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PRODUCTION AND EXCHANGE DURING THE PORTUGUESE CHALCOLITIC: THE CASE OF BIFACIAL FLAKED STONE INDUSTRIES

PRODUCCIÓN E INTERCAMBIO DURANTE EL CALCOLÍTICO EN PORTUGAL: EL CASO DE LAS INDUSTRIAS LÍTICAS DE TALLA BIFACIAL

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ABSTRACT

This study focuses on the economic organization of bifacial flaked stone industries of the Late Neolithic/Chalcolithic Portugal. It is often claimed that social hierarchies first appeared in Western Iberia during this period (ca. 3500-2500 BC). The specific research goals are: determining the production repertoire at lithic production sites, examining the possibility of craft specialization (with particular regard to artifact standardization), and investigating the geographic distribution of artifacts, in order to detect evidence of centralization.

The analyses show that the organization of economy differed markedly between different artifact classes. Production of subsistence-related lithics was decentralized and they circulated through local exchange networks, although some of them could enter long-distance exchange. Prestige-related items were exchanged over large distances and apparently were produced by specialists. The level of specialization and its importance for the economy remained modest. There is no evidence for large-scale sociopolitical integration.

RESUMEN

Este estudio se centra en la organización económica de las industrias líticas de talla bifacial del Neolítico Final/Calcolítico en Portugal. Se ha defendido a menudo que las jerarquías sociales aparecieron por primera vez en el occidente de la Península Ibérica durante este periodo (ca. 3500-2500 AC). Los objetivos específicos de la investigación son: determinar el repertorio de la producción en los talleres líticos, examinar la posibilidad de una especialización artesanal (prestando particular atención a la estandarización artefactual), e investigar la distribución geográfica de los artefactos para detectar las evidencias de centralización.

Los análisis muestran que la organización de la economía difiere de forma notable entre las distintas clases de artefactos. La producción de los instrumentos conectados con la subsistencia era descentralizada. Los útiles circulaban a través de redes locales de intercambio, aunque algunos pudieran integrarse en el intercambio a larga distancia. Los artefactos conectados con el prestigio se intercambiaron a larga distancia y, aparentemente, fueron producidos por especialistas. El nivel de especialización y su importancia para la economía siguieron siendo modestos. No hay evidencia de una integración socio-política a gran escala.

Key words: Production. Exchange. Lithic Tools. Specialization. Standardization. Complex Society. Portugal. Neolithic. Chalcolithic.

Palabras clave: *Producción. Intercambio. Utiles líticos. Especialización. Estandarización. Sociedad compleja. Portugal. Neolítico. Calcolítico.*

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INTRODUCTION

The mention of Western Iberian Chalcolithic usually evokes pictures of elaborately fortified hilltop settlements and impressive monumental tombs. Archaeologists early recognized that these remarkable structures, as well as the diversity and sophistication of the associated portable artifacts, must reflect the elaboration of societies that produced them.

In the course of more than a century of research, a number of different tenets were proposed and sometimes strongly contested about the identity of the people who were responsible for this archaeological record, as well as about the level of complexity of their social organization. One of the reasons for such interpretational diversity was the fact that the societies in question refused to fit neatly into existing evolutionary classifications. While they exhibited some of the traits considered characteristic of complex societies (that is, societies with centralized authority and hereditary inequality), they conspicuously lacked others.

This article provides a summary of a more extensive work (Forenbaher, 1997), a study of the Western Iberian Late Neolithic/Chalcolithic society through investigation of a segment of its economy, the production and exchange of bifacial lithic artifacts. Over the recent years, the Chalcolithic lithic industries and the economy of flaked stone artifacts have attracted attention of a number of archaeologists working in southeastern Iberia (*e.g.* Ramos Millán, 1986; Ramos Millán *et alii,* 1991), as well as some of their colleagues working in the western part of the Peninsula. Much of the recent research of the letter, unfortunately, remains unpublished (*e.g.* Carvalho, i.p.; Uerpmann and Uerpmann, i.p.).

The present work focuses on the role of craft specialization within the context of emerging social complexity. Its primary aims are to test two hypotheses: first, that some of the lithic production was carried out by craft specialists and, second, that the distribution of certain classes of lithic artifacts was controlled by a small segment of the society. Both are related to the question of control over economy, which is an issue of some relevance to various evolutionary explanations of economic and sociopolitical inequality.

Portuguese data provide an opportunity to apply the recently developed body of theory on craft specialization to a test case from prehistoric Europe. They also provide the challenge of trying out the applicability of that theory on a large but imperfect data set. Most of the sampled artifacts came from old collections and were supplemented by only basic spatial and temporal information. Research methodology had to be designed accordingly to accommodate such data and to permit their meaningful analysis. This methodology had to rely on variables and approaches (such as formal characteristics of the artifacts and their geographic distributions) that are least affected by the shortcomings of the data. When available, more specific information has been used to clarify a number of important details. During the period in question (roughly, between 3500 and 2500 Cal. B.C.) (1), generally lax chronological controls do not allow investigation of temporal changes at any but the roughest scale.

WESTERN IBERIAN SOCIETY AROUND 3000 B.C.

The earliest evidence suggesting social inequality and economic intensification comes from the Late Neolithic (2) (V.O. Jorge, 1989: 418-419, 1995: 145; C.T. Silva, 1993: 199, 214-215). Change in social organization is reflected in a diversification of burial monuments. A number of unusually large megalithic tombs are constructed (Gonçalves, 1994b: 250-254; S.O. Jorge, 1990a: 111, 138-139; V.O. Jorge, 1995: 145). Rock-cut chamber tombs and, possibly, the earliest tholos tombs appear before the end of the period (Gonçalves, 1994b: 254-257; S.O. Jorge, 1990a: 126-127). Burial goods become richer, more diverse, and sometimes are exotic (Gonçalves, 1994b: 312-319; Harrison and Gilman, 1977: 91, 102). The number of settlement sites increases, and the peripheral zones, which offered less than optimal conditions for agriculture, are settled. Location of settlements on elevations and hilltops becomes more common (S.O. Jorge, 1990a).

Social restructuring continues during the Early and Middle Chalcolithic. There is no general con-

(1) A coherent absolute chronology for the region is only just emerging. For a recent overview of chronometric dates, see Forenbaher 1997: 13-17.

(2) The commonly accepted sequence, based upon Estremaduran pottery styles, is adhered to. The Late Neolithic is distinguished by carinated bowls and crenellated rims, the Early Chalcolithic by channeled decoration and by the *copos*, the Middle Chalcolithic by the *folha de acácia* type of decoration, and the Late Chalcolithic by the various "Beaker" styles.

sensus, however, about the direction and scope of that change. It remains open to question whether the society is becoming more centralized and hierarchic, and if so, to what extent. Models which propose gradually increasing complexity have the appeal of simplicity and remain popular among Portuguese scholars, although all do not share that view (*e.g.*, Gonçalves, 1994b; C.T. Silva, 1983, 1993; S.O. Jorge, 1990b). The long time span certainly leaves enough room for changes, stable periods and reversals, not to mention the likelihood of diverse regional trajectories of change.

During this period, settlement patterns indicate a fully sedentary way of life and a preference for easily defensible locations. Some of the aggregate settlements are fortified and larger than others, but the evidence of settlement hierarchy or intra-site variability is ambiguous, and elite residences seem to be absent (S.O. Jorge, 1990b, 1994). Economic intensification probably involves the use of domesticated animals for their secondary products and traction power (Gomes *et alii,* 1983). There is some evidence of site specialization and of special purpose activity areas within settlements (Gonçalves, 1994a: 241; S.O. Jorge, 1994: 483; Kunst, 1995: 32, 24; C.T. Silva, 1993: 207-208, 218-219). Interregional interaction intensifies (S.O. Jorge, 1990b: 185; Lillios, 1997: 144-146; C.T. Silva, 1993: 210, 222). Mortuary ritual, however, continues to be communal, and there is no evidence of ascribed status.

Different authors offer a range of interpretations based on this evidence. At one extreme, Vaz Pinto and Parreira (1979: 139-141) hypothesize about full-blown "complex society", complete with hereditary chiefs, political and religious hierarchy, social division of labor and elementary forms of private property. Several other authors also argue for the existence of hierarchical societies, but are more careful when discussing the degree of social differentiation (S.O. Jorge, 1990b: 163, 209, 210; 1994: 490-492; V.O. Jorge, 1995: 140; Kunst, 1995: 32; Valera, 1994: 160). Still others prefer to view these societies as ranked but not hierarchic (Arnaud, 1982: 63; Gonçalves, 1994c: 123; Lillios, 1993: 114). A distinct interpretation is offered by C.T. Silva (1993: 221), who sees less social inequality during the pre-Beaker Chalcolithic than at the time of the Neolithic to Chalcolithic transition.

With the Late Chalcolithic comes further (or renewed) centralization and hierarchization (Senna-Martinez, 1995: 86-87; C.T. Silva, 1993: 221-222). Social status and personal leadership is expressed for the first time through individual burial. Prominent persons are buried with weapons, personal adornments and other unequivocal prestige goods. This becomes particularly emphatic with the late ("Incised") phase of the Beakers, the period which is considered by some to mark the beginning of the Early Bronze Age (S.O. Jorge, 1990b: 180-181, 186; V.O. Jorge, 1995: 149). Hierarchical social systems, sometimes labeled as "simple chiefdoms", are in place by that time (S.O. Jorge, 1990c: 225; C.T. Silva, 1993: 220; A.C.F. Silva, 1993: 274-275). This relatively high level of socio-economic complexity may have been short-lived, however (Gilman, 1987: 28-29). The scantiness of the archaeological record for the post-Beaker Bronze Age has been attributed to social fission and collapse (Lillios, 1993: 114).

Thus it seems that almost everybody agrees that, at the beginning of the Late Neolithic, southwest Iberian society was more egalitarian and decentralized than at the end of the Chalcolithic, by which time there is more evidence for inequality and centralization. What happened in-between is much less clear. Did the earliest hierarchies arise already at the beginning of this period, or only near its end? Was the change gradual, unidirectional and stable, or punctuated by integrations and partial collapses? What was the elite power based upon? What was the scale of those systems? Answers to some of these questions may be gained through investigation of the economy. Evidence for the existence of distinctive production modes and circulation networks for specific kinds of goods, for craft specialization and centralized management would tell us something about the organization of the society within which these activities have been taking place.

SOCIETY, ECONOMY AND CRAFT SPECIALIZATION

Craft specialization is a generally accepted concomitant of social complexity. It involves economic differentiation and efficiency that leads to interdependence, and readily lends itself to elite control (Brumfiel and Earle, 1987: 5; Chapman, 1996: 74; Clark and Parry, 1990: 309, 315, 322-323; Earle, 1987: 64; Peebles and Kus, 1977: 432; Peregrine, 1991: 1-3; Rice, 1991: 259; Sinopoli, 1988: 581; Tosi, 1984: 22). Specialists produce more of an item than their own household can use. They depend on

extra-household exchange relationships to earn at least part of their livelihood, and consumers depend on them for acquisition of goods they do not produce themselves (Costin, 1991: 3; Clark and Parry, 1990: 297-298; Perlès, 1992: 134; Shafer and Hester, 1991: 79). Technical competence by itself does not define a craft specialist. While expertise and specialization are correlated, they are different concepts: one is simply a statement of skill, while the other is a statement of social and economic relations (Cross, 1993: 65, 71).

Specialization is a relative state, not a presence/absence condition. Its investigation, therefore, must rely on comparison among multiple samples (Costin, 1991: 2, 4). The degree of specialization may be expressed as a ratio between the number of producers and a number of consumers of a given item. The lower the relative number of producers, the higher the degree of specialization (Costin, 1991: 24; Tosi, 1984: 23).

Furthermore, specialization is not a single organizational state. There are many kinds, each operating under specific circumstances and requiring, or supporting, a specific sociopolitical environment. Among the dimensions of variation that best describe it are the context of production (independent or attached), the nature of the product (subsistence or prestige related), as well as concentration, scale and intensity of production (Costin, 1991: 4-5; Brumfiel and Earle, 1987: 5). A growing number of works is contributing to the theoretical discussion of craft specialization (*e.g.* Arnold and Munns, 1994; Brumfiel and Earle, 1987; Clark, 1987; Clark and Parry, 1990; Costin, 1991; Earle, 1987; Rice, 1991; Sinopoli, 1988; Stein, 1996; Stein and Blackman, 1993; Torrence, 1986). Expectations as to the form of archaeological evidence characteristic of craft specialization can be deduced from this emerging body of theory. Of particular interest for the present study is the direct evidence from workshops and the indirect evidence of product standardization.

DIRECT EVIDENCE: LITHIC PRODUCTION SITES

A "workshop" is not just a place where something is being manufactured. It is an area where a specialized labor force performs a limited set of activities, in order to produce items for exchange; that is, for consumption outside the production unit (Clark, 1986: 29-30, 42, 46; Michaels, 1989: 144; Torrence, 1986: 60). Waste from a workshop is comprised almost exclusively of by-products of manufacture, as opposed to household rubbish which contains a mixture of various materials, including food remains and exhausted or broken tools and implements (Torrence, 1986: 146; Shafer, 1985: 298). Lithic workshops, in particular, are characterized by massive deposits of debitage, consisting almost exclusively of chipping waste, failed and abandoned half-products, and occasional discarded hammerstones (Shafer and Hester, 1983: 535). The key to the identification of workshops is the demonstration that many more of an item were produced than could have been locally consumed.

Most of the known special-purpose lithic production sites in Portugal are located in the west-central part of the country, because that is where the main flint sources are. There is some information on half a dozen of such sites that date from Neolithic or Chalcolithic, but none have been sampled in a way that would allow detailed and rigorous study of production. The data usually come from non-intensive surface collecting, or from old excavations with poor contextual information and outdated recovery methods.

The differences in production repertoires among these sites in part may be temporal, although, at this point, none of them can be dated precisely (3). Usually there is evidence of diverse reduction strategies that were employed in manufacturing of a variety of products. Production of prismatic blades appears to have been the dominant activity at Casas de Baixo (Zilhão, 1994) and Barotas (Cardoso and Costa, 1992), while bifacial preforms for Campignian-style hatchets were produced at Santana (Correia, 1912; Raposo *et alii,* 1985), among various other tools. One of the sites, however, stands out sharply against the others, by the unusual make-up of its lithic assemblage.

Arruda dos Pisões lies near the southeastern border of the large secondary flint source zone of Rio Maior. The flat bottom of the valley of Penegral, nowdays occupied by a village, is composed of recent alluvial material which abounds in flint of excellent quality for knapping, much of it in nodules

(3) Because of the almost exclusive presence of flaked stone artifacts and the absence of pottery, many of the Neolithic/Chalcolithic chipping stations have been attributed erroneously to the Paleolithic: Santana to the Mousterian, Arruda dos Pisões to the Solutrean, and Barotas to the Epipaleolithic or Early Neolithic. For further discussion see Forenbaher, 1997: 89-90, 118-120, 140-141.

fist-size and larger. The site was excavated in 1942-1943 under Heleno's direction, when several hundred square meters of it were exposed (Machado, 1964: 132,133). Its total spatial extent, most of which today is urbanized, remains unknown. Judging by the location of Heleno's trenches and the remaining surface scatter, it must have been at least 250 meters across. Among more than 11,000 recovered flaked stone artifacts was an extraordinary large number of bifacially worked pieces. Heleno himself referred to these as "Late Solutrean" (Heleno 1956: 227, 236; Zbyszewski *et alii,* 1977), a conclusion that was refuted only recently (Zilhão, 1987: 35-38, 1990: 113, 117, 1995: 31-4).

As might be expected on a site located at a flint source, cores and debitage dominate at 77%, while all tools combined (other than bifaces) constitute less than 2% of the total assemblage. These ratios would have been even more dramatic if the finds have not been kept selectively during the excavation. This is clear from the fact that the least attractive classes (nodules, chips and chunks) add up to only 1.1%. What is striking, however, is that the remaining 20% of the assemblage is composed of more than 2000 large bifacial preforms and fragments.

The greatest part of the assemblage can be explained as bifacial reduction waste. Most of the flakes would have been produced during the early stages of reduction, while the 233 bifacial thinning flakes (4% of all flakes) testify to later stages of bifacial thinning. An activity of secondary importance was blade production, evidenced by blades and blade segments which constitute 12% of the total, as well as by a few blade cores. Flaked stone artifacts dominate overwhelmingly over all other categories of archaeological materials. Household debris is virtually absent and consists of a handful of potsherds. Hammer stones enhance the site's function as a chipping station, a special purpose site primarily oriented towards production of large bifacial point preforms.

Relative dating rests on artifact typology, since chronometric dates are not available. Like most flint sources, the site was used during diverse periods, but the overwhelming majority of the material belongs to the Late Neolithic and/or the Chalcolithic. The assemblage includes scrapers, denticulates and other non-formalized tools made on small flakes which in general are characteristic of these periods (Cardoso *et alii,* 1984: 49-54, 1987: 16-17; Uerpmann and Uerpmann, in print). The bifacial artifacts themselves are preforms of large points that appear in Late Neolithic and Chalcolithic burials (Gonçalves, 1995: 225; Leisner and Leisner, 1956, 1959; Leisner, 1965). The small pottery assemblage includes several fragments of plain spheroid bowls and carinated cups which suggest a Late Neolithic date (Gonçalves, 1991; 1995: 31, 69-102). About a dozen polished stone axes were also recovered.

The haphazard character of the collection forestalled a rigorous quantitative study of production which would have included all waste. Our attention focused instead on the bifacial preforms. Their morphology, alone, allowed an informative reconstruction of the production trajectory, as well as an investigation of variability and standardization.

Three categories of preforms were recognized at Arruda dos Pisões: edged pieces, primary thinned pieces, and secondary thinned pieces (Fig. 1). Their classification was based on a number of morphological characteristics, which were considered indicative of how far into the bifacial reduction process a particular piece was rejected (Callahan, 1979: 10, 36-37). These characteristics included general outline, edge morphology, flake removal scar patterns and cross-section geometry of each artifact. Production stopped at the "secondary thinned piece" phase, after which the preforms were exported. The finished large bifacial points, found in burials, have very carefully trimmed edges, often are partially

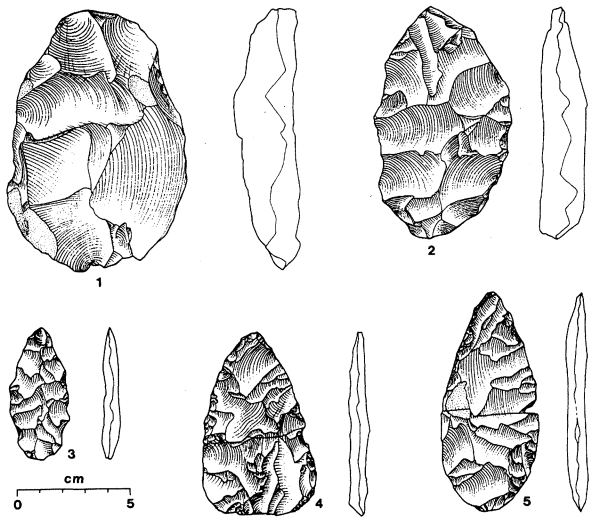

Fig. 1. Examples of bifacial preforms from Arruda dos Pisões. 1, edged piece; 2, primary thinned piece; 3-5, secondary thinned pieces: a small, a large wide, and a large elongated preform.

polished, and occasionally have been heat treated. These final stages of production were carried out elsewhere.

Formal analysis showed that the distributions of all of the observed metric variables were essentially continuous and unimodal for the preforms belonging to the early reduction stages. For those bifacial preforms, however, that were approaching their final shape, the existence of three discrete formal groups was indicated, based on differences in size, shape and proportions (Fig. 1: 3-5): a group of rather small and heavy bifaces, usually less than 70 mm. long and 30 mm. wide; a second group of larger, elongated bifaces, with the mean length and width of 90 by 40 mm.; and a third group of wide and relatively thin bifaces, with the mean length and width of 80 by 50 mm. Each of these appeared as a fairly compact group, with relatively low values of statistical measures of variability (Forenbaher, 1997: 95-114). This suggested the possibility that three standardized types of preforms had been produced at Arruda dos Pisões.

INDIRECT EVIDENCE: STANDARDIZATION OF PRODUCTS

Standardization is one of the most commonly cited indirect indicators of specialized production. It is a relative measure which refers to the degree of homogeneity or reduction of variability. It can only be expressed through comparison of two or more analytical units which should come from the same general sociocultural context and be products of closely similar technologies (Blackman *et alii,* 1993: 61; Costin, 1991: 33, 36; Rice, 1991: 268). Ethnographic and experimental data generally support the correlation between specialization and standardization. While not all goods produced by specialists are standardized, virtually all standardized products were made by specialists.

Several disparate factors, all of them related to specialization in different ways, may lead to standardization. By reducing the relative number of producers, specialization reduces variability which arises from individual idiosyncrasy. In this sense, standardization simply measures the relative number of producers (Costin, 1991: 33, 35). Routine and skill that develop through intensive production will lead to still greater consistency in the appearance of products. When production is guided by economic concerns, the outcome again is increased standardization (Blackman *et alii,* 1993: 61; Cross, 1993: 71; Rice, 1991: 268; Torrence, 1986: 43; Sinopoli, 1988: 582).

Standardization is most likely to be pronounced in the products of independent specialists, because of the economizing principles that guide their behavior (Clark and Parry, 1990: 293; Costin, 1991: 34). As opposed to that, each prestige-related item made by an attached specialist may be distinctive or even unique (Costin, 1991: 34; Gero, 1989: 95; Sinopoli, 1988: 582). Standardization, however, may be required in order to communicate specific social affiliation (Blackman *et alii,* 1993: 61; Costin, 1991: 33-34; Cross, 1993: 71) or the right of access to specialists' products (Gero, 1989: 95).

In order to judge the standardization of bifacial preforms from Arruda dos Pisões, comparative populations are necessary. Fortunately, three distinct kinds of bifacial artifacts have been widely used across Iberia during the period in question: arrow points, ovoid bifaces, and large bifacial points (Carvalho, in print; Juan-Cabanilles, 1984: 66, 1990: 9; Ramos Millán *et alii,* 1991: 62-63).

Arrow points (Fig. 2: 3-8) appear regularly in burials and settlements, often in large numbers. They are the smallest of the three classes of bifacial artifacts, usually from 2 to 4 cm. long and from 1 to 2 cm. wide. Judging by their size and shape, as well as by occasional impact fractures near the tip, most of them actually served as arrow points, either for hunting or in warfare. A variety of types has been recognized in the literature (*e.g.,* Cardoso, 1980: 290-292; S.O. Jorge, 1978; Leisner and Leisner, 1943). Most can be classified either as points with protruding base (diverse stemmed and winged types), or points with straight or concave base (including "mitriform", "Alcalar" and "Eiffel Tower" points)(Forenbaher, 1997: 226-232). They were made by pressure flaking along all edges, using small flakes or blade segments of flint or other locally available lithic raw materials that often had been heat treated (Collins and Fenwick, 1974; Inizan *et alii,* 1977).

Within Portugal, arrow point production areas have not been positively identified so far, possibly because the production debris (tiny bifacial trimming chips) would have been overlooked by standard excavation techniques. Discarded preforms appear occasionally in settlements. Judging by their ubiquitous presence and the fact that they were made of locally available raw materials, their pro-

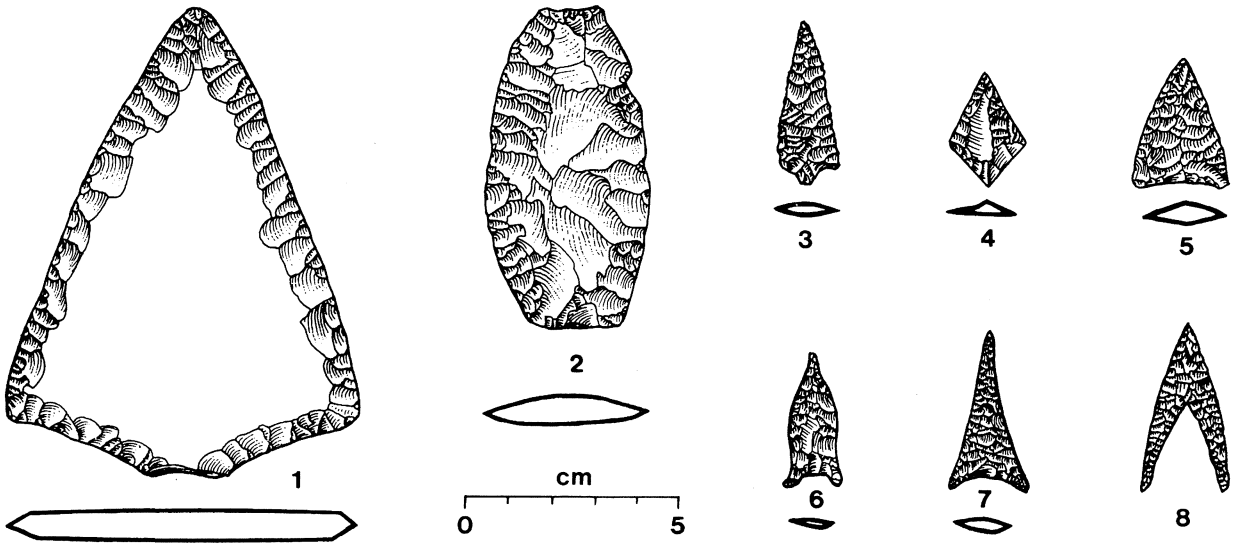

Fig. 2. Examples of bifacial artifacts. 1, large bifacial point; 2, ovoid biface; 3-8, arrow points (3, stemmed; 4, rhomboidal; 5, concave base; 6, mitriform; 7, Eiffel tower; 8, Alcalar). Provenience: 1, Cova da Moura (after Spindler, 1981, pl.14); 2, Fórnea; 3 & 7, Pico Agudo (after Spindler, 1971, fig.5); 4 & 6, Leceia (after Cardoso, 1981, pl.8); 5, Santa Justa (after Gonçalves, 1989, fig.36); 8, Alcalar (after Veiga, 1886).

duction was probably decentralized. This assumption is supported by the evidence from southeastern Iberia, where arrow points tend to be locally produced (Ramos Millán et *alii,* 1991: 64). Concentrations of debris from their production have been reported from Almizaraque (Siret, 1948) and Fortín 1 at Los Millares (Molina González *et alii,* 1986: 192-193; Ramos Millán et *alii,* 1991: 177-181). While there is some discussion whether or not this activity was carried out within a generalized household context (Molina González *et alii,* 1986: 193, 197-198; Ramos Millán et *alii,* 1991: 178, 181), the character of the remains suggests that this was simply an area where a specific activity (arrow point production) was carried out, rather than a workshop attended by specialist craftsmen.

Ovoid bifaces (Fig. 2: 2) are oval or sub-rectangular tools lacking pointed ends, shaped by invasive bifacial retouch. They are relatively thick, and their cross-section is usually asymmetric, tending towards plano-convex. Most are 4 to 8 cm. long and 2.5 to 4 cm. wide. They have been called "ovoid blades", "ovoid knives", "sickles", or "sickle blades", but all of these terms are somewhat misleading. Technologically, they are not blades. A use-wear study (Serrão and Vicente, 1980: 37-44) suggested that most were side-hafted and used for cutting, as well as scraping and whittling, rather than for harvesting wheat. They are common in settlements, but rare in burials. They were made on relatively thin, medium sized flakes that often had been heat treated. As was the case with the arrow points, production areas have not been positively identified, but their manufacture in many settlements is attested by the presence of artifacts in various stages of bifacial reduction and by occasional bifacial thinning flakes (Uerpmann and Uerpmann, i.p.).

Large bifacial points (Fig. 2: 1) differ from the arrow points by their size, and from the ovoid bifaces by a clearly differentiated point and a base. Roughly two out of three have partially polished surfaces, which is never the case with the other two classes of bifacial artifacts. They can be over 30 cm. long, but are usually from 8 to 18 cm. long and from 3 to 9 cm. wide. Most of them are relatively thin, with lenticular, symmetrical cross-sections. There is no direct evidence as to their function (Carvalho, in print; Gonçalves, 1992: 221). The wider pieces were traditionally considered as halberds, the elongated ones as daggers or lance points. These two categories, however, blend into each other without an obvious break. Most likely they were weapons, but their symbolic significance probably outweighed their practical utility (Ramos Millán *et alii,* 1991: 63).

Different lines of evidence suggest that large bifacial points were prestige-related items. First,

they were rare: a total of some 200 pieces, including fragments, is known from Portugal. Second, their value was artificially increased by polishing, a procedure which has little functional significance, but is much more labor-intensive than bifacial thinning (P. Harding, 1987: 37, 39). Thirdly, they were deposited almost exclusively in ritual contexts, that is, in burials (Binford, 1971; Chapman, 1977: 20-23; O'Shea, 1984). Furthermore, their size was sometimes 'hypertrophic' (Clark and Parry, 1990: 293, 333), preventing practical use, but stressing the importance of their public display (Wobst, 1977: 328-330). Many are in mint condition, and apparently were never used. A few have been broken and mended in antiquity; thus "repaired", they were practically useless, but could still fulfill their social function.

There are no indications that production of large bifacial points ever took place in settlements. The early production stages are well documented at the special purpose site of Arruda dos Pisões. It remains unknown where the final shaping and polishing were carried out.

Lithic assemblages from 37 sites (3 production sites, 14 settlements and 20 burial sites) were selected for the analysis of standardization. A total number of 2,770 artifacts were measured (1,421 arrow points, 377 ovoid bifaces, 63 large bifacial points and 909 bifacial preforms). For each one of them, thirteen categorical and fourteen metric variables were recorded. Most important of these are the five directly measured metric variables (length, width, thickness, edge angle and weight), and the four derived variables: "Size" is an approximation of the surface area of the artifact, and is defined as the area of the ellipse with the main axes equaling the length and width of the artifact; "Shape" is a measure of elongation, and is defined as the quotient of length and width; "Relative thickness" is defined as the quotient of thickness and width; "Thinning index" is an overall measure of the degree of bifacial thinning, defined as the quotient of weight and "Size".

Since standardization of artifacts is used here as an indicator of specialization, it would have been ideal if comparative populations came from specific production contexts. Such populations are not available for arrow points and ovoid bifaces. Using assemblages from individual settlement sites brings us as close to their specific production contexts as is currently possible. This also excludes variation caused by differences among local raw materials and, to some extent, functional or stylistic variation among different communities.

In order to improve the control over stylistic variation, further sub-division along formal typological lines was necessary. Such splitting of the sample may create problems for the investigation of standardization, because the relative degree of variability may be artificially reduced if it is partially based on dimensional criteria. To avoid this pitfall, two principles were followed. First, the relative degree of standardization was monitored for all of the nine metric variables whenever possible. The assumption was that, while splitting along the formal lines may artificially increase standardization for some of the variables, it will not influence all variables in such a manner. Second, the typological classification was always based on clearly disparate formal attributes or, in the case of large bifacial preforms, on clearly recognizable clusters of artifacts, as defined by dimensional discontinuities.

For the populations thus defined, the relative degree of standardization was measured by calculating the respective coefficients of variation for the nine metric variables listed above. Coefficient of variation is a relative measure of dispersion. It expresses the sample variability in terms independent of its mean value. This makes it suitable for comparison among populations for which relative homogeneity must be assessed independent of the respective sample means. It equals standard deviation divided by the mean (multiplied by hundred, to be expressed as percentage). The lower its value, the more standardized the population (Shennan, 1988: 43-44; Thomas, 1976: 82-85; Torrence, 1986: 64).

Due to space restrictions, all coefficients of variation for each sub-population as defined by site, type, and variable can not be listed here (Forenbaher, 1997: 368-380). A graphic summary overview is provided in Fig. 3. It shows that the coefficients of variation for arrow points and ovoid bifaces exhibit a rather scattered but roughly similar range of values. In contrast, coefficients of variation for nearly finished large bifacial preforms ("secondary thinning production stage") are always among the lowest. All three formal variants (small, large wide and large elongated preforms) have absolutely the lowest coefficients of variation for length, thickness, relative thickness and edge angle. In case of the remaining variables (width, weight, size, shape and thinning index) they are still consistently among the lowest. Large bifacial point preforms from Arruda

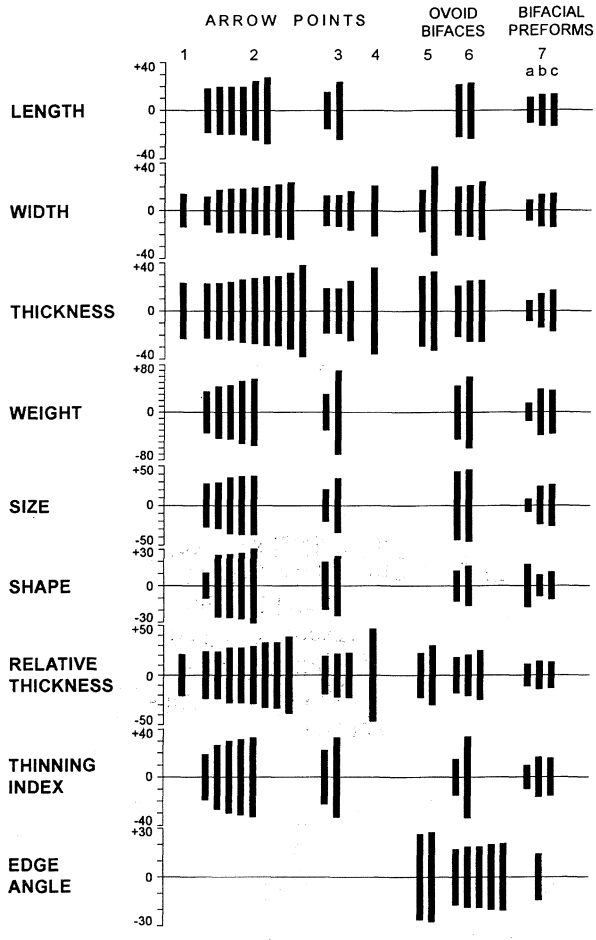

Fig. 3. Coefficients of variation for the nine metric variables, by specific site and artifact type. 1, convex base points; 2, straight and concave base points; 3, mitriform points; 4, Eiffel tower points; 5, sub-rectangular ovoid bifaces; 6, oval ovoid bifaces; 7, large bifacial preforms (a, small; b, large wide; c, large elongated).

dos Pisões are thus singled out as the most standardized of all classes and sub-groups of bifacial flint artifacts.

DISTRIBUTION

It can be argued that the form of exchange will, to some measure, reflect the organization of production (Earle, 1982: 8; Torrence, 1986: 6). Consequently, study of exchange mechanisms can provide one with additional knowledge about production, in particular, about the value of, and control over, the produced goods (Arnold, 1987: 30).

One of the most common ways to investigate exchange archaeologically is through the analysis of distribution patterns of the exchanged goods. The constraint which the distance imposes on the abundance of a non-local item is described by the "law of monotonic decrement" (Renfrew, 1977: 72). The amount of an item found at a site can be described mathematically as a function of distance from its source (Earle, 1982: 5-6; Hodder, 1974; Hodder and Orton, 1976: 98-126). One case where regression analysis has proven useful is in distinguishing between the products of low and high value, which often translates into the distinction between subsistence-related and prestige goods: since high value items have greater traveling power, their regression curves are less steep than those of the low value items (A.F. Harding, 1984: 67-105; Renfrew, 1972: 442-460; Rowlands, 1973: 594-595; Shafer and Hester, 1991: 90-91, 94; Wells, 1984: 69-71).

Peculiarities of Portuguese geology simplify the rough-scale distribution study of flint-made implements. Flint sources are located only within two clearly delimited geographic areas, one along the western, the other along the southern coast (Ribeiro 1980: 66, 78-86; Serviços Geológicos de Portugal 1968). Judging by the available evidence, the first provided the raw material for the great majority of flint artifacts during the Late Neolithic and Chalcolithic. This main procurement zone roughly corresponds to the present-day Portuguese Estremadura. Within it, there are numerous primary sources of flint contained in limestones, sandstones and shales of Jurassic and Cretaceous age. Secondary sources are located in the adjacent Neogene alluvial deposits (4). One should add that flint sources are absent in the neighboring parts of Spain. Inter-regional distribution patterns, therefore, can be investigated without the need for exact flint sourcing.

Central source location within Portugal allows distribution to be studied within a radius of over 200 km towards the north and the south. The Atlantic limits it towards the west. The logistics of field research dictated an artificial cut-off line some 100-150 km towards the east, at the present Spanish border. The neighboring parts of Spain (the provinces of Huelva, Badajoz and Cáceres) should be included if full coverage were intended. It is presumed that this omission did not influence signif-

(4) A recent and as yet unpublished study located over 30 primary or secondary flint sources in west-central Portugal. I am grateful to Jeffrey Shokler and Nuno Bicho for sharing their information with me.

icantly the outcome of the analyses and the resultant conclusions.

Investigation of distribution patterns was based on a sample of 149 sites. These include 79 settlements, 61 burial sites (26 megalithic and 8 tholos tombs, 4 rock-cut chambers, 16 caves, and 7 tombs of unknown type), as well as 9 isolated finds which in all likelihood also come from burials. A settlement site was included in the analysis if any of its occupation phases belonged to the period between the Late Neolithic and the Late Chalcolithic, and if at least partial information could be obtained (either from publications or from personal inspection) about its lithic assemblage. A burial site was included if it contained one or more large bifacial points, or their fragments. Artifacts of this class are fairly rare, and any sampling procedure which would have reduced their number further had been judged as counterproductive. The selected tombs do not stand out in any evident way from those burial monuments which do not contain large bifacial points.

The quality of information extracted from reports is highly variable, ranging from a casual mention of a few lithic artifacts to complete and detailed assemblage break-downs. Consequently, the resultant data base could not have served as a basis for unqualified quantitative comparison. The rough trends that the analyses indicated, however, are quite convincing. They document the existence of distinct general regularities in distributions of different bifacial artifact classes.

Ovoid bifaces are geographically restricted almost exclusively to the flint procurement zone (Fig. 4, left). As already stated, they are common in settlements, but quite uncommon in burials. Their apparent concentration in the southern half and absence from the northern half of the procurement zone most likely is a consequence of uneven research. While numerous settlements have been recorded and many of them excavated in the south, in the north they remain practically unknown.

For large bifacial points the pattern is reversed: they have a wide geographic distribution, but are found almost exclusively in burials (Fig. 4, right). Unsurprisingly, their highest concentration is within the flint procurement zone, but a thin, continuous scatter stretches across almost the entire Portugal. Many of these artifacts were recovered from burials which are located between 50 and 100 km away from the procurement zone. Some traveled even farther, and those in Algarve, if they indeed came from Estremadura, traveled some 200 km.

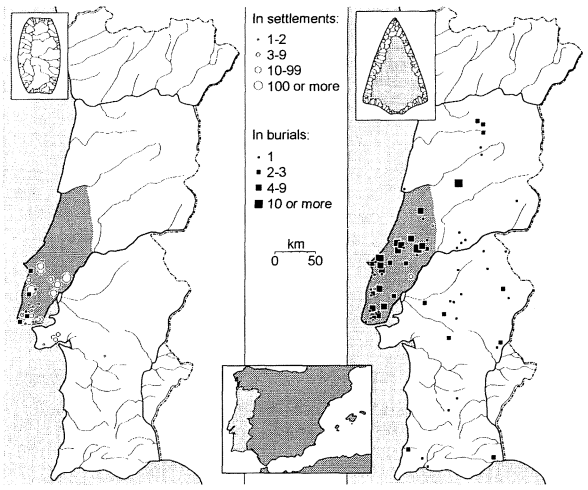

Fig. 4. Geographic distribution of ovoid bifaces (left) and large bifacial points (right). Flint procurement zone is shaded.

Arrow points exhibit two distinctly different distribution patterns, because they appear over a much wider area in burial contexts than they do in habitational contexts. In settlements, their geographic distribution closely resembles that of the ovoid bifaces: they appear commonly and in great numbers only within the procurement zone (Fig. 5, left). As opposed to that, their distribution in burial contexts closely resembles that of the large bifacial points (Fig. 5, right): greatest concentration again is within the flint bearing zone, but they are quite common in burials far beyond it as well. The

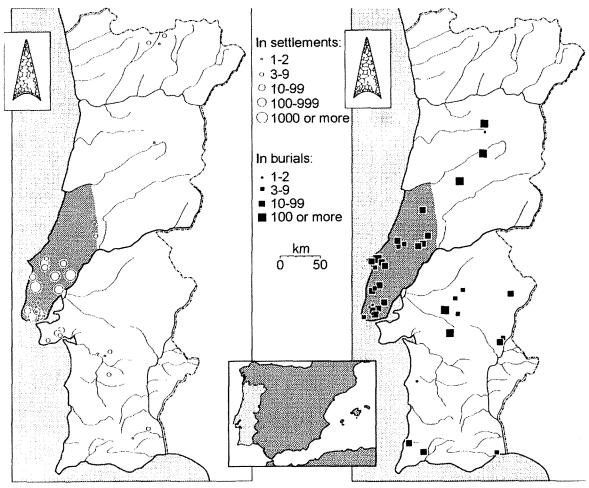

Fig. 5. Geographic distribution of flint arrow points in settlements (left) and in burials (right). Flint procurement zone is shaded.

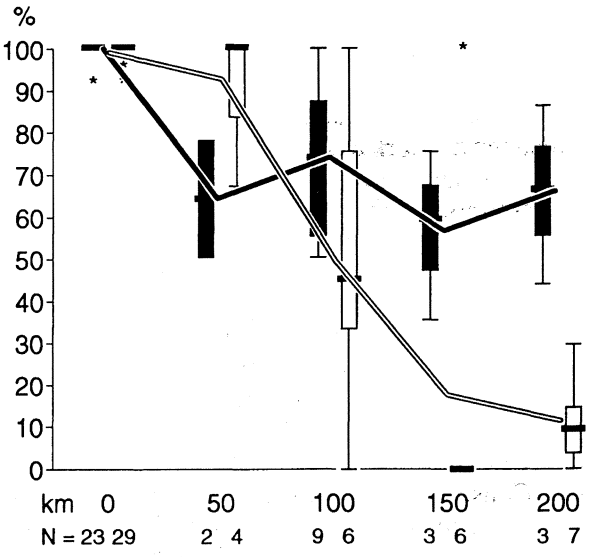

Fig. 6. Box plots and regression curves for flint arrow points in burials (black) and settlements (white). Regression curves show average relative frequencies of flint versus non-flint arrow points. Sites were grouped in five categories according to their distance (in increments of 50 km.) from the procurement zone.

map shows just a fraction of the real distribution, because many more burials that contain arrow points were not included in the sample.

Figure 6 further illustrates the contrasting distribution patterns for flint arrow points in settlements versus burials. Frequencies of flint arrow points (relative to all arrow points, flint and non-flint) were used to construct distance-decay curves for these two types of contexts. Their drop-off is fairly gradual for burial contexts, but quite steep for settlement contexts. Similar regression diagrams can not be constructed for ovoid bifaces and large bifacial points, since virtually all of those artifacts (with less than half a dozen exceptions) have been made of flint.

LITHIC ECONOMY OF THE PORTUGUESE CHALCOLITHIC

We did not attempt to trace the individual artifacts to their specific flint sources. The general impression is that the majority of subsistence-related items were made from whatever raw material was locally available. This suggests that, in general, the population had universal and unrestrained access to the local sources.

When one compares the production, the distribution, and the consumption among the three specific bifacial artifact classes, salient differences emerge. For ovoid bifaces, there is evidence of production at virtually every settlement within the flint procurement zone. Their relatively high variability suggests that many different individuals were making them at each site. Their production was dispersed, organized at a local, probably household, level. These were utilitarian objects, involved in subsistence-related activities. Apparently, they were invested with little, if any, symbolic meaning. Their relatively low value is further reflected in their distribution, which does not extend beyond the procurement zone.

Large bifacial points likewise were produced within the flint procurement zone. Several lines of evidence suggest that they were made by craft specialists. The direct evidence comes exclusively from a single special purpose production site, Arruda dos Pisões. One can, therefore, safely assume that their production was concentrated. The output of this site can not be expressed quantitatively because of the lack of spatial and temporal controls, and the selective recovery of the artifacts. It is clear, however, from the number of the recovered rejects that this production could not have been consumed locally. Control of production by an authority is suggested by the restriction of the repertoire to a single class of item, as well as by the absence, at all other sites, of debris related to the production of large bifacial points.

Preforms from Arruda dos Pisões are the most standardized of all of the contemporary bifacial artifact classes in Portugal. Minimally, this indicates that fewer producers were involved in their manufacture, compared to the number of individuals who made ovoid bifaces and arrow points at settlements. Cross-cultural comparison of standardization within this class of artifacts is severely limited by the available data. In the absence of geographically closer points of reference, information from a Mesoamerican site was used for this purpose. The level of standardization of preforms from Arruda dos Pisões compares favorably with bifacial preforms from Colha workshops, which demonstrably were produced by craft specialists (Shafer and Hester, 1991). Furthermore, Arruda dos Pisões flintknappers were at least as material-efficient as their Maya counterparts (Forenbaher, 1997: 300; Michaels, 1989: 164-166, table 5). The excellent flaking characteristics of Rio Maior flint also would

have contributed to their efficiency, as would have the spatial separation between the early and the late production stages. The latter would also facilitate control over the producers.

Exchange over large distances and deposition in ritual contexts are characteristics of valuable goods, and in particular, of symbolically charged objects that are involved in status legitimization. Large bifacial points did not enter the local exchange networks through which the subsistence-related goods circulated. Their distribution was restricted exclusively to the long-distance prestige-exchange mechanisms.

To summarize, the large bifacial points were valuables carrying social information. They were produced at a few nucleated workshops for long-distance exchange, by a small number of producers who can be characterized as craft specialists. The nature of the product, the spatial concentration of its production, and the hints of production and distribution control, all suggest that they were made by craftsmen who were attached, in economic terms, to a patron or an elite group.

Production of arrow points was organized in a similar way as that of the ovoid bifaces; that is, dispersed among most settlement sites. Their relatively high variability is closely comparable to that of the ovoid bifaces, which indicates that the number of different individuals who made them was similarly high. Arrow points, however, appear regularly both in settlement and in burial contexts. This implies that, on one hand, they were used as utilitarian objects in subsistence-related activities (as a part of the production and/or protection technology), but that they were also considered as valuable enough, or carrying enough symbolic charge, to become a regular component of mortuary ritual. In this regard, Chapman's (1981: 402) observation that arrow points are relatively much more frequent in "prestigious" tombs at Los Millares is worth mentioning.

The possibility that, depending on the context, the same object may be regarded as either utilitarian or prestige-related item, and circulate accordingly through distinct and separate exchange networks, was noted by Godelier (1977: 128-129). In Chalcolithic Portugal, flint arrow points as subsistence-related goods do not travel far. Within the source zone, they are accessible to all, and circulate through the same exchange network as other subsistence-related goods. Away from that zone, they are exotic and too valuable to be commonly used in subsistence-related activities. Rather, the contexts of their use become primarily ritual and symbolic, which is why they are deposited mainly in burials. In these contexts, they clearly carry prestige, and they probably circulate through the same prestige-exchange network as do the large bifacial points.

Why would prominent individuals or elites make efforts to control the production of the large bifacial points, and not the arrow points? This may have to do with the different levels of expertise and raw material quality which are required for their production. Small functional arrow points are relatively simple to make, and can be made from most kinds of flint. In contrast, production of large bifacial points imposes relatively high demands on the raw material quality and the expertise of the flintknapper. Consequently, it lends itself more readily to control. The scarcity and value of large bifacial points can be increased artificially by restricting access to a high-quality source of flint, and by patronizing the production of the relatively few competent craftsmen.

Finally, why is it that, unlike the arrow points, the ovoid bifaces do not exhibit the "dual nature" of subsistence-related and prestige goods? That probably has to do with their respective utilitarian functions. The first are weapons for hunting and warfare, activities which are usually associated with prestige. The second are used for more "pedestrian" domestic tasks, such as cutting or scraping, which are much less likely to carry prestigious overtones. Given the fact that hunting and warfare were predominantly male activities in most ethnohistorically documented cases, and that incipient social inequality usually means dominance of prominent males, it is tempting to see these two classes of artifacts as gender-specific.

The size and the character of the exchange networks does not suggest large-scale sociopolitical integration. Subsistence-related lithics circulated only locally, almost never traveling more than 50 km. Long-distance exchange was limited mainly to circulation of prestige items. This kind of interaction existed between Portuguese Estremadura and Southern Portugal, as well as between Portuguese Estremadura and North Central Portugal. Exchange included such complementary resources as flint from Estremadura, copper from the South, and shist and amphibolite from various sources in the interior. Subsistence-related use of amphibolite axes that were imported into Portuguese Estremadura (Lillios, 1997: 155-158) adds another dimension of complexity to the economic system.

There is little evidence that such long-distance exchange networks reached into Northern Portugal beyond the Douro river. Hard evidence of exchange with more distant (extra-peninsular) regions remains extremely scarce (Harrison and Gilman, 1977), and is limited to prestige goods, but the quantities involved were so minute that it could not have played a major role in the economy.

CONCLUSIONS

During the centuries around 3000 B.C., the period known as the Late Neolithic to Chalcolithic transition, the Western Iberian lithic production was organized in at least two different ways. One was probably based on the individual household, while the other was carried out by craft specialists. The products, depending on whether they were subsistence or prestige related, circulated through two distinct distribution mechanisms.

Such "dual" or "multiple" economic systems probably were a common, rather than an unusual occurrence, in most non-egalitarian societies. Wells (1984: 67-68) proposed that a comparable system operated during the European Late Bronze Age. More recently, Stein and Blackman (1993: 53-55) presented similar evidence from an early Mesopotamian city-state, while Perlès (1992: 119, 153) argued for a comparable model of economy in Neolithic Greece.

The nature of the product (subsistence or prestige) clearly is one of the important determining factors in how its production and exchange will be organized, but that does not mean that there is a single relationship between the nature of goods, the organization of their production, and the system through which they are distributed.

Social inequality in Western Iberian Late Neolithic and Chalcolithic is undeniable. At the same time, the level of craft specialization and the scale of sociopolitical integration seem to remain rather modest. Certainly, with regard to the bifacial lithic industries, craft specialists were relatively few in number, they were involved in the manufacture of a narrowly restricted kind of product, and were serving only a small segment of the society. Their production could not have had a major impact on the economy, at least not directly, but it could have been an important tool for maintaining the political system based on social inequality. The scale of that system was rather small in comparison to the contemporaneous "world system" which was emerging at the opposite end of the Mediterranean (Sherratt, 1993: 43-44).

Who were the patrons for whom the specialists were working? Were they "big men" whose status was achieved, or petty chiefs, whose status was ascribed? The present data can not answer that question. In any case, the intention of this study was to investigate the possibility of reconstructing the organization of a prehistoric society by studying its economy, rather than to classify it as a "tribe" or a "chiefdom". As Yoffee (1993: 72) wrote recently, sticking a label on a society does not mean that we actually know something more about it.

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