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FROM DATABASES TO ARCHAEOLOGICAL ONLINE RESOURCES. THE LOGIC OF OBJECT CLASSIFICATION

1. Introduction

In the history of archaeological computing, the establishment and the development of databases can be considered a privileged research field. Since the Seventies of the Twentieth century, thanks to the introduction and the subsequent development of computer science, databases have been used as a favoured tool for archiving and managing the large amount of data that archaeologists use during their research activity. The information included in a database must be subjected to rules, that allow coherent and logic choices. In fact, each database provides a logical description of the data, built following a model, according to which the information can be defined and organized.

The present paper outlines a brief history of database projects, with particular reference to Italy and France, since the earliest initiatives up to the actual projects shared online and constantly monitored by the international journal «Archeologia e Calcolatori».

2. The first challenge

The first challenge in the development of archaeological databases was related to automatic techniques of data processing and language standardization: how to describe similar objects homogenously, so as to be able to perform search in databanks created to catalogue archaeological items or monuments, and how to retrieve that information correctly. The first solutions to ensure uniformity of description and standardize the language were oriented to the creation of analytical "codes", designed to describe various ancient objects. In France, Jean-Claude Gardin devoted his pioneering research to this purpose. He started his work in the mid 1950s, carefully followed the international evolution of documentation systems and promoted innovative methods of investigation. Around 1955, Gardin began to use automated processing for the storage and retrieval of archaeological data with the aim of facilitating the classification of archaeological artifacts and developed some codes "pour l'analyse" of specific objects (Moscati 2013, 2016; on the Centre d'Analyse Documentarie pour l'archéologie, CADA, see http://archaeologicalcomputing.lincei.it/index.php?en/235/brochure-cada).

In this sector, some important researches were carried out in France also by René Ginouvès, professor of Classical Archaeology at the University of Paris X Nanterre. As J.-C. Gardin, he was a pioneer in the application of computer science in classical archaeology, with particular reference to the

implementation of databanks, the normalisation of archaeological language and the definition of standard descriptive terminology. He was director of the Centre de recherches d'archéologie classique at Nanterre (1969-1989), where he gave birth to a research team dedicated to the application of computer science to archaeology, the Centre de recherche sur les Traitements Automatisés en Archéologie Classique (TAAC). During the 1970s and the 1980s he developed, in collaboration with experts from various fields of research, multilingual standard vocabularies, suitable for computer applications, with particular reference to ancient mosaics, shapes of Greek vases and Greek and Roman architecture (cfr. e.g. Ginouvès 1971, 1990; Ginouvès, Guimier-Sorbets 1978).

A.-M. Guimier-Sorbets has recently recalled the activities of the Centre of Nanterre in the "Itinerary" she published in the Virtual Museum of Archaeological Computing website (http://archaeologicalcomputing.lincei.it/), a CNR-Accademia dei Lincei project that aims at retracing the development of computing archaeology, through the presentation of main scholars, institutions and projects responsible for the birth and the development of the discipline: «Le Centre s'intéressa donc très vite et de façon pionnière à la réalisation pratique de banques de données et à la recherche de logiciels permettant de prendre en compte la complexité de la documentation archéologique: on cherchait un système capable de reproduire le même degré de richesse que la publication traditionnelle et de relier les informations, sans risque de croisement, à des parties distinctes du document, éventuellement emboîtées les unes dans les autres (comme, pour une mosaïque, la bordure à bandes multiples d'un panneau inclus dans un autre panneau comportant lui aussi une bordure complexe, et lui-même inclus dans un tapis» (Guimier Sorbets 2017).

In Italy a crucial contribution was given in this sector by the Istituto Centrale per il Catalogo e la Documentazione (ICCD). Established in 1975 along with the institution of the Ministry of Cultural Heritage, ICCD was directed from its foundation up to 1990 by Oreste Ferrari, an art historian and member of the Accademia dei Lincei, that soon supported the automation of the Italian Catalogue. Ferrari promoted the computerized cataloguing from its initial stages and the difficult transition from paper record cards to electronic documents. Since the early years of his guidance of the Institute, he strongly supported the correct use of computers to achieve a more detailed cataloguing of cultural items (Signore 2009; Caravale 2015, 2016b) (Fig. 1).

The main problems concerned the definition of the methods of a formalized cataloguing system, accounting for all the variety and complexity of information that each individual item might contain. To ensure correctness and homogeneity, since the early Seventies the Institute had established some models of type-written cards, which were organized as descriptive documents containing information on items, and including photographic documentation

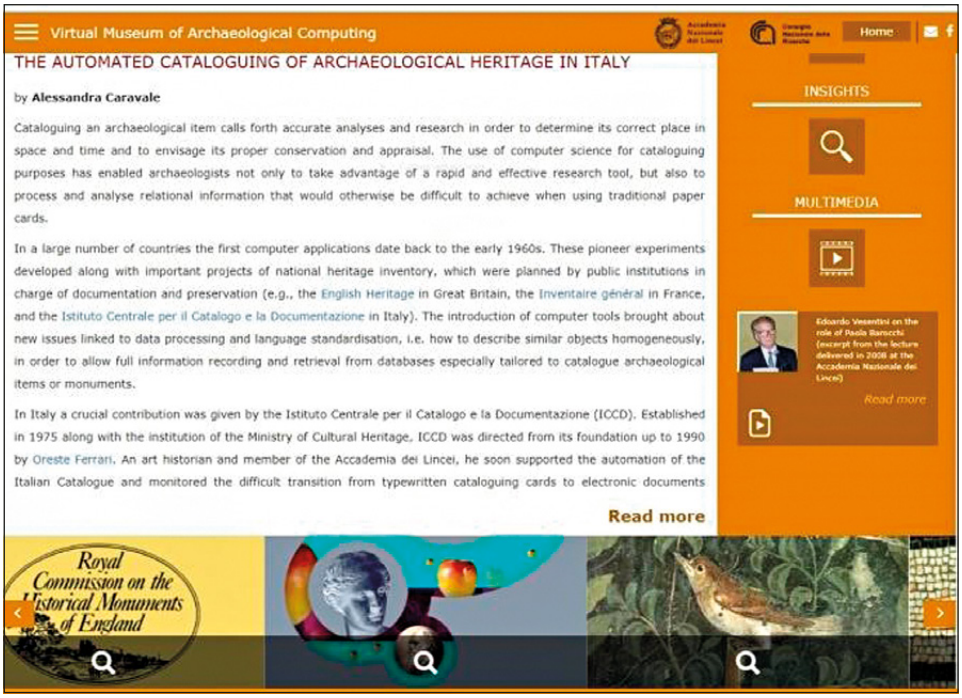

Fig. 1 – The itinerary devoted to The automated cataloguing of archaeological heritage in Italy in the Virtual Museum of Archaeological Computing website.

(Ferrari 1989, 1991; Papaldo, Ruggeri 1993). For the purpose of adapting the paper record cards to computer processing of the data and in order to avoid vagueness and non-homogeneity in the terminology, the Institute began also to provide controlled vocabularies for some categories of items: the first one for the archeological area, dating back to 1980, was related to the materials of the Final Bronze Age and the early Iron Age. Over the years, the Institute started publishing manuals providing guidance for card compilation, promoting also standards and specific software, like SAXA and DESC (Caravale 2015).

Some of the first archaeological computer projects of those years concerned the design of databases pivoting around the big archaeological *corpora*, that for their systematic approach proved particularly suitable to be submitted to automated processing. In particular, some databanks were created for archiving the information relating to Attic figured vases: among these initiatives, we can mention the computerization of the *Corpus Vasorum Antiquorum*, promoted in Pisa by Paolo Enrico Arias and based on a DBMS

that also allowed to formulate quantitative assessments (Arias, Di Bari, Orsolini 1985). Equally focused on Attic pottery was the Beazley Archive Computer Project, started in Oxford on Sir John Beazley's Archives in 1979, with the aim of creating an automated inventory of Attic vases dated between 625 BC and 350 BC (Kurtz 2009).

3. Databases and web

From the end of the Nineties, the spread of the Internet created new virtual spaces where knowledge on cultural heritage could be shared and explored. The challenge became the transfer of automated databases to the web, in a process that is still ongoing and where small projects coexist together with big national and international initiatives. The aim today is also to develop the interoperability between different systems, fundamental for the growth of information in a wider dimension and for the exchange of data at an international level.

Some archaeological databanks, such as those related to big automated *corpora*, could take advantage of the enormous possibilities of the Internet network better than others. In this case, in fact, the network inherited the intense and complex work of data automation carried out in the different archaeological projects and allowed their adequate dissemination and knowledge. For the big *corpora* the challenge of how to transfer data coming from computerized *corpora* to the web has been identified as a priority. This has involved the introduction of global standards for data recording and dissemination, allowing large *corpora* of archaeological data to be navigated. One of the first research team that pursue this challenge was linked to the Oxford University's Beazley Archive under the leadership of Donna Kurtz. In fact, over nearly four decades the Beazley Archive has developed from a personal archive, whose origins were rooted in 19th century classical scholarship, to a state-of-the-art electronic resource that can be used anywhere, at any time by anyone (http://www.beazley.ox.ac.uk/index.htm) (Fig. 2) (Kurtz 2009).

Also the *Corpus Vasorum Antiquorum*, a series of high-quality catalogues of ancient Greek painted pottery conserved in different collections around the world, published since 1922 and undertaken by the Union Académique Internationale, in 2000 commissioned to Oxford University's Beazley Archive the digitization of the fascicules, sponsored by the Getty Grant Programme. Now the digitized catalogues can be viewed and browsed online (https://www.cvaonline.org/cva/).

The projects related to the *Lexicon Iconographicum Mythologiae Classicae*, which is strictly linked to the name of Lilly Kahil as a publishing initiative promoted in the 1970s, has made freely available three main databases in the LIMC Foundation website (https://www.weblimc.org/) (Szabados 2012).

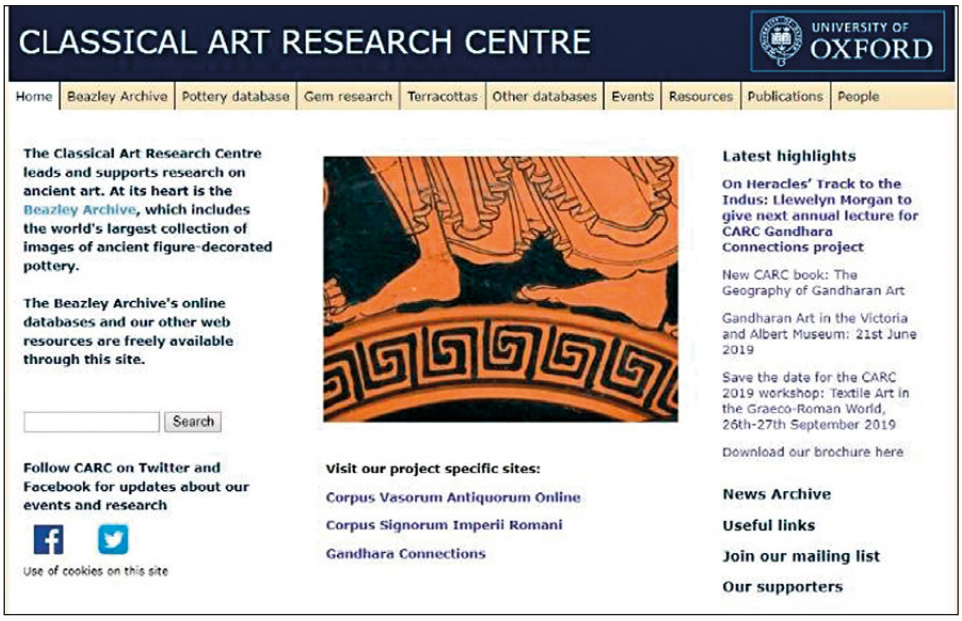

Fig. 2 – Homepage of the Beazley Archive online project.

Another significant example is the project for the computerization of Latin inscriptions collected in the *Corpus Inscriptionum Latinarum*, made available through the databases of the Electronic Archive of Greek and Latin Epigraphy (EAGLE) and recently renewed within the Europeana network (https://www.eagle-network.eu/) (Orlandi 2015; Felle 2016).

4. Databases and «Archeologia e Calcolatori»

The journal «Archeologia e Calcolatori» since 1990 is an international observatory of theoretical and methodological aspects of computing and information technology applied to archaeology (http://www.archcalc.cnr.it/). By reading the articles published during the 30 years of journal activity, we can follow the development of the main IT tools applied to the different research sectors of our discipline. The interest of the journal in the archaeological databases is evident since the first issues through the numerous articles dedicated to this topic that allow readers to follow the evolution of conceptual and logical models for data representation (hierarchical, ralational, or XML-based).

"Databases" is also one of the classes of Computer tipology classification, under which all the published articles were classified; the papers devoted to databases are more than 100 since the n. 1, 1990. They are homogenously

distributed over the years of publication and are mostly associated with the archaeological classes "Classification of archaeological finds", "Cultural Resource Managment", "Epigraphy and numismatic" and, especially for the papers published in recent years, with the entry "Data dissemination and education".

Among the papers published in the Nineties, some are related to the above-mentioned projects, like the wide cataloguing work carried out by the Italian ICCD, described by Oreste Ferrari in 1991, or the Beazley Archive, project outlined by Donna Kurtz in 1993. In particular, Ferrari in his paper explains the principles applied by the ICCD for the automatic processing of archaeological data in connection with the tasks of protection and preservation of the national cultural heritage. These principles aim at characterizing each archaeological work and at determining the relationships between these objects and their territorial context in a global historical dimension (Ferrari 1991). Donna Kurtz indeed describes the database, that in its thirteenth year was finally available online fot remote users in Europe, North America e Australia. It contained data about 40,000 clay figure-decorated vases made in Athens and published in more than 1200 publications (Kurtz 1993).

Epigraphy has played a pioneering role in the interaction between computing and archaeology and now this discipline occupies a prominent place in digital humanities; thanks to the technological evolution of the last decades, numerous projects have been developed: among these some online databases and digital editions of epigraphic texts. Since its first issues, our journal has published articles related to computing and epigraphy, concerning projects aiming to archive and process data. Numerous European initiatives were already presented in the 1991 issue (Bielman *et al.* 1991) and over time the interest in epigraphy has remained alive with the publication of further projects (among the earliest works: CAIE project, Pandolfini, Moscati 1992 and PETRAE project, Bresson, Navarro Caballero 1996).

At the beginning of the 2000s, the first online projects were published. Among these there is an important work related to the Etruscan urns: the database, called *Charun*, dedicated entirely to monuments from Chiusi (http://charun.sns.it/, now not accessible), which collected data on the urns, the tombs in which they were found and the related grave goods, together with bibliographic information (De Angelis 2005; for a recent development see De Angelis 2015) (Fig. 3a).

Another valuable project is TESS, undertaken by the University of Padua and focussed on Roman ancient mosaics, that aims to provide a key working tool for the identification of the origins of iconographic themes, their geographical distribution and the development of local taste which varies according to the context (http://tess.beniculturali.unipd.it/web/home/) (Ghedini *et al.* 2007 and more recently Ghedini *et al*. 2016) (Fig. 3b).

Fig. 3 – a) Particular of the homepage of *Charun* online project; b) Particular of the homepage of TESS project.

Over the years «Archeologia e Calcolatori» has published various articles concerning online databases. Some of these are autonomous projects and some are strictly related to geographical data as geodatabases or as part of a webGIS system. Among those still available we can remember: LiBER, on Linear B texts (http://liber.isma.cnr.it/cgi-bin/home.cgi) (Del Freo, Di Filippo 2014); *Sethlans*. Bronzi del Museo Faina, about the Etruscan and Roman bronzes conserved in the Faina collection in Orvieto (http://bronzifaina.isma.cnr.it/) (Caravale 2016a); Marmora Phrygiae (http://antares5.ibam.cnr.it/marmorasite/) (Di Giacomo, Scardozzi 2016); The Kingdom of Sicily Image Database, a digital collection of historic images (15th-20th centuries) that represent the medieval monuments and cities in Sicily (http://kos.aahvs.duke.edu/index.php) (Bruzelius, Vitolo 2018).

The journal has also monitored the actual trend of automated cultural heritage cataloguing projects, that aims to structure data on the basis of ontological models, so as to make them accessible, traceable and reusable by users and applications. In this direction goes, for example, the ArCo project,

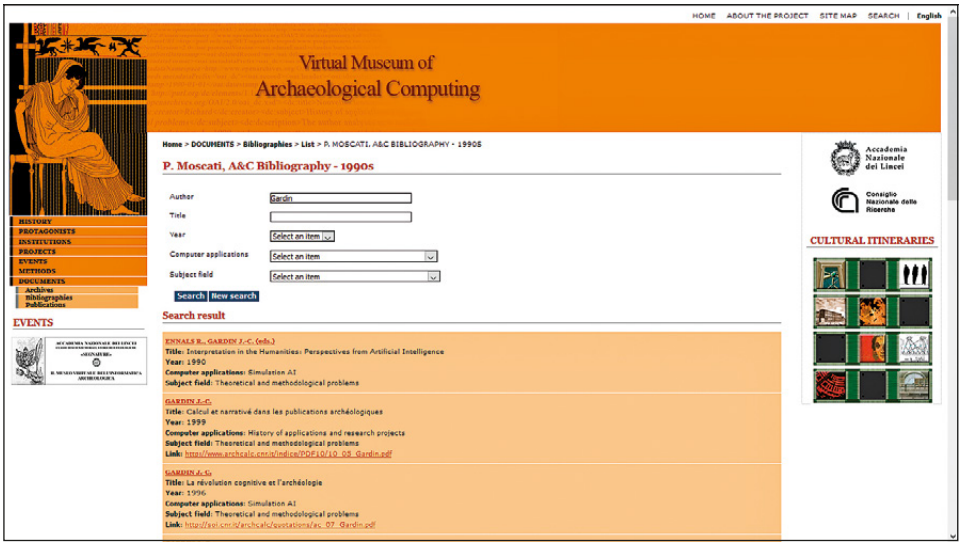

Fig. 4 – The Bibliography of Archaeological Computing in the website of the Virtual Museum of Archaeological Computing.

carried out by ICCD, together with the Istituto di Scienze e Tecnologie della Cognizione of the Italian CNR; the project aims at making available data from the Catalogo generale dei beni culturali following the paradigm of the Linked Data initiative, in an open format, in order to ensure accessibility to users and interoperability. A brief description of ArCo project is published in the last issue of «Archeologia e Calcolatori», 30, 2019 (Caravale 2019).

In the same issue we also published a paper related to the database of the Bibliography of Archaeological Computing of the Nineties, recently made available online, in the website of the Virtual Museum of Archaeological Computing (http://archaeologicalcomputing.lincei.it/) (Caravale, Ceccarelli 2019) (Fig. 4). The bibliographical database, featuring 2747 titles, includes works published over 12 years, from 1989 to 2000. The records registered in the bibliographic database have been classified into five main categories, according to their typology: articles published in specialized journals, conference proceedings, exhibition catalogues, miscellaneous works and monographs. The proportion of these five categories is distributed according to the histogram in Fig. 5. We can notice the prevalence of conference papers (44%) and articles published in specialized journals (39.6%); the records related to miscellaneous works or to monographic works or to exhibitions catalogues, associated with archaeological computing projects, are distributed according to smaller proportions, respectively 13.5%, 2.7% and 0.2%.

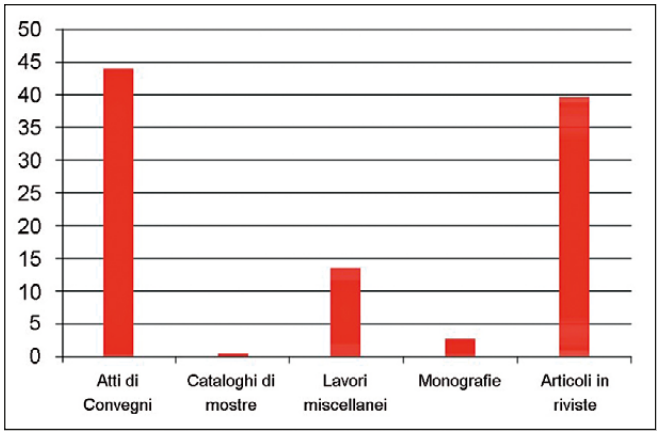

Fig. 5 – Histogram showing the distribution in the bibliographic database of conference papers, exhibition catalogues, miscellaneous works, monographs and articles.

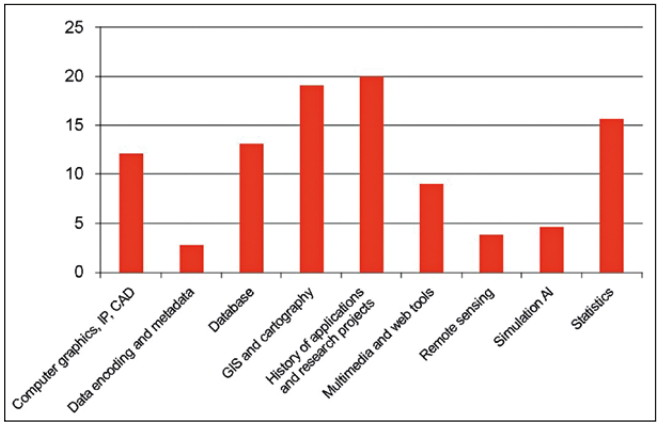

Fig. 6 – Histogram showing the distribution in the bibliographic database of the classes of Computer typology classification.

Regarding the Computer typology classification, under which all the registered items are classified, the most attested classes are distributed as follows: GIS and cartography: 19%, Statistics: 15.6%, Databases: 13%, Graphics and IP CAD: 12% (Fig. 6). In particular, the records relating to databases have a constant presence up to the second half of the 1990s and a decrease in the last four years, perhaps also due to the inclusion of many of them within the Geographic Information Systems (Caravale, Ceccarelli 2019).

The evaluation of the bibliographic database has allowed us to outline the main guidelines in the use of archaeological computing tools in 1990s, a decade that was marked by a first clear development of data computerization in all fields of archaeological research. The Nineties can be considered as a "bridge" between the first more limited experiences of previous years, started in various countries with different methods and in different times, and the exponential development of IT projects of the following decade, in which digital tools have substantially changed the archeological experiences.

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ABSTRACT

Since the 1970s, the development of archaeological databases has characterised the history of archaeological computing. The paper presents a summary of the pivotal early projects, with a particular focus on Italy and France, up to the current projects shared online. They are constantly monitored by the international journal «Archeologia e Calcolatori», that since 1990 is an observatory of theoretical and methodological aspects of computing and information technology applied to archaeology.