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Digital Scholarly Editions of Alchemical Texts as Tools for Interpretation

Sarah Lang

Abstract

Digital Scholarly Editions commonly provide annotations and visualization tools for Named Entities, dates or basic quantitative text analysis using methods based on bags of words and word counting. This paper argues that such methods are not enough to provide meaningful insight into texts from the history of science and alchemy especially, using two case studies from the alchemical texts by iatrochymist Michael Maier (1568-1622). A custom-made method for the interpretation of alchemical terms is presented which relies on the polyvalent semantic annotation of relevant yet ambiguous alchemical Decknamen and the analysis of their semantic contexts using a digital knowledge organization system.

Zusammenfassung

Digitale Editionen bieten üblicherweise Annotationen und Tools zur Visualisierung von Named Entities, Daten oder simplen Auswertungen quantitativer Textanalyse an. In diesem Beitrag wird argumentiert, dass diese weit verbreiteten Tools für eine sinnvolle Analyse im Bereich der Wissenschafts- und Alchemiegeschichte nicht ausreichen. Anhand von zwei Fallstudien aus dem Werk des Iatrochymikers Michael Maier (1568-1622) wird eine Methode zur polysemantischen Annotation uneindeutiger alchemischer Decknamen vorgestellt und gezeigt, wie damit deren semantische Kontexte mithilfe eines Wissensorganisationssystems analysiert werden können.

The iatrochymist[1] Michael Maier (1568–1622)[2] has attracted considerable attention over the last few years. Yet Maier's works are mentioned very often, but studied very little, some scholars have complained.[3] This has caused research on Maier to be highly dependent on secondary literature which is, in part, quite outdated. Criticized by Erik

[1] While the term alchemist is still used for medieval times, alchemical practitioners of the early modern period are nowadays referred to as chymists. A iatrochymist is a chymist with a medical background who creates alchemical medicines as opposed to engaging in chrysopoeia, i.e. gold-making. On the subject of alchemy see Principe 2013.

[2] On Maier see Tilton 2003; Leibenguth 2002; Tilton 2005.

[3] Wels especially criticizes this even regarding Maier's most famous and most well researched work, the *Atalanta Fugiens* (1617) (Wels 2010, 149).

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Leibenguth in 2002,[4] Volkhard Wels finds the situation had hardly improved by 2010 despite the renewed interest in Maier and his work (Wels 2010, 149). Although the popular emblem book *Atalanta Fugiens* (1617/8)[5] has recently been the subject of a Digital Scholarly Edition, the rest of Maier's corpus is not well known and is even less studied.[6] Much research on Maier's vita has been done in recent years[7] but apart from *Atalanta Fugiens* only few of his texts have been studied in detail.[8] Text mining Maier's corpus could help in solving this problem.

The language of alchemy is known for its obscurity and riddles. These are, however, not chaotic or illogical as it has been claimed in the past, prominently so by Umberto Eco (2016). Rather they represent stylistic devices typical of alchemical communication, the most important of which are the so-called *Decknamen*.[9] Furthermore, the techniques of *parathesis* and 'dispersion of knowledge' are widely used in alchemical texts and will be addressed in this article.[10] All those verbal deceits ultimately serve

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4 Leibenguth stresses: "Charakteristisch für die Maierforschung sind mit wenigen […] Ausnahmen eine Abhängigkeit und teils sinnentstellende Rezeption von Sekundärquellen sowie die weitgehende Unkenntnis der lateinischen Primärtexte." Cf. Leibenguth 2002, 8–9.

5 On *Atalanta Fugiens*, see for example: Maier 1617a; Jong 1969; Wels 2010; Nummedal and Bilak 2020.

6 The digital representation of the corpus of his printed works yields 3500 PDF pages.

7 On Maier's vita cf.: Leibenguth 2002; Tilton 2003; Purš and Hausenblasová 2016; Tilton 2020.

8 Detailed studies exist regarding Maier's doctoral theses (*Theses de Epilepsia*, 1596), *Examen* (1617), *Atalanta Fugiens* (1617) und *Cantilenae Intellectuales* (1622). Maier 1596; Maier 1617a; Maier 1617b; Maier 1622; Beck 1991; Stiehle 1991; Leibenguth 2002; Nummedal and Bilak 2020.

9 In the historiography of alchemy, the term *Decknamen* has come to refer to cover names used by the alchemists. In the case of Michael Maier, these often come from classical mythology. Case study 2 will serve to better illustrate their full extent than a theoretical definition. However, it is important to note that the term as it has become established in the research discussion is meant as a neutral one in English, without the German connotation of covering something up, potentially with a bad intent. Principe elaborates: "*Decknamen* function as a kind of code, […] serving a dual purpose: they maintain secrecy, but they also allow for discreet communication among those having the knowledge or intelligence to decipher the system. They simultaneously conceal and reveal. Consequently, *Decknamen* have to be *logical*, not arbitrary, so that they can be deciphered. If *Decknamen* could not be deciphered by readers, then total secrecy would be the result; and if the intent were to conceal information entirely, it would be far simpler for alchemists to have written nothing at all." (2013, 18).

10 Newman explains the terms in his concrete example: "Not only does our author employ dispersion de la science and the use of *Decknamen*, he uses two complementary techniques that I shall call syncope and parathesis. These terms, although altered from their usual Greek sense, will serve to characterize certain techniques of concealment within an alchemical context. By syncope I mean the elliptical description of an alchemical process, substance, or even apparatus, with the intent to conceal. We observed this in the highly abbreviated recipe for the philosophical mercury that omitted both antimony and silver, and the technique is implicit in all of Philalethes' recipes that fail to mention the role of silver or copper as a 'mediator' for making antimony metal amalgamate with mercury. By parathesis, on the other hand, I mean the heaping-up of synonyms for a given process, substance, or apparatus, again with the intention of bewildering the reader. Such parathesis is present in the profusion of names used by Philalethes for antimony in its several forms, as we remarked above." (1996, 180). Syncope, that is intentionally leaving out relevant bits of information, thus far eludes digital analysis and consequently is not addressed in this article. 'Dispersion of knowledge' means spreading out relevant knowledge over multiple books or

to make sure that 'the worthy'—that is the alchemical expert with sufficient chemical background knowledge—can follow what's being said while 'the unworthy' are excluded from the communication. This serves both to foster community amongst the alchemical authors and to hide valuable information which can be monetized on the market but also for self-fashioning and marketing purposes in the so-called 'economy of secrets'. In the 'New Historiography of Alchemy', William Newman and Lawrence Principe established a methodology for decoding *Decknamen* by reading them chemically and validating the interpretation by chemical experiment.[11]

With ongoing digitization efforts, considerable numbers of alchemical texts have become available online.[12] Of Maier's works, the *Arcana* (1614) (Maier 1614; Maier 2009) were digitized by the Early English Books Online (EEBO) project in TEI-XML; Herzog-August-Bibliothek Wolfenbüttel digitized Maier's *Symbola* (1617) (Maier 1617d; Maier 1617e) and *Examen* (1617) (Maier 1617b; Maier 1617c) in a project concerning alchemical sources of HAB with a transcription being available in TEI-XML (Feuerstein-Herz 2017). A first digital scholarly edition of Maier's *Atalanta Fugiens* has been provided by the recently completed *Furnace and Fugue* project (Nummedal and Bilak 2020).[13] Alchemy research however, has not yet considered the potential of digital scholarly editions for providing analytical tools to address the specificities of alchemical language.[14]

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documents which ultimately need to be linked back together again so one book can explain the other. This is easily addressed using semantically annotated digital editions. With dispersion of knowledge, it is imperative that key terms can be found over the whole corpus and that it can be detected when they correlate with similar other terms or else, when they seem completely out of place which is a common marker of dispersion of knowledge.

11 For the "New Historiography of Alchemy," see for example: Principe and Newman 2001; Tilton 2003, 9–18; Martinón-Torres 2011. Its agenda is broad yet the methodology for decoding *Decknamen* is most relevant for the present discussion. Essentially, the success of this method is measured in terms of coherence. The same is true for any kind of crypotological methods: In the process of encrypting, a string is deprived of its coherence. The process of decryption renders the garbled string coherent once again. Of the many possible reorderings of a garbled string, the 'correct one' is the one which is most coherent or meaningful. Especially with anagrams, which are common in alchemy too, many coherent 'solutions' are possible. Similarly, if a coherent result can be achieved in a chemical recreation of an experiment, it is deemed likely and probable that a Deckname has been correctly identified, thus conducting a best explanation 'proof' using chemistry as an 'encryption key'.

12 As of 15.08.2019, a VD-17 search currently yields 1484 hits of which 937 are digital facsimiles. Staatsbibliothek zu Berlin — Preußischer Kulturbesitz, Bayerische Staatsbibliothek München, and Herzog August Bibliothek Wolfenbüttel 2017.

13 As of the time of writing, the digital edition was not accessible to the public yet but the author had access.

14 For example: Martinón-Torres 2011, 233. Jockers criticizes this "disciplinary habit of thinking small": "The traditionally minded scholar recognizes value in digital texts because they are individually searchable, but this same scholar, as a result of a traditional training, often fails to recognize the potentials for analysis that an electronic processing of text enables." This habit, he continues, was also perpetuated in the types of digital tools commonly available for literary scholars in the past (Jockers 2013, 17).

An evaluation of effective strategies for their digital editions is thus in order. It is common for Digital Scholarly Editions to provide annotations and visualization tools for Named Entities or dates which are meant to help users explore the texts semantically. It has also become fairly established practice to offer tools for quantitative text analysis using methods based on bags of words and word counting. In this paper, two case studies relating to alchemical literature are presented: Firstly, the adequacy of word count based interpretation in the context of alchemical literature is discussed on the example of a keyword search for the Named Entity Paracelsus in the corpus of Michael Maier's printed works. Secondly, a custom-made method for the interpretation of alchemical terms is presented which relies on the polyvalent semantic annotation of relevant yet ambiguous alchemical terms and the analysis of their semantic contexts, that is the groupings these words appear in, using a digital thesaurus.

1 Case study 1: looking for Paracelsus using bags of words

A good example of what Leibenguth criticized as patchy research regarding Maier (Leibenguth 2002, 8–9) is the recurring assertion that Maier was a Paracelsian. This belief was taken for a fact until it came under scrutiny from the 1990s onwards.[15] As one of four possible answers to this question given by previous research, Leibenguth deduces Maier was a Paracelsian for his devotion to medieval alchemy which Paracelsus integrates in his theories (Leibenguth 2002, 71–73). However, Maier mentions Paracelsus very little in general and not all comments can be read as apologies. No general overtly positive narrative on Paracelsus is present. Thus, Wels argues, Maier was not a Paracelsian since Maier does not agree with contemporaries who were clearly Paracelsians on relevant theoretical aspects such as the doctrine of *tria principia* (Wels 2010, 158, 160–63, 188). Maier also praises Thomas Erastus, an opponent of Paracelsianism.[16] Thirdly, as Paracelsus was a *persona non grata*, it could be that Maier does not mention Paracelsus despite being influenced by him.[17] On the other hand, Maier does mention Paracelsus in his works, albeit infrequently, so it might be that Maier just does not care much about Paracelsus. His comments are

[15] First examples are: Beck 1991; Stiehle 1991.

[16] See also: "Zwar feierte Maier gelegentlich in Paracelsus eine Koryphäe von Weltrang und anerkannte bestimmte 'medicamenta [...] Chymica vel Paracelsica'. Von einem Paracelsisten (so z.B. Weyer, 1992, 279) kann freilich schwerlich die Rede sein (siehe Leibenguth, 1992, 68, 71f., 107; Wels, 2010): Allein schon seine Kritik an der Paracelsistischen Drei-Prinzipien- und Imaginationslehre, vor allem aber der äußerst geringe Anteil von Paracelsismen an seinem Gesamtwerk und sein Lob auf seinen 'praeceptor' [...] Th. Erastus [...] verraten Maiers feste Verwurzelung in der galenistischen Schulmedizin und im späthumanistischen Aristotelismus." (Kühlmann and Telle 2013, 956–57).

[17] Thanks to PD Dr. Ute Frietsch of Herzog-August-Bibliothek Wolfenbüttel for pointing out this possibility to me. See also: Frietsch 2013, 338.

ambiguous; some can be interpreted as positive; others are quite clearly pejorative. This might simply mean Paracelsus is not an especially important influence on Maier, yet he still mentions him due to Paracelsus's being a central figure of the German alchemical tradition.

The following questions will now be approached using readily available digital methods based on word counts like they are offered in many existing Digital Scholarly Editions:

1. Can we judge Maier's attitude towards Paracelsus using methods based on word frequencies?

2. How far do we get with these methods in general? Are they sufficient to grasp the specificities of alchemical texts? Can they, for instance, be used to help understand the meaning of the highly complex concept 'Mercurius'?

Maier's corpus was machine transcribed using the *Transkribus* Optical Character Recognition. *Voyant Tools* can be used to quickly evaluate the potential of string-based word counting. Queries of typical Paracelsian words[18] yield hardly any results: many do not appear at all, others just once or twice in the whole corpus. Querying name variants for Paracelsus, however, is more effective.[19] Figures 1 and 2 compare other authorities mentioned in Maier, such as Geber, Sendivogius, Albertus Magnus, Galen, Hippocrates, or Lullus. The results were visualized using the 'bubble lines' tool. This makes it quite clear that Maier mentions Paracelsus significantly less than all of the other authorities, especially the ones he seems to appreciate. Of course, instances where Maier talks about someone without mentioning their name cannot be tracked this way. Also, a certain error rate has to be expected with the transcriptions not having been corrected.[20] Even taking standard concerns on precision of these numbers into account, the quantitative analysis adds new insights to Leibenguth's observation, that Paracelsus is rarely cited.[21] The quantitative analysis not only shows that Paracelsus is cited very rarely by Maier, as Leibenguth had already pointed out. It also shows that Maier's mentions of Paracelsus are considerably less frequent than citations of other authorities Maier holds in high regard. This quantitative analysis

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[18] In Paracelsian theory, there are quite a few otherwise uncommon terms like 'Archeus' or 'astral' powers, etc. If Maier was a Paracelsian, he would have used these *termini technici*.

[19] He is called not only by his chosen pseudonym 'Paracelsus', but also Theophrastus Bombastus von Hohenheim. Thus the query included Paracelsus, Theophrastus and Bombastus.

[20] Even though the corpus was neither double-key corrected or cleaned up, with a rate of 1–2 errors per page, it is of sufficient quality to obtain decent results when analyzing it using *Voyant Tools*.

[21] Unlike Franco Moretti whose concept of *Distant Reading* implicitly includes the idea that serial reading alone would suffice to interpret a corpus, Jocker's methodology of macroanalysis stresses that the "zooming in and out" between the overview over a big corpus and tiny details produces "findings, not interpretations" (30). Moretti 2013; Moretti 2005; Jockers 2013, 8–10, 19, 23, 29–30.

has provided arguments "to solidify intuitions we may already have had or [...] help identify what you might want to read" (Sinclair and Rockwell 2016, 282).

But to what extent can such an out-of-the-box keyword analysis using Voyant Tools be put to use to interpret alchemical *Decknamen*? Does a word count or a visualization suffice to answer research questions relevant to the historiography of alchemy? As Franco Moretti states: "Quantitative research [...] provides *data*, not interpretation" (Moretti 2005, 9). *Voyant Tools* helps by creating a concordance of all the sentences about Paracelsus. However, the method does not go beyond this compilation of data.[22] The collation of relevant paragraphs yields no immediate information on their semantic relevance.[23] This can be demonstrated in tracking the concept of 'Mercurius': the word 'Mercurius' occurs very frequently but covers an enormous range of possible meanings in alchemy. The string querying approach counts all mentions of 'Mercurius' as the same when, in fact, they have different word-meaning-relations. Among the additional shortcomings of the software are, for example, the fact that the font size is so small given many text samples and the fact that the colours are not consistent in multiple analyses. Even in two virtually similar queries, Voyant Tools often uses completely different colours, many times even switching the colours of concepts to one previously indicating the last one. This is extremely confusing and potentially misleading. The colourings also do not behave in a very predictable way so that it would be possible to easily achieve some form of 'visual continuity'. This makes it very hard to interpret the visualizations in a comparative way. All that the following figures really show is that in a variety of personal names of scientific or alchemical authorities mentioned by Maier, Paracelsus does not stand out at all, quite the opposite. Therefore, a method is needed which allows for word sense disambiguation to take the specificities of alchemical language and its *Decknamen* into account.

2 Second case study: a digital thesaurus of alchemical concepts on the example of Saturn and the dragon's blood

A simple example can show that Michael Maier himself is very aware of the ambiguity of alchemical concepts. Let's consider a statement about 'Saturnus':

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[22] "Computational analysis may be seen as an alternative methodology for the discovery and the gathering of facts. Whether derived by machine or through hours in the archive, the data through which our literary arguments are built will always be a movement from facts to interpretation of facts. The computer is a tool that assists in the identification and compilation of evidence. We must, in turn, interpret and explain that derivative data." (Jockers 2013, 30)

[23] Sinclair and Rockwell warn: "Don't expect much from the tools. Most tools at our disposal have weak or nonexistent semantic capabilities; they count, compare, track, and represent words; but they do not produce meaning—we do." (Sinclair and Rockwell 2016, 288)

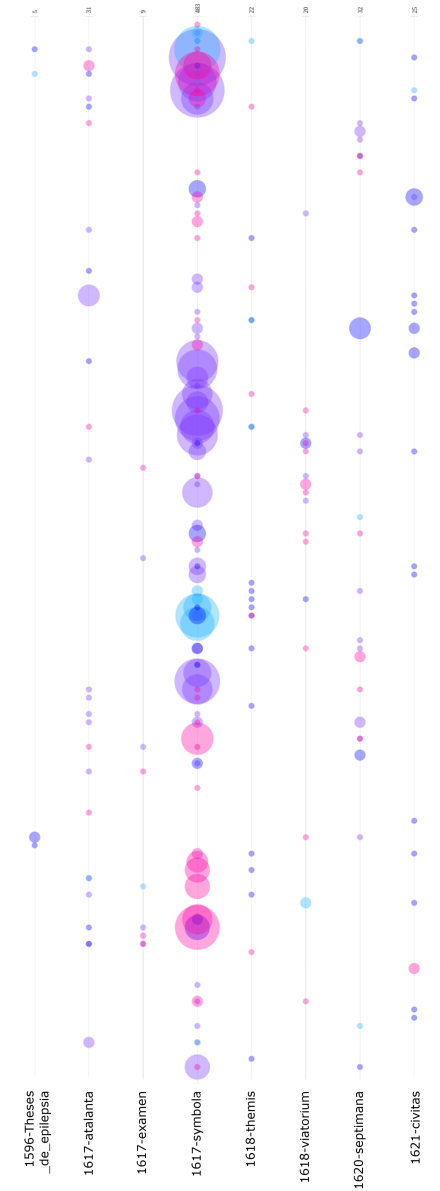

Figure 1: Overview of authorities mentioned in the Maieriana, reduced to works in which Paracelsus is mentioned at all. Paracelsus is visualized in blue, Galen in pink.

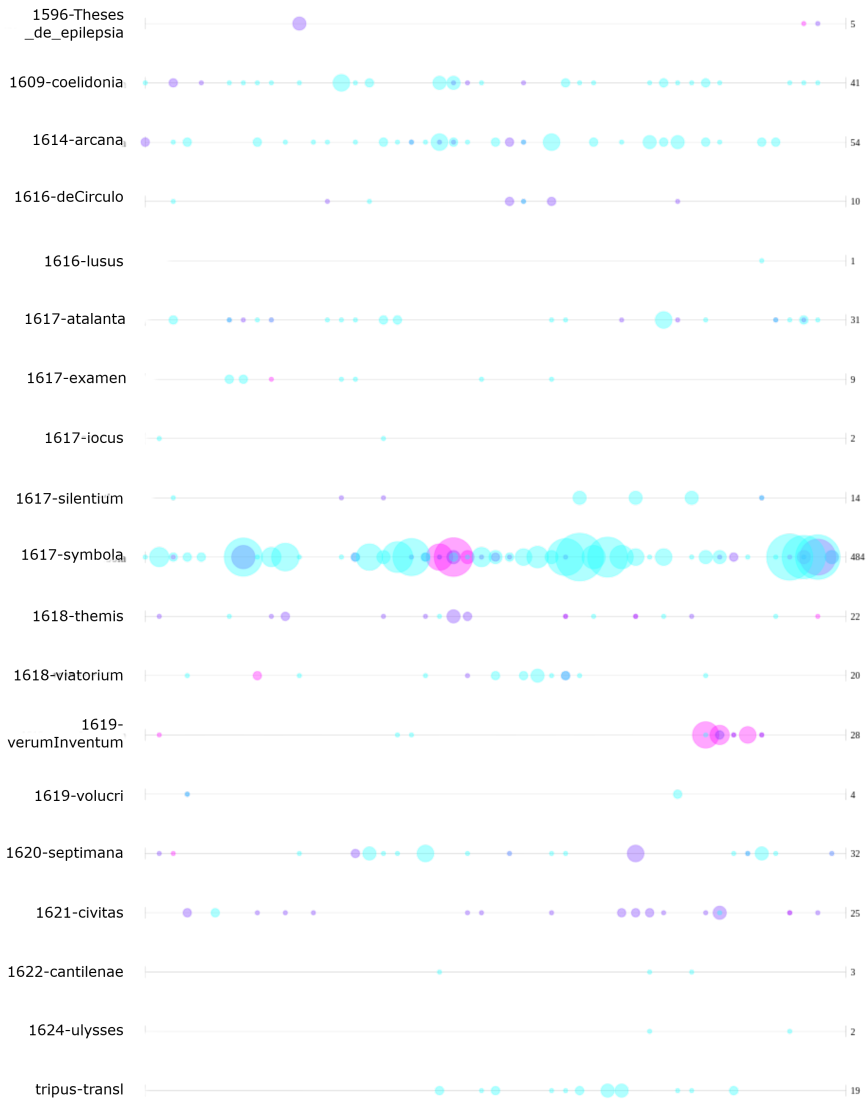

Figure 2: Overview of authorities mentioned in the Maieriana. Paracelsus is visualized in pink, Galenus and Hippokrates in purple, and all other authorities mentioned in blue.

```
:tinctura a :chemicalSubstance .
:tinctura :hasColour :red .
:tinctura :transformsTo :aurum .


:myth rdfs:subClassOf :alchemicalSymbol ;
      :hasContext :contextMythological .
:mythologicalFigure rdfs:subClassOf :myth ; a :person .
:mythologicalObject rdfs:subClassOf :myth ; a :object .
:mythologicalPlace rdfs:subClassOf :myth ; a :place .

:red :hasChemicalProperty :tinctio .

:perfectio rdfs:subClassOf :chemicalProperty .
:aurum :hasTheoreticalProperty :perfectio .
:aurum :hasColour :citrinitas .

:aurum a :chemicalSubstance .
:aureus rdfs:subClassOf :aurum .

:fixum rdfs:subPropertyOf :chemicalProperty .
:agens rdfs:subPropertyOf :chemicalProperty .

:elephas a :animal .
:draco a :animal .
:medicina :partOf :Iatrochymia .
:medicinaPhilosophica :partOf :Iatrochymia .
:medicinaPhilosophica :hasContext :contextAlchemicalTheory .
:sanguis a :alchemicalSymbol ; a :chemicalSubstance ;
         rdfs:label "cruor" .
:sanguis :hasColour :red .

:terreum :hasElement :earth.

:Iason a :mythologicalFigure .
:Apollo a :mythologicalFigure ; :hasLinkTo :Ladon .
:Ladon a :mythologicalFigure ; a :draco .
:MythologicalMercury :hasAttribute :caduceus .
:caduceus a :mythologicalObject ;
              :consistsOf :draco .
```

```
:Cadmos a :mythologicalFigure ;
        :hasRelatedStory :draco .
:vellusAureum a :mythologicalObject ;
              :madeOf :aurum ;
              :hasRelatedStory :Iason .
              :guardedBy :draco .
:AtalantaAndHippomenesRace a :myth ;
                           :partOf :AtalantaFugiensIntro ;
                           :hasActor :Atalanta , :Hippomenes ;
                           :hasObject :goldenApples .
:gardenOfTheHesperides a :mythologicalPlace ;
                       :hasRelatedStory :AtalantaAndHippomenesRace .
:goldenApples a :mythologicalObject ;
              :madeOf :aurum ;
              :guardedBy :draco .
              :hasPlace :gardenOfTheHesperides ;
              :hasRelatedStory :AtalantaAndHippomenesRace .


:Mercurius a :alchemicalSymbol .
:Sulphur a :alchemicalSymbol .
:PhilosophicalMercury rdfs:subClassOf :Mercurius ;
                      a :theoreticalSubstance .
:PhilosophicalSulphur rdfs:subClassOf  :Sulphur ;
                      a :theoreticalSubstance .
:CommonMercury rdfs:subClassOf :Mercurius ;
               a :chemicalSubstance .
:hydrargyrum a :CommonMercury .
:CommonSulphur rdfs:subClassOf :Sulphur ;
               a :chemicalSubstance .

:MythologicalMercury rdfs:subClassOf :Mercurius ;
                     a :theoreticalSubstance .
:HermesTrismegistos rdfs:subClassOf :Mercurius ;
                    a :alchemicalAuthority .

:Saturnus a :alchemicalSymbol .
:MythologicalSaturn rdfs:subClassOf :Saturnus ;
                    a :mythologicalFigure .
:PlanetSaturnus rdfs:subClassOf :Saturnus ;
```

Figure 3: Snippet view of the thesaurus of alchemical terms.

> Saturnum hic intellegimus non planetam illum mundi supremum, nec Deorum Ethnicorum quasi abavum & primum satorem (de quo in Hieroglyphicis nostris suo loco sat egimus) sed metallicam substantiam, quae plumbi vel ejus minerae, nomine appellatur, prout communiter recipitur. (Maier 1618, 44)
>
> By Saturnus, I mean here neither the outmost planet of the universe nor the pagan God, so-to-say the forefather and first founder (about whom I talked about enough in his place in my Hieroglyphics), but the metallic substance which is called by the name of lead and its minerals, like it is commonly understood. (translated by the author)

In this example, Maier himself explains which of the different possible meanings he intends. Such explanations, however, are exceedingly rare in most alchemical texts and *Decknamen* can be much more difficult than this one.

As we have seen, for infrequent terms with a reduced amount of ambiguity, like the personal name of Paracelsus, a concordance already gives us a good impression on how the word is used in a text. For the more complex concept 'Mercurius' however, the mere finding of a string is not complex enough to provide any meaningful context (at least not in a way which does not require copious *close reading* in order to make interpretation possible). A specific method which goes beyond existing out-of-the-box tools for quantitative text analysis is needed.

Michel Butor stated in his essay on alchemical language that alchemical terms are essentially arbitrary when used without context, but their grouping is not (Butor 1990, 22). After all, how could chymical experts have communicated amongst each other if their language had been completely arbitrary? If it is the groupings which determine the meaning of alchemical *Decknamen*, those need to be made explicit: Fortunately, groupings of terms can easily be analysed in an annotated corpus, and relevant relations can be made explicit in a digital knowledge organization system. In the following, a method for the enrichment of digital editions using the annotation of alchemical terms and a digital thesaurus is presented on the example of a peculiar allegory in Michael Maier's *Viatorium* (1618).

Alchemical language functions via analogies. Analogical thinking in chains of associations can be modelled digitally. By determining the context in which a term is uttered, we can gather evidence for the register of word usage, i.e., whether a chymical author is currently talking about practical chymistry or whether they use *Decknamen* to describe a more philosophical idea. This can be achieved by linking annotated strings in the text to concepts in a digital thesaurus (see Figure 3): The digital resource in question is neither a lexicon nor glossary. It was termed 'thesaurus' because this fits best with the definitions found in information science and it is the term used

to describe SKOS resources. Still, the term 'thesaurus' is ambiguous concerning the different research communities involved. Here, by 'thesaurus' we mean a digital knowledge organization resource which can be used as a hermeneutic and analytical tool. It does not aim to offer a controlled set of keywords to tag library catalogs, nor does it want to provide universal definitions for lemmata as in a glossary or lexicon. It does not want to be an introductory source to alchemical knowledge either. Its purpose is not to collect and condense all current knowledge on a topic in short entries. It is not a handbook either which serves as an entry point to research or for reference. It is a resource for the analysis of a text corpus. It is a hermeneutic, analytical tool to examine text and to bring a stronger philological text-centered focus to historical research which has been focusing on contexts of works and their authors rather than the work as text and its contents. How it is put to use will be elaborated in this second case study.[24]

The general method is as follows: A concordance is created for the occurrences of all labels from the thesaurus as they appear in the lemmatized Michael Maier corpus. This allows the creation of a specialized 'Keyword-In-Context' (KWIC) list restricted to the words in the text linked to the thesaurus. This is not a common KWIC, which provides linguistic context but rather an analysis of surrounding alchemical terms, providing a 'context of *Decknamen*'. Using their respective links to the thesaurus, these surrounding alchemical terms can provide context for the word occurrence in question. These links are annotations. The annotated *Decknamen* in a text could also be used to quickly trace the subject of a work or to determine how present a certain topic is in the larger opus of an alchemical author, etc. Annotation of alchemical terms allows us making more targeted analyses within alchemical digital editions.[25]

In his *Sanguinis Draconis Descriptio*, in the second chapter of his 1618 *Viatorium*, "On the mountain of Saturn," Maier recounts an allegory, an etiological explanation of the alchemical concept of 'dragon's blood', meant to underpin the chemical interpretations laid out before. In this allegory, he uses the stylistic device of parathesis, that is the heaping up of *Decknamen* in order to confuse a reader but, possibly, also to further illustrate his point. In example code 1, a grouping of alchemical terms around the *Deckname* 'Saturno' in the passage in question has been encoded in XML.[26] As the terms are annotated over the whole corpus, a large number of such specialized KWIC

[24] The method is also explained in Lang 2022, 2021, 2020.

[25] For example, citations in the primary source can be excluded. Maier often makes use of extensive citations. Those most certainly do not offer insight into his use of *Decknamen*, so we might want to exclude *Decknamen* coming from inside citations.

[26] For better readability, both the XML and RDF examples are reduced to incomplete or pseudo-code versions. For example, in the XML, references from the strings annotated as `<term>` to their related thesaurus concepts are omitted as not to clutter the example so much that readability of the text is impaired. The examples, thus, do not show finished data but are meant rather as tools to help explain the functioning of the method.

results can be created for the purpose of semantic analysis. The example code below shows an annotated text snippet around the *Deckname* 'Saturno' from Maier 1618, 55-56, in XML pseudocode:

```
<example n="1" ref="Maier.Viatorium.55">
    ... qui post <term>DRACONIS</term> (licet potior pars
    <term>elephantis</term> sit) dicitur, ad <term>medicinam</term>
    aliasque necessitates hominum non inutilis.
    <term>Draconem</term> hunc, cujus <term>sanguis</term> ad
    <term>medicinam philosophicam</term> assumitur, oportet
    quem probè agnoscere, ne <pb n="56"/> <term>terreum</term> quid,
    seu ex <term>terrae</term> fundo depromptum, aut aliud haud
    conveniens in ejus locum substituat.
    Est autem ex eo genere, quod <deckname>Saturno</deckname>,
    <term>Apollini</term>, <term>Aesculapio</term> et
    <term>Mercurio</term> asscribitur, quod <term>Cadmi</term>
    socios interfecit, et ab eo interfectum, quod <term>vellus
    aureum</term> observavit, quod <term>pomis aureis</term>
    <term>Hesperidum hortis</term> invigilavit, ...
</example>
```

> Its blood is then called [dragon's / snake's] blood (even though it is rather part of the elephant), quite useful to medicine and other necessities of humankind. This snake whose blood is taken as philosophical medicine needs to be properly understood, that is, not as something earthly taken from the ground, so that it is not wrongly substituted.
>
> It is of the kind, which is attributed to Saturn, to Apollo, to Aesculapius and Mercurius. It is that which killed Cadmos' comrades and was killed by him, which guarded the Golden Fleece and the apples from the Garden of the Hesperides [...]. (Maier 1618, 55-56, translated by the author.)

We can now obtain probability values indicating the most likely current semantic context by linking the words annotated as `<term>` with their related thesaurus concepts and calculate the probabilities using the following formula:

> current_context = max(sum_of_occurences_per_context)

Each term can have multiple contexts. For example, Saturnus can have the semantic context 'mythological', 'chemical', 'planet', or 'metal'. The count of possible contexts will thus be greater than the total number of terms considered. In the example, the search term for the KWIC 'Saturno' is the Deckname in question, surrounded by 15 alchemical terms in close proximity.

To make the process clear, a complete count will be given for this example (see the table in the Appendix): The concept `:draco` is defined as having `:contextAllegorical` and appears twice in the example of code (see the table in the Appendix). Plus one instance of `:elephas` which has the same semantics in

the thesaurus, this yields a total of 3 hits for `:contextAllegorical` for the passage considered.

Two occurrences of medicine ('medicina' and 'medicina philosophica') yield 2x `:contextIatrochymia`; 'sanguis' of type `:chemicalSubstance` adds one `:contextChemical`. 'Terreum' and 'terrae', belonging to the concept `:earth` yield 2x `:contextElements`. 'Saturno' as mentioned above yields one each of `:contextMythological`, `:contextChemical`, `:contextMetals` and `:contextPlanets`. The mythological figures, which follow, give a total of 8 `:contextMythological` with `:Mercurius` yielding one of `:contextChemical`, `:contextPlanets`, `:contextAlchemicalTheory`, `:contextAlchemicalTradition`, `:contextHistorical` as well as `:contextMetals` because the concept of `:Mercurius` is extremely rich in possible meanings in alchemy. For a total of 16 terms considered (including 'Saturno') the statistics are as follows:

:contextMythological	8
:contextAllegorical	3
:contextChemical	3
:contextElements	2
:contextIatrochymia	2
:contextPlanets	2
:contextMetals	2
:contextAlchemicalTheory	1
:contextAlchemicalTradition	1
:contextHistorical	1

If we wanted a percentage, the number of occurrences of `:contextMythological` divided by the number of total terms considered is: (8/16) = 50%.

It has to be noted, however, that, as Willard McCarty points out, digital models are "temporary states in a process of coming to know" in which computers are not "knowledge jukeboxes" but "representation machines" and hermeneutic tools (McCarty 2004, 255). The probabilities they offer are not 'interpretations' but 'data'. In the end, they only serve to guide the human interpreter in making informed decisions. In this example, statistically the context is mythological in total, but it is also interesting to note that following the sequence of words after 'Saturno' all other terms can be mythological in context and all share a semantic relationship with the concept `:draco`. Preceding 'Saturno', we can see that the context is mostly allegorical,

with the same :draco as a dominant intersection which appears later as a common relation after 'Saturno'. This is a good example of a semantic context switch used as an indicator in the alchemical stylistic and cryptographical device termed *parathesis*. *Parathesis* is defined as the 'heaping up of Decknamen' in which terms related to the concept or substance to which the author really wants to allude are cluttered around the text. It is meant to confuse readers who are not familiar with alchemical cryptographic devices but also possibly, in Maier's case, as a form of 'dispersion of knowledge' and demonstration of erudition. In this device, one book explains another. The context switch indicates that Maier wants the informed reader to collect hints on the substances the symbol :draco stands for in the present allegory in his other works. That is especially in his *Arcana Arcanissima* (1614) where he explains the Greco-Roman myths as alchemical allegories and recounts in detail what he thinks they mean chemically.

A use case of the method illustrated above for readers who are not extremely familiar with classical mythology is to figure out what the common relation of the current concordance is, i.e., :draco. For a reader who can see this immediately, a semantically enriched digital edition improves the hermeneutical process: For each of the single annotated entities in the short snippet (there can be a much longer *paratheses*), the corpus of Maier's printed works yields at least 300 hits each. However, only those where the terms appear in combination with a :draco are actually relevant to the analysis. A simple text query for "draco" would not help because there are many mythological beasts which qualify as :draco which are rather referred to by name and not by the string 'draco'. For example, Apollo slays a :draco named 'Python' and the dragon guard of the golden apples in the garden of the Hesperides is called 'Ladon'. If an instance of a :draco is encoded in RDF, excluding passages not relevant for the interpretation of :Saturn becomes much more efficient. Otherwise, a scholar would have to go through all the possible intertexts to determine which ones are relevant for the analogy at hand. Whether the present *parathesis* of mythological allusions in the allegory of the draco's blood adds to Maier's chemical argument has yet to be decided by chemists. However, finding possible intertexts which might contain additional information following the principle of 'dispersion of knowledge' becomes much simpler using a semantically enriched digital edition.

The next example appears immediately before the last one in Maier's *Viatorium*. But immediately before the scene discussed previously, Maier had offered an allegory of a draco and an elephant in Africa to illustrate how he thinks some individuals misinterpret the alchemical symbol of "dragon's blood":

```
<example n="2" ref="Maier.Viatorium.55">
    Cui, ut nihil est ab omni parte beatum, continuò se invidum
    et hostem internecinum <term>draco</term> praegrandis offert.
    Hic ut tam vastae beluae, cui viribus longè sit impar, damnum ingerat,
    non audens aperto <term>Marte</term> cum ea confligere,
```

```
    rem ex insidiis aggreditur hoc modo. Observat quâ viâ
    <term>elephas</term> aquatu rediturus sit, eandem, ubi arctior est,
    praeoccupat, seseque inferiori loco abscondit, donec <term>elephas</term>
    <term>aquis</term> praetumidus accedat, cujus pedibus nexus et
    gyros suo corpore sinuoso injiciens <term>sanguinem</term> libat
    et ebibit. Tandem ubi viribus defecerit <term>elephas</term>,
    <term>draconem</term> circum sese in nodum reflexum, jam
    <term>cruore</term> saturatum, deque victoria contra hostem
    obtenta securum, suo pondere in terram corruens, ipsa morte
    vindictam sumens conterit et extinguit, omni regurgitante
    et offusso ejus <term>sanguine</term>, ...
</example>
```

> Because nothing is entirely good, a huge draco often crosses his path, hostile and murderous. In order to cause damage to such an immense beast to whose strength it [the snake] is no match at all, not daring to attack it openly (aperto Marte), it attacks him in an ambush. Watching the path by which the elephant returns from drinking, the draco sets itself up where it is straightest, hidden down below until the elephant, swollen with water, approaches around whose feet and sinuous body it then binds itself, spilling [the elephant's] blood and drinking it up. At last, when the elephant's strength has waned, taking revenge for its own death, it kills the draco who, blood-saturated lays curled up around him by falling down to the floor with its whole weight; the draco, assured of its own victory, regurgitating and sprayed in [the elephant's] blood. (Maier 1618, 55, translated by the author.)

With the dominant terms 'elephas' and 'draco', the context here is clearly allegorical rather than mythological as in the following text (a detailed account will not be given for this example due to space constraints). Due to the frequent occurrence of 'sanguis', `:contextChemical` is the runner-up. However, it is notable that the concept of draco is already present here which reappears indirectly later in the mythological analogies of the *parathesis*. If we go back even further in the chapter on "The mountain of Saturnus" before the *Descriptio Sanguinis Draconis*, we find a completely different context:

```
<example n="3" ref="Maier.Viatorium.52">
    Quod si verò à <term>sulfure</term> <term>auri</term>
    <term>fixo</term> et <term>agente</term>, hoc est, <term>calido</term>
    et <term>sicco</term>, <term>tingente</term> <term>Mercurius</term>
    <term>plumbi</term> <term>coaguletur</term>, nullum est dubium ex eo,
    ut et aliâs <term>aurum</term> <term>perfectissimum</term> fieri posse,
    de quo hic non est disserendi propositum.
</example>
```

> But if it is true that Mercurius Plumbi is coagulated by the fixed and active Sulfur Auri, that is by the hot and dry which tints, there is no doubt that

> other [substances] can also be perfected into gold. An argument of which we won't speak here. (Maier 1618, 52, translated by the author.)

The concept `:aurum` is very present both via direct mentions as well as in the relations of other terms, such as 'perfectissium' or 'tingens'. Many different contexts appear of which none is dominant. However, they all have contexts which are subclasses of theoretical alchemy (`:contextAlchemicalTheory`). Combined with the dominance of gold, it is safe to interpret that the current subject is a theoretical discussion relating to gold(-making). A close reading shows that it is very likely the *sulfur auri* mentioned in this sentence which is the (theoretical) substance Maier later refers to in the *draco* allegory.

These three examples illustrate how the presence of a common theme can be disguised in alchemical texts by switching the contexts of the symbols used to refer to the substance in question. However, the new symbols still share enough associations with the old ones that machine reasoning can help make this invisible Ariadne's thread resurface again.

3 Conclusion

A Digital Scholarly Edition of an alchemical text enriched as such provides a much-needed hermeneutical tool for the interpretation of alchemical literature. The method described allows the presence of multiple possible contexts at the same time. Therefore, it is adequate to the specificities of alchemical communication styles which consciously employed polyvalent semantics as a stylistic device. Alchemical terms cannot be disambiguated in a strict sense because their ambiguity is intentional and an integral part of the semantic message. Digital annotation offers an environment for making such ambiguities explicit and machine-processable without forcing a binary disambiguation. Clearly, this method customized to the specific needs of alchemical texts provides a much deeper and more adequate interpretation than would be possible with mere word counting without making semantic interrelations explicit. Text enrichment with semantic relations provides a hermeneutical tool which is of great help when dealing with the complexities of alchemical language. Even though alchemical literature is a relatively narrow historical genre, possible applications for the method proposed are manifold even outside the realm of alchemy, such as the analysis of poetic allusions.

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4 Appendix

	:contextMythological	:contextAllegorical	:contextChemical	:contextElements
DRACONIS		X		
elephantis		X		
medicinam				
Draconem		X		
sanguis			X	
medicinam philosophicam				
terrum				X
terrae				X
Saturno	X		X	
Apollini	X			
Aesculapio	X			
Mercurio	X		X	
Cadmi	X			
vellus aureum	X			
pomis aureis	X			
Hesperidum hortis	X			
Sum	8	3	3	2

	:contextIatrochymia	:contextPlanets	:contextMetals
DRACONIS			
elephantis			
medicinam	X		
Draconem			
sanguis			
medicinam philosophicam	X		
terrum			
terrae			
Saturno		X	X
Apollini			
Aesculapio			
Mercurio		X	X
Cadmi			
vellus aureum			
pomis aureis			
Hesperidum hortis			
Sum	2	2	2

	:contextAlchemicalTheory	:contextAlchemicalTradition	:contextHistorical
DRACONIS			
elephantis			
medicinam			
Draconem			
sanguis			
medicinam philosophicam			
terreum			
terrae			
Saturno			
Apollini			
Aesculapio			
Mercurio	X	X	X
Cadmi			
vellus aureum			
pomis aureis			
Hesperidum hortis			
Sum	1	1	1