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PRODUCTION AND DISTRIBUTION OF TROAD GRANITE, BOTH PUBLIC AND PRIVATE

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Abstract

Troad granite columns are among the most widespread architectural artefacts that were found around the Mediterranean, often used together with Proconnesian bases and capitals as well as cipollino column shafts, a fact which indicates a collaboration between different marble-quarrying districts in order to standardise measurements.

In this examination we want to extend the analysis of the export of this stone outside the Tarraconense, as highlighted during the last session of ASMOSIA, in order to get closer to the channels of commerce of this stone to the various regions. We also want to study in more detail the production methods of the column shafts based on standardised measurements and the economic level of the élite who could afford the great costs of this stone and that of its transport. The presence of large column shafts implies a direct import from the Troad quarries, while the smaller shafts could have made up the return cargo of ships that had come to Rome carrying other goods.

Keywords

Troas, Granite, Column, Production, Distribution notes

Introduction

The columns in granite from Troad constitute one of the most widespread architectural artefacts in the Mediterranean together with the column shafts in *cipollino*, *sienite,* Proconnesian and Thasian marble. Its export was frequently joined with Corinthian capitals from the Proconnesian quarries, a fact that implied a production according to standardized modes which Ward-Perkins interpreted as the result of a close collaboration between different marble districts scattered all around the Mediterranean. However, the analysis of the production and the distribution of that stone should necessarily start with the evidence offered by the shafts kept in the sites as other sources of information such as quarry markings on the blocks or on unfinished shafts, do not exist. In this article we shall proceed with the analysis of the diffusion of the shafts realized in that material presenting some of the better known examples, with the exception of the columns existing in Rome and Ostia of which L. Lazzarini has published a detailed list consisting of more than 90 exemplars most of which have been reused in churches[1].

Anyway it is necessary to underline the fact that gray granite, mostly used in the grandiose architecture in Rome of the first and second century, was the granite of the Forum (we could quote its presence in Trajan's Forum, in the temple of Venus and Rome and in the Pantheon), and that its use in those architectural programmes favoured the diffusion of a taste for that type of material which was substituted in provincial environments with local gray granite or coming from the Troad quarries. The large export of this latter variety in a provincial environment was made easy by different factors as its cost was lower than the Forum granite (Lazzarini 2010a, 488) and also by the existence of a much

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1. Roma: 1 shaft in the Portico of San Giovanni e Paolo; 1 shaft in the San Felice Gate of the Quirinale Palace; 2 shafts at the entrance gate of the convent of Santi Apostoli; 1 shaft in the prothyrum, 1 shaft in the four sided-portico and 2 shafts in the church of Santa Prassede; 1 shaft in San Saba; 2 shafts in the entrance gate of the Lateran Palace; 2 shafts in the cloister of San Giovanni in Laterano; 4 shafts in the four-sided portico, 1 shaft in the lower church and 1 shaft in the upper church of San Clemente; 2 shafts in the four-sided portico of the Santi Quattro Coronati; 4 shafts in the narthex of Santa Sabina; 4 shafts in the church of S. Maria in Cosmedin; 8 shafts in S. Stefano Rotondo, a few ones in front of the Chapel of SS. Primo e Feliciano and 2 shafts in the external rotunda of that church; 2 shafts at the entrance gate of the Galleria Doria Pamphili; 1 shaft in the portico of S. Lorenzo in Lucina; 2 shafts at the entrance gate and 10 shafts in the yard of the Borghese Palace; 1 shaft in the yard and 2 shafts within the Museum of the Palazzo dei Conservatori; 7 shafts in the yard of the Palazzo della Cancelleria; 2 shafts in the entrance hall of Palazzo Farnese; 1 shaft in the portico of S. Giovanni a Porta Latina; 8 shafts in Sant'Agata dei Goti; 5 shafts in S. Crisogono; 1 shaft in S. Maria in Trastevere; 3 shafts in the portico and 7 shafts in the external right wall of S. Vitale and, finally, 2 shafts in the Pantheon and some shafts in the Trajan Temple. Ostia: 2 shafts in the Forum; 2 shafts in the nymphaeum of the *Domus di Amore e Psiche* (Lazzarini 1987, 162; Lazzarini 2010b, 140). We could add to this list a few samples from Rome, like a shaft preserved in the Villa Celimontana gardens with a lower diameter of 50 cm, certainly coming from a warehouse, and three exemplars reused inside Santa Maria in Domnica (Pensabene 2003a, 167-168).

developed organization of its exploitation and by the vicinity of its quarries to the harbour of Alexandria in Troad. Anyway the granite from Troad is also found in some important architectural programmes of the *Urbs* (cf. Note 1), as well as in the Severan alterations of Pompey's[2] theatre and of Octavia's Portico present in two columns adjacent to the propylaeun (Bruno, Attanasio 2008, 52). Finally we should like to point out that we have included a few shafts preserved around Rome, in Greece and in Turkey: areas, then, for which exhaustive numerical data are not available.

By means of that analysis it clearly appears how these shafts, starting from the second century A.D. spread around very largely. We should pay special attention to the monumental building programmes within the Mediterranean during that century and the Severan age which produced an effort to conform the production of the quarries to those programmes. An analysis of that type could offer new reading keys to better understand its distribution, for instance the presence of shafts of a large size in special architectural programmes such as in the Antonine Baths in Carthage or in the *Traianeum* at Italica, some of whose columns were reused in an edifice of the fifth century A.D. built in the nearby city of Sevilla.

Import

Only starting on the basis of a systematic catalogue of the existing pieces we shall be able to analyze the export and understand the commercial routes used for the distribution of the shafts realized in that material; in the province of Tarraco (its relevant studies were discussed during the last *ASMOSIA* Conference[3]), in Betica, in Gaul, in the *Regio I Latium et Campania,* in the *Regio II Apulia et Calabria,* in the *Regio III Lucania et Brutii,* in the *Regio VII Etruria*, in the *Regio VIII Aemilia,* in the *Regio X Venetia et Histria,* in Sicily, in *Dalmatia*, in Proconsular Africa, in some cities in Egypt, Syria, Palestine, Asia Minor, Cyprus and Crete (Table 1; Fig. 1). Anyway as part of the material has not yet been studied, it would be necessary that the scholars researching on the different areas will circulate wider and more detailed information about the presence of shafts realized in that material, with or without its archaeological context, found *in situ* or in a context of reuse. Only on the basis of those quantitative data we will be able to make it up with the loss of the architectural context of many pieces.

Tarraconensis: The study of the granite shafts from Troad of that province was taken into consideration during the last *ASMOSIA*[4] conference, therefore we offer here only a brief summary of the major results so far reached. All the preserved shafts, ca 45 exemplars, are from the city of Tarraco (Tarragona) and present dimensions very similar to one another, with an approximate height of 15-16 feet. As far as they are concerned it is very likely that they came from the same architectural complex, certainly of a public type, on account of the high cost of that material. Two are the edifices in Tarraco where those shafts were likely used; the portico *in summa cavea* of the Roman amphitheatre and the portico of the provincial forum. In the first case we are not certain of the existence of a portico, though the construction of the amphitheatre in Trajan's or Hadrian's age coincides with the moment of the largest export of that material around the whole Mediterranean. In the second architectural complex, the provincial forum, as it has been dated to the Flavian period, precedes the moment when that material was exported. On the other hand the shafts could have been set in place because of a change or of a restoration in this complex, perhaps in the time of Hadrian. We have several hints which could sustain such a hypothesis.

1) The coincidence of the diameter of the shafts in granite and that of the two Corinthian capitals in Proconnesian marble realized in Hadrian's age by workshops of the *Urbs* (Pensabene 1993, 33-35, nº 1-2) and also the probable, though not certain provenance of those capitals from the provincial forum.

2) The restoration wanted by Hadrian of Augustus' Temple (Hist. Aug., V, Adr., 12,3) which stood on the upper terrace of the provincial forum (Casas *et al.* 2009, 277-283; Macias *et al.* 2010, 423-479; Macias *et al.* 2010-2011, 151-173; Macias *et al.* 2011, 187-200; Macias *et al.* 2012). An alteration indicating that that architectural complex was modified, at least in part, in that period.

A possible result of this fact could be that the shafts in granite arrived at the city at the same time of the sojourn of the emperor Hadrian in 122 AD (*SHA*, Ael. Spart., *Vit.Hadr.*, 12).

2. Many of those shafts can be seen reused in mediaeval porticos of the 12th and 13th century and placed within the perimeter of Pompey's grandiose architectural complex or in its vicinity. This circumstance together with the similarity in their size, offered by most of them suggest that they came from that edifice: from the *scaenae frons*, from the *porticus in summa gradatione* or from the *porticus pompeiana.* A shaft in Via del Biscione nº 63 (existing height 73 cm, lowerscape diám. 60-65 cm) (Monterroso 2010, 143, nº 7, fig, 162-163); two shafts in the mediaeval portico in Via dei Giubbonari nº 63 (existing height 2,10-2,20 m, diam. 60-65 cm) (Monterroso 2010, 143-144, nº 9-10, fig. 164b-c, 165b.c); two shafts in the mediaeval portico in Via Capo di Ferro nº 31 (existing height 2.4-2,5 m, diam. 60-65 cm) (Monterroso 2010, 146, nº 12-13, fig. 166b-c, 167b-c); three shafts of the mediaeval portico in Via Santa Maria in Monticelli (existing height 1,15-1,17 m, diam. 60-70 cm) (Monterroso 2010, 146-149, nº 15-16, 20, fig. 1681-b, f, 169a-b, f); two shafts in the mediaeval portico in Via di Sant'Anna (existing height 2-2,10 m, diam. 65-70 cm) (Monterroso 2010, 153-154, nº 23-24, fig. 170a-b, 171a-b). Finally during the excavations carried out in the area of the north *aditus maximus* of the theatre and of the *scaena frons,* a fragment was found of a shaft (diam. 1,10 m) certainly from the scene (Monterroso 2010, 160, nº 34, fig. 179a). Regarding the reuse of classical material in the porticoes in Rome see: Pensabene 2008, 67-93.

3. Rodà, Pensabene, Domingo 2012, 210-227.

4. Rodà, Pensabene, Domingo 2012, 210-227.

Tab. 1. Localities featured in the text with shafts in Troad granite.

Province	City	Building	No. of shafts	Height (Feet)	Diameter (Feet)
Tarraconense	**Tarragona**	Provincial Forum or Amphitheatre	45	4.42-4.62 m (15-16)	58-65 cm
Baetica	**Cordoba**	Mosque (reused)	6	2.77-3.17 m (10)	40-45 cm
»	**Écija (Astigi)**		5		85-90 cm
»	»		2		64-66 cm
»	**Sevilla (Hispalis)**	C/ Mármoles (reused)	5	8.68 m (30)	
»	»	Cathedral (reused)	3		
»	**Itálica**	Casa de los Pájaros	3		
Gaul	**Arles**	Theatre	2		
»	»	Forum			
»	»	Hippodrome			
»	**Orange**	Theatre			
»	**Autun**				
»	**Lagrasse**	Monastery of Lagrasse (reused)	6	0.47-2.47 m	
Regio I Latium et Campania	**Pozzuoli**	Macellum, lower order of the portico	30	6.08-6.16 m	76-77 cm
»	**Cimitile**	Basilichetta dei Santi Martiri (reused)	2	2.88 m	47 cm
»	»	South Gate of the Aula Feliciana (reused)	2	2.88-3.05 m	47-48 cm
»	»	Antiquarium	1		39 cm
»	**Ravello**	Cathedral (reused)	6	3.50-3.55 m	45.5-52 cm
»	**Naples**	Santa Chiara street-Benedetto Croce street	1		
»	»	Church of S. Salvatore in Castell dell'Ovo	1	2.89 m	
»	**Amalfi**	Cathedral, portico (reused)	3		
»	**Santa M. in Capua**	Church of Sant'Angelo in Formis	1		
»	**Sant'Agata dei Goti**	Church of S. Menna (reused)	1	2.97 m	38 cm
»	»	Cathedral (reused)	2	2.65-2.80 m	60 cm
Regio II Apulia et Calabria	**Mileto Vecchia**	Chiesa Abbaziale (reused)		5.92 m (20)	70-75 cm
»	**Strongoli**				
»	**Troia**	Cathedral (reused)	1		
»	**Barletta**	Cathedral (reused)			
»	**Trani**	Church of Ognissanti			
»	»	Cathedral (reused)			
Regio III Lucania et Brutii	**Bari**	Church of S. Nicola (reused)	3		
»	»	Lungomare			
»	**Canosa**	Cathedral (reused)	4	2.94-2.98 m	37-38 cm
»	**Taranto**	Cathedral (reused)	4		
»	**Castel San Vincenzo**	S. Vincenzo al Volturno - garden			50-55 cm
»	»	San Vincenzo al Volturno - basilica	1	3.58 m	45 cm
Regio VII Etruria	**Pisa**	Behind the Cathedral			
»	**Florence**	Yard of the Opificio delle Pietre Dure	2		
»	**Lucca**	Piazza Santa Maria Forisportam	1		67 cm
Regio VIII Aemilia	**Modena**	Lapidario	1		

Province	City	Building	No. of shafts	Height (Feet)	Diameter (Feet)
Regio X Venetia et Histria	**Aquileia**	Theatre	12	(20)	
»	»	Bishop's Palace (reused)		(16)	(2)
»	**Venice**	Basilica of San Marco (reused)	8		
»	»		14		
»	**Murano**	Sottoportico Fondamenta Manin			
»	**Vicenza**	Church of Santa Corona	1		
»	**Brescia**	Entrance of the Borletto	2		
»	**Ravenna**	Archaeological Museum	2		
»	»	Church of S. Giovanni Evangelista	2		
»	»	Pulpit of the church of S. Apollinare Nuovo	1		
»	»	Palazzo Veneto	8		
Sicily	**Villa Piazza Armerina**	Entrance of the three-apse hall	2	4.12 m (14)	55 cm
»	**Palermo**	Cathedral (reused)	47		
»	»	Cappella Palatina (reused)	2	2.95-2.97 m	38-41 cm
»	»	Cappella Palatina (reused)	4	3.53-3.58 m	52-53 cm
»	»	Cappella Palatina - ambo (reused)	4	3.53-3.73 m	41-45 cm
»	»	Cappella Palatina – external lateral portico (reused)	2		
»	»	Church of S. Maria dell'Ammiraglio (reused)			
»	**Monreale**	Cathedral (reused)	15		
»	**Cefalù**	Cathedral (reused)			
»	**Siracusa**	Church of San Martino	1		
»	»	Edifice in Via della Maestranza	4		
»	»	Edifice in Via della Conciliazione	1		
Dalmatia	**Split (Spalato)**	Diocletian's mausoleum	4		53-61 cm
Proconsular Africa	**Carthage**	Antonine baths	27		
»	»	Frigidarium of the Antonine baths	8	11.6 m (40)	145 cm
»	»	Theatre	8		
»	»	Theatre – First order		5.5-5.8 m (20)	
»	»	Theatre – Second order		4.18 m (20)	
»	»	Baths of Gargilius	2	(12)	
»	**Haidra (Ammaedara)**	Portico of the Forum	1		
»	»	Second basilica (reused)	2	(12)	< 49.5 cm
»	**Bulla Regia**	Theatre	5		
»	**Útica**	Baths			
»	**Uthina (Oudna)**	Baths			
»	**Leptis Magna**	Theatre, portico *post scaenam*			
»	»	Basílica of the "Old Forum"			
»	»	Temple in the Decumano	1		
Egypt	**Alexandria**	Serapeum			

Province	City	Building	No. of shafts	Height (Feet)	Diameter (Feet)
Syria and Palestine	**Baalbek**	Temenos	1		
»	**Tyre**	Porticoes road		5.19-5.27 m (17,5)	68-68.3 cm
»	»	Portico *in summa cavea* of the hippodrome		4.14-4.22 m (14)	58-62 cm
»	**Byblos**	Nymphaeum		5.15 m (17,5)	72 cm
»	»	Church of S. John the Baptist (reused)	3		
»	»	City Castle (reused)		5.25 m	88 cm
»	**Berytus**	Decumanus maximus	5		
»	»	Burg el Keshef (reused)	2		
»	»	Crusader's Castle (reused)	52 fragments		
»	**Nazareth**	Basilica of the Annunciation			
»	**Ascalona**	Basilica		5.38 m (18)	72 cm
»	»	Entrance of the Agora	4		
»	»	Crusader's Castle (reused)	7		
»	**Gabala**	Theatre	2	4.70-4.73 m (16)	54 cm
»	»	Theatre	1	3.35 m	45 cm
"	**Laodicea**	Porticoes street		5.9 m (20)	84 cm
»	»	"		5.3 m (18)	
»	**Palmyra**	Sanctuary of Bal	2 fragments		
»	»	Via Colonnata			
Asia Minor	**Ephesus**	Via Marmorea			
»	»	Local Agora			
»	**Izmir (Smirne)**	Agora			
»	**Constantinople**				
»	**Side**	Agoras			
Cyprus	**Kourion**	Entrance gate of the basilica	2		
Crete	**Gortyna**	Great Portico		7.00 m	85.5 cm
»	»	Pretorium			
"	»	Near the church in north-east of the Pretorium			
"	»	Temple of Apollo Pitius		4.50-4.81 m	
»	»	Byzantine basilica (reused)			
»	**Heraklion**	Church of Haghios Markos	12	(11.5; 13.5; 15)	

Baetica: There are a large number of cities in that area which is still keeping shafts realized in Troad granite. Anyhow the large production of oil in that province, and its massive export to Rome in amphorae Dressel 20, would justify the arrival of many of them as a return load from Porto of the ships appointed for the commerce of oil: it was a transport system which as we shall soon see, required a very small economic investment. Anyway, on account of the great richness of that province and of her élites – some of whom were even admitted into the Roman Senate even operating in the capacity of *curatores operum publicorum* (CABALLOS 1990, 54) – one cannot exclude the request of orders for the workshops in Troad[5].

5. About the use of imported and local granite in Hispania see: Williams-Thorpe, Potts 2002, 167-194.

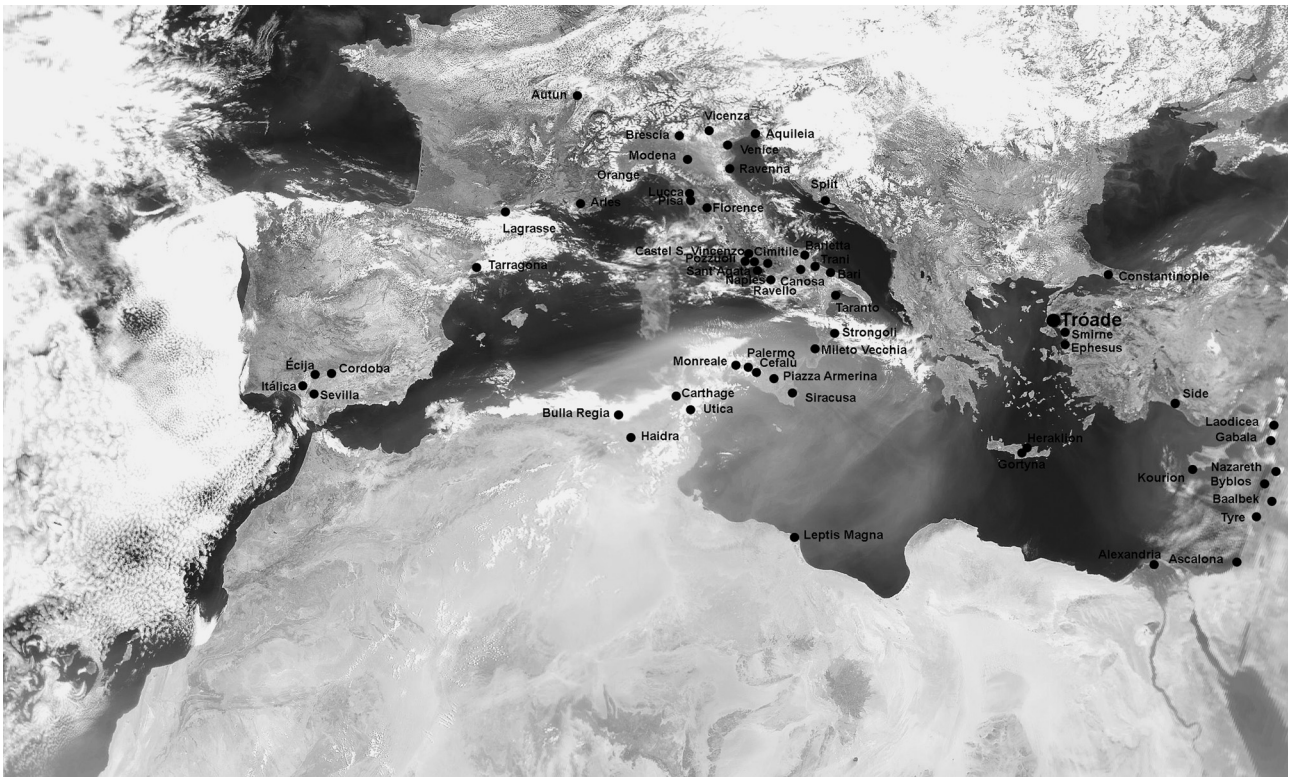

Fig. 1. Map showing the localities features in the text and in Tab. 1, with column shafts in Troad granite.

In Córdoba it is possible to find a number of shafts in Troad marble reused in the interior of the mosque; shafts analysed by A. Peña (Peña 2009, 247-272; Peña 2010, 120-127)[6] in a study continuing the results previously obtained by C. Ewert and J.-P. Wisshak (Ewert, Wisshak 1981). Moreover, eight shafts have been found probably realized with that material and reused in an indefinite building which was built between mid-fifth and mid-seventh century AD[7].

In Astigi (Écija) we know of 32 shafts in granite of which 11 are in Troad marble (Felipe 2008, 117-128; Williams-Thorpe, Potts 2002, 182-184, Table 3); anyway we are dealing with shafts of unknown provenance, many of which were reused. It is possible to distinguish two groups on the basis of their diameter: the first consisting of 5 exemplars with a diameter of 85-90 cm and the second consisting of 2 exemplars with a 64-66 cm diameter. On the other hand the shafts in granite, ca 10 m high, belonging to the Hadrian phase of the temple of the *calle Galindo* could be also in Traod marble (Buzón 2009, 112-113).

In Hispalis (Sevilla) we know five shafts reused in the building of the *calle Mármoles* (Fig. 2); they have all a similar size, with a height of 8.68 m, ca. 30 feet. The dimensions of these shafts could suggest a provenance from the *Traianeum* of the nearby city of Itálica (Márquez 2003, 138-139). Other three shafts of smaller dimensions can be found in the external walls of the cathedral in Sevilla.

Finally, in Itálica we know of three shafts coming from the so called "Casa de los Pájaros" (Williams-Thorpe, Potts 2002, 182-184, Table 3), to which we could add, as a hypothesis, the number of examples used in building the *Traianeum*.

Gallia: In Gaul the presence of shafts realized in this material is very small and limited to two exemplars coming from the theatre of Arles (Pensabene, Bruno 1998, 20-21), some columns from the Forum, one of them reused as a central pillar of the door Romanesque of Saint-Trophime (Brunet-Gaston 2006, 98), to a few exemplars from the first order of the theatre in Orange (Moretti, Badie, Tardy 2010, 144), and to a few exemplars coming from Autun[8] together with six exemplars

6. Actually they are six shafts: for two of them there are doubts about their attribution to Troad granite (Peña 2010, 126-127, 231-236, nº 5: max. height 277 and diam. 45; nº 122: max height. 294 and diam. 41; nº 130: max. height 294 and diam. 42; nº 200: max. height 307 and diam. 42-43; nº ¿201?: max. height 317 and diam. 44; nº ¿212?: max. height 279 and diam. 40). The diameters of the shafts reused in the mosque in Cordoba are slightly shorter than those in Tarragona.

7. This edifice presents a hypostyle structure with naves separated by columns with reused shafts, some in white and graysh marble and others in gray granite. The measurements of those shafts are different, as it is not possible to suppose that they are all coming from the same architectural complex (León, Murillo 2009, 410).

8. Brunet-Gaston 2006, 98. About the monuments at Autun which the columns could come from see: Olivier 1987, 55-61.

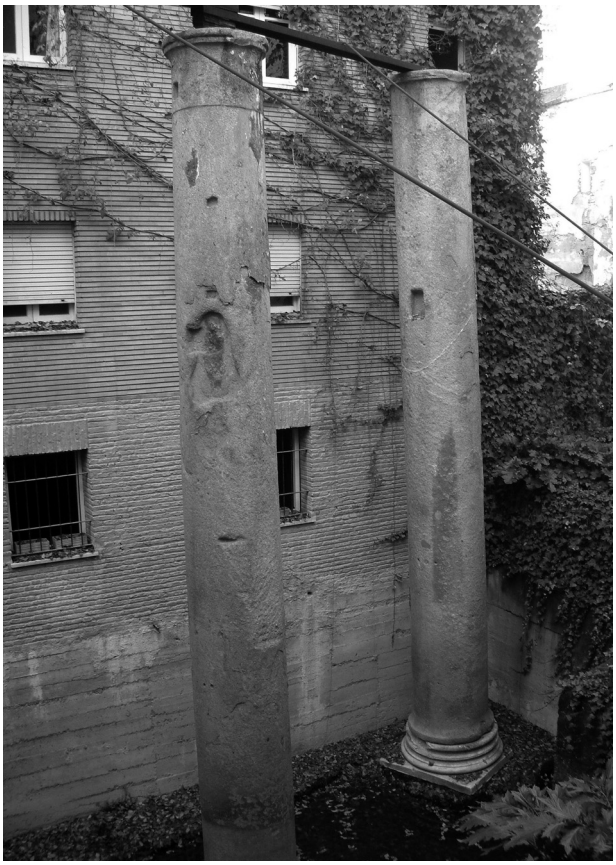

Fig. 2. C/ Mármoles (Seville, Spain), shafts in troadense (Photo: J. Á. Domingo).

reused in the Carolingian monastery of Lagrasse (Aude) (Fig. 3). Their existing height is 0.88, 1.78, 1.93 2.47, 0.47 and 2.10 m respectively (AA.VV. 2008, 74)[9].

Regio I Latium et Campania: We are here taking into consideration the Campania area only. Of the *macellum* in Pozzuoli 30 columns have been preserved made with that material coming from the lower order of the portico; eight exemplars of them, however, are still standing *in situ* with a height between 6.08-6.16 m and a lower diameter of 76-77 cm. Those shafts are accompanied by bases 38-40 cm high and by Corinthian capitals 84 cm high, which are all made in Proconnesian marble (Pensabene 2005, 132; Demma 2007, 233). To these exemplars we ought to add two other shafts of unknown provenance (Demma 2007, nº 169-170). Also in Cimitile are present two shafts in Troad granit, one of which reused in the *Basilichetta dei Santi Martiri*, 2.88 m high and with a diameter of 47 cm. Also two exemplars in the South Gate of the *Aula Feliciana*, with a diameter of 47-48 cm and a height of 2.88 and 3.05 m respectively and a fragment kept in the Antiquarium of the Antiquities Office whose maximum existing height measures 94 cm

Fig. 3. *Abbaye* of Lagrasse (Lagrasse, French), shaft in troadense (Photo: A. Blanc).

and whose upperscape measures 39 cm. Inside the cathedral in Ravello six reused shafts with a height of 3.5-3.55 m and a diameter of 45.5-52 cm are still preserved[10]. Though regarding Naples it is necessary to examine in details the shafts there preserved, it is possible to find an exemplar of Troad marble at the cross between Santa Chiara street and Benedetto Croce street which was reused in the church of S. Salvatore in Castel dell'Ovo, with a height of 2.89 m[11]. In Amalfi three columns are still preserved in the portico of the Cathedral (Lazzarini 1987, 162) whilst in Santa Maria in Capua Vetere is kept a column in the facade of the church of *Sant'Angelo in Formis*. In *Sant'Agata dei Goti* there is a reused shaft kept in the nave of the church of S. Menna with a height of 2.97 m and a lower diameter of 38 cm, there are also two shafts reused in the Cathedral facade, both with a lower diameter of 60 cm, and a height of 2.65 and 2.80 m respectively[12].

Regio II Apulia et Calabria: In the *Chiesa Abbaziale* of Mileto Vecchia have been preserved a few reused shafts, 5.92 m high (ca 20 feet) and with a diameter of 70-75 cm which could have come from the theatre of Vibo Valentia (Pensabene 2003b, 82). Other shafts are preserved at Petelia (Strongoli), at Troia, with an exemplar set in the external wall of the apse of the Cathedral in Barletta and with a shaft on the right side wall of the Cathedral, and finally at Trani, in the church of Ognissanti and also in the Cathedral (Lazzarini 1987, 162).

Regio III Lucania et Brutii: In Bari three reused shafts are kept in the church of S. Nicola (Lazzarini 2010b, 140), as well as a few fragments kept along the *Lungomare* at Canosa, four shafts reused in the crypt of

9. We thank Annie y Philippe Blanc for informing us of these pieces.
10. P. P.'s autoptic view.
11. P. P.'s autoptic view.
12. P. P.'s autoptic view.

the Cathedral, with a height of 2.94-2.98 m and a diameter of 37-38 cm (PENSABENE 2011, 607), and in Taranto four reused shafts in the Cathedral (PENSABENE, BRUNO 1998, 20-21). In the monastery of S. Vincenzo al Volturno, in the garden opposite the basilica of S. Vincenzo Nuovo, are preserved a few fragments of shafts in different materials and among which some are in Troad marble, with a diameter of ca 50-55 cm. Moreover, a shaft 3.58 m high and with a lower diameter of 45 cm was reused (HODGES 1993; 1995; DE BENEDITTIS 1995, 29-42; MITCHELL 1996, 93-107).

Regio VII Etruria: Several fragments of shafts are preserved in Pisa behind the Cathedral, two columns in the yard of the *Opificio delle Pietre Dure,* in Florence (LAZZARINI 1987, 162) and in Luca a shaft in the middle of the Piazza Santa Maria Forisportam, with a diameter of the lowerscape of 67 cm. (PUCCINELLI 2009, 165, n° 76).

Regio VIII Aemilia: A column is kept in the Lapidario in Modena (Lazzarini 1987, 162).

Regio X Venetia et Histria: A number of shafts is preserved in the city of Aquileia: 52 fragments come from the theatre area and 12 of them, ca. 20 feet high, certainly belonged to the *scaenae frons*. Moreover, we know of several exemplars reused in the bishop's palace some of which ca 16 feet high and with a lower diameter of 2 feet (PENSABENE 2006, 365-421; PENSABENE 2010a, 582-644, 65-655).

In Venice more than 14 shafts are still preserved as reused in a number of buildings: in the foundations of the *Monastero*, in the *sottoportico* of the *Ca' d'Oro*, in the fundaments of the *Pescaria San Bartolomeo*, within the *Archivio di Stato*, in the *Galleria dell'Accademia*, etc. And moreover, the numerous exemplars present in the basilica of San Marco, such as the columns in the inferior part of the west facade, in the upper part of the south facade and the six columns preserved inside the basilica, set at the corners with the transept: pieces to which can be added some plaques of the lining placed in the entrance floor and a fragment of a column sustaining a Roman basin in red porphyry standing to the right of the central nave (LAZZARINI 1997, 309-326; PENSABENE, BRUNO 1998, 20-21).

In Murano we can find some exemplars in the *sottoportico Fondamenta Manin* and a column in the lateral prothyrum of the church of Santa Corona in Vicenza. In Brescia two columns at the entrance of the Borletto and in Ravenna two columns at the entrance gate of the Archaeological Museum, two columns in the church of San Giovanni Evangelista, a fragment in the pulpit of the church of Sant'Apollinare Nuovo as well as eight columns in the Palazzo Veneto in the Piazza del Popolo (LAZZARINI 1987, 162).

Sicilia: In the villa at Piazza Armerina we can see two shafts 4.12 m high and with a diameter of 55 cm, which were reused in the entrance of the three-apse hall. They are standing on Attic bases, 31 cm high, but only one of them, the one to the north, is still preserved (GASPARINI 2008, 49). In Palermo 47 shafts are preserved which were reused inside the Cathedral (PENSABENE, BRUNO 1998, 20-21; LAZZARINI 2000, 324). Some exemplars are in the church of S. Maria dell'Ammiraglio (Martorana) (LAZZARINI 2000, 327) and other exemplars were reused in the Cappella Palatina: in the interior six shafts separate the naves and four exemplars are in the ambo whilst two exemplars are set in the external lateral portico (LAZZARINI 2000, 321-323; PENSABENE 2010b, 137-170). Moreover, fifteen shafts have been reused at Monreale, ten of which placed inside the basilica belong to a gigantic order whilst some shafts of a smaller size, are standing in the lateral portico (PENSABENE, BRUNO 1998, 20-21; LAZZARINI 2000, 324). In Cefalù several shafts of Troad marble are preserved inside the Cathedral whilst an exemplar is present in the portico (LAZZARINI 2000, 318-321; LAZZARINI 2010b, 140). In Siracusa a shaft is preserved inside the apse of the church of San Martino and four shafts in an edifice in *Via della Maestranza* and also a shaft within a building in *Via della Conciliazione* (LAZZARINI 1987, 162). Some of the shafts from the Troad existing in Sicily, mainly those of a larger size, reused in buildings belonging to the Norman period might actually come from important nearby cities even outside the island like, perhaps, Ostia or Roma (LAZZARINI 2000, 330). On this vasis, this might be the provenance of the large *rotae* in porphyry set in the floor of the Cappella Palatina (PENSABENE 1997b, 333-342).

Dalmatia: Within the Palace at Spalato (Split), actually in the external portico of the south wing of Diocletian's mausoleum, four shafts in Troad marble were reused, with a lower diameter of 53-61 cm and a height of the lowerscape of 12 cm[13].

Africa Proconsularis: The city keeping the largest number of shafts realized in that material is Carthage with 63 exemplars. From the Antonine baths come 27 shafts, 8 of which were standing in the *frigidarium* supporting the three cross vaults. Starting with the remaining fragments of those columns it is possible to figure out the following dimensions: lower diameter of 145 cm, upper diameter of 134 cm and a height of 11.6 m, equivalent to 40 Roman feet. Each shaft weighs ca. 55 tons. Eight shafts come from the second century phase (AD) of the theatre: the ones belonging to the first order of the *scaenae frons* are 5.5-5.8 m, high (ca 20 feet) whilst the whole shaft preserved just at the beginning of the street leading to the theatre, might belong to the second order. It is 4.18 m high, ca. 14 feet. Two other fragments come from the Baths of Gargilius, SW of the theatre, with shafts ca 12 feet high (LÉZINE 1968, 49-52).

13. P. P.'s autoptic view.

At Ammaedara (Haidra) at least six shafts have been preserved; one in the portico of the forum and two reused in the second basilica, from which come other 22 shafts in *cipollino* and one exemplar of *breccia corallina*. Their diameter is somewhat lower than 49.5 cm, to which a height of approximately 13 feet corresponds. At Bulla Regia five shafts are known, probably coming from the theatre. Other shafts can be seen in the Baths of Utica and of Uthina (Oudna). Finally, in Leptis Magna in Troad granite we can find: the shafts of the portico *post scaenam* of the theatre (PENSABENE 2001, 119), the columns of the Basilica of what is known as the *Old Forum*, reused in Constantine's time (*IRT* 467) as well as the columns of the temple built in the *decumanus* (PENSABENE 2001, 63-127).

Egypt: In Alexandria are kept several columns coming from the local Serapeum (PENSABENE, BRUNO 1998, 20-21).

Syria and Palestine[14]: In Baalbek one of the honorary columns from the *temenos* of the temple was made in Troad granite. In Tyre, shafts of that type can be found along the porticoes road which are 5.19-5.27 m, high and in the portico *in summa cavea* of the hippodrome with a height of 4.22 m. Several exemplars can be found at Byblos, in the nymphaeum, 5.15 m high, as well as three reused drums in the garden of the church of S. John the Baptist and finally several exemplars reused within the walls of the city castle. One of them is 5.25 m high and its lower diameter measures 88 cm. At Berytus five shafts have come from the *decumanus maximus,* and two shafts were reused in el Burg el Keshef. Fifty-two fragments are kept in the Crusaders' Castle which is standing near the *decumanus maximus* and the East forum. Several fragments are kept both outside and inside the basilica of the Annunciation at Nazareth (LAZZARINI 1987, 162). At Ascalona several exemplars coming from the basilica are 5.38 m high, are preserved, while four shafts can be seen at the entrance of the agora and seven shafts were reused in a wall of the Crusaders' Castle. Three shafts coming from the theatre are still preserved at Gabala two of which are 4.70-4.73 m high and the third is 3.35 m high with a diameter of 45 cm. At Laodicea it is possible to notice several exemplars coming from the porticoes street, 5.3 m high, besides an exemplar kept in the museum, 5.96 m high. Finally we know of two fragments of shaft in Palmyra which come from the sanctuary of Bal (PENSABENE 1997a, 413) as well as some exemplars along the *Via Colonnata* (LAZZARINI 1987, 162).

Asia Minor: Several columns are preserved in Ephesus along the *Via Marmorea*, whilst all the columns of the local agora were realized in that material[15]. All the columns of the first phase of the agora in Izmir (Smirne) were realized with that material. In Constantinople we know of several exemplars reused in different mosques like the Beyazet's, and in Side we can find several columns in the two agoras (LAZZARINI 1987, 162).

Cyprus: Two shafts from Troad are preserved in the back entrance gate of the basilica in Kourion (LAZZARINI 1987, 162).

Crete: Several shafts from Troad have been preserved in the city of Gortyna, in the external row of the so called 'Great Portico' for which we have been able to figure out its height of 7 m with a lowerscape diameter of 85.5 cm; several fragments have been preserved in the *Pretorium* and near the church discovered north-east of it; in the restoration of the Severan age of the temple of Apollo *Pitius* eight columns were included inside the cell, some of which in Troad marble were 4.5-4.81 m, high while other shafts of large size seem to have been reused in the byzantine basilica (PENSABENE, LAZZARINI 2004, 767-773). Twelve shafts of different heights (11.5, 13.5 and 15 Roman feet) probably from the Roman theatre at Knossos have been preserved as they were reused in the church of *Haghios Markos* at Heraklion (HOOD, SMYTH 1981, nº 110; PENSABENE, LAZZARINI 2004, 771).

General Considerations

The Troad granite was extensively exported all over the Mediterranean basin from the second century AD as it very clearly appears on account of the huge quantity of shafts which we have found: 63 exemplars in Carthage, 45 in Tarraco, more than 12 in Aquileia, etc. Its production, primarily aimed at large public architecture, was carried out on the basis of standard measures – we have evidence of pieces high 10, 12, 14, 16, 18, 20, 30 and 40 feet – which should have made it easier to set them onto bases and capitals generally in Proconnesian marble. In fact these dimensions are the same as those we find in some shafts left near the place of extraction in the very quarries of the Troad, whose heights, though never exactly coinciding with the ideal measures, are approximately those of 16, 20 and 40 feet.

On the basis of the size of the shafts it is possible to establish two possible commercial routes. For those of a larger size such as those of the Antonine Baths in Carthage (40 feet high with and estimated weight of 55 tons each) or those reused in the late Roman edifice of the *calle Mármoles* in Sevilla, certainly coming from the *Traianeum* of Itálica (30 feet high), we would surmise of a direct import from the workshops in Troad, as we suppose they were transported in ships able to carry such a heavy cargo; so much the more so, if the buyer was the very emperor or the colony or the governor of the province. On the other hand, the shafts of medium or small size could come from the marble deposits, run by

14. P. P.'s autoptic view.
15. P. P.'s autoptic view.

merchants or by the imperial administration, which were situated near the main harbours, such as the one of Porto. In this case one can suppose that the imperial government would send to Africa shafts as a return cargo for the ships which had transported wheat to Rome and we can suppose the same in the case of oil arriving in Rome from the Betica. Shafts which could be destined to smaller cities or to private customers to be used for the ornaments of public spaces of their respective cities. Anyway we are missing many elements to establish with certainty the reconstruction of the commercial system of those shafts.

Eventually, the fact that the managers of the quarries of the Troad, Proconnesion and of the Docimiun marbles were not exempted, at the beginning of the fifth century from paying taxes to the government (CTh. XI, 28, 9) which was the opposite of what happened to the staff of other quarries, certainly means that the Troad district offered a much developed system of workshops and perhaps of concessions, capable to satisfy not only the exigencies of the public building activity in Rome but also of the private market as the quarries continued their production also in the late antiquity. In this sense the foundation of Constantinople, and public buildings held in it, must play a role.

Costs

Despite the large diffusion in the antiquity of that granite it high cost does not appear in the *Edictum Diocletiani et Collegarum de pretiis rerum venalium* (Giacchero 1974), but it has been possible to reckon it in 29 *denarii* each m³ in the second century AD and in 75-100 *denarii* each cubic foot at the beginning of the IV century A.D. (Barresi 2003, 168-169). This estimate puts it among the more precious stones: like the *cipollino verde* (100 *denarii* per cubic foot) or the *breccia corallina* (75-100 *denarii* per cubic foot), but it results more expensive than *Pentelic* (50-75 *denarii* per cubic foot), and *Pario* (50-75 *denarii* per cubic foot), and *Carrara* (40-60 *denarii* per cubic foot) or *Proconession* (40 *denarii* each cubic foot). It resulted, notwithstanding, a little more economical than the Forum granite whose cost, in Diocletian's age was of 100 *denarii* per cubic foot, equivalent to ca 38.5 *denarii* per m³ in the second century A.D. (Barresi 2003, 168-169). On the other hand the distance of the quarries relatively to the western cities involved moreover, the availability of a large investment to finance its transport.

In fact, there are three variables which must be taken into account to figure out the cost of the transport of marble: the volume/weight of the material, the distance to cover and the used medium (the transport by road was between 35 and 40 times more expensive than the maritime transport whilst the transport by river resulted eight times more expensive than the maritime[16]). On the other hand the shafts of larger size would have been proportionally more expensive as they called for a direct import and *ex professo* from the quarries of the Troad. Moreover, because of the position of the quarries near the coast, most of the covered distance would be on a maritime route and in this case one needs to distinguish whether a whole ship would have been rented for the transport, *locatio rei*[17], or only part of the space available, *locatio loci in nave*: and in the first case the delivery of the material would have been direct while in the second case it would have depended upon the type of trade of the other products sharing the ship (Fant 2012, 530). This is anyway a fundamental question as the costs of the commercial routes appearing in Diocletian's Edict do not depend only on the distance to covered but also on the time employed as the traditional coastal navigation was much more expensive (Arnaud 1993, 225-247; 2007, 321-336).

Moreover it is necessary to distinguish between transport especially organized for a special merchandize and transport which used already existing commercial routes and also employed for other products, a case which would have proved slightly less expensive. Ships carrying bricks made in Italy at Hipona very probably would have returned loaded with blocks of marble and unfinished columns coming from the quarries of Cap de Garde (Pensabene 1974-75, 184, 187). The trade of limestone from Buixcarró, which was exported from the city of *Saetabis* (Xàtiba - Spain) from the beginning of the first century A.D. to some of the main cities situated not only along the Mediterranean coast of Spain but also inside the peninsula took the same routes used by the trade of the linen produced in the same city (Cebrián 2008, 111). Eventually, one needs to consider also the fact that the transport under the imperial denomination

16. K. Hopkins reckoned that the maritime transport bore a cost of 10 units × ton × Km., by river of 60 units × ton × Km. And by land of 550 units × ton × Km. (Hopkins 1983, 104-105). That important difference is also present in some documents of the sixteenth century referring to the quarries of Luni (Klapisch-Zuber 1969, 209): on their basis it is possible to infer a proportion between the cost of the transport by sea and by land by 1:35, a value very close to 1:42 which can be deduced from the data contained in Dioclectian's Edict (Rusell 2008, 114). On the other hand the cost the transport by river resulted also slightly more costly than that by sea; for example, the transport over land of the stone used for the construction of the portico of the *Corpus Christi* College at Cambridge, in 1583-1584, for a length of 16 Km, exceeded the 75 % of the total cost of the stone alone; the same transport by river for a distance of 130 Km exceeded the equivalent cost of the stone alone. On the basis of those data it is possible to assume a proportion between the transport by land and by river by 1:8, the same as we can derive from the data contained in Diocletian's Edict (Russell 2008, 114).

17. In some cases because of the transport of architectural elements of a large size, it was necessary to specially build *naves lapidariae,* as it is mentioned by Pliny (Plinius, N. H., 36, 1, 14) because of the transport to Rome of both obelisks in the Augustan and Caligula's age (Pensabene 1972, 319).

could cost less than the private one as the former could make use of the army as well of the *corvées* of the peasants of imperial lands (BARRESI 2000, 350). Besides the Government could, on certain occasions, requisition carts and animals for the transport of the marble (MITCHELL 1976, 106-131; ADAM 2001, 186).

Regarding the distance to cover, Diocletian's Edict fixed the price of some routes. For instance the route from *Oriens* to Rome in the late imperial age cost 18 *denarii* per m³ of carried material while the cost from *Oriens* to the Tarraconensis was over 20 *denarii* per m³ of transported material (ARNAUD 2007, 336). On the other hand, while the transport from Rome to Tarraconensis[18] had a cost of 10 *denarii* per m³, that from Rome to Gaul was over 14 *denarii* per m³. A price proportionally very high and certainly due to the fact that the latter traditionally was a coastal route and therefore needing a longer time and consequently a higher economical investment (ARNAUD 2007, 331).

Those numbers offer the possibility to near the high cost borne by the transport of the shafts from Troad from one end to the other of the Mediterranean and mainly of those of a larger size such as those coming from the Antonine baths of Carthage (40 feet high and with an approximate volume of 24 m³), or those from the *Traianeum* at Itálica (30 feet high, and with a hypothetical lower diameter of about 0,87 m and an approximate volume of 8 m³), some of them reused in Sevilla in an edifice from the fifth century.

Bibliography

AA.VV. 2008: *L'abbaye de Lagrasse, mille ans de sculpture,* Sète.

ADAM C. E. P. 2001: "Who bore the burden? The organization of stone transport in Roman Egypt", in *Economies beyond agriculture in the classical world,* London-New York, 171-192.

ARNAUD P. 1993: "De la durée à la distance: l'évaluation des distances maritimes dans le monde gréco-romain", *Histoire & Mesure,* VIII-3/4, 225-247.

ARNAUD P. 2007: "Diocletian's Prices Edict: the prices of seaborne transport and the average duration of maritime travel", *JRA,* 20, 321-336.

BARRESI P. 2000: "Architettura pubblica e munificenza in Asia Minore. Ricchezza, costruzioni e marmi nelle provincie anatoliche dell'Impero", *Mediterraneo Antico,* III, 1, 309-368.

BARRESI P. 2003: *Provincie dell'Asia Minore. Costo dei marmi, architettura pubblica e committenza,* Roma.

BRUNET-GASTON V. 2006 (dir.): *Le Lapidaire Architectonique & Décoratif d'Augustodunum (Autun),* Dijon.

BRUNO M., ATTANASIO D. 2008: "Il reimpiego nel Portico di Ottavia. I marmi del propileo monumentale", in J.-F. BERNARD, PH. BERNARDI, D. ESPOSITO (a cura di), *Il reimpiego in architettura. Recupero, Trasformazione, Uso,* Roma, 51-66.

BUZÓN M. 2009: "El Templo Astigitano de la calle Galindo: análisis e interpretación de un puzzle arqueológico", *Romula*, 8, 65-123.

CABALLOS RUFINO A. 1990: *Los senadores hispanorromanos y la romanización (siglos I al III d.C.)*, Écija.

CASAS A., COSENTINO P. L., DÍAZ Y., FIANDACA G., GARCÍA E., HIMI M., LAFUENTE M., MARTORANA R., MACIAS J. M., MENCHÓN J., MUÑOZ A., SALA R., TEIXELL I. 2009: "Integrated archaeological and geophysical Surrey for searching the roman Temple of Augustus in Terragona, Spain", in *Scienza e Patrimonio Culturale nel Mediterraneo. Diagnostica e Conservazione, esperienze e proposte per una Carta del Rischio, Atti del III Convegno Internazionale di Studi, La materia e i segni della storia*, (Palermo 2007), Palermo, 277-283.

CEBRIÁN C. 2008: "Saetabis y el comercio del Buixcarró", *Lvcentvm,* XXVII, 101-113.

DE BENEDITTIS G. (a cura di) 1995: *San Vincenzo al Volturno: dal Chronicon alla storia,* Isernia, 29-42.

DEMMA F. 2007: *Monumenti pubblici di Puteoli. Per un'archeologia dell'architettura,* Roma.

EWERT C., WISSHAK J.-P. 1981: *Forschungen zur almohadischen Moschee I.* Vorstufen, Mainz.

FANT J. C. 2012: "Contracts and costs for shipping marble in the roman Empire", in A. GUTIÉRREZ, P. LAPUENTE, I. RODÀ (eds.), *Interdisciplinary Studies on Ancient Stone. Proceedings of the ASMOSIA IX Conference,* (Tarragona 2009), Tarragona, 528-532.

FELIPE A. M. 2008: "Estudio de los shafts de granito de la Colonia Augusta Firma Astigi (Écija)", *Romula* 7, 117-128.

GASPARINI E. 2008: "Inventario degli elementi architettonici in marmo della villa: le colonne", in P. Pensabene, P. Donatella di Vita (a cura di), *Marmi colorati e marmi ritrovati della villa romana del Casale. Catalogo mostra archeologica,* Piazza Armerina, 39-50.

GIACCHERO M. 1974: *Edictum Diocletiani et Collegarum de pretiis rerum venalium,* Genova.

HODGES R. (ed.) 1993: *S. Vincenzo al Volturno, 1: the 1980-1986 excavations*, Part I, BSR Archeological Monographs 7, Roma.

HODGES R. (ed.) 1995: *S. Vincenzo al Volturno, 2: the 1980-1986 excavations*, Part II, BSR Archeological Monographs 9, Roma.

HOOD S., Smyth D. 1981: *An Archaeological Survey of the Knossos Area,* BSA suppl. 14, London.

HOPKINS K. 1983: "Models, Ships and Staples", in P. Garnsey, C. R. Whittaker, *Trade and Famine in Classical Antiquity,* Cambridge, 84-109.

KLAPISCH-ZUBER G. 1969: *Les maîtres du marbre: Carrare, 1300-1600,* (École Pratique des Hautes Études – VI Section, Centre de Recherches Historiques: Ports-Routes-Trafics 25), Paris.

LAZZARINI L. 1987: "I graniti dei monumenti italiani e i loro problemi di deterioramento", *Bollettino d'Arte,* Suppl. al n. 41, 157-172.

LAZZARINI L. 1997: "Le pietre e i marmi colorati della basilica di San Marco a Venezia", in R. Polacco (ed.), *Storia dell'arte marciana: l'architettura. Atti del Convegno Internazionale di Studi,* (Venezia 1994), Venezia 1997, 309-326.

LAZZARINI L. 2000: "Le pietre antiche colorate reimpiegate nei monumenti normanni della Sicilia Occidentale", *Boll.Acc.Gioenia Sci.Nat.*, 33, n. 357, 315-335.

18. Diocletian's Edict quotes Hispania, therefore Arnaud asserts that it actually refers to Tarraconensis, Arnaud 2007, 334, 336.

LAZZARINI L. 2010a: "Considerazioni sul prezzo dei marmi bianchi e colorati in età imperiale", in S. CAMPOREALE, H. DESSALES, A. PIZZO (eds.), *Arqueología de la Construcción II. Los procesos constructivos en el mundo romano: Italia y provincias orientales,* (Certosa di Pontignano, Siena 2008), Madrid-Mérida, 485-490.

LAZZARINI L. 2010b: "Six coloured types of stone from Asia Minor used by the Romans, and their specific deterioration problems", in CH. ROZEIK, A. ROY, D. SAUNDERS (eds.), *Conservation and the Eastern Mediterranean*, (Istanbul 2010), Dorchester 2010, pp. 140-146.

LEÓN A., MURILLO J. F., 2009: "El complejo civil tardoantiguo de Córdoba y su continuidad en el Alcázar Omeya", *Madrider Mitteilungen*, 50, 399-432.

LÉZINE A. 1968: *Carthage-Utique. Études d'Architecture et d'Urbanisme*, Paris.

MACIAS, J. M., MENCHÓN, J., MUÑOZ, A., TEIXELL, I. 2010: "La construcción del recinto imperial de Tarraco (provincia Hispania Citerior)", in J. LÓPEZ, O. MARTÍN (eds.), *Tarraco: Construcció i Arquitectura d'una capital provincial romana. Actes del Congrés Internacional en Homenatge a Theodor Hauschild* (Tarragona 2009), Tarragona, 423-479.

MACIAS, J. M., MUÑOZ, A., TEIXELL, I. 2010-2011: "Arqueologia a la nau central de la Catedral de Tarragona", *Tribuna d'Arqueologia,* 2010-2011, 151-173.

MACIAS J. M., MUÑOZ A., TEIXELL I., MENCHÓN J. 2011: "Nuevos elementos escultóricos del recinto de culto del Concilium Provinciae Hispaniae Citerioris (Tarraco, Hispania Citerior)", *XI Coloquio Internacional de Arte Romano Provincial*, (Mérida 2009), Roma, 187-200.

MACIAS, J. M., MUÑOZ, A., PEÑA, A., RAMON, M., TEIXELL, I. 2010: *Praesidium, Templum et Ecclesia. Les intervencions arqueològiques a la Catedral de Tarragona 2010-2011. Memòria d'una exposició temporal,* Tarragona.

MÁRQUEZ C. 2003: "Los restos romanos de la calle Mármoles en Sevilla", *Romula*, 2, 127-148.

MITCHELL S. 1976: "Requisitioned transport in the roman Empire: a new inscription from Pisidia", *JRS,* LXVI, 106-131.

MITCHELL J. 1996: "The uses of spolia in Longobard Italy", in *Antike Spolien in der Architektur des Mittelalters und der Renaissance,* München, 93-115.

MONTERROSO A. 2010: *Theatrum Pompei. Forma y arquitectura de la génesis del modelo teatral de Roma,* Madrid.

MORETTI J.-CH., BADIE A., TARDY D. 2010: "Les fronts de scène en Narbonnaise", in S. F. RAMALLO, N. RÖRING (eds.), *La scaenae frons en la arquitectura teatral romana* (Cartagena 2009), Murcia, 137-161.

OLIVIER A. 1987: "Urbanisme et architecture", in *Autun Avgvstodvnvm. Capitales des Éduens,* Autun, 55-61.

PENSABENE P. 1972: "Considerazioni sul trasporto di manufatti marmorei in età imperiale a Roma e in altri centri occidentali", *Dialoghi di Archeologia,* VI, 317-362.

PENSABENE P. 1974-75: "Sull'impiego del marmo di Cap de Garde. Condizioni giuridiche e significato economico delle cave in età imperiale", *Studi Miscellanei*, 22, 177-190.

PENSABENE P. 1993: "La decorazione architettonica dei monumenti provinciali di Tarraco", in R. Mar (ed.), *Els monuments provincials de Tarraco*, Tarragona, 33-105.

PENSABENE P. 1997a: "Marmi d'importazione, pietre locali e committenza nella decorazione architettonica di età severiana in alcuni centri delle provincie Syria et Palestina e Arabia", *Archeologia Classica*, XLIX, 275-422.

PENSABENE P. 1997b: "Le rotae porfiretiche nel pavimento della Capella Palatina", in R. M. Carra Bonacasa, F. Guidobaldi (eds.), *Atti del IV Colloquio dell'Associazione Italiana per lo Studio e la Conservazione del Mosaico,* Tivoli, 333-342.

PENSABENE P. 2001: "Pentelico e proconnesio in Tripolitania: coordinamento o concorrenza nella distribuzione?", *Archeologia Classica,* LII, 63-127.

PENSABENE P. 2003a: "Il reimpiego a Santa Maria in Domnica", in A. Englen (a cura di), *Caelius I. Santa Maria in Domnica, San Tommaso in Formis e il Clivus Scauri,* Roma, 166-196.

PENSABENE P. 2003b: "Il riuso in Calabria", in F. A. Cuteri (a cura di), *I Normanni in finibus Calabriae,* Catanzaro, 77-94.

PENSABENE P. 2005: "Marmi e commitenza negli edifici di spettacolo in Campania", *Marmora,* 1, 69-143.

PENSABENE P. 2006: "Reimpiego e interventi edilizi nell'Aquileia tardoantica", *Antichità Altoadriatiche*, 365-421.

PENSABENE P. 2008: "I portici nelle case medievali di Roma", in J.-F. BERNARD, PH. BERNARDI, D. ESPOSITO (a cura di), *Il reimpiego in architettura. Recupero, Trasformazione, Uso,* Roma, 67-93.

PENSABENE P. 2010a: "Disposizione e provenienza delle colonne di reimpiego nel complesso episcopale di Aquileia", in G. CUSCITO, T. LEHMAN (a cura di), *La Basilica di Aquileia. Storia, Archeologia ed Arte,* Antichità Altoadriatiche LXIX-II, Trieste, 551-660.

PENSABENE P. 2010b: "Marmi architettonici della Cappella Palatina tra reimpiego e recupero dell'antico", in B. BRENK (a cura di): *La Cappella Palatina a Palermo,* Modena, 137-170.

PENSABENE P. 2011: "Cattedrale di Canosa: reimpiego, recupero e trasformazione dell'antico nei marmi architettonici", in L. BERTOLDI (a cura di), *Canosa. Ricerche storiche,* Martina Franca, 597-664.

PENSABENE P., BRUNO M. 1998: "Aggiornamenti, nuove acquisizioni e riordino dei marmi di cava del canale di Fiumicino", in P. PENSABENE (a cura di), *Marmi Antichi II. Cave e tecnica di lavorazione, provenienza e distribuzione*, Studi Miscellanei 31, Roma, 1-22.

PENSABENE P., LAZZARINI L. 2004: "Marmi, pietre colorate e maestranze a Creta in età imperiale" in *Creta Romana e Protobizantina. Vol. III,1. Atti del Congresso Internazionale,* (Iraklion 2000), Padova, 763-785.

PEÑA A. 2009: "Análisis del reaprovechamiento de material en la Mezquita Aljama de Córdoba", in TH. G. SCHATTNER, F. VALDÉS (eds.), *Spolien im Umkreis der Macht – Spolia en el entorno del poder*, (Toledo, 2006), Mainz am Rhein, 247-272.

PEÑA A. 2010: *Estudio de la decoración arquitectónica romana y análisis del reaprovechamiento de material en la mezquita Aljama de Córdoba*, Córdoba.

PUCCINELLI A. 2009: *Elementi architettonici di spoglio nella città di Lucca,* Lucca.

RODÀ I., PENSABENE P., DOMINGO J. Á. 2012: "Columns and Rotae in Tarraco made with granite from the Troad", in *Interdisciplinary Studies on Ancient Stone. Proceedings of the ASMOSIA IX Conference,* (Tarragona 2009), Tarragona, 210-227.

RUSSELL B. 2008: "The dynamics of stone transport between the Roman Mediterranean and its hinterland", *Facta,* 2, 107-126.

WILLIAMS-THORPE O., POTTS P. J. 2002: "Geochemical and Magnetic provenance of Roman Granite Columns from Andalucía and Extremadura, Spain", *Oxford Journal of Archaeology*, 21.2, 167-194.