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QUALITATIVE AND QUANTITATIVE APPROACHES IN DIGITAL EPIGRAPHY

1. Introduction

Inscriptions are complex historical documents, whose significance is fully acknowledged only when their textual features (script, language, content, etc.) are studied in combination with the contextual information (on the material support and its provenance). Thus, epigraphy stands at the intersection of different disciplines which are especially concerned with one of those two aspects: philology and linguistics as regards the study of the text, archaeology and history of art as regards the study of the text-bearing object. It has been the task of digital epigraphy to build upon the specific methods those disciplines have developed for the electronic recording and machine processing of textual and material culture's data, selecting and integrating established computational techniques, while also suggesting novel solutions in relation to the specific challenges posed by the epigraphic (re)sources (De Santis, Rossi 2018, XIII).

The present paper aims at assessing the influence that the abovementioned disciplines – with their statistical or documentary approaches – have exerted on the "hybrid" field of digital epigraphy over time, tracing the trends in the application of quantitative vs descriptive methods, since the pioneering projects in the 1960ies until the most recent developments. The assumption is that a steadier self-consciousness of the discipline begins from the knowledge of its history, and that understanding the reasons which guided specific choices can help informing future directions of research.

2. The pioneers: indexation vs classification

After the mid-XXth century, the vastness of the documentary basis provided by comprehensive epigraphic editions such as the *Corpus Inscriptionum Latinarum*, *Corpus Inscriptionum Greacarum*, *Corpus Inscriptionum Semiticarum* and subsequent initiatives – undertaken in the previous century under the aegis of the European Academies – allowed and at the same time called for the automated treatment of the epigraphic documents. While on less-resourced corpora the application of computing technologies was experimented for linguistic objectives such as script decipherment (cfr. e.g. de Virville *et al.* 1970 on Meroitic; Packard 1971 on Linear A; Parpola 1971 on the Indus script), the main concern of Greaco-Roman epigraphy was to systematize and ease the consultation and analysis of the huge amount of available data, thus initiating the debate on the digital approaches to epigraphy.

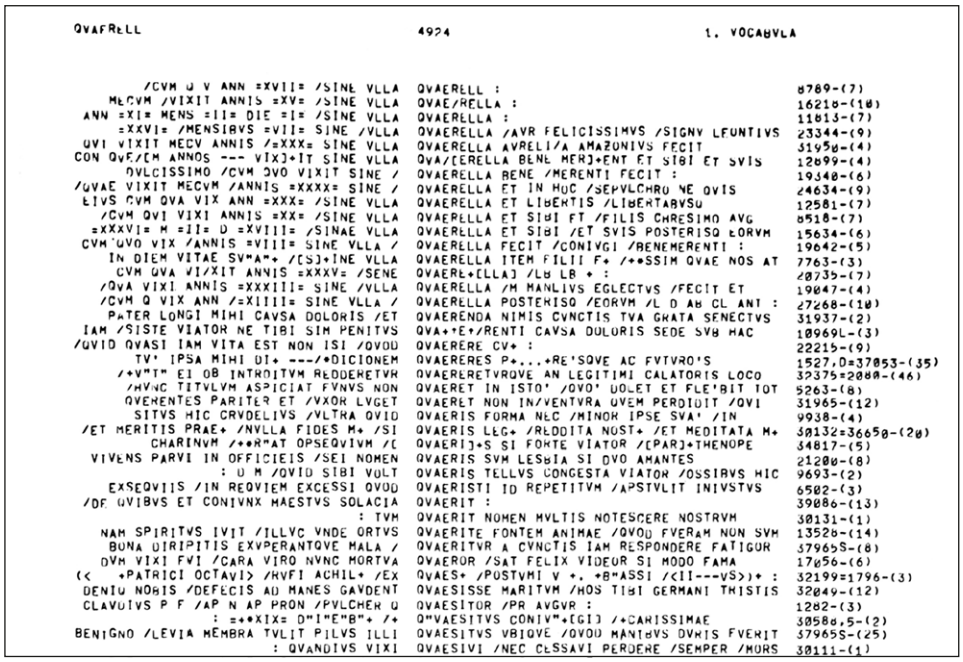


Fig. 1 – Excerpt of an output example of *CIL* VI's KWIC index (Jory 1975, 20, fig. 2, partim).

Two pioneering projects were presented at the very first International Congress of Latin and Greek Epigraphy, held in Munich in September 1972 (Baldacci, Ianovitz, Maretti 1973; Corbier, Janon 1973). Few months later, in December 1972, this theme was at the centre of the roundtable "Applications à l'épigraphie des methodes de l'informatique", organized by the CNRS in Marseille. The results of this milestone event in the early discussions on the automated processing of inscriptions were soon summarized in an article by M. Corbier (Corbier 1973), and later detailed in the 1975 volume of the journal *Antiquités Africaines*, whose section hosting the proceedings of the roundtable is meaningfully divided into three parts: the first one devoted to indexation, the second one to the presentation of a documentary system, and the last one to statistical analyses.

In the first part, the project presented by E.J. Jory of the University of Western Australia stood out as it had already produced a consistent output, a Key Word In Context (KWIC) index of the whole volume VI of the *Corpus Inscriptionum Latinarum* (*CIL*), which was «the largest collection of inscriptions from one geographical area [Rome], comprising about 25 % of all the inscriptions edited in *CIL*» (Jory 1975, 15) (Fig. 1). The automated

compilation of indices was also one of the objectives of the project presented by a team of the Università degli Studi di Milano with the contribution of the Consiglio Nazionale delle Ricerche (Baldacci *et al.* 1975), whose outstanding aim was the complete philological re-edition and update of *CIL*'s volume V. Indexation for linguistic purposes was instead experimented on a group of epigraphs from *CIL*'s volume XIII by a project of the Université de Liège, aimed at extracting the words of the inscriptions, referencing them in the texts, and attributing onomastic, morphological and syntactic information (Evrard 1975). Such early efforts towards word indexation in epigraphy can be considered to be in the wake of the development of computational methods applied to the processing of texts in the natural language, pioneered by the concordancing work of Roberto Busa S.J.'s *Index Thomisticus* since the late 1940s (https://www.corpusthomisticum.org/) (Busa 2004). Their usefulness was philological and linguistic, for the possibility of listing and comparing occurrences, restoring lacunary textual passages and compiling lexicographic lists, but it was also historical, as the indexation of lexical and onomastic items, as well as of other information that we now call textual metadata, could ease demographical and sociological studies of the ancient world, through statistical analyses.

The mathematical approach was specifically dealt with in the third part of Marseille's meeting proceedings, devoted to some case-studies of quantitative analyses carried out on the vast Graeco-Roman epigraphic corpora, with diverse objectives: from the palaeographical studies (Stéfan 1975 on Greek epigraphy) to the social studies (Aguilella Almer *et al.* 1975 and Borrillo *et al.* 1975 on Latin epigraphy).

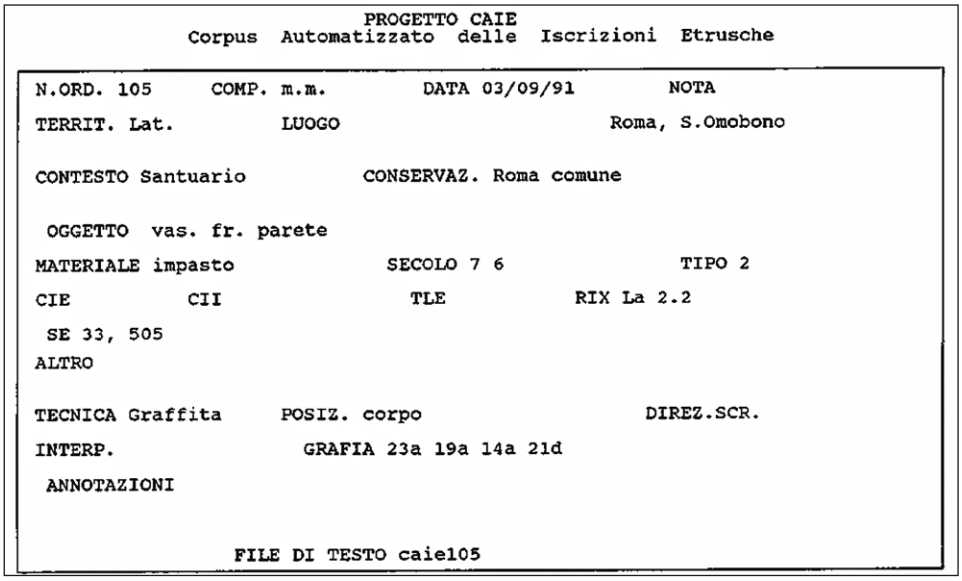
The need for a more comprehensive approach to the automated processing of inscriptions, that could itself ease the creation of indexes and the quantitative analyses of the sources, was underlined by many scholars attending Marseille's meeting, who defended the traditional conception of the epigraphic material as a historical source (cfr. in particular P.-A. Février's and R. Helly's positions; Corbier 1973, 451). The French team hosting the roundtable was in fact working on the development of the cataloguing system SYCIL, first conceived on the data of volume VIII of the *CIL*. The system (described in papers forming the second part of the abovementioned volume, among which we will just mention Corbier 1975 and Chouraqui *et al.* 1975) could be queried on the basis of the user's requests and could be expanded to record other kinds of information than just those recorded in the indices of the Corpus, in order to capture from the epigraphs the relations that are meaningful to historical research. This need to record the contextual information (i.e. material, geographical, historical) of the epigraphic source benefited from the technological advancements made in computational archaeology by the researchers of the very *Centre d'Analyse Documentaire pour l'Archéologie* of the French CNRS, directed by Jean-Claude

Gardin (Moscati 2013), as it is witnessed by the *Comptes Rendus du Comité de Direction* of the Centre of the years 1971 and 1972, published within the Virtual Museum of Archaeological Computing (Moscati, Orlandi 2019) (http://archaeologicalcomputing.lincei.it/attachment/Gardin/JCG1_2_1971_Compte_rendu.pdf; http://archaeologicalcomputing.lincei.it/attachment/Gardin/JCG1_2_1972_Compte_rendu.pdf).

Since then, the documentary and classificatory needs in digital epigraphy became more cogent than indexation and statistical analysis. Few projects of automated extraction of the *CIL* indexes were actually carried on (Di Stefano Manzella 1990, 138-139); the same can be said for the statistical works (see Agnati 1999 and bibliographical references therein). On the other hand, by end of the 1970ies, many cataloguing initiatives started to flourish, supported by the revolution of microinformatics. In 1989 the participants to Lausanne's conference "Épigraphie et informatique", solicited by the concern of the multiplication and dispersal of efforts on the same cataloguing tasks, expressed the need of a census of the existing digital epigraphy projects. Its results, published by Bielman, Ducrey and Frei-Stolba in the «Archeologia e Calcolatori» 1991's volume, counted already 40 projects in the domain of the Graeco-Roman epigraphy, some of which are still active (cfr. e.g. http://petrae.huma-num.fr/, http://db.edcs.eu/epigr/epi.php, http://insaph.kcl.ac.uk/).

3. Enlarged horizons and the need for standardization

At the very beginning of that decade, each annual volume of «Archeologia e Calcolatori» hosted at least one article devoted to digital epigraphy projects or issues, demonstrating not only the strong relation with the researches computational archaeology, but also the fervour in the field – in Italy and beyond. In particular, the 1996 volume, collecting the proceedings of the *III International Symposium on Computing and Archaeology*, included a section of 8 papers on the "Computerization of textual data", with a strong interest in epigraphy – not only in the Classics, but also in other domains of the ancient studies, such as the Italic, Aegean and Near eastern ones (cfr. e.g. Pandolfini, Moscati 1992; Godart 1996; Parmegiani 1996) (Fig. 2). The improvement of documentary systems was a catalyst of the initiatives of electronic recording of non-Classical inscriptions. Data recording in an electronic archive is *per se* a heuristic process, because of the classificatory effort it requires. Therefore, those systems were especially suited for use in the fields of research having a "younger" tradition of studies, sometimes lacking reference works such as editions of corpora and linguistic tools. Such a descriptive and taxonomical activity on "lesser-known" corpora is of course a pre-requisite of the quantitative study, in order to make sets of data consistent and rich enough to allow meaningful comparisons.


PROGETTO CAIE
Corpus Automatizzato delle Iscrizioni Etrusche

N.ORD. 105 COMP. m.m. DATA 03/09/91 NOTA
TERRIT. Lat. LUOGO Roma, S.Omobono

CONTESTO Santuario CONSERVAZ. Roma comune

OGGETTO vas. fr. parete
MATERIALE impasto SECOLO 7 6 TIPO 2
CIE CII TLE RIX La 2.2
SE 33, 505
ALTRO

TECNICA Graffita POSIZ. corpo DIREZ.SCR.
INTERP. GRAFIA 23a 19a 14a 21d
ANNOTAZIONI

FILE DI TESTO caie105

Fig. 2 – Epigraphic record from the "Progetto CAIE" database (Pandolfini, Moscati, 1992, fig. 8).

The proliferation of single initiatives of digital cataloguing entailed new challenges for the field of informatics applied to epigraphy, the most relevant of which was the need of defining and adopting common standards in order to enable interoperability. Because of the natural focus on the study of the textual aspect of the inscriptional document, the projects of digital epigraphy were prone to adopt markup languages such as SGML and later XML to describe the textual features of the inscriptions. These could be queried thanks to the development of full-text SGML-XML search engines, like the Italian TReSy (http://web.archive.org/web/20011101160300/http:/www.cribecu.sns.it:80/analisi_testuale/settore_informatico/tresy/_en_index.html). Its capability to perform retrieval of text within context was particularly effective for the study of under-resourced epigraphic languages such as Ancient South Arabian (Avanzini, Lombardini, Mazzini 2000; Avanzini, De Santis, Rossi 2018, 1-2; Fig. 3). The rich inline annotation of phenomena (primarily the editorial ones, but also the linguistic ones, those related to the disposition of the text on the support, etc.), could be easily translated into an electronic page layout in all similar to the layout of paper publications. The advantages of annotation via markup languages – such as flexibility, machine interoperability, human readability – stimulated the spread of digital epigraphic corpora, conceived as publications of philological editions on an electronic support, enriched with indices and search tools for the discovery of content.

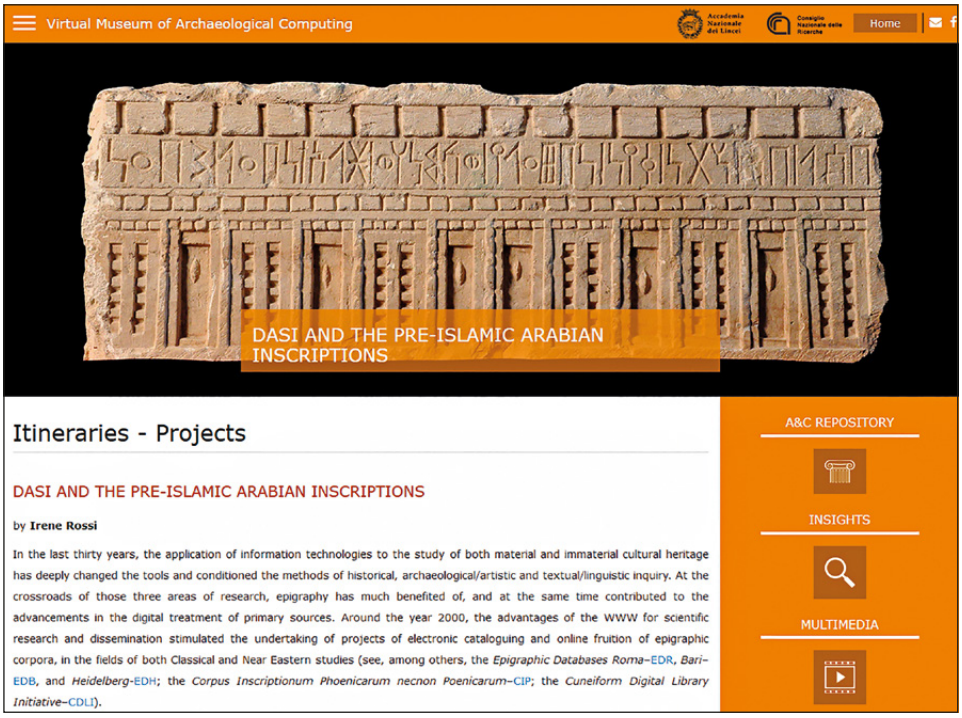


Fig. 3 – The interactive itinerary of the VMAC dedicated to the project DASI – Digital Archive for the study of pre-Islamic Arabian inscriptions, by Irene Rossi.

The success of markup languages soon urged to define shared encoding semantics and annotation guidelines. This task was carried out by the Text Encoding Initiative in the mid 1990ies. Conceived in the frame of literary and philological studies, the TEI schema pays scarce attention to the physical support of the text. As a consequence, the compliance with TEI causes a "levelling" in the description of the data related to the material and contextual aspects of the inscription, negatively impacting on the complexity of the historical information that can be extracted from the source. In response to this, a subset of the TEI specifically adapted to the features of the inscriptional sources, called EpiDoc, was released (Elliott *et al.* 2007-2016). An active EpiDoc community has grown, mainly in the domain of Graeco-Roman epigraphy, and most epigraphic projects have joined this common framework.

The description of textual features via multiple layers of inline annotation is in fact generally preferred to the parcelling of the flow of information in the boxes of a database – a matter of continuous vs discrete information.

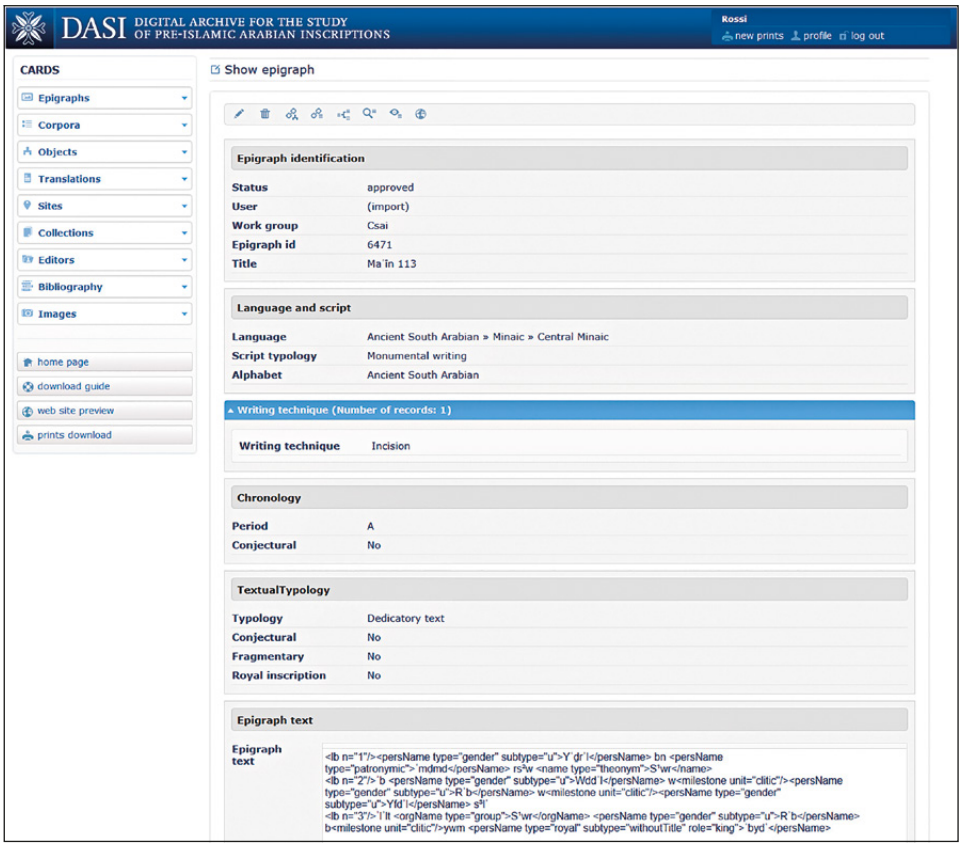


Fig. 4 – The hybrid database/XML recording system of the project DASI (http://dasi.cnr.it/).

However, XML inline annotation is not the best practice for all epigraphic materials, or the most suited for all research scopes. Some projects – mainly those working on "under-resourced" epigraphies – have opted for hybrid systems, which combine a database model for storing metadata and modules for XML textual annotation (Avanzini, De Santis, Rossi 2018) (Fig. 4). For some writing systems – especially the logo-syllabic ones like Cuneiform, Linear B, and Mayan scripts – other formal models can be more efficient in representing parallel and overlapping hierarchies (Di Filippo 2018; Prager *et al.* 2018; for a critical discussion of pros and cons of the TEI for textual scholarship, see Pierazzo 2016).

4. Qualitative and quantitative analysis in current epigraphic research

If we look at the current theoretical discussion in digital epigraphy, the main concern appears to be still on qualitative aspects. The projects have mainly focussed on the philological description of the sources for the production of curated online editions and the retrieval of textual and contextual data (Orlandi *et al.* 2014, 2017; De Santis, Rossi 2018). The need for a continuous revision and update of the digital editions, as the linguistic and historical understanding improves, frequently implies that the scarce financial and human resources attracted by epigraphic projects are mainly concentrated on this editorial effort. Less attention has been paid to the potentialities of processing this mass of information for the discover of patterns and trends in the inscription, so that quantitative studies remain underrepresented.

One reason for this is the influence of the philological approach to the inscription, deriving from the specific tradition of studies. Even the methods of computational linguistics are rarely applied to the epigraphic corpora inscription, because epigraphists working on well-known languages are usually not interested in linguistic issues; on the other hand, caution is due in carrying out computational analyses on under-resourced languages. As regards the material aspect, epigraphists are less used to quantitative approaches than archaeologists are; moreover, an inscription is usually studied for the unique historical evidence it carries: its very essence is to be the vehicle of a contingent message, written at a specific time, on a specific support, located in a specific spot. The geographic data are probably the kind of epigraphic information that has been most processed for quantitative studies, for the recent success of spatial analysis (see recently Prag 2018, based on the data of the *I.Sicily* project).

Indeed, computational quantitative studies have been traditionally carried out on disciplines which are "borderline" to epigraphy, like numismatics and sigillography (see the pioneering studies of Jean-Claude Gardin on the Near Eastern seals; Gardin 1956). This typology of materials is more suited for statistical analysis in that they consist of inscribed objects whose text is reproduced in series, i.e. are aimed at being identical or very similar in support and content to many other *specimina*. On the other hand, the papers collected in the recent volume by Bigot Juloux, Gansell and Di Ludovico (2018), show how qualitative and quantitative analysis on ancient texts and text-bearing objects, such as the Ugaritic and Akkadian sources, can be fruitfully combined to respond to specific research questions – e.g. to highlight patterns of distribution of iconographic elements on the supports, and their relations to textual items, or the patterns of attestations of individuals in the textes.

Such combined studies are especially needed now that larger sets of curated data are available. The wealth of resources that the aggregators, like

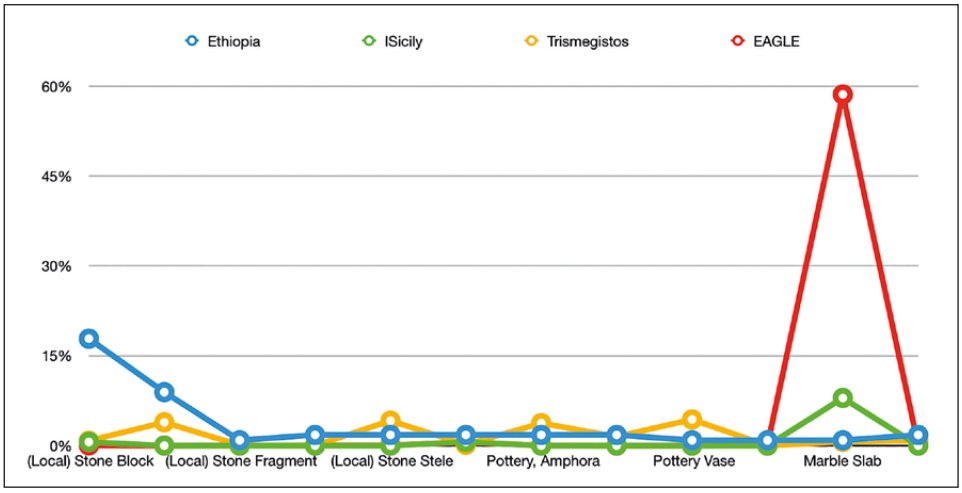


Fig. 5 – Example of quantitative analysis on the metadata of inscriptions from different datasets (Liuzzo 2019, 65, fig. 2.4).

the EAGLE network for the Graeco-Roman epigraphy (https://www.eagle-network.eu/), can harvest and process on the basis of common languages and vocabularies, opens new perspectives to quantitative research (see e.g. the experiment of verifying at what degree the epigraphic habit of Ethiopia/Eritrea in Late Antiquity was comparable to that of the Mediterranean region in Liuzzo 2019; charts are available at https://pietroliuzzo.github.io/DHEth/, see under Chapter 2) (Fig. 5). Besides aggregators, the adherence to FAIR principles which have spread in the last years across projects will ultimately enable the harvesting on the web and the reuse of epigraphic datasets, thanks to the attribution of identifiers, the adoption of open-access and long-term preservation policies, the use of interchange formats and standards, and the accurate description of data and metadata (cfr. the mission of the http://epigraphy.info/ community).

Obviously, caution is due, for the risk of comparing non-coherent data, or to process duplicates of the same object, because of the multiplication of records across different archives. However, the initiatives aimed at the identification and disambiguation of the resources, like Trismegistos (https://www.trismegistos.org/index.php), and the semantic technologies could help in discovering and selecting coherent set of epigraphic data on which to carry unexplored quantitative research. With the support of thesauri and gazetteers (e.g. http://perio.do/, https://pelagios.org/, https://godot.date/), this would also set the foundations for establishing connections of digital epigraphic collections with archaeological, literary and linguistic datasets, crossing cultural, geographical and linguistic

boundaries, as it was hoped for thirty years ago by I. Di Stefano Manzella: «Esiste poi un problema ancora irrisolto: quello della connessione fra classi di dati diversi. La storia del mondo antico è fatta di persone, di luoghi, di tempi e di oggetti (reali o metafisici) taluni legati da reciproca interdipendenza, altri ruotanti su orbite separate (anche se solidali sul piano della storia). Stabilire la rete di queste relazioni costituirà il terreno di indagine sul quale si confronteranno le menti più fervide» (Di Stefano Manzella 1990, 143-144).

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ABSTRACT

An epigraph is a complex historical document, whose significance is fully acknowledged only if its textual features (script, language, content, etc.) are studied in combination with the contextual information (on the textual support and its provenance). This is the reason why digital epigraphy lies at the crossroads of different disciplines applying ITs to textual and material sources, such as digital philology, computational linguistics, and computational archaeology. The specific interests and methods of those disciplines have exerted an influence on digital epigraphy, which is apparent in the documentary vs statistical approaches applied over time to the electronic treatment of the (re)source "inscription". The aim of the paper is to trace those trends in the application of qualitative vs quantitative methods in the history of studies of digital epigraphy, highlighting the main moments of change, until the most recent developments.