CHAPTER I.

INTRODUCTION

The richness in all types of metals of the Iberian Peninsula was praised by classical authors, such as Strabo in his Geography (STRABO, 1969), in which, specifically, the mountains which extend to the North and parallel to the river Guadalquivir are mentioned.

The fact that in the Roman period advantage was taken of those riches was clearly shown, among other numerous remains, by the millions of tons of slag which was spread over all the mining districts of the Southwest of the Iberian Peninsula, from the province of Córdoba to the most western deposits of Portugal (DAVIES, 1935; DE ALMEIDA, 1970; PINEDO, 1962, etc.).

From the more recent exploitations the mythical names of Guadalcanal still echo or, with regard to contemporary times, the enormous sulphide deposits of the Iberian Pyritic Belt, worked for the exportation of their ores.

The volume and importance of contemporary mining, still in progress, with deposits of the size of Tharsis, Aznalcóllar or Rio Tinto, seem to have produced a tendency to what has been defined as "transtemporal identification of the present environment and its economic implications" (NOCETE et al., 1993).

This identification seemed to be backed by the finds belonging to the Orientalizing period which began to be archaeologically documented in the sixties and seventies of the 20th. century (GARRIDO ROIZ, 1968; BLANCO & LUZON, 1969; BLANCO et al., 1970) and evidenced a mining activity from prehistoric times. This circumstance was also confirmed by the finding of stone tools proven to be used in mine workings (BLAZQUEZ, 1923), which had been recovered in many mineral deposits from the 19th. century onwards by geologists and miners (GONZALO Y TARIN, 1887; CANDAU, 1894; HERNANDEZ PACHECO, 1907; SERRA I RAFOLS, 1924;PINEDO, 1962; DOMERGUE, 1987), continually paying great attention to ancient workings, considered by them as an indication which could lead to the discovery of economically interesting orebodies (MONCADA Y FERRO, 1912).

With that viewpoint, the finding of Huelva Hoard was taken as proof of the metallurgical importance of Huelva in ancient times, with an organisation which showed similar characteristics to the mineral exploitation being carried out at the time when the hoard was recovered, significantly when the Tharsis mineral ore pier (one of the several which were built in the Huelva estuary) was being dredged (ALMAGRO BASCH, 1975; PINEDO, 1962).

Although the finding of the remains supporting prehistoric mining were not restricted to Huelva (HERNANDEZ PACHECO, 1907; SERRA I RAFOLS, 1924), it is in that province where, based on little previous information but which began to show a clear contradiction between the mineral wealth and the prehistoric remains discovered (CERDAN et al., 1952), the first archaeometallurgical project in the Southwest Iberian Peninsula was initiated in the 1970's by IAMS.

Archaeometallurgy already constituted a new discipline developed from a long tradition of the History of Technology, and was at that time consolidated as a field of independent research within Archaeology (TYLECOTE, 1962), with specific research teams such as IAMS in London (BLANCO & ROTHENBERG, 1981) and the German SAM (JUNGHANS et al., 1960; JUNGHANS et al., 1968).

The interest in this discipline was considerably increased by the controversy on the diffusion or not of the metallic production technologies (autoctonism versus colonialism, with the explicit proposition of an independent development in the Iberian Peninsula) and the special consideration given to metallurgy in the evolution of the social structures (RENFREW, 1976; 1978).

So, as has been defined, "Renfrew style" (NOCETE et al., 1993), the IAMS project (The Huelva Archaeo-Metallurgical Project) was initiated: if metallurgy could have been discovered independently in the Iberian Peninsula, what place would have be more appropriate for this to have happened than the area of the largest orebodies of Europe, the Southwest of the Iberian Peninsula and fundamentally Huelva, the nucleus of that mineralized zone?.

Moreover, the same mining companies which were still exploiting those deposits, in actual fact those of Rio Tinto, financed the project (BLANCO & ROTHENBERG, 1981). Perhaps, this led to the exclusion of other mines worked by "rival companies", such as Tharsis, which was studied almost at the same time by C. Domergue, and published in his "Catalogue des Mines et des Fonderies Antiques de la Péninsule Ibérique" (DOMERGUE, 1987), an impressive work not only, although to a great extent, of a summary character which was the first archaeometallurgical study covering the whole of the Iberian Peninsula.

In any case, The Huelva Archaeo-Metallurgical Project explained that its object was not "a complete survey of the Huelva province, but an endeavour to form a representative profile of the ancient extractive metallurgy of Huelva from its earliest primitive beginnings to the full development of industrial metal production in the Roman era" (ROTHENBERG & BLANCO, 1981: 34).

The basic hypothesis, perfectly logical and based, perhaps, on models from the Near East, more precisely Timna (ROTHENBERG, 1972; 1978), was that once

located the orebodies, there would be the ancient mines and next to them, also, the remains related to the transformation of ore, and the settlements.

But the first surveys carried out showed the inadequacy of the previously established hypotheses: in the area there were very few habitation sites. Because of this, it became necessary to "extend the Huelva Archaeo-Metallurgical Survey to the coastal areas, including the lower reaches and estuaries of Huelva´s rivers" (ROTHENBERG & BLANCO, 1981:35), but this resulted in a study with no connections whatever.

It began to be evident that there was a lack of connection between the location of the mineral resources and that of the prehistoric settlements, at least until the end of the Late Bronze Age.

This, which could be considered as one of the most interesting conclusions of the Huelva Project, was not properly valued, insisting with little evidence and using Peninsular parallels (Millares site) in a local indigenous development, perhaps even from an autonomous invention, of metallurgy, which would be the motor of the social transformation (BLANCO & ROTHENBERG, 1981).

In this sense, it has been affirmed that the Huelva Project was a failure as far as the articulation of the mine workings-settlements-necropolis is concerned (NOCETE et al., 1993), or to say it in another more technological way, the articulation between mining, the transformation of minerals and the production and use of metal.

But, rather than the actual interpretations made by the Huelva Archaeo-Metallurgical Project which now, after more than 20 years' research, are considered erroneous (although some did not have to wait long for its invalidation (PELLICER & HURTADO, 1980; DOMERGUE, 1987; CHAPMAN, 1991), it would be convenient to remark that the Huelva Project showed the importance of the archaeometallurgical research in order to gain knowledge of ancient societies, bringing up a series of questions, still not completely answered, which later works have tried and are still trying to resolve with new approaches and taking into account or searching for the data that Archaeology is supplying with regard to the different cultural periods.

According to the interpretation of the results, the Huelva Survey considered that "the overwhelming importance of metal in the history of the province can be appreciated by the very scale and extent of the remains of extractive metallurgy in Huelva since early Chalcolithic times" (ROTHENBERG & BLANCO, 1981:163).

This interpretation may have been the base, together with the already mentioned "transtemporal identification", of an extended vision which has considered the large ore deposits in the province of Huelva as suppliers of raw material to the prehistoric sites some distance away, such as Setefilla (AUBET et al., 1987) or Ardales (Málaga) (DURAN VALSERO, 1987), even before checking adequately the available mineral resources of the settlement areas (CHAPMAN, 1991).

That conclusion, of the importance of metal in the Chalcolithic period, was only arrived at based on the consideration of (again following parallels from the Near East) grooved stone hammers as being used exclusively in that period, with Chinflón taken as the model of mining and metallurgical technology of that moment, connected with the nearby dolmenic graves (BLANCO & ROTHENBERG, 1981), although other investigators directly involved in the Huelva Project, right from the very moment of the excavation, gave, both to the mine workings and to the adjacent settlement, a much later chronology (PELLICER & HURTADO, 1980).

Today, although in some publications a Chalcolithic date is still given to Chinflon and to the more than 70 mines in which stone hammers appeared (MOHEN, 1992: 88), the date of Late Bronze is accepted for Chinflón (CHAPMAN, 1991; ANDREWS & ROTHENBERG, 1996), although it is also considered that Chinflón, which is the only mine excavated, would be a singular case and would not invalidate the possible relation between megalithism and copper mining, nor the mining exploitation in this zone in the 3rd. millennium B.C. (PIÑON VALERA, 1990; NOCETE et al., 1993).

The grooved stone hammers could be considered as being used during the whole of the Bronze Age (DOMERGUE, 1987), although there are authors who appear to defend the idea that they were not used until the Middle Bronze Age, following their use in the Argaric period in the Southeast and of their non-existence, it is said, (which is not correct) in the Copper Age and the beginning of the Bronze Age in European mines such as the Balkan mines of Ai Bunar and Rudna Glava, the French Cabrieres and the Irish Mount Gabriel (PEREZ MACIAS, 1996).

Whatever that may be, the interpretation changed regarding Chalcolithic metallurgy from considering it as a fundamental activity which would produce fundamental social changes (BLANCO & ROTHENBERG, 1981) to the opposite extreme: an economic activity almost absent in the archaeological register which showed the insignificant role played by mining and metallurgy in the economy of those times (PEREZ MACIAS, 1996:183).

In any case, this new interpretation was made from the same approach as that which had been used to defend the contrary, without solving the mentioned disarticulation. This articulation is now trying to be reached through a North-South design, using the Odiel river as the axis (NOCETE et al., 1993), but this has been absent in the research due, partly, to the design of the research projects, both specific or general, in a East-West axis or, in the case of the general ones, without giving metallurgy much importance (CAMPOS CARRASCO et al., 1992; 1995).

In the case of the project "Análisis y Definición de los Procesos Culturales en el II milenio B.C." which

began with the object of articulating culturally the South West, different circumstances caused it to remain centred fundamentally in the Sierra de Huelva (HURTADO PEREZ, 1992a). The excavation, within this project, of the site of El Trastejón (Zufre, Huelva) (HURTADO PEREZ, 1990; 1991; 1992; HURTADO PEREZ et al., 1993; HURTADO PEREZ & GARCIA SANJUAN, 1994), has given an archaeometallurgical sequence which has allowed the study of the characteristics and evolution of metallic production in the Middle Bronze and Late Bronze Ages, as dealt with later.

The period in which the archaeological register has clearly shown the complementary nature between areas with mineral resources and zones which lack them is the Orientalizing period, whose archaeometallurgical aspects have been studied, including earlier investigations (GARRIDO ROIZ, 1968; GARRIDO & ORTA, 1978), fundamentally by the research projects under the auspices of the Archaeology Department of the Diputación de Huelva, directed by Dr. Fernández Jurado, both in the town of Huelva (FERNANDEZ JURADO, 1988-1989) and in other areas in this province (RUIZ MATA & FERNANDEZ JURADO, 1986; FERNANDEZ JURADO, 1987b; FERNANDEZ JURADO et al., 1992).

This line of investigation is complementary to the studies carried out earlier in the mineralized zones, such as Rio Tinto (BLANCO & LUZON, 1969; BLANCO et al., 1970; BLANCO & ROTHENBERG, 1981), Aznalcóllar (HUNT ORTIZ, 1995), Tharsis (DOMERGUE, 1987) and others (PEREZ MACIAS, 1996).

Recently the excavations in the Castillo de Doña Blanca (Puerto de Santa María, Cádiz) have widened the geographical limits of the orientalizing metallurgical activity to the ancient coast of the bay of Cádiz (RUIZ MATA, 1992; HUNT ORTIZ, 1995; ROVIRA, 1995a), of which the study is dealt with later.

Returning to more ancient cultural times, with the exception of Cuchillares mine site, of uncertain date (CASTIÑEIRA et al., 1988), the Chalcolithic mining, and to some extent also metallurgy, is found to be in a state of complete indefiniteness in the mineralized zones: the archaeometallurgical projects have been incapable of defining their characteristics, having only, as a base, vague data from casual finds recorded in the bibliography and some others from field surveys in "marginal zones" with regard to the "nucleus" of the orebodies (DOMERGUE, 1987; MERIDETH, 1996).

This quite obscure mining panorama continues into the Middle Bronze Age, while in the Late Bronze Age the excavated Chinflón mine would be the example of the mining and technological methods of this moment, which, as has already been seen, allow some confusion regarding those -supposedly- existing in the Chalcolithic period (BLANCO & ROTHENBERG, 1981).

However, a preliminary bibliographical revision carried out showed clearly that where the information on Chalcolithic metallurgical activities has been concentrated (not only metallic objects) is within the projects in which that aspect is not fundamental and which operated in zones far away, to a greater or lesser extent, from the known mineralized areas.

This is the case of the Chalcolithic settlements in the southern coastal zone of Portugal (ALARÇAO, 1990; MARTIN DE LA CRUZ, 1994), or the basin of the river Guadiana (GONÇALVES, 1989; MONGE SOARES et al., 1994), some of which such as Sao Bras I, are giving (apart from the proposed copper production in the Southeast Neolithic in Cerro Virtud, province of Almería, see MONTERO RUIZ & RUIZ TABOADA, 1996), the earliest radiocarbon dates for metallurgical activities in the Iberian Peninsula (CASTRO MARTINEZ et al., 1996).

In the same way, similar archaeometallurgical remains appear in the Guadalquivir Valley, in sites such as Valencina (Valencina de la Concepción, Sevilla) (FERNANDEZ GOMEZ & OLIVA ALONSO, 1985; MURILLO DIAZ, 1991; MARTIN ESPINOSA & RUIZ MORENO, 1992; SANTANA FALCON, 1993), Acebuchal (Carmona, Sevilla) (HARRISON, 1977), Amarguillo II (Los Molares, Sevilla) (CABRERO GARCIA, 1987; 1990) and a long list of sites in the agricultural area of the Córdoba province around Castro del Río (CARRILLERO et al., 1982; CARRILLERO MILLAN & MARTINEZ FERNANDEZ, 1985).

This also occurs in the alluvial plains in the Badajoz province, as in the case of the sites of La Pijotilla (Badajoz) (HURTADO PEREZ, 1980; 1984; 1988; 1991a) and Castillo de Alange (Alange) (PAVON SOLDEVILLA, 1994; 1995).

Most of the archaeometallurgical remains, with few exceptions (for example GONÇALVES, 1989; MONGE SOARES et al., 1994), have not been submitted to a specific study, offering on most cases only a more or less short description.

In actual fact, if something was characteristic of the South West, up to very recent times, it has been the lack of analyses, especially of metallic pieces, partly due to the fact that the archaeometallurgical projects, centred on the mineralized zones, did not find them and, on the other hand, the archaeological projects of a non-metallurgical nature, had not programmed the need to do them. So, for example, the idea of an initial metallurgy producing pure copper objects (BLANCO & ROTHENBERG, 1981) was refuted recently by using data from other regions (PEREZ MACIAS, 1996).

This situation, a factor which prevented the global study of archaeometallurgy, is thus consistent with the lack of specialised laboratories in the region and, perhaps, with the impression which can be drawn from the Huelva Archaeo-Metallurgical Project, that it is possible to investigate archaeometallurgy, almost

exclusively, through the by-products of extractive metallurgy.

Of the Chalcolithic and Middle Bronze periods, in the South West, for example, until recently very few elemental analyses were available: from the SAM (JUNGHANS et al., 1960; 1968), the British Museum (HARRISON & CRADDOCK, 1981), most of which came from unclear archaeological contexts, and also from rare analysed objects from specific excavations (for example, FERNADEZ GOMEZ et al., 1976; RIVERO GALAN & VAZQUEZ RUIZ, 1988) or exceptional metallic finds (ALMAGRO, 1962; AUBET et al., 1983).

For other periods, such as the Late Bronze Age, and especially the Orientalizing, a larger number of elemental analyses were available, coming from specific sites, such as the Huelva Hoard (ALMAGRO BASCH, 1975) or La Joya necropolis (ESCALERA UREÑA, 1978).

The analytical panorama has changed in the last few years, although centred fundamentally on the silver production and leaving copper metallurgy research somewhat relegated, despite having been considered, with all its implications, the Huelva Hoard as the production of a local metal industry (ALMAGRO BASCH, 1975) and having been detected a certain lack of connection between the local production from the mining zones and that of the coastal settlements (BLANCO & ROTHENBERG, 1981).

Recent archaeometallurgical research has certainly centred a large part of its interest on silver, having been proposed the existence of a local silver production since the Middle Bronze Age, suggested by the finds in La Parrita site (ANONYMOUS, 1981; 1984; BLANCO & ROTHENBERG, 1981; HUNT ORTIZ, 1986; PEREZ MACIAS & FRIAS, 1990) and other sites, such as Cerro de las Tres Aguilas, San Platón and Pozancón (PEREZ MACIAS, 1996), in a way that it is considered by some authors as a technology with knowledge of cupellation and a direct antecedent of the silver metallurgy technology practised in the Orientalizing period. The foreign influences would only suppose, it has been defended, an increase in production, but no mining technology innovation (BLANCO & ROTHENBERG, 1981) nor either a metallurgical one (PEREZ MACIAS, 1995; 1996). However, other authors consider that the use of that silver production technology in the Middle Bronze Age is not in accordance with the data provided by the silver metallic objects of this period, and consider, rather, that it indicates the use of native silver or silver ores (ROVIRA, 1995a).

The same hypotheses have been suggested for the South East of the Iberian Peninsula for the Argaric silver, although with certain differences since the question arose, due to the presence or absence of lead in the metallic silver, of the simultaneous use of native silver and silver obtained from argentiferous lead ores (HOOK et al., 1987). The latest interpretations have defended the use of native silver or silver ores; the presence of lead would only signify contamination (MONTERO, 1994).

The very complexity of the metallurgical interpretation, especially in the moments when innovations are introduced (FERNANDEZ-MIRANDA et al., 1995) and the lack of global archaeological projects, has been increased by the scarcity of analytical results (in turn, partly due to the lack of specialised laboratories) of objects from the South West.

These circumstances, as mentioned before, have made it very difficult to develop complete evolutionary syntheses which, when completed, covered wide regions such as the South of the Iberian Peninsula (HARRISON & CRADDOCK, 1981) or were based on very limited evidence (MONGE SOARES et al., 1994).

In the first case, there has been proposed for the South West, considered as a part of the Iberian Peninsula, a sequence which starts with the production of pure copper, in the Millarian period, a sign of primitive technology and evidence of an indigenous development independent of the East Mediterranean. Pure copper was followed by the use of arsenical copper, intentional alloying which would be typical of the Beaker period and would have continued into the Argaric period.

In the South West the first bronze is detected in the late Beaker period, a single object that is considered to be an intentional alloy, but the question of its possible origin was not treated. So, although rare, bronze appears in Chalcolithic contexts, as would be the case of some Palmela type arrowheads.

Bronze is also considered to be scarce in the Argaric-Middle Bronze Age, noting a series of characteristics such as maintaining the arsenical copper and the use of the monovalve moulds, when in other regions it was already out of date.

The hypothesis is also suggested of the continuity of the earlier industry because of the lack of means for producing bronze (HARRISON & CRADDOCK, 1981), which implied, in some way, its importation.

The introduction of the first bronze objects in the South East, which occurred during the Argaric period, is an aspect difficult to interpret (MONTERO, 1994).

On the other hand, based on the study of the metallurgical remains of some sites in the Portuguese basin of the Guadiana, a similar sequence was proposed, with native copper as the first production, followed by intentional arsenical copper and, in the Late Bronze Age, the introduction of bronze (MONGE SOARES et al., 1994).

A recent synthesis of archaeometallurgical character in this zone (PEREZ MACIAS, 1996), which can be considered as a general revision of the Huelva Archaeo-Metallurgical Project, showed well the state of research in the province of Huelva. From a wider knowledge of the area from the data supplied by different archaeological projects carried out in the last few years, it establishes a series of possibilities and

conclusions regarding the metallurgical activities from the Chalcolithic to the Late Bronze Age, to many of which alternative interpretations are offered in this research study.

The need of a global archaeometallurgical vision, which starts from the consideration of the mineral resources, revises the transformation and production and recognises the characteristics of the metal objects used, can be confirmed in projects as that recently published on the South East of the Iberian Peninsula (MONTERO, 1994). But this project could not have been carried out without the backing of a permanent analytical programme, which in this case was the "Proyecto Arqueometalúrgico de la Península Ibérica" (PA) which, from an analytical approach similar to that developed by the SAM, but conscious of the deficiencies of this German project, pursues new objectives, which now began with the study of the mineral resources (MONTERO, 1994).

This permanent project, the PA, backed by a competent archaeological team, has concentrated fundamentally on the elemental analysis, using XRF, of metal objects, accompanied by metallographic studies, together with ores and by-products.

As far as South West Spain is concerned, the work of the PA has supposed an important quantitative change regarding the knowledge of the prehistoric metal production, especially concerning the manufactured objects. Recently, a monograph have been published containing all the analytical results (ROVIRA et al., 1997), although some of these from South West Spain were published before by the members of the PA or other investigators, for whom the analyses were carried out, centred in concrete areas or definite cultural periods and specific excavations. Among the published works the most important are, those on the Palmela arrowheads in the Guadalquivir Valley (ROVIRA et al., 1992), the prehistoric metal production in the provinces of Cádiz (ROVIRA & MONTERO, 1994), Córdoba (LOPEZ REY, 1994), Sevilla (MONTERO RUIZ & TENEISHVILI, 1996), Huelva (ROVIRA et al., 1987; ROVIRA, 1995; 1995a; GOMEZ RAMOS et al., 1999) and Badajoz (PAVON SOLDEVILLA, 1995).

Among the not yet completely published works of the PA, of special interest is that containing data from the site Llanete de los Moros (Montoro, Córdoba) with a cultural sequence starting in the Early Chalcolithic and covering the Bronze Age, although it is still not possible to count on a structured archaeometallurgical evolution and it will be necessary to wait for these analytical data to be integrated in the correct archaeological context (ROVIRA, 1995a) by the investigators of the site (MARTIN DE LA CRUZ, 1987).

It is notable that the dynamic of occupation and exploitation (reconstructed through pollen, fauna...analysis) of Llanete de los Moros is found to be more related to the use of the resources of the agricultural land than to those of the mountains (MARTIN DE LA CRUZ, 1993).

This site also has an additional interest, apart from the continuous sequence which it appears to present, namely, the evidence of Mycenaean imports (pottery fragments) from as early as the 14th-13th. century B.C. that appears to be connected with the appearance of bronzes and which would also be present, although they were not identified as such, in other contemporary sites of the region (MARTIN DE LA CRUZ, 1989).

Considered globally, a rather disjointed archaeometallurgical panorama is seen in the South West Iberian Peninsula, with an unknown metallurgy in Chalcolithic Huelva, which area, however, is surrounded by sites in which pertinent metallurgical activities have been described: South Portugal, Guadalquivir valley, the Badajoz plain, but for which, except for a few exceptions, no references are available other than, at most, the composition of the objects.

The proposed evolutionary sequences do not appear to be agreed upon among the different investigators. So, that sequence, as had been traditionally established for a local metallurgy (RENFREW, 1976), would begin according to some, with the use of pure, native copper (MONGE SOARES et al., 1994) or produced from copper carbonates with no impurities (HARRISON & CRADDOCK, 1981; BLANCO & ROTHENBERG, 1981), although other authors consider that the alloys with arsenic are those first used, which, in any case, could be not unintentional (ROVIRA & MONTERO, 1994a), or due to the use of arsenical ores but not intentional (PEREZ MACIAS, 1996) or intentional (HARRISON & CRADDOCK, 1981).

Also, in the Chalcolithic period, according to some authors, the introduction of the first bronze alloys would occur (HARRISON & CRADDOCK, 1981), which for others only appear from the Middle Bronze Age (GOMEZ RAMOS et al, 1999) or even no earlier than the Late Bronze (BLANCO & ROTHENBERG, 1981; MONGE SOARES et al., 1994), with a local production of arsenical copper during the Middle Bronze, which in some cases is just supposition, as in Setefilla (AUBET et al., 1983), or with data which appear to support it, as in El Trastejón (HURTADO PEREZ & GARCIA SANJUAN, 1994) or in the nearby site of Puerto Moral (PEREZ MACIAS, 1996).

Silver, since its appearance in the South West during the Middle Bronze, is considered by some authors as produced locally by cupellation from jarositic type ores (PEREZ MACIAS, 1996) and by others as not cupelled and related, in any case, to other different mineral sources, native silver or silver ores (ROVIRA, 1995a).

The mining technology of the Middle Bronze is, as happens with the Chalcolithic, practically unknown.

The Late Bronze is a period which is archaeologically badly defined, with no precise limits (BELEN DEAMO & ESCACENA CARRASCO, 1995), but with a mining activity characterised through the

Chinflón excavation (ROTHENBERG & BLANCO, 1980; 1981).

Certainly it is known how the mining was but not if it was exclusively representative of that period. It is a mining activity considered as very widespread in pre-Orientalizing moments but which contrasts with a scarce local copper production which, as well, does not seem to agree with the abundance of bronze objects which could be either of local manufacture (ALMAGRO BASCH, 1975; ROVIRA, 1995) or imported (see RUIZ GALVEZ, 1995), at a time when tin is appearing as part of shipwrecks in the Western Mediterranean (PENHALLURICK, 1986) and, perhaps, a little later, in workshops on some points along the Levantine coast (GONZALEZ PRATS, 1992).

In the Orientalizing period, the ceasing of copper mining activity has been defended (PEREZ MACIAS, 1996) although the use of copper as an alloy is widespread, while the interest was concentrated on silver production, about which, as mentioned already, there is no unanimity on its being considered as imported technology or an indigenous technology expanded because of an external demand, centred on coastal points such as Huelva or Castillo de Doña Blanca.

It is in this period, either sooner or later, when it is considered that iron was introduced as a foreign innovation (PELLICER, 1989; ALMAGRO-GORBEA, 1993; ROVIRA, 1995), with no question of its earlier local production, although in some cases the analytical evidence, as in the Trastejón site, according to the published data (PEREZ MACIAS, 1996), was interpreted as evidence of iron local production.

With regard to the use of analytical techniques in the study of the prehistoric archaeometallurgy in the South West, despite the development which these techniques have had in the last few years in their application on the most varied aspects of archaeometallurgy (BACHMANN, 1982; PARKES, 1986; LEUTE, 1987; GALE, 1989), in this zone it has been traditionally restricted to elemental analyses, first by chemical methods and then physical.

Until recently, when the PA has used it frequently, metallography was only used on specific occasions, as with the material from La Joya (ESCALERA UREÑA, 1978) and in some weapons from the Guadalquivir (RUIZ DELGADO & HUNT ORTIZ, 1989).

In this panorama, there are rare exceptions. In this geographical area and with regard to the Protohistoric metal production, the study of the metallurgical materials excavated in Monte Romero has to be noted (KASSIANIDOU, 1992), with the object of not only determining the elemental composition, but also the mineralogical phases and even the lead isotopic characteristics of the finds.

Based on the results of the research projects described, in this study a new diachronic approach to the prehistoric archaeometallurgy of the South West Iberian Peninsula is designed. This approach is basically technological and of a wide geographical area, not reduced to those mineralized zones in which the metallurgical research had concentrated nor to the areas considered today of great mining significance, but rather including other areas with geological and edaphological characteristics, mineralogically sterile, but which on the other hand allow other types of economic activities.

As far as the circumstances have permitted, a whole series of specific analytical techniques have been used in relation with the concrete questions to be answered.

In this way, an effort has been made, after its definition, to articulate and, at the same time, to effect contrasts between mining, the transformation of metal and its production and use in the South West of the Iberian Peninsula, for which samples from archaeological sites belonging to different geographical areas and cultural periods have been made available.

Geographically, the chosen area corresponds -centrally- to a large part of Western Andalusia, which would coincide, according to present-day administrative division, with the provinces of Huelva, Sevilla, Northwest Cádiz and West Córdoba. At the same time, non-Andalusian zones have been studied, either directly, as the South of Badajoz province, or exclusively through the published data, as is the case of the South of Portugal.

The ample size permits a comparative, or rather complementary, study of the different zones (mineralized and non-mineralized) during the whole of the Recent Prehistory. Also, it allows all the types of relations proposed for the different periods to be covered, from a local production to cover a merely local demand, proposed not only for the Chalcolithic period (GARCIA SANJUAN, 1994), to a mining-metallurgical activity of Colonial type organised and directed towards the exportation of metals to extra-Peninsular areas (GALE et al., 1980:49).

Chronologically, this study has been confined, for practical reasons fundamentally, to the division of the large cultural periods in which Prehistory is divided in the area, although in this respect there is no unanimity (MARTIN DE LA CRUZ, 1989): Chalcolithic, Middle Bronze and Late Bronze, with a calibrated chronology extending from the end of the 4th.-beginning 3rd. millennium BC to the first centuries of the 1st. millennium BC (CASTRO MARTINEZ et al, 1996).

In the last period, the Late Bronze, to study with more detail the possible technological innovations that might have taken place, it has been subdivided into two different periods: Pre-Orientalizing Late Bronze and Orientalizing Late Bronze.

The establishing of precise limits between periods, and their chronologies, is always very problematic, especially for periods of transition. For example, for the South West various authors have noted the lengthy

continuity of the Beaker period (MARTIN DE LA CRUZ, 1989), producing a negation of the Middle Bronze or, rather, accepting the contemporaneity of different cultural manifestations, as would be the late Beaker Horizon of Acebuchal (HARRISON, 1977) and the Middle Bronze levels of Setefilla (AUBET et al., 1983), which have been related, in turn, to the cist-burial culture of Huelva and other sites such as El Trastejón (HURTADO, 1989), dated as belonging to the first half of the 2nd. millennium BC (non calibrated).

A particular problem is caused when establishing valid archaeological criteria, apart from wheel-made pottery, to decide whether a site is either Pre- or Orientalizing (BELEN DEAMO & ESCACENA CARRASCO, 1995). On the other hand, new archaeological excavations seem to be supplying evidence of earlier dates for the arrival of the Semitic influences, which would have preceded the permanent settlements (LOPEZ AMADOR et al., 1996).

Generally speaking, the placing of a particular site in a precise period has been established, and even more so if it has been published, according to the criteria of the investigator who studied it, although possible alternative dating is pointed out when it has been suggested by other investigators or when relevant indications exist, also of a metallurgical order.

To develop this investigation it has been considered imperative to know the potential of the mineral resources of the whole of this area. The defining of the characteristics of the mineral resources, their distribution and abundance is fundamental when arriving at an archaeological interpretation with regard to their relation with settlement location, the later metallurgical phases, and their consideration as a critical and controllable resource or as a resource of limited interest (MUHLY, 1989; MONTERO, 1994).

For the explanation of local metallurgy development, first of all the natural resources that could be available must be studied. To suggest an autonomous production in areas without resources can only be done in terms of commerce or exchange, which also has social and economic consequences. On the other hand, in these commercial networks metallurgical sites have been set up which, after a study of the neighbouring areas, have shown that they had mineral resources to hand (CHAPMAN, 1991).

The study of the mineralizations has been carried out by extracting data from bibliographical sources as well as by surveys of certain areas with a specific methodology, with the aim of, on the one hand, the study of mining technology and its development in the different cultural periods and, on the other hand, the selection of samples to be studied using different analytical methods.

The elemental analyses of the ores give fundamental data regarding their relation with later metallurgical phases and the production, intended or not, of metals and metallic alloys. However, the use of these results to establish the original connection between a mineralization and the metal object has been, generally, of little use.

On the contrary, that relation could be established by means of lead isotope analysis , an analytical method of which the use in the field of archaeometallurgy is based on the typical and differentiated lead isotopic composition of each mineralization and the permanent nature of that composition through the whole of the different metallurgical processes. This allows, theoretically, the establishing of the source of specific metallic objects. But, rather than arrive at determining that origin, which is also an aim, the principal objective of the use of the lead isotopes analyses has been to establish its degree of application in this area through, in the first place, the setting up of a data bank, even though limited, of the mineralizations of the different geological domains of the South West in order to, later, be able to compare them with other mineralizations already characterised, and with the metallurgical by-products and the metallic objects.

Thus, the choice of a wide geographical framework was also conditioned by the convenience in regard to the study of lead isotopes to include, to a lesser or greater degree, various geological regions, which have been the Hercynian, subdivided into the Ossa-Morena and South-Portuguese Zones, with their respective domains, the Tertiary Depression of the Guadalquivir, and also, though tangentially, the Subbetic Zone.

Another fundamental field of action is the compiling of the data referring to metallurgical activities, both from bibliography and from direct study, and, when possible, analyses of samples coming from different archaeological surveys and excavations.

As for manufactured objects, all the analytical results from the bibliography have been considered. To them a large number of analyses carried out by the PA, which have been made available for this study before being published, must be added. These, together with the results of the different analytical techniques applied in this project, have allowed a new approach to be made to prehistoric metallurgy in the South West Iberian Peninsula, which is now to be present.