DĀMOS, database of Mycenaean at Oslo – Developments and perspectives

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Introduction*

The first online version of *DĀMOS* appeared in early 2013.[1] From the beginning it was conceived as an annotated database through which users would be able to browse and search the texts in their most updated version. The annotations in *DĀMOS* make it possible to search for archaeological, epigraphic, linguistic and content features of the texts. Some of these annotations were already available for searches in the first version, but many more have been made available in the new online version, which will be described in the present article. Other annotations are not yet available because of the lack of a dedicated interface module, and others are still in progress.

Another aspect which will be discussed here is the work on integrating and connecting *DĀMOS* with other digital resources in the field of Mycenology and Classics in general. This process is still in its early stages but will hopefully benefit from, and be encouraged by the ongoing development of Digital Classics and Digital Humanities in general.

Finally, some reflections on fully digital editions of Linear B texts are

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[1]   https://damos.hf.uio.no/ [last accessed 5.11.2022].

presented here, which will hopefully contribute to the discussion on the topic.

Making all the Mycenaean documents available online

The first aim of *DĀMOS* is to allow users to read and browse all published Mycenaean documents online. This has also meant keeping them up-to-date with new finds and new editions, e.g. the 6th edition of the Knossos tablets, which appeared in 2019.[2] New practical and methodological challenges emerged, however, when three partially different, competing editions of the Pylos tablets were published between 2019 and 2021.[3] Until then, the most up-to-date edition of a given set of tablets had always been a single, authoritative one, which could be used as basic standard reference, while data from subsequent articles about joins or new readings would be incorporated in the database as soon as they were published. As a temporary solution, the texts of the documents in *DĀMOS* are (unless otherwise specified in the notes) based on *PT*[3], while discrepancies between the different editions will gradually be included in the notes. I posit, however, that a more functional solution, suitable also for similar cases in the future, requires a move towards a fully digital edition of the Linear B texts. I will return to this matter in the final part of my paper.

The new graphic interface and its search possibilities

The new online version of *DĀMOS* was launched in October 2019 at the Norwegian Institute in Athens and has superseded the old interface since February 2020.[4]

Without technical limitations (e.g. querying and loading time) and budget restrictions, the ideal solution for the online graphic interface of a database would be to make all the data available through as many modes of searching and visualization as possible. Hardly any graphic interface, however, can ever provide access to all the possible combinations of data an expert user might want to search for. This is why alongside interfaces, which make data easily available to both specialists and

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[2] *KT*[6].

[3] *ARN* in 2019-2020; *PTT*[2] in 2020; *PT*[3] in 2021.

[4] A recording of the presentation can be found here: https://www.youtube.com/watch?v=NZu-WR_rW6tA.

a broader audience, raw data should also be made openly available to the research community wherever possible.[5] In this way, any researcher can fully search and manipulate the data according to their particular research needs. A similar solution is now also being developed for *DĀMOS* (see *infra*).

Data visualization

As in the previous version of *DĀMOS*, document level metadata (e.g. series, find-place, etc.) and lower level metadata (i.e. pertaining to lines, words and signs) are searchable through two different search mechanisms, each of which gives priority to the visualization and browsing mode that best seemed to suit those data.

Document level metadata are made searchable through a filtering interface (Fig. 1). This is made up of columns showing the available values for each metadata category. By choosing the desired values, a subset of documents can be selected, visualized, browsed and read one by one in the browsing panel (Fig. 2). Here, text, document level metadata and external links to available pictures of the object are shown. A basic tablet bibliography with references to the main handbooks and anthologies, primarily designed for use in teaching, completes the browsing module.[6]

Through the word search interface, lower level metadata are made searchable, and search results are shown in tabular form together with the relevant line(s), hand attribution, dating and find-place. Quick access to browsing through the full text of the related documents is given through pop-up windows. Finally, the results can be downloaded as a CSV-file, a format which is easily readable (for example in a spread sheet) and reusable.

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[5] Cf. BLEIER & KLUG 2018, XIII; FRANZINI *et al*. 2019, 15.

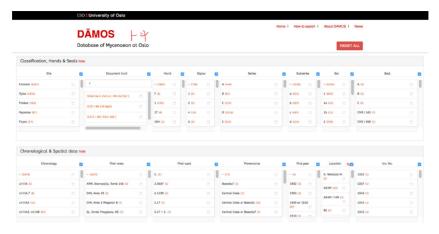[6] References to BERNABÉ & LUJÁN 2020 and *Manuale* have been added.

Fig. 1. *DĀMOS* filter module.

Filtering and browsing the documents

Filtering possibilities have been improved by allowing the user to filter the documents for multiple values from the same category at the same time (e.g. selecting to browse the documents from Pylos and Mycenae concomitantly). Further, while all other filter choices will exclude documents that do not contain the chosen feature, adding a single document from the *Document* column (which lists all individual Linear B documents) is always possible. In this way, it is possible to create a user-defined subset of tablets, independently of all other variables. For example, if users wish to browse through – or perform word searches in – the subset of tablets from Knossos written by Hand 115, but want to add **KH Ar 4** to the subset, they can simply add it by selecting it in the *Document* column.[7] Finally, clicking on a given tablet (part of the subset or otherwise) in the *Document* column will always make it appear in the *Document* tab of the browsing interface.

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[7]   Selecting a value for a given column, e.g. 'Thebes' in the *Site* column, will make non-relevant values in other columns, including the *Document* column, disappear. To see these values, users can click on *Show/hide empty*.
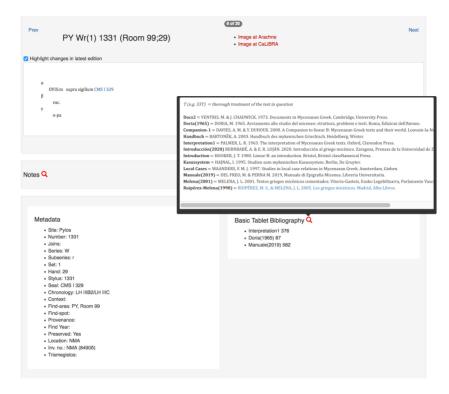
Fig. 2. *DĀMOS* browsing module.

A number of new metadata categories have also been added, which can be used to filter the subset of documents that a user might wish to select. These are described below.

Chronology

The modelling of the data regarding the dating of Mycenaean documents is not straightforward.[8] Different publications, as is well known, might assign different dates for the same group of documents and vary in the way in which they group documents. With the present interface, the only viable solution seemed to be to create a list of document groups that all sources agreed should be grouped together,[9] and assign them

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[8] See also AURORA 2015, 87.

[9] Some publications might place two of these groups together, but no publication would split any of them into further subgroups.

to a time span, broad enough to encompass slightly different date estimates, but narrow enough to be meaningful. Time spans are indicated with '-' (e.g. LH IIIA2-LH IIIB), while transition periods are indicated with '/' (e.g. LH IIIB2/LH IIIC). In the few cases where different date estimates are irreconcilable, i.e. too far apart in time, as in the case of the Knossos documents, these groups have been assigned different alternative dates divided by 'or' (e.g. LM IIIA1 or LM IIIA2 or LM IIIB). A fuller account of the structure of these groups will be included in the forthcoming database documentation.

An important complement of these chronological data is the archaeological context in which a given object was found. This can, of course, be different from the final dating of the document. While the archaeological context is not yet searchable in the present interface, it has been entered – when available – in the database, and it can be found in the *Metadata* section of the *Document* tab.

Find-area, find-spot and provenance

Find places have been divided into a broader *Find-area* and a more precise *Find-spot* (currently only relevant for the Pylos documents and the vases from Malia). The provenance of the vases, as reported by John Killen,[10] has also been added to the metadata in *DĀMOS* and made available for browsing via the filter.

Location, inventory number, recovery date (year)

Location refers to the museum or private collection where the objects are currently preserved. Where available in the literature, or thanks to direct information from museums, it is now also possible to search for the year in which an object was found and the inventory number currently assigned to it in the local collection.

Seal impression

The documents can also be filtered by the presence of a given seal impression. As in the previous version of *DĀMOS*, a link in the document text leads to the seal post –when available– in the digital *CMS* hosted by the *Arachne* database.

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[10] Killen 2011.

Joins and previous document number

The previous version of *DĀMOS* had a dedicated filter column for searches for joined tablets. In the new interface, the *Document* column works as a concordance where all numbers ever assigned to a Mycenaean document can be found together with its new number. In this column, all Mycenaean documents are listed, together with all instances of a number no longer indicating a main document; the latter preceded by '!'. Thus, by searching in the search field above this column, it is possible to find any Mycenaean document with its current, or previous, number and any joined tablet. Numbers previously assigned to a document are followed by '>'; joins are followed by '>+;' and, as usual in standard publications, documents no longer preserved are included between '<' and '>.' Thus it is possible to look for all document numbers no longer used by typing '!' in the search field above the 'Document' column; to search only for old denominations by typing '=;' joins by typing '>+;' all documents no longer preserved by typing '<' and, finally, to look for all previously assigned numbers by typing ' > ' (with a space before and after '>', to distinguish this search from a 'join' search).

   Finally, it would, of course, be very useful to include in the searchable metadata the detailed information about the history and composition of each tablet as it is presented in the 'Reconstruction' chapters of the Melena and Firth publications,[11] as well as the physical descriptions of the objects which are now usually published in the standard editions. It is my hope that these data will be made available in a digital format, which will allow their integration into the data set of *DĀMOS*, or any other such database, without unnecessary reduplication of work, such as manually entering data taken from a printed publication.

Textual searches

Textual searches have been significantly enhanced in the new online interface. As in the previous version of *DĀMOS*, after using the browsing filter to select the desired subset of data, users can perform a word search. What has been added to the new version is a multiple word search and advanced search options for both simple and multiple word searches.

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[11] *KT*⁶, 535-683; *PT*³, 283-373.

Multiple word search

The multiple word search (Fig. 3) allows users to search for up to five words co-occurring in the same line or in the same text (this parameter can be set in the menu *Where to search*). This search also allows users to determine *proximity*, i.e. the number of words within which the searched words should occur. It is also possible to determine this space as being 'near,' 'before,' or 'after' the first word of the search. The *proximity count* can be further defined so as to include all elements present in a transcription or to exclude word dividers (',') and philological notation (e.g. *vacat*, *quantum satis, graffito*, etc.) from the word count, so that in the sequence '*pa-ro, da-mo,*' the word divider is not counted and *pa-ro* and *da-mo* are considered adjacent (i.e. the search scope is 'within 1 word').
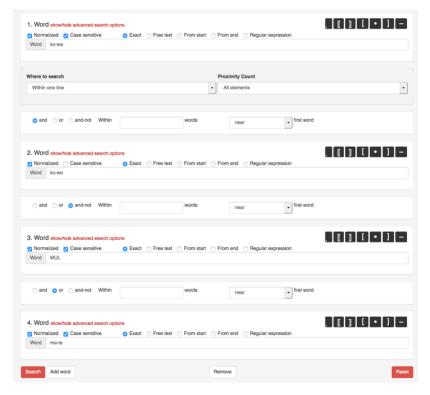

Fig. 3. *DĀMOS* multiple word search.

Logical operators that can be used in multiple word searches are: AND, AND NOT and OR. The AND and AND NOT operators in this search always refer to the first word. OR always adds a free-standing word that can be searched for in addition to the AND/AND NOT group. For instance, a search for '*ko-wa* AND *ko-wo* AND NOT MUL OR *ma-te*' will return all the documents which contain *ko-wa*, *ko-wo*, but not MUL, together with all the documents that contain the word *ma-te*.

Advanced (multiple) word search

Perhaps the biggest improvement in *DĀMOS*' new online interface is the introduction of an advanced search option for both simple and multiple word searches (Fig. 4). This search function is built on, and gives access to, most of the epigraphical annotations stored in the database, which were automatically generated (but subsequently refined manually), when text files with the transcriptions were imported into the database.[12] Users can now search for a given category of words: syllabic words, logograms of different kinds (ligatured, specified, etc.), monograms, metrograms, numerals and philological notation, including the start or the end of a broken ('[', ']') or erased area ('[[', ']]') in the text. It is not necessary to specify a content for the word to be searched, so that, for example, all instances of monograms can be retrieved by simply choosing the word type 'Logogram: monogram' and starting the search.[13]

Advanced searches can be further specified for the preservation state of the target word(s), i.e. certainty of reading, reconstruction state, presence of erasures or damages. Users can thus decide whether their search should include or exclude non-reconstructed words (e.g. *ko-wa*), partially reconstructed words (e.g. *ko-[wa]*), or completely reconstructed words (e.g. *[ko-wa]*). In the same way, users can include or exclude certain readings (e.g. *ko-wa*), partially uncertain readings (e.g. *ko-ẉạ*), or completely uncertain readings (e.g. *ḳọ-ẉạ*). Finally, the same holds true

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[12] On the import process: AURORA 2015, 25-26; on the epigraphical annotations: AURORA 2017, 87-91.

[13] A very large search such as, for example, one which would retrieve a complete list of all Mycenaean words, requires a powerful machine and very good internet connection in order not to be timed out by the server. However, a substantial search like, for example, a non-case sensitive, free text search for 'a' (returning 13181 lines) should be possible on an average computer with an average internet connection.
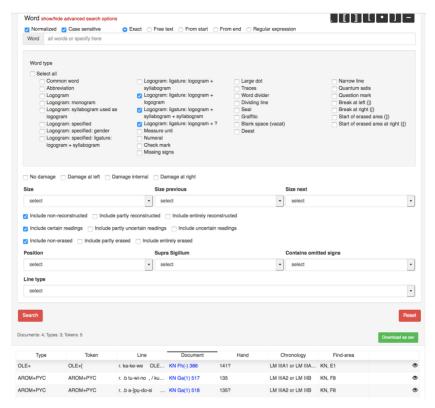
Fig. 4. *DĀMOS* advanced search options.

for non-erased (e.g. *ko-wa*), partially erased (e.g. *[[ko-]]wa*), or completely erased occurrences of a word (e.g. *[[ko-wa]]*). This means that, for example, if users wished to retrieve only the certain occurrences of a word written by a given scribe, they would probably exclude conjectures and uncertain occurrences, but include the erased ones. The search can be further refined by specifying whether the word searched for is transcribed as 'not damaged' (e.g. *ko-wa*), 'damaged at left' (e.g. *]ko-wa*), 'damaged at right' (e.g. *ko-wa[*) or having an 'internal damage' (e.g. *se-to[-i]-ja*).

Words (and combinations of words) can also be searched according to their particular position in the text. Thus, words can be searched for that appear over a seal impression (*supra sigillum*); (partially) written under the text line to which they belong; or written, usually in smaller characters, above their line (e.g. *ʿqe-te-oʾ*). In current editions, howev-

er, the latter can also be represented by being assigned to a line of the '.1a' type.[14] Therefore, a search for words completely or partially written above the line must also include results from a 'Line type' search. This can be done by choosing the desired 'Line type' (ruled, unruled, single line, etc.) in which the word(s) searched for should occur.

The advanced search also allows the user to look for words containing modern corrections of omitted signs (e.g. *ME<RI>* in **KN Gg 7232**). The insertion of modern corrections in the text, however, is very limited in current editions, with the corrections rather being proposed in the apparatus.[15]

Finally, searched words can also be defined as being of bigger ('+1'), smaller (the current editions of the Knossos tablets present three degrees of smallness, represented in the search menu as '-1', '-2', '-3')[16] or of the same size as the previous word ('normal') in the same line. Words can also be searched for according to the size ('same', 'smaller', 'bigger') of the preceding or following word in the same line. This search feature is somewhat problematic since it is based on a transcription convention that has generally not been used for the Pylos documents.[17] Melena and Firth explicitly state that 'no representation is given in the transcribed text of the relative sizes of the signs.'[18]

Linguistic annotations

The main challenge in annotating the Mycenaean texts is the need for allowing for multiple competing interpretations of both the form and the function of a given word. This is, of course, due to the well-known shortcomings of Linear B in rendering ancient Greek phonology and morphology, and to the concise and fragmentary nature of the extant texts. I have previously described these challenges and the solutions which have been adopted and tested in *DĀMOS* for the modelling of the data and the annotation strategy.[19] Nominal forms (nouns and adjectives) and participles constitute ca. 90% of the attested Mycenaean

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[14] Cf. *PT*[3,] liii-liv.

[15] Cf. *PT*[3], l.

[16] **KN Ak 612**.C: "da-te-we-ja / ko-wo / me-zo 1 ⟦ko̞-wo̞ / me̞- ⟧" contains the only case where the edition marks three degrees of progressive decrease in the relative size of the words in a line.

[17] It was used, however, in Melena 1992-1993a; 1992-1993b; 1994-1995; 1996-1997.

[18] *PT*[3], l.

[19] Aurora 2015, 27-29; 2017, 93-96.

word occurrences. While the annotation of the other word classes has been completed (although it is not yet available for online searches), the annotation of these forms is unfortunately not yet finished. The data model for the annotation of case,[20] however, has been further refined and systematized in order to attain a more economical representation of the data while still including a range of possible form/function combinations that include all possible forms of any of the possible case systems proposed in the literature.[21]

Let us look at an example: the annotation of *u-wa-si-jo* in **KN Ai 115** (*pa-ro , u-wa-si-jo , ko-wo*) is stored in the database in two different posts of the *ling_word* table (the table in which the linguistic annotation of each word occurrence is stored). These two posts are further connected through a *foreign key* to the post for *u-wa-si-jo* in the *phys_words* table (the table where 'epigraphical' words are stored). In one *ling_words* post, *u-wa-si-jo* is analysed as being a noun dependent on the preposition *pa-ro,* in the other as an adjective belonging to the prepositional phrase *pa-ro , u-wa-si-jo , ko-wo*. In both posts, therefore, *u-wa-si-jo* is considered part of a prepositional phrase and allows the following interpretations of form/function combination (depending on the interpretation of the text and on the theoretical point of view on the Mycenaean case system):

> singular dative with source/origin function
> singular locative with source/origin function
> singular instrumental with source/origin function
> singular dative with locative function
> singular locative with locative function
> singular instrumental with locative function
> singular ablative with source/origin function
> plural ablative with source/origin function
> singular *o*-genitive with source/origin function

These two posts are condensed and annotated in *DĀMOS* as:

> 1.
> N
> s;dat|loc|ins|;sou

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[20] Cf. Aurora 2017, 93-94.
[21] Cf. Hajnal 1995, 8-16, for an overview.

s;dat|loc|ins|;pos
s|p;abl;sou
s;gno;sou

2.
Adj
s;dat|loc|ins|;sou
s;dat|loc|ins|;pos
s|p;abl;sou
s;gno;sou

These posts will be used to build searches for given form/function combinations.

Relevant features of variation in Mycenaean (e.g. alternations as the one in *te-mi-ti-ja*/*ti-mi-ti-ja* or in the derivational suffix *-ti-ra$_2$*/*-ti-ri-ja*) are also in the process of being tagged,[22] while prosopographical data based on the works of Dimitri Nakassis and Hedvig Landenius Enegren[23] have been entered, but need to be revised before being made available online.

Linked (open) data

In order to give users easy and quick access to data stored in relevant digital resources within Mycenology or Classics, more links have been added to the individual document posts. In this way, most Linear B documents are now connected to one or more pictures and to databases where further metadata or textual searches can be done. In addition to *Arachne* and the online Sir Arthur Evans Archive of the Ashmolean Museum, links are now included to the individual document posts in *CaLiBRA*, *LiBER*, *pa-i-to* Project, National Archaeological Museum at Athens, British Museum and Fitzwilliam Museum. In this way, *DĀMOS* can also be used to find pictures and other resources about a given Linear B document. A step in the direction of linking Mycenaean data with other Digital Classics resources is the interlinking of *DĀMOS* with the database *Trismegistos*, which, among other things, assigns a stable unique identifier to each document from the ancient world. Using the

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[22] For a list of such features, see BERNABÉ & LUJÁN 2020, 328-329; GARCÍA RAMÓN 2016, 242-243.
[23] LANDENIUS ENEGREN 2008; NAKASSIS 2013.

data in *DĀMOS*, *Trismegistos* now provides a stable unique identifier for each Linear B document, as it does for papyri and inscriptions. In this way, Mycenaean documents can be retrieved together with later documents from, for example, Thebes, if users search for ancient documents from that location. A link to the post in *Trismegistos* is to be found in the Metadata section of *DĀMOS*' browsing module.

EpiDoc

EpiDoc is "an international, collaborative effort that provides guidelines and tools for encoding scholarly and educational editions of ancient documents [...] [It] specifies a subset of the Text Encoding Initiative [TEI]'s standard for the representation of texts in digital form using the Extensible Markup Language (XML), a technical standard promulgated by the World Wide Web Consortium. It addresses not only the transcription and editorial preparation of the texts themselves, but also the history, materiality and metadata of the objects on which the texts appear."[24]

For *DĀMOS*, we chose initially not to make use of EpiDoc and rely instead on a relational database for the storage of its data. While this choice was made for good reasons and still presents advantages for the entering and manipulation of the data,[25] the creation of an export system that can convert *DĀMOS*' textual data into EpiDoc-compliant XML-files is a current goal.

Together with Gabriel Bodard, therefore, I have started to devise the alignment of EpiDoc to the Wingspread convention.[26] This means the integration into EpiDoc of tags corresponding to the transcription rules of the Wingspread convention. EpiDoc is a widely used standard in the Digital Classics community: papyrus texts are coded with EpiDoc in *Papyri.info*, as are inscriptions in the resources which are part of *Epigraphy.info*, while *LGPN* online makes use of a compatible TEI-XML format. The main motivating factor behind our work, thus, is *interoperability*: creating EpiDoc-compliant XML files of the Linear B texts will make exchange and integration of data with other Classics resources

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[24] https://sourceforge.net/p/epidoc/wiki/Home/ [last accessed 28.11.2022].

[25] Aurora 2015, 24; 27-29. On the choice between XML and relational databases in epigraphy see Di Filippo 2018; Franzini *et al.* 2019, 16-17; Liuzzo 2017.

[26] The Mycenaean section, published in the latest release (9.3) of the EpiDoc guidelines (Bodard *et al.* 2007-2021), can be found here: https://epidoc.stoa.org/gl/latest/app-epi-mycenaean.html. This is still work in progress and collaboration and contributions are of course most welcome.

much easier and, ultimately, possibly automated. Survival over time of the data contained in *DĀMOS* is another concern which creating XML export files gives an answer to.

Database documentation and data download

DĀMOS has now been migrated from a MySQL to a MariaDB database and a full account of its structure will soon be published. Downloading possibilities are currently limited to downloading word search results, but the ultimate goal is to make the whole data set of *DĀMOS* freely accessible under a Creative Commons *Attribution-NonCommercial-ShareAlike* license (CC BY-NC-SA)[27] and in various formats, including a Plain Text (TXT) version of the texts.[28]

Towards a fully digital edition of the Mycenaean texts

DĀMOS is, of course, not an original digital edition of the Mycenaean texts,[29] but it neither is a fully digital edition. It does fulfil many of the requirements outlined in the literature for scholarly digital editions (e.g. advanced search functionalities, different data visualization modes, links to images)[30] and "cannot be given in print without a significant loss of content and functionality," but it still presents features of a 'digitized edition', in that it does not yet fully embrace the shift towards a 'digital paradigm' in the organization and presentation of data;[31] that is, it does not fully exploit the possibilities offered by digital tools. *DĀMOS* is also not a fully critical edition. It does have notes which explain the reasons behind a number of choices taken in the representation of the texts, but it does not have a full *apparatus criticus*.[32]

A critical edition of Mycenaean texts fully exploiting the possibilities of digital infrastructure would require a full apparatus of variant readings, restitutions and other textual criticism, tagged by edition. This apparatus should, of course, be combined with appropriate visualiza-

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[27] https://creativecommons.org/licenses/by-nc-sa/4.0/.

[28] Downloadable TXT-files appeared to be a very common *desideratum* in a recent survey of users of digital editions (Franzini *et al.* 2019, 16-17).

[29] Although it could be considered *an edition of editions* (Reggiani 2017, 238).

[30] Cf. Fischer 2019; Franzini 2012-; Sahle 2016.

[31] Sahle 2016, 27-28.

[32] The graphic interface of the *LiBER* database does, in fact, have an *apparatus criticus*. This is, however useful, still presented as a digitized and not a digital *apparatus criticus*.

tions, allowing users to visualize the texts with or without restitutions, to choose the desired edition or the desired variant readings. In this way, different contemporary editions of a given text could be easily accommodated and represented together.[33] Further features of a fully digital edition[34] include access to advanced imaging of the documents (e.g. 3D and RTI)[35] and text-image linking as in the *SigLA* database.[36] Such an edition would, of course, also offer a solution to the concerns about the limitations of current transcription conventions (e.g. in representing word size variation or damaged and erased areas) raised by Melena and Firth,[37] and contribute precious data for a future online edition of *DMic*.

A fully digital and critical edition of the Mycenaean texts is one of the current goals of the work with *DĀMOS*. However, not all the elements of such an edition need to be stored in *DĀMOS*. Digital editions, because of their scope, tend to be collaborative endeavours and might, in fact, be better thought of as having a distributed architecture, integrating data from different resources.[38]

If the first step is broad collaboration on the digitization of the data of current editions, the really crucial point is that future editions of Mycenaean texts should be conceived and produced (also) as (preferably) open access digital data sets that can easily be integrated into – and made accessible through – platforms such as *DĀMOS* or *LiBER*.

Paper editions, although they cannot, due to limitations of the medium, reproduce all the features of a digital edition, can always be easily derived from digital editions. In fact, a digital edition allows for multiple possible print editions according to the needs of editors and users. Digitizing print editions, on the other hand, is time consuming and does not result in a digital edition without extensive manipulation and enrichment of the data. Naturally, the data set of a scholarly rigorous digital edition will also provide an invaluable and time saving starting point for any new edition.

Finally, data sets from older and superseded editions could, in time, also be digitized and integrated. While this can hardly be a priority in

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[33] Fischer 2019; Keeline 2017, 351-353.

[34] Cf. Franzini 2012-.

[35] Greco & Flouda 2017; Nakassis & Pluta 2017.

[36] Salgarella & Castellan 2021.

[37] *PT³*, xlviii-li.

[38] Fischer 2019, 213-214.

a field with small budgets, it would give a full historical overview of the history of the decipherment and interpretation of the Mycenaean documents.

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