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# On One of the Boundaries of the Constituent Conception of Grammar

LADISLAV NEBESKÝ

It is here demonstrated how the structure of one type of simple mathematical expressions conspicuously goes beyond the boundaries of the constituent conception of grammar.

In many mathematical works containing the terms "language" and "grammar", the former is used to mean a set of strings over a finite set of symbols, and the latter to mean some recursive medium capable of enumerating the given set of strings (i.e. "language"). The terms "language" and "grammar" originate of course in linguistics, where their content is much more complex. Sentences of natural language have their own structure which is motivated by the manner in which communication by sentences may be realized. Chomsky [1] requires of the grammar of a natural language not only that it enumerate the set of its sentences, but also that it describe the structure of each sentence (cf. Nebeský [4]). Much of the complexity of the terms "language" and "grammar" remains to them even outside the framework of linguistics proper — in the study of artificial languages of communication, and thus in languages of communication generally; cf. Curry [2].

An expanded method of describing the structure of sentences is their gradual break-down into immediate constituents. Sentences then have a hierarchical structure which is often represented, for example, by the use of rooted tree. The principle of immediate constituents lies behind. Chomsky's phrase grammars, but also behind various other grammatical systems; cf. Postal [5]. Not even transformational grammars give up the constituents principle; they merely supplement it. And Curry's [2] more general conception of grammar also arises out of the constituents principle.

However, in natural languages there exist grammatical phrases of arbitrary length in which there is no satisfactory motivation for the inner constituent hierarchization. This applies at least to some types of coordinational constructions; cf. Dik [3]. They have their analogy in arithmetical expressions of the type

$$p + q + r + s + t .$$

Such expressions may be of any length and there is no reason for (any possible means of) additional bracketing, i.e. hierarchization of their constituents.

The core of these notes is the demonstration of another type of mathematical expressions, whose structure – in the author's opinion – goes even more markedly beyond the constituents conception of grammar. We have in mind expression of the type

$$a > b\,, \tag{1}$$

$$c \leqq d < e\,, \tag{2}$$

$$f < g \leqq h \leqq i \tag{3}$$

in which the letters stand for numbers. Expressions of this type are quite common in the language of mathematical practice. And their length is in no way restricted.

If we look more closely at expressions (1), (2), and (3), we shall see that they have the nature of sentences. The same character is also shared by some of their subexpressions, namely

$$c \leqq d\,,\quad d < e\,,\quad f < g\,,\quad g \leqq h\,,\quad h \leqq i\,, \tag{4}$$

$$f < g \leqq h\,,\quad g \leqq h \leqq i\,. \tag{5}$$

A sentence which contains no further sentence as its own subexpression will be called an elementary sentence. Sentence (1) and sentences (4) are clearly elementary. Each is made up of two noun phrases (i.e. the names of numbers) and of a symbol, which, together with Curry [2], we may call an infix which is a two-argument functor.

Sentence (1) contains a single elementary sentence (itself), sentence (2) contains two elementary sentences, and sentence (3) contains three. It may be stated of each of the sentences of this type that all the elementary sentences contained in it are entirely equivalent as to their standing; no hierarchization of the elementary sentences is sufficiently motivated. At the same time, however, any two adjacent elementary sentences in each sentence of this type are *incidental* (their intersection is a noun-phrase). Thus not only are elementary sentences not hierarchized in higher and higher constituents, but they do not even behave as immediate constituents to one another.

Thus the grammatical structure of sentences (2), (3) and others recall a chain with elementary sentences in the role of equivalent interlocking links.

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VÝTAH

## O jedné z mezí složkové koncepce gramatiky

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Je ukázáno, jak struktura jednoho typu jednoduchých matematických výrazů (takových, jako jsou (2), (3) apod.) nápadně přesahuje meze složkové koncepce gramatiky.

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