Data Structures for Etymology: 
towards an Etymological Lexical Network

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Abstract  
In this paper, we present a generic analysis of etymological data intended to provide a uniform framework for modeling such information in lexical databases. Based on the explicit reification of etymons and of the links between them, our proposal provides means to state additional constraints for both, as well as a preliminary set of standard descriptors to be used to this end. The model has been extensively tested on a variety of concrete cases extracted from the TLFi (Trésor de la Langue Française informatisé), allowing us to identify further mechanisms (alternatives, multiple links, composition, etc.) needed for etymological data representation. Taking into account the current standardization efforts within ISO committee TC 37/SC 4 to define a specification platform for lexical data (aka LMF, Lexical Markup Framework), we try to show that our proposal could be a possible contribution to this project.

1 Introduction

Lexical data appear in a wide variety of forms. With regard to the lexicographical content, the data may range from basic morpho-syntactic structures (e.g. Morphalou) to important editorial projects that cover multiple levels of synchronic description, such as morphological information, syntactic constructions, sense related information (definitions, examples, usage notes, etc.), but also diachronic information. With regard to the underlying data structures, lexical data range from relatively loosely structured machine readable dictionaries to highly structured lexical databases, primarily intended to be accessed by natural language processing tools or by human users via specific search interfaces.

From a computational point of view, this situation prevented in the past the design of one single data structure that fits all the possible needs. On the other hand, users would benefit from uniform access to similar information across heterogeneous lexical resources. Standardization in lexicography has therefore been subject to strong debates, leading for instance to the Print Dictionary chapter of the TEI (TEI P5, 2005) that tries to combine structured and unstructured views of lexical entries. Some consensus has also been achieved on representation models for highly structured lexical data, in particular within the context of exchangeable NLP lexica (cf. the EAGLES, ISLE/MILE or LMF projects). For diachronic information however, the situation is less advanced: there is no current practice to be considered as a good candidate for a standard. The TEI view on diachronic information, howev-
er, is in fact a loose tagging of some bits of information currently to be found in etymological notes. In practice, even important digitization and encoding projects of national reference dictionaries (e.g. TLF or DWB) did not tackle the difficult issue of structuring diachronic and etymological information present in the original print versions.

Doing so would require two different steps: first, to analyse carefully the linguistic data and to elaborate a model of the structures underlying etymological information; second, to develop a parser able to analyse the source text of etymological notes in current dictionaries and to annotate the data accordingly.

This paper is mainly concerned with the first step: we want to show that it is possible to apply coherent modeling principles to currently unstructured lexicographical information, that is etymological data, as appearing in general language dictionaries with wide lexical coverage. The resulting model, based on a careful analysis of etymological data in the TLF, is anchored in the wider context of Lexical Markup Framework (LMF), an ISO initiative intending to elaborate standardizable, while still customizable, data models for synchronic lexical databases. Our model is based on the overall hypothesis that etymological data might be thought of as a lexical network, i.e. a graph, whose nodes are lexical units (located in space and time) and whose arcs are typed etymological relations. Based on this assumption, we propose a data structure which tries to remain as compatible as possible with the data structures so far developed for synchronic lexical entries.

2 Etymology as a part of diachronics

For the current purpose, we restrict ourselves to general language dictionaries, i.e. dictionaries following *grosso modo* semasiological lexicographical principles such as, for instance, accounted for by the TEI chapter on print dictionaries (TEI P5). In no case do we intend to address here the issue of etymological dictionaries whose both macro- and microstructure rely on different organization principles, such as the *Französisches Etymologisches Wörterbuch* (FEW, cf. Buchi 1996). We consider diachronic information along the lines of its modern, large acceptation as "a word’s biography" (Baldinger, 1959). As such, it covers both etymological information in a restricted sense and historical notes: the first inform about origin and primitive significance of a lexeme in its source language, whereas the second inform about successive changes of form and meaning in the target language. Such diachronic information in a large sense can for instance be found in the OED, in the DWB or in the TLF.

As part of diachronic information, etymology properly speaking is concerned with the origin and evolution of the lexeme before it entered into the target language. It is generally presented as a set of one or more etymons, associated with an etymological class (inheritance, loan word, word generation). Note that etymons in this sense are related to only the oldest sense, but not to all individual senses in the modern stage of the considered language. In the example of Figure 1 (TLF), the etymon for the oldest sense of *pamplemousse* (sense 1a) is the Dutch *pompelmoes*. The etymological class is therefore the class of loan words. The etymon itself is a compound of *pompel* and *limoes*. Additionally to core information about etymons and etymological classes, etymological notes may provide bibliographical
references for etymological hypotheses and/or discuss other issues such as phonetic evolution, concurrent hypotheses, confidence statements, secondary etymons and motivations (popular etymology), testimony of etymons or intermediate evolution stages.

Figure 1. Etymological information for the entry pamplemousse (TLF)

3 A data model for etymological information

In the following sections, we use the modeling principles of the LMF project, developed within the ISO committee TC 37/SC 4 (Francopoulo & Monte, 2005).

Figure 2. The LMF metamodel and the etymological extension

Those principles rely on Ide & Romary (2004), Bunt & Romary (2004) and Salmon-Alt et al. (2005), and allow a user to combine a metamodel, which informs the main components of the data structure with data categories, corresponding to elementary information units attached to the nodes of the metamodel. In the case of lexical structures, a metamodel is itself the combination of a core metamodel (a fairly simple structure organizing a lexical database into lexical entries, described as a couple of a form and a hierarchy of senses) and lexical extensions, seen as additional modules attached to the core metamodel (Figure 2). In our case, we will consider more in detail the kind of extensions needed for etymological information. In particular, we will show how lexicographical data structures initially proposed for synchronic databases might be adapted to outline the structure of etymological information in dictionary entries, while reusing existing components and data categories, and keeping the changes as minimal as possible. The idea behind this is to ensure a maximal
compatibility with external LMF compliant databases, especially in order to avoid redundan-

3.1 Etymology

We start with the assumption that the fundamental function of etymological notes is to
assign (at least) one etymon to the lexical unit under consideration, and to provide informa-
tion about the type of the relation holding between them. Therefore, we propose a basic lexi-
cal extension for etymological notes (Etymology) that accounts for the description of ety-
mons and links. Under the assumption that lexical entries are purely polysemous (do not
contain homonyms), the Etymology component occurs at most once for a given lexical entry.
It is further structured by means of Etymon and Etymological Link components.

3.2 Etymons

Etymons are basically words, located in time and space, which stand in a particular
diachronic relation to other words. As such, it seems convenient to describe etymons in the
same way as lexical entries. Hence, in terms of LMF, they might be characterized by any
existing data category used in the description of synchronic lexical entries. Among those
basic descriptors, language, orthography, pronunciation, gloss, part-of-speech and inflec-
tional information are able to capture most of the linguistic features associated with etymons
in current dictionaries.

However, a careful analysis of data as such in Figure 3 (TLF) points to some differences
to be taken into account:

• The coverage of the language attribute should be extended to more fine-grained geo-
graphical and diachronic variants than those currently available from the ISO 639 series.
Figure 3 illustrates this for languages such as a. fr. ("ancien français"), gaulois, picard or
a.b.frq. ("ancien bas francique").

• As opposed to the description of synchronous lexical data, etymons might be reconstruc-
ted, or hypothesized word forms. Those are graphically indicated by an asterisk (cf. *werra).
Moreover, the information about the word form might be totally unknown, as for the etymon
of Latin ENCAUSTUM (Figure 3). As a consequence for the data model, we propose to
encode the status of word forms by a newly defined data category testimony with an appro-
priate range of values.

• In case of composition (cf. pamplemousse), it should be possible to refer to a set of
(possibly embedded) etymons, one for each part of the compound, and to factorize common
descriptors, such as language.

• As opposed to composition, derivation (cf ronfler) rises the question of the lexicograph-
ical status of derivational affixes and non autonomous roots: the hypothesis of etymons as
lexical entries leads to the assumption that those morphemes are to be treated as lexical
objects in the same way as autonomous lexical entries. This assumption is in line with
indepth theoretical work on derivational morphology (Corbin 1987). Practically, the TLF
 treats derivational prefixes and suffixes as separate lexical entries.
### 3.3 Etymological links

**Etymological Link** components stand for etymological relations between linguistic units. They might be thought of as directed and typed arcs between etymons, i.e. lexical entries. A link is basically characterized by two elementary data categories: an *etymological target* (the synchronic lexical unit) and an *etymological source* (the etymon). Both point to structures similar to lexical entries. In short, the linguistic material is mainly recovered from the current dictionary, and corresponds either to lexical entries of the dictionary or to etymological units as described in the previous section. However, in principle, it should be possible to point also to existing external resources, e.g. for another language or another time span.

Etymological links are typed by an *etymological class* (loan word, inheritance, word generation). Additionally, they may bear information about the bibliographical reference, confidence level or other notes. This simple data model accounts for different cases of etymological structures as found in current dictionaries, including etymological chains, multiple etymons (standing in conjunctive or disjunctive reading), and multiple evolutions of a same etymon.

- *Etymological chains* are built from lexical units standing in direct etymological filiation relations (cf. *amour*, *ameur*, *AMOR* in Figure 3). Sometimes, etymological information in dictionaries is limited to the direct etymon, i.e. the most recent item of the chain, fulfilling the conditions for being considered as an etymon (for instance, the Latin word for French inheritants). However, dictionaries contain often more than one etymon, trying to provide also the etymon of the etymon and so on. Etymological chains can be easily represented by encoding more than one etymon and link under a same lexical entry.

- *Multiple etymons* may occur in a disjunctive reading. This is frequently the case for more than one hypotheses about etymological filiation. As an example, the French *gleys* has been related in the literature alternatively to the Russian *glej* or the Ukrainian *hlej*. In case there is a preferred solution, the alternative links might be weighted with confidence scores or attributed to scientific authority (bibliographic sources).

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### Table: Some examples of etymological data (TLF)

<table>
<thead>
<tr>
<th>MODERN FRENCH</th>
<th>DIRECT ETYMON</th>
<th>SECONDARY ETYMON</th>
</tr>
</thead>
<tbody>
<tr>
<td>guerre</td>
<td>a.b. freq. *worn</td>
<td></td>
</tr>
<tr>
<td>encre</td>
<td>lat. ENCAUSTUM</td>
<td>gaulots (?)</td>
</tr>
<tr>
<td>luir</td>
<td>a.fr. *luisir</td>
<td>lat. LUCERE</td>
</tr>
<tr>
<td>ronfier</td>
<td>lat. RONFL-</td>
<td></td>
</tr>
<tr>
<td>albarelli</td>
<td>it. albarelli/albarella</td>
<td></td>
</tr>
<tr>
<td>amour</td>
<td>a.fr. *ameur</td>
<td>lat. AMOR</td>
</tr>
<tr>
<td>pamplemouss</td>
<td>nlt. <em>pompelmoes</em></td>
<td>nlt. <em>limoes</em></td>
</tr>
</tbody>
</table>

* Figure 3. Some examples of etymological data (TLF)
• Multiple etymons also occur in conjunctive readings. As an example, one may think of re-motivation in popular etymology, such as for French choucroute. Initially, it is an Alsacian loan word (corresponding to German Sauerkraut), that has been influenced phonetically by French chou, due to semantic proximity. In those cases, it is plausible to consider both Sauerkraut (i.e. his Alsacian variant) and chou as contributing etymons for choucroute. The link between chou and choucroute may be typed as a secondary or re-motivating link.

• Multiple evolution of the same etymon is a frequent case, especially for languages with a recent and well documented parent language, like Latin for French. As an example, Latin DIRECTIARE is considered as a possible etymon for French adroit as well as for adresser. In our proposal, those cases might be treated without redundance: the etymon has to be described only once (say, in the entry for adresser), and the link to the target adroit can refer to this etymon as its source.

4 An integrated example

The application of the previously introduced principles to the TLF example of Figure 1 leads to the sample data structure in Figure 4: The nodes in the graph are lexical entries in a virtual network for pamplemousse, pompelmoes and (pompel+moes), respectively. The first one has not to be described furthermore, since it is the anchoring entry for the etymological information (and as such supposed to be described out of the etymological part). The second one corresponds to the direct etymon pompelmoes, whose descriptors (language, part-of-speech, gender and gloss) are able to capture all the information provided in the source. The TLF goes still further in etymological chain, and characterizes pompel and moes as parts of the compound. We consider this as a complex etymon, built from two subparts, each with its proper set of descriptors. The three lexical entries are part of a common etymological chain. Therefore, we need two links in order to express the relationships between them: a first link, with pompelmoes as the source and pamplemousse as the target, is typed as a loan word relation. The second one relates pompel and moes to the compound pompelmoes. Note that we are also able to record in an appropriate way the bibliographical reference and confidence indication. Finally, Figure 5 shows a simplified XML implementation of the first subgraph (i.e. the lexical entry pamplemousse and its direct etymon pompelmoes) of the data structure in a TEI like format. Note that the basic building blocks for the characterization of a lexical entry (<form> and <sense>) are completely reusable for the description of an etymon, and the language has been implemented as an standardized xml:lang attribute.
5 Perspectives: the etymological network

To summarize, the current model of etymological structures as presented here has two important characteristics: it is based on the hypothesis that the quintessence of etymological information can be expressed as a directed and acyclic graph, whose nodes and arcs are labelled with various descriptors. Furthermore, it relies on the assumption that the nodes of the graph are autonomous lexical entities, i.e. lexical entries, whose status as etymons is only a functional one. On the practical side, this assumption allowed us to reuse basic building
blocks and descriptors already defined in current initiatives on the standardization of lexical content representation (TEI, LMF), with only a small number of adjustments.

On the theoretical side, this perspective opens the way towards an etymological network, in which etymological links are seen as relations between entries recovered from one or more external lexical databases providing access to lexical material of any language across time and space, including reconstructed forms and affixes. In this view, the physical description of etymons as subordinate to lexical entries should be understood as a provisional solution, only intended to compensate for the lack of external lexical databases. Note that nothing prevents the implementer from externalizing from now onwards the descriptions of etymons, if he/she wants to do so. In practice, this is what we intend to do with the information annotated automatically in the etymological notes in the TLF, especially to avoid redundancy in the description of etymons. The idea of an etymological network is also the main reason for us to support shared, reusable and ideally standardized data models for diachronic data, which still remains as close as possible to existing recommendations and practice in the field of lexicography.

References

A. Dictionaries


Presentation.html

MORPHALOU Lexique morphologique ouvert du français: http://actarus.atilf.fr/morphalou


TLF Trésor de la Langue Française. CNRS, Editions Gallimard,. 16 volumes: http://atilf.atilf.fr/tlf.htm

B. Other Literature


