

## PRESENCE OF OLEA EUROPAEA AND VITIS VINIFERA IN ARCHAEOLOGICAL SITES FROM THE IBERIAN PENINSULA

RAMÓN BUXÓ I CAPDEVILA

### Abstract

The olive and the grape vine remains retrieved from archaeological excavations, show that they had been collected from the wild long before their cultivation in the Iberian Peninsula. The extension of the cultivation of the olive in the Western Mediterranean is normally seen as a feature of the Greek and Roman civilizations, although other arguments concerning the intentional cultivation of the tree in this region should not be excluded. Nevertheless, the situation in Spain is very controversial, on the one hand, is considered that the Phoenicians introduced the cultivated olive, and, on the other hand, the introduction of the cultivation of the olive was a late development linked to colonization by the Romans. Several hypotheses concerning the origins of viticulture in the Western Mediterranean are in agreement that it can only have been practised during the Iron Age, and that the Greek or Phoenician colonizations must have caused changes in the cultivation systems. Some theories concerning the possibility of an earlier production of wine (or at least on a large scale) have been discovered recently in Cuesta del Negro (Granada), which is probably an indication of local use of the grape for consumption. Archaeobotanical data shows that the Greeks may have introduced the viticulture into Northeastern Spain through their colony at Empúries, whilst in the rest of the Peninsula a close connection is postulated between the presence of the Phoenicians and the beginnings of grape cultivation. The difficulties are to confirm local cultivation or importation of grapes from other areas of the Southern Mediterranean, there is till present no evidence to confirm the theory that grapes consumed by early Iron Age communities were originated from improved varieties of wild grape.

### Introduction

Olive and grape vine exploitation were the most classical fruit of the Mediterranean basin. Since the Prehistory the Mediterranean peoples centred around the gathered and cultivation of olives and grape vines which provided valuable storable oil, fruits, dried raisins, and juice for fermentation of wine.

Archaeobotany evidence is being enlarged with new studies in the Iberian Peninsula, and far documented cereals and pulses, but also this fruits trees specially in diverse areas of the Mediterranean area.

### Archaeobotanical evidence for olive exploitation

#### Synopsis of finds of *Olea*

Charcoal analysis has proved the presence of the oleaster olives (*Olea europaea* subsp. *oleaster*) in the western Mediterranean. In the south of France, isolated fragments

of the genus *Olea* have been identified in the early Würm, and specially since of the late Paleolithic at Cova de l'Esperit (SOLARI & VERNET, 1990). In Mediterranean Spain (Fig. 1), the wild olive is found in charcoal from the Epipaleolithic (10860±160 BP) at Cueva de Nerja (Nerja, Málaga), with a maximum extension at the Neolithic (c. 2360 bc) at Can Tintorer (Gavà, Barcelona) (ROS MORA, 1992).

Its evolution is similar to that found on the eastern coast which is present since the beginning of Neolithic (c. 7000 BP). Around 4500 BP (late Neolithic), it is marked by the disappearance of pines and, specially, the green oak and the increase of wild olive



Fig. 1. Location in Spain of the main archaeological sites with evidence of *Olea europaea* and *Vitis vinifera*.

and the garigue formations of Leguminous, *Juniperus*, *Erica*, which indicate a maquis vegetation of *Rosmarino-Ericion* (BADAL & al., 1994). In the south-east of Spain, the Cueva del Toro (Antequera, Málaga) has given evidence of wood remains from the middle and late Neolithic (4300-3200 bc) which were then notably predominant in the Chalcolithic (2500-1900 bc) at Campos (Cuevas del Almanzora, Almeria), El Malagón (Cullar Baza, Granada), Las Pilas (Mojácar, Almeria) (RODRÍGUEZ-ARIZA, 1992) and Los Millares (Sta. Fé de Mondújar, Almeria) (RODRÍGUEZ-ARIZA & VERNET, 1991); and during the Bronze Age (1900-1200 bc) at Fuente Alamo (Cuevas del Almanzora, Almeria) (SCHOCH & SCHWEINGRUBER, 1982), at Cerro de las Viñas (Coy, Murcia) and at Rincón de Almendricos (Lorca, Murcia) (GRAU, 1990).

Charcoal analysis show differences from the early Chalcolithic to the late Chalcolithic. Certain species are constant, such as *Pinus halepensis*, *Pinus nigra* or *sylvestris*, *Quercus ilex*, *Quercus coccifera*, *Pistacia lentiscus*, *Pistacia terebinthus*, and *Tamarix*. But leguminous plants, willows (*Salix*) and olives all have a tendency to develop and the extension of the latter in particular is very significant for the late Chalcolithic, whilst *Populus* become increasingly rare, and *Cistus*, *Erica*, *Rosmarinus*, *Alnus* and the *Fraxinus* all disappear.

The transformation of the environment noticed in the Chalcolithic of Los Millares, as at Campos, is intensified to favour the wild olive. The predominance of the wild olive could be linked to a local pattern of the type *Quercu-lentiscetum* with undergrowth formed by *Rosmarino-Ericion* (RODRÍGUEZ-ARIZA & VERNET, 1991).

Seed remains analysis show, through the presence of olive-stones, that the findings of *Olea* easily pre-date the period in which it started to be cultivated: olive-stones have been found in the south of France in the Mesolithic of Cova de l'Esperit (LEVEAU & al., 1991) and in a Bronze Age at the cave of Las-Caounos (Gruissan) and of Gaiugnas at Cabrespine (MARINVAL, 1988). We have recently identified an olive-stone in a Bronze Age at the cave of Montou (Rosellón), which is in accordance with the anthracological data, in which a large number of carbonized remains of this taxon are also described. In Italy, the remains of wild olive is identified in the Mesolithic at Grotta dell'Uzzo (COSTANTINI, 1991).

In the Iberian Peninsula references to the wild olive are in close agreement with the anthracological data: in the middle Neolithic at Can Tintorer (BUXÓ & al., 1992), and in the Chalcolithic/early Bronze Age at Cova 120 (Sadernes, Girona) (AGUSTÍ & al., 1987) and Cueva de Nerja (HOPF & PELLICER CATALÁN, 1970); in the Chalcolithic at Los Millares and at Campos (BUXÓ, 1993), and finally in the Bronze Age at Fuente Alamo (STIKA, 1988) or at Serra Grossa (Alacant) (HOPF, 1971).

### Identification criteria for the remains of olives trees

The paleobotanical data give important information concerning the Mediterranean origins of the olive-tree. Nevertheless two highly important problems remain: (1) how to separate a wild specimen from a cultivated specimen, and (2), still on the subject of identification, how to know if a wild olive specimen represents a spontaneous wild tree or is in fact an example of a tree that has "gone wild" having lost the characteristics of a cultivated specimen?

With regard to the first question, neither palynological nor macroremains analysis can differentiate between wild and cultivated specimens. In palynological terms we can start to distinguish the cultivated olive once the percentage of *Olea* pollen increases significantly, or when these are accompanied by herbaceous plants such as *Centaurea solstitialis*, which grow in the areas of cultivation (TRIAT-LAVAL, 1982). In anthracological terms, tests have been carried out based on tree-rings (VERNET & al., 1983; RODRÍGUEZ & VERNET, 1991). Analysis shows that the annual growth of the rings is in correlation with environmental conditions; measures of growth show differences between trees with fast growth and those with slow growth. We now associate trees with fast growth with the cultivated variety, whilst those with slow growth generally correspond to the wild type.

The morphological study of olive-stones gives no indications which enable us to determine if they come from the wild or the cultivated olive. The similarity between stones of wild and cultivated remains renders the distinction between collection and cultivation in early sites impossible where *oleaster* olives occur in masses in the same areas (ZOHARY & HOPF, 1994).

Some studies maintain that the wild varieties produce stones with a length of less than 10 mm (cf. RENFREW, 1973). Nevertheless we can observe that, of the carbonized olive-stones from the prehistoric period in the Iberian Peninsula, some reach lengths more than 10 mm (Fig. 2): in the case of Los Millares, of the three stones measured, two have readings similar to stones of the wild olive (the same as at Cueva del Toro), but the third is nearer to the size of cultivated olives (BUXÓ, 1993).

The olive is one of the plants that is best adapted to the Mediterranean climate, growing in regions where winter temperatures most not be lower than -16 degrees C. and dryness is not excessive (50 degrees C.). The olive flourishes in well-drained limestone or sandy soils and in regions with an average annual rainfall of between 200 and 800 mm. The wild olive is in modern times a major component of the vegetation group of the thermophile calcicoles (*Oleo-lentiscetum*). It occupies zones with an altitude of between 0 and 300 metres, primary sites free of human cultivation, and also re-colonizes areas formerly cultivated (ZOHARY & SPIEGEL-ROY, 1975).

### **The cultivated olive: processes of diffusion or of local cultivation**

The presence of the cultivated olive can only be confirmed after the start of the fourth millenium in the Near East (ZEIST, 1980: 135). Cultivation began in an area corresponding to northern Palestine and southern Syria, between 3700-3200 bc, in the Chalcolithic, at Tuleilat Ghassul to the north of the Dead Sea (ZOHARY & SPIEGEL-ROY, 1975), and at other sites at the same period such as Abu Hamid and Tell esh Shuna, in the Jordan valley (NEEF, 1990). There is nothing to enable us to put forward confirmed hypotheses concerning oleoculture in each area: the case of the sites in the lower Jordan valley is problematic, since in modern times wild olives are not found here due to insufficient precipitation. Certain authors have considered the possibility that olives were imported for the nearby mountains of Judaea or the upper Jordan valley, where the olive grows spontaneously (ZOHARY & SPIEGEL-ROY, 1975), whilst others

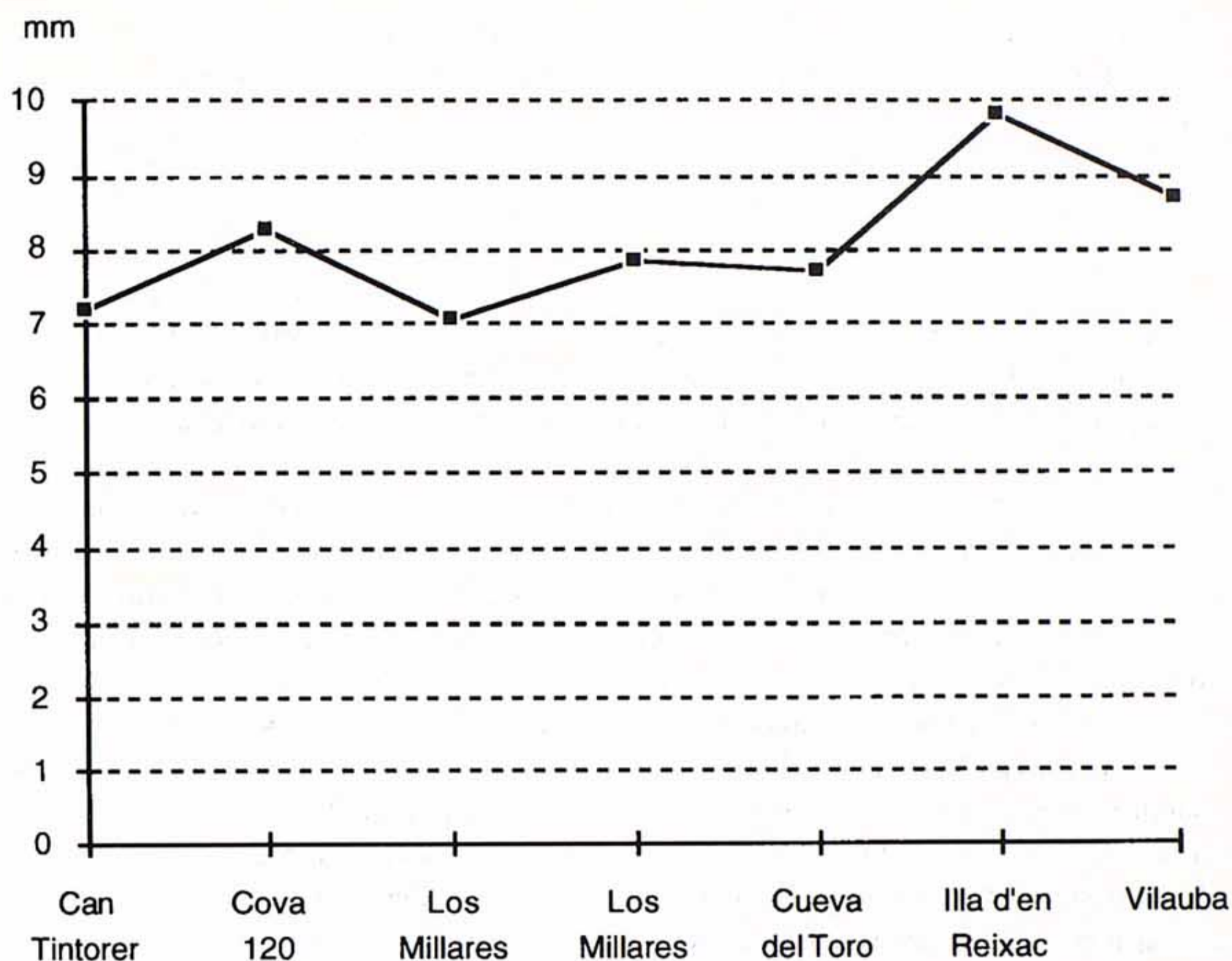


Fig. 2. Length dimensions of the archaeobotanical remains of *Olea europaea* in several archaeological sites of Spain. *Wild olive*: Can Tintorer - Middle Neolithic; Cueva del Toro - Middle Neolithic; Los Millares - Chalcolithic; Cova 120 - Chalcolithic/Early Bronze Age. *Domesticated olive*: Illa d'en Reixac - Iron Age (4th. century BC); Vilauba - Late Roman Period (5th century AD).

have postulated that the olive-trees at Tuleilat Ghassul were irrigated (ZEIST, 1980: 135). Furthermore, the plentiful presence of the olive before the Chalcolithic makes it plausible that hunter-gatherers and early farmers gathered olives (LIPHSCHITZ & al., 1991).

In Greece, documentary sources and archaeobotanical data prove the cultivation of the olive towards 2500 bc (ZEIST, 1980), but it is only in the 7th. and 6th centuries bc that texts mention production intended for export (BOARDMAN, 1976). More recent studies show a spreading of the cultivation of the olive from the time of the Mycenaean era, although the picking of wild olives was probably still predominant (AMOURETTI, 1986). Furthermore, other authors have made a case for dating the cultivation of the olive from the time of the late Bronze Age, since the few data and the lack of structures associated with its production do not enable us to confirm if cultivation was practised in earlier periods (RUNNELS & HANSEN, 1986). Finally, a recent study shows from the findings at Kommos (recent Minoan) elements which were used for the production of oil intended for export (BLITZER, 1991: 100).

The olive cultivation into the west Mediterranean basin was probably introduced by the Greek colonists in the north area, but also by the Phoenician in the south of the Iberian Peninsula, although the extension was more related to the Roman civilization. In the south of France, the cultivation of the olive was apparently introduced by the

Greeks and extended by the Romans (LEVEAU & al., 1991). In the south of Spain, at the phoenician site of Castillo de Doña Blanca, there is a presence of the olive between 600-575 bc, but the author indicates that they were locally picked (CHAMORRO, 1992); and, in the north-east of Spain, the archaeological sites which present the domesticated olive are from the second Iron Age (i.e., Illa d'en Reixac -4th century bc-) and from the Roman period (i.e., Vilauba).

Nevertheless, the situation with regard to the olive in Spain is very controversial: on one hand, SCHULTEN (1962) considers that, the Phoenicians introduced the cultivated olive towards the end of 2nd. millenium; whereas on the other hand, TARRADELL (1975) divides the information from classical authors into three groups: those who deny the presence of olive-trees in the pre-Roman era (cf. Plinius), those who confirm their presence (cf. Avienius), and others who explain the presence of the olive-tree specifically (cf. Apicius). Tarradell concludes that the whole body of information comes from authors of the Roman era writing after the 2nd. century AD, who did not know the Iberian Peninsula directly and confined themselves to using two or three different sources for their writings. He comments that the introduction of the cultivation of the olive was a late development linked to colonization by the Romans.

The two hypotheses concerning the introduction of the olive into Spain need to be examined. The archaeobotanical data show that the wild olive was present in the region during the Neolithic, the Copper and the Bronze Ages, always in areas with a thermo-Mediterranean or lower meso-Mediterranean climate, which makes it more difficult to establish the start of cultivation, nevertheless show differences in the arrival of the olive (compared to the south of France) below the level of southern Catalonia. These differences can be explained not only by the development of the area's bioclimate, but also by different cultural influences. In these terms we must consider if it is possible to reach a valid conclusion by comparing the above data with macroremains samples of *Olea* taken from Phoenician sites. Are we dealing here with olives originating from localized cultivation in the south and east of the Iberian Peninsula? Should we consider the possibility that the varieties cultivated in the area were substituted by others from the Roman period onwards?

### **Archaeobotanical evidence for grape vine exploitation**

The grape is undoubtedly, together with the olive, the most important species in the Mediterranean, but prefers a somewhat cooler and more humid climate. The wild grape is found near rivers, in forests and in any more or less humid areas in southern Europe. It is important to note that the pips from wild grapes can be distinguished from those of the cultivated fruit.

It is accepted as normal that in morphometric terms the samples of small pips originate from the wild grape (*Vitis vinifera* L. subsp. *sylvestris* C. C. Gmelin.): they have rounded or cord-shaped contours and have a short beak. By contrast, the pips of the cultivated grape are large and elongated, are ovoid or piriform, and there is a clearly developed beak. Mensuration provides a ratio between the breadth and the length of the pip (STUMMER, 1911) and a ratio between the length of the beak and the length of

the total pip (SMITH & JONES, 1990), which allow us in many cases to distinguish between wild and cultivated grapes. According to RENFREW (1973), the average value for ratio of width and length in the case of the wild grape is between 63 and 83 with a peak of 64-65; the average value for cultivated specimens is between 44 and 75 with a peak around 55.

The grape-pips found at Cuesta del Negro (Purullena, Granada) show variations in shape: some are intermediate between the wild and the cultivated varieties, but others are very close to the cultivated type. In the biometric study, in which certain remains are of a size reminiscent of the cultivated type: the average length is 5.2; the average ratio of width over length is 63 and the average length of the beak compared to total length is 53. It is impossible to make a definitive conclusion concerning the attribution of the 27 remains of grape found to either the wild or the cultivated types, but the presence of wine-must in a funerary context and also that of certain grape-pips would tend to link certain specimens to the cultivated variety, even if this is exceptional for that period. Other recent studies which appear to show wine production in the Chalcolithic have been disproved (RIVERA & WALKER, 1991: 905-908). In this context the Cuesta del Negro results call for prudence, although we would suggest the denomination of the samples close to the cultivated type under the label *Vitis* sp.

### **The grape in the western Mediterranean: autochthonous or imported**

The findings of *Vitis* in the Mesolithic at l'Abeurador (south of France) (MARINVAL, 1988), at Grotta dell'Uzzo (Italy) (COSTANTINI, 1991) or at the cave of Franchthi (Greece) (HANSEN & RENFREW, 1978) prove the indigenous nature of the grape in the Mediterranean area. This is also confirmed by the palynological analysis carried out at Marsillargues on the edge of the lake of Mauguio in Languedoc (PLANCHAIS et al., 1977).

Viticulture was widely practised in the 3rd millenium in the region of the Aegean and the eastern Mediterranean. The results from the sites at Lerna in Greece, and those from the site at Myrtos in Crete (2200-2000 bc) (RENFREW, 1973), where presence of a wine-press is postulated, suggest that viticulture was well established at this period. This is confirmed by the palaeoethnobotanical investigations at Kastanas, showing that the grape was cultivated from the late Bronze Age onwards (KROLL, 1983). In the Near East pips from cultivated grapes have been found from the early Bronze Age (2900-2700 bc) at Lachish (HELBAEK, 1960), Jericho (HOPF, 1983) and Arad (HOPF, 1978), and also from the same period at Bad edh-Dhra in Jordan (MCCREERY, 1981). According to various authors, remains of grapes in the area should be considered as proof of the cultivation of the grape, and therefore of its importation, since the wild grape is absent from the region (ZOHARY & SPIEGEL-ROY, 1975).

The ancient texts show that it was the Greeks who introduced the cultivation of the grape into southern of France towards 600 BC; it is possible that they based local production of the vine on wild autochthonous varieties, with or without the additional introduction of cultivated plants. Archaeological and paleobotanical evidence also indicates that it was the Greeks who introduced the cultivation of the grape into Italy: this could be dated to before of pre-urban Rome (800-600 bc) (ZEIST, 1980).

Viticulture in the Iberian Peninsula is more difficult to analyse than is the case for the southern of France (Fig. 1). Data shows the presence of cultivated grape from the 5th-4th centuries bc onwards in several archaeological sites (BUXÓ, 1993) (Fig. 3): Illa d'en Reixac, Ullastret, Cova de Can Sadurní (Gavà, Barcelona), Alorda Park (Calafell, Tarragona), Vilar d'en Met (Sitges, Barcelona), and it is suggested that the Greek from Massalia may have introduced it into northeastern Catalonia through their colony at Empúries, whilst in the rest of the Peninsula a close connection is postulated between the presence of the Phoenicians and the beginnings of grape cultivation (HARRISON, 1989: 226).

Archaeological data for eastern Spain show the presence of structures associated with grape cultivation from the 6th century bc at Alt de Benimaquia (Dènia, Alacant) (GÓMEZ BELLARD & al., 1993), whilst in the south, at the Castillo de Doña Blanca, the cultivated grape represents a significant percentage at all phases of occupation (675-500 bc) (CHAMORRO, 1992), but it seems difficult to us to confirm local cultivation or importation of grapes from other areas of the southern Mediterranean (in this case the Phoenicians would have brought their own cultivation techniques). In this respect it should be noted that different aspects of the archaeological structures found on site from the 8th. century bc indicate eastern contacts (RUIZ MATA, 1986).

On the other hand, we know very little about either the presence of the wild grape or of some type of cultivation before the periods of colonization in the Iberian Peninsula (Fig. 1). Findings in the north-east of the region confirm the presence of the pips from the Neolithic (BUXÓ, 1993) at La Draga (Banyoles, Girona), Cova 120 and Can Tintorer; from the Bronze Age, at Bòbila Madurell (Sabadell, Barcelona); and from the Chalcolithic at Cova Punta Farisa (Fraga, Huesca) (ALONSO & BUXÓ, 1995) (Fig. 3). Whilst in the east, pollen of *Vitis* found from the later Paleolithic (27000-25000 BP) at Cueva de les Calaveres (Benidoleig, Alacant) (FUMANAL & DUPRÉ, 1983), and at Cueva de les Mallaetes (Barx, València) (DUPRÉ, 1980), but charcoal remains of grape are only found from the Iberian period onwards (GRAU, 1990). The presence of cultivated grapes towards the 3rd millenium was postulated at the site of El Prado (Jumilla, Murcia) (RIVERA & WALKER, 1989), but has been discounted in a more recent study (RIVERA & WALKER, 1991).

Also, to mention the results to the samples of grapes studied at Cuesta del Negro, which we have included under *Vitis* sp. These remains, which are intermediate between the wild and cultivated varieties, are extremely interesting because the sample is taken from a tomb and wine-must has been detected at another burial-place. For the present this remains the only discovery of its type, although plant remains data show grape-pips in the Bronze Age at Castellón Alto, as well as a pedicle from the Chalcolithic at Los Millares. Otherwise, indications from anthracological and palynological data are rare; in one case, charcoal remains have been identified in the Argar at Fuente Amarga (but without being able to determine whether they are of the wild or cultivated variety) (RODRÍGUEZ-ARIZA, 1992). Palynological analysis shows the presence of the wild grape in the middle Pleistocene at Padul (Granada) (FLORSCHÜTZ & al., 1971), and findings of pollen towards 4480 BP in at La Laguna de las Madres (Huelva) is thought to show the existence of an area of grape cultivation (STEVENSON, 1985).



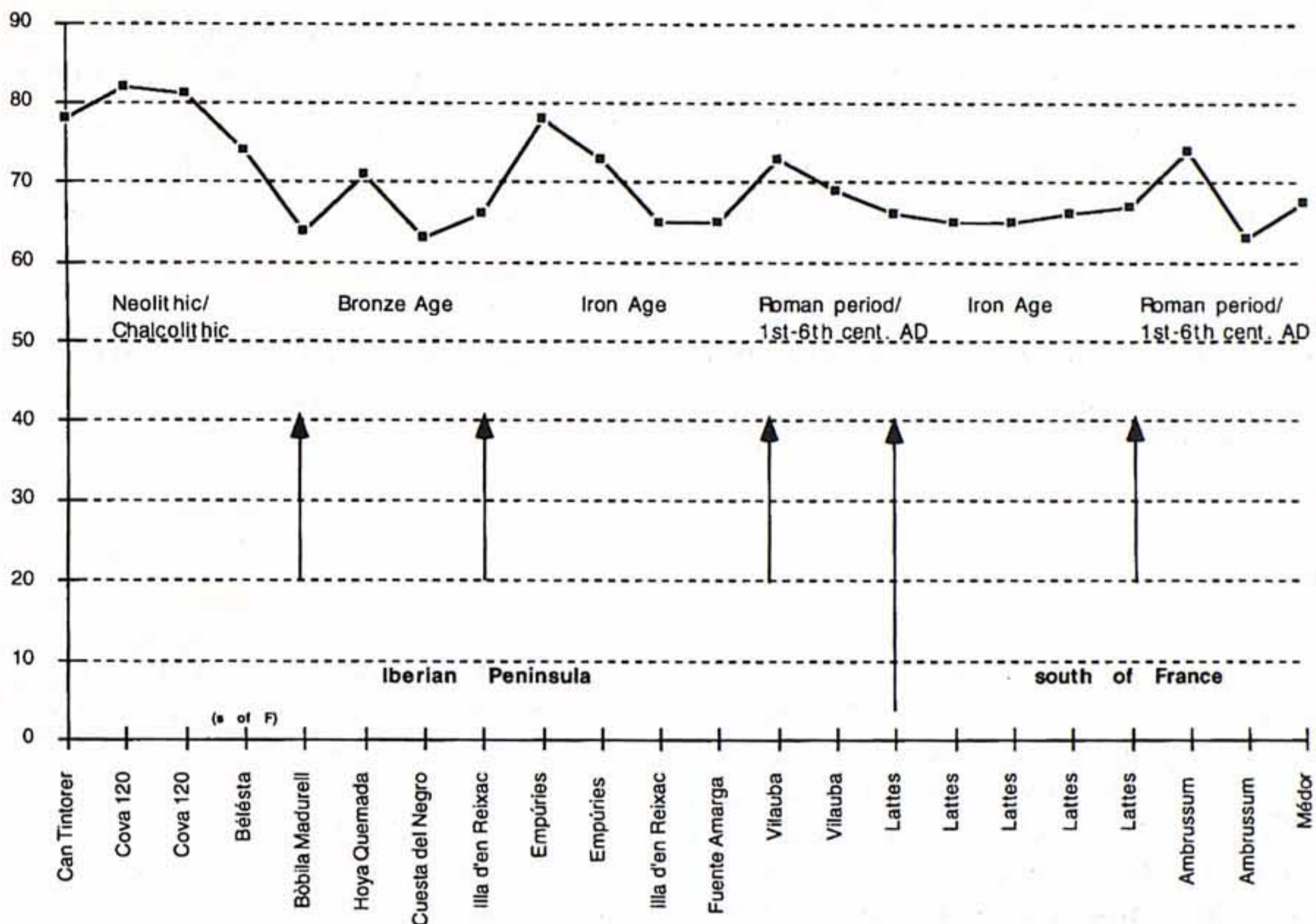


Fig. 3. Index values (breadth/length) of the archaeobotanical remains of *Vitis vinifera* in several archaeological sites of Spain and south of France.

The wild grape is found especially in humid areas, which could explain the higher frequency of findings of grape remains in the area corresponding to southern France and in the north-east of Spain, whilst in the south and east of the Peninsula they are less common from the Bronze Age. There is as yet no evidence to confirm the theory that grapes consumed by early Iron Age man originated from improved varieties of wild grape. It is possible that on the one hand the Greeks from the colony at Marseille -in the case of south of France and the north-east of Spain-, and on the other hand the Phoenicians -in the case of southern and eastern Spain- may have introduced cultivated grapes, in parallel with a local production of grapes developed from wild autochthonous grapes.

## Conclusions

The extension of the cultivation of the olive in the western Mediterranean is normally seen as a feature of the Greek and Roman civilizations, although other arguments concerning the intentional cultivation of the tree in this region should not be excluded. Nevertheless, the archaeological evidence has demonstrated that olives were collected from the wild long before their cultivation.

Together with olive, archaeobotanical evidence proves the local use of the grape as a food source, and this could have taken the form of other types of consumption

besides wine, such as fresh fruit or dry fruit and cakes or flour based on grape-pips, but the problem of the origin of the cultivated grapes remains is still unresolved. Other theories concerning the possibility of an earlier production of wine (or at least on a large scale) have been discounted recently, although it is important to note the presence of grape-pips in the context of a burial at Cuesta del Negro, which is probably an indication of local use of the grape for consumption.

The exploitation of the grape vine in the western Mediterranean had been practised up to the First Iron Age (8th-7th centuries bc), and the colonizations, Greek or Phoenician, must have caused changes in the processes of transformation and cultivation.

## References

- AGUSTÍ, B., G. ALCALDE, F. BURJACHS, R. BUXÓ, N. JUAN-MUNS, J. OLLER, M. T. ROS, J. M. RUEDA & A. TOLEDO (1987). *Dinàmica de la utilització de la cova 120 per l'home en els darrers 6000 anys*. Girona.
- ALONSO, N. & R. BUXÓ (1995). *Agricultura, alimentació y entorno vegetal en la Cova Punta Farisa (Fraga) durante el Bronce medio*. Lleida.
- AMOURETTI, M. C. (1986). *Le pain et l'huile dans la Grèce Antique*. Paris.
- BADAL, E., J. BERNABEU & J. L. VERNET (1994). Vegetation changes and human action from the Neolithic to the Bronze Age (7000-4000 B.P.) in Alicante, Spain, based on charcoal analysis. *Veget. Hist. Archaeobot.* **3**: 155-166.
- BLITZER, H. (1991). Olive cultivation and oil production in Minoan Crete, in M.C. AMOURETTI & J. P. BRUN (Eds.): *La production du vin et de l'huile Méditerranée*, *Bull. Corresp. Hellén.* **26**: 369-378. Aix-en-Provence.
- BOARDMAN, J. (1976). The olive culture in the Mediterranean: its culture and use, *Philos. Trans. Royal Soc. London*, **B 275**: 187-193.
- BUXÓ I CAPDEVILA, R. (1993). *Des Semences et des fruits. Cueillette et Agriculture en France et en Espagne méditerranéennes du Néolithique à l'Age du Fer*. Ph. D. Dissertation. Montpellier.
- , M. CATALÁ & M. J. VILLALBA (1992). Llavors i fruits en un conjunt funerari situat en la galeria d'accés a la Mina 28 de Can Tintorer (Gavà). *Cypsela*, **9**: 65-72.
- CHAMORRO, J. G. (1992). Campaña de flotación en el Castillo de Dña. Blanca (Pto. Sta. Ma. Cádiz): Método, Muestreo y Resultados, in: P. LÓPEZ (ed.): *Arqueología Medioambiental a través de los macrorrestos vegetales*: 84-106. Madrid.
- COSTANTINI, L. (1991). Origen i difusió de l'agricultura a l'Itàlia meridional. *Cota Zero*, **7**: 103-114.
- DUPRE, M. (1980). Análisis polínico de sedimentos arqueológicos de la Cueva de les Malladetes (Barx, València), *Cuad. Geogra.* **26**: 1-22.
- FLORSCHUTZ, F., J. MENÉNDEZ-AMOR & T. A. WIJMSTRA (1971). Palynology of a thick Quaternary succession in southern Spain. *Palaeogeogr., Palaeoclimatol., Palaeoecol.* **10**: 233-264.
- FUMANAL, M. P. & M. DUPRE (1983). Schéma paléoclimatique et chono-stratigraphique d'une séquence du paléolithique supérieur de la région de Valence, Espagne. *Bull. Assoc. Fr. Etude Quaternaire* **1983** (1): 39-46.
- GÓMEZ BELLARD, G., P. GUERIN & G. PÉREZ (1993). Témoignage d'une production de vin dans l'Espagne Préromaine, in: M. C. AMOURETTI & J. P. BRUN (eds.): *La production du vin et de l'huile Méditerranée*. *Bull. Corresp. Hellénique* **26**: 379-395. Aix-en-Provence.

- GRAU, E. (1990). *El uso de la madera en yacimientos valencianos de la Edad del Bronce a la época visigoda. Datos etnobotánicos y reconstrucción ecológica según la antracología*. Universidad de Valencia. Ph. D. Dissertation.
- HANSEN, J. & J. M. RENFREW (1978). Palaeolithic–Neolithic seed remains at Franchthi Cave. *Nature* **271**: 349-352.
- HARRISON, H. J. (1989). *España en los albores de la historia: Iberos, Fenicios y Griegos*. Madrid.
- HELBAEK, H. (1960). The palaeoethnobotany of the Near East and Europe, in R. J. Braidwood & B. Howe (eds.), *Prehistoric investigations in Iraqi Kurdistan. Studies in Oriental Civilization* **31**: 99-118. Oriental Institute. Chicago.
- HOPF, M. (1971). Vorgeschichtliche Pflanzenreste aus Otspanien, *Madriider Mitteilungen*, **12**: 101-114.
- (1978). Plant remains, strata V-I, in: R. AMIRAN (ed.): *Early Arad I. The chalcolithic settlement and early bronze age city*. 64-82. Israel Explor. Soc. Jerusalem.
- & M. PELLICER CATALÁN (1970). Neolithische Getreidefunde in der Höhle von Nerja (Málaga). *Madriider Mitteilungen* **11**: 8-34.
- KROLL, H. (1983). Die Pflanzenfunde, *Kastanas. Ausgrabungen in einem Siedlungshügel der Bronze- und Eisenzeit Makedoniens 1975-1979*. Berlín.
- LEVEAU, PH., C. HEINZ, H. LAVAL, PH. MARINVAL & J. MEDUS (1991). Les origines de l'oléiculture en Gaule du sud, données historiques, archéologiques et botaniques. *Revue d'Archeométrie* **15**: 83-94.
- LIPHSCHITZ, N., R. GOPHNA, M. HARTMAN & G. BIGER (1991). The beginning of Olive (*Olea europaea*) cultivation in the Old World; A reassessment. *J. Arch. Sci.* **18**: 441-453.
- MC CREERY, D. W. (1981). Flotation of the Bab edh-Dhra and Numeira plant remains, *Annu. Am. School Oriental Res.* **46**: 119-132.
- MARINVAL, P. (1988). *L'alimentation végétale en France du Mésolithique jusqu'à l'âge du Fer*. Paris.
- NEEF, R. (1990). Introduction, development and environmental implications of olive culture: The evidence from Jordan, in S. BOTTEMA & al. (Eds.): *Man's role in the Shaping of the Eastern Mediterranean Landscape*: 295-306. A. A. Balkema. Rotterdam.
- PLANCHAIS, N., J. RENAULT-MISKOVSKY & J. L. VERNET (1977). Les facteurs de l'évolution de la végétation dans le sud de la France (côté à moyenne montagne) depuis le Tardiglaciaire d'après l'analyse pollinique et les charbons de bois, in: H. LAVILLE & J. RENAULT-MISKOVSKY (eds), *Approche écologique de l'homme fossile. Sup. AFEQ* **17**, 323-327.
- RENFREW, J. M. (1973). *Paleoethnobotany. The prehistoric food plants of the Near East and Europe*. New-York.
- RIVERA, D. & M. WALKER (1989). A review of Palaeobotanical findings of early *Vitis* in the Mediterranean and of the origins of cultivated grape-wines, with special reference to new pointers to prehistoric exploitation in the Western Mediterranean, *Review of Palaeobotany and Palynology*, **61**: 205-237.
- & M. WALKER (1991). Grape remains and direct radiocarbon dating: a disconcerting experience from El Prado, Murcia, Spain. *Antiquity* **65**: 905-908.
- RODRÍGUEZ-ARIZA, O. (1992). Human-plant relationships during the Copper and Bronze Ages in the Baza and Guadix Basins (Granada, Spain), *Bull. Soc. Bot. Fr.* **139**: 483-494.
- & J. L. VERNET (1991). Premiers résultats paléocologiques de l'établissement chalcolithique de Los Millares (Sta. Fé de Mondújar, Almería, Espagne), *Second Deya Conference, Archaeological Techniques, Technology & Theory*. Deya.
- ROS MORA, M. T. (1992). Les apports de l'antracologie à l'étude du paléoenvironnement végétal en Catalogne (Espagne), *Bull. Soc. Bot. Fr.* **139**: 483-494.

- RUIZ MATA, D. (1986). Castillo de Dña. Blanca (Pto. de Sta. Maria), stratigraphische untersuchung einer orientalisierenden ansiedlung. *Madriider Mitteilungen* **27**: 87-115.
- RUNNELS, C. N. & J. HANSEN (1986). The olive in the Prehistoric Aegean: the evidence for domestication in the Early Bronze Age. *O. J. A.* **5**: 299-308.
- SCHOCH, W. & F. H. SCHWEINGRUBER (1982). Holzkohlenanalytische ergebnisse aus der bronzezeitlichen Siedlung Fuente Alamo, prov. de Almeria. Spanien, *Archäologisches Korrespondenzblatt* **12**: 451-455.
- SCHULTEN, A. (1962). *Geografía y Etnografía antiguas de la Península Ibérica*. Madrid.
- SMITH, H. & G. JONES (1990). Experiments on the Effects of Charring on Cultivated Grape Seeds. *J. Archaeol. Sci.* **17**: 317-327.
- SOLARI, M. E. & J. L. VERNET (1990). Données nouvelles sur la végétation préhistorique des Corbières, d'après l'analyse anthracologique de la Cova de l'Esperit (Salses, Pyrénées Orientales). *II Coloquio Internacional de Botánica Pirenaico-Cantábrica*, Jaca, Espagne.
- STEVENSON, A. C. (1985). Studies in the vegetational history of S.W. Spain. II. Palynological investigations at Laguna de las Madres, S.W. Spain. *J. Biogeogra* **12**: 293-314.
- STIKA, H. P. (1988). Botanische untersuchungen in der bronzezeitlichen höhensiedlung Fuente Alamo. *Madriider Mitteilungen* **29**: 21-76.
- STUMMER, A. (1911). Zur Urgeschichte der Rebe und des Weinbaues. *Mitt. Anthropol. Ges. Wien* **41**: 283-296.
- TARRADELL, M. (1975). La expansión del aceite y el uso de lucernas. Un elemento metodológico para la historia agraria del Mediterráneo antiguo, *Actas de las Ias. Jornadas de Metodología aplicada de las Ciencias Históricas I. Prehistoria y Historia Antigua*, 173-184. Santiago de Compostela.
- TRIAT-LAVAL, H. (1982). Pollenanalyse de sédiments quaternaires récents du pourtour de l'Etang de Berre. *Ecol. Medit.* **8**: 97-115.
- VERNET, J. L., E. BADAL & E. GRAU (1983). La végétation néolithique du sud-est de l'Espagne (Valencia, Alicante) d'après l'analyse anthracologique. *C.R. Acad. Sci.* **296 III**: 669-672.
- ZEIST, W. VAN (1980). Aperçu sur la diffusion des végétaux cultivés dans la région méditerranéenne, in: La mise en place, l'évaluation et la caractérisation de la flore et de la végétation circum-méditerranéenne. *Naturalia Monsp. Hors Sér.* 129-145.
- ZOHARY, D. & P. SPIEGEL-ROY (1975). Beginnings of fruit growing in the Old World, *Science*, **187**: 319-327.
- & M. HOPF (1994). *Domestication of Plants in the Old World*. London.

#### Address of the author:

Ramón Buxó i Capdevila, Museu d'Arqueologia de Catalunya, Centre d'Investigacions Arqueològiques, Pedret 95, 17007 Girona, Spain.