futuroclassico

Towards an Online Database of Ancient Dramatic Meters

The centrality of metrical patterns to an understanding of ancient drama is widely acknowledged[1]. Playwrights' choices of meters, and their arrangements of syllables and words within those meters, determined to a great degree what happened musically during theatrical performances, and they contribute significantly to the emotional tone, themes, and characterization of

[1] The database described in this article is being produced under the auspices of the Humanities Digital Workshop at Washington University in St. Louis. Our thanks to the staff of the Humanities Digital Workshop (Douglas W. Knox and Stephen Pentecost), and to the following student interns who have assisted on the project: Jacqueline Baik, Ariadne Bazigos, Zixing Chen, Max Coady, Jordan Coley, Shangwei Deng, Lucas Dube, Emelyn Hatch, Petey Kraemer, Lydia McKelvie, Ian McNeely, Zakery Oglesby, Henry Schott, Elena Steiert, Tumaini Ussiri, and Di Wang. Thanks also to the organizers of the conference "Ancient Greek Theatre in the Digital Age", to the editors and referees of «FuturoClassico», and to numerous colleagues who have offered suggestions on the database, especially David Chamberlain, Anna Conser, Tom Keeline, Joe Loewenstein, and Micah Zeller. Funding for the database work has been provided by the Department of Classics, the Faculty of Arts and Sciences, the Humanities Digital Workshop, the Interdisciplinary Project in the Humanities, and the Office of Undergraduate Research at Washington University in St. Louis, and by John and Penelope Biggs.

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pp. 143-164

Greek and Roman plays[2]. The complexity of Greek and Roman dramatic meters, however, and the wide variety of meters used, makes true appreciation of what those meters accomplish difficult, especially because it is hard to compare uses of metrical patterns across the corpus of ancient drama in a comprehensive way. In response to these difficulties, the authors of this paper, along with colleagues and student assistants at Washington University in St. Louis, are working on a tool that will, when completed, chart metrical patterns in each of the extant plays of Greco-Roman antiquity and permit users to complete many types of statistical analyses of those patterns.

The seed of this project lies in the publication in 2016 by Timothy Moore, along with colleagues from the Libraries and the Humanities Digital Workshop at Washington University in St. Louis, of a database that charts the meter of each verse in the extant plays of Plautus and Terence (http://romancomedy.wulib.wustl.edu/)[3]. The database allows users both to see easily the meters of each verse in Roman Comedy and to compare the use of different meters and types of meter by playwright, play, character, and character type. It soon became clear to us that an expansion of this database to Greek and other Roman drama would be desirable, but that such an expanded database should have a very different design to increase its usefulness for scholars, students, and performers.

First, a database moving beyond Roman Comedy requires careful thought regarding sources. Much controversy remains and will no doubt always remain about the scansion of Plautus and Terence, but Cesare Questa's magisterial *T. Macci Plauti Cantica* and some other works provided good foundations upon which to

[2] See, for example, Dale 1968; Scott 1984 and 1996, Zimmermann 1985-1987; Parker 1997; Moore 2012; De Poli 2013.

[3] The database was created with the technical assistance of William Porter of Polytrope LLC, Kieran Etienne of the Washington University in St. Louis Libraries, and Douglas W. Knox of Washington University in St. Louis' Humanities Digital Workshop.

build for the Roman Comedy database[4]. In the treacherous waters of Greek dramatic lyrics, finding such authorities is more challenging. Second, the Roman Comedy database has the line as its basic unit. As we pondered a database that included Greek drama, it became clear that uncertainties surrounding colometry would make any statistics based solely on lines exceedingly problematic. Ideally, we would want to be able to keep track not only of lines, but also of cola and metra, and of syllables, the least variable of units. Third, the Roman Comedy database includes only some of the text and has actual scansion only occasionally in its note boxes[5]. We wanted users of our expanded database to be able to see the entire text of the plays, with scansion. We therefore decided to proceed as follows.

First, we decided we would do best to start with Euripides. Euripides' corpus is the largest in ancient drama aside from Plautus', and his use of music and meter marks a key transition between the chorus-centered musical techniques characteristic of earlier Greek drama and the music centered on actors' monodies found in later theater[6]. For most of Euripides an open access text, Gilbert Murray's 1902-1909 Oxford Classical Text, is available online through the Perseus project[7]. Murray's text is problematic in many ways, and more authoritative texts, such as James Diggle's Oxford Classical Texts, are still under copyright (Diggle,

[4] The 2016 database uses Questa 1995 for the polymetric portions of Plautus; Leo 1895-1896 and Lindsay 1904-1905 for the remaining verses of Plautus; Questa 1984, pp. 400-401 for the lyrics at Terence's *Adelphoe*, 610-617; and Kauer-Lindsay 1958 for the remaining verses of Terence.

[5] David Chamberlain's "Greek and Roman Verse" site (hypotactic.com [Chamberlain 2021]) offers fully scanned versions of the extant plays of Roman Comedy, as well as of Aeschylus' *Persians, Prometheus Bound*, and *Seven against Thebes*, but it does not do the kind of statistical work that we would like our database to do. For other digital projects including or hoping to include Greek and Latin dramatic meters, see Colombi *et al.* 2021 (http://www.pedecerto.eu/public/index); Fusi 2021 (https://fusisoft.net/chiron/); and Tueller 2021 (https://miketueller.github.io/article/hylas-at-scs/).

[6] See especially Csapo 1999-2000; Wilson 1999-2000; and Hall 2002.

[7] Murray 1902-1909; Crane *et al.* 2021 (http://www.perseus.tufts.edu/hopper/).

1981-1994). A request to Oxford University Press to use Diggle's texts as our base was rebuffed. Frederico Lourenço's scansions of Euripides' lyrics based on Diggle's text, however, are open access, and Professor Lourenço was happy to have us use them (Lourenço 2011). We decided, therefore, that our best course would be to use Murray's text, as presented by Perseus, as our foundation, but to adjust the text and scansion of lyrics and anapests to match Diggle's text, and to follow the arrangement of lines and the bracketing of Diggle's text in the remaining parts of the plays.

As our first step, the authors and numerous student assistants have been preparing, refining, and proofing templates, produced using Microsoft Word, of Euripides' metrical patterns. We started with Murray's text of the lyrics and anapests as found on Perseus, but we adjusted that text to match Diggle's text. For the lyrics we have added Lourenço's scansion and his identification of meters, periods, end-of-line hiatus, and *brevis in longo*. The anapests we have scanned ourselves by hand. The lyrics and anapests are thus included in their entirety, scanned, in the templates. The templates do not include full texts of passages in iambic trimeter and trochaic tetrameter, where our database will largely reproduce Murray's text. We do, however, note where Diggle brackets lines – whether or not these lines are bracketed by Murray – and where he arranges lines in a different order from Murray. We also make note of extrametric lines and antilabe in passages in iambic trimeter and trochaic tetrameter. The result is a set of templates for each Euripidean play, like the one shown here for the first 152 verses of *Orestes*:

PROLOGUS: 1-139
1-139: ia3
Diggle brackets 15
Diggle brackets 33
Diggle brackets 51
Diggle brackets 71
Diggle brackets 73
Diggle brackets 82
Diggle brackets 110
Diggle brackets 127
Diggle brackets 139

PARODOS: 140-207
140-207: lyrics (lyric, includes responding stanzas)
STROPHE 1: 140-152

‒ ˘ ‒ ˘ ‒ ˘ ˘ ˘ ‒ ˘ ‒		
ΧΟΡΟC cῖγα cῖγα, λεπτὸν ἴχνος ἀρβύλας	140	hypodoc, doc
˘ ‒ ‒ ˘ ‒		
τίθει, μὴ κτύπει [μηδ' ἔστω κτύπος].	141	doc
˘ ˘ ˘ ‒ ˘ ‒ ˘ ˘ ˘ ‒ ‒ ‒		
Ηλ. ἀποπρὸ βᾶτ' ἐκεῖc' ἀποπρό μοι κοίτας.	142-3	doc2
˘ ‒ ‒ ˘ ‒		
Χο. ἰδοὺ πείθομαι.	144	doc
˘ ‒ ‒ ‒ ˘ ˘ ‒ ˘ ‒		
Ηλ. ἆ ἆ cύριγγοc ὅπως πνοὰ	145	doc cr
‒ ‒ ˘ ˘ ˘ ‒ ˘ ‒ ‒ ‒ ‒		
λεπτοῦ δόνακος, ὦ φίλα, φώνει μοι.	146	doc2
˘ ˘ ˘ ‒ ˘ ‒ ˘ ˘ ˘ ‒ ˘ ‒		
Χο. ἴδ' ἀτρεμαῖον ὡς ὑπόροφον φέρω	147	doc2
˘‒ ‒ ‒ ‒		
βοάν. Ηλ. ναί, οὕτωc·	148	doc
˘ ˘ ˘ ˘ ˘ ˘ ˘ ˘ ˘ ˘ ˘ ˘ ˘ ˘ ˘ ˘		
κάταγε κάταγε, πρόcιθ' ἀτρέμας, ἀτρέμας ἴθι·	149	doc2
˘ ˘ ˘ ˘ ˘ ˘ ˘ ˘ ˘ ˘ ˘ ˘ ˘ ˘ ˘ ˘		
λόγον ἀπόδοc ἐφ' ὅτι χρέος ἐμόλετέ ποτε.	150-1	doc2
˘ ˘˘ ‒ ˘ ‒ ˘ ‒ ‒ ˘ ‒		
χρόνια γὰρ πεcὼν ὅδ' εὐνάζεται.	152	doc

Ideal, of course, would be a database that records all the possibilities of text and meter, with a kind of "metrical apparatus criticus". At least for the time being, though, we feel that such thoroughness is unattainable, so we thought it best to start with the most authoritative text we could produce. Our belief is that this kind of acknowledged grafting of features of Diggle's text onto the text of Murray both meets the demands of reliability and is within the bounds of fair use.

The next step is to create an XML version of each play, combining the templates with Murray's text as presented by Perseus. XML (Extensible Markup Language) offers a comprehensive set of tools for document encoding, enabling us to translate our initial, handmade templates into a machine-readable format. Our process for XML encoding is as follows. In order to capture the plays' overlapping metrical and textual features, we divide each document into nested blocks of text using XML tags. We apply this process of "wrapping" or "tagging" throughout the play. Figure 1 shows an example of our tagging of *Orestes*, 140-141.

```
<div1 type="Parodos">
 <div2 type="strophe" n="1">

  <milestone unit="speaker" n="Chorus"/>
  <l n="140"><seg type="metron" met="hypodoc"><seg type="syll" ana="long">σῖ</seg><seg
      type="syll" ana="short">γα<milestone unit="word"/></seg><seg type="syll" ana="long"
      >σῖ</seg><seg type="syll" ana="short">γα,<milestone unit="word"/></seg><seg
      type="syll" ana="long">λεπ</seg></seg><seg type="metron" met="doc"><seg type="syll"
      ana="short">τὸ</seg><seg type="syll" ana="short">ν<milestone unit="word"
      />ἴχ</seg><seg type="syll" ana="short">νο</seg><seg type="syll" ana="long"
       >ς<milestone unit="word"/>ἀρ</seg><seg type="syll" ana="short">βύ</seg><seg
      type="syll" ana="long">λας<milestone unit="word"/></seg></seg></l>
  <l n="141"><seg type="metron" met="doc"><seg type="syll" ana="short">τί</seg><seg
      type="syll" ana="long">θει,<milestone unit="word"/></seg><seg type="syll" ana="long"
       >μὴ<milestone unit="word"/></seg><seg type="syll" ana="short">κτυ</seg><seg
      type="syll" ana="long">πεῖ.<milestone unit="word"/></seg></seg><seg type="syll"
     >[μη</seg><seg type="syll">δ'<milestone unit="word"/>ἔc</seg><seg type="syll"
      >τω<milestone unit="word"/></seg><seg type="syll">κτύ</seg><seg type="syll"
      >ποc].<milestone unit="word"/></seg></l>
```

Figure 1

First, we divide the plays into blocks of text according to their section. For example, lines 140 to 207 of *Orestes* are wrapped in tags indicating that this block of text is its own section, the parodos. In *Orestes*, there are 15 of these sections, so each has received tags marking its beginning and end. With a few exceptions, we follow for our sections the division of each play into prologue, episodes, stasima, and exodos proposed by Aichele (1971, pp. 50-51). Within each section, we also mark strophes, antistrophes and other stanzas wherever those divisions occur.

These sub-sections are then broken down further by wrapping every line with XML's line tags, which include the line number. Every line is then broken up into its component metra or cola, with tags indicating the beginning and end of the metron or colon, as well as its name. For our purposes, we are defining a metron/colon as a either a basic metrical unit that is repeated to form verses or a named unit of meter. Though we acknowledge the important differences between metra and cola[8], and the uncertainties

[8] See *e.g.*, Pretagostini 1978.

regarding just what makes a colon, it seemed best at least for now to treat these two types of units in the same way. We will continue to work on refining these distinctions as we proceed[9].

The tagging of sections, metra, and cola is being done by hand. Because manually dividing lines into words and syllables would be extremely time consuming, we have created a program using the Python programming language to perform this smaller-scale tagging. The Python program searches through each metron and colon within the XML text and identifies word boundaries. Because the metrical features we are interested in often cross word boundaries, words do not receive their own tags. Instead, the program automatically marks the end of each word with an XML feature called a milestone. Unlike tags, which delineate the beginning and end of a section, each milestone indicates a single point in the text. The use of milestones rather than tags allows us to treat words as discrete and countable objects while ignoring them for the purposes of metrical analysis. We have not, at least for now, tagged caesurae, but users of the database can find them by following the alignment of word end and metron/colon end in the XML or the online database.

After appending milestones to the end of each word, we break metra and cola into syllables. The program carries out automatic syllable identification using James Tauber's syllabifier function, part of the Greek accentuation Python library (Tauber 2017). We then identify the length of each syllable as short or long using a scansion tool developed by Anna Conser[10]. Once the length of each syllable has been determined, our program automatically wraps the syllable with tags indicating its length. Lastly, the program outputs a revised, fully annotated XML document. Automatic scansion leaves many syllables uncertain and makes occa-

[9] Our thanks to one of the referees for «FuturoClassico» for some useful suggestions about how to handle metra and cola.

[10] Conser 2018. Conser has been using this tool as part of her project analyzing the role of tonic accents in the melodies of Greek tragedy's choral songs, on which see Conser 2020 and 2021.

sional errors, so as a final step in the production of XML texts, readers check the length of each syllable by eye.

Our first goal is to complete XML documents for each play of Euripides. These documents will be made available, open access, online, in the hopes that they will prove useful for others who might wish to develop ways of using these machine-readable texts. In the meantime, we are working to make the information in the XML documents accessible, visually appealing, and valuable for all users. To that end, we are developing a website to display the data that has been previously encoded with XML. A prototype of the site as of November 2020 is currently available online at https://ada.artsci.wustl.edu/euripides/.

We constructed the framework of our website using the standard web design languages HTML (Hyper Text Markup Language) and CSS (Cascading Style Sheets). Since one of the most important aims of our database is to help researchers find patterns in the data, we have also created interactive tools for highlighting, filtering, and counting various metrical attributes. We developed these tools using a combination of the programming language JavaScript and the JavaScript library D3 (https://d3js.org/).

Figure 2 shows the page of the web site that includes *Orestes*, 807-819.

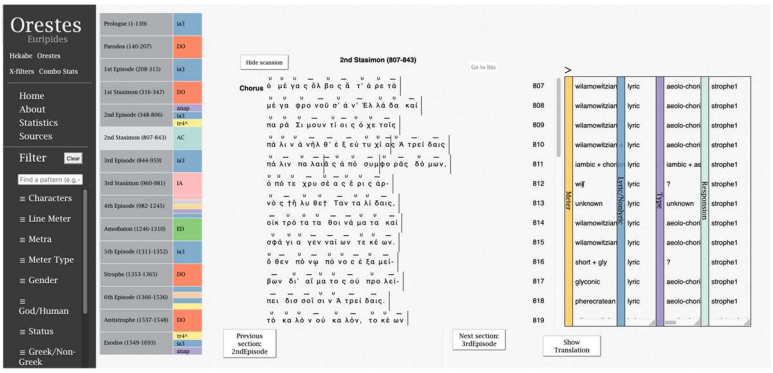

Figure 2

The central feature of the site is a text box containing the text of Euripides' play. Here users can scroll through the play, move between sections, and search for a specific line[11]. Users can also choose to view the play as plain text or with overlying scansion. We represent the scansion as images of a macron or breve, which are attached to each syllable according to its XML label. We use CSS to overlay each syllable with its length, while employing JavaScript to toggle the overlay on or off.

The grid to the left of the text box is both a visualization of the play's overarching structure and a navigational tool. The gray boxes on the left of the grid represent play sections. Clicking on one of these boxes activates a JavaScript function that calls up the corresponding section in the text. The colored boxes on the right of the grid represent changes in the dominant meter used within a section. Each color corresponds to a different meter or meter type.

The collapsible panels to the right of the text box display metrical information about each line, including the name of its meter, whether the meter is lyric or not, the type of meter, and the stanza to which it belongs. By clicking on the box at the bottom right of the screen, users can replace these columns with the relevant section of the translation provided on the Perseus site.

It is important to note that not all of the metrical information shown in the panel section is extracted directly from the XML. In order to avoid having to repeatedly enter characteristics of meters as XML tags, we created a JSON (JavaScript Object Notation) file that lists the information associated with each meter (figure 3). This approach allows us to call up the relevant data at any time, simply by using JavaScript to check the meter names included in the XML tags against their corresponding entries in the JSON file.

[11] We are currently working on a method of indenting lines connected to previous lines through synapheia.

```
  {
    "Louren\u00e7o abbreviation": "ia",
    "Ours": "ia",
    "name": "iambic",
    "type": "iambic",
    "paradigm": "x\u2012\u23d1\u2012",
    "metrical elements": 4,
    "notes": "often occurs in pairs (Louren\u00e7o's 2ia=our ia2; 8 metrical elements) and threes (Louren\u00e7o's 3ia=our ia3; 12 metrical elements)"
  },
  {
    "Louren\u00e7o abbreviation": "ibyc[superscript]chol",
    "Ours": "ibyc\/chol",
    "name": "ibycean with cholosis",
    "type": "enoplian",
    "paradigm": "\u2012\u23d1\u23d1\u2012\u23d1\u23d1\u2012 \u2012 \u2012",
    "metrical elements": 9,
    "notes": "ibycean (\u2012\u23d1\u23d1\u2012\u23d1\u23d1\u2012 \u23d1 \u2012) in which a long syllable replaces the last short syllable; in other plays this will sometimes be aeolo-choriambic"
  },
```


Figure 3

In order to enable users to explore the text and the associated metrical data as easily as possible, we also developed a system for filtering the text. At the far left of the main page, a dropdown menu allows users to isolate all the lines that meet certain criteria by selecting checkboxes. The filter options are divided into categories based on attributes of character or meter. Users can input their own scansion as a string of longs (-) and shorts (⏑) in order to search for a particular metrical pattern. Filters from different categories can also be combined to perform a more specific search. For example, a user who wants to know how often the chorus delivers iambics in *Orestes* would first expand the "Character" menu and select the "Chorus" checkbox. This action prompts a JavaScript function to search the XML for sections of the play that are marked by the appropriate tag. For filter options that refer to character or metrical attributes not encoded in the XML – *e.g.*, "Greek" – the JSON files are used to determine which characters and meters should be included in the search.

The page then automatically updates to display a new section below the main elements of the site. This area includes a text box containing all of the lines that meet the search criteria – in this case, all lines spoken by the chorus. Above the text box, we print the total numbers of lines, syllables, and metra/cola that were in-

cluded by the user's search. The meters and meter types of those lines, along with the sections in which those lines appear, are also displayed (figure 4).

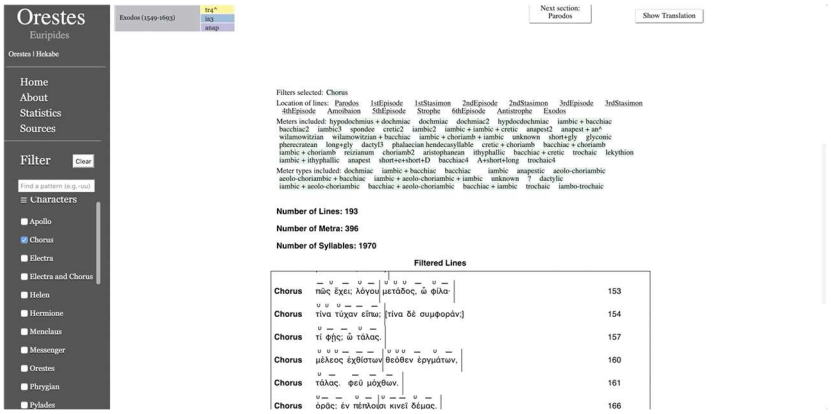

Figure 4

In order to study only those verses delivered by the chorus in iambic meters, the user would then move to the "Meter Type" menu and click "iambic". This will update the text box and the associated information, displaying and counting only the lines delivered by the chorus in iambic meters (figure 5).

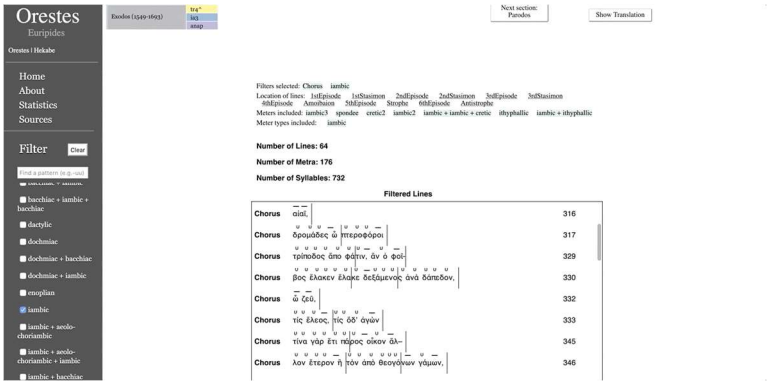

Figure 5

Although the filter system displays raw totals of lines, metra/cola, and syllables, it is still primarily centered around the text. We believe a more quantitative approach will also be useful. Therefore, we have dedicated a separate page of the website to numerical analysis of the plays. The Statistics page calculates both the total and relative proportion of the text that fits user-selected criteria. Quantitative comparisons can be made in terms of lines, syllables, metra/cola, or words.

For example, if users want to make a side-by-side comparison of how many lines each character in the play delivers in iambic meters, they can make a selection as in figure 6:

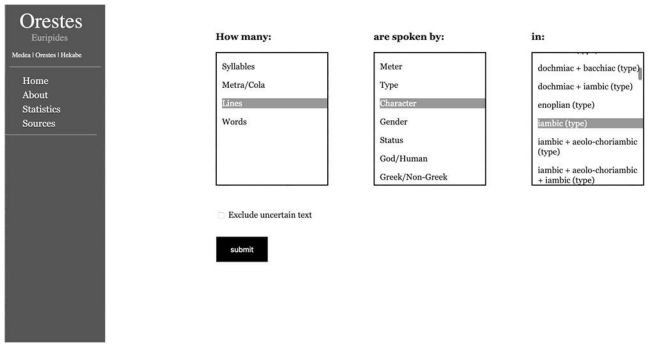

Figure 6

The results of their query are then calculated using JavaScript. We use the Plotly JavaScript library (https://plotly.com/javascript/) to present the data in the form of a bar graph, pie chart, and table, as is seen in figure 7.

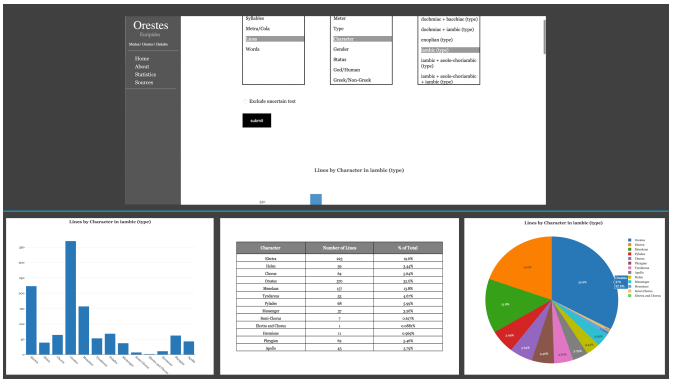

Figure 7

These graphs and tables can also be downloaded by the user as image files. In addition to individual characters, the user can compare characters categorized by gender, social status (free or enslaved), whether the characters are divine or mortal, and whether they are Greek or non-Greek. Users can also move beyond characters and character types to see how often different meters and meter types are used in the play as a whole, and we are working on developing more ways for users to search for specific patterns of short and long syllables.

We feel that we have built a solid foundation for the database we envision. Still, the database is very much a work in progress, and much work remains to be done. In the next months we will be dedicating our efforts primarily to finding ways to make the entry and proofing of data more efficient, addressing areas of ambiguity in our tagging, refining our means of identifying meters and meter types, and preparing the database for the inclusion of additional plays.

Our database is exceedingly labor-intensive. The creation of metrical templates, including the incorporation of Lourenço's scansion and the scansion of anapests, as well as the marking of sections and cola, extrametric lines, antilabe, and differences between Diggle's and Murray's texts, is all done by hand, as is the tagging of sections and metra/cola in the XML documents. The automatic tagging of words is straightforward, but our current

automatic scansion program leaves many syllables uncertain, requiring extensive correction by hand. Much of this labor is inevitable, and we are fortunate in having at Washington University in St. Louis a steady supply of talented graduate and undergraduate students who can enter data and generous internal funding for such student interns (we will also seek external funding as the project continues). Nevertheless, because of the amount of material we hope ultimately to include in the database, we continue to seek ways that more steps in our process can be automatized or otherwise made less labor-intensive. Members of our team are beginning that process by looking closely at Anna Conser's scansion program, finding ways that the program can be adjusted to leave fewer uncertain syllable lengths without producing inaccuracies, and developing efficient methods of proofing and correcting the scansion.

As with any digital project, we are faced with the reality that computers deal in binary oppositions. We will need to decide, as we proceed, how within this world of "yes" and "no" we should respond to the countless uncertainties in the text and scansion of Greek drama. The principal areas of uncertainty we need to address are our treatment of plosives followed by liquids and other situations in which a syllable might be long or short, the many places where the text is uncertain, the distinction between lyric and non-lyric meters, and the categorization of individual lines and longer portions of the play by meter type.

We must first decide how to respond when the length of a syllable is not certain. When a plosive is followed by a liquid, for example, the playwrights had license to treat the previous syllable, if it included a short vowel, as long or short. Often the metrical position of the syllable makes clear whether it is long or short, but occasionally such syllables occur in places like the first position of an iambic metron, which could be filled by a long or a short syllable. Because it appears that in most Greek drama short was the more common length of such syllables (West 1982, p. 17) we mark all such syllables short when they occur in metrical positions that could be filled by a long or a short syllable, as Lourenço does here at *Orestes*, 966a:

⏑ – ⏑– | ⏑ – ⏑ ⏑ ⏑
Κυκλωπία, |σίδαρον ἐπὶ 966a 2ia

In other places as well where there is uncertainty regarding the length of a syllable, we have thought it best to mark the syllable as either long or short, following what seems the most likely prosody, rather than marking syllables as uncertain. As we continue our work and find more such syllables, we may wish to reconsider this decision.

We are continuing to ponder how best to handle the many places in Greek drama where the text and/or meter is uncertain. At *Orestes*, 206, for example, Lourenço assumes a pair of dochmiacs based on responsion, but because of the cruces in Diggle's text he only scans the first two syllables. For the sake of thoroughness, we have marked as short or long each of the syllables printed by Diggle in cases such as this, again following what we think are the most likely lengths in cases where there is prosodic ambiguity:

⏑ ⏑ ⏑ ⏑ ⏑ ⏑ ⏑ ⏑ _ ⏑ ⏑ ⏑ ⏑ _
ἄγαμος †ἐπὶ δ' ἄτεκνος ἄτε βίοτον† ἀ 206 doc2

We are working on a system that will allow users to choose whether or not such uncertain texts are included when they use the database for calculations.

We feel it is very important that users of the database be able to determine easily which verses in a play are lyric—and therefore were probably sung—and which are nonlyric and were probably spoken or chanted[12]. Our database therefore identifies each line as lyric or nonlyric. This dichotomy brings challenges when we consider iambic trimeters that fall within lyric sections, and anapests. It is clear that some iambic trimeters within lyric

[12] On the performance modes of various meters, see Pickard-Cambridge 1968, pp. 156-167; Moore 2008 and 2012, pp. 92-104.

sections are themselves lyrics, but others should almost certainly be described as nonlyric, such as when one character delivers iambic trimeters in contrast to another who delivers lyrics: one character is speaking while the other sings[13]. Sometimes, however, it is much harder to decide whether an isolated iambic trimeter should be considered lyric or nonlyric. Similarly, some anapests are clearly nonlyric, some certainly lyric, but there is often ambiguity surrounding how passages in anapests would have been performed[14]. As we proceed, therefore, we will need to make our own judgment calls on these meters, annotating our decisions carefully within the database, and perhaps creating a third category of "uncertain" in this realm. We have not attempted to track a category of "recitative", for verses that are chanted to accompaniment, as opposed to being sung to accompaniment on the one hand or spoken without accompaniment on the other, because of the many uncertainties surrounding that category and its application.

Our classification by meter type brings several challenges, as we consider lines that are best described as including two meter types, meters that can belong to more than one type, and the labeling of sections of the play by meter type. Problems of this nature are typical of data projects like ours, which must steer between including too few categories, and hence losing meaningful data, and including so many categories that the data become too difficult to use.

As was noted above, we have made our database work in a way more granular than the line, tagging metra/cola, words, and syllables. Following standard practice, however, our identification of meters is based on the line. This system works very well in the nonlyric portions of the plays but brings challenges in the lyrics. First, Diggle, like all editors of tragedy, creates lines in his text that combine metra/cola that are best described as belonging to different meter types. As was noted above, for example, Lou-

[13] See Barrett 2007; Goldhill 2013, pp. 110-129.
[14] See, *e.g.*, Zimmermann 1985-1987, vol. 1, pp. 266-268.

renço identifies *Orestes*, 145 as a dochmiac plus a cretic. Dochmiac is its own meter type, but a cretic, at least in this case, is best described as a syncopated iambic metron (Parker 1997, p. 28). How best to handle this kind of combination? So far, we have used the concept "line meter", and have identified both the meter and the meter type of *Orestes*, 145 as "dochmiac + cretic". This is accurate but leads us to have a vast number of meters and meter types that are of limited value for a user seeking to do statistical comparisons. We will be working in the next weeks and months on a system that will allow us to keep track of combinations like these but at the same time produce more manageable ways of categorizing meters and meter types.

A related problem is names that can apply to cola of more than one meter type. Our current system connects colon name and meter type in a JSON file, so that, for example, every cretic is classified as within the iambic meter type. But metricians agree that some cretics are best classified as being within their own meter type, cretic (West 1982, pp. 54-55). Likewise, paroemiacs are usually categorized as catalectic anapestic lines, but they are sometimes best classified as enoplians (Lourenço 2011, p. 77). As we proceed we will need to develop ways of classifying meters such as these more accurately.

In the visual presentation of the plays, we have divided plays into differently colored units based on meter types. Again, this is straightforward in the nonlyric sections but can be complicated in the lyrics. Because many lyric sections include at least a few verses that can best be described as belonging to a different type from the others, coding every change of meter type in lyric sections would lead to a mixture of colors of limited value. We have therefore based our color scheme on what we call the "dominant meter type". In *Orestes*, in most songs one type of meter clearly dominates. But the song of the enslaved Phrygian (1369-1502) veers so wildly from one meter to another that at least for now we simply call it "mixed". Other plays have far more songs where no meter type appears to dominate, and we are still pondering how we will find a balance between misleading precision and vague lack of description. We will need to develop a consistent

set of principles for marking stanzas and astrophic lyric passages in four different ways. Sometimes variations from a meter type will be so rare that the entire stanza or passage can be marked as having one dominant meter type. Elsewhere it will be best to record the dominant meter type as changing mid stanza or mid passage. Some stanzas and passages present erratic and frequent changes in which two different meter types dominate. For these we will want to develop color codes matching that specific mix. And in some passages, like the Phrygian's monody, change between various meter types is so frequent and erratic that we will do best simply to mark the stanza or passage as "mixed"[15].

Finally, we need to move beyond the individual play. We started the project with some experimental work on *Medea* and have now completed databases for *Hekabe* as well as for *Orestes*. Templates for all of Euripides are nearly complete, and XML documents for *Bacchae* and *Electra* will soon be finished. So far, however, all our statistical work is based on the individual play. To be truly useful, of course, the database will need to be able to produce statistics not only across plays, but even across authors and genres. Our next big task, therefore, will be working on how we can bring this about. This will require some restructuring of the database's architecture, so that statistics can be gathered from a large corpus of data as efficiently and accurately as possible. Members of our team have now begun work on this key task.

There is, then, much work to be done, and we will value any suggestions readers wish to offer on how we should take our next steps. We hope, though, that when completed our database will be of great use not only to scholars interested in ancient drama's meter and music, but also to students at all levels and to performers of the plays.

[15] A related concern is the classification of verses with aeolic elements. We currently follow Dale (1968, pp. 131-156) in identifying all such passages as aeolo-choriambic, but as we proceed we will probably adjust these identifications in response to Parker's distinction between aeolo-choriambic and aeolo-iambic (1997, pp. 70-84).

Towards an Online Database of Ancient Dramatic Meters

Abstract.
The authors of this paper, in cooperation with others, are working to create an online, open access database that presents and analyzes the metrical patterns of all Greek and Roman drama. We have begun with Euripides, creating XML versions of each play's Greek text and translation, using for lyric sections the scansions of Frederico Lourenço's *The Lyric Metres of Euripidean Drama*. The text is marked with various XML features indicating speaker changes, meters, metra/cola, periods, and basic divisions of the play. Each syllable of the play is identified and tagged as long or short via a combination of automatic and manual scansion. With the help of JavaScript and standard web design tools such as HTML and CSS, the XML versions of the plays are then used to create a website that shows scansion throughout the plays, displays metrical patterns in ways easy to comprehend, and allows one to see numerous statistical features of the tragedians' use of meter. Alongside the XML documents, we make use of JSON files to generate a navigational grid, keep track of meters used in the play, connect the Greek text and the translation, and associate the names of characters with information such as their gender and status. It is hoped that when completed the database will be useful not only to scholars interested in Greek drama's meter and music, but also to students and theater practitioners.

Keywords.
Meter, Euripides, XML-TEI annotation, tragedy, database, JavaScript, JSON.

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BIBLIOGRAPHY

Aichele 1971: K. Aichele, *Das Epeisodion*, in W. Jens (ed. by), *Die Bauformen der griechischen Tragödie*, Wilhelm Fink Verlag, München, pp. 47-83.

Barrett 2007: W.S. Barrett, *Lyric-and-Iambic Duets in Euripides*, in M.L. West (ed. by), *Greek Lyric, Tragedy, and Textual Criticism: Collected Papers*, Oxford University Press, Oxford, pp. 386-419.

Chamberlain 2021: D. Chamberlain, *Greek and Roman Verse - Audio-Visually Enhanced* [http://hypotactic.com/ (2021-8-3)].

Colombi *et al.* 2021: E. Colombi, L. Mondin, L. Tessarolo and A. Bacianini, *Pedecerto* [http://www.pedecerto.eu/public/index (2021-8-3)].

Conser 2018: A. Conser, *Aconser/Greek_scansion*, Python [https://github.com/aconser/greek_scansion].

Conser 2020: A. Conser, *Pitch Accent and Melody in Aeschylean Song*, «Greek and Roman Musical Studies» VIII, 2, pp. 254-278.

Conser 2021: A. Conser, *The Musical Design of Greek Tragedy*, Dissertation, Columbia University, New York.

Crane *et al.* 2021: G. Crane *et al.*, *Perseus Digital Library* [http://www.perseus.tufts.edu/hopper/ (2021-14-3)].

Csapo 1999-2000: E. Csapo, *Later Euripidean Music*, «Illinois Classical Studies» 24-25, pp. 399-426.

Dale 1968: A.M. Dale, *The Lyric Metres of Greek Drama*, 2nd edition, Cambridge University Press, London.

De Poli 2013: M. De Poli, *Fra metro e parola: considerazioni sulla poesia drammatica Greca*, Acta Sileni V, S.A.R.G.O.N., Padova.

Diggle 1981-1994: J. Diggle, *Euripidis fabulae,* 3 volumes, Clarendon Press, Oxford.

Fusi 2021: D. Fusi, *Chiron* [https://fusisoft.net/chiron/ (2021-8-3)].

Goldhill 2013: S. Goldhill, *Choreography: The Lyric Voice of Sophoclean Tragedy*, in R. Gagné-M. Govers Hopman (ed. by), *Choral Mediations in Greek Tragedy*, Cambridge University Press, New York, pp. 100-129.

Hall 2002: E. Hall, *The Singing Actors of Antiquity*, in P. Easterling-E. Hall (ed. by), *Greek and Roman Actors: Aspects of an Ancient Profession*, Cambridge University Press, Cambridge, pp. 3-38.

Kauer-Lindsey 1958: R. Kauer-W.M. Lindsay, *Terenti Afri Comoediae*, reprint of 1926 edition with additions by O. Skutsch, Clarendon Press, Oxford.

Leo 1895-1986: F. Leo, *Plauti Comoediae*, 2. Aufl., Weidmann, Berlin.

Lindsay 1904-1905: W.M. Lindsay, *T. Macci Plauti Comoediae*, Clarendon Press, Oxford.

Lourenço 2011: F. Lourenço, *The Lyric Metres of Euripidean Drama*, Humanitas Supplementum 12, Centro de Estudos Clássicos e Humanísticos, Coimbra, available on line at https://classicadigitalia.uc.pt/en/livro/lyric_metres_euripidean_drama.

Moore 2008: T.J. Moore, *When Did the* Tibicen *Play? Meter and Musical Accompaniment in Roman Comedy*, «Transactions of the American Philological Association» CXXXVIII, 1, pp. 3-46.

Moore 2012: T.J. Moore. *Music in Roman Comedy*, Cambridge University Press, Cambridge.

Murray 1902-1909, G. Murray, *Evripidis Fabvlae*, Clarendon Press, Oxford.

Parker 1997: L.P.E. Parker, *The Songs of Aristophanes*, Clarendon Press, Oxford.

Pickard-Cambridge 1968: A.W. Pickard-Cambridge, *The Dramatic Festivals of Athens*, revised by J. Gould and D.M. Lewis, Clarendon Press, Oxford.

Pretagostini 1978: R. Pretagostini, *Sistemi κατὰ κῶλον e sistemi κατὰ μέτρον*, «Quaderni Urbinati di Cultura Classica» 28, pp. 165-179.

Questa 1984: C. Questa, *Numeri innumeri: ricerche sui* cantica *e la tradizione manoscritta di Plauto*, Edizioni dell'Ateneo, Roma.

Questa 1995: C. Questa, *Titi Macci Plauti Cantica*, QuattroVenti, Urbino.

Scott 1984: W.C. Scott, *Musical Design in Aeschylean Theater*, University Press of New England, Hanover, New Hampshire.

Scott 1996: W.C. Scott, *Musical Design in Sophoclean Theater*, University Press of New England, Hanover, New Hampshire.

Tauber 2017: J. Tauber, *Jtauber/Greek-Accentuation*, Python [https://github.com/jtauber/greek-accentuation].

Tueller 2021: M. Tueller, *Hylas at the SCS* [https://miketueller.github.io/article/hylas-at-scs/ (2021-8-3)].

West 1982: M.L. West, *Greek Metre*, Clarendon Press, Oxford.

Wilson 1999-2000: P. Wilson, *Euripides' Tragic Muse*, «Illinois Classical Studies» 24-25, pp. 427-449.

Zimmermann 1985-1987: B. Zimmermann, *Untersuchungen zur Form und dramatischen Technik der Aristophanischen Komödien*, 2. Aufl., 3 Bd., A. Hain, Königstein; Athenäum, Frankfurt.