The Ancient Graffiti Project: Geo-Spatial Visualization and Search Tools for Ancient Handwritten Inscriptions

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ABSTRACT

This paper discusses how the Ancient Graffiti Project publishes the digital content of ancient epigraphic material and makes handwritten inscriptions from the first century AD more accessible through the use of geo-referenced, spatial interfaces, interlinked and expanded reference data, and innovative tools that enhance searching. Ancient graffiti are texts, but they are texts that exist within a physical environment. We have designed the Ancient Graffiti Project (AGP) to provide a richer understanding of these handwritten inscriptions from the first century AD in their archaeological context. Interactive maps allow a user to retrieve and analyze all the graffiti in a particular location. These and other tools, from filters that refine searches to brief descriptions and translations to explain the content of these writings, have been designed to reach multiple audiences, including scholars, students, and interested members of the public. We discuss how we have designed AGP from its inception to be integrated within and interoperable with the Epigraphic Database Roma. The spatial and physical context of graffiti also allows us to link with other spatially oriented digital projects on the ancient world, including the ancient gazetteer Pleiades.

CCS CONCEPTS

•Applied computing →Arts and humanities;

KEYWORDS

epigraphic databases, visualization, ancient history, archaeology

ACM Reference format:

Rebecca Benefiel, Sara Sprenkle, Holly M. Sypniewski, and Jamie White. 2017. The Ancient Graffiti Project: Geo-Spatial Visualization and Search Tools for Ancient Handwritten Inscriptions. In *Proceedings of Digital Access to Textual Cultural Heritage, Göttingen, Germany, June 2017 (DATECH '17)*, 6 pages.
DOI: 10.1145/3078081.3078104

1 INTRODUCTION

The handwritten wall-inscriptions (graffiti) of ancient Pompeii and Herculaneum provide abundant, fascinating epigraphic material

for the study of Roman antiquity. Graffiti are highly individualized and heterogeneous in content, format, handwriting, and expression; therefore, multiple factors hinder attempts at studying ancient graffiti collectively and holistically. The Ancient Graffiti Project (<http://ancientgraffiti.org>) has been designed: 1) to provide a scholarly resource for the study of graffiti by providing accurate, comprehensive, and up-to-date critical editions of each inscription; 2) to lower the barriers to the study of ancient graffiti and everyday Latin for non-expert communities, including high school students; and 3) to facilitate new avenues of research through digital tools, a user-friendly interface, and a digital resource that is interoperable and integrated within leading digital humanities initiatives.

As a born-digital project, AGP is designed to offer ample illustration and rich contextual data for each inscription. Many graffiti are deteriorating rapidly as the wall plaster upon which they were written remains exposed to the elements. We have therefore begun a program of fieldwork, surveying and recording the ancient graffiti that still survive to document each inscription as fully as possible before it disappears.

This paper presents our design and implementation of the Ancient Graffiti Project (AGP). AGP unites data from the Epigraphic Database Roma (edition of text and metadata, which our team prepares for EDR) with additional metadata specific to this class of inscriptions, which we are collecting from our fieldwork.

In Section 2 of this paper, we describe the motivation for developing the Ancient Graffiti Project, including the limitations of current epigraphic databases and the opportunities presented by a new digital resource focused on ancient graffiti. In Sections 3 and 4, we outline the methodology we have employed in constructing AGP and discuss how we enhance the epigraphic data presented in EDR with graffiti-specific metadata. The Ancient Graffiti Project architecture is described in Section 5, while the features of the user interface are documented in Section 6. Section 7 offers our reflections on the current state of the Ancient Graffiti Project prototype and discusses our plans for future development.

2 MOTIVATION FOR THE PROJECT

The concept and design for the Ancient Graffiti Project arose from work with the Epigraphic Database Roma (EDR). The aim of EDR (www.edr-edr.it) is to re-edit, digitize, and make publicly available the ancient inscriptions of Italy from the archaic period up to the seventh century AD. Launched in 1999, EDR now contains more than 81,000 inscriptions. While a great majority of these inscriptions were carved into stone, EDR was designed to incorporate other inscribed material as well, including wooden tablets, silver rings, and ancient graffiti scratched on walls [3, 6].

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DATECH '17, Göttingen, Germany

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DOI: 10.1145/3078081.3078104

EDR was organized around a collaborative framework, with teams responsible for inscriptions from different geographical areas (http://www.edr-edr.it/it/strutt_it.php). Rebecca Benefiel was the EDR supervisor responsible for the handwritten wall-inscriptions of Campania. She began editing the ancient graffiti of Pompeii in 2011 and contributing inscriptions to EDR in 2012. As Benefiel and her team moved forward, it became clear that these ancient graffiti and their well-preserved archaeological context offered additional information that was not applicable for other types of inscriptions. Benefiel began to consider how the medium-specific characteristics of graffiti could be expressed through additional metadata and tools for visualization. With the addition of Sara Sprenkle as Technical Director in 2013 and Holly Sypniewski as Assistant Director in 2015, we designed and began to build a project that would work in conjunction with EDR and provide direct access to the corpus of handwritten inscriptions [2].

EDR is a well-established project with a stable infrastructure for data, a clear set of guidelines for editing and standards for digital publication, and a supervisory structure that ensures quality and consistency of the published inscriptions. As such, it provides a solid foundation for AGP. EDR also has a memorandum of understanding with the Italian Ministry of Culture to publish digital images of Italian cultural heritage for educational use. This crucial agreement allows EDR to host pictures of the artifacts which bear ancient inscriptions.

Inscriptions carved onto stone or marble make up more than 80% of the entries in EDR; they often present longer texts and can be formulaic in nature, which allows them to be understood and translated relatively easily, as long as one knows the conventions and abbreviations for the particular type of inscription. Texts inscribed on other types of material are not as easily or quickly comprehended. Additional filters and metadata for specialized corpora such as brick stamps or graffiti are thus best provided by individual projects that can be tailored to the unique physical and orthographic features of the collection. In general, ancient graffiti are brief, fragmentary texts with frequent non-standard abbreviations. They require greater context to be understood. A digital resource that provides translations and descriptions of the content of each inscription will therefore promote users' understanding of these handwritten inscriptions.

The specific archaeological context of graffiti in Herculaneum and Pompeii can almost always be determined due to the optimal preservation of these sites, and context is essential to interpretation of these often enigmatic texts. For Herculaneum, however, there was no open-access or copyright-free map of the site to use as a base for AGP. Three published plans of the site were unavailable. OpenStreetMap (<https://www.openstreetmap.org>) featured only a few scattered buildings for the site of Herculaneum. Pleiades, the gazetteer of ancient places (<https://pleiades.stoa.org/>), provided large-scale geographic visualization at the level of the city. We have therefore created a full-site plan of the site in OpenStreetMap and we are currently working with Pleiades to add geographic detail at a more granular level so that it is possible to point to a precise location or building within the ancient city.

With a project dedicated to a particular class of inscription, it is possible to add additional details that provide more specific information relevant to that kind of artefact. For example, EDR offers data

Figure 1: AGP data collection and digitization process

fields for the findspot and current location of an inscription. For graffiti, when we know not only the general location but the type of property where the message was found, the location of graffiti can be enhanced by categorizing the type of building (e.g. public building, house, tavern, inn). Moreover, many ancient buildings and properties in Pompeii have been assigned multiple names over the years. A focused epigraphic project, such as AGP, can ensure standardization of individual addresses and the names of precise locations within a city, at the level of the individual building. In addition, numerous fields are required to capture the array of measurements necessary to document a graffiti fully. As handwritten texts, graffiti are rarely written in even, horizontal lines. Letter sizes and shapes can vary within a single word, since some texts have elaborate flourishes for certain letters. Graffiti are also written at varying heights on the wall surface. It is therefore helpful to publish the height of the graffiti from the ground and a range of measurements to provide full context for each inscription.

3 AGP METHODOLOGY

Envisioning an epigraphic database focused specifically on ancient graffiti, we began to design the Ancient Graffiti Project to be a digital resource that would be interoperable with EDR and that would provide enhanced metadata and search capabilities for ancient graffiti. We started by determining what graffiti-specific data would be helpful to scholars and non-specialists who wish to study these inscriptions. We then developed a two-part approach to gathering data and publishing each graffiti in the AGP database, as shown in Figure 1.

As with all epigraphic projects, we begin with a study of the published information on each graffiti, gathering bibliography and reconciling variant readings. This information is structured by the EDR submission format. Since many graffiti are still extant *in situ*, we have the opportunity to study them on-site with personal autopsy. Our project therefore incorporates fieldwork to collect a greater range of contextual data and to create a series of illustrations for each inscription in the form of photographs, enhanced photographs, and line-drawings. After we process the field data, we input the data and upload the images to EDR, where they are published under the aegis of the EDR's agreement with the Italian Ministry of Culture. We host the AGP-specific data (detailed in

Figure 2: Line drawing of CIL IV.10567

Section 4) in our own database. At periodic intervals, we request an export of data from EDR, which we then import back into AGP.

In parallel to the data collection and processing, we developed the infrastructure to manage the data (Section 5) and iteratively developed tools to help users visualize and understand ancient graffiti (Section 6). We frequently seek feedback from focus groups of potential users about the interface and then modify the interface, informed by the feedback.

We have actively sought to incorporate AGP into the epigraphic landscape. The launch of the EAGLE (European network of Ancient Greek and Latin Epigraphy) search engine in late 2015 revolutionized the field of epigraphy, as EAGLE now makes the epigraphic content of more than twenty databases available via a single portal (<http://www.eagle-network.eu/basic-search/>). The Ancient Graffiti Project is one of these contributing partners.

4 AGP DATA

4.1 Additional Data

Along with greater specificity regarding locations listed in Section 2, we incorporate additional metadata into the record of each graffito in the AGP database. Here we mention three new types of data that we have implemented: captions that introduce each graffito, translations of every text into English, and measurements that provide greater context for graffiti.

4.1.1 Captions. Ancient graffiti are usually brief texts, and, even when a scholar can read Latin, it is often hard to make sense of many of these messages. Graffiti might feature a partial or interrupted word, a set of initials, or only the first few words of a popular poem or quotation of literature. In the graffito in Figure 2, it is possible to recognize certain words, but what does the rest of the text mean? We therefore decided to create a short description or caption for each graffito. The caption briefly summarizes the content of the text and appears as a heading for each inscription. For example, we describe the inscription shown in Figure 2 as a “Grammatical Exercise.” (For more information on this graffito, see <http://ancientgraffiti.org/Graffiti/graffito/AGP-EDR140039>.)

Ancient graffiti, and indeed most inscriptions, have traditionally been presented without heading or guidance to the content. We chose to provide these captions both for the benefit of scholars

and to reach a broader base of users, including undergraduate and high school students who may be unaware of the range of topics that ancient Romans addressed when writing graffiti on their walls. These captions are also designed to give users an overview of each inscription and increase their ability to skim a results page quickly.

4.1.2 Translations. Translations are the most expedient way to open the content of an epigraphic database to the broadest group of users. AGP is the first epigraphic resource for ancient graffiti that offers a translation of each inscription. These translations appear on the results page for each search and on the individual graffito page (“See more information”) for each inscription.

Given the brief nature and the fragmentary state of many graffiti, there are times when an inscription cannot be translated in a way that would convey its content to casual readers. Our translations are literal and adhere as closely to the original Latin word order as possible while maintaining fluidity and sense. When graffiti are fragmentary, we use ellipses in the translation to denote parts of the text that are too damaged to translate. If a name is abbreviated, we offer the missing letters in parentheses, e.g. A(ulus). Parentheses are also used to provide alternate readings when a word may have multiple translations and the context does not make clear which option is correct. We include question marks among the captions and translations to make clear that these personalized inscriptions can involve a level of uncertainty.

4.1.3 Measurements. As we discussed in Section 2, one of the motivations for AGP was to provide greater contextual metadata for graffiti since their appearance differs so greatly from many other types of inscriptions. Providing a fuller array of measurements for each graffito can help scholars better understand the physical presentation and visual impact of these texts. Recent scholarship has discussed the height of a graffito from the ground as a possible indicator of who wrote it [5].

Because we are conducting our own field research as part of AGP, we have been able to collect detailed measurements for each surviving graffito, including the height of each inscription from the ground. When available, this measurement is published on AGP as part of the individual results page for each graffito.

4.2 Location Data

AGP provides standardized data for the location of each graffito in Pompeii and Herculaneum. Because it is valuable to study graffiti in their spatial context, the primary user interface is structured to search for graffiti by their location. It is therefore essential to have a consistent and accurate set of the findspots of graffiti. Since our project is currently focused on these two cities, we can provide fine-grained contextual information about the precise buildings where graffiti were found. We do not publish the precise coordinates of a graffito within a house or on a particular wall, to protect this sensitive material since many graffiti remain *in situ* and are often unprotected.

Providing accurate, up-to-date locations for these inscriptions addresses the largest obstacle at present to studying and organizing ancient graffiti collectively: the difficulty involved in determining a text’s location. Currently, it requires several steps even to collect all the graffiti from a particular location. For example, the ancient

Figure 3: Architecture of AGP

graffiti from the theater corridor in Pompeii were scattered in four separate locations within the *Corpus Inscriptionum Latinarum* (CIL) vol. IV, its supplements, and its addenda. Furthermore, a complete revision to the numbering system of Pompeian addresses that occurred after the publication of the city map in CIL IV (1871) has left more than a thousand ancient graffiti in Pompeii unable to be located on a current map of the site. Other city-blocks have been subsequently re-numbered, so that the published locations for nearly half of Pompeian graffiti are incorrect or require correlation with a map that is no longer printed (cf. Franklin [4]). Additionally, the locations of some graffiti are known only by the name of the building used at the time of publication. Many buildings have had several names, some of which were used only briefly.

In AGP, all locations for graffiti have been checked against the publication history, correlated to the current maps of Pompeii and Herculaneum, and standardized for consistency. This research has allowed us to create a locational data set with these features:

- Primary property name, presented in English
- Designated primary entrance for each property
- Classification of each location by property type

We also identify the category of building from among eight broad classifications: brothel, house, inn, public building, sacred space, shop, tavern, and workshop. In so doing, AGP seeks to provide greater context for graffiti. Providing building classifications also gives a user the ability to compare types of graffiti that appear in multiple locations with the same general function.

5 AGP ARCHITECTURE

Before we discuss how users can access and interact with our data through our Web interface, we describe how we implemented our application. The architecture of AGP, as shown in Figure 3, is built on freely available tools. We store our data in a PostgreSQL database and leverage Elasticsearch for fast indexing and searching of the data. Information about the properties in the maps (e.g., name and location in the image) are stored in XML files. The Web application’s backend is built using JavaEE technology and Spring MVC. The front end provides users with access to the data in human-readable (HTML) and machine-readable (JSON) forms.

We have created image maps of each city and we store information about each property, including name and the representations

Figure 4: Example results page on AGP

of each shape. Since no copyright-free map of Herculaneum was available, we created an open-access, non-proprietary map of the site in OpenStreetMap (<https://www.openstreetmap.org/#map=19/40.80597/14.34756>). For Pompeii, we use a map from the Pompeii Bibliography and Mapping Project (<http://digitalhumanities.umass.edu/pbmap/>) by Eric Poehler, who generously shared it with us.

Bringing together the location data and map images, the application generates interactive maps, which are implemented using freely available jQuery plugin ImageMapster (<http://www.outsharked.com/imagemapster/>) and which are used to enable searching and to visual results. Our prototype’s source code is freely available on Github at: <https://github.com/AncientGraffitiProject>.

6 AGP USER FEATURES AND TOOLS

The goal of the AGP user interface is to enable users—experts or the curious—to discover and learn more about ancient graffiti. This section describes the various tools we provide for all users.

6.1 Discovery Tools

We offer several ways for users to explore our collection. A menu at the top of the screen offers the possibility to browse all the inscriptions of the database. However, making sense of the large collection may overwhelm users. Therefore, we offer several ways for users to search the collection in smaller subsets.

6.1.1 Search by Map. In response to the difficulties currently involved in finding the graffiti from a particular location (see Section 4.2), we designed a search mechanism that allows users to search for graffiti by selecting a location, using interactive maps of the sites. When a user hovers over a particular building, the name and address of that building will appear. For an expert, the property information will tell them if they are looking at the appropriate location, while a non-specialist will learn the name and can easily scan through the city’s buildings. Users can select one or multiple locations and then click “Submit” to search those locations.

6.1.2 Filters. To help users better understand the large corpus of ancient graffiti, we designed a set of filters to work in conjunction with browsing capability. These filters allow a user to refine and/or restrict a search, or to create a multi-faceted query. The filter options appear on the left hand side of the screen of any results page. The options include various metadata, such as city, property type, writing style, language, and others. A user can select and combine any number of filters. One example might be to search all graffiti in Herculaneum (City) that appear in taverns (Property Type) and were written in charcoal (Writing Style). It is also possible to search entire sections of the site by choosing entire insulae or city-blocks. With each filter selected or deselected, the refined results are automatically returned.

Combining multiple filter selections involves both OR and AND selection. Choosing multiple selections within a filter category will retrieve graffiti that fulfill either (OR) characteristic, e.g., selecting both “Boats” and “Gladiators” in the Drawing Category will return graffiti that feature boats *or*, i.e. as well as, graffiti that feature gladiators. Selecting across filter categories will refine or limit a search (AND). For example, choosing Insula IV of Herculaneum (Insula) and Greek (Language), will return only these graffiti that fulfill both characteristics, i.e., they appear in Herculaneum, Insula IV, *and* they are written in Greek (see Figure 4).

6.1.3 Featured Graffiti. We have created a page of “Featured Graffiti” to provide an entry point for non-specialists to learn about ancient graffiti. At present, we have focused on Herculaneum and have selected representative inscriptions (e.g. names, notes, poetry, alphabets). We have designed this page with students and teachers in mind. One function is a button that allows a user to hide or show the translation of the graffiti, which could be used by a teacher to quiz a class or a student to quiz him or herself. The inscriptions are presented with links to full information on the graffiti and images, if available. We plan to create further content and enhance the functionality of this page.

6.2 Presenting Graffiti

We carefully designed AGP to present graffiti in ways that highlight their distinguishing characteristics and features.

The results page is designed to be understood equally well by scholars and non-experts. It provides basic information: a brief identification or caption, the text of the graffiti (or a description of the image if a figural graffiti), and its provenance, including city and individual property. A link then takes the user to a page with more information. The location of the graffiti retrieved by the search is highlighted on a small map on the results page. The particular building or findspot is also presented as a hyperlink so that it is possible to then retrieve with a single click all the graffiti that appear in the same location.

6.2.1 Individual Graffiti. Clicking “See more information” from the results page takes a user to the Individual Graffiti page. Here, the caption and text of the graffiti (or description of the image, in the case of a figural graffiti) are presented first, with a button to display a key explaining epigraphic conventions used in presenting the text. Then follows a table of information, including the translation, format and context information, critical apparatus, bibliography,

Figure 5: Photograph of CIL IV.10547

and a link to the inscription in EDR. On this individual graffiti page, it is also possible to download its information as JSON.

On the right of the page, an image gallery presents any available illustrations. Photographs come from the fieldwork we conducted in Herculaneum in 2014 and 2016. We recently decided to create a series of images for each graffiti when the graffiti still survives. It is difficult to photograph graffiti, since there is sometimes minimal contrast between the subtle scratches of the ancient graffiti and other marks on the wall-plaster. We are therefore creating enhanced photographs and line-drawings to render the inscription more legible. These images appear in a gallery that features a central image with smaller images below. The gallery allows you to click among the images, so that if you cannot see the graffiti in the photograph (see Figure 5), you can then click the enhanced photograph with the overlay marking out the text (see Figure 6) and toggle back and forth between images. This innovative feature of AGP assists the user in identifying what are often now faint traces of letters. (For further information on this inscription, see <http://ancientgraffiti.org/Graffiti/graffito/AGP-EDR140131>.)

Double-clicking on the main image in the image gallery takes a viewer to a higher-resolution photo on the EDR server, which allows for closer examination of a larger image. Below the image gallery, or simply on the right of the page if no images are available, is a map highlighting the findspot of the graffiti.

6.2.2 Individual Property. Every individual graffiti page also includes a link to a page providing metadata about the property where it was found. This property metadata page lists the city (with link to Pleiades), address, standard name in English, standard name in Italian, and property category. The page provides the user with context about the location of the graffiti and highlights the location of the property on the city map. Users can download this property information as JSON. Finally, the page provides a link by which a user can retrieve all the graffiti in that particular property.

Figure 6: Enhanced photograph of CIL IV.10547 with overlay

Figure 7: View of property metadata page

6.3 Linking to related resources

We have created bidirectional links between AGP and EDR at the level of the individual inscription. This allows a user who has discovered a graffito through a search in EDR to move to AGP and learn more about ancient handwritten inscriptions. Conversely, a student who has approached AGP to learn about writing in a particular building in Pompeii and, for example, discovers an interesting name may then move to EDR and search for that name among other types of inscriptions in Pompeii, or indeed in all of Italy.

The city of each graffito and the property metadata pages are also linked to Pleiades at the city-level for both Herculaneum and Pompeii. For properties in Pompeii, we plan to create links to the Pompeii Bibliography and Mapping Project (<http://digitalhumanities.umass.edu/pbmap/>) and to the photographic archive, Pompeiinpictures.com. We are also working with Pleiades to capture locations at the level of the individual property.

7 CONCLUSIONS

The Ancient Graffiti Project provides an accurate, comprehensive critical edition of handwritten inscriptions for scholars, while making this material available in an open-access digital format that is also accessible to high school students, teachers, and interested members of the general public. AGP has been well-received, as indicated by over 43,000 views since 2013 and from feedback on presentations at conferences, universities, and high schools. AGP is already used in high school and university classrooms, cited in scholarship [1], and catalogued in the Research Databases and Digital Collections of the American Academy in Rome (<http://aarome.org/research/resources/periodical-indexes>).

We have so far made more than 500 inscriptions available on AGP. We continue to expand the content to include more inscriptions from Herculaneum, Pompeii, and the villas of the surrounding countryside. AGP also holds the potential to incorporate ancient sites that have preserved graffiti and that are located outside of central Italy. Since it is difficult to photograph ancient graffiti and most of these inscriptions have not previously been illustrated, we are also currently creating a series of enhanced photographs and line-drawings to represent the palaeography and visual aesthetic of these inscriptions.

We also plan to refine the tools and features of the site. Our top priorities are making the data more easily accessible for bulk download through a REST API and creating more interactive maps that can better show the distribution of graffiti at the property level. We will also be incorporating new search features and linking to additional digital resources on the ancient world.

ACKNOWLEDGMENTS

We thank Soprintendente Massimo Osanna and the Soprintendenza Archeologica Speciale per Pompei, Ercolano e Stabia for the opportunity to work on-site documenting these inscriptions. We are grateful to the National Endowment for the Humanities for a Digital Humanities Start-Up Grant. Our thanks go also to the Associated Colleges of the South, the Center for Hellenic Studies, the Mellon Foundation for Digital Humanities at Washington and Lee University, and our institutions for their support. AGP would not be possible without our wonderful team. For a full list of team members, please see: <http://ancientgraffiti.org/about/about-us/>

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