

KNOWLEDGE, ANALYSIS
AND INNOVATIVE METHODS
FOR THE STUDY AND THE DISSEMINATION
OF ANCIENT URBAN AREAS



Proceedings of the KAINUA 2017
International Conference in Honour
of Professor Giuseppe Sassatelli's 70th Birthday
(Bologna, 18-21 April 2017)

edited by
Simone Garagnani, Andrea Gucci

ARCHEOLOGIA E CALCOLATORI

28.2

2017

All'Insegna del Giglio

KNOWLEDGE, ANALYSIS
AND INNOVATIVE METHODS
FOR THE STUDY AND THE DISSEMINATION
OF ANCIENT URBAN AREAS



Proceedings of the KAINUA 2017
International Conference in Honour
of Professor Giuseppe Sassatelli's 70th Birthday
(Bologna, 18-21 April 2017)

edited by
Simone Garagnani, Andrea Gausci

ARCHEOLOGIA E CALCOLATORI

28.2

2017

All'Insegna del Giglio

Realizzazione grafica della sovracoperta di Marcello Bellisario
Rivista «Archeologia e Calcolatori» (ISSN 1120-6861, e-ISSN 2385-1953)
ISBN 978-88-7814-785-0, e-ISBN 978-88-7814-786-7
© 2017 – All’Insegna del Giglio s.a.s. – www.insegnadelgiglio.it
Firenze, dicembre 2017
Stampa, Andersen S.p.a.
Abbonamento: € 40,00. Spedizione: Italia, gratuita; estero, a carico del destinatario.

I dati forniti dai sottoscrittori degli abbonamenti vengono utilizzati esclusivamente per l’invio della pubblicazione e non vengono ceduti a terzi per alcun motivo.

TABLE OF CONTENTS

SIMONE GARAGNANI, ANDREA GAUCCI, ELISABETTA GOVI, <i>Ancient reality and contemporary research. An introduction to the Conference KAINUA 2017 and its Proceedings</i>	11
ANCIENT CITIES: PAST AND CURRENT PERSPECTIVES	
MARIO TORELLI, <i>From ruins to reconstruction: past and present</i>	27
PAOLA MOSCATI, <i>Archaeological computing and ancient cities: insights from the repository of «Archeologia e Calcolatori»</i>	47
KAINUA PROJECT	
GIOVANNANGELO CAMPOREALE†, <i>Sulla genesi della città nell'Italia preromana. Economia, sociologia, urbanistica: il caso dell'insediamento dell'Accesa</i>	69
ELISABETTA GOVI, <i>Kainua-Marzabotto: the archaeological framework</i>	87
ANDREA GAUCCI, <i>Kainua Project: principles, theoretical framework and archaeological analysis</i>	99
GIULIA MORPURGO, CHIARA PIZZIRANI, CHIARA MATTIOLI, <i>The craft settings in Kainua-Marzabotto: places and archaeological issues</i>	113
STEFANO SANTOCCHINI GERG, ENRICO ZAMPIERI, BOJANA GRUŠKA, GIACOMO MANCUSO, <i>Topographical survey and digital models</i>	129
SIMONE GARAGNANI, <i>Archaeological Building Information Modeling: beyond scalable representation of architecture and archaeology</i>	141
AURELIO MUZZARELLI, MALIK FRANZOIA, <i>The ancient Digital Terrain Model and the infrastructure of the Etruscan city of Kainua</i>	151
BOJANA GRUŠKA, GIACOMO MANCUSO, ENRICO ZAMPIERI, <i>Building materials and virtual models of the Etruscan city of Kainua</i>	165
GIUSEPPE SASSATELLI, <i>Kainua Project Special Session: conclusioni</i>	177
ETRUSCAN CITIES AND THEIR LANDSCAPES: NEW PERSPECTIVES, INNOVATIVE METHODS AND DISSEMINATION	
CARMINE PELLEGRINO, AMEDEO ROSSI, <i>Contemporary landscape and the archaeological record. An integrated approach to the study of the Etruscan-Samnite site of Pontecagnano (SA)</i>	189
MARIA PAOLA BAGLIONE, BARBARA BELELLI MARCHESINI, CLAUDIA CARLUCCI, LAURA MARIA MICHETTI, <i>Pyrgi, harbour and sanctuary of Caere: landscape, urbanistic planning and architectural features</i>	201

GIOVANNA BAGNASCO GIANNI, MATILDE MARZULLO, ANDREA GARZULINO, <i>The last ten years of research at Tarquinia</i>	211
GIUSEPPINA ENRICA CINQUE, HENRI BROISE, VINCENT JOLIVET, <i>Civita Musarna (VT), il suo territorio e la chora di Tarquinia in età ellenistica: uno spazio ritualmente suddiviso?</i>	223
PATRICIA S. LULOF, MAARTEN H. SEPERS, <i>The Acquarossa Memory Project. Reconstructing an Etruscan town</i>	233
EMANUELE TACCOLA, LISA ROSSELLI, <i>Understanding Etruscan art and architecture through 3D modeling: the case of Volterra</i>	243
TOMMASO QUIRINO, <i>Open architecture RDBMS and GIS as tools for analysing the Etruscan presence in the Po Plain: towards a model of the urban/non urban landscape</i>	253
FROM THE ANCIENT CITIES TO THE LANDSCAPES: PROJECTS AND RESEARCHES	
FRANK VERMEULEN, <i>Scanning and visualization of Roman Adriatic townscapes</i>	269
ALESSANDRO CAMPEDELLI, MARCO DUBBINI, MARTINA MONICA, <i>Geo-archaeological study of the territory of Burnum's Roman site (Croatia) through LANDSAT multi-temporal satellite images and high resolution GeoEye</i>	277
ILARIA ROSSETTI, <i>Reshaping the urban space: Bakchias in Ptolemaic and Roman times</i>	291
FEDERICA BOSCHI, ENRICO GIORGI, MICHELE SILANI, <i>Reconstructing the ancient urban landscape in a long-lived city: the Asculum Project – combining research, territorial planning and preventative archaeology</i>	301
FERRAN CODINA, GABRIEL DE PRADO, ISIS RUIZ, ALBERT SIERRA, <i>The Iberian town of Ullastret (Catalonia). An Iron Age urban agglomeration reconstructed virtually</i>	311
ANNA CHIARA FARISELLI, FEDERICA BOSCHI, MICHELE SILANI, MELANIA MARANO, <i>Tharros – Capo San Marco in the Phoenician and Punic Age. Geophysical investigations and virtual rebuilding</i>	321
SIMONE MANTELLINI, <i>A city and its landscape across time: Samarkand in the ancient Sogdiana (Uzbekistan)</i>	333
STARTING AND ONGOING PROJECTS	
STEFANO FINOCCHI, VINCENZO BALDONI, <i>Numana and its ancient territory: new data and research perspectives</i>	345

GIUSEPPE LEPORE, ENRICO GIORGI, VINCENZO BALDONI, FEDERICA BOSCHI, MARIA CONCETTA PARELLO, MARIA SERENA RIZZO, <i>New methodologies to analyze and study the Hellenistic-Roman quarter in Agrigento</i>	353
MICHELE SILANI, ENRICO GIORGI, FEDERICA BOSCHI, GABRIELE BITELLI, ALBERTA MARTELLONE, <i>Seeing into the past: integrating 3D documentation and non-invasive prospecting methods for the analysis, understanding and reconstruction of the ancient Pompeii. The case of the House of Obellio Firmo (IX, 14)</i>	361
ISABEL ESCRIVÀ, JOSÉ J. MARÍN, ALBERT RIBERA, MIQUEL ROSSELLÓ, ALFREDO SANTONJA, <i>Reconstructing the Late Antiquity Episcopal Complex of Valentia</i>	369
GERVASIO ILLIANO, <i>Misenum: the harbour and the city. Landscapes in context</i>	379
VALERIA POSCETTI, SAVERIO GIULIO MALATESTA, VIRGINIA CIRILLI, FRANCESCO LELLA, VITO RONDINELLI, SALVATORE ESPOSITO, MARCO BALSÌ, <i>Preliminary results of the Castelmonardo Project</i>	391
METHODOLOGIES, APPLICATIONS AND INTEGRATED SOLUTIONS	
MARIA ROUSSOU, FRANCESCO RIPANTI, KATERINA SERVI, <i>Engaging visitors of archaeological sites through “emotive” storytelling experiences: a pilot at the Ancient Agora of Athens</i>	405
MARCO GAIANI, <i>Management and communication of archaeological artefacts and architectural heritage using digital IS. What today? What next?</i>	421
ANDREA D’ANDREA, ANGELA BOSCO, MARCO BARBARINO, <i>A 3D environment to rebuild virtually the so-called Augusteum in Herculaneum</i>	437
GIOVANNA LIBEROTTI, CORRADO ALVARO, <i>Using laser scanner technology to analyse mud-brick architecture in the ancient Near East. The Palatial Complex of Arslantepe (Malatya, Turkey)</i>	447
MOISÉS HERNÁNDEZ CORDERO, <i>Geomatics approach to surveys for Late Antiquity buildings. The Episcopal Palace in Side, Turkey</i>	457
FILIBERTO CHIABRANDO, GIULIA SAMMARTANO, ANTONIA SPANÒ, GRAZIA SEMERARO, <i>Multi-temporal images and 3D dense models for archaeological site monitoring in Hierapolis of Phrygia (TR)</i>	469
ELISABETTA DONADIO, RICCARDO MAZZA, FEDERICO BARELLO, <i>Multimedia digital solutions from image and range based models for ancient landscapes communication</i>	485
VALERIA CERA, <i>Knowledge and valorization of historical sites through low-cost, gaming sensors and H-BIM models. The case study of Litternum</i>	497

ALFONSO IPPOLITO, MARTINA ATTENNI, CRISTIANA BARTOLOMEI, <i>Digital acquisition: reflections on data quality</i>	507
AARON PATTEE, ARMIN VOLKMANN, MATTHIAS UNTERMANN, <i>Integrative GIS-based investigation of the medieval fortress architecture of Pfalz, incorporating photogrammetry, geoinformatics and landscape analysis</i>	521
JACOPO BONETTO, ARTURO ZARA, <i>The Nora Virtual Tour: an immersive visit in the ancient city</i>	531
SILVIA BERNARDONI, MARCO MONTANARI, RAFFAELE TROJANIS, <i>Open History Map</i>	539
GIOVANNI AZZENA, ROBERTO BUSONERA, CHIARA PERINI, <i>The future (?) of effective protection</i>	549
SHORT PAPERS	
SARA LORETO, <i>Gropello Cairoli (PV): computer applications for historical-topographic synthesis</i>	563
ANNACHIARA PENZO, FEDERICA PRONI, ANTONIO GOTTARELLI, <i>The archaeological settlement of Monte Bibebe (Bologna)</i>	571
ILENIA GRADANTE, DAVIDE TANASI, <i>3D digital technologies for architectural analysis. The case of the “Pagan Shrine” in the Catacombs of Santa Lucia (Siracusa, Sicily)</i>	581
FRANCESCO GABELLONE, IVAN FERRARI, <i>Reconstruction of Villino Florio’s wooden ceiling using 3D technologies</i>	587
FRANCESCO GABELLONE, IVAN FERRARI, FRANCESCO GIURI, MARIA CHIFFI, <i>3D technologies for a critical reading and philological presentation of ancient contexts</i>	591
ANTONIO PECCI, FABIO DONNICI, <i>When there was no GIS system: rediscovering archaeological researches of the 19th century through the use of the drone. The case study of Mount Siri (Anzi, Basilicata)</i>	597
MARTIJN VAN DER KAAIJ, <i>Heron Visualisation Engine. Visualisation and dissemination of semantic cultural heritage data</i>	603
TATIANA VOTROUBEKOVÁ, <i>Etruscan rock-cut tombs with decorated façades. A 3D approach</i>	609

THE CRAFT SETTINGS IN KAINUA-MARZABOTTO: PLACES AND ARCHAEOLOGICAL ISSUES

The study of the Etruscan city of Marzabotto, the ancient Kainua, requires some reflections on the production and craft component which played such a large role in the history of this centre (SASSATELLI 1989, 53-74; NIJBOER 1998, 119-129, 196-202; GOVI 2007, 30-44; MORPURGO in press).

In fact, excavations have brought to light a well-developed production structure over time which, especially for the Etruscan world, makes Marzabotto an undoubtedly privileged, paradigmatic context for the study of this particular aspect (Fig. 1).

Thanks to contributions from the most recent investigations, together with the revision of older excavation data, this theme has in recent years benefitted from a series of updated reflections which, often with the support of a multidisciplinary approach, now allow us to tackle the topic from a totally renewed perspective.

The quality and variety of the data collected permits analyses from multiple points of view which individually only partly face the complexity of the issue, dense as it is in implications not only on an architectural and urban planning level, but also on social, economic and political-institutional levels.

The following reflections will therefore be dedicated on the one hand to presenting the dynamics controlling the relationship between the craftwork component and the topography of the city, and on the other hand, in greater detail, to examining some aspects related to the characteristics of the spaces involved in these activities, the relevant structures, the production cycle and the materials produced by such processes.

1. CRAFT PRODUCTION BETWEEN PHYSICAL SPACE AND URBAN ORDER

The evidence currently available to us, as is often the case, is exclusively related to pottery and metallurgical production (Fig. 1).

Limiting ourselves therefore to “merely” these two production sectors, the documentation available allows us firstly to observe the existence of a precisely graded nature in the structuring of the installations. In fact, next to small-scale domestic furnaces, aimed at satisfying the needs of a family or at most a limited group of people, the investigations have revealed the presence of contexts whose characteristics, complexity and internal articulation could refer to production of a commercial nature, aimed at the local population, but perhaps also for export.

Clear evidence comes, for example, from the metallurgical workshop brought to light in *Regio V, insula 5* (LOCATELLI 2005; MALNATI, LOCATELLI

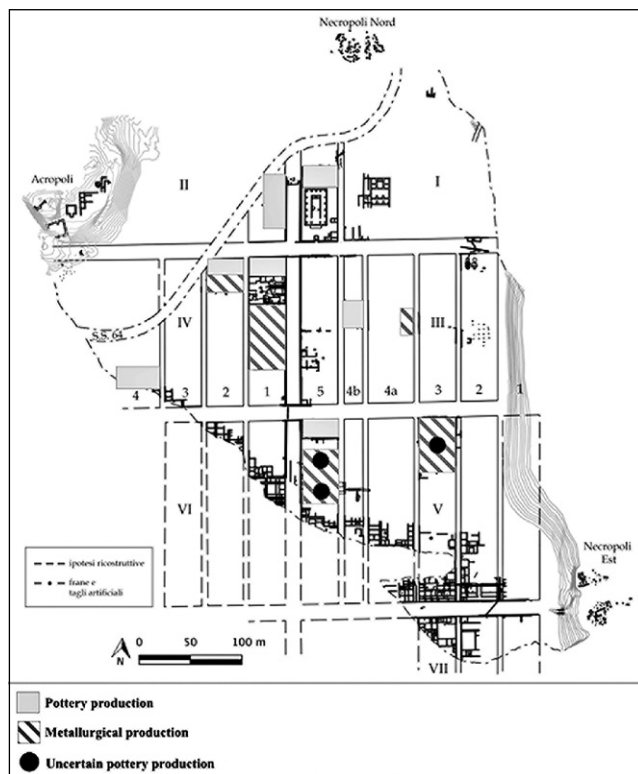


Fig. 1 – The evidence of pottery and metallurgical production in the Etruscan city.

2006), or the “Great Furnace” for the production of pottery and bricks located in *Regio* II, 1 (SARONIO 1965), traditionally considered workshops of a public character, but whose original nature, as we shall see in the light of new acquisitions, may now be further specified.

Undoubtedly the most significant contribution to this topic comes from the recent excavations carried out by the Chair of Etruscology at the University of Bologna in House 1 of *Regio* IV, 2 (GOVI, SASSATELLI 2010). These have brought to light a building complex whose life appears to have been marked by a series of large-scale structural modifications which indicate the progressive change from a residential area to one with an increasingly more marked manufacturing vocation, as revealed by the presence of numerous furnaces and provisions for pottery production (POZZI 2010), but also by some technological indicators in the field of metallurgy (CHIARANTINI *et al.* 2010), with a complexity that has no comparison elsewhere within the city (Figs. 2-3).



Fig. 2 – Furnaces (red) and provisions for pottery production (light blue) in House 1.



Fig. 3 – Virtual reconstruction of the city.

The knowledge of such a context has thus led to some important considerations which, particularly in the absence of real comparisons within the Etruscan world, suggest an alignment between Marzabotto and what has been noted in Greece and Great-Greece, thanks to more recent studies on the relationship between cities and craftwork, confirming the high level of shared experience between these cultural fields from the 6th century BCE (GOVI 2014).

The relationship between residence and workshop must have certainly been more complex than earlier studies realised (SANIDAS 2013, 213-218). In fact, what has come to light allows us to reconsider the accepted idea that there was a strict contraposition between simple domestic buildings and large-scale structures of a public nature, emphasizing the important role played by extensive structures in which residential functions were combined with large-scale productive activities, according to a previously recognised model, e.g. Athens (TSAKIRGIS 2005) and Olynthus (CAHILL 2005).

The presence of a residential component cannot be excluded even within those workshops, already noted, which were considered to have had an exclusively public function. These are in fact contexts not only investigated in a partial manner, but which, together with a notable quantity of technological indicators, also revealed materials usually associated with residential contexts.

Even if the frequent lack of chronological indicators limits analysis, another issue which recent studies have raised is how this interference between production and residential vocations, a good description of the city's highly developed craft panorama, was extremely dynamic over the course of time (GOVI 2016; MORPURGO in press). The results from the excavations in House 1, supported by comparisons with other evidence in the city, have in fact shown how the buildings were subject over time to major modifications, often specifically due to the requirements of increased productivity. Of particular interest in this regard are also the data coming from House 5 of *Regio* IV, 1, where some large-scale changes, realistically datable to the second half of the 5th century BCE, show the conversion of the complex into an area with a workshop function of a prevalently metallurgical nature, perhaps closely dependent on the adjacent living unit (GAUCCI 2016).

The carrying out of different activities within a single context, as revealed once again by the excavations in House 1, but also perhaps in other sectors, is another absolutely characteristic feature, again with comparisons in Greece and Great-Greece (e.g. Athens, Eretria), where evidence suggests that workshops were rarely dedicated to one exclusive manufacture (ESPOSITO, SANIDAS 2012; HUGUENOT 2012, with further references at note 44).

Moreover, the case of Marzabotto, certainly the most significant in the Etruscan world, is well-suited to investigating how craft activities were part of the urban fabric, favouring the detection of possible connections and location tendencies.

An overview reveals a notably wide, capillary distribution of these establishments in all the main sectors of the city so far examined, certainly favoured by the presence of a water table throughout the plateau which guaranteed an easy supply of water.

This circumstance, in the past considered a peculiarity of Marzabotto and a primary reason for its accentuated manufacturing vocation, actually seems to have wider confirmation in the Greek world yet again, where more recent approaches to urban planning suggest reconsidering the concepts, often misapplied, of working quarters, zoning and marginalization of production activities (ESPOSITO, SANIDAS 2012; SANIDAS 2013, 233-234).

If the analysis of spatial dynamics takes into consideration the graduality of the structures brought to light, what clearly emerges is a systematic placing of the largest workshops in pre-eminent points of the urban space and in particular near the main road axes, following a commercial logic which suggests a consideration of the probable connection between the sites of production and those aimed at the sale of the products.

A strong element conditioning the location of those establishments capable of great productive dynamism must have been the sacred areas, on the basis of a relationship between religion and production, already noted in Padanian and Tyrrhenian Etruria (SASSATELLI 1985) and which, thanks to recent studies (DI GIUSEPPE 2012, 2016; *Gli artigiani e la città* in press; *Espaces sacrés* in press), appears more and more to be a recurrent, widespread phenomenon.

The discovery of the great civic sanctuary in the northern sector (GOVI 2017), once seen as merely a peripheral area and now considered a nerve centre of the city, leads us to consider that such a sanctuary must have played a highly active role in the structuring and progressive expansion of the production establishments (Fig. 3).

Emblematic evidence in this regard is the “Great Furnace” in *Regio II*, 1 (Figs. 4-5). As previously stated, it was for a long time considered a workshop aimed at satisfying the great request for pottery and bricks in the city. More recently, however, its functions are thought to have been linked to the requirements of the adjacent sanctuary (SASSATELLI 2011). The evidence for this is not only the obvious topographical proximity, but above all the discovery among the excavated material of a series of objects which are fully justified if interpreted precisely in relation to the adjacent temples. Of particular importance in this regard is a pair of moulds used to manufacture votive heads and an inscription written into the unfired clay of a vase which, very coherently, bears the theonym *tin[- -]*.

This complex is therefore a workshop which was not only responsible for the building and successive restoration of the monumental constructions, but was also dedicated to the production, firing and probably also the sale of products functional to the sacred areas.

Finally, it has been proposed to recognise how this proximity to religious buildings and the projection on *plateia* B, which must now be ranked as a genuine *via sacra*, might justify the progressive manufacturing transformation discovered in House 1, aimed at the production of objects intended, even if not solely, for regular visitors to the sanctuary (Fig. 3) (GOVI 2016)

G.M.

2. THE WORKSHOPS FOR THE PRODUCTION OF POTTERY: ARCHITECTURAL RECONSTRUCTION OF THE WALLS AND BUILDING MATERIALS

Since 1988, researchers from the Department of History and Culture at the University of Bologna have analysed in detail pottery production in the archaeological remains of the several craft workshops in Marzabotto (MORPURGO in press). Among the numerous furnaces, the “Great Furnace” in the *Regio* II, 1 and the craft system of House 1 have been studied in depth (OSSANI 2003-2004; POZZI 2004-2005; GOVI, SASSATELLI 2010). The archaeological records have been examined in their entirety in order to reconstruct all the aspects of the life cycle of an ancient house-workshop. This research has been able to determine the plan of the building, its architectural structure, its location and the typology of the craft installations. In addition, pottery and other objects found in the archaeological layers are thought to be products of the workshop itself or items used by people working or living in the building.

Excavations in the “Great Furnace” were carried out during the 1960s by P. Saronio and concerned only a part of the ancient plan (SARONIO 1965) (Fig. 4). As the research on the field was not conducted as a stratigraphic excavation and the study of the archaeological records has only been completed recently, the proposed reconstruction hypotheses of the ancient features of the workshop and of the kilns, although probable, do not lead to an exhaustive knowledge of the architecture of the building (Fig. 5).

In contrast, the considerable importance of House 1 depends on recent excavations, followed by an immediate analysis of the archaeological records, along with painstaking observations of all the signs and features useful to the architectural reconstruction of the ancient walls, the roof, indoor areas and courtyards as well as the building materials used (GOVI 2010a, 2010b) (Fig. 6). This attention to detail is fundamental for the restitution of non-preserved archaeological structures, so the House 1 remains have been extremely relevant for the conclusions reached. Their significance derives from the evidence obtained which can be used in order to propose a correct reconstruction of the ancient features of the house-workshop. We are thinking in particular of the relationships between the walls, the position of the stake holes and the width and depth of the foundation structures. Moreover, an evaluation of the different kinds of terracotta elements discovered in the ground layers and

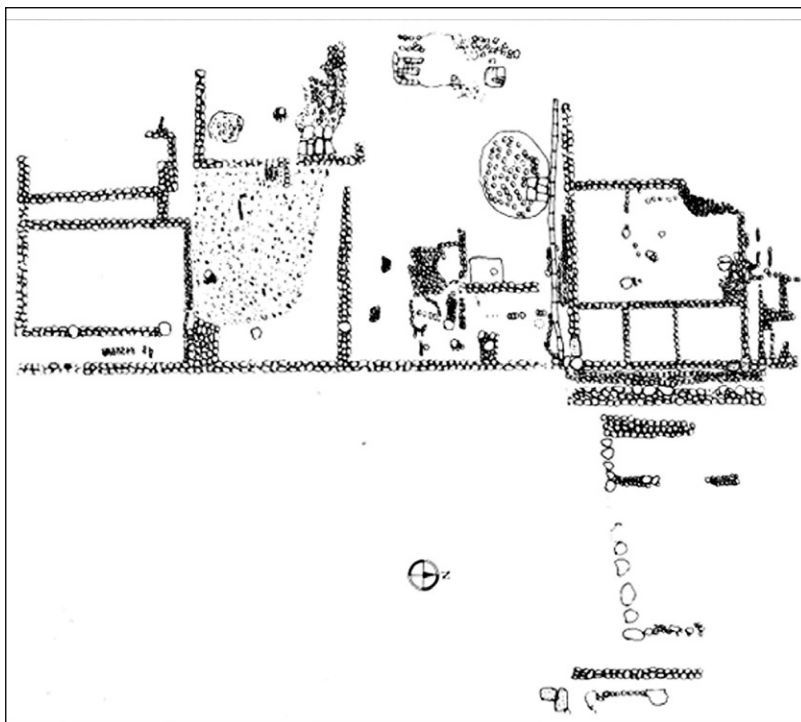


Fig. 4 – The archaeological remains of the “Great Furnace”.



Fig. 5 – The first virtual reconstruction of the “Great Furnace” in 2000 (after SAS-SATELLI, TAGLIONI 2000).



Fig. 6 – Position of the stake holes in House 1.

the position where an angular tile fragment was found, helps us understand where the *compluvium* was located. The knowledge of a notable quantity of building materials is a very rare occurrence in Etruscan archaeology.

Thanks to the integrated analysis of all these aspects, it has been possible to reconstruct the original features of the house-workshop House 1 (GOVI 2010a, 2010b; GOVI in this volume, Fig. 5). The house underwent some radical modifications during the time of its activity, from the end of the 6th to the middle of the 4th century BCE. Probably most of them were the consequence of the life cycle of each kiln, whereby the creation or dismantling of an installation must have determined the general reorganization of the area in which it had been built. Therefore, it can be presumed that new constructions or, more frequently, the demolition of parts of the buildings, of which House 1 consisted, are the result of the changes in the working activities in the house. All the kilns were built outdoors, in the courtyards of the house. The exact location of each workshop was selected so that the structure could be protected by the walls of buildings still in use or by those of dismantled rooms (POZZI 2010, 280), which were not completely destroyed for this reason.

The greatest revelation of House 1 consists in the real possibility to reconstruct the whole productive process of ceramic items from clay to their final utility, for example, items that could be used for storage or everyday use such as vases along with bricks and tiles used to make walls or roofs or even in the construction of the kilns themselves. There were tanks for the provision of the water, basins made of tiles for the refinement of clay, a porch for drying vases before firing and in addition large holes in the ground have been discovered in the southern area of the workshop (Fig. 2). During the dismantling of the various out-houses over the years, many building materials were thrown into these holes.

This is an extremely rare case in the archaeology of pre-Roman Italy and unique in the Etruscan world in the 5th century BCE. This outstanding discovery has permitted the conservation of a class of materials, namely mud bricks, that are normally lost because of their perishability. Besides the preservation of the bricks, which we know belonged to the walls of the building of this house and more generally to the architectural structure of the whole town of Marzabotto as well, many fragments of tiles have been discovered. As a result, it is possible to state that the bricks and tiles from House 1 have finally given a definitive answer to the longstanding question about the architectural materials and features of the Etruscan city of Marzabotto (GOVI 2010b; PIZZIRANI, POZZI 2010). This offers an important contribution to the knowledge of Etruscan architecture in the 5th century BCE, which represents frontier research as regards building materials, which are rarely preserved.

The measurements of the House 1 bricks (about 30×20 cm) are essentially standard and fit perfectly with the most common width of the building foundations in Marzabotto. According to Vitruvius (*De arch.* II 8, 17-18), foundations as large as those which were built in Marzabotto, with walls made of mud bricks, were able to support a two-storey building. The dimensions of the stone foundations for the mud brick walls were 60 cm so they could be constructed either with three bricks fixed closely together lengthways, or two aligned bricks placed sideways on (PIZZIRANI, POZZI 2010, 305). It may be presumed that the two building techniques were associated and alternated in the wall texture, in order to improve the static behaviour of the structures (PIZZIRANI in press).

The tiles from House 1 are extremely relevant as well. The study of the finds from the archaeological layers of this house-workshop has led to the recognition of a precise size of tile, which probably was used all across the town (PIZZIRANI, POZZI 2010). This tile format was surely used for the construction of the house roofs and for the roof of the Temple of *Uni*, only recently discovered. Finds in the cistern near the more recent Temple of *Tinia* belong to a larger format of tile, that can be assumed to represent an improvement in building techniques, commensurate with a temple which dominates the whole city.

It can be said in conclusion, that the archaeological records of Marzabotto, and especially House 1, offer the most complete documentation on building materials used in the 5th century BCE. Thanks to House 1, we know where and how building materials were produced and which purpose they served either to make kilns, houses, or temples. The discoveries in the workshop in House 1 make it possible to reconstruct not only the ancient structures, in a very precise way, but also a whole process: the one that generated an entire city from clay and firing, since the bricks and tiles produced by the furnaces in Marzabotto brought the city to life, following a similar pattern to that of the Foundation Rite

C.P.

3. CRAFTWORK PRODUCTION: THE ARCHAEOMETRIC PERSPECTIVE

The city of Kainua, due to its great productive dynamism and notable manufacturing vocation, offers an extraordinary, privileged overall picture for analysing the phenomenon of pottery and metallurgical production in all its aspects (MORPURGO in press) (Fig. 1). We are in fact able to evaluate this phenomenon from beginning to end, having the precise places and structures of production, strategically placed within the urban fabric. The study of these contexts offers us a well-developed framework of the final destination of the products as can be deduced from, for example, the “Great Furnace” which based its production on the specific requirements of the adjacent sanctuary. We are therefore aware that the craft workers had a precise intention in differentiating their production according to the contexts (residential, sanctuary and funeral functions).

Such a complex phenomenon has therefore been analysed according to a scale ranging from the individual excavation context, namely the House 1, *Regio IV, 2* (GOVI, SASSATELLI 2010), to the entire city and from the city to the entire surrounding territory.

Starting therefore with the productive aspect, the archaeometric analyses of ceramic crockery have principally been carried out on the etrusco-padana ware, which is commonly found in Marzabotto and in all of the Po Valley Etruria (MORANDI *et al.* 1996, 341-350; 1997, 40-45). This production is subdivided into four classes on the basis of their clay: fine pottery, grezza, bucchero and grey clay (Fig. 7).

The mineralogical and chemical analyses and their statistical elaboration (cluster analysis) have confirmed the local production of these etrusco-padana ceramics, since all the samples have the same compositional matrix. The differentiation of the four classes therefore came about only at the moment of actual creation of the vase, through the use of different techniques. Further studies are required to understand the technical and technological processes



Fig. 7 – “Etrusco-padana” productions: fine pottery, bucchero and gray clay.

involved in the crockery production using bucchero and grey clay, separating them by complexity of creation compared to the other ceramic classes (NANNETTI *et al.* 2010, 421-437).

As regards the methodology, linking the archaeometric contribution to the morphological-formalistic studies has been crucial in the creation of a typological atlas of all the pottery forms proven to be of local production (MATTIOLI 2013) not only in Marzabotto but in all of the Po Valley Etruria. It is fundamental to clarify that in the “etrusco-padana” production, not all the crockery forms conform to the four ceramic classes. In fact, it is clear that there was a differentiation in production between functionality and use of the vases. It has therefore been possible to understand a precise selective intention both by the vase-makers and by the commissioners who must have had a very clear idea of the functional necessities of the vases, of the production techniques which differentiated them and the role that they played within the social group that selected them. There are in fact vases produced in all the classes and other products which exist only in the more technically refined classes, such as in bucchero and grey clay.

The production of vases can be divided into two broad categories: those intended for daily food consumption and those reserved for the storing and preparation of food. The choice of the ceramic class to be used therefore depended both on the daily function of the vases and on the wish to give these vases a qualitative value. Fine pottery, for example, in the 5th century BCE, became the identifying product of a culture spreading and standardizing its forms throughout Padania and moreover involving cultural areas of Northern Italy which had commercial interests with the Po Valley Etruria, such as

the ancient Veneti (Este, Padua and Altino), Ligurian and Lombard (area of Golasecca culture) territories (MATTIOLI 2011, 119-129).

The choice of making specific vase shapes exclusively in bucchero and grey clay represents a more efficient way to bestow greater prestige.

The Po Valley Etruria production is considered widely standardized on a massive scale not only within individual contexts such as the city of Kainua, but also in all of the Po Valley Etruria for a period lasting over two centuries (6th-4th centuries BCE). Within this substantial productive homogeneity, there are some evident local traits which make the territory uniform. However, there are also distinctive traits which reveal local traditions. Studies integrating archaeometry and archaeology have thus provided scientific certainties on the technical and technological experience acquired by the vase-makers.

Furthermore, archaeometric analyses have been carried out on samples of black glazed pottery, a very well-documented production throughout the city of Kainua, with the aim of verifying a local production in imitation of Attic products and those of Tyrrhenian Etruscans (NANNETTI *et al.* 2010). The results have confirmed the local production (GAUCCI 2010), adding a further fundamental piece to the city's productive and cultural aspects. So in the Etruscan city there was not only pottery production of a local tradition, differentiated by functionality and technology, but also more refined production such as the black glazed pottery which deliberately imitated imports.

We have examined a series of artefacts, also in clay, commonly defined as “concotti” which must have had different functions (MORANDI *et al.* 1995, 219-227). Analyses have been carried out on samples of square bricks, other samples traceable to wall plaster defined as “incannucciati”, fragments of the perforated floor of a kiln and finally vitrified bricks. The aim was to establish whether these construction materials had undergone a firing process and, if so, at what temperatures. The results have established that the samples of bricks, “incannucciati” and the structural furnace elements, excluding the perforated floor fragments, reached temperatures between 600°C and 750°C. The vitrified bricks exceeded a temperature of 900°C while the samples of perforated floor reached and maybe exceeded 800°C. These results have opened interpretative issues of notable interest and have led us to review some aspects which were previously taken for granted. The bricks and fragments of “incannucciato” fired at high temperatures must therefore be considered components of de-commissioned furnaces, rather than structural elements of the house.

Finally, mineralogical, micro-textural, chemical and compositional studies of metal artefacts and slag remains from metallurgical work have allowed us to identify the type of metallurgical activity carried out in the residential context (CHIARANTINI *et al.* 2010, 439-481). Archaeometric studies have been carried out on fragments of moulds, slag and various metal fragments found in abundance during the excavations in House 1. The analyses have

confirmed that pottery production was certainly the main craft activity carried out in House 1, but some of the fragments of slag and many metal fragments confirm that in the same context there were also activities for the production of copper and bronze objects. As in other areas of Marzabotto, among the metallurgical materials found in House 1 there are neither waste materials traceable to copper reduction processes nor much less remains of combustion minerals, evidence which suggests that in this sector of Marzabotto work was done using only more or less unrefined metals, whose reduction must have been carried out elsewhere, probably near mineral mining areas.

Detailed analysis of these types of materials thus provides a more complete, exhaustive vision of the typology and variety of the production activities carried out inside the building.

To continue the scientific research, it would be fundamental and desirable to extend the research method used for pottery also to all the other forms of production which characterise a wide, complex panorama of production activities in the city of Kainua and all of Etruria.

C.M.

GIULIA MORPURGO, CHIARA PIZZIRANI, CHIARA MATTIOLI

Alma Mater Studiorum – Università di Bologna

Dipartimento di Storia Culture Civiltà

giulia.morpurgo2@unibo.it, chiara.pizzirani@unibo.it, chiara.mattioli4@unibo.it

REFERENCES

- CAHILL N. 2005, *Household industry in Anatolia and Greece*, in B.A. AULT, L.C. NEVETT (eds.), *Ancient Greek Houses and Households. Chronological, Regional, and Social Diversity*, Philadelphia, University of Pennsylvania Press, 54-66.
- CHIARANTINI L., GIUNTI I., BENVENUTI M., COSTAGLIOLA P., VERDIANI G. 2010, *Indagine archeometrica di alcuni resti di lavorazione metallurgica*, in GOVI, SASSATELLI 2010, 2. *I materiali*, Bologna, Ante Quem, 439-454.
- DI GIUSEPPE H. 2012, *Black-Gloss Ware in Italy. Production, Management and Local Histories*, BAR international Series 2335, Oxford, Archaeopress.
- DI GIUSEPPE H. 2016, *La ceramica a vernice nera e l'economia del tempio*, in *Santuari Mediterranei tra Oriente e Occidente. Interazioni e contatti culturali. Atti del Convegno internazionale (Civitavecchia, Roma 2014)*, Roma, Scienze e Lettere, 143-156.
- Espaces sacrés* in press, *Espaces sacrés et espaces de production: quelles interactions dans les nouvelles fondations?* (Napoli 2017).
- ESPOSITO A., SANIDAS G. 2012, *La question des regroupements des activités économiques et le concept de «quartier d'artisans»: quelle approche?*, in A. ESPOSITO, G.M. SANIDAS (eds.), *Quartiers artisanaux en Grèce ancienne. Une perspective méditerranéenne*, Villeneuve d'Ascq, Presses universitaires du Septentrion, 11-21.
- GAUCCI A. 2010, *La ceramica etrusca e figurata a vernice nera*, in GOVI, SASSATELLI 2010, 2. *I materiali*, Bologna, Ante Quem, 45-76.
- GAUCCI A. 2016, *Nuovi studi sull'isolato "Mansuelli" di Marzabotto (Regio IV, Insula I)*, «Annali della Fondazione per il Museo Claudio Faina», 23, 243-299.

- Gli artigiani e la città* in press, *Gli artigiani e la città. Officine e aree produttive tra VIII e III sec. a.C. nell'Italia centrale tirrenica. Atti del Convegno internazionale (Roma 2016)*.
- GOVI E. 2007 (ed.), *Marzabotto an Etruscan Town*, Bologna, Ante Quem.
- GOVI E. 2010a, *L'analisi planimetrica e la ricostruzione delle fasi edilizie*, in GOVI, SASSATELLI 2010, 1. *Lo scavo*, Bologna, Ante Quem, 179-203.
- GOVI E. 2010b, *Le tecniche di costruzione*, in GOVI, SASSATELLI 2010, 1. *Lo scavo*, Bologna, Ante Quem, 205-222.
- GOVI E. 2014, *Etruscan urbanism at Bologna, Marzabotto and in the Po Valley*, in E.C. ROBINSON (ed.), *Papers on Italian Urbanism in the First Millennium B.C.*, Supplementary Series 97, «Journal of Roman Archaeology», Supplementary Series 97, Portsmouth, 81-111.
- GOVI E. 2016, *L'architettura domestica di Marzabotto tra vecchi scavi e nuove indagini*, «Annali della Fondazione per il Museo Claudio Faina», 23, 187-241.
- GOVI E. 2017, *La dimensione del sacro a Kainua-Marzabotto*, in E. GOVI (ed.), *La città etrusca e il sacro. Santuari e istituzioni politiche. Atti del Convegno (Bologna 2016)*, Bologna, Bononia University Press, 145-179.
- GOVI E., SASSATELLI G. 2010 (eds.), *Marzabotto. La Casa 1 della Regio IV – Insula 2, 1-2*, Bologna, Ante Quem.
- HUGUENOT C. 2012, *Production et commerce dans la cité hellénistique d'Érétrie*, in A. ESPOSITO, G.M. SANIDAS (eds.), *Quartiers artisanaux en Grèce ancienne. Une perspective méditerranéenne*, Villeneuve d'Ascq, Presses universitaires du Septentrion, 175-199.
- LOCATELLI D. 2005, *La fonderia della Regio V, insula 5: elementi per la definizione di un'attività produttiva*, in G. SASSATELLI, E. GOVI (eds.), *Culti, forma e artigianato a Marzabotto: nuove prospettive di ricerca. Atti del Convegno di Studi (Bologna 2003)*, Bologna, Ante Quem, 213-238.
- MALNATI L., LOCATELLI D. 2006, *Ricerche sulla metallotecnica a nord degli Appennini: un riesame della "fonderia" di Marzabotto-Kainua*, «ΑΓΩΓΗ», 3, 347-355.
- MATTIOLI C. 2009, *La produzione ceramica etrusco-padana in Emilia Occidentale*, in C. CHIARAMONTE TRERÈ (ed.), *Archeologia preromana in Emilia occidentale. La ricerca oggi tra monti e pianure. Atti del Convegno (Milano 2006)*, Milano, Cisalpino, 203-217.
- MATTIOLI C. 2011, *La ceramica etrusco-padana tra Etruschi e Veneti*, in I. FAVARETTO, F. GHEVINI, G. GORINI, I. COLPO (eds.), *Tra protostoria e storia. Studi in onore di Loredana Capuis*, Roma, Quasar, 119-129.
- MORANDI V., NANNETTI M.C., MINGUZZI V., MONTI S., MARCHESI M., MATTIOLI C., DE SALVO F. 1996, *Ceramics from the Etruscan city of Marzabotto: Geochemical-mineralogical approach and connections with raw materials*, «Mineralogica et Petrographica Acta», 39, 341-350.
- MORANDI V., NANNETTI M.C., MINGUZZI V., MONTI S., MARCHESI M., MATTIOLI C. 1997, *Ceramiche e argille della città etrusca di Marzabotto*, in S. SANTORO BIANCHI, B. FABRI (eds.), *Il contributo delle analisi archeometriche allo studio delle ceramiche grezze e comuni. Il rapporto forma-funzione-impasto. Atti della I Giornata di archeometria della ceramica (Bologna 1997)*, Imola, Bononia University Press, 40-45.
- MORANDI V., NANNETTI M.C., MINGUZZI V., TRENTINI P., MARCHESI M., MATTIOLI C. 1995, *Caratterizzazione minero-geochimica di varie tipologie di concotto di età etrusca (Marzabotto, Bo)*, «Mineralogica et Petrographica Acta», 38, 219-227.
- MORPURGO G. in press, *Luoghi di produzione urbani tra Bologna e Marzabotto*, in *Gli artigiani e la città. Officine e aree produttive tra VIII e III sec. a.C. nell'Italia centrale tirrenica. Atti del Convegno Internazionale (Roma 2016)*.
- NANNETTI M.C., MINGUZZI V., ZANTEDESCHI E., ESQUILINI E. 2010, *Le analisi archeometriche*, in GOVI, SASSATELLI 2010, 2. *I materiali*, 421-437.
- NIJBOER A.J. 1998, *From Household Production to Workshops: Archaeological Evidence for Economic Transformations, Pre-Monetary Exchange and Urbanisation in Central Italy from 800 to 400 BC*, Groningen, University of Groningen - Department of Archaeology.

- OSSANI M. 2003-2004, *La grande fornace di Marzabotto (Regio II, insula 1): I vani settentrionali*, Master Dissertations, University of Bologna, Advisor prof. G. Sassatelli.
- PIZZIRANI C. in press, *Tecniche costruttive nell'edilizia domestica etrusca tra VI e IV secolo a.C.*, in *Alle origini del laterizio romano. Nascita e diffusione del mattone cotto nel Mediterraneo tra IV e I secolo a.C. II Convegno Internazionale "Laterizio" (Padova 2016)*, «MEFRA».
- PIZZIRANI C., POZZI A. 2010, *Laterizi e materiali da costruzione*, in GOVI, SASSATELLI 2010, 2. *I materiali*, 285-314.
- POZZI A. 2004-2005, *La grande fornace di Marzabotto (Regio II, insula 1): I vani meridionali*, Master Dissertations, University of Bologna, Advisor prof. G. Sassatelli.
- POZZI A. 2010, *Le fornaci e gli apprestamenti artigianali*, in GOVI, SASSATELLI 2010, 1. *Lo scavo*, 255-283.
- SANIDAS G.M. 2013, *La production artisanale en Grèce. Une approche spatiale et topographique à partir des exemples de l'Attique et du Péloponnèse du VII^e au I^{er} siècle avant J.-C.*, Paris, CTHS.
- SARONIO P. 1965, *Nuovi scavi nella città etrusca di Misano a Marzabotto*, «Studi Etruschi», 33, 385-416.
- SASSATELLI G. 1985, *Fornaci per terracotte*, in G. COLONNA (ed.), *Santuari d'Etruria. Catalogo della Mostra (Arezzo 1985)*, Milano, Electa, 46-47.
- SASSATELLI G. 1989, *La città etrusca di Marzabotto*, Casalecchio, Grafis Edizioni.
- SASSATELLI G. 2011, *Città etrusca di Marzabotto. Una fornace per il tempio di Tinia*, in D.F. MARAS (ed.), *Corollari. Scritti di antichità etrusche e italiche in omaggio all'opera di Giovanni Colonna*, Pisa-Roma, Fabrizio Serra, 150-158.
- SASSATELLI G., TAGLIONI C. (eds.) 2000, *Città etrusca di Marzabotto*, CD-Rom, Bologna, HitStudio Editori.
- TSAKIRGIS B. 2005, *Living and working around the Athenian Agora: A preliminary case study of three houses*, in B.A. AULT, L.C. NEVETT (eds.), *Ancient Greek Houses and Households. Chronological, Regional, and Social Diversity*, Philadelphia, University of Pennsylvania Press, 67-82.

ABSTRACT

Excavations in the Etruscan city of Marzabotto, the ancient Kainua, have brought to light a well-developed production structure over time which, especially for the Etruscan world, makes Marzabotto an especially favourable, paradigmatic context for the study of this particular aspect. Thanks to the contributions from the most recent investigations, together with the revision of older excavation data, this theme has in recent years benefitted from a series of updated considerations. The quality and variety of the data collected permits analyses from multiple points of view, not only on an architectural and urban planning level, but also on social, economic and political-institutional levels.

28.2

2017

Knowledge, Analysis and Innovative Methods
for the Study and the Dissemination of Ancient Urban Areas
Proceedings of the KAINUA 2017 International Conference

€ 72,00

ISSN 1120-6861

e-ISSN 2385-1953

ISBN 978-88-7814-785-0

e-ISBN 978-88-7814-786-7



9 788878 114785 0

ARCHEOLOGIA
E CALCOLATORI