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An endeavour to identify Roman bridges built in former *Hispania*

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Over the course of history, bridges have enjoyed wide social acclaim as proven by the numerous references to them in popular tradition and in historical documents. This has not been reflected in the field of surveys however, where the number of books devoted to the subject is quite low in comparison with that of those centred on architectural works. The first specific study of bridges was written in 1716 by Henri Gautier. The fact is that historians have shown little interest in ancient public works and engineers have not paid too much attention to them either.

Following the establishment of new policies of preservation and appraisal developed in Europe in the second half of the twentieth century, when the notion of heritage transcends architectural monuments, this tendency would change and the historical and heritage value of many technical constructions (former industrial installations and historical public works in general) began to be acknowledged as new categories of cultural heritage were defined. Within this new context, in recent decades a number of studies have appeared on ancient bridges which, in general terms, describe the works in question and provide historical documents yet without analysing in any great depth the stonework, an essential factor in the investigation of their constructional history, above all in the cases of the oldest bridges, on which scant documentation is available.

Our study will focus precisely on this feature, and will attempt to furnish a systematic analysis of the formal and constructional characteristics of Roman bridges in *Hispania*, applying a method of work that has enabled us to reach a series of conclusions which will prove vital in the identification.

Methodology

Over the last few years a certain methodology has been developed to further the identification of the Roman bridges in *Hispania*, based on the analysis of the stonework of surviving bridges (Durán 1996; Durán 2001). Initially the idea was to gather the maximum amount of information published on the bridges in question, all of them of unquestionable Roman origin, and to obtain as much data as possible by means of precise topographical upliftings of them all. Varying historical and territorial determinants were taken into account, as was their transformation over the course of time, while other geo-technical, structural and hydraulic factors were also analysed. The resulting data has enabled us to systematise these works, and obtain a set of constructional and formal features that will prove extremely useful in ensuring accurate identification.

It is difficult to date these bridges with precision due to their formal and constructional likeness over various centuries, which has led us to restrict our object exclusively to identifying them. This limitation will no doubt be overcome in future thanks to the undertaking of new historical, archaeological and constructional studies in the sphere of the former Roman Empire.

Analysis of Hispanic Roman Bridges

Bridge building throughout the Roman Empire was carried out by technically skilled specialised workers in the military, whose work was no doubt subject to precise rules. The stonework, a paradigm of fine construction, was executed in a solid stable fashion to ensure its eternity, as described by Caius Iulius Lacer, the architect from Alcántara who erected his work for it to last «forever, over the centuries of the world».

Standardising the intrinsic features of such constructional rigour will enable us to identify the possible Roman origin of ancient bridges. Yet scholars have not always proceeded in this way, and have occasionally identified bridges as Roman when these presented stone vaults of an indefinite date, or merely influenced by the popular term used in reference to them. In our opinion the adjective «Roman» should not be applied indiscriminately to any bridge that happens to exist where a former Roman bridge once stood, but exclusively to those bridges that have preserved their original stonework almost entirely, or else those that, while only preserving a part of this, are still distinguishable as Roman despite subsequent reconstructions. The Sommieres bridge in the French region of Provence for instance, can be considered Roman in spite of its successive reconstructions, for it preserves the shape and many of the specific features of Roman works. On the contrary, Ponte Vella in Ourense cannot be regarded Roman despite having preserved a part of its original work, because Mediaeval and modern reconstructions have completely altered its primeval form. In cases that do not fall neatly into either category, we have opted for the expression «bridge in the Roman tradition» describing works which, in addition to possessing certain historical conditions, present other constructional features that enable us to presume the previous existence of a Roman bridge in the same spot.

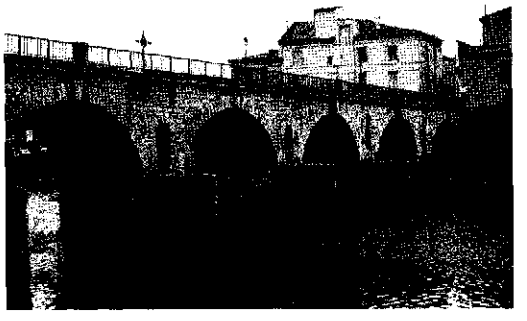

Figure 1
Bridge of Sommières

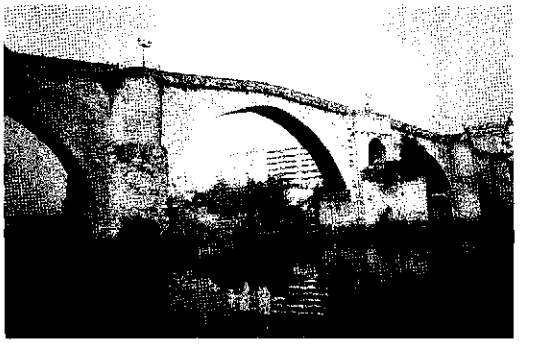

Figure 2
Bridge of Ourense

The task of identification proves easier in the case of ashlar masonry, as the scabble, the bond and the painstaking execution are the first clearly recognisable signs. In the case of ashlar (*opus vittatum*), schistose, brick (*opus latericiae*) or a combination of these materials, the difficulty increases, for such works are barely distinguishable from others made at a later date. No bridge made of masonry or of flagstones has been identified in former *Hispania*, and only one built of bricks has been officially recognised. A schistose bridge quoted as Roman is the one on the outskirts of former *Asturica Augusta* (Astorga), on the French road to Santiago. At present somewhat covered by earth, it presents segmented arches measuring 3.60 m wide and its roadway has a slight double slope. Having analysed the work in some depth, one reaches the conclusion that none of its features allow it to be identified as Roman, an assumption reinforced by the fact that it stands outside the route uniting Astorga and León.

Identifying brick bridges is not an easy task either, as this material has remained practically unaltered over many centuries. Only the size, constructional layout and comparison of such works with other Roman examples allow positive identification. The Mérida sewer (Alcantarilla de Mérida), the only

work classified as Roman, was built on the former road between *Emerita Augusta* and *Bracara Augusta*, according to a plan drawn up by the master builder Fernando Rodríguez in 1796 (González Tascón 2002, 143). The size of brick used in this bridge was 29.6 × 44.4 × 5.5 cm, laid out in radial stretcher and header courses, exactly the same as the Roman bridge in Saint Albans, England (Harney 1990, 45). The stonework in another example, the Roman bridge in Carmona, however, presents no specific feature betraying such an origin, despite standing in the place where a wider bridge had existed previously, according to remains preserved on both abutments and a layout resembling arcading. Yet the Roman bridge over the river Odiel, in the vicinity of Aracena, standing on the *Urion-Arucci* road (Ruiz Acevedo 1998, 84–85) did perhaps preserve a Roman arch, the one with the smaller span, presenting the same constructional characteristics as the Alcantarilla de Mérida.

Of the thirty-two bridges in *Hispania* (Spain and Portugal) examined in this study, only one preserves very few remains (Aljucén bridge in Cáceres), while six others preserve quite a significant proportion of original stonework and have suffered a number of reconstructions (Ponte Vella, Ponte Cigarrosa, Ponte Navea and Ponte de Baños de Molgas in Ourense, Ponte Romana in Lugo and Bridge of the Devil in Martorell). Two are of dubious Roman origin yet have traditionally been regarded as Roman (Villa del Río and Los Pedroches bridges in Cordova), and the remaining twenty-three preserve much of their original stonework (Durán 1996, 167–178). The studies carried out have allowed us to determine nine characteristics or constructional features taken as the basis of the identification process.

Figure 3
Mérida sewer

Figure 4
Bridge of Carmona

Formal and Constructional Singularities of Hispanic Bridges

The uniformity of Roman construction in time and space is quite obvious in bridges, as the singularities observed in those built in *Hispania* appear in other works built in other regions of the empire, a fact that enables us to suggest, having defined their peculiarities, that all works that present them, totally or partially, are quite likely to be of Roman origin. None of these features, widely present in Roman works, proves this fact in itself, and must be accompanied by further evidence of a historical or

archaeological nature, for many such traits have been used in bridges built at later dates.

Bridge Width

One of the most interesting features of these works is their width. Most of the bridges built in *Hispania* and in other parts of the Roman Empire are over five metres wide, a significant dimension compared with bridges built later, especially in the Middle Ages, which were seldom so wide. Perhaps this was because Roman builders preferred not to reduce the breadth of the roads (usually six or seven metres wide) on their course over the bridges.

Our study has centred on 146 different widths, many of them measured for this purpose and the others taken from Galliazo's survey (Galliazo 1996). The results obtained show that only 18.5% of the bridges measured less than five metres wide, in other words, 81.5% exceeded this value, while only 5% of bridges had a width of less than four metres. As an example, we present the widths of bridges in Roman *Gallaecia* (Galicia and northern Portugal):

— Between 4.50 and 5.00 m – A Pontóriga bridge (4.50 m), Sao Lourenço sewer and Ponte Freixo (4.60 m)
— Between 5.00 and 6.00 m – Ponte de Lugo (5.00 m), Ponte Pedriña (5.74 m), Ponte San Miguel (5.50 m) and Ponte da Ribeira o Forno (5.50 m)
— Between 6.00 and 6.50 m – Ponte de Pedra (6.00 m), Ponte de Chaves (6.10 m), Ponte Cigarrosa and Ponte Vella de Ourense (6.15 m), Ponte Bibei and Ponte Navea (6.30 m)
— Over 6.50 m - Ponte de Lima (7.10 m), Ponte do Arquinho (7.30 m)

Figure 5
Ponte do Arquinho

The Horizontal or Slightly Inclined Grade Line

The platforms in 75% of the bridges studied have horizontal grade lines, while the other 25% present a slight inclination with slopes of roughly 3%.

If we extend this analysis to bridges in other regions we notice that most have similar characteristics, although those with horizontal grade lines are dominant. Pont Julien, in the French department of Vaucluse, presents the greatest inclination, yet even in this case the slopes are no higher than 9%.

Figure 6
Pont Julien

Rustic Work

Rustic work appears in all the bridges in *Hispania*, and in most of those preserved in other parts of the former Roman Empire. The taste for this form of scabble was a Greek legacy that can be traced back to many military constructions from the Hellenistic period onwards, with aprons made of rustic work (Adam 1982). The reasons explaining its appearance could be both economical, as rustic work avoided carving the totality of exposed face, and practical, designed to protect the edges of the ashlars during their transport and laying up. Subsequent use in

Roman times obeyed aesthetic motives, for when the rustic work was placed in the lower areas of constructions it granted them a sense of robustness (Lugli 1957, vol. 1: 208), as we see in the bridge at Alconetar in Cáceres and in the Bridge/Aqueduct of the Devil in Tarragona.

The most frequent form of rustic work in the masonry of bridges in *Hispania* is rough-hewn exposed face, occasionally with chamfered edges and in most cases with bands dressed with chisels or fine gradines on one or several edges, forming *anathyrosis* (Lugli 1957, vol. 1: 207).

This feature is quite common in Roman constructions yet its mere presence in ancient bridges does not guarantee this origin, as it has been employed over the course of time and has even been copied in reconstructions dating from later periods, thus producing confusion. Rustic work practically identical to the original stonework was carried out by Portuguese stonemasons in the reconstruction of two arches of the Segura bridge in 1571 for instance, such a fine imitation that it is barely distinguishable (Durán 1996, 175).

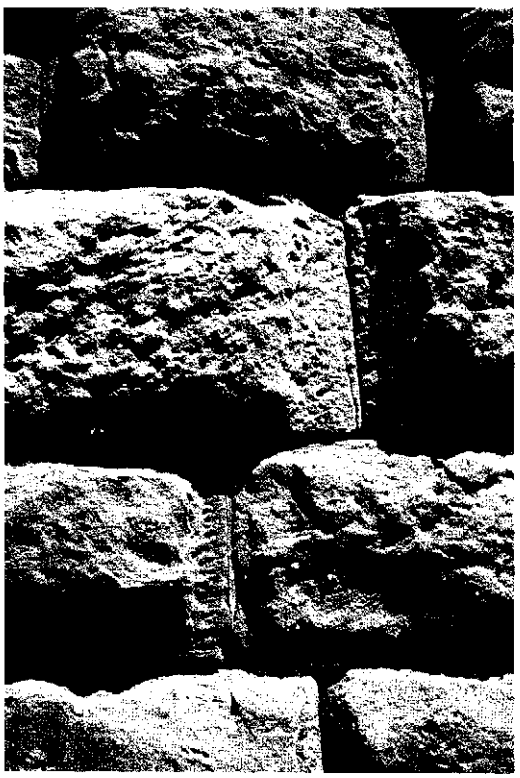

Figure 7
Bridge of the Devil in Martorell

Alternate Stretcher and Header Courses

The alternation of masonry units in stretchers and headers in the same course, or the presence of alternate courses of units in stretchers and headers are bonds that the Romans also copied from Greek construction, where they originally appeared when structures built with logs of wood alternately placed crosswise to grant them stability were subsequently reproduced in stonework. Of the two dispositions, the latter (alternate courses of stretchers and headers) is the most frequent in Roman construction, further proving its systematic nature, well suited to the Roman concepts of planning, efficiency and speedy execution (Adam 1996, 119).

Bonds of alternate courses of stretchers and headers appeared in a number of ancient works such as the Servian Wall in Rome, built between 378 and 352 BC, the walls of Falerii Novi, built in 240 BC and the viaduct of Ponte Picchiao in via Flaminia, built in 220 BC (Ballance 1951, 88). Defined by Lugli as a «Roman system» (Lugli 1957, 175) due to the frequent appearance of *opus cuadratum* in works, it was also employed in a fair number of bridges. Despite having been considered a feature

Figure 8
Ponte Freixo

characterising construction before the age of Augustus, its presence in works of an obviously later date invalidates this opinion (Ballance 1951, 95). This bond is usually found in the lower parts of abutments and piers, designed to connect the stonework of these areas subject to greater thrusts and movements than the rest. In this position we find it in Ponte Freixo in Ourense, where a uniform unit of masonry was employed, measuring 1 × 1 × 3 feet placed in alternate courses of stretchers and headers. In fact it can be traced in 67% of the thirty-two bridges in *Hispania* we have been analysing, usually beneath the springing lines of the vaults in the inner parts of piers and abutments and on the channelling walls.

Figure 10
Ponte Freixo

Ashlars with Holes in Dovetail Shape

Roman construction adopted this way of connecting units of masonry by means of leaden cramps or dowels, reproducing joinery. Other more simple forms of linkage were also employed (Ginouvès and Martín 1985, vol. 1: 28), some of them until recently, such as the U-shaped metal cramps identified in Ponte de Pedra, Portugal. This sort of cramp is easy to make by bending the two ends of a reinforcing bar, and equally easy to put in place, as it fits neatly into the two cavities that are then filled by tapping lead to subject it.

As for the dovetail mark, we must say we find it an extremely interesting feature that does not appear in works from later periods. Some authors hold the opinion that this way of connecting stonework died out during the first century AD (Adam 1996, 57), at the height of the Roman era. In our view this was not the case in the construction of Hispanic bridges, for this trait appears in later works such as Ponte Freixo.

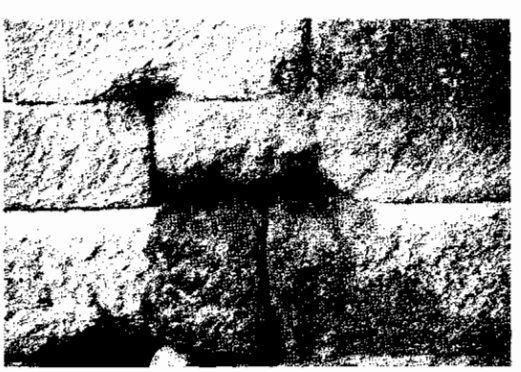

Figure 9
Ponte de Pedra

This sort of linkage was placed in those areas of the work subject to greatest external actions, areas susceptible of registering the most important movements, usually the lower spans of abutments and piers, and the paving of the foundation. We have only come across this form of cramp, joining voussoirs, in one case outside of the region of *Hispania*, to be precise in the Chemtou bridge in Tunisia.

Few are the cramps that have survived, whether made of metal (usually stemming from the Middle Ages) or of hard wood such as ash, holm oak or olive. Two were sent by the engineer Alejandro Millán to the Real Academia de Historia in 1859, discovered during the works of restoration of the Alcántara bridge in Cáceres (Blanco 1977, 68), and others were found, reduced to ashes, at Ponte Freixo during the works of consolidation carried out between 1989 and 1990 (Alvarado, Durán and Nárdiz 1989, 69). The scarcity of cramps was taken by G. Boni as the basis of his assumption that the double dovetail did not obey any constructional purpose but was merely reminiscent of the double-bladed axe, an ancient religious symbol widespread throughout the Mediterranean basin (Lugli 1957, 237).

The double dovetail may be difficult to discern in some works, for it is usually placed in the inner part of the stonework and can only be detected if the work is

incomplete or the units of masonry are removed from their original positions. The existence of the typical extraction holes and, if visible, the paving of the foundation also enable us to identify this sort of linkage.

The double dovetail appears in five of the thirty-two Roman bridges in *Hispania*, namely, in the cutwaters of Ponte Freixo, in the channelling walls and the right abutment of Ponte Navea and in the paving of the foundation of the piers in Ponte Cigarrosa and the Segura and Villa del Río bridges. More recently we have also come across it in the foundation and the supporting walls in the Pertusa bridge in Huesca, an example not included among the thirty-two we have focused on.

Uniformity in the Thickness of Vaults

This constructional feature must be clarified, as the uniformity we are broaching should not be understood in absolute terms. Given that practically no bridge has a constant vault thickness throughout its directrix, we have decided to consider uniform only the threads whose variations in height do not exceed 10%. The thickness studied is that of the rib, the only thickness clearly visible in most bridges, as that of the inner areas is only seldom perceptible.

The degree of thickness is more noticeable comparing the vaults of Roman bridges with those on Mediaeval examples, for the latter present voussoirs of more irregular sizes. Some Roman works occasionally evince a lack of uniformity, but this is generally confined to a gradual variation of the height of the voussoirs, from the keystone to the supports, or else to the existence of voussoirs of exceptional size in the springing lines, in the haunches or in the very keystones.

To the relative uniformity of the exterior threads present in 95% of the Roman bridges we have studied, we must add the fact that the works that have enabled us to observe the complete extrados of a vault (Ponte Freixo, Ponte do Arquinho, Alconetar bridge, Ponte de Lima, Ponte San Miguel, Ponte Ribeira do Forno and the aforementioned Pertusa bridge) thickness is constant throughout the width. This is probably true in most Roman bridges, save in exceptional cases such as the ribbed vaults of the Augustus bridge in Narni, Italy, and the vault made of cement and stone rings in the San Martín bridge in Aosta. In Mediaeval bridges however, it is quite frequent to find arrises or ribs that are thicker than the central areas.

Figure 11
Ponte do Arquinho

Figure 12
Bridge of Merida

Careful Execution of the Bond and Joints of Masonry Units

This feature is also held in higher esteem as opposed to the neglect evident in Mediaeval stonework, as the bonding and quality of the scabble in Roman masonry stands out compared with stonework of later periods. In our opinion, the refinement of the joints and the precise fitting of the ashlars distinguish Roman works and are useful tools in the task of identification.

Manipulation Holes in Masonry

In this section we shall study the holes for hoisting the units of masonry with gripping-tools, and those made on the upper or lower edges of the ashlars to facilitate their positioning with levers.

The small holes appearing more or less in the centre of the ashlars and voussoirs were made to hold the teeth of the metallic gripping-tools (*ferrei forfices*) used in hoisting pieces (Adam 1996, 52). They are frequent in Roman constructions and, of course, in numerous bridges, and their most common shapes are triangular, circular and rectangular. Due to the fact that these holes was not exclusive to this period –the use of gripping-tools similar to *ferrei forfices* is still a widespread practice today— their presence in ancient bridges does not necessarily prove a Roman origin. In spite of this, and given that they appear in 67% of the bridges we have been analysing, we consider them sufficiently meaningful to deserve inclusion in this set of features.

Figure 13
Ponte Freixo

The flattening practiced on the edges of the units of masonry to facilitate their placing in position with levers can be observed in a number of bridges in *Hispania*, such as Ponte Freixo and Ponte Bibei, yet never in later works. This characteristic is typical of Roman constructions and its presence in ancient works can be taken as sufficient evidence of Roman origin.

Dimensions in Roman Units of Longitude

The results of the transformation of the most significant dimensions of an ancient bridge into Roman units must be regarded with some reserve, especially if it is employed as the sole procedure to justify their Roman origin. The first problem appears when it is impossible to obtain accurate knowledge of the original dimensions. This is the case when the origin of the measurements is unclear, as for instance in constructions with rustic work on the joints or on the external face of the stonework (the difference between these two measurements may be of up to fifteen or twenty centimetres). It also occurs when it is likely that the measurements have suffered modifications due to a variety of reasons, as a result of which the bridge will be affected throughout its practical existence (avenues, excess loads, earthquakes, movements, etc.).

The study of dimensions is usually undertaken to discover the modular design of each work and the geometric relations between its various parts, as well as to translate the most significant dimensions into units of measure of the Roman age, generally expressed in feet. Sometimes the results are slightly forced, particularly when the idea behind the use of abundant arithmetical calculations of various multiples and sub-multiples of feet, and even fractions, is to find measurements in Roman units that adjust to the most significant dimensions of the bridge.

This dimensional analysis may prove interesting if and when it is not the only means used to identify a work, but merely a complementary test. This is particularly important if it is carried out with excessive yet useless rigour, employing average metrological values expressed in centimetres, applied either to the search for relations between different parts of a bridge —the golden section of between the

spans of the Alcántara bridge and Ponte Freixo has been discovered— or to the adjustment in feet of the most outstanding dimensions.

Finally, we would like to point out the striking fact that many of the dimensions of Hispanic correspond approximately to whole numbers of feet, and that certain values (10.40 m, 6.00 m, 4.60 m, 3.60 m, etc.) are often repeated.

The Identification of Roman Bridges

In order to further the probability of successful processes of identification the stonework must present as wide a set as possible of the features expounded. Even so, there will be cases in which it will be difficult to reach a definitive conclusion, and the only option will be to wait for new knowledge and research to provide a solution.

We have been studying bridges in former *Hispania* for a number of years now, obtaining a variety of results, some of which we shall set out here. One of the most interesting results is that of the Villa del Río and Los Pedroches bridges in Cordova, constructed on the route of the so-called Via Augusta between *Castulo* and *Corduba*, and traditionally regarded as Roman. However, certain features of the surviving stonework made us doubt this origin (Durán 1996, 177–178). The Roman nature of the bridge at Villa del Río seems justified by the presence of rustic work, by the possibly original symmetric disposition (it once had a fifth arch that has not been preserved), by the existence of dovetail holes in the paving of the foundation and by the typological resemblance to the Italian bridge of Calamone, on Via Flaminia. Nonetheless, the seamed voussoirs of the ribs and the abutment of an arch in the set of arch stones of an outlet supported by a narrow pier, appear to us to be constructional regulations of Moorish origin. A seam is a constructional device that improves the earthquake-resistant performance of the arch by preventing the voussoirs from sliding, a contrivance that Roman architects were familiar with although they did not apply it very frequently (it appears, for instance, in the wedge-shaped lintels of the theatre in Orange and in the arches on the lower body of the tomb of Theodoric the Great in Ravenna). At a later date this resource was also employed in Moorish construction, as can be appreciated in the Moorish buildings of Andalusia (as, for instance, in the Puerta de Sevilla in the walls of Carmona, and in the Pinospuente bridge in Granada).

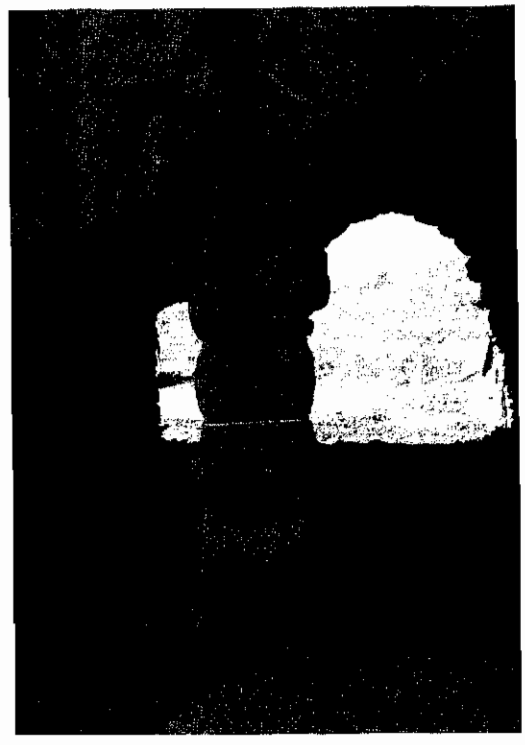

Figure 14
Bridge of Villa del Río

As a constructional composition, the narrow pier measuring 45 cm shared by two vaults with the same number of outlets is too slender for Roman taste. In fact it does not appear in any other Roman bridge, not even in the aforementioned Calamone bridge. Moreover, there is a genuine possibility of it being unstable under certain circumstances, according to the studies undertaken (Durán 1996, 178).

The Los Pedroches bridge also presents seamed voussoirs, and here again, their presence leads us to query the Roman origin of the present stonework, or of a part of it at least, as its three vaults have obviously been reconstructed at a later date, still in the Moorish period, with much narrower voussoirs than those with the seams. In our opinion, both bridges are reconstructions of previous Roman bridges, of which the original foundation and formal layout have been preserved.

Another interesting bridge of ancient appearance, of which only the first courses of rustic work on its piers have survived, is Ponte Ponsul, located some 20 km east of Castelo Branco in Portugal, that stands next to another bridge completed in 1875 during the reign of D. Luis I of Portugal. Studying them some years ago, we reached the conclusion that the presence of rustic work was not sufficient evidence to allow us to classify it as a Roman bridge, in spite of the fact that its erosion denoted age and that it stood along the route of a road possibly linking Mérida-Alcántara-Segura-*Conimbriga* in quite a straight line. The ogival plan of the cutwaters and buttresses, unknown in the Roman bridges in Europe yet a common feature in works of the thirteenth, seventeenth and eighteenth centuries, also made us doubt. However, in a recent trip to Tunisia we visited the ruins of the Roman bridge of Chemtou, over the wadi Mejerda in the ancient city of *Simitthu*, and observed that the cutwaters and buttresses also had ogival plans. Having discovered a genuinely Roman precedent for these initially disconcerting piers of Ponte Ponsul made us reconsider our first opinion and take into account the possibility that the remains discovered did in fact stem from a former Roman bridge.

Another case we have studied in depth is the Roman bridge of Fortanete in Teruel, which has a segmented arch with a span measuring 10.40 m and a width of 3.60 m. The fact that the stonework of this bridge presents two of the features previously described, that is, the rustic work of the voussoirs and the possibility of expressing the two measurements in whole numbers of feet (35 and 20 respectively), not to mention that the flattening of the arch is equal to that of the original arch of the Alconetar bridge, lead us to believe that this is in effect a Roman construction. Nonetheless, the sharpness of the arrises of the voussoirs and of the rustic work, denoting a lack of age, the narrowness of the roadway and the lack of uniformity in the thickness of the ribs raise doubts that cannot be resolved until further research provides conclusive evidence for positive identification.

In northern Portugal we have analysed two bridges pertaining to former Gallaecia, Ponte do Arco da Geia over the river Labruja, near the city of Ponte de Lima, and Ponte do Arco over the river Vizelas, between the cities of Guimaraes and Amarante. The former has an arch with a uniform set of arch stones measuring 60 cm high, eroded rustic work measuring 4.00 m wide

Figure 15
Ponte Ponsul

Figure 16
Bridge of Chemtou

(13.50 feet) and a span of 10.70 m (36 feet). The latter presents two vaults, the largest of which is also the oldest and has a span of 12.60 m (42 feet) and a width

Figure 17
Ponte do Arco

of also 4.00 m, with uniform voussoirs measuring 70 cm and eroded rustic work, while the smaller vault is clearly modern. The fact their most important dimensions are expressed in feet, that the rustic work of the voussoirs is eroded, that no traces made by Mediaeval masons are distinguishable and even that they stand in very Romanised areas close to the *Limia* and *Salacia* mansions respectively, on the route of former road links could tempt us to believe we are before two Roman arches. However, we do not consider these factors to be sufficient to identify the works as Roman, despite clearly belonging to the Roman constructional tradition.

The location of a bridge on the route of a Roman road could be, as in the case of Ponte Ponsul and in the two previous examples, an issue corroborating the Roman origin of a construction. Such is the case of

Figure 18
Pontarrón de Los Garabíos

Pontarrón de Los Garabíos, near Valencia de Alcántara, which in addition to being located on a road that possibly linked the Lusitanian *Valentia* and the bridge of Alcántara, has an arcading composed of two equal vaults with spans measuring 8.40 m (28 feet), a width of 4.50 m (15 feet) and some ashlars with rustic work scattered around the present construction built by the Order of Alcántara. It is clearly not a Roman bridge, although we do consider it a legacy of Roman constructional inspiration.

To conclude this essay we shall refer to the remains of a bridge in Pertusa, Huesca, built over the river Alcandre on the route of Road No. 1 on the Antonino Itinerary, and the possibility that these be the only surviving elements of the former Roman bridge. Informed of its existence by the investigator Moreno Gallo, we observed enough characteristics in these remains to harbour no doubts that their origin was in effect Roman —the vault was wide (5.70 m/19 feet), the masonry presented holes to hold the double dovetail cramps, the bond had been carefully executed and the channelling walls on the upstream side have survived, as in the case of the Bridge of the Devil in Martorell, Ponte Navea and Ponte Bibel.

Epilogue

A number of bridges in *Hispania* that have traditionally been regarded Roman should be reconsidered, as the constructional and formal analysis of their stonework would be sure to provide new information leading to a change in attribution. Among other instances, we believe that the stonework in the Luco de Jiloca bridge in Saragosse, the Pollensa bridge in Majorca, the Mantible bridge in La Rioja, the Colloto bridge near Oviedo, the Medellín bridge in Badajoz, the Tardomar bridge in Burgos and the Cihuri bridge over the river Tirón, also in La Rioja, should be the object of detailed examination for, from our point of view, they do not possess sufficient identifying traits nor is there historical data of sufficient substance to confirm their Roman origin.

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