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CURRENT THEORETICAL APPROACHES TO SCIENTIFIC TRANSLATION: A CONTRASTIVE RESEARCH

Background. *The relevance of this research is determined by the immediate need of scientific translation as a progressively developing subfield of Translation Studies in developing its own methodological principles and approaches within the framework of the general theory of translation. The article considers the latest theoretical approaches and tests their applicability to specialised translation, in particular to the translation of scientific texts.*

Methods. *The study employs general scientific methods of analysis, synthesis, classification, systematization, descriptive analysis, as well as specialized research methods of discourse analysis, comparative translation analysis.*

Results. *This review paper has analysed the existing theories of translation according to their orientation on the source text and/or target text against the background that the source text was previously considered as the most important element in translation. In our research, we have traced in the translation theory a shift of focus away from source text frameworks towards a more communicative approach in terms of which translation is now viewed as a communicative process with the guiding factors of the message and the recipient. As to approaches that could be instrumental in analysing specialised translation in general and scientific translation in particular, we have found it useful to apply a more balanced notion of equivalence called pragmatic equivalence ("functionality plus loyalty" model), which could be a useful guide for specialized translators in their professional activity. Importantly, in this dynamic notion of equivalence the accent is not on the supremacy of either the source text or the target text but on the equal significance of the two. In our research, we have investigated the types of equivalence achievable in scientific translation – referential, pragmatic, text-informative. In particular, we looked into the pragmatic equivalence of analysed research articles and their translations, while specifying the translators' orientation on source or target text.*

Conclusions. *Our analysis has proved that modern translators of scientific texts try to maintain a balanced attitude towards the source and target texts, with equal attention to both texts, which is definitely helpful in choosing appropriate translation solutions and achieving a pragmatically successful translation.*

Keywords: *specialised translation, scientific translation, translation theory, source-oriented approach, target-oriented approach, translation equivalence, referential equivalence, text-normative equivalence, pragmatic equivalence.*

Recent years have seen a significant shift of research interest towards specialized translation due to the growing demands of technology, globalization, and diverse professional fields. Translation scholars in their research are moving beyond general linguistics and focusing more on expert domains – legal, medical, scientific, technical – to explore challenges of translating specialised texts for specific audiences, which requires a deeper analysis of theory and practice.

In our research, we will focus on scientific translation as one of the highly-demanded types of translation activity. Originally being investigated together with technical translation, scientific translation is now viewed as a separate area of specialised translation. Previously the translation of scientific (broadly called academic) texts was given little theoretical attention, but now it is becoming a promising subdiscipline of Translation Studies, which is yet to develop its own methodology – criteria, founding principles, research principles and approaches, specific methodological principles in particular. Among a large number of contrastive studies on academic genres, only a few could be applied in translation research (Károly, 2022, p. 340). But, much to the translation scholars' delight, the mid-1990s gave considerable growth to theoretical investigation of translation of academic texts in general and scientific texts in particular. This became possible primarily due to the development of research methods within the general theory of translation and the growing use of English as the lingua franca of world scholarly communication (Károly, 2022, p. 340).

In keeping with a broad definition of scientific and technical translation as 'translation of expert-to-expert writing in the theoretical and applied fields of the natural sciences, engineering and technology' (Krein-Kühle, 2011, as cited in Károly, 2022, p. 342), for the purpose of our research we will use, following K. Károly, the term 'scientific translation', also broadly, to refer to the 'translation of expert-to-expert writing in the theoretical and applied fields of the natural and social sciences in communication for both research and



academic purposes' (Károly, p. 342). This field identifies three main forms of translation: (1) interlingual translation (or translation proper), to be used by scholars who cannot read and/or write in certain relevant languages. The translation process here is practically invisible as the (translated) texts (research articles, monographs, etc.) are perceived not as translations but as 'local' texts, and their translators are not overtly recognised – readers perceive a translation as the original. As it is generally accepted, dominant here is a target-oriented approach (Toury, 1995) that assumes adherence to target language norms and emphasizes the acceptability of the translation. Failing to comply with the rules and norms of the target culture, the (translated) research article risks to be rejected by the academic journal (Károly, 2022, p. 342). This kind of translation is also referred to as covert (as opposed to overt) translation (House, 1997); (2) self-translation (Bassnet, 2013; Rabacov, 2013) or auto translation (Grutman, 1998). Self-translators have command of the two languages, write their work in one language and then render it into the other (Grutman, 1998, p. 18); (3) researchers' own scientific papers, written in the relevant language, which is usually English, irrespectively of their proficiency. The goal here is to get published in English language international journals (Snell-Hornby, 2006; Pisanski Peterlin, 2008).

In the second, practical part of our paper, we will investigate the translation of the Ukrainian language research articles for the English-language version of the high-rank Ukrainian scientific journals. We will consider a case of interlingual translation, performed by a subject-matter specialist whose name is stated in the article (Ovsak, 2025a, b). The second case study (Biliak, 2025a, b) is presumably a self-translation, with the translator's name not mentioned. The empirical material will be analysed with the purpose of illustrating the prevalent approaches applicable to translating scientific texts that are discussed in the first, theoretical part of our research.

To begin with, it should be noted that, as viewed by J. Byrne (Byrne, 2012, p. 8), one of the most difficult aspects of translation theory is that scientific and technical translation have long been bypassed by scholars, and there is no theory that specifically describes scientific and technical translation. Some models have formed as general theories of translation, others have originated from particular types of translation (literary translation, bible translation). One can barely apply any of the available theories to scientific and technical translation.

Difficulties may be caused, as A. Chesterman (Chesterman, 2000, as cited in Byrne, 2012, p. 8) emphasizes, by the fact that many theories of translation 'adopt a binary approach to translation consisting of diametrically opposed extremes'. Some examples of this include formal vs. dynamic equivalence (Nida, & Taber, 1969), semantic vs. communicative (Newmark, 1977) and covert vs. overt (House, 1977). This approach definitely strives to make the theories easier to describe, however, it makes the translation process somewhat oversimplified. Translation, of course, has 'shades of grey' – new scenarios, unexpected combinations of factors, etc. This means that 'trying to shoe-horn a translation into one category or the other is often uncomfortable, if not impossible. Conversely, having too many categories or options can make classifying a particular translation scenario equally challenging' (Byrne, 2012, p. 8). A lot of significant research has been done in the domain of Languages for Special Purposes and text typologies. But there is still a lot to be done to comfortably apply a theoretical model to scientific and technical translation.

When trying to place scientific translation within a theoretical framework, we first need to look at the general, most prevalent, theoretical approaches to translation.

Translation scholars can broadly group the existing theories according to their orientation on the source text (ST) and/or target text (TT). Traditionally, the source text has been considered as the most important element in translation, since it is the starting point for the whole translation process and the basis upon which target texts are produced (Byrne, 2012, p. 9). But recently, the translation theory has shifted its focus away from source text frameworks towards a more communicative approach – translation is now viewed as a communicative process with such guiding factors as the message and recipient, i.e. the content and the target audience. And this makes the investigation of translation more distinct and understandable as we can relate it to actual real-world events with real participants (Byrne, 2012, p. 9).

However, very often in translation theory, there are cases when these two categories – source text and target text – overlap: a theorist may apparently adhere to the target text norms, while there may be varying levels of orientation on the source text in terms of different theories (Byrne, 2006, p. 25). The generally acknowledged division of theories into source- and target-oriented is not questioned at all, but here appears an idea of possible balanced attitude of the translator towards the source and target texts. The question here is how to place specialised translation in general and scientific translation in particular within a certain theoretical framework.

Nevertheless, there is a helpful idea where to start from – and this idea presented by G. Toury (Toury, 1995) is that translation is greatly influenced "by two major roles: 1) the translation is a text in a particular target

language and culture, and 2) the translation constitutes a representation in one language of another text existing in another language and culture" (Toury, 1995, as cited in Byrne, 2006, p. 25). G. Toury further explains that a translator makes a choice between the requirements of the two different roles, and this is an initial norm. This choice, depending on which role he/she preferred, determines whether the translation can be treated as adequate or acceptable. Thus, G. Toury states that "whereas adherence to source norms determines a translation's adequacy as compared to the source text, subscription to norms originating in the target culture determines its acceptability" (Toury, 1995, p. 57).

Following J. Byrne (Byrne, 2006, p. 24), we can conclude that adequacy is generally viewed as a term associated with source text-orientated attitudes and approaches, while acceptability, on the contrary, focuses on the target text. In our view, J. Byrne's conclusions in relation to technical translation can well apply to the scientific translation whose aim is also to achieve a high level of acceptability, as scientific texts are meant to function first as target language texts. Summarizing G. Toury's ideas and stating their importance for specialized translation, J. Byrne emphasizes that adequacy and acceptability can be displayed on both a macro- and a micro-level. On a macro-level, the author states, the text may adhere to target culture norms, however, on a micro-level, not all translation solutions need to comply with the overall macro-level strategy. It is actually possible to create a target-orientated text even if the translator has to sometimes fall back on source-orientated solutions on a lower level (Byrne, 2006, p. 24). This particularly applies to technical, and, in our view, to scientific translation as well – in these translation types some sentences can and must be translated precisely, as close to the original as possible, while other sentences or even paragraphs need much more radical translation shifts.

Reviewing major translation theories in their relation to specialised translation, a prominent contemporary specialised translation scholar F. Scarpa in her "Research and Professional Practice in Specialised Translation" (Scarpa, 2020) describes the notion of 'translation equivalence', i.e. the exact nature of the relationship between ST and TT, as "an issue that has been central in translation theory up until the 1980s and long before Nida's (1964; Nida, & Taber, 1969) distinction between 'formal or linguistic equivalence' (correspondence limited to the surface linguistic structures of ST and TT, i.e. word-for-word/literal translation) as opposed to 'dynamic or functional equivalence' (communicative correspondence seeking sameness of response in ST and TT readers, i.e. sense-for-sense/free translation)" (Scarpa, 2020, p. 115).

The centrality of equivalence, as suggested by A. Pym (Pym, 2004, as cited in Scarpa, 2020, p. 115), may be caused with, "the clients' potential mistrust towards translators because their work cannot be checked by whoever commissioned the translation (who generally does not know the source language) and is often purported to be in the name of somebody else (the source text producer)".

As A. Pym mentions in his later work (Pym, 2023, p. 10), the idea that "something we say in one language can have the same value as its translations into other languages. The relation between the start text and each translation is then one of equivalence ('equal value'), no matter whether the relation is at the level of form, function, or anything in between". A. Pym further notes that equivalence does not state that languages are the same – it just says that some values can be the same. And many theories share such assumption. For some theories, the things of equal value exist before the act of translation begins. On that view, it does not matter whether you translate from language A into language B or vice versa. This kind of equivalence is closely connected with linguistic analyses that compare how different languages can express the same thing in various ways. On the other hand, equivalence can be viewed as something operative in the translation situation itself. It is this kind of equivalence that many translators, clients, and translation users find important in translation: it can be interpreted as a relation between texts, as a goal in the translator's mind, as a promise the translator makes to the receiver, and as an assumption the receiver makes when approaching a text as a translation. The concept of equivalence, as A. Pym emphasizes, should be appreciated in all that complexity. However, the word has been interpreted in many different ways. What is bad, A. Pym states, that its meanings are often mixed up, and "the consequences are disastrous" (Pym, 2023, p. 12).

With various opinions existing on the relevance of translation equivalence, since the 1970s the general theory of translation has been guided by "a dynamic and relative parole-oriented approach to translation, i.e. based on equivalence relations obtaining between texts in real time and real situations" (Scarpa, 2020, p. 115). With regard to specialised translation, as F. Scarpa states, this pragmatic approach "has totally replaced the more static and absolute langue-oriented notion envisaged in formal equivalence, i.e. based on formal similarity at the level of the abstract system underlying language" (Hatim & Munday, 2004, as cited in Scarpa, 2020, p. 115). This 'pragmatics turn' (Snell-Hornby, 2006; Hatim, 2013 [2001]) in both linguistics and Translation Studies has been evoked with the concepts of 'communicative function' and 'text' as language

used in a specific situation that cannot be separated from the cultural context in which it is embedded (Scarpa, 2020, p. 115).

In theoretical approaches to translations, the notion of translation equivalence has undergone conceptual changes – the thought that language is closely connected with context has caused a move from "a purely linguistic and abstract view of 'sameness' of meaning to a weaker view where meaning is variable across linguistic and cultural divides, and 'sameness' has been replaced by more realistic expectations such as 'matching' or 'similarity'" (Chesterman, 2016, as cited in Scarpa, 2020, p. 116). Since then, scholars have viewed equivalence as a context-bound relationship that needs a translator as a mediator between different social/cultural contexts. Translation practitioners, though, do not completely share this view – they still treat equivalence mostly with regard to sameness of meaning between the source and target texts. Quite logical comes B. Mossop's (Mossop, 2016, as cited in Scarpa, 2020, p. 116) proposal that the core of Translation Studies should be 'invariance-oriented', in other words focus on the translator's decision made at the moment of text production (i.e. his/her 'mental stance') to provide for sameness (process-focused invariance/sameness), if compared to the result of "after-the-fact comparisons of source text and translation wordings" (product-focused equivalence) (Scarpa, 2020, p. 116).

So, the flexible nature of translational equivalence can be demonstrated by the possibility of making texts in different languages (more or less) equivalent at various levels (semantic, syntactic, stylistic, pragmatic/functional) – this depends on the translation unit being analyzed (word, group, phrase, paragraph, whole text) as well as the type of text being translated. Such a dynamic and broad-based view of equivalence has been clearly expressed by its most prominent representative W. Koller (Koller, 1995, as cited in Scarpa, 2020, p. 117), who identifies five different types of equivalence that can be achieved between source and target texts, and each of them guides the translator in his/her choice. Denotative or referential equivalence assumes that the source and target texts refer to the same thing in the 'real world'. Connotative equivalence provides that the source and target texts evoke the same associations in the minds of native speakers of the source and target languages. Within the text-normative equivalence, the source and target texts are used with similar textual conventions in the source and target languages. In terms of pragmatic or dynamic equivalence, the source and target texts are used in matching contexts and with a similar effect on their respective readers. Formal/aesthetic equivalence is achieved when the source and target texts have similar orthographic or phonological features (Hatim, & Munday, 2004; Kenny, 2011). The translator then should set a hierarchy among these types of equivalence he/she needs to achieve, with regard to the translation task given, the actual text to be translated and, more broadly, the specific translation situation.

Thus, pragmatics has contributed an invaluable vision of equivalence to specialised translation, which is in its essence a situational activity. We agree with F. Scarpa (Scarpa, 2020, p. 117) in that the most applicable types of equivalence to be achieved between specialised source and target texts are referential, pragmatic and text-normative. Referential equivalence owes to the translator's own subject-matter competence and is grounded on the high degree of invariance of meaning which is necessary in specialised translation (Mossop, 2016), whose main premise is the faithful conveyance of meanings across different languages. Just one important remark is to be made about the translator's subject-matter competence – it in some degree differs from that of the expert. As P. Newmark (Newmark, 1988, as cited in Scarpa, 2020, p. 117) once said, "you [the translator] are learning a language rather than the content of the subject" and consequently "to translate a text you do not have to be an expert in its technology or its topic; but you have to understand that text and temporarily know the vocabulary it uses". Pragmatic equivalence assumes "the target text's optimal effectiveness and efficiency for the target discourse community and appropriateness for their very specific professionally or subject-related communicative needs" (Scarpa, 2020, p. 117). Eventually, text-normative equivalence is achieved by the translator's ability to identify and apply the standardised conventions that guide LSP text genres at all levels of textualisation, from text organisation to terminology, in both source and target languages. The most outstanding example of a pragmatic approach to translation is that of J. House's (House, 1997, as cited in Scarpa, 2020, p. 117), who offers as a guiding principle the 'functional equivalence' that must be reached between the sources and target languages in a certain communicative situation in such degree that, in case of conflict between semantic (i.e. context-free) and pragmatic (i.e. contextual) equivalence, "it is always necessary to aim at equivalence of pragmatic meaning, if necessary at the expense of semantic equivalence" (House, 1977, as cited in Scarpa, 2020, p. 117).

One can find other pragmatic approaches to equivalence in theoretical works focused on translation as an act of communication, with an emphasis on its wider social/cultural aspects and the translator as a mediator. For instance, M.A.K. Halliday's (1992) functional approach to translation accentuates that translation is a social activity and the translator is a social being (Robinson, 2003). Consequently, semantic equivalence

between the source and target texts coincides with their functional equivalence in a specific context and translation is viewed as a "guided creation of meaning" (Halliday, 1992, as cited in Scarpa, 2020, p. 117). And to reach functional equivalence and cope with all the translation challenges in a text, the translator must take into consideration all four levels of contextual information, where the first two refer to the immediate linguistic environment ('lexicogrammatical context' and 'context of discourse'), and the other two relate to the non-linguistic environment ('context of situation' and 'social/cultural context').

Translation equivalence is also viewed from another angle – in the E.-A. Gutt's (2000) cognitive model, grounded on D. Sperber and D. Wilson's (1995[1986]) "relevance theory of communication", the underlying principle that guides translation is 'optimal relevance', which provides that the recipient gets the expected meaning without taking unnecessary thinking effort (Scarpa, 2020, p. 118). In terms of this model, equivalence is within communicative success, and it can differ due to the fact that the target text receivers' expectations, situational context and cognitive experience are different from those of the source text receivers. In a 'direct' translation, where the status of a text as a translation is known, equivalence is to be understood as an 'interpretative resemblance' of the source text context of production to the target text context of reception. This can be illustrated with the functional approach to translation adopted within international institutions such as UNO and OECD, where translators are required not to adjust a translation to a different use or type of audience from those of the source text – they are instead asked, keeping the same communicative purpose of the source text in the target text, to put the source text receivers on the same level with the target text ones. In a 'relevant' translation, the target text reader can then assume to recognise the original 'informative intention' of that text just as it was meant by the source text sender and was recognised by the source text receivers (Scarpa, 2020, p. 119).

Such an 'assumption of equivalence supported by E.-A. Gutt's approach symbolizes a deep turn in the equivalence paradigm (Scarpa, 2020, p. 119), as well as an indicative shift away from the centrality of the notion of equivalence in translation theory. Such a change had actually already started with the so-called 'cultural turn' in the late 1970s and mid-1980s as part of the rise of the new independent discipline of Translation Studies, when equivalence began to be seen as theoretically misleading.

As F. Scarpa further summarises, since equivalence lost its meaning of 'having the same communicative value as the source text', it was downgraded to the more general meaning of 'translational relationship' between two texts, one of which is regarded as the translation of the other in a certain social and cultural system. And the supreme position of the source text over the target text – the traditional ground of the paradigm of equivalence, started to be renounced (Scarpa, 2020, p. 119).

In fact, in the functionalist approaches to translation that originated in the 1980s, with Skopostheorie as the most influential (Vermeer, 1983; Reiss & Vermeer 1991[1984]; Vermeer 1996), the major focus of translation as a 'purposeful activity' falls on the communicative goal or purpose (i.e. the *skopos*) of the target text, and the crucial point influencing the translator's choices is achieving "a text functioning in a target-culture for target-culture addressees" (Vermeer, 1996, as cited in Scarpa, 2020, p. 119). And the anticipated purpose (*skopos*) that the target text is to fulfil in the target context, as conditioned by the translation 'initiator' or 'commissioner' can actually differ from the communicative purpose that the source texts had in the source context. This means that J. House's functional equivalence model cannot guide the translator in his/her strategies, which are on the contrary influenced by the *skopos* of the target text which is initially stated in the translation brief that the translator is to receive from the commissioner when accepting the translation task (Scarpa, 2020, p. 119). This is an essential notion in specialised translation, that specifies the recipients of the translation, its purpose, sets out requirements and guidelines on the style, graphical layout and, ideally, terminology to be used in the target text.

From the specific point of view of specialised translation, as the author importantly observes (Scarpa, 2020, p. 120), functionalism is beneficial in shifting the focus away from a view of translation as just a source text reproduction, towards viewing translation as a professional activity and the translator as an expert who produces target texts which are intended to be used as independent texts in the target culture.

However, when the functionalists' accent on the target text is taken to extremes – especially when they state that a source text is just an "offer of information" (Vermeer, 1986), thus making the target text the only guiding principle for translators and the term 'equivalence' meaning only 'adequacy or appropriateness to a *skopos*' – the diminishing of the importance of the source text in the translation process sounds quite radical for at least three reasons (Scarpa, 2020, p. 120). The first is practical and deals with the translation brief, which is overemphasized in this model. Yet in professional practice, translators often do not get any extratextual information and rely just on the text to be translated in their decision making. The second cause is largely theoretical and accentuates the crucial role of the source text in the definition of translation itself.

On balance, this is a positive shift. However, a 'dethronement' of the source text from being the sole factor determining the structure of the target text can also diminish the role of the source text in keeping the boundaries between translation and other modes of cross-language communication (as for example adaptation, summary, rewriting etc.). Thirdly, regardless of the fact that functionalist theories have been accepted more instrumental in non-literary than literary texts, specialised translation (and scientific and technical translation in particular) is usually distinguished by a close source text/target text relation in terms of content and also by functional invariance. Let alone the fact that specific areas of professional translation such as the translation of legal documents or scientific texts are grounded on the underlying assumption that the target text is in fact a very close reformulation of the source text.

As the author (Scarpa, 2020, p. 120) rightly notes, the perspective of equivalence in specialised translation outlined in her book complies with the less ideological and more balanced idea of functionalism represented by Ch. Nord's (1991) "functionality plus loyalty" model, which could be a useful guide for specialized translators in their professional activity. The model comprises the ethical notion of the translator's 'loyalty', i.e. his/her moral responsibility to produce a functional target text which adheres to the requirements of the translation *skopos* determined by the initiator of the translation process and the needs of the users of the translation. The target text must take care of the interests of the source text author, thus restoring the importance of the source text-in-situation (Nord, 1992, as cited in Scarpa, 2020, p. 121). F. Scarpa importantly refers to this dynamic notion of equivalence, where the accent is not on the supremacy of either the source text or the target text but on the equal significance of the two, as pragmatic equivalence. It has been successfully proved by specialized translation practitioners that this type of relationship between the source and target texts can be generally achieved in this macroarea of translation, where source and target text readers share similar professional goals and a great amount of common knowledge, and the norm is for contexts of use and main communicative purpose(s) to match in the source and target texts (Scarpa, 2020, p. 121).

This norm is vividly expressed by Clause 1.1. of the FIT Europe "Code of Professional Practice" (FIT) which obliges professional translators to "at all times maintain the highest level of work, ensuring fidelity of meaning and register, unless demanded otherwise by the client". Pragmatically, this implies two conditions to be fulfilled (Scarpa, 2020, p. 121). First, the source text communicative (in most cases informative) purpose should match both the purpose(s) of the translation determined by commissioner and translator, and the purpose(s) assigned to the target text by its prospective readers. Second, target text intended readers should have the same background specialised knowledge as the source text readers. In order to get a pragmatically successful translation, the following criteria should be observed: 1) the target text appropriateness for an implied purpose in its new communicative situation, 2) the target text's optimal effectiveness and efficiency taking into account the target audience's expectations, 3) the source text author's communicative purpose and standpoint, 4) the translator's communicative purpose, 5) the communicative purpose of the translation initiator (which can differ from that of the source text author).

We strongly support this dynamic view of the notion of equivalence and find it particularly applicable for the needs of scientific translation analysis since it is both a useful category for investigating specialised translations and a guideline for translation practitioners in their search of translation solutions, particularly in the micro-area of individual translation units. This goes in line with B. Mossop's (2016) view that the most producers in the translation industry stay invariance-oriented, since in everyday practice translators deal mostly with specialised genres (legal, technological, financial, scientific, medical and administrative) and they are in need of such an approach (Scarpa, 2020, p. 122). However, for the recent decades academic publications have been reflecting everyday translation situations only partially, mostly focusing on how translations differ from their sources, but not on the translator's search of sameness between source and target texts. A theory of specialised translation should then acknowledge the subjective importance of equivalence, by which translators believe in the equivalence of source and target texts and their clients accept this belief of equivalence: such "non-relativist and non-linguistic 'equivalence beliefs'" are truly considered by A. Pym (1995) as the very foundations making translation "work as a social practice" (Pym, 1995, as cited in Scarpa, 2020, p. 122).

Thus, if summarized in modern terms, the goal of a specialised text translator is to achieve a pragmatically successful translation. Here the pragmatic equivalence comes to the fore – a slightly modified notion, which is instrumental in target text analysis. Referential and text-normative types of equivalence are also looked into. At the same time, as our analysis has proved, modern translators of specialised texts try to maintain a balanced attitude towards the source and target texts, with equal attention to both texts, which definitely helps them to choose an appropriate translation solution.

Having investigated the original and translated research articles (Biliak, 2025a, 2025b), (Ovsak, 2025a, 2025b), we would like to admit quite a high degree of equivalence, achieved by both translators.

First of all, adequately rendered, within the text-normative equivalence, are scientific terms and terminological phrases – largely by transcoding (most terms, in line with terminography conventions), word-for-word translation (1, 3, 5, 6, 9), with necessary permutations (7, 8, 10), modulations (2):

1) *земна атмосфера* – *earth's atmosphere*, 2) *дистанційні вимірювання* – *polarization measurements*, 3) *ступінь лінійної поляризації* – *degree of linear polarisation*, 4) *аерозоль* – *aerosol*, 5) *відновлення мікрофізичних параметрів* – *recovery of microphysical parameters* (Ovsak, 2025a, 2025b); 6) *графен для сенсорів* – *graphene for sensors*, 7) *підкладка для сенсорів на основі графену* – *substrate for graphene-based sensors*, 8) *контакти графен-метал* – *graphene metal contacts*, 9) *поверхневі контакти* – *top contacts*, 10) *виготовлення графенових сенсорів Холла* – *production of graphene Hall sensors* (Biliak, 2025a, 2025b).

Terms function in translated sentences quite naturally, due to apt translator's solutions:

1. *Гнучкі матеріали, такі як поліетилентерефталат або поліїмід, дозволяють інтегрувати графенові сенсори в різні пристрої, що носяться, або у гнучку електроніку, що дає змогу розробляти гнучкі сенсори* (Biliak, 2025a, p. 297). – *Flexible materials, such as **polyethylene terephthalate** or **polyimide**, allow graphene sensors to be integrated into various wearable devices or flexible electronics, which makes it possible to develop flexible sensors* (Biliak, 2025b, p. 297).

Generally, analysed translations demonstrate translators' loyalty to the source text (a more source-oriented approach), with no dramatic source text shifts – the translators, in keeping with the requirement of high degree of invariance of meaning in a specialised translation, strove to achieve maximum referential equivalence:

2. *Графен залишається одним з найбільш досліджуваних матеріалів завдяки своїм унікальним фізичним властивостям та двовимірній структурі* (Biliak, 2025a, p. 296). – *Graphene remains one of the most studied materials due to its unique physical properties and two-dimensional structure* (Biliak, 2025b, p. 296).

3. *Увага приділена метал-графеновим контактам, де крайові контакти мають значно кращу провідність, ніж поверхневі* (Biliak, 2025a, p. 296). – *Attention is paid to metal-graphene contacts, where edge contacts have significantly better conductivity than surface contacts* (Biliak, 2025b, p. 296).

4. *Автори підкреслюють, що на поточному етапі розвитку графенової електроніки немає єдиного технологічного процесу, як у класичній напівпровідниковій промисловості, що вимагає подальших досліджень для створення більш ефективних сенсорів* (Biliak, 2025a, p. 296). – *The authors emphasize that at the current stage of development of graphene electronics, there is no single technological process, as in the classical semiconductor industry, which requires further **research** to create more efficient sensors* (Biliak, 2025b, p. 296).

5. *Нещодавно компанія SpaceX успішно запустила місію 'Fourth Transporter', яка, окрім комерційних цілей, також включала наукові дослідження* (Biliak, 2025a, p. 297). – *Recently, SpaceX successfully launched the Fourth Transporter mission, which, in addition to commercial purposes, also included **scientific research*** (Biliak, 2025b, p. 297).

6. *Перші продукти на основі графену вже вийшли на різні ринки, хоча поки що переважно в нішевому масштабі* (Biliak, 2025a, p. 297). – *The first **graphene-based** products have already entered various markets, although so far mostly on a niche scale* (Biliak, 2025b, p. 297).

Thus, in the above Examples 2–6 we can observe maximum source and target text closeness, both in form and meaning, mostly word-for-word translation, with minor changes (*pl-sg* noun forms (Examples 4, 5), permutations (Example 6), etc.). Radical shifts were not necessary in achieving the overall goal of pragmatic equivalence.

In other cases, translation shifts were inevitable – the translators demonstrated a more target-oriented approach, trying to render the meaning in conformity with the target text norms, in their desire to achieve the necessary pragmatic effect. For instance, in the examples below, by making necessary syntactic changes the translator brought the target sentences in accordance with the subject-verb order of the English sentence, if compared to the Ukrainian sentences that have more flexible sentence structure:

7. *Проводяться космічні дослідження приладів на основі графену* (Biliak, 2025a, p. 297). – ***Space research** of graphene-based devices **is underway*** (Biliak, 2025b, p. 297).

8. *Для них розробляється вимірювальне обладнання, а також створюються спеціальні математичні алгоритми визначення загальних спектральних оптичних характеристик атмосфери та мікрофізичних параметрів її аерозольної складової* (Ovsak, 2025a, p. 504). – ***Special measuring equipment is developed for them, and special mathematical algorithms are created** to determine the general optical spectral characteristics of the atmosphere and the microphysical parameters of its aerosol component* (Ovsak, 2025b, p. 498).

9. Для наступного шару, як правило, **використовують Au**, оскільки це один із найбільш застосовуваних металів для контактів з графеном завдяки його високій провідності та хімічній стабільності (Biliak, 2025a, p. 298). – For the next layer, **Au is usually used**, as it is one of the most commonly used metals for contacts with graphene due to its high conductivity and chemical stability (Biliak, 2025b, p. 298).

Target language norms also allowed the translators of the analyzed texts to replace longer Ukrainian prepositional phrases with more compact noun clusters:

10. В атмосфері над позицією виявлена присутність двох аерозольних мод з **нормально-логарифмічним розподілом частинок за розмірами** й відновлено низку їх мікрофізичних параметрів (Ovsak, 2025a, p. 497). – The presence of two aerosol modes **with the normal-logarithmic particle size distribution** is revealed, and some of their microphysical parameters are recovered (Ovsak, 2025b, p. 497).

11. **Контакти на основі хрому** мають менший контактний опір порівняно з Ti (Biliak, 2025a, p. 298). – **Chromium-based contacts** have lower contact resistance compared to Ti (Biliak, 2025b, p. 298).

12. Обговорюються технології виробництва графенових сенсорів Холла, зокрема, **метод хімічного осадження з парової фази (CVD)**, який широко використовується для створення промислових сенсорів (Biliak, 2025a, p. 296). – Technologies for the production of graphene Hall sensors are discussed, in particular, **the chemical vapor deposition (CVD) method**, which is widely used to create industrial sensors (Biliak, 2025b, p. 296).

As the translation analysis proves, in English language scientific texts sentences tend to be shorter than in Ukrainian scientific language texts. Such compression is achieved by various translation techniques, stipulated by target language norms: compression through a compound premodifier (Example 13), gerund ("**at processing**") which helps reduce the sentence avoiding the excessive use of *of*-structures (Example 14), reduced participle construction (Example 15):

13. На сучасному етапі індустрія графену є прикладом **ринку матеріалів, що стрімко розвивається** (Biliak, 2025a, p. 297). – At the present stage, the graphene industry is an example of **a rapidly developing materials market** (Biliak, 2025b, p. 297).

14. Цілями даної роботи були **перевірка** ефективності роботи алгоритмів Методу **при обробці** спектральних фазових залежностей ступеню лінійної поляризації неба отриманих в [7], та порівняння відновлених мікрофізичних параметрів частинок аерозольних мод зі значеннями відповідних величин, отриманими в [7], а також з параметрами, визначеними засобами вимірювань й алгоритмами обробки даних мережі "AERONET" [8] (Ovsak, 2025a, p. 504). – The aim of this work was **to verify** the efficiency of the Method algorithms **at processing** the spectral phase dependences of the sky linear polarization degree obtained in [7] and compare the recovered values of microphysical parameters for aerosol mode particles with the corresponding values obtained in [7] and with the values measured by the instruments and data processing algorithms of the AERONET network [8] (Ovsak, 2025b, p. 498).

15. **Цей матеріал іноді називають "білим графеном!"**, він також має гексагональну структуру, але з атомами бору та азоту (Biliak, 2025a, p. 303). – **Sometimes called "white graphene"**, this material also has a hexagonal structure, but with boron and nitrogen atoms (Biliak, 2025b, p. 302).

The sentences below display a frequent use by the translator of an instrumental replacement technique, when a Ukrainian adverbial modifier changes to an inanimate agentive subject. This brings the translation in conformity with target language grammar norms and makes it more acceptable for the reader:

16. **В таблиці 1 порівнюються** різні технологічні параметри сенсорів холла які розглядалися у даному дослідженні (Biliak, 2025a, p. 301). – **Table 1 compares** the different technological parameters of the hall sensors considered in this study (Biliak, 2025b, p. 301).

17. Слід відмітити, що **на рис. 2 вказані** значення параметрів σ^2 та β (870 нм), які використовувалися при розрахунках приведених залежностей (Ovsak, 2025a, p. 506). – It should be noted that **Fig. 2 also demonstrates** the values of the parameters σ^2 and β (870 nm), which were used in the calculations of the exhibited dependences (Ovsak, 2025b, p. 500).

18. До того ж **у Методі використовуються** залежності DoLP неба, отримані вимірюваннями за умов ясного неба, коли присутність у повітрі навіть сильно поглинаючих світло частинок є дуже малою (Ovsak, 2025a, p. 506). – Additionally, **the Method uses** the sky DoLP dependences measures under clear sky conditions, when the presence of even strongly light-absorbing aerosols in air is very low (Ovsak, 2025b, p. 499).

The translator of scientific texts is to be aware of (and make necessary changes) the differences in grammatical nature of source and target languages – there are more verbal than nominal constructions in the English language if compared to the Ukrainian language:

19. Вчені з Нідерландів та Чилі розробили прилади, в конструкції яких були елементи на основі графену **для вивчення** впливу космічних подорожей та умов космосу на графенові компоненти

(Biliak, 2025a, p. 297). – *Scientists from the Netherlands and Chile have developed devices with graphene-based elements to study the impact of space travel and space conditions on graphene components* (Biliak, 2025b, p. 297).

Keeping the grammatical differences in view, the translator also uses *active-to-passive* transformations (when the doer of the action is obvious from the context, as in Example 20) and sometimes *passive-to-active changes* (to make the translation more personal by introducing the subject ("**we**"), which is an excellent example of translator's bringing the target text closer to the reader, striving to achieve the pragmatic equivalence, see Example 21):

20. *Причину такої розбіжності ми розглянемо нижче* (Ovsak, 2025a, p. 510). – *The origin of this discrepancy will be considered below* (Ovsak, 2025b, p. 504).

21. *Тому наступним було виконано відновлення параметрів частинок Fine mode й визначене кількісне співвідношення виявлених основних мод у аерозольній складовій атмосфері* (Ovsak, 2025a, p. 507). – *Therefore, at the next stage, we recovered the parameters of the Fine mode particles and determined the quantitative ratio between the detected main modes in the aerosol component of the atmosphere* (Ovsak, 2025b, p. 503).

In their desire to make the translation more "reader-friendly", such that facilitates the understanding of the text by the target audience, the translators skillfully used various techniques, such as antonymic translation (Example 22), generalization (Example 23), explication (Example 24):

22. *Крім того, не рідкісні техногенні катастрофи та природні катаклізми значно розширюють вказане поле діяльності відповідних муніципальних відділів та підрозділів державних служб з надзвичайних ситуацій* (Ovsak, 2025a, p. 503). – *Furthermore, man-made and natural disasters happen rather frequently and substantially expand the indicated activity field for relevant municipal departments and units of state emergency services* (Ovsak, 2025b, p. 497).

23. *Товщина цього шару становить від декількох десятків нанометрів, коли його використовують як діелектрик для затвора* (Biliak, 2025a, p. 302). – *The thickness of this layer is from several tens of nanometers when it is used as a dielectric for the gate* (Biliak, 2025b, p. 301).

24. *Наступний етап – підбір параметрів Coarse mode* (Ovsak, 2025a, p. 506). – *At the next stage, we fitted the parameters for the Coarse mode* (Ovsak, 2025b, p. 500).

Especially important for a translator of scientific texts is the ability to render in the target text the register and style, by carefully choosing appropriate equivalents: a formal equivalent *hereafter referred to as* perfectly fits in the academic style of the sentence. Additionally, a long compound sentence here is split into two simple ones, which complies with the norms of the language of science and makes the translation more acceptable for the target audience:

25. *В роботі [4] авторами запропоновано Метод відновлення мікрофізичних параметрів багатомодової аерозольної складової атмосфери за даними спектральних поляриметричних вимірювань неба (далі по тексті Метод), який дозволяє визначити кількість основних аерозольних мод та ряд мікрофізичних параметрів їх частинок, а також спектральні значення загальних параметрів газово аерозольного середовища атмосфери* (Ovsak, 2025a, p. 504). – *In work [4], the authors proposed a method (hereafter referred to as the Method) to recover the micro physical parameters of the multimode aerosol component in the atmosphere using spectral polarimetric measurements of the sky. It allows the number of main aerosol modes and some microphysical parameters of the engaged particles, as well as the spectral values of the general parameters of the gas-aerosol component in the atmosphere environment, to be determined* (Ovsak, 2025b, p. 498).

However, in the analysed translations there are sentence fragments that do not facilitate the understanding of the texts by the target reader but make them difficult to perceive. One of such cases is the translator's decision, in his desire to stick to the target sentence word order, to place the predicate too far from the subject. One of the remedial ways in Example 26 could be the use of the formal subject *there* at the beginning of the sentence ("**There have been analysed...**") or the use of a generalizing introduction at the beginning of the sentence where the subject and predicate go together, as in Example 27:

26. *З використанням раніше запропонованого авторами Методу відновлення параметрів багатомодової аерозольної складової атмосфери, проаналізовано дані поляризаційних вимірювань неба над позицією CESAR Observatory, Нідерланди* (Ovsak, 2025a, p. 497). – *With the method previously proposed by the authors for recovering the parameters of the multimode aerosol component in the atmosphere, the data of polarization measurements of the sky above the position of CESAR Observatory, the Netherlands, at 14:55 UTC on July 9, 2013, have been analyzed* (Ovsak, 2025b, p. 497).

27. **Визначені:** ефективний радіус (r) і дисперсія (σ^2) функції нормально логарифмічного розподілу частинок за розмірами; дійсна частина комплексного показника заломлення частинок (n_r) (Ovsak, 2025a, p. 504). – **The following quantities were determined:** the effective radius, r , and dispersion, σ^2 , of the normal logarithmic particle size distribution function and the real part of the complex refractive index of particles, n_r (Ovsak, 2025b, p. 498).

There were also some mistranslations that hampered the understanding of the target text, decreasing the degree of its pragmatic equivalence. These cases are though rare (as in Example 28, where non-conveyed is the idea of devices being produced on graphene basis) and can be explained by the lack of attention to the original text on behalf of the translators whose general subject-matter competence is very high:

28. Графен досліджують і створюють на його основі **прилади** різні технологічні гіганти, такі як Intel, IBM, HP, Samsung, LG, Bosch [4–8] та багато інших (Biliak, 2025a, p. 296). – Graphene is being researched and **developed** by various technology giants such as Intel, IBM, HP, Samsung, LG, Bosch [4–8] and many others (Biliak, 2025b, p. 296).

So, the findings of our study of research articles and their translations are that the translators generally achieved the pragmatic equivalence, which is truly dynamic. The translators demonstrated both source- and target-oriented approaches in their search for adequate solutions. As for the translation shifts, they were generally positive and facilitated the understanding of the content by the target text readership. No cardinal changes were made – the translators tried to stick to the rule of the golden mean in the use of translation transformations. In the analysed translations we observe a balance in adhering to source and target texts norms, with the translators' strategies being mostly invariance-oriented. The types of equivalence most relevant in specialised translation – referential, pragmatic and text-normative – were reached, and the overall goal of pragmatically successful translation was fulfilled.

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СУЧАСНІ ТЕОРЕТИЧНІ ПІДХОДИ В НАУКОВОМУ ПЕРЕКЛАДІ: КОНТРАСТИВНЕ ДОСЛІДЖЕННЯ

Вступ. Актуальність нашого дослідження зумовлена необхідністю розробки в науковому перекладі як перспективній підгалузі перекладознавства власних методологічних принципів і підходів у межах загальної теорії перекладу. У статті проаналізовано сучасні підходи в дослідженні наукового перекладу з метою перевірки доцільності їх використання у спеціалізованому перекладі, зокрема у перекладі наукових текстів.

Методи. У роботі застосовано загальнонаукові методи аналізу, синтезу, класифікації, систематизації, описового аналізу, а також спеціалізовані методи дискурс-аналізу та контрастивно-перекладознавчого аналізу.

Результати. Досліджено класичні теорії перекладу щодо їхньої орієнтації на вихідний та/або цільовий тексти з огляду на те, що вихідний текст традиційно вважався головним елементом у перекладі. Прослідковано загальне перенесення уваги дослідників з концепцій, орієнтованих на текст оригіналу, до більш комунікативного підходу, в межах якого переклад розглядається як комунікативний процес, а ключовими чинниками є повідомлення і реципієнт. Щодо можливих ефективних підходів до наукового перекладу, проаналізовано більш збалансоване поняття еквівалентності – прагматичної еквівалентності зокрема, яке

може стати провідним для дослідників спеціалізованого перекладу та перекладачів-практиків. Висвітлено, що в контексті прагматичної еквівалентності в центрі уваги не лише вихідний або лише цільовий тексти, а обидва тексти аналізуються рівноцінно. Досліджено типи еквівалентності, релевантні для наукового перекладу – референційна, нормативно-текстова та прагматична еквівалентність. Проаналізовано тексти оригіналу і тексти перекладу наукових статей з огляду на ступінь їхньої прагматичної еквівалентності.

Висновки. У результаті дослідження окреслено збалансований підхід перекладачів до вихідного і цільового текстів, що, безперечно, допомагає перекладачеві у прийнятті відповідних перекладацьких рішень для досягнення прагматично успішного перекладу.

Ключові слова: спеціалізований переклад, науковий переклад, теорія перекладу, підхід, орієнтований на вихідний текст, підхід, орієнтований на цільовий текст, еквівалентність перекладу, референційна еквівалентність, нормативно-текстова еквівалентність, прагматична еквівалентність.

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