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Lieve JOOKEN, Peter LAUWERS,
Toon VAN HAL and Raf VAN ROOY

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THROUGH THE EYES OF GRAMMAR: RICHARD SALTER STORRS'S (1830-1884) SENTENCE-MAPS

Nicolas MAZZIOTTA
(Université de Liège)

Abstract: In the nineteenth century, the teaching of grammar in the United States increasingly made use of diagrams to represent the structure of a sentence. Diagrams represent syntactic relations by means of discrete graphical elements ("reifications") or by specific arrangements thereof on the bi-dimensional plane ("configurations"). Richard Salter Storrs, who was a teacher in a school for deaf-mute pupils, proposed a diagrammatic system favoring reification over configuration in order to make syntactic relations visible. Such a choice, uncommon in the U.S. at that time, has now become the most common and straightforward way of representing labeled dependencies.

Introduction

This paper investigates the topic of "sentence diagrams" which were produced by grammarians in the United States in the nineteenth century. Around the beginning of the second half of the nineteenth century, American grammarians began to switch from a word-based conception of grammar, focusing on morphology, to a clause-based conception, with a stronger focus on the relations between words (Linn 2006: 77). Fig. 1a is a sample of such a diagram drawn by Stephen W. Clark (1810-1901) in 1870, putting to use the system he had developed in Clark (1847). Fig. 1b and Fig. 1c are samples of other systems available at that time (see Brittain 1973 for a review of most of the systems). Although it would require a careful examination of the graphical elements of those diagrams to establish the impact of Clark's contribution (Mazziotta 2020b), it appears that the rationales of his diagrams clearly inspired other authors, such as Alonzo Reed (d. 1899) and Brainerd Kellog (1834-1920) (Fig. 2c).

Building on previous works of mine (Mazziotta 2019; 2020b), I intend to explain how visual means were used to express similar syntactic analyses in the sentence diagrams of the kind designed by Richard Salter Storrs (1830-1884). From 1853 until the end of his life, Storrs was a renowned

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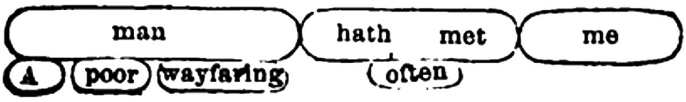

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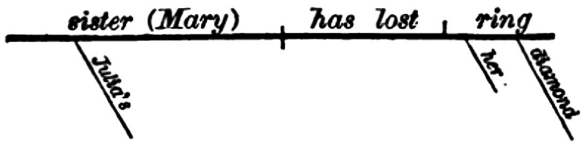

Fig. 1 — Diagramming systems:
(a) Clark (1870: 196); (b) Burt (1869 [1868]: 275);
(c) Reed – Kellogg (1880 [1876]: 70).

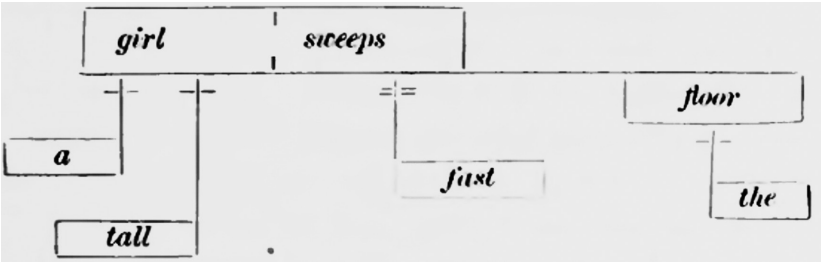

Fig. 2 — Example of Storrs's sentence-map (Storrs 1881: 149).

teacher at the deaf-mute Asylum in Hartford (Connecticut), where he taught English to deaf-mute students (Job 1885: 9). His method consisted in representing the logical structure of the sentence in a visual way. Since his students could not hear grammatical explanations, he drew diagrams to make grammar visible. Fig. 2 is an example of the kind of diagram put to use by Storrs, which he calls a "sentence-map".

Storrs mainly used his system in the classroom, and combined diagrams with sign language (a feature which I will not investigate in this paper). Porter (1861) gave a concise presentation of its rationales in the *American Annals of the Deaf and the Dumb*, and Storrs himself explained his conventions in a series of three articles entitled "Methods of Deaf-mute Teaching", published in the same journal (Storrs 1880a; 1880b; 1881).

A more comprehensive textbook relying on the same basic principles was published, with permission, by Francis Andrew March (1825-1911): *Parser and Analyzer for Beginners* (1870 [1869]; see Brittain 1973: 60-67 for a criticism of March's diagrams). I will discuss diagrams drawn by Storrs as well as some drawn by March, but I will not systematically review the differences between them.

Clark had already developed his system (Fig. 1a) in his *Practical Grammar* (Clark 1847) by the time Storrs presented his conventions. The members of the community of Hartford were well aware of that (Porter 1861: 42-43). Storrs himself claimed that he developed his system independently, and that it had been shaped by the specific necessity of his classrooms:

> This general principle of visual illustration of language construction has had numerous and ingenious previous applications, and has been made the basis of several text-books; and I claim no other originality for the device I am describing than that it was wholly and independently wrought out by me in my earliest experience as a deaf-mute teacher, under the stress of such a teacher's necessity, and that it has some important advantages over any system with which I have subsequently become acquainted. (Storrs 1880a: 117)

The sections of this paper are organized as follows. In Section 1, I present the theoretical foundations of my analysis: the notions of *reification* and *configuration*, which refer to the ways in which conceptual units can be represented on a graphical plane. Section 2 deals with the means of representing syntactic relations in Storrs's system, by means of what I call *reified* relations. Section 3 elaborates on the previous one in order to study means of expressing the type of syntactic relations by the use of *labels*. Section 4 focuses on the modeling of function words (prepositions and conjunctions). These sections will also show that many of Storrs's conventions and concerns are still of prominent importance in dependency-based approaches (Tesnière 2015 [1959]; Mel'čuk 1988). That point is highlighted in the conclusion.

1. *Reification and Configuration*

An intuitive comparison between Fig. 2 and the diagrams in Fig. 1 leads to the rough conclusion that words are spatially arranged on a two-dimensional plane with some supplementary devices such as strokes, bubbles, boxes and other symbols. In order to provide the necessary theoretical framework for a study of syntactic diagrams of all kinds (from the first diagrams in the nineteenth century to ICA and dependency

diagrams of the twenty-first century), Mazziotta – Kahane (2017) and Mazziotta (2019) propose making a strong distinction between two means of representing elements of syntactic analyses: *reification* and *configuration*.

Reification refers to discrete *graphical entities* (Groupe μ 1992); i.e. graphical units that represent conceptual elements of the analysis (words, relations, groups, etc.) and that can be perceived as independent from the rest of the diagram. For instance, if the conceptual units to be reified are words, they can be reified as in Fig. 1a, by means of bubbles. In Fig. 2, boxes perform the same function. Such entities *reify* the conceptual unit of *word*. In Fig. 1a, even if bubbles touch each other, thus merging their boundaries, a trained viewer can still focus on independent bubbles and consider them as discrete entities.

However, entities are not necessarily minimal. In Clark's diagrams, words are actually reified by complex entities that can be called *labeled bubbles*, consisting of a bubble arranged with an autonymic written form of the word. Thus, in order to achieve a better description, one needs the concept of *configuration*.

Configuration refers to meaningful arrangements of graphical entities. The horizontal or vertical arrangement of the bubbles in Fig. 1a expresses grammatical relations. The bubble containing the word *man*, for instance, is placed to the left of the bubble containing the words *hath met*, which intends to represent that *man* is the subject of *hath met*. There is no reification of the subject-predicate relation which is expressed in its entirety by means of the relative positioning of the entities that reify words. Reification and configuration are combined in order to build complex entities that are conceived as units. For instance, in Clark's system, the combination of an autonymic written form and the bubble surrounding it is the labeled bubble that actually corresponds to the concept of *word* in syntactic analysis.

Configurational means and reification are two alternative ways of visualizing units and structures. Some diagrammatic systems favor minimalistic approaches, such as Clark's (Mazziotta 2016). In such cases, configurational means are prominent. Other systems favor entities that reify conceptual units such as grammatical relations, thus resulting in diagrams containing more entities than the former. Storrs's diagrams are clearly representatives of the second kind.

2. *Reified Relations*

In the first paper of his series, Storrs explains why he thinks that diagrams are suitable devices for teaching grammar:

> [A diagram] does, however, as has been seen, truly and really ***represent thought***, and if it is kept vitalized in the pupil's mind by constant reference to his own conscious thought, it will be found helpful, only helpful, and that exceedingly. The sentence-map may be used advantageously under either method of unfolding language to the deaf-mute — the scientific or the natural; but in addition to its most general value, as [118] visually illustrating **thought-relations**, it has also for the scientific method further and special advantages. It is a characteristic of this method that it seeks to **give great individuality to each element** of the sentence as successively developed, affirming for each such element its own specific office and fundamental necessity. Any device, therefore, which enables the teacher to **isolate each such element, and hold it apart by itself**, while still exhibiting it in a recognized relation to the rest of the sentence, must be of very special advantage to such a method. (Storrs 1880a: 117-118, my emphasis)

Storrs argues that diagrams are tools that facilitate the representation of thoughts (analogously to sign language in his approach). In his conception, syntactic relations are individual "thought-relations" that can be described and categorized individually. Storrs's pedagogical concerns are prominent, but he is well aware that analytical procedures are also profitable to scientific investigation. The main consequence of this stance is that most grammatical relations are reified in the diagrams. This is a strong element of contrast with other contemporary systems. Again, I will illustrate this by means of a comparison between Clark's system (Fig. 1a) and Storrs's (Fig. 2). As has already been mentioned, Clark's minimalist system expresses relations by configurational means. Clark's "adjuncts", such as determiners, adjectives, adverbs and equivalent PPs, are placed underneath the bubble that reifies the word they complement. This is illustrated in Fig. 1a: *a*, *poor* and *wayfaring* are placed underneath *man*. Similarly, the object (*me*) of the transitive verb is simply placed to the right of it (*hath met*). In Storrs's system, most relations are reified by a stroke occurring in between boxes: in Fig. 2, a horizontal stroke corresponding to the "objective relation" connects the object *floor* to its right with the verb *sweeps*, and vertical strokes connect adjectives and adverbs to the words they complement. This basic principle can give rise to redundancy, since the relative positions of the boxes would already be sufficient to distinguish between different kinds of relations.

The diagrams in Fig. 2 clearly reveal that reification of syntactic relations was far from being a generalized practice in the United States at that time. By contrast, European scholars, more precisely scholars active in Germany and Eastern Europe, tended to make use of reified relations (Coseriu 1980; Osborne 2020; Imrényi 2020) in their diagrams. Hence, their diagrams share important similarities with modern dependency trees and Tesnière's "stemmas" (Tesnière 2015 [1959]; see also Swiggers 1994 and Mazziotta 2019); see for instance the diagram in Fig. 3.

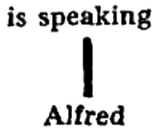

Fig. 3 — Reification of the verb-subject connection (Tesnière 2015 [1959]: Chapter 52, §7).

The reification of most syntactic relations highlights foundational features of the analysis: words are linked *directly* by *binary* and *directed* relations. Such features are typical of dependency-based frameworks (Mazziotta – Kahane 2017).

As the next section will show, Storrs's diagrams employ specific graphical devices to distinguish between different types of relations, similarly to modern diagrams, which use numbers or grammatical terms as labels applied to reified syntactic relations in order to distinguish between different types.

3. *Labeled Entities*

In Section 1, I explained that the combination of a bubble and a written word can be described as a labeled bubble, the word performing the role of a label vis-à-vis the bubble. By *label*, I mean an entity that makes a statement about another entity in order to build a complex sign, i.e. a *superentity*. In my previous example, the written word is a statement about the bubble, meaning "this bubble reifies this word".

By definition, only entities can be labeled by other entities; non-discrete means of expressing the analysis cannot. The consequences of this approach are illustrated by another contrast between Clark's and Storrs's diagrams. The configurational representation of Clark's "adjuncts" in Fig. 1a does not suggest any further classification between the different

types of "adjuncts" that Clark acknowledges in his works (Mazziotta 2016): *a*, *poor* and *wayfaring*, which are "adjectival", use the same graphical conventions as *often*, which is an adverb. Clark could have added additional labels on some of the bubbles, but he did not, and neither did any of the many authors who proposed similar systems. On the contrary, the fact that Storrs reifies relations allows him to easily label the corresponding entities:

> The mode of attaching other modifiers by a vertical line is shown in [some figures]; the single and the double cross lines distinguishing them respectively as adjective and adverbial. (Porter 1861: 46)

Storrs's theoretical apparatus overtly acknowledges several types of "combinations" (the term seems to refer to spatial as well as to grammatical configurations), i.e. syntactic relations:

> The elements, technically stated for brevity, are: the subject and the predicate united in the predicative combination, and expanded respectively by the attributive and objective combinations, including under this last both direct or complimentary and the adverbial or supplementary objects. (Storrs 1880b: 249)

In Fig. 2, the strokes that reify "attributive" relations between nouns and adjectives (e.g. between *girl* and *tall*) are labeled with single perpendicular dashes, whereas the strokes that reify "adverbial" relations (e.g. between *sweeps* and *fast*) are labeled with double dashes.

In the formal apparatus, labels can combine to refine information or to enhance its visibility. Firstly, labels can be cumulative. For instance, in Fig. 4, adverbial complements are labeled with letters that express their

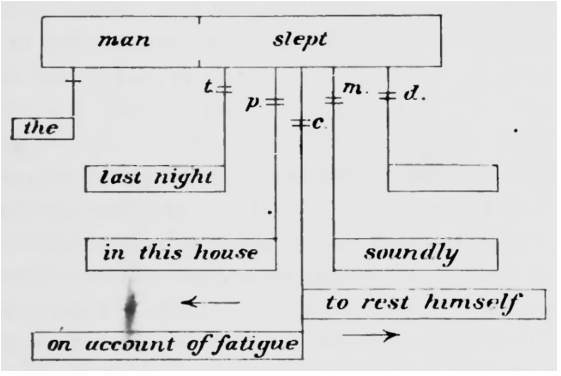

Fig. 4 — Semantic types of adverbial dependents of the verb (Storrs 1881: 155).

semantic subtypes ("t." for "time", "p." for "place", etc.). The arrows at the bottom of the diagrams also serve as labels identifying two different kinds of "causes" ("c."): true cause on the left, and purpose on the right.

Two formal interpretations are possible: either the letter-like labels are additional labels that apply to the same stroke as double dashes, or they are labels *over labels*, i.e. they are precisely attached to the double dashes. In the latter case, letter-like labels are better described as *metalabels*, which actually need other labels in order to be used in a meaningful way, as is the case here.

Secondly, labels are obviously redundant at times. In his textbook, March (1869/1870), who mainly uses Storrs's system, provides a list (with related page numbers) of the special entities used as labels, in a special index entitled "diagrams":

> SIGNS, predicative (|), 18; quasi-predicative (¦), 65, 68, 70, 81; attributive (—), 22, 24; objective (V), 20 ; dative (\ ), 34 ; adverbial (=), 26, 34; words supplied (()), 58. (March 1869/1870: VI)

The entities corresponding to "predicative", "quasi-predicative" and "words supplied" are actually reifications of relations. The other four are labels. The "attributive" and the "adverbial" entities have been mentioned before. Uses of the other two labeling entities, "objective" and "dative" are illustrated in Fig. 5 (see Section 4 on function words).

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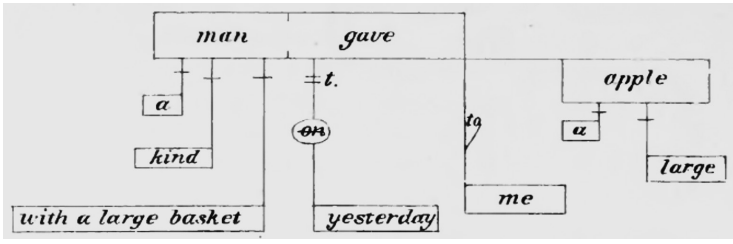

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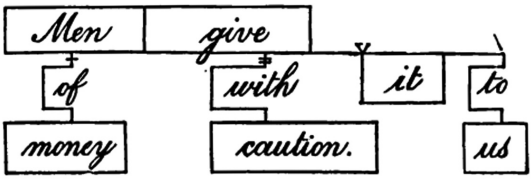


Fig. 5 — (a) Storrs (1881: 156); (b) March (1869/1870: 34).

The use of "V" is redundant: in Fig. 5b, it marks the box that reifies the object *it*, which is placed in a very specific configuration, under a stroke that continues the base stroke underneath the subject and the predicate. March uses this label, whereas Storrs does not (Fig. 5a), but the amount of information provided is exactly the same. The oblique dash marking the dative is placed onto the horizontal line by March (above *to us*), and on the vertical line by Storrs, similar to his positioning of horizontal dashes. Storrs clearly considers a paradigm of labels: horizontal dashes and oblique dashes are placed in a similar position on the vertical strokes that reify the relations.

Again, the practices that have just been described are very close to the ones that can be observed in modern diagrams since (at least) Tesnière. The classical stemma in Fig. 6a and the dependency tree in Fig. 6b are both examples of symbolic or textual labels.

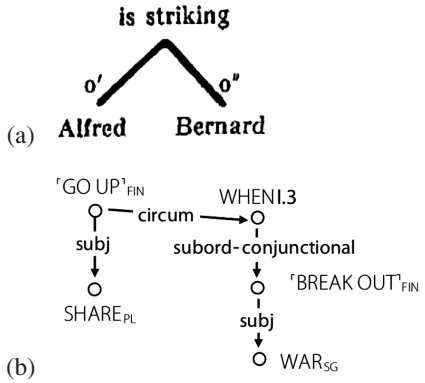


Fig. 6 — Labels in dependency diagrams:
(a) Tesnière (2015 [1959]: Chapter 52, § 9);
(b) Mel'čuk – Iordanskaja (2015: 26).

Fig. 5a contains two intriguing entities which I will discuss in the next section: a crossed out *on* appearing in a bubble (meaning that this word is "understood" although it is not present) over the stroke that reifies the adverbial relation between *gave* and *yesterday*, and the written form *to* next to the stroke that reifies the dative relation. Similarly, Fig. 5b contains prepositions (*of*, *with* and *to*) next to different types of angled strokes.

4. *Function Words*

At Storrs's time, prepositions and conjunctions were sometimes regarded as reifications of the relations between content words. Let us consider the following excerpts and diagrams (Fig. 7) from Clark (1847):

> A Preposition is a word used to express a relation of other words to each other. (Clark 1847: 10)

> It should be remembered that Prepositions connect words by *showing a relation*. Another class of words is used simply to connect words and phrases, similar in construction, and to introduce sentences. Hence, […] a word used to join Words or Phrases, or to introduce a Sentence, is a Conjunction. […] Conjunctions used to introduce Auxiliary Sentences, and some others, constitute also an index or type of the office of the sentence which they introduce. (Clark 1847: 97)

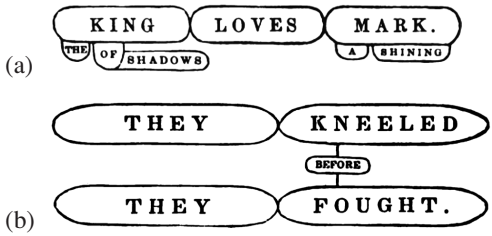


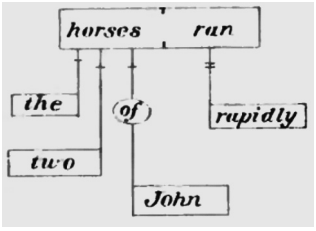
Fig. 7 — Function words as relations:
(a) Preposition as a relation (Clark 1847: 23);
(b) Conjunction as a relation (Clark 1847: 25).

I will not enter into a complete analysis of the conventions used by Clark to integrate function words in his diagrams (see Mazziotta 2016: 317-322). My main point is that function words are not considered as normal words: bubbles that reify prepositions (Fig. 7a, *of*) are attached both vertically and horizontally with regard to other bubbles, and bubbles that reify conjunctions interrupt a stroke that reifies a relation — a rare case in Clark's system (Fig. 7b, *before*). Whereas prepositions continue to be part of the phrases they introduce (from a graphical perspective, they appear on the same horizontal level), conjunctions are completely external to them. Clark even says that they "constitute also an index or type of the office of the sentence which they introduce", i.e. they label the type of relation that is reified by the stroke they interrupt. From a linguistic perspective, function words are considered both as words and as grammatical marks that correspond to various relations between words.

This combination of functions also becomes clear from a graphical perspective: entities corresponding to function words are reifications of both relations and words, and conjunctions are both labels and words.

Let us consider prepositions in Storrs's theory:

> There is, indeed, a variety of this phrase map representation which I have sometimes used, in which the linking preposition is placed between the principal word of the phrase and the word which it modifies, upon the line which connects the two, thus —



[Fig. 8 — Illustration of the position of a preposition in Storrs's diagrams.]

> This has, perhaps, the theoretical advantage of showing more clearly to the eye the real office of the preposition as a linking and relating word; but, upon the whole, I have found the larger weight of advantage to be upon the side of unifying the whole phrase within the rectangle. (Storrs 1881: 153)

Storrs uses three different conventions to represent prepositions in his diagrams: as a label beside a stroke (*to*), in a bubble on the stroke (*of*, *on* in strikethrough) or inside the connected rectangle (cf. the quotation). The end of the last quoted excerpt points towards a conflict between Storrs's theoretical understanding of this word class and what were supposedly his teaching habits (cf. "advantage", which may refer to practical considerations). His follower, March, generalizes one single way of representing prepositions: as can be seen in Fig. 5b, prepositions are placed next to the angle stroke representing the adverbial or adjectival relation. From a formal perspective, such modeling of prepositions could be considered as a means to identify them as labels over a grammatical relation, or, alternatively, suggests that some grammatical relations are actually established between three units rather than two (ternary relations).

The status of function words has always been a common issue in dependency-based approaches, and there still seems to be no consensual solution (Osborne – Gerdes 2019). Several alternatives have been proposed (Kahane – Mazziotta 2015): function words as relations, function words as heads or dependents or function words as third element in a

ternary relation, function words as labels over a relation, covering, in other words, all the possibilities that seem to emerge from interpreting Storrs's apparatus.

Conclusion

There are two ways of representing syntactic relations in diagrams (Section 1): *reification* by discrete graphical entities or *configurational* conventions regarding the relative positioning of the entities. To my knowledge, Storrs's diagrams are the first that have been used in the United States to systematically reify most of the syntactic relations (Section 2). The use of reified relations is a convenient way to make graphical assertions about these relations and to classify them. Such assertions are *labels*, as has been discussed (Section 3).

Diagrams using combinations of reified relations and labels over these relations are common devices in current dependency syntax. Dependency trees are not very different from Storrs's "sentence-maps", except for the (secondary) fact that Storrs uses a symbolic paradigm of labels (different kinds of dashes). Nevertheless, in his *Annotated Bibliography of Publications on Dependency Theory*, Hays (1965) overlooked Storrs: of the grammarians discussed in the present contribution, he only mentions Clark[1] and Reed – Kellogg, just before Tesnière.

Still, one can say that Storrs was almost a dependency grammarian. That also means that he had to tackle common unsolved problems that still remain relevant in dependency frameworks. I have focused on the status of function words (Section 4): prepositions and conjunctions are grammatical tools that constrain the syntactic structure of the sentence. Their presence is compulsory for syntactic relations between content words to exist. Therefore, they can be regarded as governors, as dependent entities or as members of a ternary relation, depending on the theoretical/formal choices made to describe their behaviors.

To my knowledge, Storrs has never been recognized as an early dependency grammarian before. It is true that his diagrams and theoretical concerns are not fully dependency-based (e.g. the subject-predicate relation reminds more of NP + VP). However, his analyses show many similarities with modern dependency theory. There seems to be no obvious traditional route linking Storrs to the well-known pioneers of dependency grammar

[1] For an evaluation of Clark's system as a precursor of dependency theory, see Mazziotta (2020a).

(Imrényi – Mazziotta 2020), but his systematic reification of relations and the use of labels were some of the many secular dependency-based ideas that emerged for the first time in a visual form in Storrs's works.

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