

G.A. Yessenbayeva, D.N. Yesbayeva

*Ye.A. Buketov Karaganda State University, Kazakhstan;
Shanghai Factory-Amigo EC Technology Co., Ltd, China
(E-mail: esenbaevagulsima@mail.ru)*

Some scientific and technical translation aspects on mathematics and mechanics

This paper discusses the issues and methods of professional translation of scientific and technical papers by the example of mathematics and mechanics. Translation of scientific and technical documents is the field of professional and translation activity; therefore the professional translation should be performed by highly qualified personnel, commanding a foreign language, professional knowledge and specific terminology, being able to adequately and competently express their thoughts in the target language. Improving translation quality of scientific and technical texts on mathematics and mechanics is achieved through a deep understanding of the work content, knowledge of specialized mathematical and mechanical terms and collocations, using of suitable translation methods. In the article translation examples of mathematical and mechanical terms and collocations are considered, translation constructions and patterns for mathematical and mechanical sentences are given, methods for eliminating mistakes in the translation of mathematical and mechanical texts are researched. The article is mainly focused for mathematicians and mechanics.

Keywords: scientific and technical translation, mathematics, mechanics, term, translation constructions, translation methods.

Every area of translation presents its own difficulties, and the scientific-technical translation field is no exception. Scientific and technical texts are of great importance as to their content and form. Over four million articles are published annually besides a great amount of books on the problems of mathematics and mechanics.

As English became the universal language in the 21st century, most scientific research is now written in English all over the world. Nowadays, the world is facing globalization in the growing demand for communicating scientific technical knowledge to the public in the form of different media including different mathematical and mechanical reading materials. Perhaps there is also an increasing call for translation of these vital types of knowledge into language for the readers. Hence, it is essential for translators and interpreters to be aware of the translation problems that may affect the quality of translations.

Scientific research is the most popular source of translation work and some of the most thorough and yet complex research is carried in the mathematical and mechanical fields. Translation may involve a whole range of difficulties and thus, it can be a very challenging activity. Every language is different from variations in syntax, grammar rules, and grammatical structure. Thus, the translation process could be an uphill struggle.

Nowadays technical translation is an issue of the day as the teachers who work in universities have to face certain difficulties while translating. Translation of scientific and technical text is a multidimensional and multifaceted process determined by the system and norm of the two languages involved. It is not only dependent on the two cultures and the communicative situations, but also directly dependent on the referential situation and the functional parameters, of the source/target text.

So what are the usual and common problems in scientific translation?

I. Firstly, absolute accurate and subject knowledge of mathematics or mechanics is key, as so often. The world of scientific research is vital and thus, a foreign audience requires expert translators who are competitive and reliable in the scientific translation field. Translation of scientific and technical literature is a sphere of translation activity, in which the professional performance of the work can be done only by highly trained technicians who have good knowledge of the subject area and its specific terminology, who speak a foreign language perfectly well, and (most importantly) who know how to properly express their thoughts (without getting off the point and style of the original) in the target language.

A translator must be fully aware of what s/he is translating to render precisely the content of the text. Special attention must be paid to terms and understanding of technical texts for readers. Therefore, translators in science and technologies have to specialize in a foreign language and a particular subject field. In fact, there are two types of translators: linguist translators and engineering translators. The former usually require penetration into the subject matter, the latter need good language skills. The accuracy of the scientific and

technical translation is determined by how well the translator commands the source language and the subject of discussion [1]. If the translator does not understand the meaning of a mathematical or mechanical text, then how can he translate it?

II. Secondly, technical translation covers the translation of many kinds of specialized texts and requires not only a high level of subject knowledge but mastery of the relevant terminology.

The peculiarity of technical translation of scientific documentation is an excessive amount of specialized terms, service and introductory words, frequent use of abbreviations and realias. The importance of consistent terminology in technical translation, for example in mathematics and mechanics, as well as the highly formulaic and repetitive nature of technical writing makes technical translation using translation classical terminology databases especially appropriate and understanding for readers.

A translator must take great pains to get familiar with the system of terms in the appropriate field and make good use of technical dictionaries and other books of reference.

The term is thought to be an emotionally-neutral word conveying a name of a concrete notion that refers to this or that field of mathematics and mechanics. In specialized literature terms possess the main semantic meaning. A term is characterized by availability of definition, precision of semantics, independence, stylistic neutrality (absence of expression), brevity, lightness of functioning in various word-forms and capacity of combining with language.

In mathematics and mechanics there are a lot of word terms that have a large number of synonyms. It is necessary to apply and use the translation of the term generally accepted in the specialized literature. For example, «напряжение» – «stress» (Do not use words: «voltage» or «strain»); «деформация» – «deformation» (Not: distortion (искажение), warp, deform, deflection (отклонение), alteration (изменение)); «устойчивость» – «stability» (Not: sustainability, resistance, resilience, steadiness, resistant, firmness); «разрушение» – «destruction» (Not: demolition, fracture, rupture, damage (перелом, повреждение), disruption, breaking (нарушение)); «жидкость» – «fluid liquid» (Not: liquid); «оболочка» – «shell» (Not: cover, covering (покрытие)); «manifold» – «многообразие» (Not: diversity, multiformity, great variety, diversification, vast vane); attach – присоединять, (sometimes, приклеивать) (Not: glue) and etc.

To translate precisely, it is not enough to know an equivalent of the term. It is crucial to know the exact place of the concept, denoted by the term, in relation to other concepts.

In specialized translation, search for Interlingua equivalents is a time-consuming activity even for an experienced translator. Therefore, the mid-1960s and early 1970s gave rise to term banks, or terminological data banks, that is systems for storing specialized vocabulary in electronic form. Term banks are commercially available (TERMIUM, for example, is available on CD-ROM).

The translation of units of measurement depends on the system they are expressed in. If in metric system, weights, measures and quantities are usually retained. If expressed in imperial system (miles, pints, pounds, etc.), they are normally converted to the metric system.

While the presence of specialized terminology is a feature of technical texts, specialized terminology alone is not sufficient for classifying a text as «technical» since numerous disciplines and subjects which are not «technical» possess what can be regarded as specialized terminology [2].

Specific requirements for the scientific and technical translation are the ability to suggest accurate terminology equivalents, which is a necessity for adequate translation. Rather serious issue in the translation of scientific and technical texts is the problem of non-equivalent terms. The origin of non-equivalent vocabulary is differences in the realis of scientific environment. In this case, most of the non-equivalent terms can be translated by calquing, using the lexical and grammatical transformations. Another translation issue is when one English term corresponds to several terms of the Russian language. In this case, the translator requires not only a high enough level of native language and standard of speech, but also deep knowledge in the field the document to be translated refers to. Specialized terms are to be translated using special dictionaries.

III. Besides terms in informative texts there are generally scientific word-combinations in general usage. This vocabulary is characterized by the fact that it does not have the property to denote notions and objects of a certain scientific and technical field. Generally scientific and technical vocabulary consists of words, word-combinations, separate formations, special patterns and clichés used for expressing links and relations between terminated notions and objects, also for expressing quality, quantity and other estimate characteristics while differentiating and classifying generally scientific and technical notions [2].

Scientific and technical word-combinations are used in certain fields for describing various concrete concepts and processes in mathematics and mechanics: lateral (external, internal) load (боковая (внешняя,

внутренняя) нагрузка); inner (outer) expansion (внутреннее (внешнее) разложение); side overload (боковая перегрузка); rapid increase in viscosity (быстрое увеличение вязкости); stress-strain state (напряженно-деформированное состояние); strain state (деформированное состояние); angular momentum (момент количества движения); gravity-forced motion (движение под действием силы тяжести); loss of stability (потеря устойчивости); rigid strip (string) (жесткая полоса (струна)); rigid fixed (be attached to) (жестко закреплен (прикреплен к)); stiffness of the (a) structure (membrane) (жесткость конструкции (мембраны)); rigidity of steady motion (жесткость стационарных течений); mechanics of deformable solids (механика деформируемых тел); fracture mechanics (механика разрушения); unsteady flux (нестационарный поток); carrying body (несущее тело); load-bearing (несущий нагрузку); area (element) of maximal shear (площадка максимального сдвига). The translator needs to know such phrases.

In technical texts the peculiarity of these word-combinations consists of the difficulty determining their meanings in the original text, and matching of translation equivalents in the target language. For example, обобщенные функции – distributions (Not: generalized functions); собственные вектора – eigenvectors (Not: proper vectors); простые группы или числа – prime groups or numbers (Not: simple groups or numbers); старший коэффициент – leading coefficient (Not: elder coefficient); линейно соединены – arcwise connected (Not: linearly connected); это утверждение корректно – the statement is well defined (Not: the statement is correct) and etc.

There is a great amount of words and word-combinations so called false friends of translators (for instance, contribution – технологический, data – данные, decade – десятичный, instance – экземпляр, simulation – моделирование, equipment – техника, оборудование). Transliteration method can distort the meaning of translated text.

IV. There are certain techniques in order to eliminate scientific and technical translation problems. Following these techniques doesn't entirely mean that the translation product would be error free. There may be some techniques on how to make the scientific translation more effective and easy. These include back translation, consultation with other people and interviews or questionnaires or any kind of test that will eventually help to solve translation problems.

When it comes to translation it has always been sound advice that the translation product should be accurate, which includes the adequacy and equivalence of the translation. In addition, most linguists believe that there are two types of equivalence: formal and dynamic. Formal equivalence focuses on the form as well as the content of the message, whereas dynamic equivalence focuses on producing an equivalent effect on the target language. The concept of the translation equivalent effect may however be rather vague.

Many translators perform translation using different techniques which they would think will suit to the translation type and the complexity of the area. However, the main point here is that the translation process has to find the effective ways in order to obtain the most accurate translation possible for readers. Expertise in the specialized field and linguistic proficiency are the most essential factors needed in order to produce a high-quality translation product. Without it, translation article search, including communication and understanding would be vague.

Translation as a whole is a balance of art and science influenced by both theory and practice. Having knowledge of both the linguistic features as well as the mathematical and mechanical features of translation applies directly to the field of technical translation. The structural and lexical differences between languages could be one the major problem in translation, especially, translating mathematical and mechanical papers from one language to another.

Another one is the problem of grammar: every language has grammatical rules, which every translator and interpreters should clearly understand in producing an accurate scientific translation. Surely, if a translator does not have sufficient knowledge about the source and the target language, everything in the translation product can be an embarrassing disaster. The quality and result are determined by the peculiarities of the source text. Therefore, the interaction of text and translation is one of the issues for the theory of translation.

The translation process features a number of special methods aimed at creating adequate translation. Let us recall some methods that are also used in technical translation. Experts distinguish two translation methods: direct and indirect translation.

Indeed, the message in the original language may properly be translated in the target language, since it is based on the parallel categories, either the parallel concepts. Although, sometimes due to structural or metalinguistic distinctions, some stylistic effects can't be transferred to the target language, without changing in varying degrees, the order of the elements or even lexical items.. It is clear that in the second case, it is necessary to resort to more sophisticated methods – indirect methods of translation. Borrowing, calquing and

literal translation are methods of direct translation. Transposition, modulation, equivalence and adaptation are indirect translation.

Direct translation methods. Borrowing is the simplest method of translation. Borrowed approximately from 50 languages, lexical items account for almost 75 % of the vocabulary of the English language and include layers of vocabulary borrowed from various historical periods and under the influence of different conditions of existence and development. Many borrowings under the influence of the system, into which they have entered, undergo significant phonetic, grammatical, and even semantic changes, adapting to the phonetic, grammatical and semantic laws of the system. The process of assimilation can be so deep that the foreign origin of such words is not obvious for native English speakers and is exposed only with the help of etymological analysis.

Literal translation is to transfer the structure of the sentence without changing the construction and without substantial changing the word order. If the Russian sentence has a structure similar to the English one and it can be used without violating the grammar rules and reasoning, the literal translation of mechanical papers is acceptable.

Indirect translation methods. Transposition refers to the method, which consists in replacing the words in one language without changing the meaning of the sentence in the second language. Replacement is often necessary because of the different grammatical structures in the language. The translator shall use the method of transposition, if the resulting pattern matches better the whole phrase or allows you to restore the stylistic features.

Modulation is a variation of the message, using a phrase with the different meaning in the original language and the target language for the transfer of the same idea. This method can be resorted when it is clear that literal translation or even transposition results in a grammatically correct statement, which is not contrary to the spirit of the target language. Inadequate translation can be avoided through modulation.

In addition to modulation, concretization method is widely used in translation, i.e., the translator uses a narrow meaning, belonging to a word, but does not provide a new, as in modulation.

Equivalence often occurs that two texts describe the same situation through very different stylistic and structural means. Most of equivalences are stable and are part of the idiomatic phraseology, including clichés, sayings, adjectival or substantive fixed patterns and so on, e.g., dog bolt – откидной болт, cast iron – чугу́н, liquid rockets – ракеты на жидком топливе, etc.

Quite often is used a translation method called grammatical replacement, which can be seen at the level of word forms or the whole sentences.

Compensation is used when some semantic elements and stylistic peculiarities can't be transferred reliably. The translator shall remember that the translation is not just the transfer of meaning of text from one language to another, it's also transfer of cultures.

Adaptation. When the situation in the original language does not exist in the target language, it shall be transferred through a different situation, which we consider an equivalent [3].

V. The important feature of technical texts that is reflected in the selection and usage of language means is to reach brevity and compactness of narration. Therefore, there are so many special constructions and stamps there. Misunderstanding of these constructions leads to the mistakes in translation.

We give several frequently encountered constructions and stamps together with examples of their filling.

1) «For any (понятие) such that (штамп) in follows that (штам)». For any $\varepsilon > 0$ such that $\|ef\| = 1$ in follows that $f \in T_\varepsilon$. Remember that the comma before the word-combination «such that» is not put. This is a gross mistake.

2) «By definition, put (штам, формула)». By definition, put $P_n = \{x \in P_n : \|x\| < n\}$ [4].

VI. The distinctive features of scientific and technical style are preciseness, clear logic, compressive character, impersonality, formality. Preciseness is a basic property of a scientific and technical text, and it should be strictly maintained in translation.

The main function of the scientific and technical style is informative. To convey logical information, prove its novelty and significance is the main goal of a scholarly, scientific or technical author. This style is used in professional spheres of mathematics, mechanics and other technical sciences.

The scientific and technical style involves the following substyles: scientific, technical, instructional (educational), popular science substyle. The substyles are classified into the following genres: monograph, manual, textbook, article, report, technical description, discussion, etc.

Preciseness and reliability of a scientific text is also established with references and citations. The Russian style researcher N. Razinkina compared references with currency, by which scientists pay their intellectual debt to their predecessors. The bibliography is considered to be a kind of social control over scientific value and reliability of the results of research.

The translation process always takes place strictly within the logical thinking, i.e., those who are capable of thinking logically are likely to make the proper translation. Experts in logic say that to understand an unfamiliar term, we need to analyze the context. In the course of this analysis, we set different semantic connections and relationships between the unknown term and other words, the meaning of which is well known. Such cases are very common in the translation from the foreign language into the native language.

Clear logic is achieved through a system of logical connections and interrelations. A stock of linking phrases will help a translator make a connection between a point in the past and future, to refer a receptor forward or back. For example, As we will see... – Как будет видно... As I said earlier... – Как было сказано раньше... Linking phrases help to develop a point (Moreover... – Кроме того... Despite this... – Несмотря на это... According to our estimates,... – Согласно нашим подсчетам...)*

Logical enumeration of classification in a scientific text is a matter of graphical hierarchy: first come Roman numerals (I, II, etc), then Arabic numerals (1, 2.), then, if necessary, Arabic numerals with a parenthesis: 1), 2), followed by capitalized letters (A, B), lowercase: a, b, or lowercased letters with parenthesis: a), b). It is advisable not to change the hierarchy of enumerating elements, since a different order will seem illogical. In marking the enumeration, the translator (like the author) should be consistent.

A specialized mathematical and mechanical technical text tends to emphasize thematic components by various means because the theme serves as a linking element between what has been said in the text and what will follow (new, rheumatic element). English texts, though, often manifest their implicit character and do not verbalize the thematic component of the sentence. Therefore, in the more explicit Russian text, a translator has to extend the sentence by adding an implied thematic element:

Economy and compressive character of the text. A scientific text must provide a reader with maximal information within a minimal time period and with minimal effort. This stylistic feature of technical translation is achieved with lexical and grammatical means, such as: using compressive structures, like attributive clusters (a liquid rocket – ракета на жидком топливе), Complex Subject (these devices were proved to be sufficiently reliable), Complex Object (assume this to make...), reduced adverbials (if found), article ellipsis (General view is that...); abbreviation (PC = personal computer; CD-ROM = Compact Disk-Read-Only Memory). It is necessary that a translator decipher all the abbreviations in the original (by using every available dictionary and reference book) and render them according to the standards. If the form has no standard abbreviated form in the target language, it is given in full form. The abbreviations that cannot be deciphered are retained in the source language.

Impersonality is a measure of the extent to which the producer of a text avoids reference to him/herself or to the receptor. Such avoidance is far commoner in written than in spoken texts, and in Russian than in English. Using impersonal and indefinite structures, passive constructions, infinitive clauses, etc. provides the impression of the impersonal and objective style. Several calculations were run. – Было проведено несколько вычислений.

As has been mentioned, in English texts a smaller degree of impersonality is acceptable, as compared with Russian. This results in a more frequent usage of personal pronouns (I, we, you) in English. Such sentences are often translated from English into Russian by infinitive clauses or impersonal constructions: If we prove a theorem... – Если докажем теорему...

English instructions and directions normally list instructions in the imperative mood. To observe impersonality as a characteristic feature of a Russian technical style, it is recommended translating the imperative verbs by Russian infinitives:

«To solve the Cauchy problem, you need to follow the following scheme:

a). Bring the initial equation to canonical form in the new coordinate system and return to the original coordinate system.

b). Integrate the resulting equation in the canonical form.

c). Find arbitrary functions from the initial conditions of the Cauchy problem.»

Some authors prefer to use the so-called 'royal plural': we – мы. Today this usage is considered somewhat outdated. It is better to keep an impersonal style.

You should favor the active voice. The active voice tends to grab the readers' attention. The active voice indicates action, while the passive voice indicates inactivity. Mathematical writing is boring enough; keep

your writing lively. Many writers use the person such as \I «and \we» to avoid the passive voice. Remember to allow other objects to be active: solutions can mean something, data of the given problem can show something, etc.

Formality. This feature results from the author's tendency to avoid connotative words in the scientific text. However, research by N. Razinkina and other linguists has shown that English scientific text is not void of expressive elements, which greatly differs from the Russian style. Metaphors and bright similes are not infrequent in the English scientific text. Since this feature is so different in English and Russian, translators generally leave out metaphors in the Russian translation according to the rule of functional equivalence [3].

VII. To understand and correctly translate mathematical or mechanical statement in symbols, you need to achieve the following objectives:

1. To understand statements to form a correct equation.
2. To translate mathematical statement in symbols.
3. To appreciate the use of different symbols in mathematics.

Translating words to symbols. The job of the problem solver is to translate the problem from phrases and statements into mathematical expressions and equations, and then to solve the equations.

As problem solvers, our job is made simpler if we are able to translate verbal phrases to mathematical expressions and if we follow the method of solving applied problems. To help us translate from words to symbols, we can use mathematical and technical dictionaries. Translate each phrase or sentence into a mathematical expression or equation.

Exercises. a) Three more than seven times a number is nine more than five times the number: $3 + 7x = 9 + 5x$.

b) In variation problems we are provided with an expression $J[y]$ that «eats» whole functions $y(x)$ and returns a single number. Such objects are often called functionals to distinguish them from ordinary functions. The functional is the mapping of the space of smooth (having derivatives of all orders) functions to the whole number axis: $J[y]: C^\infty(R) \rightarrow R$.

VIII. Peculiarities of translation of scientific and technical papers. A significant role in the scientific and technical papers is played by prepositions and complex conjunctions (e.g., in order that, provided that, as though, etc.) which create logical connections between the individual elements of sentences. In addition, the scientific and technical papers frequently use adverbs, which are integral parts of the development of logical thinking.

Under the realias of mechanical, scientific and technical papers we understand the titles, the brands of equipment and materials. The realias, as a rule, are not translated but transliterated or given in the text in their original writing. Optimal translation solution for the phraseology is a search for identical phraseological items in the target language. In the absence of direct correspondence, the original statement can be translated by searching for similar items, having a similar meaning with the original one.

Stylistic peculiarities of the translation of scientific and technical papers are language clarity, lack of expressive, emotional and imaginative patterns.

Knowledge of the typical translation errors and their causes contribute to their prevention. Translation errors are divided into two main types: functional and informative. Functional and informative errors are functionally unreasonable deviation from the original text, adversely affecting the transfer of its meaning. In terms of its negative impact on the quality of the original source translated, they are divided into the «distortions» and «inaccuracies». The distortions are errors in the translation, misleading the translation recipient about the content of a source text. Inaccuracy features lesser degree of equivalence violations, and less misleading impact.

Grammatical peculiarities of the translation of scientific and technical papers are characterized by frequent use of participial and verbal adverb phrases, simple, expended and complex sentences, passive voice, infinitive, participial and gerund phrases.

The great danger for the translator lies in the fact that both English and Russian feature a lot of similar grammatical forms and syntactic structures, the functions and meanings of which do not match in the languages. Similar names of such forms and constructions, borrowed both in Russian and in English from Latin, should not be misleading. English infinitive and participle functionally and meaningfully differ from the corresponding Russian forms. In the course of translation, it is required to use grammatical transformations. Functional correspondence is achieved by a complete change of structures, word order and by replacing parts of speech and sentence, adding and omitting words. The ability to adequately translate foreign text is one of

the goals of training, even though it is not aimed at training a highly-qualified translator. The essence of adequate translation is not the transfer of letters but the spirit of the text. Each language has its own unique means, characteristics and properties, so to faithfully convey an image or phrase; sometimes a translator shall completely change them [5].

In conclusion, technical translation is a type of specialized translation involving the translation of papers produced by technical writers (owner's manuals, user guides, etc.), or more specifically, texts which relate to technical subject areas (mathematics, mechanics) or texts which deal with the practical application of scientific and technical information. Technical translation covers the translation of many kinds of specialized texts and requires a high level of subject knowledge and mastery of the relevant terminology and writing conventions. In addition to making texts with technical terms accessible for a wider ranging audience, technical translation also involves linguistic features of translating technological texts from one language to another.

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Г.А. Есенбаева, Д.Н. Есбаева

Математика және механика бойынша ғылыми-техникалық аударманың кейбір қырлары

Мақалада ғылыми-техникалық жұмыстарды кәсіби аударудың сұрақтары мен әдістері математикалық және механикалық мысалдар негізінде қарастырылды. Ғылыми-техникалық құжаттарды аудару — бұл кәсіби және аударма жұмысының саласы, сол себепті кәсіби аудармамен өз ойын және мақсатын анық тілде білдіре алады, шет тілдері, кәсіби білімі мен нақты терминологияны білетін адам айналысуы керек. Математика және механика бойынша ғылыми-техникалық мәтіндердің аударма сапасын жоғарлату жұмысының мазмұның терең түсіну, математикалық және механикалық терминдер мен сөз тіркестерінің мамандандырылған білімі, аударманың керекті әдістемелерін қолдануы арқылы жүгізілді. Авторлар мысал ретінде математика және механика терминдерімен сөзтіркестері, математикалық және механикалық сөйлемдердің конструкциясы мен шаблондарының аудармасы келтірген, математика және механика текстерінің тыс қалған аудармаларының әдістерін зерттеген. Ең бастысы, бұл мақала математиктер мен механиктерге бағытталған.

Кілт сөздер: ғылыми-техникалық аударма, математика, механика, термин, конструкция аудармасы, аударма әдісі.

Г.А. Есенбаева, Д.Н. Есбаева

Некоторые аспекты научно-технического перевода по математике и механике

В данной статье рассматриваются вопросы и методы профессионального перевода научно-технических работ на примере математики и механики. Перевод научно-технической документации — это область профессиональной и переводческой деятельности, поэтому профессиональный перевод должен выполняться высококвалифицированным персоналом, владеющим иностранным языком, профессиональными знаниями и конкретной терминологией, способным адекватно и грамотно выражать свои мысли на целевом языке. Повышение качества перевода научно-технических текстов по математике и механике проходит через глубокое понимание содержания работы, знание специализированных математических и механических терминов и словосочетаний, использование подходящих ме-

тодов перевода. В статье рассмотрены примеры перевода математических и механических терминов и словосочетаний, приведены конструкции и шаблоны перевода математических и механических предложений, исследованы методы устранения ошибок перевода математических и механических текстов. Статья предназначена, главным образом, для математиков и механиков.

Ключевые слова: научно-технический перевод, математика, механика, термин, конструкции перевода, методы перевода.

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