ENGLISH TEXT
SUMMARY

THE IBERIAN NUCLEUS ON MONTJUÏC. THE MAGÒRIA OR PORT SILOS. BARCELONA

David Asensio i Vilaró
Xabier Cela i Espín
Carme Miró i Alaix
Maria Teresa Miró i Alaix
Emili Revilla i Cubero

Montjuïc stands on the seashore and on the banks of the Llobregat River, an important waterway. This location, together with the mountain's natural resources, such as its quarries, have made it a significant place in the history of the city of Barcelona.

This article analyses the human occupation of Montjuïc during Iberian times by examining the results of the various archaeological campaigns on the mountain, from the earliest excavation led by Serra Ràfols in the 1920s, a by-product of the works for the World's Fair and the opening of the railway system, to the present day. The analysis looks particularly at the materials unearthed in the excavations conducted in 1990 as a result of the works leading up to Olympic Games.

Archaeological remains from the Iberian era have been found in a number of sectors of the mountain: the south-west face, the area of Port Castle, the upper part of the cemetery in the south-west and the sector of the Pont de l'Esparver bridge, crossed by what was once Via de Magòria (now Avinguda dels Ferrocarrils Catalans), where the most important part of the nucleus has been documented, including a large field of silos, one of which contained a cistern-well, as well as traces of the residential area.

The earliest documented settlement, situated on the south-west face of the hill, has been dated to the 7th century BC and could have been a small seasonal enclave. Phoenician material and a large quantity of locally made pottery have been found here.

There is evidence of a second phase in the ancient Iberian period (6th-5th centuries BC) that is noted for the existence of Attic black-figure ware, Etruscan *bucchero nero* ware and a Punic-Ebusitan amphora T.1.3.1.2. Whereas much of the material from this period has been found at later levels, there are also remains from this time associated with a silo.

During the Middle Iberian period (second half of the 5th century BC and early 4th century BC), the field of silos, the principle remains of the Iberian nucleus, was in operation. The silos are of remarkable size and have a large storage capacity. Ten of those found here have a capacity of more than 20,000 litres (one can hold 50,000 litres and another 80,382 litres), while the average of the largest silos located elsewhere, such as Mas Castellar in Pontós and Turó de la Canya d'Avinonet, is 5,000-7,000 litres. The quantity and quality of the imported materials unearthed, which make up 17% of the individual pottery items recorded, are also impressive: Attic pottery with black varnish and red figures done in a repertoire of forms that surpass those usually found in most Iberian settlements in Catalonia, Apulian red-figure ware, pottery from western Greece, pale-body Massaliot pottery, Ebusitan pottery done in black varnish, virtually every kind of Punic amphora from the 4th century BC and a variety of Greek amphorae, as well as Punic-Ebusitanian and central Mediterranean common ware, pottery that was without question rare in other Iberian population centres. A number of the structures of the settlement have also been documented, including a possible defensive or enclosure wall, although this has not been excavated.

The nature and function of the nucleus on Montjuïc during this period must be related to a field of silos adjoining an urban centre of a certain size, which had areas where grain surplus to requirements for local consumption could be accumulated, typical of port installations. The size of the silos, the unsurpassable geographical location of the nucleus, with a port and communication routes inland, and the quality, quantity and range of imported materials, associated with the evidence of the few structures located and the widespread dispersal of findings across a large area of the mountain, are all factors that suggest that this was an important nucleus—a powerful urban centre on which the economic and political structure of the surrounding territory was reliant—rather than an area where surplus was stored, as would be expected of a small rural establishment such as Mas Castellar in Pontós or of an isolated port redistribution point such as the Illeta dels Banyets del Campello.

This centre of power in the south of Layetania could have vied for supremacy as a capital with Burriac in Cabrera de Mar, traditionally regarded as the capital of the Layetani. There are two possible hypotheses arising from this: firstly, the territory politically linked with the Layetani might have been much larger than thus far commonly accepted and could have included a significant part of central Catalonia, at the very least the area along the waterway consisting of the Llobregat and Cardener rivers and hence a geographical unit; or secondly, the two nucleuses could have each been capitals but at different times, for example Montjuïc could have been the chief nucleus in the 4th century BC, a role that could then have been taken over by the settlement of Burriac in the 3rd century BC. The silos must have been operating at their peak between the 4th and the 3rd centuries BC, a period when the upper levels of the cistern-well were also reached. Also documented from this epoch is a large collection of pottery, though without context in various sectors. With regard to the imported items, there are notable black-varnish pieces from western workshops (Roses, small seals), early Campanian A and a relative abundance of Ebusitan amphora types T.8.1.2.1. and T.8.1.3.1., as well as numerous examples of Graeco-Italic amphorae in the oldest variants of forms.

The Iberian nucleus on Montjuïc continued in the late 3rd century BC and there is significant evidence of imported materials in the 2nd and 1st centuries BC, including fine tableware (Campanian B or B-oid), as well as vases of the amphora type (Punic, central Mediterranean, Tripolitanian and Italic) and pieces of ordinary pottery, in the main of Italic provenance. Mention must also be made of the Barkeno mint, which minted silver drachma in imitation of the drachma of Emporion, dated to the 3rd century BC.

THE IBERIAN CART FROM THE SILOS OF THE PORT OF MONTJUÏC, BARCELONA
IN MEMORY OF AND TRIBUTE TO JOSEP DE CALASSANÇ SERRA I RÀFOLS

In 1946, a cart dating from the 4th century BC was found inside one of the silos excavated in the area of the Pont de l'Esparver bridge on Montjuïc. The two wheels and part of the metal wheel fittings were recovered and marks left by the wood were observed. The vehicle was a cart with solid wheels and was used for transport purposes. It is important to remember that it was found in a major trading centre. We do not know whether the cart came to be in the silo by chance—perhaps disposed there as rubbish—or whether it was a ritual deposit, as Josep de Calassanç Serra i Ràfols believed. This article includes some of the documentation compiled by Serra i Ràfols at the time of the discovery. The find is also placed in the wider context of the carts and wheels dating from this period in the Iberian Peninsula. Our work consisted solely of reading, putting in order and summarising all the documentation concerning the discovery of this cart in the silos of the port of Montjuïc held in the archives of the Institute of Catalan Studies, of presenting it in a new light and of finding information produced since Serra i Ràfols ended his research.
It is not our purpose to consider at length the place where the cart was found, since this journal includes an article on the Iberian nucleus on Montjuïc that deals with the silos. It is worth indicating, however, that we know from Serra i Ràfols' diaries that during the excavations of 1946, this silo furnished most archaeological material—in the main Attic pottery—and was the largest one excavated. Together with silo number 3, which was excavated in 1990, it is the largest silo found in Catalonia.
It should be noted that only the structure of the cart, marks left by the wood and metal parts were found. No remains of the draught animals were located. The only other materials found were pieces of pottery, Attic red-figure ware, that we can date to the 4th century BC.

PARALLELS

As indicated earlier, the discovery of the cart on Montjuïc is not unique, although few remains of vehicles from this period of history have survived. Other examples include a wheel found in Badalona. In the settlement of El Castellet in Tivissa, remains of the iron rim of a cart wheel were found. During excavations conducted by the Institute of Catalan Studies at the settlement of Sidamunt, various fragments of iron appeared, some of them belonging to the remains of carts, such as a large ring, two clamps and the possible remains of a wheel rim. Iron remains (now held in the reserves of the Catalan Museum of Archaeology) that could have come from a cart or a number of small carts were found during the first excavations of the Iberian settlement of Puig Castellar. A further example is the site of Camp de les Lloses in Tona, where various fragments of wheel rims, possibly from solid wheels, a clamp, fittings and part of a rim were found.
In addition to these fragments, there is a wheel measuring 77 cm in diameter and 6 cm wide. They are pieces of iron riveted together (Duran, Mestres, Principal, 2008). Lastly, mention must be made of the discovery in 1922 of iron wheel remains in the settlement of Azaila in Cabezo de Alcalá.
In addition to these remains found in inhabited sites, a wide range of wheels, parts of carts and even entire carts have been located in necropolises, especially in the south of the Iberian Peninsula. Among the most famous of these, and the most studied, are the wheels from Toya (Fernández-Miranda, Olmos, 1986). Remains of wheels were also found in the necropolis of Galera. Mention must be made of the find of an entire cart inside a cremation burial site of Iberian culture discovered during preventive excavations on Calle Corredera in the city of Lorca (García, Quiñones y Precioso, 2006). Other remains were also found in Alcacer do Sal in Portugal, a necropolis that seems to date from the same period as those of Toya and Galera. An insightful study of the cartwheel remains found there was produced by Cabré (1924).

THE CART

The cart found on Montjuïc was a transport cart and was undoubtedly used to transfer grain from settlements nearby to the trading centre, the port at the foot of Montjuïc. The most notable feature of these cart is its wheels, which are solid in structure. Judging by the oldest depictions of carts that we know of and from the characteristics of carts of a primitive nature found in a number of places, the earliest wheel was the solid wheel. Carts with solid or partly solid wheels capable of rotating with the axle or not are regarded as primitive carts. In the oldest carts known, the axle seems to have been fixed, as in the *chirrión*, a cart found in the Iberian Peninsula in which the wheel and axle are connected and rotate together. This kind of cart was most commonly found in the north of the peninsula, particularly in mountainous regions.

CONCLUSIONS

The cart is not an object of elemental or universal culture (Aranzadi, 1917), as it was not introduced into a number of geographical areas of the world until the modern era. Carts require the existence of a track along which it can travel, a path that must additionally be wider and in better condition than that used by horses or pack animals. Little is known about pre-Roman tracks but there must have been a large number of them, some of which would have covered long distances, while others would perhaps have merely linked the lands attached to a hamlet, village or *oppidum*. Though they have not been the subject of significant study, numerous examples of such local tracks have been found near or in villages. The ruts left in these tracks by wheels attest to the use of carts. The study of these wheel marks provides fascinating evidence, not of the width or other characteristic of wheel rims—the ruts have only survived in paved or stony stretches and must have required numerous carts to form them, hence they are much larger than each individual rim would have been—but because they give us an idea of the width of the carts and above all because a wheel rut necessarily indicates a wheel and cart, a detail of crucial importance in pre-Roman times, since the area where wheel ruts are found is also the area where carts existed.
We do not know why the cart was inside the silo but it was undoubtedly due to a ritual act that we have no knowledge

THE CENTURIATION AND STRUCTURING OF THE *AGER* IN THE COLONY OF BARCINO: ARCHAEOMORPHOLOGICAL ANALYSIS AND LANDSCAPE MODELLING

Josep Maria Palet Martínez
J. Ignacio Fiz Fernández
Hèctor A. Orengo Romeu

of. Most of the studies on carts from the Iberian era deal with carts found in tombs and with their ritual and symbolic function. There is also considerable literature on the cart as an instrument of war, as part of the warrior's armaments. In addition, it should be noted that the ownership of carts is connected with an aristocracy, with a warrior or ruling elite, as demonstrated by the princely tombs found, which are comparable with similar tombs of the Celtic world in Central Europe. Ricardo Olmos talks of a path to the afterlife, reflected in the carts in tombs. In any event, it is evident that the cart is always associated with the idea of travel or transport.

It only remains to say that of the group of silos found in the port of Montjuïc, the largest two each have a singular feature: one is the silo in which the cart was located and the other is the silo in which the cistern-well was found. These have a different infill, with the first levels consisting of earth and stone until we reach a level of rubble that seems to serve as a seal for something, in the first case the cart and in the second the cistern. Both date from the same era, the 4th century AC, the high point of the entire complex. Consequently, it may be that the presence of the cart did not come about by chance but has a symbolic meaning, as Josep de Calassanç Serra i Ràfols asserted.

The structuring of the *ager* of the colony of Barcino is presented in this study that takes as its starting point the archaeomorphological research conducted in the 1990s in the plain of the Pla de Barcelona, the first ever territorial study of an area—the city of Barcelona and its surroundings—rendered confused by urban development. This circumstance meant that the methodology had to be rethought in order to adapt the research to the problems specific to the area of study. With regard to the Roman period, the results demonstrated the importance of the founding of the colony of Barcino, which went hand in hand with a restructuring of the regional road network and the organisation of the *ager* of the city by means of the system of centuriation.

The methodological innovation introduced in this study consists of the application of Geographical Information Systems (GIS). The previous archaeomorphological studies were revised using digital techniques: the treatment and georeferencing of maps and images obtained by remote sensing, automated metrology, photogrammetry, techniques for calculating visibilities, statistics and systems for generating 3D representations. The introduction of GIS in archaeomorphological studies made reconstructions reliable and ensures highly accurate planimetry, an essential aspect in the search for centuriations. GIS also enable cartographic information to be integrated quickly and accurately and provide an extraordinary analytical capability.

A regressive cartographic base was developed in which the most modern map made it possible to georeference the oldest cartographic elements using common control points. The initial map taken as the baseline was the digital 1:5,000 topographic map produced by the ICC (Catalan Institute of Cartography). In addition, the ICC's 1:5,000 orthophotographic series was also used and the plan of the city of Barcelona in the years 1933-1936, drawn by V. Martorell, was georeferenced. This map was used to georeference the oldest plans. The cartographic base also includes the orthophotos dating from 1947. A digital model of the terrain, in which each cell measures 5 x 5 m, was developed using the altimetric information of the ICC's 1:5,000 digital topographic base. The archaeomorphological results of earlier studies were georeferenced and included in the cartographic base. The lines were redigitized but the reconstructed lines were adapted to the more reliable cartographic information provided by the new cartographic base. The calculation of visuals from prominent places in the plain applied to the study of the centuriation was one of the GIS applications employed and made it possible to address the problem of perceiving the territory as it was at the time of the founding and its subsequent manifestation in the geometric structure of the colony. Tools were used in the study to determine the visible areas from particular places in order to identify points from which the fundamental lines of the centuriation would have been defined. In Barcino, the study proceeded on the basis of the hypothesis of the location of a *locus gromae* at the highest point of the colony, the area of the Mons Taber. The centuriation would have been planned from this point with the aid of other visual elevations in the territory. The elevation would have served in effecting the *limitatio* works using initial visuals produced with the help of the *groma*. The research postulated that other topographical points that were easily visible in the territory would have been sought from this point and taken as a reference for applying the calculations needed to draw the structure of the centuriation, as well as the *ratio* that defined the modulation.

The results show that the founding of Barcino occasioned the creation of the centuriation structure and a road network coeval with it. This road network was defined by the Via Augusta and the secondary roads off it that linked the urban centre to other areas outside the plain and the paths that were part of the grid system. It has been noted that various stretches of Via Augusta are connected following the theoretical grid of the centuriation, constituting the diagonal of various centuria. This indicates that there was a unified concept of the whole of the colony—urban founding, the road network and the centuriation—that can be precisely dated to

ACCESS ROADS TO THE NORTH-WEST AND SOUTH-WEST GATES OF BARCINO THROUGH THE ARCHAEOLOGICAL EVIDENCE

Francesc Busquets
José Espejo
Vanesa Triay
Alex Moreno
Alessandro Ravotto

between the time of the founding of Barcino and the works on the road that we know of from the milliaries dating from the 8th century BC. The research conducted has made it possible to document that the centuriated structure was planned using a basic module of 15 by 20 *actus*, together with blocks modulated to 15 *actus* that survived in two areas of the plain. The centuriation extended across the flatter parts of the plain, avoiding hilly areas such as Montjuïc, the slopes of Guinardó and the peaks of Collserola. In these places, the roads followed the relief. Even so, the centuriation covered a relatively small area of the *ager Barcinonensis*, in the Pla de Barcelona, and extended from the coast roads but did not penetrate into the lowest delta lands.

The work reveals the usefulness of employing GIS to study centuriated landscapes. The study of visuals shows the relationship between four highly visible topographical points that would have served as references in the application of geometrical calculations to draw the main limits of the centuriated structure: the Mons Taber and, in the territory, the hills of El Putget and Les Tres Creus and the elevation of Santa Madrona on Montjuïc. The study of visuals between these points makes it possible to deduce the theoretical design of the main *limites* of the centuriated area and to determine the 15 x 20 *actus* module of the grid.

The body of data included in the study has made it possible to determine in detail the function of the Augustan centuriation, a typically Roman approach to rationally organising the space, in apportioning the land in the *ager*, but also in dividing land not assigned into a grid structure. The territory of Barcino reflects a multifaceted reality, with the existence of land not assigned in the theoretical grid or of centuria that were not all ploughed.

In this article, we present the results of recent excavations that have made it possible to document new stretches of road. The excavations concerned are those conducted at numbers 9 and 11-13 on Avinguda del Portal de l'Àngel, numbers 41-47 on Carrer Canuda, numbers 2-4 on Carrer de la Flor (in progress at the time of writing) and at number 140 on Carrer Hospital. These stretches of road lie in the areas immediately outside the walls on the west side of Barcino and correspond to the north-west and west thoroughfares. This characterisation of the space leads us in turn to attempt to contextualise the archaeological evidence existing in these two roads into the Roman city. In other words, it is our aim to clarify the panorama of the archaeological knowledge that we have of the accesses to the north-west gate of the *decumanus* and the south-west gate of the *cardo*.

At the present time, we have archaeological evidence of three different road thoroughfares. If we analyse the engineering works and the characteristics of the construction of each of these stretches of road, we can learn what types of *viae* existed in the west and north-west sector of the *suburbium* closest to the city.

The road located at the properties on Avinguda del Portal de l'Àngel was made using stones of various sizes and small fragments of pottery incrusted into well-beaten clayey and sandy soil that lies directly on the natural geological ground. The result was a top wearing surface that was very hard and compacted. In addition, in the largest stretch documented, at least two levels can be observed. We believe that these levels correspond to successive repairs to the base course over time The north-east/south-west orientation of the roadway is scored by narrow longitudinal lines identified as the tracks left in the surface by wheeled vehicles.

In the two smallest stretches found to the west of the first length of road, the evidence reveals a poorer state of conservation and the absence of any upper layer of repairs. Even though the technique used is the same, just one layer of less than 10 cm in depth has been recorded. As indicated earlier, this is probably due to the fact that this is a later repair in which a stretch of unknown dimensions was completely relaid but less carefully than the original.

The excavations have made it possible to document the north-east edge of the road, yet the width of 4.8 m that is visible does not represent the full breadth of the roadway since it extends into the neighbouring property. Nevertheless, thanks to the planimetry provided by those in charge of the work, we have been able to determine that the full width was 5.4 m. In principle, it would seem that none of the *limites* typical of this kind of construction have been preserved, perhaps because they were removed so that the stone could be put to re-use elsewhere.

The section of the road seems to indicate that the surface of the roadway must have been slightly convex at the centre to ensure that water drained off, thereby preventing puddles and standing water. However, this central crown disappeared over the course of successive repairs.

The other stretch of road documented thus far, which is situated in what is now Plaça Vila de Madrid, reveals engineering works consisting of various roadbed layers, which augmented the top wearing surface. These successive changes to the levels of the top surface used by traffic should be seen as reforms and repairs carried out during the time that the road was in use, above all in response to possible floods and the accumulation of alluvial silt resulting from the frequent spates of the torrents in the area, as well as to the continuous occupation of the area as a necropolis between the 1st and the 3rd centuries AD.

The third road documented, the stretch found in the area of what is today Carrer Hospital, was constructed using a technique based on a solid course made up of medium-sized unevenly-shaped pebbles. The top surface used by traffic has not been observed.

The construction of this kind of roadway usually followed the same pattern. Two parallel trenches were dug and the edges (*umbos*) were marked by means of two walls, the *limites*, built using reasonably regular stones. The soil in between was then removed and the

trough refilled with pebbles or medium-sized or large regular stones, which consolidated the base (*gremium*) on which the top wearing surface (*summum dorsum*) was laid.
In the case of Carrer Hospital, the base consists of a single layer of pebbles of irregular shape laid to a depth of 20 cm directly onto clay.
As remarked earlier, the documented remains of the Carrer Hospital roadway are incomplete and hence we are unable to say what the width of the road was. A maximum width of 2.8 m has been documented, as has one of the two *limites*, namely the northern one which consists of two rows of reasonably regular stones some 50 cm wide.
Given the importance of the road in question, since it was one of the main access routes to the city of Barcino, it is reasonable to suppose that it must have been of considerable width. It is likely that the roadway was more than 5 m (between 17 and 20 Roman feet) wide, in other words, sufficient for two carts to pass by each other.
If we analyse all this information from the point of view of space and chronology, we can arrive at a series of conclusions and hypotheses regarding the way that the western road network in the immediate environs of the city of Barcino was structured.
The *decumanus* of the city, to the north, would have extended in a north-west direction and for the first few hundred metres would have run parallel to one of the city's aqueducts. This thoroughfare has been preserved in what is now Carrer dels Arcs. We do not know how wide it would have been but it must have spanned the distance from the aqueduct (to the east) to a funeral monument of the mausoleum kind that must have been situated on the western side of the path, beyond the edge of the roadway.
Some 200 m from the city's northern gate, this road crossed another path running south-west to north-east.
We currently have no information regarding the north-west side, but it has been possible to document more than 30 m of the stretch that ran south-west.
Some 140 m towards the south-west of this preserved stretch, the road came to another crossroads. Another road in the north-west/south-east direction ran completely parallel to the access road to the north *decumana* gate and some 175 m equidistant from it. It is interesting to note that this distance is virtually the equivalent of the Roman measurement of 5 *actus* or 600 Roman feet.
The crossroads of these two roads would have been situated at the point where what is today Carrer Canuda would have run into the present-day Plaça Vila de Madrid.
We only have archaeological evidence for the south-east side of this new thoroughfare. Towards the north-west, certain morphological signs point to the fact that it would have headed in the direction of what is today Sarrià.
This stretch has been interpreted since its discovery in the 1920s as a *via sepulchralis*. We also know of some 30 m of its length. In width, it is very similar to the previous road yet its measurements are less precise—between 4 and 5 m—for the reasons described earlier. In its engineering, however, it is very different, as it has a series of wearing surfaces or courses laid one on top of the other.
It is possible to deduce from the preservation of the road in a number of streets and from the topography of medieval Barcelona that it continued towards the south-east. If we extend the thoroughfare, we can see that it runs along Passatge Magarola, through Pla del Pi (where a pedestal previously described was recently found) and along Carrer Cecs de la Boqueria before joining up with the south-east thoroughfare into the city at the south gate of the *cardo* of Barcino.
Of the thoroughfare that ran west from the south-west gate, we know of just one stretch located near Plaça Pedró on what is today Carrer Hospital. As mentioned earlier, this thoroughfare has been identified with the branch of Via Augusta that headed towards the Llobregat.
Few traces have been discovered thus far, but in the characteristics of their construction they closely follow the standard section of a Roman road as described by the Latin author Statius while observing the building of a stretch of the Via Domitiana in Italy, featuring *limites*, *umbos*, *gremium*, *summum dorsum*, etc. The finding of this small stretch has archaeologically confirmed that this thoroughfare ran eastwards towards Creu Coberta.
We believe that the origins of the structure of the western network of roads into Barcino date back to the colony's founding in the 1st century BC. At the same time that the city was founded, a centuriated network was established with a complex planned road network in association with it that linked the entire colony's area of influence. This road system was one of the cornerstones of the structure of the *ager barcinonensis*, at least in the western *suburbium* until the late Empire. This is evident in the orthogonality of all the structures found thus far, which meticulously follow the alignments and orientations of the road network.

ARCHITECTURE AND CONSTRUCTION SYSTEMS IN BARCINO DURING LATE ANTIQUITY. MATERIALS, TECHNIQUES AND MORTARS: INDICATIVE REMAINS IN THE SITE OF PLAÇA DEL REI

This article aims to outline the characteristics of the construction techniques used during late Antiquity in Barcino based on the analysis of the various buildings in the Episcopal Complex.
The detailed analysis of the site of Plaça del Rei, involving a number of different aspects and complemented by the use of analytical techniques, has provided an understanding of the entire conserved archaeological complex and established the incontrovertible chronology of its various phases.
The study of the construction techniques is based in the main on those buildings for which there is considerable archaeological evidence, that are well contextualised stratigraphically and which are reliably dated. The article concentrates on the construction techniques used in the second half of the 6th century AD but also makes reference to techniques dated to the 5th century AD.
With regard to the 6th century AD, the analysis was conducted in a global manner with special attention paid to the three most significant buildings of greatest size—the cruciform church, the bishop's palace and the court building or residence of the *comes civitatis*, the seat of civil authority in the city during the Visigothic era—but also the baths and the outbuildings adjoining the main buildings, as well as corridors, porticoes and passages. The study of the stratigraphy and of the various construction techniques was complemented by chemical analysis and C-14 dating of the mortars.
This study made it possible to identify very distinctive construction systems which, from the outset, proved to be clear indicators of chronology.
The characteristics were systematically repeated in all the buildings in the Episcopal Complex, to the extent that the construction techniques at the site have themselves become indicative of date.
It is not possible to speak of construction techniques and late Antiquity without referring to the issue of spoliation or the dismantling of other buildings to enable materials to be reused. Cities are themselves natural quarries and such action in Barcelona in the 5th and 6th centuries AD has revealed that spoliation was controlled by the public authorities, as demonstrated by the dismantling of a public work of military character as important as the one related to the defence of the city.
The structures at the site dating from the 5th century AD have survived only in part and the study of the construction techniques was based essentially on the *aula* or reception hall and the bishop's residence. The analysis was complemented by an examination of other structures from the same period consisting of various outbuildings adjoining the main buildings, corridors and porticoes.
The study of the construction techniques of the 6th century is based in the main on the analysis of the three buildings that are best preserved: the cruciform church, the bishop's palace and the court residence. These buildings are completely alike in technique, including in their exposed masonry and other visible aspects and in their foundations, with evidence found of a wide range of construction methods and devices used.
The cruciform church was analysed fundamentally from its foundations: for the study of the bond of the exposed masonry, we were able to examine the facing of the bishop's palace that has survived to a height of almost three meters, as well as various walls of the residence of the *comes civitatis* and of the baths complex.
We first analysed the structures at ground level, the masonry and ashlar walls, walls built using the technique of *opus africanum*, adobe walls and other elements such as the pillars. We then described the excavated or semi-excavated structures, their foundations (continuous, stepped and sloping) and their footings.
The state of preservation of the bishop's palace and the residence of the *comes civitatis* is such that it was possible to undertake a study of the steps and windows. Through marks left in the structures, it was additionally possible to document the use of embedded scaffolding, drainage systems and methods for allowing rainwater to drain away. The facings, floors and other features, such as the continuous benches, niches and sealing and insulation systems, were also examined.
The study techniques used to analyse the mortars were optical microscopy using incident and transmitted light, selective dyes and microchemical tests, optical fluorescence microscopy, Fourier transform infrared spectroscopy (FTIS) and X-ray diffraction (XRD).
C-14 dating of a number of samples made it possible to establish definitive chronologies for some buildings.
The datings were obtained using accelerator mass spectrometry (AMS), a system of measurement that produces accurate results since it allows the moment of the construction of the building to be determined.
In terms of construction, little is known about the 6th and 7th centuries AD, although in recent years the archaeology of this period has produced significant new information, above all in the urban setting, which makes it possible to draw certain initial conclusions.
In almost all cases, such buildings are representational and most of them are religious edifices. In them we find that the patterns of the classical world continued while new elements that became a feature of the architecture of the period appeared.
In Barcelona, the analysis of the metrology and modulation of the representational buildings dating from the 6th century AD reveals that the constructions were carefully planned and were built in a unitary form to accurate, detailed architectural plans that totally transformed the previous topography.
The buildings erected were considerable in size: the archaeological remains convey the impression that the architecture was solid, the walls thick and the foundations strong, characteristics in keeping with the weight of the building, which influenced the depth of the foundations and the load channelled to them, such as the vaults and arches.
Leaving aside the representational buildings, models for domestic architecture are rare. In Barcelona, it is only possible to say that from the 6th century AD, we have evidence of the division of certain *domus*, conversions that reveal smaller domestic structures built using less durable materials.
The panorama that we can draw from this indicates that, in comparison with the previous model, there was a process

THE METROLOGY AND MODULATION OF THE 6TH-CENTURY BUILDINGS IN THE EPISCOPAL COMPLEX IN BARCELONA

Julia Beltrán de Heredia Bercero
Emili Revilla i Cubero

of change in traditions and construction models, with a clear distinction between private building and the public construction programmes instigated by the established authorities, in which the bishops and their religious buildings, prestigious, representational architecture, played a notable part.

The analysis of the construction techniques documented in Barcelona in the 6th century in the buildings in the Episcopal Complex was complemented by a study of the unit of measurement and systems of proportions used in the representational architecture. The study considered the three buildings erected as part of the eastward expansion of the Episcopal Complex: the cruciform church, the bishop's palace and the residence of the civil authority in the city, the *comes civitatis*.
The first step consisted in identifying the metrological pattern common to all three buildings in order to establish the unit of measurement and its proportions. This made it possible to demonstrate the existence of a fixed module that coincides with a unit of measurement of 0.3015 m, a measurement that can be regarded as in keeping with the values of a Roman foot.
Once the module was known, attempts were made to confirm the geometrical functioning of the three buildings.
It was shown that the organisation of the architectural form is based on a series of rules determined by a compositional matrix that organises and distributes the various elements of the architectural structure, reflecting the original idea of the programmed arrangement. The module was the essential value at the time the project was defined, since it determined its metrical co-ordination and the series of measurements used in the building based on intelligible mathematical ratios. In the projection of the buildings presented here, the 3-4-5 Pythagorean triangle, together with the square and its duplication, is the main mathematical shape that governed the proportions,
The bishop's palace was organised around a long central body and two almost symmetrical wings. The façades feature a system of linked towers distributed along a stretch of wall, forming a series of bodies that jut in and out.
It seems that the building was planned using the geometrical shape of a square. Its floor plan is made up of nine squares of 25.5 *pedes*, which between them give rise to a quadrilateral of 76.5 *pedes*.
These squares frame a central square and the two wings of the palace and, together with the Pythagorean triangles they generate, define the modulation and the dimensions of the various parts of the building.
The court building, interpreted as the residence of the Visigothic county authority in the city, is rectangular in floor plan and is organised on the basis of three arms, also rectangular, that are distributed in a U-shape around an open space, a courtyard that provides the structure of the building and which was overlooked by the main façades.
The floor plan of the building is a rectangle measuring 46 x 64 *pedes*, a compositional schema that seems to have originated from the duplication of a square measuring 46 x 46 *pedes*.
The bays delimiting the two vertical arms of the U and the central courtyard are not centred in relation to the squares, nor are they symmetrical with each other, though their modulation is governed by precise geometrical planning.
The cruciform floor plan of the church is unusual: the crossing and the chancel are much more developed than the lateral arms and the nave, which are shorter. In addition, the structures are slightly oblique, a circumstance that may be related to their alteration to adapt them to the adjoining buildings or to action taken by the master builder. The church is oriented to the south-east and would have occupied a rectangular area of 72 x 67.5 *pedes*. The construction of the floor plan initiates in the geometrical shape of a rectangle measuring 27 x 36 *pedes* that defines the crossing, at the centre of which stands the altar. This rectangle matches the Pythagorean properties that emerge from a 3-4-5 arithmetical triangle in which the relationship between the sides is 1.333.
The chancel has the same measurements as the crossing, a circumstance that we do not believe to have come about by chance but is instead deliberate: architecturally and symbolically, the crossing and the chancel are the two most important parts of the religious building.
The study reveals the existence of a prior plan that was well defined, with buildings that were perfectly structured and modulated, and construction that followed a meticulous, carefully planned

programme of works. In addition, the study highlighted the rational composition of the various spaces based on a rhythm, a symmetry and constant proportions, which made it possible to establish precise geometrical ratios. The proportions and the geometrical shapes are repeated in the three buildings, demonstrating the presence of unitary, coherent planning and completely identical construction techniques.
The project for the Episcopal Complex of Barcino did not consist solely of a coherent architectural design for each building, but was a unitary design that covered the entire architectural complex erected in the second half of the 6th century BC. This is evident in the dimensions of the necropolis linked to the cruciform church, for example. The dimensions of the rectangle forming the chancel and the crossing are the same as those that establish and define the south and west limits of the portico surrounding the necropolis, and the same triangle governs the size of the surface of the two rectangular rooms adjoining the chancel of the church.
In short, this is a veritable official urban project of considerable ambition in which the principles of symmetry and homogeneity are at work.

The excavation of a site where a hotel was due to be built at the junction between numbers 26-30 on Carrer Hospital and number 2 on Carrer Morera resulted in the location and documentation of a relatively well preserved circular kiln that was a source of a large quantity of pottery items.
The pottery produced here was limited exclusively to two types of common ware, tableware, or 'glazed green' pottery, and other ordinary items used in the pantry or for storage and transport purposes, with glaze applied to bodies produced using an oxidising firing or reduced-fired bodies, though such pieces were significantly fewer in number.
The pottery workshop and kiln produced a very limited range of different items, most of which were intended for use in the pantry, above all earthenware bowls and pitchers with a spout and handle, and green tableware items, including small jugs for holding liquids, serving platters, bowls and plates with a lip. Cup-type oil lamps with a single hole were also made in the kiln, though this lighting item accounts for only a small percentage of its output. It is interesting to note the recording of a group of oxidised pottery pieces painted using manganese oxide, consisting in the main of small jugs, in keeping with pieces documented in the Islamic world of the east and the south of the Iberian Peninsula from the mid-12th century to the opening 30 years or so of the 13th century.
An analysis of the characteristics of the bodies reveals their composition to be low in lime in general, and that they were fired at temperatures of 900-950°C. Most of the pieces were fired in an oxidising atmosphere, though some reduced-fired bodies were recorded, as were those of mixed firing, produced using a reducing firing followed by cooling in an oxidising atmosphere.
Archaeometric studies have revealed the presence of items produced in the pottery on Carrer Hospital, or another pottery nearby, among other collections of pottery excavated in the city of Barcelona.
The trade and distribution of green tableware and monochrome glazed common ware from Barcelona has been demonstrated by its presence in finds in numerous excavations of sites around the Western Mediterranean. The pottery was traded along the main maritime trade route in the Mediterranean, which linked Barcelona with Provence, Sardinia, Naples and Sicily. The flow of trade between Barcelona and these regions increased due to a series of royal edicts, as well as contact with Naples and merchants settling in a number of trading posts around the Mediterranean. The finding of the kiln on Carrer Hospital and the archaeometric analysis of its materials have furnished us with data that allow us to make comparisons with those of the places where these goods were received.
The results of the archaeomagnetic studies and of the collection of pottery found at the kiln on Carrer Hospital reveal that it was in use during the second quarter or early part of the second half of the 13th century.

THE PRODUCTION OF GLAZED COMMON WARE IN THE POTTERY ON CARRER HOSPITAL IN THE 13th CENTURY BASED ON THE IDENTIFICATION OF ITS ARCHAEOMETRIC CHARACTERISTICS

J. Buxeda i Garrigós
J. G. Iñañez
C. Capelli

Following the discovery of the 13th-century kiln in the pottery on Carrer Hospital, its archaeometric characteristics were analysed with a view to defining a group of reference for the pottery produced in Barcelona in the 13th century, about which relatively little was known.

A total of 26 pottery items from the excavations of the workshop were sampled. These pieces came from various stratigraphic units and represented a wide variety of types. In addition, five individual pieces that had previously been analysed were used for preliminary comparative purposes in the study of the archaeometric characteristics of the pottery items found in the infill of the deposit of the site on Carrer Sant Honorat. The archaeometric characteristics of the pieces of pottery were analysed using X-ray fluorescence (XRF), X-ray diffraction (XRD) and optical microscopy for analysing thin sections (OM). All the items were dated to the 13th century.

The results have made it possible to define two groups of reference for this production centre. The first of these, Hpc, includes eleven individual items and corresponds to production that is low in lime. The second, Hc, includes 18 individual items and corresponds to lime-enriched output. The differences between these two groups—which were made using the same initial clay—are based on the variation in CaO added to the clay batch. This distinction between pottery that is low calcareous and pottery that is calcareous, thus requiring the use of two different technologies, is not clearly reflected in variations in the type of pottery manufactured, nor does it suggest an evolution in manufacturing technology, since the items were found side by side in the various stratigraphic units of provenance. It is, therefore, difficult to explain the wide variation in calcium content, but this fact confirms that the glazed common ware produced in the workshop on Carrer Hospital included pottery that was both low in lime and lime-enriched pottery.

In addition to these 29 items that came from the pottery workshop on Carrer Hospital and which were produced there, a stewpot also found at the site was included in this study of archaeometric characteristics (MJ0426). This was the sole item of pottery cookware studied. The results clearly demonstrated that this piece was not produced in the kiln, confirming that the workshop specialised in common ware, most or all of which was glazed. One of the earthenware pots (MJ0431) does not match the defined pottery output of the kiln on Carrer Hospital. Nevertheless, the pottery produced on Carrer Hospital is compatible petrographically with the pieces represented by the items MJ0426 and MJ0431 with a local origin, indicating that despite the existence of different pottery outputs, they could all have originated in the Pla de Barcelona.

With regard to firing temperatures, estimates reveal a wide variation, as is usual in centres of pottery production. This is due precisely to the fact that the items found in production centres are those which, for some reason, were not distributed to consumers. In these circumstances, it is difficult to infer the pottery workshop's technical capability in its firing and its ability to produce well-manufactured pieces, but even so there are items fired at temperatures of 950-1000°C, temperatures that are, possibly, ideal for manufactured pottery goods.

Lastly, it should be noted that once the characteristics of the output of the kiln had been established and the two groups of reference, Hpc and Hc, had been defined, the next stage was to re-evaluate, with greater assurance of accuracy, the possible origin in Barcelona of the supposedly locally-made green tableware and primitive earthenware described in the study of the materials found in the deposit on Carrer Sant Honorat. The calculation of the Mahalanobis distances from the centroids of the two defined groups showed that all the potentially locally-produced items in the deposit on Carrer Sant Honorat are compatible with the pottery made in Carrer Hospital. This result not only confirms the local origin of the items, though they were not necessarily produced in the kiln on Carrer Hospital, but also seems to indicate the existence of a culture of pottery production unlike that of the 14th century and thereafter. The primitive earthenware, green tableware and glazed common ware of the 13th century were made using the same raw materials and the same method for producing the clay body. This and the finding of the workshop on Carrer Hospital in a part of the Raval neighbourhood where pottery-making was previously unknown could suggest that at this time the area might have been a major centre of pottery manufacture, with the existence of various workshops that exploited the same raw materials and used the same method to prepare the clay body, though these were later abandoned.

The establishment of the archaeometric characteristics of the output of the workshop on Carrer Hospital represents a considerable advance in the knowledge of pottery production in Barcelona in the 13th century and will enable this knowledge to be furthered in future studies.