

The nature of scientific/technical texts from viewpoint of translation studies

Eva Mastná

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Tomášek, M. *Překlad v právní praxi*. Praha: Linde Praha, a.s., 2003.

Verdonk, P. *Stylistics. Oxford Introduction to Language Study*. Oxford: Oxford University Press, 2002.

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Mgr. Vlasta Vaculíková

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prof. PhDr. Vlastimil Švec, CSc.
děkan



doc. Ing. Anežka Lengálová, Ph.D.
vedoucí katedry

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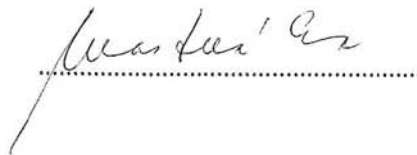
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ABSTRAKT

Cieľom bakalárskej práce je vypracovať podrobnú literárnu rešerš o podstate vedeckých a technických textov. Práca pozostáva z dvoch hlavných častí, a to z teórie a analýzy. Teoretická časť predstavuje súčasnú klasifikáciu štýlov, so špeciálnym zreteľom na charakteristiku vedeckého, technického a administratívneho štýlu z hľadiska prekladateľských štúdií. Účelom práce je poskytnúť čitateľovi prehľad vlastností vybraných štýlov, ktoré musí prekladateľ rešpektovať pri prekladaní z anglického jazyka do jazyka českého a naopak a prehľad základných pravidiel, ktorými sa musí riadiť. Analýza pomáha naplniť hlavný cieľ práce, a to podporiť teoretické poznatky uvedené v teórii a nájsť spoločné rysy medzi vybranými úryvkami textov z oblasti ekonomiky, práva, fyziky a chémie.

Kľúčové slová: klasifikácia štýlov, vedecký a technický štýl, administratívny štýl, prekladateľské štúdiá

ABSTRACT

The aim of the bachelor's thesis is to undergo a deep survey of the nature of scientific and technical text. The thesis consists of two main parts, theory and analysis. The theory deals with introducing contemporary classification of styles, and mainly to describe scientific, technical and legal style from the viewpoint of translation studies. The purpose of the theory is to provide a reader with the aspects of chosen styles that a translator must consider and main principles he/she must follow when translating from English into Czech and vice versa. Analysis fulfills the main objective of the thesis, to support given knowledge about the scientific and technical translation and to find common feature among selected substyles represented by excerpts of texts from the fields of economics, law, physics, and chemistry.

Keywords: Classification of Styles, Scientific and Technical Style, Style of Official Documents, Translation Studies

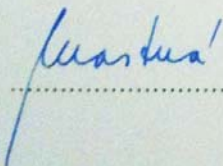
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DECLARATION OF ORIGINALITY

I hereby declare that the work presented in this thesis is my own and certify that any secondary material used has been acknowledged in the text and listed in the bibliography.

May 4, 2010


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I. INTRODUCTION

This bachelor's thesis surveys the basics of translating technical and scientific texts. The thesis consists of two parts: theory and analysis. The theoretical part summarizes the current scholarship on the topic, thereby setting the foundation for the analytical section. The analytical section applies the previously discussed translation theories.

This thesis attempts to discern the nature of scientific and technical texts, the stylistic genres on which they are based, and the relationship between the nature and genre of the texts and their translations. It then explores the possibility of a common set of rules for translating scientific and technical texts. Such texts comprise wide range of literature related to science and technology. This range itself shapes the character of translations.

A translator must be fully aware of the stylistics, lexicology and syntax that differ considerably in belles-lettres, newspaper, or legal styles. However, arguments have been made concerning the classification of the legal style. Therefore, this thesis will examine the legal style as well in order to prove or disprove a resemblance with scientific and technical texts. All of these aspects are crucial in searching for similarities and differences among particular types of scientific and technical texts.

It is important to challenge generally accepted principles of translation because language is a fluid entity influenced by factors such as society, new trends or technological progress. This thesis, through analysis of excerpts, attempts to discern to what extent these factors influence the translations of scientific and technical texts. Source texts and translated texts will be compared and examined according to set parameters. These excerpts represent utterly different types of scientific and technical texts such as medical, chemical, and technical, as well as legal.

Even though these excerpts represent only a few types within a broad range of different texts, they suffice for the purpose of drawing general conclusions, chief among them being that a set of rules for translators of scientific and technical texts is possible.

However, the variability and specification of each type must be carefully considered by the translator, and even in scientific and technical text every translation should be treated as a unique text and should not be translated mechanically.

II.

THEORY

1 NATURE OF THE STYLES IN ENGLISH LANGUAGE

Translation and language are two entities unable to exist separately. Translation belongs with no doubt among the most challenging tasks a human can undergo. To fulfill this task, it is crucial for translator to grasp the knowledge of stylistics. Stylistics is the fundamental discipline building the base of information about particular styles, which are vital for a translator's work. That is why the introductory chapter of the thesis deals with stylistics.

Stylistics is a linguistic discipline concerned with the study of style in language. Style in language refers to a distinctive manner of expression, through whatever medium this expression is given physical shape. Therefore, stylistics can be defined as the analysis of distinctive expression in language and the description of its purpose and effect. (Verdonk 2002, 4)

The thesis aims to introduce the nature of the styles with subsequent application of this knowledge in the analytical part. The main purpose of the thesis is to describe the nature of scientific and technical texts, their features and the way they should be translated.

One important approach to the study of style is based on an analysis of meaning into its “denotative” and “connotative” elements. This is to analyze meaning into a stylistically neutral “cognitive meaning” and an “expressive” or “affective” element which is the concern of stylistics. (Turner 1973, 27)

The next chapter deals with defining functional styles according to contemporary linguist's classification.

1.1 Classification of functional styles

There exists a variety of styles as there are numerous human activities in the world. They all need to use language to convey the results of their efforts. This variety of styles is summarized in the following classification.

A style of language can be defined as “*a system of coordinated, interrelated and interconditioned language means intended to fulfill a specific function of communication and aiming at a definite effect*”. (Miššíková 2003, 114) These language means are the main elements that create distinctions among the styles. Styles are in constant development as a result of the progress and changes in human activities.

The development of each style is predetermined by the changes in the norms of Standard English. (Miššíková 2003, 114)

This generally agreed classification is also presented by Miššíková (2003, 115-122).

- *The belles-letters style* – is the style of *the language of poetry, fiction and drama*.
- *Publicistic style* – the most obvious subdivisions are distinguished: *oratory*, i.e. speeches and orations, *essays* and *articles*. The aim is to persuade a reader or listener that the given information is correct and to have an impact on public opinion.
- *Newspaper style* – contains such diverse categories as news reports, editorial comments, imaginative articles, reviews, letters, headlines, sub-headings, announcements, list of sport results, cartoon dialogues, competitions and many kinds of advertising. (Crystal 1997, 392)
- *Scientific and technical style* – is applied when certain scientific knowledge or information obtained from scientific research has to be conveyed.
- *Administrative style or the style of official documents* - the language of business documents, the language of legal documents, the language of diplomacy, and the language of military documents.

Introduction of main styles mentioned above has divided styles into five main categories. They differ in their nature. The aim of next chapters is to define the essence of scientific, technical and legal texts and to discuss their features thoroughly.

1.2 Nature of Scientific and Technical texts

Scientific and technical texts will be discussed in this chapter from the aspect of general features characteristic for particular styles and from the aspect of terminology.

The style of science creates the fundamental part of the non-fiction style. It has informative function not only in particular field of science, but also in broader sense, because administrative style can be considered as scientific style as well. (Knittlová 2005, 136)

I agree with Knittlová as far as the administrative style is concerned. However, the question whether this style has or has not that many common features will be also the aim of the analysis. Miššíková (2003, 121) introduces her own perception of scientific and technical style in a slightly different way:

“The language of science is governed by the aim of the functional style of scientific prose, which is to prove the hypothesis, to create new concepts, to disclose the internal laws of existence, development, relations between different phenomena, etc. The language means

used, therefore, tend to be objective, precise, and unemotional, devoid of any individuality; there is a striving for the most generalized form of expression”.

In last decades, the scientific and technical style has been split into many new and more specialized styles as a result of progress of technology and higher specialization. Nowadays, every branch of science has its own terminology, but there can also be found differences in syntax. (Knittlová 2005, 136)

Huge progress in numerous fields of science made recently and emerging of new ones motivates linguists to study language and its styles constantly.

1.2.1 General Features of Scientific and Technical Style

Scientific and technical style will be viewed from the aspect of different features.

Scientific and technical style has some distinctive characteristics from which the most important are the use of terms, objectivity, accuracy and expertise (Mistrík, 1970). In terms of language means, the constructions of the gerund and participle are used to make the text more condense and precise. Parentheses also frequently occur. (Miššíková 2003, 120)

The first and most noticeable feature of this style is the *logical sequence of utterances* with a clear indication of the interrelations and interdependencies. (Miššíková 2003, 121) Logical sequence of utterance is definitely important to comply with the following general features.

Second distinctive feature is as well the use of terms specific to each given branch of science. Each scientific field of human activity generates the greatest amount of new words. As a result of constant efforts to discover essence of things and phenomena, there is a need to name new concepts subsequently by means of coining new words. (Miššíková 2003, 121)

Third characteristic feature of scientific style is what we may call *sentence-patterns*. They are of three types: (Miššíková 2003, 121)

- postulatory,
- argumentative,
- formulative.

There are some other features of scientific prose such as the use of quotation and references, the frequent use of foot-notes, digressive in character, and the impersonality of scientific writings. (Miššíková 2003, 122) Impersonality is required to preserve the character of the style which should be “invariant to all observers”. Impersonality can be achieved by means of (Turner 1973, 181):

- using passive constructions,
- using general pronoun *we*,
- using mostly a third-person style (to be discussed later),
- using abstract nouns formed from verbs and adjectives

Now let us have a look at the usage of passive voice.

The usage of passive suppresses the author's role and exclusively aims to describe the facts and phenomena. It appears also in cases where not only the agent (*konatel*) but also agency (*působil*) is irrelevant and the only thing that matters is the affected subject. Knittlová (2005, 137) uses the following examples:

"This concentration is assumed to lie...", *"The method can be considered well suited for..."*

"...nuclei are irradiated..." (Knittlová 2005, 140)

In the example mentioned above, avoiding to express the agent of a text can be seen, because from the pragmatic aspect

It is also possible to use active forms in combination with general pronoun *we* as a subject "*we*", which refers more obviously to the author. It is common mostly in the texts of exact sciences. However, general *we* occurs more often in Czech technical texts than in English ones.

"We deduced, we observe, we define, we obtain, we can express, we see, we note, we consider, we assume, we have experimentally verified, we placed..." (Knittlová 2005, 139)

The first way how to use quotations or references is done, second is very frequently used – third-person expressing, which is discussed into detail in the following paragraphs.

In his practical manual "The Structure of Technical English" A. J. Herbert considers the following formula as the basic feature of scientific and technical style in contemporary texts (Knittlová 2005, 140):

IT IS + ADJ + TO + INF

He introduces necessary expression to be used and uses them as convenient prefabricates (Knittlová 2005, 140):

<i>IT</i>	<i>IS</i>	<i>ADJ</i>	
<i>it</i>	<i>is</i> <i>seems</i> <i>appears</i>	<i>easy</i> <i>possible</i> <i>necessary</i> <i>advisable</i> <i>preferable</i> <i>useful</i>	<i>difficult</i> <i>impossible</i> <i>unnecessary</i> <i>inadvisable</i> <i>Useless</i>
	<i>proves</i> <i>becomes</i>	<i>instructive</i> <i>advantageous</i> <i>practicable</i> <i>common</i> <i>usual</i> <i>essential</i>	<i>Disadvantageous</i> <i>Impracticable</i> <i>Uncommon</i> <i>Unusual</i>

Tab. 1 Frequent expressions in scientific and technical style I (Knittlová 2005, 140)

<i>IT</i>	<i>IS</i>	<i>ADJ/Vpp</i>	<i>THAT</i>
<i>It</i>	<i>is</i>	<i>likely</i> <i>possible</i> <i>evident</i> <i>clear</i> <i>obvious</i> <i>desirable</i> <i>essential</i> <i>known</i> <i>assumed</i>	
<i>It</i>	<i>has been</i>	<i>decided</i> <i>arranged</i> <i>planned</i> <i>shown</i> <i>proved</i> <i>demonstrated</i> <i>noticed</i>	<i>that...</i>
	<i>will be</i> <i>should be</i>	<i>seen</i> <i>appreciated</i> <i>noted</i> <i>realized</i>	

Tab. 2 Frequent expressions in scientific and technical style II (Knittlová 2005, 140)

There can also be found synonymic phrases as the following example shows.

E.g.: *It is of practical importance to establish.* (Knittlová 2005, 142)

New paragraph often begins with *It is true that ...*, *but...* - *It is obvious that....* Impersonal sentences of this type bring minimum semantic information and serve only as introduction of the sentence presenting the basic thought. (Knittlová 2005, 142)

E.g.: *It is evident that investigations should be made for other exposure times. – It can be seen that the series limits...are in very close agreement.*

It is one of the features of scientific and technical style, because the presumptions and statements are usually not presented directly. (Knittlová 2005, 142)

It is mostly caused by the fact, that newly revealed facts often need a great amount of time to be proved and that is why using general pronoun *we*, in my opinion, is recommended only if the scientific phenomenon is confirmed and proved as a truth. The example demonstrates the situation where there is no certainty yet.

E.g.: *...the difference does not appear to greatly affect the calculated value...*

The above-mentioned impersonal sentences have great occurrence of **modal verbs** (*must, should, ought to, can, may, might*). They have usually weaker lexical meaning when used in this style. According to J. A. Zverevy they lose their lexical meaning mostly with verbs *to note, to notice, to remark, to observe, to mention*, partially also with the verb *to say*. It is necessary to realize that this modality is not subjective author's attitude to conveyed facts, but this modality is objectified, which is in compliance with objectifying of scientific style. (Knittlová 2005, 142)

E.g.: *It may be noted... -It should be noted... -It might be remarked... -It ought further to be remarked.*

Russian linguists analyze English scientific style in many of their dissertation theses. They have noticed that *would* is used in every person of singular and plural to express repetitive action in the present, in the past and in the future: *The instrument would give readings every ten minutes*. Other works deal with the usage of the verb *to seem* that weakens the meaning of the following verb. This leads to *understatement*. In impersonal instructions *should* is usually used, which is less authoritative than a strict verb *must*, and that conforms the overall atmosphere of scientific and technical texts (Knittlová 2005, 142):

E.g.: *Safety precautions should be observed at all times – The process of cooling should continue for several hours*

Therefore, the use of modal verbs is convenient when giving indirect instructions.

Direct form of instruction is expressed in imperative, that is used also in hypotheses or mathematical formulas, e.g.: *Assume a Cartesian coordinate system...-Let us examine a couple of cases – Let V be the vector analytic signal...*(Knittlová 2005, 143)

Another basic and no less important feature of scientific language is objectiveness.

Objectiveness of scientific language means is connected also with specific usage of language means named *intellectualization* or *rationalization*. It means direction to a concrete and precise expressing, which are helpful in suppressing emotionality or expressivity. (Knittlová 2005, 151)

To conclude the chapter dealing with general features of scientific and technical style, it is better to present them again in a brief and concise form. The summary of main features of scientific and technical style is listed according to Knittlová (2005, 157):

- Strictly logical syntax and sentence ordering
- Explicitness
- Objectiveness
- Impersonality
- Lack of emotional load
- Condensation

After introducing main features in this chapter, a precise image of the features frequently used in this style has been developed. I suppose, that the extent to which particular features are represented in the given text can vary, which depends mainly on the purpose of scientific and technical text and on its recipient. There are even features listed in the summary, which could be discussed to a greater extent. Lack of emotional load appears to be with no doubt the general condition for scientific and technical texts. However, attempts to denote new concepts arising in the field of young and competitive scientific branches, equally reflect their dynamics and that is often transferred into their names (see chapter 3.3)

1.2.2 Scientific and Technical Terminology

To understand thoroughly the nature of scientific and technical terminology, it is vital to spread a few words on behalf of terminology as well.

The system of terminology in scientific style is not closed and constant as one might think. It is in constant development as the new scientific disciplines emerge and develop (Knittlová 2005, 152), as it has been already mentioned in the previous chapter.

Words used in scientific prose will always have tendency to be used in their primary logical meaning. No words should be used in more than one meaning. Furthermore, terms are coined so as to be self-explanatory to the greatest possible degree. But in spite of this a new term in scientific prose is generally followed (or preceded) by an explanation. (Miššíková 2003, 121)

Terminology is neither emotional nor ambiguous; the terms have narrow meaning and limited field of usability. However, according to recent English studies on lexical structures, there can be found a range of terms with a certain degree of expressivity, for example *conductor alive (vodič pod proudem)* in radio engineering, or the majority of terms used in cosmonautics such as *crashlanding, splash-down*. (Knittlová 2005, 152)

In my opinion, this fact might be caused by more reasons. It is either to enable to enter a world of exact sciences to masses of people, or it is caused by new scientific branches (see 1.2.1)

In modern scientific prose, there is an exchange of words between particular fields of science. It is a result of collaboration among specialists in related sciences and it has proved successful in many fields (Miššíková 2003, 121). Even common words in unusual collocation may define a technical style. (Turner 1973, 173) With regards to Mr. Turner, who expressed this thought in 1973, the tendency nowadays may even lead to more frequent occurrence of common words in scientific and technical English.

Technical terms may pass into the general language. When this happens, a word used by a restricted group of people in a restricted situation becomes used more widely by more people and the reference will tend to be less concentrated or precise. (Turner 1973, 179)

To conclude important facts about scientific and technical terminology and general features, there is a fitting explanation according to Knittlová. Selection of lexical units also complies with the requirement of precise transmitting of thoughts and ideas. Scientific style is conceptual, typical word classes are nouns, possibly adjectives, and mainly technical expressions (terminology). Terminology is carefully chosen in order to be unequivocal. Subjective and expressive expressions generally do not occur in the style. The more scientific the style is, the more specific the terms are. In the particular scientific branches and their language we can get by with low lexical variety, therefore the index of repetition is quite high. According to the research, when comparing this style to other styles, it has the highest index. (Knittlová 2005, 137)

Vocabulary is also stereotyped as well as syntax is. However, this feature is not negative, just quite the opposite; it supports the function of this style and it is convenient for precise and clear understanding of foreign language scientific text. (Knittlová 2005, 138)

Stereotype of scientific and technical texts definitely is not the issue to argue about. Routine in using the same terminology in some fields can be easier but also misleading.

Besides the terminology specific for a particular scientific disciplines, there are also used so called *semiterms* used in this style. Semiterms are words that, unlike the specific terms, occur in a broad range of meanings, they are common for number of scientific disciplines (*process, effect, feature, to function, to operate, to effectuate, to modify*, etc.). (Knittlová 2005, 155-156)

Literary expressions aren't a rare phenomenon in this style. Expressions such as *negligible, obviate, propagate* create a stiff impression, though. Typical expressions are even those of everyday usage such as *use, show, call, write, consider, treat, maintain*, etc. (Knittlová 2005, 157)

Preferring more typical expressions is in compliance with the efforts to achieve plain English. This characteristic feature is used in case when long and stiff expressions are grossly unfactual, deceptive, evasive, or highly confusing. (Crystal 1997, 383)

To conclude this chapter, it is understood that terminology varies significantly with particular field of science, e.g. aerospace, business/finance, automotive industry, chemistry, civil engineering, computers, electrical/electronic engineering, environment, law, medicine, military and nautical subjects, patents, social sciences, and many others. (Sofer 2006, 99-111)

All the branches mentioned above have their own vocabulary and the terminology. This chapter aimed to describe the meaning of words and their proper usage. We have so far discussed the nature of scientific and technical texts

1.3 Nature of the Language of Official Documents

The following chapter deals particularly with the attributes of the language of official documents. It is also known and referred to as administrative style. It has been the issue for several years.

Language of official documents, possibly known as administrative style is according to J. Mistrík used for denoting the youngest and the least problematic functional style. (Knittlová 2005, 127) Of all uses of language, the language of the law is perhaps the least communicative. In fact, the legal writers use specific jargon which does not reflect the needs of general public. (Miššíková 2003, 122)

In contrast, it is important to realize that the administrative style is not homogenous, and those texts which require the complete and correct understanding of a reader (or applicant) should be written in plain English, avoid ambiguous terms and difficult legal jargon. (Crystal 2001, 383)

1.3.1 Style of Official Documents and its Features

This chapter introduces the style of official documents. After brief definition of a style, the main features of this style will be defined, described and discussed.

From a linguistic aspect, this style is basically quite stereotyped, lexically and syntactically indigent and fairly primitive as far as the composition of the text is concerned. (Knittlová 2005, 127)

It is to be discussed where this style should belong and how it is classified. However, some stylists, for example J. Mistrík, include administrative style among the scientific and technical style. (Knittlová 2005, 127)

Impersonality is the first one from the range of other significant features of scientific and technical style. Another feature, from a viewpoint of syntax, is precise verbalization and *logical sentence order*. There is a mutual relationship and dependency between the two mentioned features. (Knittlová 2005, 145)

Another feature is connected to precise sentence order – *the ordering of the sentence constituents*, or *of the clauses within a sentence*. Scientific style starts from the known *theme*, the conveyor of logical subject as the element bringing no new information but relating to the information mentioned before or known from the context, and proceeds to the *rheme*, the conveyor of logical predicate. However, if the subject is at the head of the sentence, its role is very strong so that the position adverbial becomes often a subject in English scientific style (Knittlová 2005, 145):

E.g.: *The chapter 8 discusses... - Fig 4 shows diagrammatically – Table VII gives the calculated energies.* Possible translations into Czech are: *V kapitole 8 se hovoří o... - Na obr. 4 je schematicky znázorněn... -V tabulce VII jsou uvedeny vypočítané energie* (Knittlová 2005, 145). Rhematization will be discussed into more detail in chapter 2.3.

Legal texts are primarily written and designed to some purpose, the aspect of functionality is, in my opinion, predominant.

Functionality of legal subsystem leads to basic requirements for legal language such as semantic exactness, non-ambiguity, brevity, comprehensibility, determinateness, and non-expressiveness. (Tomášek 2003, 28):

Besides the special nomenclature characteristic of each variety of the style, there are certain features common to all varieties (Miššiková 2003, 122):

- the use of abbreviations, symbols, contractions,
- the use of words in their logical dictionary meaning,

- no words with emotive meaning except those which are used in business letters as conventional phrases of greeting or close, as *Dear Sir, Yours faithfully*.

The distinctive properties appear as a system. The style is not recognizable only through vocabulary. The syntactic pattern of the style is as significant as the vocabulary though not perhaps so immediately apparent. (Miššíková 2003, 123)

It is necessary to realize that today the administrative style is much more varied than it was before, because the communication of private companies differs significantly from the official authorities. (Knittlová 2005, 128)

When discussing the legal text from the viewpoint of complexity of sentences, it is possible to declare that in the English legal style the use of complex sentences prevails, as well as the use of declarative sentences. Usage of interrogative and exclamatory sentences is very rare. Most of the legal sentences are designed according to the formula: “If x is valid, then z will be valid as well”, i.e. before something could possibly happen, it must comply legally with certain conditions, for example: “*Thereafter if no renewal fee is received and no extension of life is requested, the patent will cease.*” (Knittlová 2005, 130)

Besides the fact that English legal style shows frequent use of complex sentence, certain formula, it can be considered from the viewpoint of using nouns in language.

According to Knittlová, legal English is highly **nominal**. Semi-clauses are often used. **Postmodification** is much preferred in nominal phrases, because it expresses the relationship explicitly by using many prepositions, therefore it guarantees correct understanding and prevents imprecise or mistaken interpretation. (e.g.: “*...for grounds for protesting the allowance of any claim contained in the application...with an explanation of the relevance of such prior art to the allowed claims...*”). (Knittlová 2005, 130)

Usage of determiner “*such*” without indefinite article (“*such title of interest*”) is also very typical. Intensification adverbs “*very*” and “*rather*”, common in other styles, do not appear in legal language because of their vagueness. (Knittlová 2005, 130)

As mentioned above, legal English style is highly nominal. Here can be listed some of them.

Abstract nouns are frequent element in administrative style (“*request, proposal, conditions, authority, provisions, advantage, and benefit*”...). Verbs are usually chosen from a restricted group of verbs (“*accept, require, agree, state, issue, register, specify, constitute, command, perform, prevent, observe, cause, exercise, warn, remind*”). Modal verbs are used, usually “*shall*” or “*may*” + passive infinitive (for example “*shall be constructed*”, “*may be revoked*”), where “*shall*” always expresses the obligatory

consequence of the legal statement (“*the patentee shall have and enjoy the whole profit*”). Traditional feature of this style is reflected in usage of archaisms (“*hereinbefore, heretofore, hereunder, aforesaid*”) and formal words and phrases such as “*duly, during the term of years herein mentioned, graciously pleased*” (Knittlová 2005, 131). On the other hand, Old and Middle English words (*aforesaid, forthwith, hereafter, heretofore said, thenceforth, thereby, theretofore, whereby, witnesseth*) are no longer in general usage (Crystal 2001, 391).

Another interesting feature is the occurrence of *pair-synonyms* (“*Terms and conditions, conditions and provisions, use and exercise, described in and by the following statement, obtained if and when*”). Roman influence cannot be avoided as well. It has a very strong position in administrative style. A lot of French terminology has been borrowed (“*assurance, sign, extension, condition, patent, date, revocable, contract, cause, application, benefit, accept, condescend to the request*”). (Knittlová 2005, 131)

Different branch of legal style is represented by the style of diplomacy (documents used in diplomacy), which tends to have sometimes pathetic feeling and **proclamative** nature and it is very similar to publicistic style. Other genres are announcement genres – instructions, notices, ordinances, and the style of business. (Knittlová 2005, 135)

Business style stands as a clearly recognized genre of administrative style with a whole range of specific features that we can encounter mainly in business correspondence (*obchodní korespondence*). It consists of:

- inquiries (*dotazy*),
- offers (*nabídky*),
- orders (*objednávky*),
- invoices (*faktury*),
- claims and complaints (*reklamace a stížnosti*),
- dunning letters (*upomínky*) and plenty of various regulations, forms etc.

When translating official documents, it is necessary to get informed about appropriate terminology, established phrases and formulas specific for the given style in the target language. As far as the fundamental function of official style is to convey information – relevant and contents related – as precisely and clearly as possible, then formulas often play the role of terms. A translator needs to take this into consideration and to avoid any attempt to achieve linguistic and lexical variety, to modernize the style or to make it more accessible. Quite the opposite, a translator should hold on to such expressive means that

are used in similar target language documents even if they differ slightly or considerably from the source language expressive means. (Knittlová 2005, 136)

The features of some texts in legal style such as *wordiness*, *lack of clarity*, *pomposity*, and *dullness* can be considered negative. (Crystal 2001, 391)

To avoid the above mentioned negative features, legal translators are now encouraged to strive for linguistic purity and their primary task is to produce text that promotes uniform interpretation and application of the single instrument. (Sarcevic 2000, 120)

The chapter introduced main features of legal styles such as impersonality, lack of emotional load, logical sentence order, ordering of constituents within a sentence, and particular language means used in this style. Legal style is, as well as English language highly nominal. Business style has been mentioned as well. It can be easily recognized by the business correspondence where it is yours. Among them are inquiries, offers, orders, invoices, claims and complaints, and dunning letters. The next chapter will discuss the legal text from the viewpoint of terminology.

1.3.2 Legal Terminology

To complete the discussion about the style of legal documents, this chapter focuses on the legal terminology. It will try to answer a few questions. First of them is what is the most distinctive and recognizable about the legal terminology and the second is what the most frequent lexical units are in legal style.

Miššíková (2003, 122) mentions some other peculiarities of the style of official documents here. At the level of lexis the most striking feature is a special system of clichés, terms and set expressions by which each substyle can easily be recognized (*e.g. I beg to inform you, I beg to move, provisional agenda, the above-mentioned, hereinafter named, on behalf of, private advisory, Dear Sir, We remain, your obedient servants, etc.*) In fact, each of the subdivisions of this style has its own peculiar terms, phrases and expressions which differ from the corresponding terms, phrases and expressions of other variants of this style. Thus in finance we find terms like extra revenue, taxable capabilities, liability to profit tax. In legal language *to deal with a case, summary procedure, a body of judges, as laid down in* can be found. Likewise other varieties of official language have their special nomenclature, which is conspicuous in the text, and therefore easily discernible. (Miššíková 2003, 122)

Among the most frequent lexical units used in legal style are (Crystal 2001, 391:

- **Common words with uncommon meanings:** action – *law suit*, avoid – *cancel*, hand – *signature*, presents – *this legal document*, said – *mentioned before*.
- **Latin words and phrases:** *affidavit, alias, alibi, corpus delicti, per stirpes, ejusdem generis, ex post facto, in personam, lex loci actus, nolle prosequi, quasi, res gestae, retraxit, sui juris, vis major*.
- **Words derived from French:** many now in general use, e.g. *appeal, assault, counsel, plaintiff, verdict*, and others such as *demurrer, easement, estoppels, fee simple, lien, tort*.
- **Technical terms with precise and well-understood meanings:** *appeal, bail, contributory, negligence, defendant, felony, injunction, libel*.
- **Less precise terms and idioms, in standard use in daily legal discussion (legal argot):** *alleged, issue of law, objection, order to show cause, strike from the record, superior court, without prejudice*.
- **Formal or ceremonial words and constructions** in written documents and in spoken courtroom language: *signed, sealed, and delivered; Whereas...(in contracts), You may approach the bench; Comes now the plaintiff; Your Honour; May it please the court; I do solemnly swear...; The truth, the whole truth, and nothing but the truth*.
- **The conscious use of vague words and phrases** to permit a degree of flexibility in interpretation: *adequate cause, as soon as possible, fair division, improper, malice, nominal sum, reasonable care, undue interference*.
- **The use, conversely, of words and phrases to express precise meaning:** *irrevocable, in perpetuity, nothing contained herein*.

Legal terminology was summarized in this chapter by means of broad classification of the most frequent legal terms in English language. Therefore, it can be concluded that legal terminology consists mainly from common words with uncommon meanings, Latin and French words, technical terms, formal, ceremonial, etc.

Basically, the terminology of legal style consists of clichés, terms and set expressions. They are mostly constant. It may be caused by the rigid nature of legal style that does not undergo radical changes most of the time.

2 TRANSLATING SCIENTIFIC AND TECHNICAL TEXTS

The second major part of theoretical part is dedicated to translating scientific and technical texts. As the headline may hint, chapter number 2 will be dedicated to translating and everything related to that. First of all, contemporary translation theories will be defined and discussed, their purpose and outcome as well. After short and brief discussion of the theories of translation, particularly its categories, there is chapter that deals with basic principles of translating. In my opinion, the principles are quite general, but, considering a wide range of styles, it is good to have some common rules that must be followed by every translator.

According to Hatim and Mason (1990, 2), *“translation is a useful test case for examining the whole issue of the role of language in social life. In creating a new act of communication out of a previously existing one, translators are inevitably acting under the pressure of their own social conditioning while at the same time trying to assist in the negotiation of meaning between the producer of the source-language text (ST) and the reader of the target-language text (TT), both of whom exist within their own, different social frameworks.”* (Hatim, Mason 1990, 1)

Christian Nord (2005, 32) defines translation as the production of a functional target text maintaining a relationship with a given source text that is specified according to the intended or demanded function of the target text (translation skopos). Translation allows a communicative act to take place which because of existing linguistic and cultural barriers would not have been possible without it.

Functionality is considered to be the most important criterion for a translation, but certainly not the only one. There has to be a certain relationship between the source and the target text. Therefore and undoubtedly, the translator is committed bilaterally to the source text as well as to the target-text situation, and is responsible to both the ST sender and the TT recipient. Christiane Nord calls this “loyalty”. (Nord, 2005, 32)

I agree with Christiane Nord, that functionality is important for either the source text or target text. Therefore, translator must feel committed to both the text and the result of this relationship is something more than just a mechanic translating. Loyalty is just a name for the relationship between translation and translator.

2.1 Contemporary Translation Theories

To deal with translation and, more specifically, with translation of scientific and technical texts, it is highly necessary to introduce the contemporary translation theories. This chapter operates with the basic terminology inevitable for every translator, i.e. the process of translation, the source text (ST), the target text (TT). In the final part, Jakobson's categories interlingual, intralingual and intersemiotic translation are introduced.

Translation studies are now understood as an academic discipline concerned with the study of translation covering the whole spectrum of research and pedagogical activities, training translators and developing criteria for translation assessment. (Baker 2001, 277)

Jeremy Munday (2001, 5) Susan Bassnett (2002, 22) and others definitely agree on definition of translation and its types according to Jakobson (1959/2000, 114). The term translation itself has several meanings: it can refer to the general subject field, the product (the text that has been translated) or the process (the use of producing the translation, otherwise known as **translating**). **The process of translation** between two different written languages involves the translator changing an original written text (the **source text** or **ST**) in the original verbal language (the **source language** or **SL**) into a written text (the **target text** or **TT**) in a different verbal language (the **target language** or **TL**). This type corresponds to *interlingual translation* and is one of the three categories of translation described by the Czech structuralist Roman Jakobson in his seminar paper *On linguistic aspects of translation* (Jakobson 1959/2000, 114). Jakobson's categories are as follows:

1. **intralingual** translation, or *rewording*: an interpretation of verbal signs by means of other signs of the same language;
2. **interlingual** translation, or *translation proper*: an interpretation of verbal signs by means of some other language;
3. **intersemiotic** translation, or *transmutation*: an interpretation of verbal signs by means of signs of non-verbal sign systems.

It is the interlingual translation which is the traditional, although by no means exclusive focus of translation studies.

“The purpose of translation theory, then, is to reach an understanding of the processes undertaken in the act of translation and, not, as is commonly misunderstood, to provide a set of norms for effecting the perfect translation.” (Bassnett 2002, 43)

Translation theory, in my opinion, is a very important discipline. It searches, compares, derives and creates norms and new procedures for achieving good translation.

2.1.1 Basic Principles of Translating

Translating as a procedure, an art, or an activity in general means that he/she should do it right and to be productive. I have chosen two opinions about what the basic principles of translations are. 1st one is according to Tytler and the second according to Nida (issued almost 60 years later) to compare just the slight difference in spite of the time gap.

Hatim and Mason (1990, 16) summarize the basic “laws on translation” introduced by Tytler (1907):

- that the Translation should give a complete transcript of the ideas of the original work,
- that the style and manner of writing should be of the same character with that of the original,
- that the Translation should have all the ease of original composition

A more recent formulation of the basic “requirements” of a translation are to be found in Nida (1964, 164):

- making sense,
- conveying the spirit and manner of the original,
- having a natural and easy form of expression,
- producing a similar response.

According to Basnett (2002, 29) a translator in determining what to use in English, he/she must:

- accept the untranslatability of the SL phrase in the TL on the linguistic level,
- accept the lack of a similar cultural convention in the TL,
- consider the range of TL phrases available, having regard to the presentation of class, The status, age, sex of the speaker, his relationship to the listeners and the context of their meeting in the SL,
- consider the significance of the phrase in its particular context – i.e. as a moment of high tension in the dramatic text.

2.1.2 Types of Translation

Translation as a procedure or a method has its own rules and ways how to progress. There is seven main translation procedures that translator should follow, or can choose yours from you,

Knittlová (2005, 14) claims that even though there exist a variety of procedures, ways and methods used for translation, all of them should lead to the same target – to achieve the

most appropriate form of a translation. Fjodor, Levý and Catford, the former translation theorists, did not always use the distinctive terms and named them generally as procedures. Contemporary Russian, German, or Czech linguists dealing with translation studies refer to the comparison between French and English stylistics from Canadian authors Vinay and Darbelnet. They operate with seven main translation procedures that solve the lack of equivalence (Knittlová 2005, 14):

1. *Transcription* – more or less adapted transcription to the utterance of TL.
2. *Kalk* – literal translation
3. *Substitution* – substituting one linguistic means with another equivalent one (e.g. substitution of nouns by personal pronouns and vice versa).
4. *Transposition* – i.e. necessary grammatical changes resulting from the differences in SL and TL systems.
5. *Modulation* – the change of aspect (e.g. *angle-joint of the pipe: koleno potrubí*)
6. *Equivalence* – Knittlová does not consider this one as a suitable term for using of stylistic and structural means different from the source text.
7. *Adaptation* – substitution of a situation described in ST with different adequate situation, e.g. when there is no equivalent of saying in TL.

Translation is a very complex task to manage. A translator must not only need to know their source language well; they must also have a thorough understanding of the field of knowledge covered by the source text (Krijtová 1996, 35). Translators should ensure a result that even sounds as natural as possible – though some translators have argued that, for certain types of text (e.g. scientific material), where translation accuracy is more crucial than naturalness, it makes more sense for translator to be more fluent in the source text. (Crystal 2005, 346)

2.1.3 Equivalence in Translation and its Typologies

This chapter is supposed to reveal to a reader the concept of equivalence and its typologies. I have divided equivalence according to more than just one classification, because it is impossible to grasp the whole essence of equivalence following just one type of classification. I have added the typology introduced by Baker, Nida, Koller, etc. They all offer different view at equivalence, whether equivalence at the word-level or from larger aspect, and others.

Equivalence is a central concept in translation theory, but it is also a controversial one (Baker 2001, 77). According to Crystal the aim of translation is “to provide semantic

equivalence between the source and target language” (Crystal 2005, 346). Apparently simple statement hides many problems, all of them connected to the standards of equivalence that should be expected and accepted. Exact equivalence is of course impossible. Basically, the equivalency can be considered from the viewpoint of lexicology, syntax or grammar (grammatical units used in SL and TL). (Baker 1992)

Equivalence is commonly established on the source language (SL) and the target language (TL) and thus on their **referential** or **denotative equivalence** and **connotative equivalence** (Baker 2001, 77). According to the effect the SL and TL have on their respective readers, the equivalence is distinguished as **dynamic** (Nida 1964) or **pragmatic equivalence** (Koller 1989, 102).

Routledge Encyclopeda of Language (Baker 2006) adds other types of equivalence:

- **Text-normative equivalence:** the SL and TL words are used in the same or similar contexts in their respective languages. (Koller 1989, 102)
- **Formal equivalence:** the SL and TL words have similar orthographic or phonological features. (Nida 1964)
- **Textual equivalence:** combination of ST and TT information flow and roles of cohesive devices. (Baker 1992)
- **Functional equivalence:** not all the variables in translation are relevant in every situation, and thus translators must decide which of the variables should be given priority (Newman 1994, 4695)

Baker (1992) offers fundamental and comprehensive look at the classification of equivalence. She divides equivalence into the following groups:

- **Equivalence at word level:** aspect of word as a unit in different languages (for further reading see also Hatim and Mason 1990, 180).
- **Equivalence above word level:** collocations, idioms and fixed expressions.(for further reading see also Basnett 2002, 31)
- **Grammatical equivalence:** grammatical vs. lexical categories.
- **Textual equivalence: thematic and information structures:** Hallidayan approach vs. the Prague school position on information flow.
- **Textual equivalence (cohesion):** reference, substitution and ellipsis, conjunction, lexical cohesion.
- **Pragmatic equivalence (coherence):** coherence and processes of interpretation (implicature).

A translator can reach nearly absolute equivalence when translating the terms of Greek and Latin origin, even if a problem may appear here as well. The most difficult terms to translate are those which occur only in the particular language and have no equivalence in TL. The possible solution here is to use substitution in compliance with the stylistic norm and the system of TL. (Knittlová 2005, 153)

Translating of internationalisms may seem convenient. On the other hand, the mechanic translation of them can be treacherous. Knittlová demonstrates the issue on the following examples: (Knittlová 2005, 153)

Ex.: *some techniques – nejsou některé techniky, ale spíše metody, patent application – není aplikace patentu ani patentová aplikace, ale patentová přihláška, etc.*

According to the recent study on the creation of new terms in the magazine *American Speech*, contemporary scientists tend to digress from using classic languages as the source and start to seek in the vocabularies of their own languages. More than a third of new terms is created only on the basis of semantic shift/change. Another third of them is created by linking already existing lexical units in English language. A fifth of them is borrowed from other contemporary languages. The rest is created by less frequent word-formative processes. (Knittlová 2005, 153)

2.2 How to Translate Scientific and Technical Texts

Translating scientific and technical texts may not be attractive for some translators. It is the matter of choice, though. I agree on this point with Byrne saying, that this type of translation has been largely neglected. However, the aim of this chapter is not to discuss the issue of the value of technical and scientific translation. The purpose is to introduce main aspects to a reader, which are advised to be aware of at least and to follow them.

Technical translation has been long considered as not particularly exciting or attractive one compared to other types of translation serving as nothing more than an exercise in specialized terminology and subject knowledge. According to Byrne, this vocational and industrial type of translation has been largely neglected in the literature on translation theory. However, there is also a different opinion, that technical translation is a much more promising area for theoretical investigation. (Byrne 2006, 1)

It is important to realize that scientific and technical translation are not the same and such, cannot be compared equally. (Byrne 2006, 1) However, the following chapter intends to show the most fundamental common features and the peculiarities which will be later

discussed in the analytical part in the analysis of the excerpts from technical and scientific texts.

2.2.1 Aspects of Scientific and Technical Translation

This chapter will discuss particular aspects of scientific and technical translation. Aspects such as causative structures, linking elements for maintaining logical sentence order, rhematic position both in Czech and English) and condensation will be described with example for an illustration.

There are fixed patterns and structures that are different in SL and TL. A translator must be aware of them in order to achieve uniformity and proper comprehensibility of translation. A very frequent structure is causative structure.

According to Knittlová (2005, 143-144) Causative structures are very frequent element in scientific English. They interrelate with the voice. It is mainly the following one:

MAKE + N + ADJ

E.g.: *This makes the problem easy.* – *This makes/renders the metal hard.*

When translating into Czech, it will be necessary to change the construction (*Tím se kov tvrdí*) or to use the equivalent paraphrase (*Two sheared versions of the wave front under test interfere within the interferometer, making the instruments especially suited for the investigation of gradients - proto jsou tyto přístroje zvláště vhodné pro zkoumání gradientů*).

Other causative structures are formed by the usage of:

ENABLE, ALLOW, PERMIT, CAUSE, MAKE + INF

Basically, it is the type of causative structures with infinitive that are usually transformed into Czech by means of the subordinate clause.

E.g.: *Safety valves allow the metal to cool slowly.* – *Bezpečnostní ventily umožňují, aby kov pomalu chladl.* (Knittlová 2005, 145)

To achieve logical sentence order, there are **linking elements** – a translator should not definitely leave them out. There are words with high frequency such as *thus, however, therefore, moreover, then, furthermore, so, in addition, on the other hand, nevertheless, again, also, yet, still, meanwhile, besides, first, finally, consequently, now*, and others.

However, logical sentence order is achieved not only by using appropriate linking elements but also by appropriate theme – rheme distribution within sentences.

When translating scientific and technical texts, it is very important to find the *rheme* in SL text and to place it to appropriate position in the ending part of a sentence in the Czech translation. This rhematic position is very typical for Czech language even if the rheme is possible to be pointed out, or by means of specific syntactic constructions. (Knittlová 2005, 145)

When speaking about rhematic position in English, it is necessary to mention that English has fixed word order within a sentence, and thus to achieve rhematic position, it has to use syntactical, lexical or morphological means, in contrast to Czech, where it can be easily achieved by simple change in word order.

There are many ways in English how to indicate rheme. A common possibility is to place a rheme behind predicate expressed by verbs *to be*, *to seem*, *to appear*, *to stand*, *to live*, *to lie*, and *to hang*. In addition, this enables a combination with *there*.

E.g.: *There is a close connection between the value of the intrinsic spin of an elementary particle and the symmetry character of the wave function.* – *Mezi hodnotou intrinsikního spinu elementární částice a symetrickou povahou vlnových funkcí existuje těsná spojitost.*

E.g.: *It is this interaction that causes the absorption.* – *Právě tato interakce způsobuje absorpci.* (Knittlová 2000, 145)

According to Knittlová (Knittlová 2005, 145) rheme can be indicated in the Czech language by using various linguistic means:

- It can be indicated lexically by means of *only*, *merely*, *just*. On the other hand, the theme is pointed out by means of using definite article, pronouns (personal, relative, possessive, and demonstrative), or expressions such as *such*, *similar*, *one – the other etc.*
- An indefinite article may indicate rheme as well.
- Using preposition *by* with passive predicate (agent, source of action, circumstantial adverbial of manner).

E.g.: *These properties of photoelectric effect were first explained by Einstein.* – *Tyto vlastnosti fotoelektrického jevu vysvětlil jako první Einstein.* (Knittlová 2005, 145)

As mentioned before in chapter 1.3.1, the logical word order in the sentence is one of the key features of scientific and technical style. If the principle of logical word order in the sentence would not be respected by a translator, and the English word order would be preserved in the Czech translation, we might be introducing such a translation to a Czech

recipient that would not comply with the object of communication intended in the source text. (Knittlová 2005, 146)

E.g.: *These phenomena will not be considered in the present book.* - *V této knize se o těchto jevech mluvit nebude.* (Knittlová 2005, 146)

The principle of logical word ordering is equally applicable for ordering of clauses within a complex sentence. Formal structures and complex sentences without ellipses¹ are predominant in scientific and technical style. *That* and *which* are not omitted in English subordinate nominal clauses. One of the most frequent expressive means that indicate relations between clauses are conditional relative conjunctions (*if, unless*), other linking elements are *providing, provided, on condition*. Another frequent prepositions are those of temporal nature (*before, as, while, as soon as, when, until, once, after*), of consequence (*so that, with the result that, as a result of, in consequence of, consequently, therefore, whence*) and those of cause (*because, since, as, because of, on account of, owing to, due to*). Translators often wrongly preserve the original placement of the circumstance adverbial as in English source text. Therefore, a translator translating into Czech needs to be aware of this and to change the order of clauses within a sentence. (Knittlová 2005, 146)

Every translator must be aware of the fact that the primary objective in scientific style is its functionality (pragmatic aspect). Even though the stereotype is functional here and the syntactic structures may have (mainly in mathematics and logic) the nature of terms, it does not mean that a translator is supposed to translate them literally. Precise and comprehensible transfer of relevant information is fundamental. Therefore, translators can break the sentence units and rebuild them, if it is on behalf of clarity. The form is secondary when dealing with scientific and technical texts. What is primary is the content, which happen to be very complex and a translator mustn't make the understanding of the text more difficult to the reader of the TT by using cumbersome, complex and intricate clause constructions. (Knittlová 2005, 148)

Condensation has already been mentioned as a characteristic feature of scientific and technical style. When translating into Czech, it is necessary to enlarge and specify these condensed structures. It is possible to do it by adding clauses containing finite verb forms.

¹ **Ellipsis** (elliptical construction) refers to the omission of an item that would otherwise be required by the remaining elements. This is the case of leaving something unsaid which is nevertheless understood. (Baker 1992, 186)

However, Czech language in scientific and administrative style is also more condensed compared to other styles. (Knittlová 2005, 148)

When we compare Czech language in scientific and administrative style with the Czech language in e.g. in literature, we can find out that the Czech language in scientific and technical style is more nominal than Czech language used in the theatre.

E.g.: *To obtain tolerance levels by applying Eq.(13) to certain specific aberration types, we must...* - *Abychom zjistili toleranční hranice tím, že budeme aplikovat rov. (13) na jisté typické druhy aberací, musíme určit ...*

The consistency of expressing is reflected also in using of noun groups – semantic condensers. It is often a hard case to translate for a translator. In English, the semantic relation between particular juxtaposed substantial pre-modifiers is not explicitly indicated, and yet this relation can be immensely various. A. J. Herbert demonstrates the issue on the following examples:

Steam consumption = the consumption **of** steam

Metal tubes = the tubes **made of** metal

Friction losses = losses **caused by** friction

In the translation of the examples into Czech, it is obvious how the Czech language is able to use variety of linguistic means:

Steam consumption = Spotřeba páry (the use of genitive)

Metal tubes = kovové roury (adjective implies the material used for the pipes)

Friction losses = ztráta při tření (the use of preposition)

On the opposite, Czech language requires the explicit expression instead. (Knittlová 2005, 149)

E.g.: *Steam corrosion inhibition* – zamezení koroze způsobené párou.

Consistency in this sense is applied also in translations of the headlines in scientific and technical style.

E.g.: *The search-and-rescue laser* – Využití laseru k vyhledávání a záchraně letců (na moři). (Knittlová 2005, 150)

The structure of headlines in English scientific style differs from the structure of the headlines in Czech. English headlines are typical for repeated occurrence of the same lexical unit (mainly the scientific and administrative styles tend to repeat pronouns). With respect to the Czech language, traditional forms with empty words such as *upotřebení*, *použití* are still preferred. (E.g.: *Holography and medicine* – *Upotřebení holografie v lékařství*). (Knittlová 2005, 151)

We can experience two main difficulties when searching for optimal equivalences of such English terms in scientific and technical style. One of them is the different semantic condensation between SL and TL. (Knittlová 2005, 153)

Semantic condensation is considerably more frequent in English, as it has already been mentioned as one of the main features of scientific and technical style (see chapter 1.3.1). It enables to create such nominal structures in English which cannot be formed in Czech because it is synthetic flexional language. (Knittlová 2005, 153)

Knittlová recommends that the key to decode the noun groups is the fact, that in such nominal phrases, the description is hierarchical. However, there can be hidden various relationships in the underlying structure of compound terms. Vagueness and ambiguity can be exclusively reduced by matter-of-fact knowledge of the given extralingual reality. When translating into Czech, a translator must, in most cases, convert the pre-modifying nouns into explicative and descriptive equivalents. (Knittlová 2005, 153)

The second problem that a Czech translator might be confronted with is the problem of equivalency in translating distinctive metaphors. The occurrence of these metaphors in English scientific style shows a rising tendency. Czech language is not that accessible and open to metaphors of sudden inspiration in this style. On the other hand, Czech scientific terminology is willing to adopt foreign expressions and adopt them (e.g. *wi-fi*, *hi-fi*, *leasingová společnost*, *forfaiting/factoring* (bank.), *hedžovanie/hedžing* (bank.)). (Knittlová 2005, 154)

Standardized terminology system in exact sciences (chemistry, medicine, and some technical disciplines), it is a possible way to achieve equivalence. On the other hand, the humanity studies differ in this aspect. They reflect immense diversity of cultural traditions and social structures. Therefore, equivalence cannot be achieved easily.

It is crucial to analyze the scientific text's content first and then search for equivalents complying with the standard of TL. In many cases, translator has to choose an alternative solution when standard method of translation cannot be applied, for example periphrastic form. It is necessary to be aware of the fact that the description is very explicit when translating into a language that is more implicit; the asymmetry cannot be neglected, it would lead to redundancy otherwise. Other types of shift can be observed also in terms of concrete/abstract or specific/general expressions. (Knittlová 2005, 156)

Aspects of scientific technical translation were the major concern of this chapter. Causative structures and verbs, they often occur with, in the text, logical word order, and

how to achieve it, standardized terminology, and semantic condensation were all defined and demonstrated on

2.2.2 Machine Translation of Scientific and Technical Texts

I have decided to include one chapter in my thesis that would deal with machine translation as far as my thesis discusses the translation of scientific and technical text and modern life we life brings a lot of possibilities. The chapter deals with the history of machine translation, the several attempts that have been undergone, individual technical projects and their perspective to life.

The idea of using machines to provide translations between natural languages has been recognized since 1930s, but appropriate climate for development arose after the World War II. The founder of the field, Warren Weaver, inspired several groups to begin research programmes into MT during the 1950s, and great claims were made for the future of the subject. (Crystal 2005, 352)

The term Computer-Aided Translation (CAT) refers to a translation modus operandi in which human translation (HT) is aided by computer applications. A competing term, Machine-Aided Translation (MAT), is also in use, particularly within the software community involved in developing CAT applications (Quah 2006, 6). MAT represents the use of computationally organized data banks and all kinds of peripheral equipment to help translators in their work (Crystal 2005, 353). *“A key characteristic is that a human translator takes control of the translation process and technology is used to facilitate, rather than replace HT”*. (Baker 2001, 49)

Technology-based solutions to translation needs are a natural consequence of the shortened timeframe available for translation and increasing budgetary constraints resulting from globalization, as well as the progressive digitalization of source content. CAT has become the predominant mode of translation in scientific and technical translations and localization, where technology is employed to increase productivity and cost-effectiveness as well as to improve quality. The CAT tools range from general-purpose applications such as word processors, optical character recognition (OCR) software, Internet search engines, etc., to more translation-oriented tools such as multilingual electronic dictionaries, corpus analysis tools, terminology extractions and terminology management systems. Having emerged as one of the earliest translation technologies in the 1970s, translation memory (TM) was commercialized in the mid 1990s (Somers 2003a, 31), becoming the main CAT tool since the late 1990s. (Baker 2001, 48)

Language is a complex system that theoretically could function due to set rules from the viewpoint of mathematics. However, the spoken language contains errors, shifts, ellipsis, and gaps and therefore due to its structural nature the concept of machine translation has its own cracks and it might fail. (Gentzler 2001, 51)

To conclude the actual status of using machine translation, it is unlikely that machines will replace human translators in the foreseeable future; but they can be very helpful with routine translation work and enable much more material to be processed would be the case otherwise. To mention some of the firms providing with the systems that can process quantities of scientific texts in certain areas, it is Automated Language Processing System (ALPS), Weidner Communications or Logos Corporation in Germany. (Crystal 2005, 353)

According to Kingscot (2002) there has been an estimate that technical translation accounts for some 90% of the world's total translation output each year. It is not a surprising fact considering the importance given to availability of technical information in variety of languages as a result of increasing international interest of many companies and partly of legislation (mainly EU) or international standards. Furthermore, international cooperation in scientific, technological and industrial activity completes the whole demand for technical translation and proves its significant role in translation studies and its praxis. (Byrne 2006, 3)

In my opinion, it is improbable, that at least for the next decade that the MAT and CAT will be able to replace human work. The idea mentioned above is useful only for routine translations in high amounts of issue. Language is a complex system. On one hand it functions according to a wide range of set rules, on the other hand it can behave unexpectedly.

III. ANALYSIS

3 ANALYSIS OF SELECTED EXCERPTS

The analysis aims to analyze selected excerpts from various fields of science and law. Excerpts from chemistry and physics will be discussed as representatives of exact sciences; excerpt from economics (banking) as a representative of Social Sciences and excerpt of legal document will be analyzed as a representative of administrative style.

The aim of partial analyses is to compare individual translations, the methods used for translation and aspects of equivalence will be also considered and examined. Finally, I will try to draw conclusion on the basis of these analyses concerning the general features of each style. Main focus will be set on common features of all styles mentioned in the analysis and to conclude whether it is possible to use a common set of rules to translate them or whether they all need to be treated individually when being translated.

3.1 Analysis of Economic Text Translation

Basic Principles of Banking issued by Univerzita Karlova v Praze. Translation was carried out from Czech language (SL) into English language (TL). The chapter examined from the viewpoint of translation is called *Tržní segmentace a heterogenita v České republice (Market segmentation and bank heterogeneity in the Czech Republic)*. (Mejstřík 2008, 84-87). (See P I-P IV)

3.1.1 Lexical and Grammatical Equivalence

Translated text can be examined from numerous aspects. I will examine the excerpts from the viewpoint of equivalence and methods used for translation (see chapter 1.2.1) and equivalence (see chapter 2.1.3).

In the Czech version, the noun *bank* is omitted (not translated) when it functions as premodifier. I suppose, it is because the fact that *bankovní heterogenita* has been sufficiently discussed in the previous chapter. In contrast, English headlines do not avoid repetition of the particular word (E.g.: ...*heterogenita*... – ...*bank heterogeneity*...). Therefore the English equivalent of heterogeneity conveys seemingly more limited semantic meaning, but Czech expression, when part of a text as a whole, implies the same meaning. Similar situation occurred in the following examples:

E.g.: ...*nelehké úkoly transformace a rizika s tím spojená*... - ...*transformation tasks and risks*...

E.g.: ...*hodnotná aktiva*... - ...*valuable fixed assets*...

Social sciences are characteristic with looser use of figurative linguistic means:

E.g.: ...*padli za oběť konkurenčnímu boji*... - ... (they) fell victim to a competitive battle.

E.g.: ...*byly zahrnány do začarovaného kruhu*... - ...were locked in the vicious circle...

(Metaphor)

In the TL text, there also occurred significant omissions of given information, by means of which the TL text does not convey exactly the same semantic information as in SL. The semantic aspect of the adverbial became broader with more possible interpretation. Following examples show that the TL text omits information or uses more general expressions instead.

E.g.: ...*v polovině 90. let*... - ...at one time...

E.g.: ...*primární vklady*... - ...deposits...

E.g.: ...*drobní střadatelé*... - ...depositors...

Substitution as a method of translation was used in the following example. 'Biased' has replaced 'v rozdílech přístupu ke'. The noun group in SL was substituted with an adjective, semantically conveying the same meaning, and only the lexical units were changed.

E.g.: ...*v rozdílech přístupu ke corporate governance*... - ...on the **biased** corporate governance...

The following example demonstrates, firstly, the modulation (change of aspect) in translation of the word *problém*, which has been translated as *roles* (referring to both of them). Secondly, lexical units are often changed and there may occur a slight semantic difference caused by different perception of given entity.

E.g.: ...*problém morálního hazardu a nefairového jednání*... - **the selection bias and moral hazard roles**...

E.g.: ...*většina drobných střadatelů zůstala u České spořitelny*... - **most depositors were accustomed to saving mainly in the Czech Savings bank**...

E.g.: ...*přilákat vkladatele*... - ...attract **deposits**... (vklady)

E.g.: ...*prošel podobnou vlnou konsolidací jako v ostatních zemích* - **has consolidated in parallel with worldwide tendencies**...

Transposition (change of grammatical structure) occurs frequently in scientific style. It is caused by different language systems of SL and TL. Both structures (passive in CZ and general we in ENG) have if not the same than similar effect on the recipient. Therefore, this translation can be evaluated as appropriate. Transposition during the translation from

SL into TL has influenced neither the meaning nor the effect. The following chapter 3.1.2 deals with this kind of equivalence.

E.g.: **Je nutné mít na paměti...** - **So we have to keep in mind...**

3.1.2 Textual and Pragmatic Equivalence

This chapter deals with slightly different kind of equivalence. It analyses the text as a whole (a sentence or a paragraph), focusing on coherence and cohesion preserved in translated text. Furthermore, syntactical aspect is also considered, i.e. how were the sentence constructions modified and why.

A translator has taken into consideration the functionality and pragmatic aspect of the following text, and in order to make the text in TL equally comprehensible, he/she changed the position of **klientům**, and consequently had to add the verb *access to* (clients):

Text in SL:

Tržní segmentace byla založená na rozdílech v přístupu k primárním vkladům a klientům, schopnosti poskytnout půjčky, zároveň také v rozdílech v přístupu ke corporate governance (bank a jiných nefinančních insitucí) a také ve využití neetickch „one-shot games”, které někdy vlastníci používali.

Translation in TL:

Market segmentation was based on differences in access to deposits, the availability of loans and access to clients, as well as on the biased corporate governance of banks and non-financial corporations, supplemented by the unethical one-shot games of owners.

Firstly, when analyzing the following text, we can focus on the position of rheme. In SL text (Czech) rheme is in the middle of sentence and in TL is placed in the final part of sentence, because the rheme (new information) is given by adverbial of place.

Text in SL:

Jinak řečeno, problém morálního hazardu a nefairového jednání byl v tranzitivních ekonomikách ještě zvýrazněn.

Translation in TL:

In other words, the selection bias and moral hazard roles had been amplified in volatile transitional economies.

Word *problém*, used in singular in SL text, cohesively refers to both *the selection bias* and *moral hazard*. It is substituted by expression *roles* in TL text, in plural form, and equally refers to both already mentioned entities.

The difference between SL and TL in the following text is striking. English translation is more concise and complex, which provides a reader with more intelligible information. The English translation practically did not omit any given information, and still achieved more comprehensible translation.

Text in SL:

Zároveň měli tyto banky kvůli své velikosti i omezenější přístup na mezibankovní trh, kvůli menšímu počtu poboček i omezenější přístup k vkladatelům. Z toho plynuli mnohem vyšší náklady na zdroje.

Translation in TL:

Their access to funds was limited by their size (by smaller shareholder's equity), compounded by a small number of branches and higher borrowing costs.

To maintain cohesion word *they* refer to big banks is used as a subject in previous sentence in TL text. The English translation may be shortened considerably; the use of language is much more effective, though.

Text in SL:

Naopak velké banky se pouštěly do velkých, někdy megalomanských obchodů, které se ukázali jako velmi rizikové.

Translation in TL:

They granted too big and too risky loans.

Similar situation occurs in the following example, however, the translation is presented from the opposite aspect.

Text in SL:

Tyto banky však nebyly dostatečně velké na to, aby se do jejich záchrany pustil stát jako v případě velkých bank později.

Translation in TL: *But these big banks were too-big-to-fail, so the state helped at the end.*

Language used in analyzed excerpt from the field of Economics complied with the general features attributable to given style of science. There were used specific terminology (deposits, corporate governance) and terms typical for scientific style in general (hence), passive construction, 3rd person style (impersonality) and logical sentence order.

3.2 Analysis of Legal Text Translation

For the analysis of legal translation, I have chosen two different excerpts of legal style. First of them, is the excerpt of the Act No 6/1993 Coll. on the Czech National Bank (A) in

Czech language as SL and its English translation. The second material for analysis is **The Act No 21/1992 Coll. on Banks (B)**. Both of the excerpts were also published in the Basic Principles of Banking (Mejstřík 2008, 168-173) issued by Univerzita Karlova in Prague.

3.2.1 Lexical Equivalence and Grammatical Equivalence

Firstly, I will analyze the excerpt from the act regulating the activities of the Czech National Bank. (See P V)

Excerpt A: **The Act No 6/1993 Coll. on the Czech National Bank**

Substitution, as a method of translation has been used in the following examples, where lexical units have been replaced by those more accurate ones for the purpose of TL text. Used lexical units are given, and a translator must be aware of the terminology used in legal documents in order to preserve the validity of the document.

E.g.: *Hlavní cíle regulace jsou formulovány v zákoně o České národní bance č. 6/1993 Sb., v platném znění.* - *According to Act No 6/1993 Coll. on the Czech National Bank, as amended,...*

E.g.: *V souladu s tímto cílem a) určuje...* - *In accordance with its primary objective it shall a) set...*

E.g.: *...zúčtování bank...* - *...clearing between banks...*

E.g.: *...vykonává dohled nad osobami působícími na finančním trhu...* - *...(shall) supervise the activities of entities operating on the financial market...*

Moreover, there are some lexical units added in TL text in comparison with the SL text.

E.g.: *...provádí další činnosti.* - *...carry on other activities pursuant to the Act.*

Excerpt B: **The Act No 21/1992 Coll. on Banks (See P VI)**

E.g.: *Pravidla stanovená Zákonem o bankách č. 21/1992 Sb., v platném znění:...* - *Rules set by Act No 21/1992 Coll. on Banks, as amended:...*

E.g.: *...důležitou součástí licenování...* - *...an important attribute of licensing...*

E.g.: *...fungující v rámci EU...* - *...applicable within the EU...*

E.g.: *...není třeba získavat licenci od regulátora hostitelské země...* - *...without having a license granted by the host regulatory authority...*

E.g.: *...nucená správa...* - *...conservatorship...*

E.g.: *...pravidla obezřetného podnikání...* - *...prudential rules...*

We can observe that grammatical and lexical changes occur frequently in order to maintain the functionality of the TL text. The use of specific terminology and its knowledge is no less crucial to meet this target.

3.2.2 Textual and Pragmatic Equivalence

The purpose of analyzing the translation from the textual and pragmatic aspect has been already mentioned in the chapter 3.1.2. It is applied equally on the legal text analysis.

The main difference roots in grammatical and lexical changes made by a translator in order to convey the same meaning. SL text's noun group (*podmínkou vstupu do odvětví*) has been replaced by phrase *for banks to enter the sector*. The same happened with *přidělení licence*. Apparently, a translator preferred using verbs in this case, in spite of the fact that English is more nominal language in comparison with the Czech language. The author of the Czech ST attempted to express itself more formally. However, a translator did not use finite verbs in full sentences, but decided to use infinitive *for banks to enter the sector*.

Text in SL:

Licencování (kriteria autorizace): podmínkou vstupu do odvětví je přidělení licence (§ 4-5).

Translation in TL:

Licensing (authorization criteria): for banks to enter the sector a license must be granted and certain requirements must be met, Art. 4-5

The main distinction between SL and TL in the following example is made by use of different tense in SL and TL. SL text uses the future simple which is replaced by present simple in TL. However, both carry the same meaning, of course. This example shows the nominal tendency in English (*for revoking the license*). In contrast, this is expressed by means of finite verb form and subordinate clause in Czech.

Text in SL:

Zákon stanoví i důvody, které vedou k odnětí bankovní licence (§ 34-35).

Translation in TL:

The Act also sets forth reasons for revoking the license (Art. 34-35).

The reason for the word order in the English sentence is fixed word order that must be followed. Rheme (the Czech National Bank) must have definite article. That is why the rheme cannot be marked neither with an article nor the word order. *Only* serves as the

marker. Another alternative could be placing the phrase the Czech National Bank in the end of a sentence using *by*.

Text in SL:

Nucenou správu může uvalit jen Česká národní banka.

Translation in TL:

Only the Czech National Bank can impose conservatorship.

Analyzed excerpts from legal documents bear the main features of administrative style, such as the use of abbreviations (CNB), symbols (§), contractions (Art.), the use of words in their logical dictionary meaning, no words with emotive meaning, significant syntactic pattern, and also modal verbs were used (shall, must). The language of legal documents proved to be concise, logical, with respect to given patterns which must not be neglected.

3.3 Analysis of the Translation of Text from the Field of Physics

For the analysis of the translation from the field of Physics, I have chosen the excerpt from the publication *Částicová fyzika (Particle Physics)* written by Frank Close (2008, 48-54). The publication is designed to serve as a guide through the world of fundamental particles that create the universe. It is intended make the topic more accessible. Therefore, the style of the language, in which the book is written, corresponds with the author's intention to introduce the findings and new discoveries in the particle physics to a larger audience. Thus, the style is placed on the border between the scientific style and popular scientific style. However, it contains more features of English scientific style.

Translation was carried out from English as SL into Czech as TL. It is important to be aware of this fact, because the features characteristic for English scientific style not so frequently occurring in the Czech scientific style. (See P VII-P X)

3.3.1 Lexical Equivalency and Grammatical Equivalence

The title of a chapter, chosen for analysis, is called *Vůně kvarků (Quarks with flavor)*. In spite of the fact, that the word *vůně* has a strong emotional undertone, which opposes to the general truth, that scientific terms generally lack any emotional subtext. However, the terms denoting newly created concepts are based on connotations and expressive words, they are so-call motivated (e.g. Big Bang theory).

The title is characteristic for English scientific style, I suppose, which is known for more figurative expressions occurring in this style. When speaking about quarks, this

expression has been borrowed from English and it is commonly used in the language of physics.

The following examples show the use of specific terminology or words frequently used in relation with given issue (quarks *cluster*).

E.g. ... *three quarks clustered together* ... - ... *tři kvarky seskupené dohromady* ...

E.g.: ...*an intrinsic angular momentum, or 'spin'* ... - ...*jakýsi vnitřní moment hybnosti*...

Some words become semantically more limited in TL text as the following example show:

E.g.: ...*hard*... - ...*velmi obtížné*...

Considering the fact, that given excerpt is designed to present given topic in the most comprehensible but interesting way, we can find also other lexical units with emotional load (*nugatory*). Besides, there are added modifying words in TL thus distinguishing the particles (ze všech známých) in order to make the translation coherent, while in SL, I suppose, the definite article *the* conveys the similar meaning (*from all the particles*).

E.g.: ...*the most nugatory from the particles*... - ...*bezpochyby (se jedná o) nejvíc plachou ze všech známých částic*.

E.g.: ...*en route*... - ...*který jim stojí v cestě*...

3.3.2 Textual and pragmatic equivalence

There are is used in SL to express rheme – position varies in both SL and TL. In the Czech translation, change of sentence construction was necessary in order to express rheme by means of its position at the end of a sentence. The complex sentence has been also split into two sentences in SL text in order to achieve equal comprehensibility of the text. Cohesion is marked by pronouns either in SL and TL texts referring to quarks of up and down type. However, using cohesive device in TL (*těchto částic*) can be misleading, because they are not specifically mentioned in the sentence, and further reading is necessary to assure what particles the author was referring to.

Text in SL:

There are two different varieties (or 'flavours') of quark needed to make a proton or a neutron, known as the up and down (traditionally summarized by their first letters u and d respectively).

Translation in TL:

Ke vzniku těchto částic nicméně nestačí kvarky libovolné, potřebujeme, aby byly vždy dvou různých typů (neboli „vůni“). Existující prvky nazýváme up a down (obvykle zapisovány podle prvních písmen svého názvu, tedy u a d).

As I have mentioned at the beginning of the chapter 3.3, the text under scrutiny can be defined as pure scientific style that hints a slight tendency to have some features in common with popular scientific style. Personification (*quarks grip one another so tightly*), can be considered as well as kind of figurative linguistic means, which gives more attraction to quarks, supposedly, and helps an author to present the topic in an interesting way or as an expressive linguistic means possessing strong emotional undertone as a part of terminology typical for this kind of new discoveries in this field.

Initiative to start a conversation can be signaled by using *we* in the example.

Text in SL:

Quarks grip one another so tightly that they are forever imprisoned in groups, such as the threesome that forms the entity that we call proton.

Translation in TL:

Kvarky se navzájem drží tak pevně, že jsou navždy uvězněny do skupin, třeba takových, které tvoří protony.

The language means used in this excerpt show, that words of common usage can be used in scientific style in a very narrow and specific meaning. Another distinction that can be observed here is different grammatical equivalence in expressing the name of the entity – *proton* – using *we* (*které tvoří protony – that we call protons*) is very common in English scientific style.

There is an introductory phrase '*Platí totiž, že*' added by a Czech translator in order to make the translated text equally coherent.

Text in SL:

Nature seeks the state of lowest energy, which translates in this case to the state of lowest mass.

Translation in TL:

Platí totiž, že příroda preferuje stavy s co nejnižší energií, což vztaheno na tento případ znamená rovněž nejmenší hmotnost.

If we have a look at the sentence preceding this one, we can see that TL text would have not been that easy to read and would not seem natural to a reader:

Tento proces se nazývá rozpad beta; dochází k němu proto, že neutron má mírně větší hmotnost než proton. (Platí totiž, že) příroda preferuje stav s co nejnižší energií, což vztaheno na...

A change in sentence construction has been made in translation of the next example, and it corresponds with the SL. It was necessary to enlarge the text with '*Je naprosto (netečné)*' and '*a je proto*' to add the information why it is hard to detect those particles. We can also observe a significant semantic shift in equivalence in *that act within the bulk matter* in SL, which describes the process of electric forces within neutrinos itself, and *které ovlivňují normální hodnotu* in TL, which focuses already on the result of the process. It is an example of modulation as a method of translation when the aspect of particular entity changes during the translation.

Text in SL:

*Oblivious to the normal electric forces that **act within the bulk matter**, neutrinos are hard to detect.*

Translation in TL:

(Neutrino) Je naprosto netečné k elektrickým silám, které ovlivňují normální hodnotu, a je proto velmi obtížné je vůbec detekovat.

The last example that I enter here for scrutiny represents the whole paragraph. Participle clause in ST *Oblivious to the normal electric forces that act within the bulk matter* and the infinitive structure *are hard to detect* show/prove the nominal tendency of English. English is very fond of these condensed structures – Czech translation is based on clauses, that contain finite verb forms, TT version is less condensed and therefore more explicit, it expresses the logical relationship between the clauses by an explicit linker A PROTO. Figurative expressions (*the lottery of chance*), sayings (*once in a blue moon*) and metaphors (*naše vyhlídky na polapení neutrino se zvyšují – that chance comes to our aid*) are very refreshing in the text and can make the dull text more interesting. Besides, we can observe semantic changes (e.g. *the first - první výhodou*), where the object is more closely characterized in TL than it is in SL. The choice of using more common expression in SL proves this theory as well (e.g. *the Sun is putting down – Slunce jich produkuje tolik*).

Text in SL:

*The first is to use very intense sources of neutrinos so that **the lottery of chance** means that one or two **will bump into** atoms in **some detector** and be recorded. Although a single neutrino might only interact **once in a blue moon** (or a light year), the **Sun is putting out** so many **that chance comes to our aid**. You or I have almost no chance of winning the lottery, but enough people enter that someone does. With enough neutrinos shining down on us, a few will hit atoms **en route**.*

Translation in TL:

První výhodou je, že máme k dispozici velmi intenzivní zdroje neutrin, takže šance, že některé z nich vyhraje onu srážkovou loterii a přece jen se srazí s nějakým z atomů v našich detektorech, je vcelku slušná. I když má jediné neutrino schopnost interagovat sotva jednou za uherský rok (nebo spíš za ten světelný), Slunce jich produkuje tolik, že se naše vyhlídky na polapení neutrina podstat zvyšují. S takovým množstvím neutrin, které na nás dopadají, se již sem tam nějaké dokáže trefit do některého z atomů, který jim stojí v cestě.

To conclude the analysis of the text from the field of Physics, I have observed all the features characteristic for scientific style, with the exception of the use of figurative linguistics means which create the emotional relationship between the author and the text. Consequently, the scientific text can even show the author's purpose was to attract broader audience of readers and to get them interested in the given topic. However, the level of complexity of given text requires the reader (and the translator) to be well supplied with the knowledge in Physics.

3.4 Analysis of Chemical Text Translation

For the purpose of the last analysis I have chosen a text from the field of Chemistry. The excerpt originally comes from the publication Organic Chemistry (McMurry 2008, 482-483) written in English language as SL and the Czech translation was gained from the Edition *Překlady vysokoškolských učebnic, svazek 2*. The text is designed primarily for the students of organic chemistry at technical universities and universities offering chemistry as main studying program. The style of the language is scientific, with a lot of special terminology. However, we can notice the author's choice of presenting information, which is more accessible in order to enable students to understand difficult topics easier.

(See P XI–P XIV)

3.4.1 Lexical Equivalence and Grammatical Equivalence

Style of language used in chemistry, as a style of exact science, requires from a translator to have a thorough knowledge in the field, otherwise the translation might be incorrect and misleading. The following example proves the statement:

E.g.: ...numerous sites of unsaturation... - ...vice násobných vazeb...

Without the knowledge of chemistry, the usual translation could possibly be multiplied bonds. However, from the semantic aspect of the text as a whole, this would be an incorrect translation.

Generalized translation can be also found in the text. Phrase *unsaturated compounds* were from SL translated into TL only as *sloučeniny* in general. The translation is correct, if it is obvious from the text the only the unsaturated compounds are being referred to. Otherwise, this semantic enlargement could lead to more possible interpretations.

E.g.: ...*unsaturated compounds*... - ...*sloučeniny*...

English adverbial of manner implies mutual relationship among the bonds. However, a Czech translator might have felt that it would have been better to express explicitly the mutual relationship with additional lexical unit in order to convey the essence of the facts which is obviously important.

E.g.: ...*they react independently*... - ...*reagují na sobě zcela nezávisle*...

The use of specific terminology is crucial feature for the analyzed text (enones/enony, alkenes/alkeny, ketones/ketony). They are mostly loan words, specific for a field of chemistry in general, as a part of more or less unified language used in this field.

3.4.2 Textual and Pragmatic Equivalence

The texts are not semantically equivalent. The text in SL is aimed on explanation that compounds of particular bonds alternating (so-called conjugated compounds) have distinctive characters. In contrast, the text in TL is aimed primarily on informing a reader how this kind of compounds is called. The distinctive characteristics are mentioned loosely in the continuing text. Another difference has occurred during the translation. It is the introductory phrase *In particular*, which has been translated as *Odlišné chování* in TL. It is possible to agree on the fact, that the TL translation follows the main purpose of functionality, i.e. to enable an understanding for a Czech reader so that syntactic structure is changed and semantic equivalence is achieved from the broader aspect by changing lexical units and adding new ones (within the whole paragraph, not strictly within one sentence).

Text in SL:

In particular, compounds that have alternating single and double bonds –so-called conjugated compounds – have some distinctive characteristics.

Translation in TL:

Odlíšné chování mají zejména násobné vazby, které se vzájemně střídají s vazbami jednoduchými a tak vytvářejí konjugované systémy.

In contrast with previous example, this one demonstrates the situation, when the translation preserved the syntactical, semantic and textual equivalence, mostly because the nature of the sentence enabled it.

Text in SL:

*Conjugated enones (alkene + ketone) are common structural features of many biologically important molecules such as progesterone, the hormone that prepares the uterus for implantation of a **fertilized** ovum.*

Translation in TL:

*Konjugované enony (alken + keton) jsou běžnými strukturními typy biologicky důležitých molekul, např. progesteronu, hormonu, který připravuje děložní sliznici pro **zachycení** oplozeného vajíčka.*

The last example illustrates a very common feature for translations from English into Czech. Final position of rheme is typical for Czech language in contrast to the English language, where new information can be expressed in more ways; here it occupies initial position in the sentence. To achieve proper translation, rebuilding of a sentence in TL is necessary.

Text in SL:

*The base-induced elimination of HX from an allylic halide is **one of such** reaction.*

Translation in TL:

***Jednou z takových reakcí** je eliminace HX z halogenalkanu účinkem báze.*

The style of language used in the chemic text consisted of following general features that proves the style can be considered scientific. It is mainly the use of great amount of specialized terminology, logical ordering of sentences, consistency in information flow, the use of iconic language for the interpretation of information put verbally (illustrations of molecules, bonds among them, various charts, graphs and other types of visual illustrations). The information were presented predominantly in 3rd person, however, first person of plural form (we) occurred frequently as well, which is typical for presenting the results of tests and experiments or explaining how to proceed to make some.

3.5 Summary of the Analysis

The aim of the Analysis was to present four different excerpts from various fields of exact sciences, social sciences and law. Their translations from the English language into the Czech language and vice versa were the main concern of particular analyses. Two main aspects were discussed:

1. Aspect of general features of the styles used in individual texts with subsequent comparison of the features on the basis of the knowledge introduced in the theoretical part, and consequently, their confirmation or denial.
2. Aspect of translations of given excerpts (where methods of translation were examined), and the aspect of equivalence were considered and evaluated.

Each style discussed in the thesis has demonstrated both common and distinctive features. The difficulty of translation and requirements for a translator with regards to the depth of knowledge in each field of science vary from one style to another. Legal documents stick to the rules of style the most. Exact Sciences, in contrast to administrative style, provide translator with slightly more space for his/her own linguistic intentions. However, it depends on the nature of the text (scientific style vs. popular scientific style) and who is the recipient of the text (students, broad public, or the specialist in the field). Social Sciences (Economics, Humanities) can operate with much more diversified linguistic means as far as the nature of the text enables them to.

CONCLUSION

Translation is an art. It is one of the greatest challenges for a man, for translator. The translation itself requires working with the most fluid and immensely complex system – and yet the most beautiful - a language. Translating is a process where loyalty is that strong bond between good translator and good translation.

The purpose of the thesis was to define and describe the nature of scientific and technical text from the viewpoint of translation studies. My thesis was divided into two main parts, theoretical and analytical part. I attempted to create a coherent background for the analysis providing it with the fundamental knowledge from the field of translation studies and stylistics. Having gained sufficient knowledge, I could move towards the main part – the analysis.

The analysis was based on four excerpts from selected translations coming from different fields of study within the scientific and technical style. The main idea of the analysis consists in comparison of four excerpts from the field of economics as a representative of social sciences, from the field of physics and chemistry as representatives of exact sciences and excerpt from the legal and official documents. The given excerpts underwent individually thorough analysis of features characteristic for the style they were written in. Moreover, methods of translation and types of equivalence were identified and subsequently the ST and TT were mutually compared.

Having drawn conclusions from the analysis, I have found out following observations. Legal text proved to have many features in common with the three remaining representatives of scientific and technical style. The excerpt from the Act on Bank activities proved to have the highest requirements on the exactness of translation. Excerpts from chemistry and physics respected all the features characteristic for the given style, however, the author as well as translator could operate with linguistic means more loosely in order to create text that would be more accessible for the recipient of information. Excerpt from physics even demonstrated the new tendency in scientific style. It is related to discoveries of new concepts. Therefore, there emerge expressive terms that convey significant emotional load. It reflects the dynamics of modern times and refreshes the dullness of scientific text without undermining its technical and scientific validity.

To conclude my observations, I would like to emphasize that the findings gained during the analysis have proved right that each translation is exceptional and should be treated as such a unique piece of linguistic art.

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APPENDICES

- P I Banking principles I CZ
- P II Banking principles I ENG
- P III Banking principles II CZ
- P IV Banking principles II ENG
- P V Act No 6/1993 Coll.
- P VI Act No 21/1992 Coll.
- P VII Physics I CZ
- P VIII Physics I ENG
- P IX Physics II
- P X Physics III
- P XI Chemistry I CZ
- P XII Chemistry I ENG
- P XIII Chemistry II CZ
- P XIV Chemistry II ENG

APPENDIX P I: BANKING PRINCIPLES I CZ

ale přehnaně omezilo možnost diverzifikace, tudíž zvýšilo rizikovost, očekávanou monopolní ziskovost a náklady monitorování a omezilo dosažení úspor z rozsahu.

Bankovní heterogenita se projevuje zejména **při porovnání malých a velkých bank**. Např. rozsáhlé americké analýzy (např. Sinkey, 2002) ukazují, že velké banky mají tendenci k odlišné struktuře aktiv s lépe diverzifikovanými úvěrovými riziky, k většímu podílu mimorozvahových aktivit, k většímu podílu lépe říditelných velkých a institucionálních vkladů (ale nepojištěných), k nižším úrokovým maržím (rozdílům přijatých a vyplacených úroků). Souvisí to zřejmě mj. s tím, že centrální banka nedovolí pád velké banky („too big to fail“, „TBTF“). Obdobně je to i v České republice, kde malé banky mají malý prostor pro optimalizaci rizika.

II.4 Tržní segmentace a heterogenita v České republice

Vývoj českého bankovního trhu prošel podobnou vlnou konsolidací jako v ostatních zemích (skupina G10, 2001). Do roku 2003 přežilo pouze 35 bank. V roce 2004 a 2005 se počet stabilizoval na 36. Státem vlastněná Konsolidační banka, s.p.ú., byla transformována na nebankovní instituci Českou konsolidační agenturu (ČKA). Malé a střední banky, které byly v polovině devadesátých let tak početné, padly za obět konkurenčnímu boji.

Tabulka II-5: Počet bank dle typu a velikosti³ v ČR, 1995–2006

	1995	1997	1998	1999	2001	2002	2003	2005	2006
<i>Operativní banky</i>									
Velké banky	5	5	5	5	3	4	4	4	4
Střední banky	10	13	12	12	10	9	9	9	9
Malé banky	24	13	12	9	8	9	7	5	5
Pobočky zahraničních bank	10	9	10	10	10	9	9	12	13
Stavební spořitelny (vždy se zahr. účastí)	6	6	6	6	6	6	6	6	6
Banky v nucené správě	0	4	0	0	1	0			
Celkem	55	50	45	42	38	37	35	36	37
Ostatní banky bez licence	4	10	18	21	25	27	30	31	

Zdroj: Zpráva o bankovním dohledu, ČNB, 1995–2005, Zpráva o výkonu dohledu nad finančním trhem, ČNB, 2006

Tržní segmentace byla založená na rozdílech v přístupu k primárním vkladům a klientům, schopnosti poskytnout půjčky, zároveň také v rozdílech v přístupu ke corporate governance (bank a jiných nefinančních institucí) a také ve využití neetických „one-shot games“, které někdy vlastníci používali. Jinak řečeno,

³ Od roku 2002 se používá nová klasifikace velikosti bank dle velikosti bilanční sumy, velké banky (nad 100 miliard Kč, střední banky (15–20 miliard Kč), malé banky (méně než 15 miliard Kč), viz www.cnb.cz.

APPENDIX P II: BANKING PRINCIPLES I ENG

limited the possibility to diversify – and so increased the risk, the expected monopoly profitability and monitoring costs – and in this way also limited economies of scale.

Bank heterogeneity is clear especially when comparing small and large banks. For example, extensive American analyses (e.g. Sinkey, 2002) demonstrated that large banks tend to have a different asset structure with better diversified credit risks, a substantial share of off-balance sheet activities, a higher share of huge and (uninsured) institutional deposits, lower interest margin (the difference between interest income and expense). It is also connected with the “too big to fail” doctrine, (the central bank does not let a large bank fail). The situation is similar in the Czech Republic, where small Czech banks have limited space for risk optimisation.

II.4 Market segmentation and bank heterogeneity in the Czech Republic

The bank market has consolidated in parallel with worldwide tendencies (Group of Ten, 2001), and only 35 banks survived up to 2003. In 2004 and 2005 the number of banks stabilised at 36. State-owned Konsolidační banka was transformed into a non-banking firm ČKA. Small and medium-sized banks, which were so numerous at one time, fell victim to a competitive battle.

Table II-5: Number of banks according to the type and size³ in the Czech Republic 1995–2006

	1995	1997	1998	1999	2001	2002	2003	2005	2006
<i>Operating banks</i>									
Large Banks	5	5	5	5	3	4	4	4	4
Medium-sized banks	10	13	12	12	10	9	9	9	9
Small banks	24	13	12	9	8	9	7	5	5
Foreign banks branches	10	9	10	10	10	9	9	12	13
Building societies (always with foreign particip.)	6	6	6	6	6	6	6	6	6
Banks under administration	0	4	0	0	1	0			
Total	55	50	45	42	38	37	35	36	37
Other banks without license	4	10	18	21	25	27	30	31	

Source: Banking Supervision Report, CNB, 1995–2005, Financial market supervision report, CNB, 2006

Market segmentation was based on differences in access to deposits, the availability of loans and access to clients, as well as on the biased corporate governance of banks and non-financial corporations, supplemented by the unethical

³ Since 2002 a new statistical methodology has been applied for size classification according to the volume of balance sheet: Large bank – (over CZK 100 billion), medium-size bank (CZK 15–20 billion), small bank (under CZK 15 billion) – see www.cnb.cz.

APPENDIX P III: BANKING PRINCIPLES II CZ

problém morálního hazardu a nefairového jednání byl v tranzitivních ekonomikách ještě zvyrazněn.

Velké banky byly schopny přitáhnout primární depozita domácností, i přes negativní reálnou úrokovou míru (většina drobných střadatelů zůstala u České spořitelny) nebo získat dostatečné velké zdroje na mezibankovním trhu za nižší úrokovou míru (neboť tyto instituce byly považovány za velké na to, aby padly (TBTF)). Z toho důvodu mohly velké banky poskytnout svým nejlepším klientům i výhodné úrokové sazby.

Zároveň velké banky zdědily relativně hustou pobočkovou síť a širokou paletu firemních klientů s obchodní i úvěrovou historií a hodnotnými aktivy, které mohly být v obchodních případech poskytnuty jako zástava.

Z toho důvodu si mohly velké banky své klienty vybírat a nabídnout jim výhodnější podmínky (co do úrokové sazby a vyššího objemu) ve srovnání s menšími bankami.

Malé banky byly zahrnuty do začarovaného kruhu, kdy na ně zbyli klienti s horší úvěrovou kvalitou (vyšším úvěrovým rizikem). Zároveň měly tyto banky kvůli své velikosti i omezenější přístup na mezibankovní trh, kvůli menšímu počtu poboček i omezenější přístup k vkladatelům. Z toho plynuly mnohem vyšší náklady na zdroje. Výsledkem bylo, že menší banky poskytovaly úvěry menším a rizikovějším klientům (s kratší historií a omezeným množstvím aktiv, které by sloužily jako zástava).

I přes popsané startovní výhody velkých bank se problémy nevyhnuly ani jim. Naopak velké banky se pouštěly do velkých, někdy megalomanských obchodů, které se ukázaly jako velmi rizikové. Je tedy nutné mít stále na paměti, že celkové ztráty velkých bank v konečném součtu daleko překročily ztráty malých a středních bank. Tyto banky však nebyly dostatečně velké na to, aby se do jejich záchrany pustil stát jako v případě velkých bank později.

Devadesátá léta 20. století (především první polovina) se vyznačovala velkou poptávkou po úvěrech (velkou měrou i díky privatizačním úvěrům). Toto prostředí banky svádělo k půjčování a přijímání vyšších rizik.

Likvidní krize vyplývající ze špatných úvěrů a neospravedlnitelných růstových ambic vedla k nutnosti přilákat další vkladatele, a to i za cenu vysokých úrokových sazeb. Vyšší úroky vyplácené vkladatelům však odčerpávaly prostředky, které by byly třeba ke krytí ztrát ze špatných úvěrů.

Nelehké úkoly transformace a rizika s tím spojená, nezkušený personál bank, podvody zapříčiněné morálním hazardem a nefairovým jednáním vedly k sérii selhání (kapitola XII).

APPENDIX P IV: BANKING PRINCIPLES II ENG

one-shot games of owners. In other words, the selection bias and moral hazard roles had been amplified in volatile transitional economies.

Large banks had been able to attract the primary savings of households despite the negative real interest rates (e.g. most depositors were accustomed to saving mainly in the Czech Savings bank) or acquire sufficient funds on the inter-bank market at lower interest, since this was seen as safer, also TBTF aspects could be applied. Hence, these banks could offer their best clients a lower prime interest rate. They inherited a relatively dense branch network and a wide range of larger business clients with a credit and business history as well as valuable fixed assets, which could have been used as collateral for loans.

As a result, large banks selected their clients and provided the best ones with cheaper and larger loans under better terms than competing small banks.

The small banks were locked in the vicious circle of facing higher risk from creditors with a limited credit history. Their access to funds was limited by their size (by smaller shareholders' equity), compounded by a small number of branches and higher borrowing costs. Thus, they were limited to providing smaller, more expensive loans that were less attractive to the best and more reliable clients, and thus they attracted less desirable clients and projects. They had to assume the higher risk associated with clients who possessed a short or bad track record and insufficient assets to serve as collateral.

Even big banks had several advantages over smaller banks at the beginning, also these banks got into big problems. They granted too big and too risky loans. So we have to keep in mind, that total losses of big banks far exceeded the losses of smaller banks. But these big banks were too-big-to-fail, so the state helped at the end.

In the early 1990's the enormous demand for loans was multiplied by leveraged privatisation buyouts and created an excess demand, which increased the propensity of the banks to accept higher risks.

Liquidity crises attributable to non-performing loans and unreasonable growth ambitions resulted in an attempt to attract deposits by increasing deposit rates, incentives that wiped out the extra-margin from credit activities predetermined for the provisioning of underlying, and often non-performing, loans. Transformation tasks and risks, inexperienced staff and frauds caused both by selection bias and by moral hazard created a series of specific failures (see Chapter XII).

APPENDIX P V: ACT NO 6/1993 COLL.

V.2.1 Hlavní součásti regulace v České republice

- a) Hlavní cíle regulace jsou formulovány v **zákoně o České národní bance č. 6/1993 Sb.**, v platném znění. ČNB je hlavním dozorovým orgánem nad finančním (tedy i bankovním) trhem. Dle zákona o ČNB tato pečuje o cenovou stabilitu. V souladu s tímto cílem a) určuje měnovou politiku, b) vydává bankovky a mince, c) řídí peněžní oběh, platební styk a zúčtování bank, pečuje o jejich plynulost a hospodárnost a podílí se na zajištění bezpečnosti, spolehlivosti a efektivnosti platebních systémů a na jejich rozvoji, d) **vykonává dohled nad osobami působícími na finančním trhu, provádí analýzy vývoje finančního systému, pečuje o bezpečné fungování a rozvoj finančního trhu v České republice a přispívá ke stabilitě jejího finančního systému jako celku**, e) a provádí další činnosti.

Nebylo to však vždy tak, že Česká národní banka měla v kompetenci dohled nad celým finančním trhem, (viz příloha 1). Teprve od 1. dubna 2006 (dle zákona č. 57/2006 Sb.) byl dohled nad finančním trhem integrován v České národní bance. ČNB tak převzala a sjednotila aktivity, které byly doposud rozptýleny v jiných institucích (dohled nad pojišťovnami a penzijními fondy prováděl Úřad pro dohled nad pojišťovnami a penzijními fondy, tento úřad byl podřízen ministerstvu financí, dohled nad obchodníky s cennými papíry prováděla Komise pro cenné papíry a dohled nad družstevními záložnami prováděl Úřad pro dohled nad družstevními záložnami).

V.2.1 Main parts of repulation in the Czech Republic

- a) According to **Act No 6/1993 Coll. on the Czech National Bank**, as amended, CNB is the main supervising authority. The primary objective of the CNB is to maintain price stability. In accordance with its primary objective it shall a) set monetary policy, b) issue banknotes and coins, c) manage the circulation of currency, administer payments and clearing between banks, promote smooth and efficient operations, and contribute to the safety, soundness and efficiency of payment systems and their development, d) **supervise the activities of entities operating on the financial market, the evolution of the financial system, see to the sound operation and development of the financial market in the Czech Republic, and contribute to the stability of its financial system as a whole and** e) carry on other activities pursuant to the Act.

It was not until April 2006 that CNB was in charge of the supervision of the whole financial market supervision, (see also Annex 1). Only since 1 April 2006, financial market supervision in the Czech Republic has been integrated into the Czech National Bank, which has taken over the thus far fragmented activities of the Finance Ministry's Office of State Supervision of Insurance Companies and Private Pension Schemes, the Czech Securities Commission and the Office for the Supervision of Credit Unions.

APPENDIX P VI: ACT NO 21/1992 COLL.

b) Pravidla stanovená **Zákonem o bankách č. 21/1992 Sb.**, v platném znění:

- licencování (kriteria autorizace): podmínkou vstupu do odvětví je přidělení licence (§ 4–5). Zákon stanoví i důvody, které vedou k odnětí bankovní licence (§ 34–35). Důležitou součástí licencování je princip tzv. „jednotné licence“ fungující v rámci EU (tento „evropský pas“ pro zakládání *poboček* v hostitelských zemích EU znamená, že není třeba získávat licenci od regulátora hostitelské země, §5c–5m).
 - nucenou správu může uvalit pouze Česká národní banka,
 - v případě likvidace návrh na likvidátora podává také jen ČNB (§ 36)
 - ČNB schvaluje akcionáře banky a prodeje podniku či jeho části (dle §16–20). Akcie bank mohou být jen zaknihované, banka nesmí na valné hromadě připustit účast akcionářů, jimž ČNB pozastavila akciová práva, či nedoporučila jejich vstup (např. Union banka a její potenciální investor Investmart).
- c) **Bankovní tajemství a jeho uvolnění.** Např. Centrální registr úvěrů umožňuje sdílení informací o neplatičích a částečně tak překonává informační asymetrii mezi věřitelem a dlužníkem.
- d) **Pravidla obezřetného podnikání.** Banka má samozřejmě své obchodní plány, zároveň však musí dodržovat základní pravidla obezřetného podnikání, která

b) Rules set by the **Act No 21/1992 Coll. on Banks**, as amended:

- licensing (authorization criteria): for banks to enter the sector a license must be granted and certain requirements must be met, Art. 4–5. The Act also sets forth reasons for revoking the license (Art. 34–35). An important attribute of licensing is the “single license principle” applicable within the EU; this “European passport” enables banks to set up branches in host countries without having a license granted by the host regulatory authority, Art. 5c–5m,
 - only the Czech National Bank can impose conservatorship,
 - in case of liquidation, only the Czech National bank can submit a proposal for the nomination of the liquidator (Art. 36),
 - CNB approves shareholders and the sale of the bank or its parts (Art. 16–20). A bank may issue shares to which voting rights are attached as book-entry (dematerialised) shares only. CNB may suspend the exercise of certain rights of the shareholder (e.g. to enter or vote in a General meeting), as in the case of Union banka vs. the investor Investmart.
- c) **Banking secrets and its liberalization.** The Central register of credits, for example, enables the sharing of information on clients in default and in this way partly overcomes the asymmetric information inherent in the debtor/creditor relationship.
- d) **Prudential rules.** While carrying on its business, a bank is required to abide by certain prudential rules aimed at limiting the risks of the banking business so as

APPENDIX P VII: PHYSICS I CZ

Vůně kvarků

Tři kvarky seskupené dohromady stačí k vytvoření protonu nebo neutronu. Ke vzniku těchto částic nicméně nestačí kvarky libovolné, potřebujeme, aby byly vždy dvou různých typů (neboli „vůní“). Existující kvarky nazýváme *up* a *down* (obvykle zapisovány podle prvních písmen svého názvu, tedy *u* a *d*). Dva kvarky *up* a jeden kvark *down* vytvoří proton, dva kvarky *down* a jeden kvark *up* neutron.

Kvarky jsou elektricky nabité. Kvark *up* nese $2/3$ kladného elektrického náboje, zatímco kvark *down* má záporný elektrický náboj o velikosti $-1/3$. Celkový elektrický náboj je pak jednoduše součtem nábojů jednotlivých kvarků uvnitř částice. V případě protonu $p(uud) = 2/3 + 2/3 - 1/3 = +1$, pro neutron je výsledkem $n(ddu) = -1/3 - 1/3 + 2/3 = 0$.

Částice mají také jakýsi vnitřní moment hybnosti neboli spin. Velikost spinu je vyjádřena v jednotkách Planckovy konstanty h dělené 2π . Tato kombinace se v částicové a atomové fyzice nazývá redukovaná Planckova konstanta a značí se $\hbar = h/2\pi$. Protony, neutrony a kvarky mají každý spin o velikosti $1/2$, neboli $\hbar/2$.

Částicová fyzika

kvark	up	down
Náboj	$+2/3$	$-1/3$
Mc^2 [MeV]	$\cong 4$	$\cong 5$
Spin	$1/2$	$1/2$

Tabulka 2. Vlastnosti kvarku *up* a kvarku *down*.

APPENDIX P VIII: PHYSICS I ENG

of quarks known as quantum chromodynamics, of which we shall learn more in Chapter 7. Its ability to describe the interactions of quarks and gluons at distance scales below 10^{-16} m has passed every experimental test.

Quarks with flavour

Three quarks clustered together are sufficient to make a proton or a neutron. There are two different varieties (or ‘flavours’) of quark needed to make a proton and neutron, known as the **up** and **down** (traditionally summarized by their first letters, *u* and *d* respectively). Two ups and one down make a proton; two downs and one up make a neutron.

quark	Up	Down
Charge	+2/3	-1/3
Mc ² (MeV)	≈ 4	≈ 5
Spin	1/2	1/2

The heart of the matter

7. Properties of up and down quarks.

The quarks are electrically charged. An up quark carries a fraction $2/3$ of the (positive) charge of a proton, while a down quark carries a fraction $-1/3$ (that is, negative). Thus as the total electric charge of a collection is the sum of the individual pieces, we have for the charge of a proton $p(uud) = 2/3 + 2/3 - 1/3 = +1$, and of a neutron $n(udu) = -1/3 - 1/3 + 2/3 = 0$.

Particles have an intrinsic angular momentum, or ‘spin’. The amount of spin is measured in units of Planck’s quantum, h divided by 2π ; as this combination occurs throughout atomic and particle physics it is denoted by the symbol \hbar . The proton, neutron, and the quarks each have an amount $\hbar/2$, or in the usual shorthand, ‘spin 1/2’.

APPENDIX P IX: PHYSICS II

První výhodou je, že máme k dispozici velmi intenzivní zdroje neutrin, takže šance, že některé z nich vyhraje onu srážkovou loterii a přece jen se srazí s nějakým z atomů v našich detektorech, je vcelku slušná. I když má jediné neutrino schopnost interagovat sotva jednou za uherský rok (nebo spíš za ten světelný), Slunce jich produkuje tolik, že se naše vyhlídky na polapení neutrina podstatně zvyšují. S takovým množstvím neutrin, které na nás dopadají, se již sem tam nějaké dokáže trefit do některého z atomů, které jim stojí v cestě. S dostatečně velkou nádobou materiálu (nejspíše vody nebo železa či čistícího prostředku – opravdu, chlór je dobrým detektorem neutrin) lze proto občas nějaké to sluneční neutrino zaznamenat. V důsledku toho jako nový obor vědy vznikla i tzv. neutrinová astronomie. Prozatím nám odhalila třeba to, že k nám ze Slunce dopadá podstatně méně neutrin, než jsme očekávali na základě teoretických předpovědí. Ale problém nespočívá ve Slunci, jak by se mohlo zdát; spíše to vypadá, že pes je zakopán někde na cestě k nám. Kde, to se dozvíte v kapitole 10.

The first is to use very intense sources of neutrinos so that the lottery of chance means that one or two will bump into atoms in some detector and be recorded. Although a single neutrino might only interact once in a blue moon (or a light year), the Sun is putting out so many that chance comes to our aid. You or I have almost no chance of winning the lottery, but enough people enter that someone does. With enough neutrinos shining down on us, a few will hit atoms en route. So with a big enough tank of material – maybe water, or iron, or even cleaning fluid (the chlorine is particularly useful in detecting neutrinos) – it has been possible to

APPENDIX P X: PHYSICS III

Quarks grip one another so tightly that they are forever imprisoned in groups, such as the threesome that forms the entity that we call the proton. No quark has ever been isolated from such a family; their universe extends only for the 10^{-15} m that is the extent of the proton's size and it is this confinement within the 10^{-15} m 'femtouniverse' that we call the proton that gives them collectively an energy of ~ 938 MeV, which is the mass of the proton. We saw how length and energy are related, and that distances of the order of 10^{-15} m correspond to an energy of around 1 GeV. The precise correspondence of relevance here involves factors of 2 and π which go beyond this Very Short Introduction, with the result that an up or down quark, which were it free would have a mass of only a few MeV, when restricted to a femtouniverse of 10^{-15} m has an energy of some 200–300 MeV. The quarks are interacting strongly with one another (which must be so as they do not escape!) and the full details of how the mass of the proton turns out to be precisely 938.4 MeV is beyond our ability to derive from theory at present.

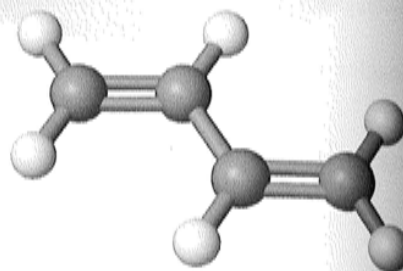
The heart of the matter

Pokusíme se nyní dát na oba tyto problémy odpověď.

Částicová fyzika

Kvarky se drží navzájem tak pevně, že jsou navždy uvězněny do skupin, třeba takových, které tvoří protony. Žádný kvark nebyl nikdy oddělen od své rodiny. Jejich vesmír má velikost 10^{-15} m, tedy rozměr protonu, a kvark je do tohoto svého „femtovesmíru“ doslova uzamčen. Toto uvěznění dává kvarku celkovou energii ~ 938 MeV, tj. hmotnosti protonu. Vysvětlili jsme si už, jak jsou spolu propojeny rozměry a energie a že rozměr 10^{-15} m odpovídá energiím okolo 1 GeV. Precizní popis této závislosti je spojen s faktorem 2π . Podrobnější rozbor problému si v této úvodní knize ušetříme, důležité ale je, že výsledkem je právě skutečnost, že samostatné kvarky mají energii jen několik MeV, zatímco když jsou vázány do femtovesmíru o rozměru 10^{-15} m, vzroste jejich energie na 200–300 MeV. Kvarky spolu silně navzájem interagují (což musí, nemohou-li se navzájem opustit); úplné vysvětlení toho, proč je hmota protonu přesně 938,4 MeV, ale při současném stupni poznání částicové fyziky neznáme.

Kvark *down* je jen o pár MeV hmotnější než kvark *up*. Nevíme, proč tomu tak je (dokonce ani nevíme, proč tyto fundamentální částice, tedy kvarky a elektron, mají právě takovou hmotnost, jakou mají), ale vysvětluje to, proč je neutron o něco málo hmotnější než proton. Kvarkové trio *uud* (proton)



14

KAPITOLA

Konjugované dieny a ultrafialová spektroskopie

V kap. 6 až 8 jsme probírali sloučeniny, které měly v molekule jednu dvojnou nebo trojnou vazbu. Mnoho organických sloučenin ale v molekule obsahuje více násobných vazeb. Jsou-li násobné vazby v molekule vzájemně dostatečně vzdáleny, reagují na sobě zcela nezávisle. Jsou-li však dostatečně blízko, mohou se navzájem ovlivňovat. Odlišné chování mají zejména násobné vazby, které se vzájemně střídají s vazbami jednoduchými a tak vytvářejí **konjugované systémy**. Například buta-1,3-dien je konjugovaný dien a má některé vlastnosti zcela odlišné od nekonjugovaného dienu, penta-1,4-dienu.



buta-1,3-dien
(konjugovaný; alternující
dvojně a jednoduché vazby)



penta-1,4-dien
(nekonjugovaný; nealternující
dvojně a jednoduché vazby)

Mnoho barviv, jejichž molekuly mají velký počet pravidelně se střídajících jednoduchých a dvojných vazeb, způsobuje nádherné zbarvení ovoce a květin. Například lykopen, červené barvivo obsažené v rajských jablíčkách, je konjugovaný **polyen**. Konjugované **enony** (alken + keton) jsou běžnými strukturálními typy biologicky důležitých molekul, např. progesteronu, hormonu, který připravuje děložní sliznici pro zachycení oplozeného vajíčka. Konjugované cyklické molekuly, např. benzen, tvoří samostatnou skupinu látek a budou podrobně probírány v následující kapitole.

14

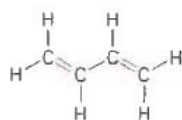
Conjugated Compounds
and Ultraviolet
Spectroscopy**Organic KNOWLEDGE TOOLS**

ThomsonNOW Throughout this chapter, sign in at www.thomsonedu.com for online self-study and interactive tutorials based on your level of understanding.



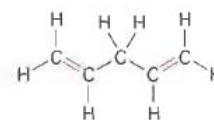
Online homework for this chapter may be assigned in Organic OWL.

The unsaturated compounds we looked at in Chapters 6 and 7 had only one double bond, but many compounds have numerous sites of unsaturation. If the different unsaturations are well separated in a molecule, they react independently, but if they're close together, they may interact with one another. In particular, compounds that have alternating single and double bonds—so-called **conjugated** compounds—have some distinctive characteristics. The conjugated diene 1,3-butadiene, for instance, has some properties quite different from those of the nonconjugated 1,4-pentadiene.



1,3-Butadiene
(conjugated; alternating
double and single bonds)

double and single bonds)



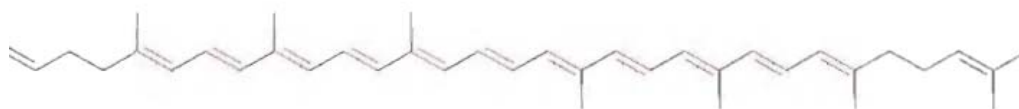
1,4-Pentadiene
(nonconjugated; nonalternating
double and single bonds)

double and single bonds)

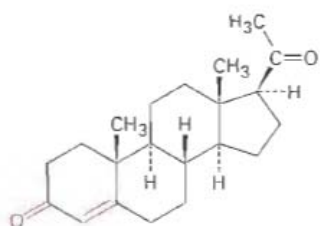
WHY THIS CHAPTER?

Conjugated compounds of many different sorts are common in nature. Many of the pigments responsible for the brilliant colors of fruits and flowers have numerous alternating single and double bonds. Lycopene, for instance, the red pigment found in tomatoes and thought to protect against prostate cancer, is a conjugated *polyene*. Conjugated *enones* (alkene + ketone) are common structural features of many biologically important molecules such as progesterone, the hormone that prepares the uterus for implantation of a fertilized ovum. Cyclic conjugated molecules such as benzene are a major field of study in themselves. In this chapter, we'll look at some of the distinctive properties of conjugated molecules and at the reasons for those properties.

APPENDIX P XIV: CHEMISTRY II ENG



Lycopene, a conjugated polyene



Progesterone, a conjugated enone



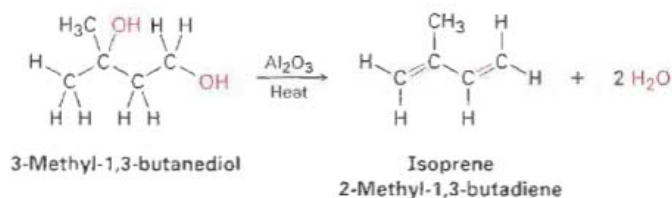
Benzene,
a cyclic conjugated molecule

14.1 Stability of Conjugated Dienes: Molecular Orbital Theory

Conjugated dienes can be prepared by some of the methods previously discussed for preparing alkenes (Sections 11.7–11.10). The base-induced elimination of HX from an allylic halide is one such reaction.



Simple conjugated dienes used in polymer synthesis include 1,3-butadiene, chloroprene (2-chloro-1,3-butadiene), and isoprene (2-methyl-1,3-butadiene). Isoprene has been prepared industrially by several methods, including the acid-catalyzed double dehydration of 3-methyl-1,3-butanediol.



One of the properties that distinguishes conjugated from nonconjugated dienes is the length of the central single bond. The C2–C3 single bond in