C_{60} та їх природа наведено в табл. 1 (стовпчики 2 та 3, відповідно). Тут ϵ_2 – уявна складова діелектричної функції ϵ (Gorishny, 2023a, p. 320). – The energies of the transition in the spectra of the imaginary component ϵ_2 of the dielectric function of C_{60} hexane solutions (ϵ_2 -spectra), **as well as** their assignments, are quoted in Table 1 (columns 2 and 3, respectively) (Gorishny, 2023b, p. 320).

The translator of scientific texts should also have a clear understanding of the grammatical nature of source and target languages, keeping in mind that in the English language there are more verbal than nominal constructions, if compared to the Ukrainian language (see Examples 7 and 8):

7. За даними мас-спектрометрії [10], у **процесі синтезу** фулеренів утворюються молекули з різною кількістю атомів вуглецю, яка описується загальною формулою C_{2n} , де натуральне n число змінюється в межах 26–35 (Gorishny, 2023a, p. 318). – According to the mass spectrometry data [10], when **the fullerenes are synthesized**, molecules with various numbers of carbon atoms are formed. They are described by the general formula C_{2n} , where the natural number n varies from 26 to 35 (Gorishny, 2023b, p. 319).

8. **Для дослідження** оптичного поглинання тонкі плівки C_{60}/C_{70} різної товщини d в межах 25 ... 195 нм наносили на кремнеземні підкладки методом термічної сублімації у вакуумі 6,5 мПа (Gorishny, 2023a, p. 319). – **To study** their optical

absorption properties, thin C_{60}/C_{70} films with various thicknesses d within an interval of 25–195 nm were deposited onto silica substrates in a vacuum of 6.5 mPa using the thermal sublimation method (Gorishny, 2023b, p. 319).

The translator's grammar competence also allowed to adequately render the meaning of the sentence by using gerund instead of the noun and by making syntactic changes to bring the target sentence in accordance with the subject-verb order of the English sentence:

9. *При підгонці лінії спектра поглинання плівки C_{60} були знайдені Гаусіани для зон γ , B, D, F і G (Gorishny, 2023a, p. 320). – **When fitting the absorption spectrum profile of C_{60} films, the Gaussian functions for zones γ , B, D, F, and G were determined** (Gorishny, 2023b, p. 320).*

Sentence 10 is another example of grammar competence of the translator who made adequate word order changes with regard to theme/rheme distinctions between the two languages:

10. *Це означає, що в плівках C_{60}/C_{70} **основним компонентом є C_{60}** (Gorishny, 2023a, p. 320). – **This fact means that C_{60} is the main component in the C_{60}/C_{70} films** (Gorishny, 2023b, p. 322).*

Knowing the opportunities of the English grammar, the translator skilfully applied compression in rendering the Ukrainian descriptive word combination (Example 11) and made apt syntactic reconstructions (Example 12) to better express the cause-and-effect relations between the sentence members:

11. *Піки поглинання плівок C_{70} **зміщені в червону сторону** відносно відповідних піків його гексанового розчину [10, 23] (стовпчики 1 і 2) (Gorishny, 2023a, p. 320). – **The absorption peaks for C_{70} films are red-shifted with respect to the corresponding peaks for the C_{70} hexane solution [10, 23] (see Table 2, columns 1 and 2)** (Gorishny, 2023b, p. 320).*

12. *Отже, наведений вище аналіз спектрів поглинання (рис. 5) показав, що до складу плівки C_{60}/C_{70} входять C_{60} і C_{70} (Gorishny, 2023a, p. 323). – **Hence, from the above analysis of the absorption spectra shown in Fig. 5, it follows that both C_{60} and C_{70} enter the composition of the C_{60}/C_{70} film** (Gorishny, 2023b, p. 323).*

However, it is necessary to note that syntactic transformations must be used cautiously and strictly in accordance with the target

language syntactic norms – for example, to avoid placing the sentence predicate far from the sentence subject (Example 13), which contradicts the science language norms that recommend using subject and verb as close as possible:

13. У [16] **подано огляд** найважливіших теоретичних та експериментальних статей, спрямованих на з'ясування властивостей нижчих збуджених станів C_{60} та C_{70} (Gorishny, 2023a, p. 318). – **A review of the most important theoretical and experimental papers aimed at elucidating the properties of the lowest excited states in C_{60} and C_{70} was made in work [16]** (Gorishny, 2023b, p. 318).

The following sentences emphasize the importance of translator's knowledge of the subject area the source and target texts belong to. And this knowledge allowed him to use such translation techniques as addition (Example 14), modulation (Example 15), contextual replacements (Example 16). The analysed text fragments show that the translator is very much knowledgeable and experienced in physics:

14. Смуги поглинання плівок C_{60} і C_{70} зміщені в червону сторону відносно відповідних смуг спектрів їх розчинів, що зумовлено міжмолекулярною взаємодією у твердому стані (Gorishny, 2023a, p. 318). – **It was found that the absorption bands of the C_{60} and C_{70} films are shifted to the red with respect to the corresponding bands in the spectra of their solutions, which is a result of the intermolecular interaction in the solid state** (Gorishny, 2023b, p. 318).

15. Внесок C_{60} (лінія 4) у поглинання C_{60}/C_{70} оцінювали шляхом віднімання (Gorishny, 2023a, p. 322). – **The C_{60} contribution (curve 4) to the C_{60}/C_{70} absorption was calculated by subtracting the C_{70} spectrum (curve 3) from the mixture one (curve 1)** (Gorishny, 2023b, p. 323).

16. Тому дослідження спектрів поглинання розчинів і плівок чистих C_{60} та C_{70} є актуальним для ідентифікації цих речовин у твердих сумішах синтезованих фулеренів (Gorishny, 2023a, p. 319). – **Therefore, the study of the absorption spectra of the solutions and films of pure C_{60} and C_{70} substances is a challenging task for their identification in solid mixtures of synthesized fullerenes** (Gorishny, 2023b, p. 319).

An interesting translation solution was taken by the translator when rendering the same Ukrainian sentence fragment (Example 17

and 18) – to avoid tautology, he decided to use different translation techniques – a clause and a calque (with a transposition), respectively:

17. *Відносна інтенсивність цієї смуги зростає зі збільшенням товщини плівок C_{60}/C_{70} (табл. 3, рядок 10) (Gorishny, 2023a, p. 324).* – *The relative intensity of this band **increases as the thickness d of the C_{60}/C_{70} film grows** (Table 3, row 10) (Gorishny, 2023b, p. 323).*

18. *Їх відносна інтенсивність зростає зі збільшенням товщини плівок C_{60}/C_{70} (Gorishny, 2023a, p. 324).* – *Their relative intensities increase **with the increasing thickness of the C_{60}/C_{70} films** (Gorishny, 2023b, p. 324).*

Multi-component terms peculiar of scientific texts were translated as compact noun clusters:

19. *Молекулярний квазисферичний кластер C_{60} утворений 12 п'ятикутними і 20 гексагональними гранями з 60 атомами карбону в їхніх вершинах (Gorishny, 2023a, p. 318).* – *A **molecular quasi-spherical cluster C_{60}** is formed by 12 pentagonal and 20 hexagonal faces with 60 carbon atoms at their vertices (Gorishny, 2023b, p. 318).*

All things considered, our research proves that it is important for scientific translators to be highly-trained in the subject area the original and translation belong to, to be knowledgeable about the basic rules of transition from the source to the target language, to be competent in using complex translation transformations (lexical, grammatical, stylistic), to observe the norms of the language of science.

All the above said gives a sufficient ground to consider a special theory of scientific translation a promising subdiscipline within the Translation Studies, with its own criteria, founding principles, research principles and approaches, specific methodological principles that yet need to be formed. It is a well-demanded translation type that requires a comprehensive methodological research, which will definitely strengthen the general theory of translation.

REFERENCES

- Baker, M. (Ed.). (1998). *Routledge Encyclopedia of Translation Studies*. Routledge.
- Baker, M., & Saldanha, G. (Eds.). (2009). *Routledge Encyclopedia of Translation Studies*. (Ed.). Routledge.

Baker, M., & Saldanha, G. (Eds.). (2019). *Routledge Encyclopedia of Translation Studies*. (Ed.). Routledge.

Byrne, J. (2006). *Technical Translation: Usability Strategies for Translating Technical Documentation*. Springer.

Halliday, M. A. K. (2004). *The Language of Science* / J. J. Webster (Ed.). Continuum.

Karaban, V. I. (2004). *Translation of English Scientific and Technical Literature: Grammar Difficulties, Lexical, Terminological and Genre-Stylistic Problems*. Nova Knyha [in Ukrainian]. [Карабан В.І. (2004). *Переклад англійської наукової і технічної літератури. Граматичні труднощі, лексичні, термінологічні та жанрово-стилістичні проблеми*. Нова книга].

Karaban, V. I. (2012). Special Translation Theories: How Many of Them Do We Need? *Naukovi zapysky. Series "Philological sciences (linguistics)"*, 104(1), 26–31 [in Ukrainian]. [Карабан, В.І. (2012). Спеціальні теорії перекладу: скільки їх (потрібно)? *Наукові записки. Серія "Філологічні науки (мовознавство)"*, 104(1), 26–31].

Károly, K. (2022). Translating Academic Texts. In K. Malmkjær (Ed.), *The Cambridge Handbook of Translation*. (pp. 340–362). Cambridge University Press.

Montgomery, S. L. (2000). *Science in Translation. Movements of Knowledge Through Cultures and Time*. University of Chicago Press.

Montgomery, S. L. (2010). Scientific Translation. In Y. Gambier, & L. van Doorslaer (Eds.), *Handbook of Translation Studies: vol. 1*. (pp. 299–305). John Benjamins Publishing Company.

Olohan, M. (2007). The Status of Scientific Translation in Translation Studies. *Journal of Translation Studies*, 10, 133–144.

Olohan, M. (2013). Scientific and Technical Translation. In C. Millán, & F. Bartrina (Eds.), *The Routledge Handbook of Translation Studies*, (pp. 425–437). Routledge.

Olohan, M. (2016). *Scientific and Technical Translation*. Routledge.

Olohan, M. (2019). Scientific Translation. In M. Baker, & G. Saldanha (Eds.), *Routledge Encyclopedia of Translation Studies*. (pp. 510–514). Routledge.

Olohan, M. (2022). Translating Technical Texts. In K. Malmkjær (Ed.), *The Cambridge Handbook of Translation*. (pp. 321–339). Cambridge University Press.

Scarpa, F. (2020). *Research and Professional Practice in Specialised Translation*. Palgrave–Macmillan.

SOURCES

Gorishny, M. P. (2023a). Surface Morphology of the Films of the C_{60}/C_{70} fullerene mixture. Identification of C_{60} and C_{70} in the C_{60}/C_{70} Films Using Absorption Spectra. *Ukrainskyi fizychnyi zhurnal – Ukrainian Journal of Physics*, vol. 68, 5, 318–327 [in Ukrainian]. [Горішний М. П. Морфологія поверхні плівок суміші фулеренів C_{60}/C_{70} . Ідентифікація C_{60} та C_{70} у плівках C_{60}/C_{70} за їх спектрами поглинання]. *Український фізичний журнал*, т. 68, 5, 318–327. <https://ujp.bitp.kiev.ua/index.php/ujp/article/view/2023087/2985>.

Gorishny, M. P. (2023b). Surface Morphology of the Films of the C_{60}/C_{70} fullerene mixture. Identification of C_{60} and C_{70} in the C_{60}/C_{70} films Using Absorption Spectra (*O. Voitenko, Trans.*). *Ukrainian Journal of Physics*, vol. 68, 5, 318–327. <https://ujp.bitp.kiev.ua/index.php/ujp/article/view/2023087/2984>.

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НАУКОВИЙ ПЕРЕКЛАД ЯК ПЕРСПЕКТИВНА ПІДДИСЦИПЛІНА ПЕРЕКЛАДОЗНАВСТВА

У статті проаналізовано передумови для визначення наукового перекладу як однієї з підгалузей сучасного перекладознавства, з огляду на зростання дослідницького інтересу до перекладу наукових текстів. Висвітлено особливості формування наукового перекладу окремо від технічного перекладу. Підсумовано погляди теоретиків наукового перекладу на необхідність та можливість формування спеціальної теорії наукового перекладу, із власними критеріями, принципами побудови, методами та підходами, методологічними принципами. Окреслено релевантні для методології дослідження перекладу риси наукових текстів, що можуть відігравати важливу роль у визначенні основних проблем перекладу. Труднощі, з якими може стикатися перекладач наукових текстів, проілюстровано на прикладі перекладу української статті з галузі фізики. Наведено аналіз перекладацьких рішень, спрямований на вирішення таких проблем і встановлення відповідності

нормам наукового викладу і нормам мови перекладу загалом. У статті окреслено діапазон та перспективи розвитку спеціальної теорії наукового перекладу як окремої галузі науки про переклад.

Ключові слова: *наука, науковий переклад, перекладознавство, теорія наукового перекладу, релевантні для перекладу риси наукових текстів, методи та принципи дослідження.*

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