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127. Word-formation and technical languages

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Abstract

The article begins by introducing specialized communication as the main domain of technical languages. It presents a brief survey of the development of the general theory

of terminology. Next, technical terms and their types, sources and definitions are discussed. Section 5 is dedicated to the semantic and formal motivation and word-formation characteristics of terminological denomination in Czech in comparison to English and other languages which are or have been sources for direct terminological loans or loan translations. Technical languages display dynamism in their word-formation, marked traditionally by a continuous tendency towards internationalization.

1. Introduction

In any given environment, language acquires or forms differential and specialized variants of expression, which are known as, and have usually been referred to as, *register for special purposes* or *language for special purposes* (Halliday, McIntosh and Stevens 1964; Firth 1968; Halliday 1994). This holds true as well for one of the traditionally most important communicative spheres of any society in any time: specialized communication. To describe technical languages and their specific characteristics, including word-formation, the starting point should be specialized communication as a whole (with its texts, style and situation) since it has an impact on real use and the choice of linguistic devices (cf. similar topics in Hoffmann, Kalverkämper and Wiegand 1998–99). Moreover, as has been pointed out by Čmejrková, Daneš and Světlá (1999), over the past few decades, linguistic interest has shifted from the “language of science” to “scientific communication”. For lack of space and with respect to the main topic of this handbook we shall concentrate, however, on terminological word-formation and adjacent procedures in the formation of terms.

2. General overview

Specialized communication and its language are closely connected with terminological culture (i.e. careful attention to the national terminology in its largely international character) as a component of linguistic culture as a whole. Basic terminological problems are always linked to the national language, which serves the entire national community while respecting its contacts with other languages and communities. Present-day specialized communication is characterized by internationalization and globalization.

The precision of the specialized work must be achieved by a precise communicative instrument. An important role is played in this respect by vocabulary, in which, for the purposes of specialized communication, terms have evolved as a specific stylistic layer. Terms are considered the most characteristic feature of specialized expression in general, which is why, as a rule, considerable linguistic attention is paid to them within the framework of a special terminological (and terminographical) theory. These aspects are thoroughly reflected in *Languages for Special Purposes. An International Handbook of Special-Language and Terminology Research* (Hoffmann, Kalverkämper and Wiegand 1998–99), to which we shall refer in section 4.2, before demonstrating theoretical and practical considerations of term formation in Czech in comparison with other languages (section 5). At the same time, Czech may be of a more general interest because of the

ways in which it has responded to the influence of Latin and German terminology in the previous centuries, and of English in the world of today.

3. Theory of technical languages

Interest in specialized terminology, chiefly for practical reasons, has traditionally concentrated on terms and their harmonization and standardization. The development of the modern theory of terminology has been shaped above all by four schools: those of Vienna, Prague, Moscow and Québec. The concept of specialized language as a substantial part of specialized discourse (communication) was elaborated in the 1970s (in France and in Canada) in connection with the communicative and pragmatic orientation of linguistics (and its socioterminological trends at that time). An effort was made to return the study of terminology to the study of the real use of language (*parole*). Scholars connected to the Prague Linguistic Circle held the view that a specialized language should not, as was frequently the case, be the same thing as the sum total of the lexical and phraseological peculiarities that differentiate it from current speech. Modern theorization has shifted to a communicative approach; more recently, use is being made of the findings of cognitive science and of language corpora for the collection of examples (for details see Sager 1990).

The traditional theory of terminology understood terms as mere denominations of scientific findings (concepts). Later, the close relations between terms and discourse were emphasized, among others, by Jernudd (1994: 72) who is also known for his works on the evolution of linguistic and terminological management (see Chiu and Jernudd 2001). The notion of a “theory of language management” was used first by Jernudd and Neustupný in 1987. This theory had developed step by step from the 1960s within the framework of sociolinguistics and on the basis of language planning (for further details see Neustupný 2002).

In the theory of language management, linguistic problems on the most varied levels (state, special branch, organisation) are solved alongside related societal and communicational problems. In specialized communication, this theory emphasizes the institutional authorization of terminology, in cooperation with experts on research into languages for special purposes. It happens, however, that it is not always adequate to look at terminology only as the end result of terminological processes. The framework of language planning and management (cf. Jernudd 1994 on the “management model of language”) facilitates bringing terminological problems into the study of LSP (language for special purposes) without limiting it to mere recording and classification of its lexical units.

4. Formation of technical terms

Terms – as units of natural language – fulfill several basic functions: cognitive, interpersonal, inter-textual and referential (Temmerman 2000: 236). As a rule, they are delimited as words with a meaning that is relatively precise and independent of the context, often subject to some special convention or regulation, as for example with technical terms defined by standards associations (Halliday et al. 2004: 171). The lexical meaning of a

term is conceptual, its unambiguity in a given field is guaranteed by its definition; sometimes it is fixed by convention (especially in the case of social-science terms). Understanding terms is vital for the understanding of the entire specialized text; therefore, terms are regarded as text units, i.e. their naming function is accomplished in specialized communication.

According to expert estimates, the total number of terms in highly developed modern languages is about three million. In most specialized texts, terminology accounts for 30–80% of the vocabulary (Alberts 1999) that shows a certain stereotypicality, confirmed, for instance, by the index of repeated words, which is higher than in other styles. The volume of scientific knowledge doubles on average every five to fifteen years (Alberts 1999); this growth is reflected in terminology as an instrument for extending specialized knowledge. It is practically impossible in any (natural, national) language to name new objects and discoveries exclusively by using a simplex word, which is why term formation includes the formation of multi-word terms. Kocourek (1979) points out that lexical phrases have unlimited possibilities for naming concepts. However, Stoffa and Krobotová (2002) emphasize that a limitation exists precisely in specialized fields in that only certain means of expression are utilised as elements of terminological word-combinations (e.g., numerals, copulas, prepositions; others are not used at all, e.g., interjections or particles).

4.1. Technical terms: primary and secondary term formation

The formation of (new) terms based on existing vocabulary is caused by the need to name (new) concepts for the further development of knowledge and communication in a given specialized field; at the same time, these procedures reflect the usage of terminology in a given specialized field. A substantial number of terms arise through terminologization, i.e. the adoption and semantic specification of words from common vocabulary: in a broader sense, terminologization represents a case of utilizing denominational and word-formation types and means for the needs of designation in individual specialized fields.

Sager (1997: 27) distinguishes primary and secondary term formation. In the case of primary term formation, the term has no direct linguistic precedent, even though there may be traces of motivation or more or less strict rules for its formation (e.g., *atom*, *vitamin*). In the case of secondary formation, there always exists a model, cf. E. *oxide*, *sulfide*, G. *Oxid*, *Sulfid*, Cz. *oxid*, *sulfid*, Russ. *oksid*, *suľ'fid*, and older calques for *oxide*: Cz. *kysličník* ← *kyslík* 'oxygen' (← *kyselný* 'sour'), Russ. *okisel*, *okis*' (← *kislyj* 'sour'), etc. Whereas a primary creation may arise spontaneously, a secondary formation can be proposed and controlled. Secondary formation is more often governed by norms than primary creation is, because the emergence of new terms has to be justified, mainly by reference to existing terms to which the new terms have to adjust. Terminologists should therefore lay down directives for term formation in the specific specialized field based on word-formation models in general language. At present, secondary term formation predominantly consists of the transfer of English terms into other national languages. In Sager's (1997) understanding, however, secondary formation does not mean translation, even though parallels exist between the two processes, e.g., in both cases reconceptualization of the original content may simultaneously occur.

In a specialized field, processes of determinologization are generally less frequent than those of terminologization (determinologization occurs most often in journalistic style, where it is chiefly terms in the forefront of public interest that are determinologized). Its essence is the loss of terminological validity (definition) of naming, combined with semantic change or shift (e.g., E. *city syndrome*, G. *Großstadtsyndrom*, Cz. *syndrom velkoměsta*, Russ. *sindrom goroda*). Terminologization and determinologization are an expression of the dynamic relations between specialized and non-specialized vocabularies.

4.2. Procedures of term formation

Term formation can be based on metaphor, word-formation and the formation of multi-word terms of different structural types, which in turn are amenable to abbreviation, the formation of acronyms, etc. The individual techniques can be accompanied by borrowing and loan translation.

There are, however, numerous cases where more than one naming procedure is applied (e.g., metaphor, compounding and multi-word expression) with different results in individual languages, including the results of loan translation, cf. E. *pacemaker* / *artificial pacemaker* / *cardiac pacemaker* / *heart pacemaker* / *artificial cardiac pacemaker* and its abbreviation *ACP*; G. *Herzschrittmacher* lit. 'heart pacemaker' and *HSM*; Cz. *kardiostimulátor*; Russ. *pejsmeker* (a direct loan from English with graphical adaption of the English pronunciation), *serdečnyj ritmovoditel'* lit. 'heart-REL.ADJ rhythm-driver' or *voditel' ritma serdca* lit. 'driver rhythm-GEN heart-GEN'; E. *AIDS-related complex* and *ARC* – a compound adjective as part of a multi-word term and its abbreviation, G. *AIDS-bedingter Komplex* 'id.', and Russ. *SPID-associirovannyj kompleks* 'id.' (*SPID* is the abbreviation of the Russian translation of E. *Acquired Immune Deficiency Syndrome* – Russ. *Sindrom priobretennogo immunnogo deficita*).

a) Metaphorization

Semantic terminologization by shift of meaning, metaphorization and metonymization (cf. Drozd and Seibecke 1973; sometimes called "analogical denomination", see, e.g., Masár 2000: 37) consists in the application of an existing designation to a new concept in a certain terminology. Sometimes one and the same metaphor may occur in different disciplines, e.g., E. *field*, G. *Feld*, Cz. *pole*, Russ. *pole* in physics, electrical engineering, linguistics, etc.; Latin *radix* 'root of a word', G. *Wurzel*, Cz. *kořen*, Russ. *koren'* in linguistics; E. *iron rose*, *ring silicates* (Tatje 1999: 1425), G. *Eisenrose*, *Ringsilikate* (compounds), Cz. *železná růže*, *kruhové silikáty*, Russ. *železnaja roza*, *kol'cevye silikaty* (both sequences of relational adjective and noun), in mineralogy.

b) Derivation

As can be seen in numerous articles in Hoffmann, Kalverkämper and Wiegand (1998–99), individual technical languages make different use of word-formation categories and types of the general language.

According to Zerm (1999: 1414), the leading suffixes of action nouns in the English terminology of black metallurgy are *-ing* (*lending*, *sintering*) and *-ion* (*decarbonization*); of other abstract nouns: *-ity*, derived from adjectives in *-able* and denoting the possibility

of a process (*furgeability*); of concrete nouns: *-ite* (*ferrite*, *cemenite*), etc. In addition, there are numerous compound adjectives denoting similarity (e.g., *rope-like*, *cone-shaped*). An active role is also played by prefixation of words of different parts of speech (e.g., *super-alloy*, *descaling*, *non-aging*, *semi-killed*, *to reroll*).

Several articles dealing with English terminology underline the active role of conversion; cf., for instance, in computer language: N → V: *format* → *to format*, *alphatest* → *to alphatest*, *flowchart* → *to flowchart*; V → N: *to interrupt* → *interrupt* ‘feature of a computer that permits the temporary interruption of one activity in order to perform another’ (Müller 1999: 1449).

Referring to examples from various Russian technical languages, Hoffmann (1999: 1541) states that there are terminologies where derivatives represent up to 37% of all terms (e.g., in mathematics, physics and chemistry). He also demonstrates differences in the frequency of suffixes in different terminologies, e.g.:

Tab. 127.1: Suffix frequency in Russian technical languages (adapted after Hoffmann 1987: 119)

| | | 1. Medicine | 2. Physics | 3. Chemistry | 4. Philosophy |
|----|---|----------------|----------------|----------------|----------------|
| 1. | 1.–4. Abstr. ← V | <i>-enij-e</i> | <i>-enji-e</i> | <i>-enij-e</i> | <i>-enij-e</i> |
| 2. | 1. Abstr. ← V; Dim. ← N 2.–3. Abstr. ← A 4. Abstr. ← N, A | <i>-k-a</i> | <i>-ost'</i> | <i>-ost'</i> | <i>-stv-o</i> |
| 3. | 1.–3. Abstr. ← V 4. Abstr. ← A | <i>-anij-e</i> | <i>-ij-e</i> | <i>-anij-e</i> | <i>-ost'</i> |
| 4. | 1. Abstr. ← A 2., 4. Abstr. ← V 3. Abstr. ← N, A | <i>-ost'</i> | <i>-anji-e</i> | <i>-stv-o</i> | <i>-anij-e</i> |
| 5. | 1. Abstr. ← N, A 2. Abstr. ← V; Dim. ← N 3. Abstr. ← N, Concr. (e.g., substances) ← A 4. Abstr. ← N, A | <i>-stv-o</i> | <i>-k-a</i> | <i>-ot-a</i> | <i>-izm</i> |

Not all suffixes found in general language, are productive in technical languages; moreover, except for the leading role of Russian deverbal abstract nouns in *-enij-e*, individual suffixes can be differently exploited in technical languages (cf. also the Czech suffix *-ik* which is terminologized in chemical vocabulary, e.g.: *vápno* ‘chalk, lime’ → *vápník* ‘calcium’, *soda* ‘soda’ → *sodík* ‘natrium, sodium’). Certain types of word-formation can be active in terminology whereas they lack productivity in general language; cf., for instance, Russian secondary adjectives like *židkostnyj* ‘fluid, fluidal, fluidic, liquid, liquid-based’ (← *židkost* ‘liquid (noun)’ ← *židkij* ‘liquid (adj.), fluid’), e.g., *židkostnyj amortizator* ‘liquid-spring shock-absorber’; *častotnyj* ‘frequency (adj.)’ (← *častota* ‘frequency’ ← *častyj* ‘frequent; rapid’) or derivatives from diminutives (desemantized in special languages), e.g., Russ. *jazyčkovyj* lit. ‘lug-REL.ADJ’ ← *jazyčok* ‘lug; lit. tongue-DIM’ (part of a transformer). In case of affixal synonymy terminological word-formation

can be characterized by specialization; cf., for instance, Russian adjectives referring to the verb *svarit* 'to weld': *svarnoj* 'welded; referring to welding' in *svarnoj šov* 'weld-seam' vs. *svaročnyj* 'welding; serving for welding' in *svaročnyj apparat* 'welder, welding device, welding unit' (see Ohnheiser 2000: 100). Compounds (e.g., *metalloobrabotka* 'metal-working', *vodootvodčik* 'steam-trap', *krovoobrašćenie* 'blood circulation') are less representative of Russian special languages (cf. Hoffmann 1999: 1541).

Several authors underline the relatively complex word families in technical languages; cf. Baakes (1999: 1442) on English terms from electrical engineering and electronics: *E. magnetic, magnetism, magnetize, magnetizable, magnetizability, demagnetize, demagnetizer*. Cf. identical derivational relations in German: *magnetisch, Magnetismus, magnetisieren, magnetisierbar, Magnetisierbarkeit, de-/entmagnetisieren, Demagnetisierer*, or Russian: *magnitnyj/magnetičeskij, magnetizm, namagničivat', namagničivaemyj, namagničivaemost', razmagničivat', razmagničivatel'*.

c) Composition and formation of multi-word terms

Dealing with the recent English special language of mineralogy, Tatje (1999: 1425) underlines the role of interdisciplinarity in this field, which includes terms of neighbouring disciplines like mining, geology, physics and chemistry. An important role is played by compounds and multi-word terms (complex nominals and phrases) of different structure, e.g., N+N: *water molecule* (cf. also G. *Wassermolekül* (compound), Cz. *vodní molekula* (rel. A+N), Russ. *molekula vody* (N+N-GEN)); A+N (+N...): *single crystal* (cf. G. *Ein-/Monokristall*, Cz. *monokrystal*, Russ. *monokristall* (compounds)), *heavy liquid* (cf. G. *Schwerflüssigkeit* (compound), Cz. *těžká kapalina* and Russ. *tjaželaja židkost'*, both A+N).

Typical of technical languages is the combination with symbols in different types of compounds and multi-word terms, e.g.: *E. SEM-EDS analysis* (= *Scanning Electron Microscopy-Energy Dispersive X-ray Spectroscopy analysis*), *Nicolet model 800 FTIR spectrometer* (*FTIR = Fourier transform infrared*), *REE-bearing* (*REE = Rare Earth Elements*) (Tatje 1999: 1425; see also section 5.2).

Adjectival compounds are represented by formations such as *E. graphite-monochromated* (Tatje 1999: 1425), cf. G. *Graphit-monochromiert*, Russ. *monochromatizirovannyj grafitovym monokristallom* lit. 'monochromated graphite-REL.ADJ-INSTR monocrystal-INSTR') or formations expressing quantitative characteristics (*E. -rich, -free*), e.g., *E. sulfate-free* (cf. G. *sulfatfrei*, Cz. *bez sulfátů* lit. 'without sulfates', Russ. *bessul'fatnyj* lit. 'without-sulfate-ADJ').

d) Abbreviation and clipping

The large number of multi-word terms enhances the tendency towards abbreviation; according to Brunt (1999: 1455) it is the length of the names that has made abbreviations essential. He provides, among others, examples from the field of medicine, such as *E. ENT* (← *ear, nose, throat*); cf. analogously formed G. *HNO* (*Hals-, Nasen-, Ohren-* 'throat, nose, ear'), in Czech the equivalent abbreviation *ORL* refers to the borrowing *oto-rhino-laryngologie* 'otolaryngology'. In Russian, the scientific term is the loanword *otolarinologija* or *laringootorinologija*, whereas informal designations (professionalisms and colloquial formations) reflect the trend towards abbreviation, e.g., Russ. *UGN vrač* 'ENT doctor' (← *ucho* 'ear', *gorlo* 'throat', *nos* 'nose') or *lor-vrač* 'id.' (← *larin-*

gootorinologija); besides, an “analytical compound” is attested *vrač uxo-gorlo-nos* lit. ‘doctor ear-throat-nose’. English clippings like *GYN* (*gynecology*) and *PEN* (*penicillin*) must also be regarded as professionalisms (cf. Brunt 1999: 1455).

For Russian technical languages Hoffmann (1987: 175) points out the frequency of initial abbreviations, for instance, in military terminology: Russ. *OP* – *ognevaja pozicija* ‘firing position’, *mpb* – *motopechotnyj batal'on* ‘motorized infantry battalion; lit. moto[=motorized]infantry-REL.ADJ battalion’. He also provides examples consisting of a combination of different types of word-formation, such as Russ. *MGD-generator* = *mag-nitno-gidrodinamičeskij generator* and E. *MHD generator* – *magnetohydrodynamic generator*. The increasing formation of initial abbreviations in different areas of terminology may, however, lead to homonyms, e.g., Russ. *RU* 1. *radiouzel* ‘radio control post; lit. radionode’, 2. *raspredelitel'noe ustrojstvo* ‘distribution system’, 3. *regulirovanie usilenija* ‘gain control’, 4. *rele upravlenija* ‘control relays; lit. relays control-GEN’, etc.

e) Term formation and language criticism

In spite of terminological normalization and standardization (see section 5.1) there are also cases which do not fulfill the criteria of unambiguity (cf., for instance, the criticism of medical terminology referred to by Bunt 1999: 1413). This is especially true of designations in new disciplines and technologies as, for instance, data processing. Müller (1999: 1444 ff.) points out problems such as “semantic fluctuation and ambiguity” and “abundance of synonyms” (p. 1447), cf. E. *terminal*, *display* (*visual display terminal*, *video display terminal*, *video display unit*), *user terminal*, *display station*, *data station*; “abundance of metaphors”, and “obsession for compounds” (p. 1448). “On the other hand, the shortness of expression goes along with a loss of precision”, cf. *segment header check sequence* and *HCS* besides other types of abbreviations (*cd* or *change dir* for *change directory*) and acronyms, e.g., *PILOT* (*Programming Inquiry Learning or Teaching*) and clippings, e.g., *compusec* (*computer security*) (p. 1449). In spite of his criticism concerning “computerspeak”, Müller admits that the fast-moving nature of terms reflects the dynamics of a given sector.

5. Term formation and its description in Czech

Scholars affiliated with the Prague Linguistic Circle held the view that a specialized language should not, as was frequently the case, be regarded as the sum total of the lexical and phraseological peculiarities that differentiate it from current speech. To the present, Czech investigations into terminology have been strongly influenced by the works of the Prague school and especially Havránek’s (1932) distinction between the functions of language and the corresponding “functional languages” (cf. Hausenblas 1994: 327; Těšitelová 1998: 1549):

Tab. 127.2: Functions of language and functional styles (Hausenblas 1994: 327 after Havránek 1932)

| | |
|----------------------------------|--------------------------------|
| Conversational function | Colloquial functional language |
| Practical specialized function | Practical functional language |
| Theoretical specialized function | Scientific functional language |
| Aesthetic function | Poetic functional language |

Another characteristic of Czech studies is the application of Dokulil's onomasiologically oriented word-formation theory to the analysis of term formation. The word-formation of terms is based mostly on the onomasiological categories of transposition and mutation. Modification is typical of terms which are derived by prefixation, but also of terms formed by diminutive suffixes. Onomasiological categories (see Dokulil 1962: 225–230; also article 6 on word-formation in onomasiology, and article 58 on categories of word-formation) denote basic conceptual structures establishing the foundations of naming in a given language:

- a) In the transpositional type, a phenomenon, usually conceived as dependent on a substance, becomes conceived as independent of it, e.g., in deadjectival transposition (Cz. *vodivý (kov)* 'conductive (metal)' → *vodivost* 'conductivity'), in deverbal transposition (*budit (elektrinu)* 'to excite (electricity)' → *buzení* 'excitement (of electricity)', or in denominal transposition *elektron* 'electron' → *elektronový* (rel. adj.);
- b) In the mutational type, the phenomenon of one conceptual category is characterized (and named) according to its relation to an element of another conceptual category (Cz. *budit (elektrinu)* 'to excite (electricity)' → *budič* 'exciter', *poledne* 'noon, midday' → *poledník* 'meridian');
- c) In the modificational type, the content of a given concept acquires a supplementary modifying feature, e.g., diminution, in term creation often combined with metaphORIZATION (Cz. *sklep* 'cellar, basement' → (*plicní*) *sklípek* '(lung) alveole'; Lat. *alveolus* is also a diminutive ← *alveus* 'hollow'). For prefixation see section 5.1.

Terms as a result of word-formation processes are marked by a relatively high degree of systematization. Moreover, users are aware both of existing word-formation models and of their obligation to use terms. Frequently, when creating terms, it is considered more advantageous to use words and types more distant from common (colloquial) language or words from a foreign environment, which have no connotations (the latter are undesirable in terminology). As Havránek (1932) pointed out, generally speaking, it is easier to form words derived from foreign terms than from artificially created native terms.

5.1. Types of Czech term formation

As with the common vocabulary, it is (or has been) mainly affixation that is represented in Czech (Slavic) term formation; however, composition and the formation of multi-word terms represent a generally higher proportion than in the common language. Multi-word terms are largely represented in the terminologies, e.g., in Slovak up to 77% (cf. Masár 2000: 35). According to the findings of statistical investigations into Czech terminology (Těšitelová 1999: 1549), one-word denominations comprise about 50% of

all terms, 35% of which are of foreign origin, multi-word terms (of the type N+A/A+N, N+N, rarely Adv+A) comprise about 39% in the natural sciences and 34% in the humanities.

As has already been shown in section 4.2 where we refer to examples of the terminologies in various languages, the word-formation types and structures of terms are diverse and specific according to the phenomena named, sometimes dependent on the respective discipline and its word-formation traditions. Two characteristic features of present-day Czech term formation can be observed (the examples will be mostly taken from medical terminology, see also Bozděchová 2009):

a) The use of sets of word-formation affixes

There is a preference for suffixes in deriving terminological names of certain categories (cf. also Masár 2000), e.g., substances, tools, etc. (Cz. *-dlo*: *rozpouštědlo* ‘solvent, dissolving agent’ ← *rozpouštět* ‘to (dis-)solve’, *chapadlo* ‘tentacle’ ← *chápat* obsolete in the meaning ‘to grasp’), abstract nouns (Cz. *-ace*: *personifikace* ‘personification’, *proliferace* ‘proliferation’), relational adjectives (Cz. *-ní*: *krevní (oběh)* ‘blood (circulation)’, *antivirální* ‘antiviral’), (metaphoric) diminutives (Cz. *člunek* ‘weaver’s shuttle; lit. small boat’, *stolička* ‘molar; lit. stool’).

Derivatives with negative or privative meaning are also significant, especially those formed with the international element *non-* (and its domestic equivalents in the individual languages, in Czech *ne-*; see also article 79 on negation in the Slavic and Germanic languages) or further international elements: *i-/in-*, *a-/an-*, *de-/dez-*, etc. Lexical negation fulfills a predominantly intellectualizing function and thereby strengthens terminological dichotomies of the type “A vs. non-A” (see Lotko 1973). For terminology, negative prefixes (morphemes) are also suitable because they usually narrow down the semantic spectrum of the derived lexeme, thus changing a polysemous word, for example, into a monosemous one, cf. Cz. *kov* → *nekov* ‘metal – non-metal’, and derivatives based on loans such as Cz. *devizový* → *bezdevizový* ‘with foreign exchange; lit. foreign exchange-REL.ADJ – without foreign exchange’, *cyklóna* → *anticyklóna* ‘cyclone – anticyclone’, *harmonie* → *disharmonie* ‘harmony – disharmony’, etc.

b) The activity of composition and the formation of multi-word terms

As has been shown by Wiese (1999: 1279) for German medical terminology, English has a growing impact also on this field. Besides calques there are numerous direct loans of complex terms such as *AIDS-related complex*, *Slow virus disease*, *Pacemaker-Twiddler-Syndrom*, etc. According to Šlosar (1999: 78 f.), composition plays a more important role in contemporary Czech than it did in the past, especially in the development of terminological systems. Word-formation devices are semantically specified thanks to a systematic approach to term formation, which, at the same time, is a reliable guide to the normalization of terminology.

Determinative compounds in contemporary Czech terminology are comparatively rare, cf. loans like *termoreceptor* ‘thermoreceptor’ and newer calques (without a linking vowel) such as *Elektra-komplex* ‘Electra-complex’, *grampozitivní/gramnegativní* ‘Gram-positive/Gram-negative’. The traditional models of Czech compounds are also enriched by international models consisting of graphic abbreviations and (mathematical) symbols and a word, e.g., *G-algebra*, *16 α-hydroxylace* ‘16 α-hydroxylation’, *virus LPP-1*, *receptor IL-4*, etc.

In the present-day terminological system there is a tendency towards multiverbation, i.e. the formation of multi-word terms (*paměťové buňky* ‘memory cells; lit. memory-REL.ADJ cells’, *vodní tryskový skalpel* ‘hydrojet scalpel, water jet scalpel; lit. water-REL.ADJ jet-REL.ADJ scalpel’, *trvale udržitelný rozvoj* ‘sustainable development; lit. constantly sustainable development’). The formation of multi-word terms is more active than compounding, which either corresponds to the structure of the adopted international terms (see the examples above) or is influenced by the linguistic peculiarities of Czech denomination; cf., for instance, English compound terms containing proper names and the correspondent Czech multi-word terms containing deonymic possessive adjectives: E. *Calmette-Guérin bacillus* – Cz. *Calmetův-Guerinův bacil*, E. *Parkinson disease* – Cz. *Parkinsonova choroba*, or genitives (in foreign names in *-i* and *-e* = adjectival genitive forms), e.g., E. *Corti membrane* – Cz. *Cortího membrána*; in some cases there are, however, variants: Cz. *Basedowova nemoc* and (more rarely) *nemoc Basedow* – E. *Basedow's disease* (*Grave's disease*).

Some terms which name complex and specific referents can have the character of descriptive multi-word denominations and essentially represent a shortened definition of the named referent (typically in sciences), e.g., E. *loss of bone density* – Cz. *ztráta hustoty kostí* lit. ‘loss density-GEN bones-GEN’, E. *wobble base pairing* – Cz. *kolísavé párování bázi* lit. ‘wobbling (adj.) pairing (noun) bases-GEN’.

Specialized communication, compared to everyday communication, also uses abbreviations to a greater degree, mainly initial abbreviations (e.g., *DNA*, *DVD*, *PVC*).

A specific type of terminologization (and motivation) is the formation of eponymous names, which are mostly based on the names of real persons (most often scientists who were the first to describe or discover the phenomenon in question) and geographical names (as a rule representing the location or an event connected with the named phenomenon). The essence of eponym creation is depropriation. They are used, for instance, in some medical branches, such as clinical names of diseases, syndromes, etc. (see Bozděchová 2009), cf. E. and Cz. *joule*, Cz. *rentgen* ‘X-ray apparatus’, from G. *Röntgen*.

In practice, mainly in the interest of normalization of terminology, terms are frequently formed according to rules agreed on in advance, and the appropriate vocabulary is collectively laid down through normalization (for instance, by ISO – International Organization for Standardization, or FCAT – Federative Committee on Anatomical Terminology). In this way, appropriate word families (see also section 4.2), expressing a mutual connection between related concepts, are created. The systematic nature, the validity and the reproducibility of terms is reflected in nomenclatures which arise within the framework of some terminologies (anatomical or clinical nomenclature in medicine, etc.); cf., e.g., Cz. *žila* ‘vein’ with co-hyponyms of the following types:

A+N(*žila*): *královská žila* ‘basilic vein, lat. vena basilica’; as can be seen by the literal meaning ‘king-REL.ADJ vein’, Czech adapted the false etymology (possibly in analogy to G. *Königsvene*, cf. also Russ. *carskaja vena* lit. ‘tsar-REL.ADJ vein’) which associated *basilica* not with Arab. *al-baslik* ‘inner, internal’, but Greek *basileus* ‘king’;

A+A+N(*žila*): *velká skrytá žila* ‘great saphenous vein’ (in the Czech term, *saphenous* is translated: ‘hidden’), *hřbetní lopatková žila* ‘dorsal scapular vein’;

N(*žila*)+(A-GEN)+N-GEN: *žila blanitého hlemýžďe* ‘vein of the cochlear aqueduct’.

Another complex of multi-word terms is based on the structure A+N, with A being the relational adjective of *žila*, e.g., *žilní chlopeč* ‘venous valve’.

Multi-word nomenclature names may preserve the Latin word order, e.g., N+A, N+A+A, etc., which emphasizes the species-differentiating feature, cf. Lat. *plexus venosus* – Cz. *pleteň žilní* ‘venous plexus’, Lat. *Felis silvestris* – Cz. *kočka divoká* ‘wild cat’, etc. However, numerous Czech collocations show a reversed word order: A+N, A+A+N, etc. (cf. Cz. *ptačí chřipka* – Lat. *influenza aviaria* ‘bird flu’, *hluboká stehenní tepna* – *arteria profunda femoris* ‘deep artery of thigh’).

Increasingly, it has been shown that from the functional point of view, unified international nomenclatures prove to be most suitable as they ensure precision and facilitate the work of scientists.

5.2. Dynamisms of word-formation in technical languages

From its very beginning, terminology has aimed at internationalization; at present this tendency has become especially evident. As a result of this tendency and of contemporary globalization, a further characteristic feature of the vocabulary of specialized texts (along with terminology) is a growing share of foreign and hybrid words, including the adoption of the motivation of foreign terms, for example, in Czech: *hardware*, *monopolizace procesoru* ‘processor monopolization’, *voucher*, *eurokonto* ‘euro-account’, *firemní know-how* ‘company know-how; lit. company-REL.ADJ know-how’, *politainment*, *entertainizace* ‘entertainization’, *dietologie* ‘dietology’, etc.

Depending on the area of specialization, new terms are derived to a greater or lesser degree from Latin and Greek, more recently also from English. Many nomenclatures are traditionally based on Latin models, especially in the natural sciences (see section 5.1). Terminological anglicisms are adopted in less traditional, newer and more modern fields (ecology, management, alternative medicine); this is similar to what happens with internationalisms in most European languages (Gester 2001; Waszakowa 2003, see also article 96 on foreign word-formation in Polish). New borrowed terms are frequently marked by their idiomaticity/figurativeness (e.g., *playstation*, *hot money*, *sleeve note* ‘information on the cover of a record or CD’). Older terminological idioms adopted from foreign languages often have an equivalent (mostly a loan translation) in domestic terminology, cf. Lat. *dens sapientiae* – Cz. *zub moudrosti* and Pol. *ząb mądrości* both ‘wisdom tooth; lit. tooth wisdom-GEN’ as in F. *dent de sagesse*, G. *Weisheitszahn* (compound lit. ‘wisdom-tooth’); Lat. *Via Lactea* – Cz. *Mléčná dráha* ‘Milky Way; lit. milk-REL.ADJ way’, Pol. *Droga Mleczna* lit. ‘way milk-REL.ADJ’ as in F. *voie lactée*, G. *Milchstraße* (compound), etc.

International terms are used mainly in (international) specialized communication; at the same time, their influence helps to create a national terminology (and its nomenclatures) analogically to other languages, see, e.g., the international prefixes and suffixes of terms or the similarly specialized formation of compounds, cf. Cz. *anemie* ‘anaemia’, *leukemie* ‘leukaemia’, *dyslexie* ‘dyslexia’, *dysgrafie* ‘dysgraphia’, *astrologie* ‘astrology’, *urologie* ‘urology’, *hydrofobie* ‘hydrophobia’, *hydrocentrála* ‘hydroelectric power station’, *hydrodynamický* ‘hydrodynamic’, *hydrostatický* ‘hydrostatic’, *kardiostimulátor* ‘cardiostimulator, pacemaker’, etc. (The term “neoclassical word-formation” or “neoclassical composition” is not common in Bohemistic studies, but can be found in Czech works on Romance languages.) Internationalization is also characteristic of multi-word terms (see above).

A typical phenomenon of modern international terminologies (especially in the sciences) is the combination of elements of general language with artificial languages; use is made of specialized formal non-lexical means, e.g., expressions on the borderline between words and patterns, schemes (*CD8+ lymfocyty* ‘CD8+ lymphocytes’, *Fc epsilon RII*, *C++ builder*). Their use leads to the creation of “mixed” texts, because they contain explicitly “artificial” elements.

These new specialized foreign terms, predominantly of English origin, or terms created by analogy with English models, are beginning to cause changes in some typologically characteristic features of Slavic languages, e.g., principles of attributive determination, agreement of the dependent adjective, gender differentiation, etc. Compare, e.g., *CT vyšetření* ‘CT examination’: The international abbreviation *CT* as a modifier lacks any case and agreement marking, whereas the constituents of Cz. *computerová tomografie* ‘computer tomography’ are marked as feminine (the relational adjective *computerová* agrees with the fem. noun in *-ie*). At the same time, the use of *computerová tomografie* as modifier of *vyšetření* ‘examination’ would only be possible with a prepositional case form: *vyšetření pomocí computerové tomografie* lit. ‘examination by help of computer-REL.ADJ-GEN tomography-GEN’. (The colloquial variant *CéTečko* or *cétěčko* ‘CT’, derived from the abbreviation *CT*, is inflectable and thus allows a shorter modification: *vyšetření cetěčkem* ‘CT examination; lit. examination CT(coll.)-INSTR’.)

Similar examples are loans and (hybrid) calques such as Cz. *video-EEG*, *NK-buňky* ‘N(atural) K(iller) cells’, *non-REM-spánek* ‘non-R(apid) E(ye) M(ovement) sleep’, and also *cross-circulation technika* ‘cross-circulation technique’, *minimal invasive chirurgie* ‘minimal invasive surgery’ with *minimal invasive* as indeclinable modifier (instead of *minimálně* (adv.) *invazivní* (adj.) *chirurgie*’); E. *key-hole surgery* (G. *Schlüssellochchirurgie*) has been translated as *operace klíčovou dírkou* lit. ‘surgery key-REL.ADJ-INSTR hole-INSTR’.

Abbreviated/clipped names are frequently created (e.g., in Czech *sono* ← *sonografické vyšetření* ‘sonograph examination’), based on foreign terminology. These are usually professionalisms and slang names. Unlike real terms, they do not belong to the standard component of the vocabulary, their domain being spoken specialized discourse, in which they hold the same validity as terms. Real and slang terms can in fact be mutually complementary (by no means alternative), because many slang terms lack a standard-language equivalent (or if so, the equivalent may be clumsy, artificial or unused). The boundaries between slang terms and professionalisms are not rigid; transitions between these two types of specialized names can go both ways.

6. Conclusion

The formation of terms inspired by the development of cognitive processes and the need for specialized communication constitutes a deliberate effort by expert scholars, ideally in cooperation with linguists. Therefore, term formation differs from word-formation in common vocabulary chiefly by a higher consistency in the application of particular types of designation, including word-formation models, and by the binding nature of terms once they have been agreed upon and become standardized (cf. section 5.1). Every terminology is connected with the development in the field concerned. Its logical arrangement as a whole should thus be understood historically and functionally.

In contemporary term formation, the main tendencies are:

- a) the growth in productivity of a number of models on which the denomination of the basic categories rests;
- b) the increased regularity of word-formation models; and
- c) the effort to specialize word-formation devices for expressing certain word-formation (conceptual) meanings.

Alongside the actual creation of terms (based on word-formation), increasing use is being made of further sources: the adoption of foreign terms, metaphorization and de-proprialization (formation of eponyms). As a result of the growth of terminologization of foreign loans (predominantly English) and of internationalization, most of the present-day languages display an increased international character in their professional communication.

7. References

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