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Environmental Exploitation and Social Structure in Prehistoric Southeast Spain

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Abstract

Our main concern is not only to understand past environments and societies, but also to consider the present dramatic aridification process which threatens large parts of the southeast of the Iberian peninsula and North Africa. The introduction of a more 'technical' archaeology in recent years has produced a growing body of palaeo-environmental data. Its interpretation proceeds in a rather mechanical and isolated way, producing monolithic 'histories' of different aspects of the same reality. Our proposal for an archaeological theory is based upon three factors which interact to form a totality (termed the socioecological system): the socio-economic formation, the social exploitation of natural resources and the natural environment. The dialectical relationship between the socioeconomic formation and the natural environment takes place by means of social exploitation. As the empirical evidence in the archaeological record is the result of the interaction of these three factors, we analyse as a case study the eco-archaeological implications of the material record from Gatas, a Bronze Age settlement in southeast Spain.

Introduction

The southeast of the Iberian peninsula is an arid environment which contains an archaeological record showing the development of complex societies during the period from the Neolithic to the Bronze Age. Debate centres on the causes of this development, and on the meaning which can be given to existing data on change in climate and environment in this area over the last six thousand years (arguments summarized in Chapman 1990: 97-168, 211-19). This debate raises issues which are relevant not only to our study of change in past societies, but also to our historical understanding of the process of desertification in the Mediterranean. In this paper we propose a conceptual framework for the analysis of past cultural and ecological change in the southeast, as developed in the context of two research projects. We begin by summarizing the geo-ecological and archaeological contexts for southeast Spain, and then we discuss some of the empirical evidence for environmental and climatic change in that area since prehistory. After an outline of our conceptual framework for analysis of the archaeological record, we present preliminary results from a multi-phase project centred on the excavation of a Copper and Bronze Age settlement at Gatas (Turre, Almería).

The Geo-ecological Context

The southeast of the Iberian peninsula (Fig. 1) is known as the most arid region in Europe. Walter (1970) has included this region in his ecological system in ecotone-zone III-IV, which lies between the subtropic-desert zone III and the typical Mediterranean zone IV. Climatically, the southeast is defined by high temperatures and little rainfall. Most of the region falls under the 400 mm isohyet. Yet successive mountain chains, which run in a northeast–southwest direction and which are separated by Tertiary valleys, provide a highly irregular topography and climatic-ecological pattern.

The main characteristic of rainfall in southeast Spain is its irregularity, which makes it highly unpredictable. Years of greater rainfall can be followed by extreme aridity (e.g. see the variation in maximum annual rainfall of 117-331 mm for Almería and 50-500 mm for Vera [Freitag 1971: 168-69; Völk 1973: 269]). The irregularity of the rainfall also appears in its intensity: while torrential events are the most discussed, by far the most frequent rains are of very low intensity and have little influence on the soils

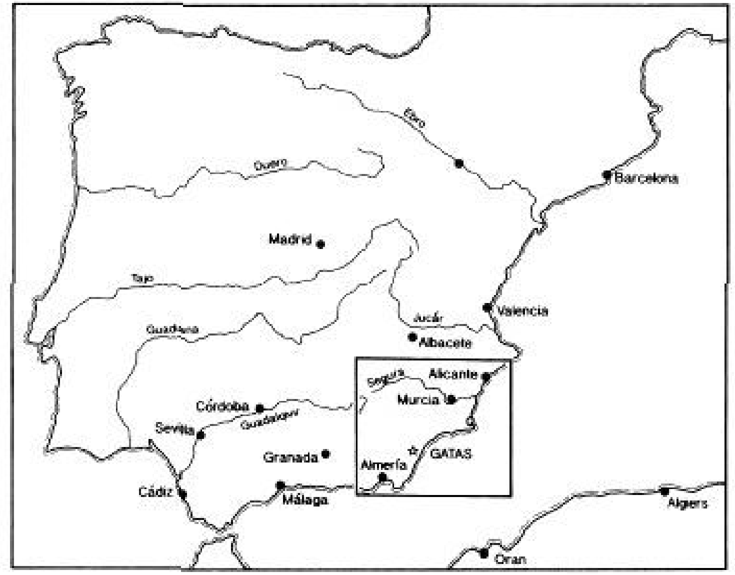

Figure 1. *The Iberian Peninsula, with the location of Gatas in the Vera basin to the northeast of Almería.*

(Geiger 1970: 25). Under present conditions, most riverbeds are dry during a large part of the year, and can be defined best as 'wadis'. The main reasons for the lack of rainfall in southeast Spain are the surrounding mountain chains of the Betic System, and the general atmospheric circulation (Capel 1983). The Sierra Nevada at its western fringe, the Sierra de Cazorla towards the northwest, the mountain region around Alcoy at the northeastern limits, and the Atlas mountains in North Africa isolate this region from the climatic instabilities of the Atlantic and the Mediterranean.

The extreme aridity during the summer coincides with the highest temperatures, reaching up to 50°C. Temperatures in the southeast are extremely regular, presenting annual means between 15°C and 18°C, and there exists no month when 30°C cannot be reached (Geiger 1970: 33). Along the coastal zones, temperatures seldom get below 0°C, while in the interior contrasts between summer and winter temperatures are more extreme.

Today the vegetation is steppe-like or of semi-desert character, with dominant species such as *Artemisia* or *Lygeum spartum*. Nevertheless, the naturalness of this environment has been seriously questioned (Freitag 1971). In areas of more difficult access, which have not been much altered by human society, light forests, consisting basically of a *Pinus halapensis* and *Pistacia* association, can still be detected in nearly all parts of the southeast.

The Archaeological Context

These modern, arid environmental conditions have had a strong influence on archaeologists in their view of the development of the prehistoric societies of southeast Spain. Most interpretative models which have been developed so far see a determining link between the economic and social complexity achieved in this region from the Neolithic to the Bronze Age (Chapman 1978; Chapman 1990: 141-49, 211-19; Gilman 1976; Mathers 1984a; Mathers 1984b).

In contrast to the surrounding areas (Central and Western Andalucía, and the Levantine region), where the Neolithic period is well represented, in the southeast its existence and duration are the subjects of debate. The reasons for this are the scarcity of material evidence from Neolithic occupations, as well as the difficulties posed by their interpretation (old excavations, small samples, reliance upon megalithic tomb typologies and few absolute dates; e.g. Chapman 1990: 59-65). All the known Early Neolithic sites (caves and settlements) are located in the interior regions (Chapman 1990: 65-69), which today have greater humidity, and the fact that the first evidence for the occupation of the arid zone by settled agricultural communities in later prehistory apparently cannot be dated before the later 5th or 4th millennia Cal BC has been used to argue for a late colonization of southeast Spain. The argument is that the arid conditions of the region hinder, and have also hindered in the past, the existence of dry-farming agriculturalists. Thus the first occupation (i.e. the Late Neolithic) must have been associated with, and permitted by, the introduction of irrigation technologies (Gilman 1976: 316). The relation between later occupation and scarcity of water/irrigation is founded on the premise that climate has remained stable during the last six thousand years (Gilman and Thornes 1985: 13). What remains unexplained by this 'irrigation model' is the factor which led to the sudden colonization and exploitation of the arid region in the Later Neolithic. Only Ramos Millán (1981: 250) attempts to explain this process as the consequence of demographic pressure, while Chapman (1990: 221-27) tries to place it within the wider context of the agricultural colonization of the Iberian peninsula.

Nevertheless, authors who have defended the concept of a stable climate (Gilman 1976; Chapman 1982; Mathers 1984a; Mathers 1984b), as well as those who support the idea of more humid conditions (Lull 1980; Lull 1983; Ramos Millán 1981), agree in interpreting the material evidence from the Neolithic to the Bronze Age in terms of increasing social inequalities. During the Copper Age (Chapman 1977; Chapman 1990: 69-83), represented in southeast Spain by the Millaran culture, named after the type-site of Los Millares (about 3000–2400 Cal BC), this complexity has been linked with the significant increase in the density of settlements (generally fortified and situated on plateaux, dominating riverbeds and possible natural routes of communication), the adoption of metallurgy, the construction of collective tombs (megalithic monuments, *tholoi*, artificial and natural caves) and the development of extensive trade networks involving 'exotic' elements (ivory, ostrich-egg shell, etc.).

Chapman (1978: 272; 1982: 48-49) associated the origin of this social complexity in the Copper Age with the restricted access to, and control of, critical resources (principally water). A shift to more arid climatic conditions led to population aggregation in larger, permanent settlements located around reliable water sources, thus ensuring the intensification and stabilization of agricultural yields. This process had two main consequences: (1) the emergence of corporate groups with institutionalized leadership and of new arrangements related to land rights and inheritance (as expressed symbolically through megalithic tombs); (2) the emergence of part-time specialists, including metallurgists, and the development of large trade networks, primarily involved in the exchange of prestige goods. More recently, Chapman (in Chapman *et al.* 1987: 97; Chapman 1990: 125-28) has stressed the small-scale nature of water control facilities in the archaeological record of the southeast, as well as the variability in the form and scale of subsistence intensification (1990: 148-49) and in the archaeological evidence for such intensification.

> Not all sites were centres of water control, or specialised livestock management or metallurgical production, nor can we yet assume that intensification in animal and crop management took place at the same rate at all sites in all areas. Nor can we assume that increased complexity is everywhere the product of agricultural

intensification . . . In some cases it might be argued that intensification was the consequence of increased complexity (Chapman 1990: 214).

Mathers (1984a; 1984b) has explained the changes of the 3rd and 2nd millennia BC by means of the interaction of different factors: strong climatic variability of the local ecosystems, devices to guarantee the stability of food procurement, population density, intensive economic strategies and more centralized political control. The main factor in this model is again the scarcity of water, which limits the amount of arable land and furthers the development of intensive technologies for hydraulic control. So a considerable potential for population growth and settlement expansion is provided. The irregularities of the water supply (annual differences) generated mechanisms of intercommunal exchange of food, which caused greater regional integration. The interaction of all these elements explains the development of sociopolitical control, and the emergence of a prestige-goods economy.

Gilman (1976; Gilman and Thornes 1985) has also considered aridity as the prime mover in local socioeconomic dynamics. These climatic conditions forced a greater labour investment in the land (e.g. irrigation techniques) that needed to be defended by a military elite, which was able to appropriate communal surpluses. On the other hand, Ramos Millán (1981) started from the assumption of a more humid environment during the Copper Age. He argued for the existence of dry agriculture and demographic pressure, which led to a spatial expansion of Copper Age populations and then a change to intensive agriculture through irrigation. He also proposed an egalitarian social context for the Chalcolithic period (a 'Big-Man' system). Finally 'territorial contradictions' between local communities resulted in the emergence of Argaric chiefdoms.

The Bronze Age begins around 2400–2200 Cal BC and is represented in southeast Spain by the Argaric culture, named after the type-site of El Argar (see Fig. 2; Lull 1983; Chapman 1990: 84-92). Most earlier sites were now abandoned in the lowlands, and the new settlement pattern shows a preference for habitation on hillsides in sheltered areas at the foot of higher mountains. This new pattern has been seen as the result of the growing importance of strategic-defensive conditions (Gilman and Thornes 1985: 175-81). Furthermore, in addition to cultural continuity from the Copper Age, important changes in the material culture were taking place. Metallurgy increased in frequency, and silver and gold production was added to that of copper and, occasionally, bronze (Chapman 1990: 160-66).

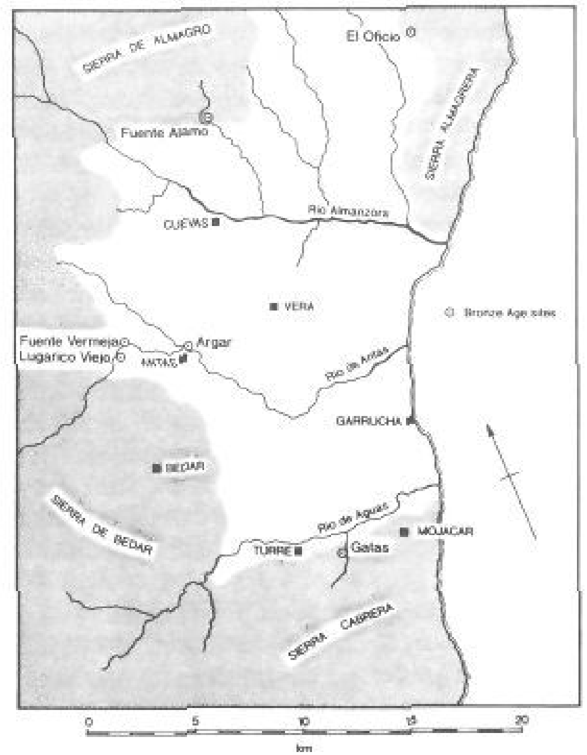

Figure 2. *The Vera basin and it surrounding sierras, showing the main Bronze Age sites discovered by the Siret brothers in the 1880s and mentioned in the text of this paper. Gatas is located in the northern foothills of the Sierra Cabrera to the south of the basin (redrawn from Siret and Siret 1887).*

Metal production, as well as pottery manufacture, show higher degrees of standardization (Lull 1983).

Lull (1980; 1983) was the first to give explicit consideration to the existence of a more humid environment during the 3rd and 2nd millennia BC, through an ecological interpretation of the faunal remains from different sites. This led him to argue that agriculture need not necessarily be linked to the practice of irrigation. The development would be from the self-sufficient communities of the Copper Age to the complementary production of Bronze

Age settlements, with metal and foodstuffs being exchanged, depending on the local availability of these resources. This requires the existence of a dynamic of regularized exchange networks, and leads towards the development of communication and transport, which is controlled by a directing group separated from subsistence production. Lull (1983: 456) especially emphasized the transformation of the role played by metallurgy, which changed from a mainly domestic to a professional sphere, thus involving a larger amount of social labour.

Burial rites also changed with the emergence of the Argaric culture, with mainly individual burials in cists, urns, or artificial caves. These now appear inside the settlement, often under house floors, and the differences between the grave goods from one burial to another are marked. The presence of a powerful group, the association of it with items of power/prestige, and the role of arms in the funeral ritual show the institutionalization of repression at the social level (Lull and Estévez 1986), indicating the existence of a class society, and possibly the development of a state formation. This inference is supported for the Upper Guadalquivir valley in the same period by Nocete (1989), while Chapman (1990: 206) infers the existence of political centralization and social stratification for the southeast from settlement and burial data.

A new cultural change occurred around 1600 Cal BC, with the beginning of the so-called Later Bronze Age (Chapman 1990: 92-94). Many settlements were abandoned, but at present no newly occupied sites have been found. The architectural structures of this period are practically unknown. Evidence of mortuary practices is largely absent from the archaeological record (Chapman 1990: 206-207), and no explanatory model has yet been developed for the social organization of the next 600 years. Possibly, the Argaric class structure collapsed as a consequence of a crisis in this socio-economic formation (Lull 1983: 457). Was this crisis itself perhaps created by problems experienced in maintaining regional political and economic integration throughout the southeast (Chapman 1990: 217)? Around 1100–900 Cal BC, the so-called Final Bronze Age started and saw the beginning of a development towards a new urban society, in connection with developments in the central and eastern Mediterranean, and in particular with the Phoenician expansion (Aubet 1987; Harrison 1988).

Ecological Discussion

Through this outline of current debates, we can see that the problem of aridity stands at the centre of most archaeological models: all of them maximize environmental aspects and minimize social factors. The question which arises on an empirical level is whether the premise is correct that the southeast was as arid in prehistory as it is today.

There is still little information about past environmental conditions in the southeast compared to other regions of Europe, and what is available is often contradictory (Risch and Ferrés 1987). Nevertheless geobotanical studies (Freitag 1971; Völk 1973; Ferrés and Risch 1987) have shown how much the vegetation has changed from its original 'climax' conditions, although the existing endemisms seem to show similar conditions for prehistoric times as for today. The few palaeobotanical studies undertaken so far (Schoch and Schweingruber 1982; Stika 1988; Rodríguez Ariza and Vernet 1988), all based on charcoal identifications, confirm the presence of these endemisms during the Copper and Bronze Ages. Moreover, the ecological evaluation of the wild fauna from different Copper and Bronze Age sites shows, through the presence of species such as *Cervus elaphus*, *Capreolus capreolus*, *Lynx pardina* or *Meles meles*, that woodland biotopes were part of the ecosystem of this region (Lull 1983: 23-49; Risch and Ferrés 1987: 68-75; Chapman 1990: 107). Yet their extent remains unclear, partly also due to the paucity of pollen analysis in the region—the only published data in the coastal lowlands coming from the Copper Age site of Almizaraque (López 1988: 340-41).

If the reconstruction of the natural vegetation has proved to be a difficult task, to do the same with the original soils seems even harder (Freitag 1971: 165). Although the geomorphological analyses of Thornes and Gilman (1983) have shown that in general erosion rates are low today, especially when surfaces are covered by vegetation, an extensive sedimentological study undertaken by Hoffman (1988) in order to reconstruct the evolution of the Holocene coastline along the Mediterranean coast of southern Spain has shown the dramatic soil movements taking place. All river mouths show considerable changes, resulting largely from sedimentation, so that the present coastline is several kilometres more advanced than 6000 years ago. The terrestrial sediments accumulated during the Holocene have a maximum depth of 20 m, the marine sediments reach up to 60 m, and large alluvial fans at the mouths of the rivers reach into the sea (Hoffman 1988: 119-20).

Accumulation rates of 80 m per thousand years could be calculated for some rivers (Hoffman 1988: 122). A recent study shows that today there exist erosion rates of over 50 tonnes per hectare per year on 26 per cent of the surface of southeast Spain, and that 76 per cent of the surface presents rates which are higher than the tolerable limit for natural vegetational development, i.e. between 3 and 15 tonnes per hectare a year (García Camarero 1989: 8). This does not mean that the general surface forms have changed in the southeast, but it implies that there have been massive alterations of the original soil on these surfaces, which has had consequences for the vegetation, as well as for the potential of agriculture.

In addition, Rohdenburg and Sabelberg's studies (1973: 132-33) have shown the general loss of Holocene soils due to erosive processes; in large areas, the column of the Holocene soils is missing, so that either the bedrock or the calcium carbonate horizon forms the surface. The main cause of the present situation is human activity, as in general the Holocene is defined as a period of 'morphodynamic stability' of intensive soil formation (Rohdenburg and Sabelberg 1973: 75). Hoffman (1988: 121-22), furthermore, states that the process of soil accumulation in the river estuaries is principally the consequence of deforestation in the past: yet the accumulation rates seem to have decreased recently. The explanation for this is that the more easily erodible soil has already been transported, and historical evidence of the development of these processes exists (Houston 1964; Hoffman 1988: 51). This decline of easily erodible material could be a reason for the relatively low erosion values provided by the hydrological models used by Thornes and Gilman (1983) around archaeological sites, areas of long environmental exploitation, and it shows the weakness of this type of approach towards an assessment of past ecological conditions.

Certain sedimentary cores obtained by Hoffman (1988) in the river mouths contained fresh and brackish water molluscs which, together with the regularity of deposition of the sediments, indicates a regular water flow in the rivers during prehistoric times. Evidence for the marked fall in the modern level of the water table in the southeast can also be cited: the annual fall of 70 cm in the Campo de Níjar, for example (Ochoa *et al.* 1973).

So far, the evidence provided by these few palaeoecological studies shows that important environmental changes have taken place during the last eight thousand years, and that the ecological conditions during later prehistory were rather different from the present ones, especially with respect to the accessibility of resources such as water, better quality soils, wood and wild

fauna. Yet many questions remain open, especially those concerning the qualitative and quantitative evaluation of these changes. One of the most important questions for the verification of the ecological assumptions of archaeologists is the cause of environmental change. While most scholars agree that human alteration of the vegetation is fundamental, and that no large-scale climatic changes have taken place, the influence of smaller climatic fluctuations on environment and society has generally been underestimated (e.g. Chapman 1978: 265-66; Chapman 1990: 108-10). So a slight increase in the rainfall (e.g. from 250 mm to 350 mm *per annum*), or merely a more stable and predictable rainfall pattern than the present one, would have considerable implications for dry-farming in southeast Spain. Nevertheless, the methods used to support or reject the hypothesis of climatic change (e.g. faunal and botanical remains, or sedimentological profiles) are ambivalent in this respect. They can be understood as indicators of human action as well as climatic fluctuations; information of a different order which depends only on climatic conditions is not available. But even if we accept the existence of *maquia* woodland in large parts of the southeast, as most studies are indicating, little is known about how climatic conditions would be affected by it on a regional scale. Because of the relevance that these types of questions and studies have for the present process of desertification, they should be central issues of palaeoecological research.

While in central and northern Europe climatic fluctuations during the Holocene are better known (Schönwiese 1979), and specific international projects exist, little has been done so far in the Iberian Peninsula (López-Vera 1986). That climatic fluctuations existed also in the western Mediterranean has already been suggested by Rohdenburg and Sabelberg (1973). Surface relief and soil profiles in southern Spain and Portugal indicate that the general conditions of stability were interrupted by short phases of 'morphodynamic activity', but the dating and duration of these events remains to be established. It also seems to be difficult simply to apply to southeast Spain the climatic fluctuations detected in northern and central Europe, and concepts like 'pluvial' or 'inter-pluvial' are misleading in the Mediterranean (Butzer 1961; Völk 1979). In the same way, it remains unknown whether the climatic fluctuations of the Sahara and West Africa (Muzzolini 1985) ran parallel or opposed to those taking place in the western Mediterranean. But even with more empirical evidence, a correlation of cultural processes with changes in the rainfall values is practically impossible. While most of the present methods involve an uncertainty factor of around ± 500 years when applied in arid environments (Muzzolini 1985), the delay between a climatic change and the reaction of organic and inorganic nature to it generally tends to be around 250 years (Frenzel 1977: 300). This means that the dating of climatic change is normally too imprecise to be linked to changes from one socioeconomic formation to another.

Towards a Socioecological Proposal

Our own research has developed from these ecological and archaeological questions and perspectives, as a part of the 'Gatas Project: Society and Economy in Southeast Spain during the 3rd and 2nd Millennia BC' (Chapman *et al.* 1987), and as part of the project of the Spanish research council (Dirección General de Investigación Científica y Tecnológica del Ministerio de Educación y Ciencia) entitled 'The Origins of the Desertification Process in the Southeast of the Iberian Peninsula: Palaeoclimatology of the III-I Millennia BC'. Our main concern is not only the reconstruction of past environments, but also the consideration of the present dramatic aridification process which threatens large parts of southern Europe and north Africa. The aim is to look for a historical dimension for the ecological projects promoted by UNESCO, especially the LUCDEME project ('The Struggle against Desertification of the Mediterranean') in southern Spain (Carrera 1989).

On the other hand, a major problem of many palaeoecological analyses, especially in the Iberian peninsula, is their isolation from a more general historical-ecological approach. The introduction of a more technical and scientific kind of archaeology in recent years has resulted in a tendency to collect palaeo-environmental data, which is presented as a kind of appendix to traditional stratigraphic-typological archaeology. The interpretation of the data proceeds in a rather mechanical and one-directional way: thus the seeds are related to cultivation, charcoal represents the woodland around the settlement, faunal remains are equated with the economy, and so on. The results are the usual monolithic 'histories' of different aspects of the same reality, and the consequence is the present compartmentalization of knowledge, and a static archaeology. What is still missing is a conceptual framework which considers the relationships between ecology and society, but which does not reduce history to the assumption that a maximizing tendency exists in all cultures with respect to their use of resources and energy (as was the case, for example, in much work of the Cambridge 'palaeoeconomy school'). Rather, we want to understand the ways in which social and political systems interact with natural environments. In this way, society becomes part of the ecosystem, and environment is no more just a natural formation, but becomes social as well, while history is forced to consider both aspects. Such attempts towards an 'ecological history' (in which, for example, social power relations cannot be seen independently from the environmental conditions) have been proposed by critical economists (e.g. Martínez Alier 1984), conscious of the inadequacy of liberal economic theory in explaining past and present social and environmental transformations.

The conceptual framework we propose for an archaeological theory is based on three factors, interacting with each other in a totality, termed *the socioecological system*: the socioeconomic formation, the social exploitation of natural resources, and the natural environment. The dialectical relationship between the socioeconomic formation and the natural environment takes place by means of social exploitation. This means that nature is not only to be understood in a purely material sense, but also socially (for example, through the decisions, strategies and rights of use any society imposes on 'natural' space). Thus the view of natural environment as the mere 'supermarket' of society is avoided, in the same way as is ecological determinism. Rather, the aim is to understand the consequences that different political, juridical, social or economic events have had through time on environmental conditions, and which strategies of exploitation were chosen by human communities under certain natural and socioeconomic conditions. The essential idea is that natural conditions are implicit in the existence of any social organization, but that it is society which ultimately decides the forms of exploitation it is to use, and that these decisions depend on political relations in the same way as on the technical means of exploitation. This means that an 'ecological history/prehistory' is not the account of the evolution of environment during thousands of years (i.e. another 'history'), but that it attempts to construct a totality from the differences in the archaeological record and to understand the relationship between environmental transformation and socioeconomic formation.

The proposed conceptual framework implies a specific view of the archaeo-ecological record. Only an integrated archaeological perspective, along the lines of the conceptual framework outlined above, can avoid circularity and partiality in our understanding of history. As a consequence, we propose that the questions to be asked must refer to the socioeconomic formation, as well as to the social exploitation of the resources and to the natural environment, because all empirical evidence is the result of the interaction of these three factors. This raises the question as to how the different types of information in which we are interested can be isolated for analysis.

Lull (1988) proposed a framework for a different conceptualization of the archaeological record with this aim in mind. It consists of three concepts:

1. *Artefacts*, defined as artificial products which constitute the physical means of societies.
2. *Arteusos*, literally 'used by art or skill' as opposed to artefacts which are 'made by art or skill', and defined as natural products whose presence in an archaeological site is the result of human action and which have a social benefit.
3. *Circundata*, defined as those parts of nature which interact with the social context.

From the proposed socioecological perspective, all *circundata* are considered as potentially socially conditioned, while all archaeological data—*arteusos* as well as *artefacts*—contain information in the form of *circundata*. For example, charcoal from an archaeological layer is not just the reflection of the existing woodland (i.e. *circundata*), but also the evidence of a certain labour and transport energy used during the process of appropriation, which reflects social organization or differential access to resources. Thus one could state that the control of organic energy can produce just the same social inequalities as metalwork or irrigation, and yet none of the models proposed for the southeast considers it.

In this proposed conceptual framework, the *circundata* represent the natural environment, while *artefacts* inform us about the socioeconomic structures and the *arteusos* refer to the social exploitation of resources. Yet the actual archaeological material makes reference to all three categories, the result of the analysis depending on the biases in our research and our interest in the past in relation to the present. The advantage of a 'socioecological' archaeology is that it forces the scientist to question her/his forms of producing knowledge. In practice, such an approach compels the existence of interdisciplinary discussion, rather than mere collaboration.

A Case Study in Southeast Spain

An attempt to develop such a programme has been made through the excavation of the Copper and Bronze Age site of *Gatas*, in the most arid part of southeast Spain. It is located in Almería province at the southern limits of the Vera basin (Fig. 2), a flat Tertiary basin of marls extending 15-20 km in an east–west direction, and surrounded on nearly all sides by mountain chains between 500 and 1000 m high. On its eastern side, the valley opens towards the Mediterranean sea over a distance of 26 km in a north–south direction. The Vera basin is also defined by two rivers, the Almanzora in the north and the Aguas in the south, while a third river, the Antas, crosses through the centre of the valley. The Gatas settlement lies on a limestone hill (alt. 253 m) two kilometres south of the river Aguas, at the foot of the Sierra Cabrera, the mountain chain which delimits the Vera basin on its southern side. The only access to Gatas is from the Aguas. From the settlement, large parts of the Vera basin can be seen, but from the nearest part of the basin it is difficult to see Gatas, which is protected to the south by a series of Tertiary sandstone hills, running parallel to the Sierra Cabrera (Fig. 3). Figures from the nearest meteorological station (c. 10 km to the north at Vera) indicate that rainfall at Gatas lies below the 300 mm isohyet (Völk 1973). Vegetation around the settlement (Ferrés and Risch 1987: fig. 9.1) consists of the usual southeast species, although in a closer formation than in most parts of the Vera basin, indicating the more humid conditions of the northern slopes of the Sierra Cabrera. Today most slopes contain abandoned agricultural terraces, which date back to the Islamic settlement of this region; no older terraced systems have been detected through intensive survey. To the north of Gatas, between the limestone hills and the crystalline slopes of Cabrera, there is a stretch of shallow and fertile land. This is known today as the most productive land in the whole basin, and citrus trees are the main crop grown here (Fig. 3). Traditionally, many families lived from the agriculture of this area, as historical documents and the number of abandoned farmhouses show.

Gatas is a settlement of about 10,000 sq m (Fig. 4) and is considered as a classic Argaric site. It was first excavated at the end of the last century by the Siret brothers (1887) and is only 13 km away from El Argar itself, a larger settlement which lies approximately in the middle of the basin. The cultural sequence defined by the recent work at Gatas (Chapman *et al.* 1986; Chapman *et al.* 1987; Castro *et al.* 1987; Buikstra *et al.* 1988; Castro *et al.*

Figure 3. *View of Gatas (centre) and its territory looking north from the sierra Cabrera. Immediately beyond Gatas is the cultivated land of the* cortijo *of Gatas, separated by limestone outcrops from the Vera basin to the north.*

1989) reaches from Chalcolithic levels to the end of the Bronze Age. Afterwards the settlement was abandoned, but new occupation took place during the intensive settlement of the Sierra Cabrera in the Islamic period, around the 10th to 11th centuries AD. After a first phase of fieldwork consisting of surveying in 1985, a second phase of sondage excavation took place in 1986–87. The third and final phase consists of extensive excavation of certain parts of the settlement. The present results come mainly from the four trenches (*S1–S4*), each measuring 4 × 4 m. *S1* was placed on the upper part of the hill, and provided a stratigraphic sequence from the Copper Age to the end of the Bronze Age; no architectural structures were recovered, as the surfaces probably represent open spaces between adjacent houses. *S3* was located on one of the lower terraces of the hill, to the north of *S1*, and here architectural remains with well-preserved floors were recovered; chronologically they range from the Argaric period to the Later Bronze Age, while on top an Islamic farmhouse was found. *S2* lies at the southeastern foot of the hill, where a sequence from the Argaric period to the end of the Bronze Age

was recovered. *S4* was also located at the foot of the hill, some metres further to the southwest of *S2*, close to the dry river bed.

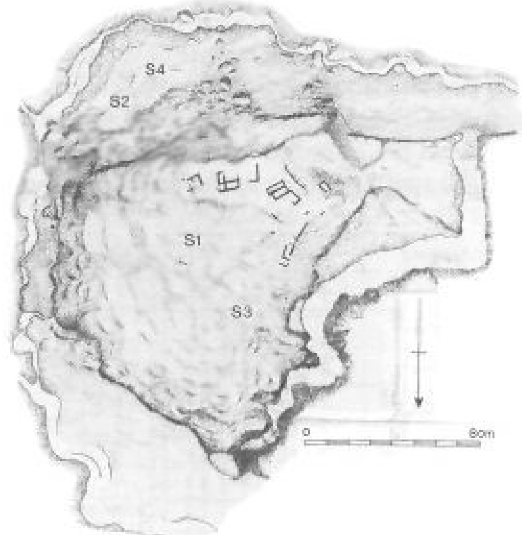

Figure 4. *The Gatas settlement, as published by Siret and Siret 1887, with the addition of the approximate location of the four trenches excavated in 1986–87.*

The discussion which follows makes use mainly of the preliminary results of analyses of the botanical, faunal and lithic remains from the stratigraphic excavations of these four trenches at Gatas: the full results and analyses will be published in the project's second monograph. While it may be objected that the overall sample size of the materials recovered from these excavations is still small (e.g. the trenches themselves have covered less than one per cent of the entire settlement), we believe that they have interesting implications and show how the conceptual framework employed in the project can provide an alternative to previous fieldwork projects undertaken in the southeast. As preliminary results, they are available to be evaluated against the larger samples of materials which are being recovered in the project's third phase.

The Botanical Remains

The charcoal remains of *S2* and *S3* have been identified by Rowena Gale (see Figs. 5-6). Seven pollen samples from *S1*, *S2* and *S3* were analysed by Michael Keith-Lucas (University of Reading), but the preservation of pollen at Gatas was very poor, each sample yielding only a few pollen grains and thus making the results merely indicative rather than definitive. In their interpretation as *circundata* the species identified at Gatas represent the typical southwestern Mediterranean vegetation. All of them exist today in southeast Spain, and all but *Phillyrea* sp., *Spartium junceum*, *Tamarix* sp., *Erica* sp. and *Salix* sp. still appear today in the immediate surroundings of the site.

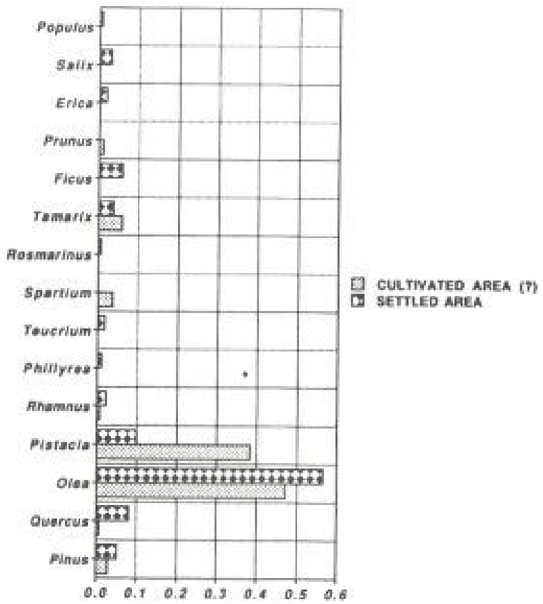

Figure 5. *Percentage frequency of species identified from charcoal remains in cultivated and domestic contexts at Gatas.*

The identifications, limited as they are to genus type, cannot be used to identify the smaller climatic fluctuations which may have occurred during the Holocene in this region. While species such as *Pistacia lentiscus* or *Tamarix africana* appear in the southeast and in North Africa with even less than 200 mm rainfall, all of them can also tolerate higher rainfall. Rather

than being a matter of presence and absence, it would be necessary to know the importance these species had in the natural vegetation, and the vegetational associations which existed. Nevertheless, a mild temperature regime, similar to the present, is indicated by plants which today do not appear in the interior of the southeast where winter temperatures fall below 0°C; such plants include *Myrtus* sp. at Gatas, and *Lavandula dentata* (Stika 1988) and *Tetraclinis articulata* (Schoch and Schweingruber 1982) at Fuente Alamo, a Bronze Age settlement on the northern edge of the Vera basin (Fig. 2).

Most of the flora present at Gatas coincides very well with one of the climax associations defined in Freitag's geobotanical study (1971). *Quercus*

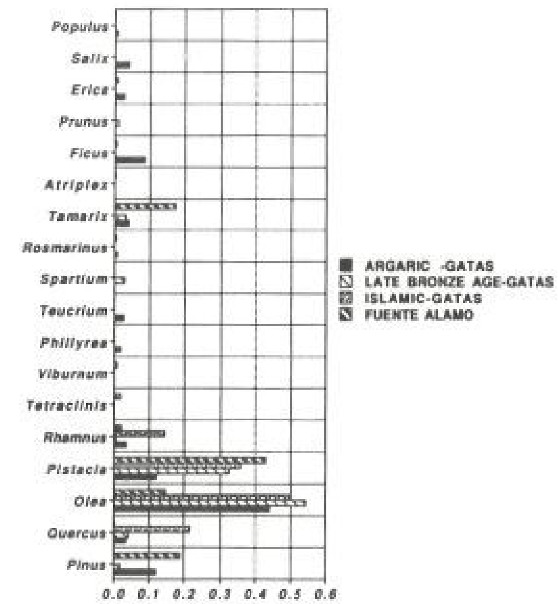

Figure 6. *Percentage frequency of species identified from charcoal remains from successive occupation periods at Gatas and from Fuente Alamo (data for the latter from Schoch and Schweingruber 1982).*

coccifera, Olea europea, Pistacia lentiscus, Rhamnus alaternus or *Rhamnus lycioides, Rosmarinus officinalis, Teucrium* sp. and *Phillyrea angustifolia* are part of a shrub woodland 1.5–2.5 m in height, which is loosely covered by *Pinus halapensis* 6–12 m in height. The only important element of this association missing so far in the Gatas and Fuente Alamo samples is *Juniperus* sp., one of the best adapted plants in southeast Spain. Today, the drier the climatic conditions are, the more important *Pinus* and *Juniperus* become, while shrubs appear less in more open formations (Freitag 1971: 245-46). *Tamarix africana* also appears next to this association, but mainly in the valley bottoms, where salt accumulates at the surface by capillary movement during the dry summer period (Freitag 1971: 247). In summary, it can be stated that this association of plants would exist today in the southeast under undisturbed conditions in coastal areas with mild winters, high insolation values, and a yearly rainfall between 250 mm and 450 mm.

A different vegetational association is represented by *Populus* sp., and *Salix* sp. In addition, the evidence of *Ulmus* sp. and *Alnus* sp. pollen grains supports the inference of a tree vegetation along riversides with flowing water in the vicinity of Gatas. It is interesting that even today some *Populus* grows next to a spring above Gatas, thus showing the potential of the present-day area under undisturbed conditions (Ferrés and Risch 1987: 128).

If we understand the same material as *arteusos*, our questions refer to the exploitation of woodland in the different periods and areas of the occupation of Gatas. From a diachronic perspective, it is interesting to note that while the main species remain unaltered over time, the more humid riverside association seems to have disappeared or been cleared by the Later Bronze Age. Although the charcoal sample from Islamic contexts is small, the same *Quercus coccifera–Pistacia lentiscus* shrub woodland seems to have existed. Thus it can be suggested that the social exploitation of the environment does not appear to have changed its overall balance even by Islamic times (Fig. 6).

Some of the plants could be cultivated. At the Bronze Age site of Fuente Alamo, over a thousand fig seeds were identified, and the cultivation of *Ficus carica* was suggested (Stika 1988: 33). The cultivation of *Olea* has been proposed for a long time in the southeast (most recently by Rodríguez Ariza and Vernet [1988] on the basis of the frequency and dimensions of olive charcoal from Los Millares), but cannot be verified botanically (cf. Runnels and Hansen 1986). If the over-representation of *Olea* at Gatas reflects the extension of this species among the vegetation, it cannot be part of a natural association. Its dominating position could well be caused by the cultivation of olive trees, especially in the Later Bronze Age, and in mediaeval times it is verified through historical documents. It is also the first time that *Prunus* sp. has been identified in a prehistoric context in southeast Spain, but its cultivation remains open to question, given the large variety this genus presents.

S3 includes an area of dwellings belonging to all periods, where different domestic units could be identified. The charcoal remains found here represent the exploitation of the environment by its inhabitants. The anthropogenic character of the sample can be seen in the different biotopes from which species were selected and the identified species show a whole range of possible uses, as organic energy, raw material, medicines, etc. For example, the resin of *Pistacia lentiscus* wood has antiseptic properties; the tannin contained in the bark of *Quercus robur* (of which one sample has been found in *S3*) is used to tan hides, as dye, and for medicinal purposes; the bark of *Rhamnus* sp. is also used as a dye and to tan hides.

Through the study of the seed remains from Gatas, and the morphology of the soils, Martin Jones (in Buikstra *et al.* 1988) suggested that *S2* was an area of cultivation at the southern foot of the hill of Gatas, next to the modern *barranco*. The species identified from *S2* all belong to the same vegetational association, and the samples taken show less variety than in *S3*. The charcoal remains from *S2* (included under 'cultivated area' in Fig. 5) show the evolution from the natural vegetation consisting of *Tamarix* and *Pistacia* under the more humid conditions of the proximity of the riversides, through the introduction of *Olea* in the later Argaric period and the domination of *Olea* in the Later Bronze Age, to an open landscape in the latest levels, represented by *Spartium junceum* and again *Tamarix* and *Pistacia*. *Spartium junceum* especially appears only in landscapes with no tree cover, mostly on abandoned fields and deforested surfaces. Its wood content is limited and it is not used by humans. All these factors suggest that the charcoal remains of *S2* are mainly the consequences of burning down the vegetation at the southern foot of the hill, rather than of selecting wood as an *arteuso* or as an *artefact*. The presence of *Olea* supports the idea of a cultivated area; the charcoals could be the remains of the trimming of the trees under cultivation. Jones's study (Buikstra *et al.* 1988) also produced olive seeds from *S2*, together with barley and possibly grape pips. While all the seeds found in the settled area of *S1* and *S3* were in a fully processed state, the deposits on the southern slope produced a large variety of assemblages and mineralized seeds, indicating that cultivation was possibly taking place here, particularly during the Later Bronze Age. The dominant species recovered by Jones from the Copper Age to the end of the Bronze Age is *Hordeum vulgare*, which occurs almost to the exclusion of other cultivated species during the main Argaric period. Legumes, represented by *Vicia faba* and *Vicia sativa*, mostly appear during the earlier Argaric period.

As *circundata*, all crops and weeds indicate that irrigation systems were not essential for agriculture. Recently, even on the gypsum and marl surfaces of the area of the Aguas valley closest to Gatas, with 275 mm annual rainfall, dry agriculture has been dominant (Capel and Pascual 1984). Only 1.7 per cent of the cultivated area is irrigated, while 91 per cent is used for growing cereals, mainly barley. *Olea*, *Vitis* and *Prunus amygdalus* are cultivated without irrigation too, and show the general adaptation of these species to the arid environment, even under the present market conditions.

As *arteusos*, the principal question concerns the social implications of the possible transformation of a more varied agricultural production during the earlier Argaric into an extensive dry monoculture based on barley during the full Argaric period. At least it is clear in the case of Gatas, as well as that of Fuente Alamo (Stika 1988), that Mediterranean polyculture was not a prime mover of social differentiation during the Argaric, since *Olea* and *Vitis*, and possibly irrigation, were introduced in a period of supposed socioeconomic 'decline', in the Later Bronze Age. Two points are of interest in relation to this observation. Firstly, the data from Gatas and Fuente Alamo contrast with claims for Copper Age cultivation of *Vitis* based on pollen cores near Huelva in the Guadalquivir valley (e.g. Stevenson 1985) and on botanical remains from El Prado in Murcia (Rivera Núñez and Walker 1989), although the contemporaneity of grape pips with the archaeological deposits of this latter site needs to be demonstrated. Secondly, the Later Bronze Age data from Gatas and Fuente Alamo suggests again the restoration of a more diversified agriculture, which probably provided more security for local communities. Such diversity is unexpected in a period which has traditionally been considered one of 'decline', and highlights our present uncertainty over the nature of social and economic change within the Southeast during the long time span of the Later Bronze Age.

The Faunal Remains

The macrofaunal remains from Gatas were studied by Annie Grant (then at the University of Reading) and, although the number of identified bones is relatively small, some interesting observations can be made (Figs. 7-8).

The most characteristic feature of the faunal assemblages is that the relative importance of domestic species exploited seems to have remained virtually unchanged from the Bronze Age to Islamic times. The very slight

increase in the wild fauna in the Later Bronze Age reflects a wider trend in settlements of this period in the southeast. If we consider these remains as

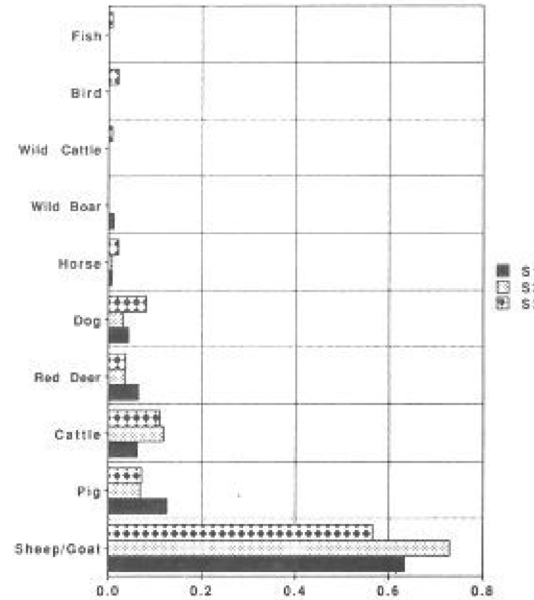

Figure 7. *Percentage frequency of faunal remains by species from trenches 1, 2 and 3 at Gatas.*

arteusos, they could be interpreted in terms of changes in the rights of use of natural resources; something which was previously socially restricted was now accessible to everyone. This idea finds support in the fact that the few wild fauna of the Argaric period appear unequally distributed within the settlement, and are located predominantly in the higher part (*S1*). A larger sample would be necessary to evaluate this proposition.

The information derived from the faunal remains as *circundata* supports the idea of the existence of a Mediterranean woodland (whatever its extent) in the proximity of Gatas, and of better hydrological conditions than at present. The existence (albeit in low frequencies) of red deer, which today are absent from the Sierra Cabrera, confirms historical data and indicates

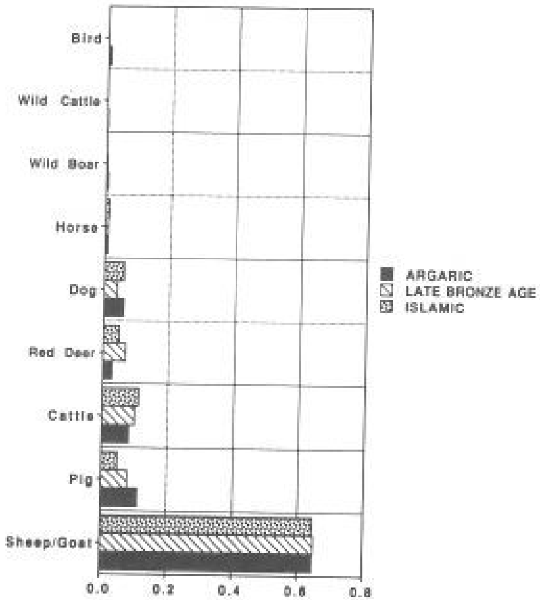

Figure 8. *Percentage frequency of faunal remains by species in successive occupation periods at Gatas.*

that the ecological equilibrium of the southeast was lost more recently than the Later Bronze Age. The larger numbers of red deer bones found at Fuente Alamo, 20 km to the north of Gatas, in both the Argaric and the Later Bronze Age occupation levels (von den Driesch *et al.* 1985) adds support to this inference for the Vera basin as a whole.

The malacological remains were studied by Matilde Ruíz and Viçent Marí (Universitat Autònoma de Barcelona) and Joseba Imanol (Zoological Museum of Barcelona). Molluscan remains were important mainly during the Argaric occupation, both as part of the diet and as ornaments. With respect to the use of space, it is interesting to note that on the lower terraces of the settlement in *S3*, the high frequency of ornamental shells is contrasted with the presence of few edible molluscs, whereas higher up the hill in *S3* the opposite is the case. This supports the idea of differentiated access to certain resources or differentiated activities, as was also indicated by the macro-faunal remains.

The Stone Resources

Quantitatively, the most important raw materials recovered from Gatas were the stone resources, used mainly as construction materials. All the stone remains have been studied by Roberto Risch. The main characteristic in the selection of construction materials, seen as *circundata*, is the dominant use of limestone (Fig. 9), which is part of the bedrock of Gatas itself. Travertine and schist are available below the settlement. Only sandstone and conglomerate come from one kilometre to the north (Carulla 1987: fig. 10.5). In the form of *arteusos*, the construction materials show the same exploitation strategies in all periods, and the exclusive use of local material.

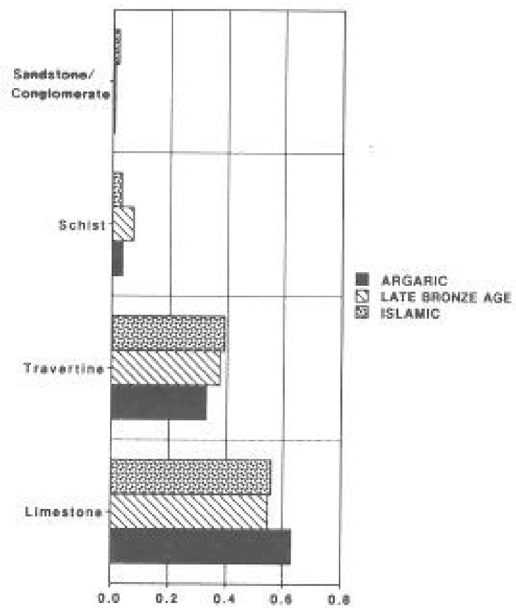

Figure 9. *Percentage frequency of different building materials used in successive occupation periods at Gatas.*

The raw materials used for stone tool production confirm as *circundata* the tendency to employ mainly local resources. Apart from the rock types already mentioned, quartzite and marble are also available on the southern side of Gatas. Greenstones are not found in the surrounding area, and the nearest primary source lies some 10 km away to the west-northwest in the Sierra de Bédar (see Fig. 2), but it can also be found in the Pleistocene rubble layers which cover parts of the Tertiary sediments of the Aguas valley, 2-3 km to the north of Gatas (Kölling 1985: 34). The frequent use of

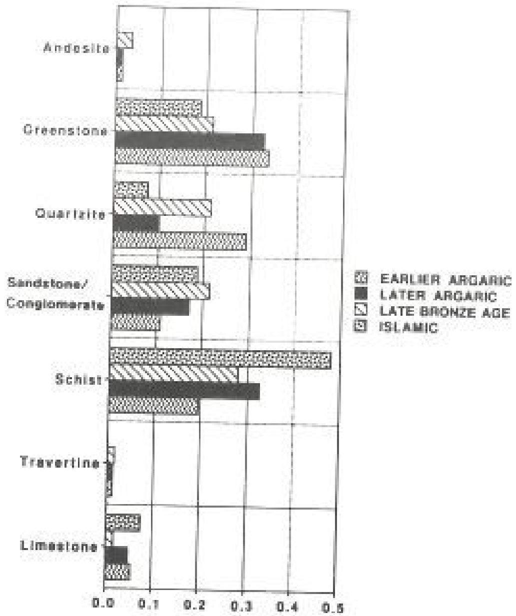

Figure 10. *Percentage frequency of different stones used for tools in successive occupation periods at Gatas.*

cobblestones confirms that these formations were exploited. The only material which seems to come from outside of the Vera basin is andesite, possibly introduced from the area around Mazarrón, some 60 km to the north. The distribution in time and space of geological materials used for the production of tools shows no significant differences (Risch 1989) (Figs. 10-11). The minor differences seem to be due more to different uses of stone in time and space than to the socially restricted access to raw material. It is interesting to note that copper ores are also available as surface debris immediately to the south of Gatas (Carulla 1987), but the results of lead-isotope analyses on ore deposits in the Vera basin and beyond (currently being undertaken by N.

Gale and S. Stos-Gale, University of Oxford) are required before the use of this raw material can be discussed further. The local availability of the stone

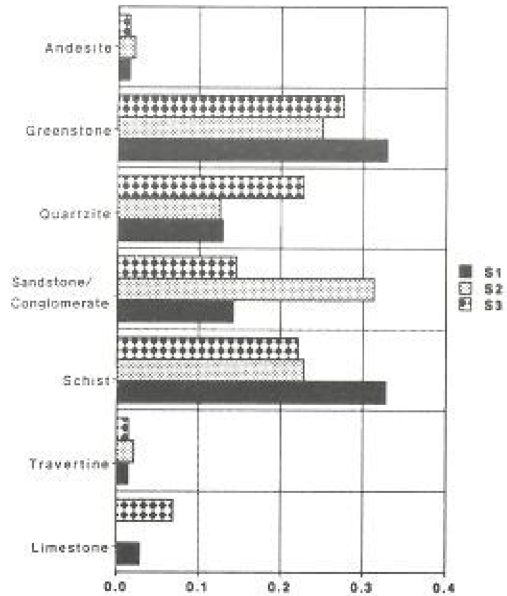

Figure 11. *Percentage frequency of different stones used for tools in trenches 1, 2 and 3 at Gatas.*

material, and the low degree of standardization shown by the artefacts, suggest that these were possibly produced by each domestic unit through direct access to the sources (Risch 1989).

Looking at the stone materials in the form of *artefacts*, significant changes appear in time and space (Figs. 12-13). While in the earlier Argaric period percussive and abrasive instruments were dominant, the full development of the Argaric brought about an important increase in the use of grinding stones. This reflects very well the different types of crop cultivation, consisting of extensive cereal production, during this period; with the more diversified agriculture of the Later Bronze Age, the proportion of grinding stones decreased. The relatively high frequency of axes and adzes in the later Argaric is surprising, as these tools are usually seen as typical of earlier periods and as successively replaced by metal ones during the Bronze Age.

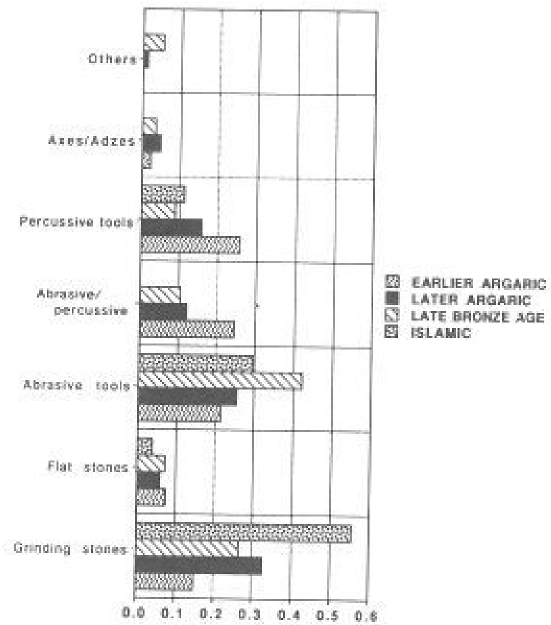

Figure 12. *Frequency of stone tools used in successive occupation periods at Gatas.*

With regard to spatial differences, the domestic character of *S1* and *S3* is indicated by the high frequency of grinding stones. Whether the over-representation of abrasive/sandstone instruments present in *S2* is linked to possible agricultural activities in this area remains speculative. The proposed social differentiation of different parts of the settlement (i.e. *S1* and *S3*) is not reflected by the majority of the working tools. Division of labour does not seem to have existed in the case of the subsistence activities taking place in the domestic space. Nevertheless, axes, adzes and the only two moulds found so far at Gatas appear dominantly in *S1*, and this suggests that restricted access to some instruments of production existed during the Argaric period.

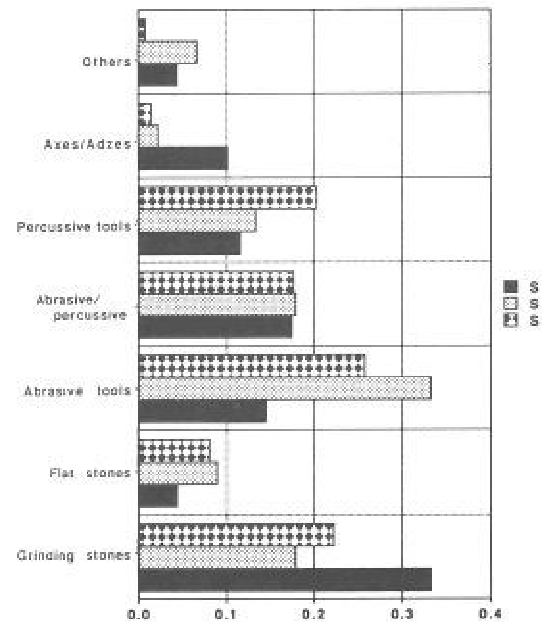

Figure 13. *Frequency of stone tools in trenches 1, 2 and 3 at Gatas.*

Conclusions

A series of ideas concerning environmental conditions and social evolution in arid southeast Spain have resulted from the discussion of the material remains from Gatas, and it is probably necessary to emphasize the insufficiency of existing archaeological models with respect to the evidence from this site. For example, forms of subsistence intensification such as Mediterranean polyculture and irrigation do not yet appear to have been present in the archaeological record of Gatas until the Later Bronze Age, while changes in forms of animal exploitation visible in upland sites in Granada (e.g. increased use of cattle and horse [Gilman and Thornes 1985: 24-28; Harrison 1985]) are seemingly absent. Apart from any other considerations, this emphasizes the empirical variability in the archaeological record of southeast Spain, and hence in the nature of cultural change in prehistory. The existing archaeological models have yet to take such variability fully into account.

In the form of *circundata*, the material evidence cannot provide definite information about smaller climatic fluctuations during the Holocene. Interpretations in favour of more humid climatic conditions, as well as of a climate like the present one, are possible, depending on the quantitative value one wants to give the steppe-like or woodland species. Rather, Gatas shows what the overall natural environment of the arid southeast was like before its modern alteration.

The information of the *arteusos* shows that the social exploitation of the natural environment concerned the immediate surroundings of Gatas for about 90 per cent of the resources during all occupation periods. Only around nine per cent of the resources used relate to a larger area of the Aguas valley, but this area could not have been larger than a radius of 6-8 km around Gatas. Only about one per cent of the materials recovered was introduced to the site from outside the Vera basin, and may not have been obtained through direct access.

The evidence of the *artefacts* shows that the manufacture of the instruments of production took place at the domestic level, and that subsistence activities were undifferentiated inside the settlement. Only in the full Argaric period did some tools, as well as the wild fauna, seem to have a restricted distribution. The existence of social inequality is also suggested by the grave goods of this period at Gatas.

The fact that most of the materials used for the reproduction of the socioeconomic formation are local gives prime importance, from an ecological perspective, to the strategies chosen for environmental exploitation. An over-exploitation of the area would limit the reproduction of nature as well as of society. Given this premise, the evidence from Gatas suggests that extensive and specialized subsistence strategies appear in the only period with evidence for social differentiation—that is, the fully developed Argaric period. We propose that this correlation is not an accidental one, but rather the consequence of the political structures of the Argaric society. In the Later Bronze Age, a more diversified agricultural production took place. Apparently these are the same characteristics as in the early Argaric period, but need not necessarily have been caused by the same social conditions. Our hypothesis is that the situation of local environmental exploitation was contradictory to the extensive, and partly exclusive, crop production on which was based, in part, the differentiated social

organization of Gatas. The fact that, under possible environmental stress (caused by extensive cultivation) the Argaric elites were unable politically to bring a larger area under their strategies of exploitation, and/or that the lower classes resisted the progressive social inequality, might explain the disappearance of the later Argaric socioeconomic system. In general, self-sufficient and egalitarian societies tend to be more careful not to over-exploit their natural resources than those where the producers, and those who decide what is being produced, are not the same.

The same development took place once again over 2000 years later, when the feudal elite managed to achieve what their Argaric predecessors had been unable to do. The earlier Islamic socioeconomic system, known also from historical studies, was based in this area on small and mainly undifferentiated communities, which exploited a diversified subsistence base. After the military occupation of the southeast by the Castilian kingdom during the 14th and 15th centuries AD, an extensive cereal cash-crop production was imposed. One of the consequences of the new exploitation strategies was the collapse of the ecological equilibrium, which until then was well adapted to the arid climatic conditions. The result of this process is the present dry, treeless and eroded condition of the landscape in the southeast of the Iberian peninsula.

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M. Ruíz Parra, R. Risch, P. Castro, P. González Marcén and V. Lull are members of the Department of the History of Precapitalist Societies and

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