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TECHNICAL INNOVATION IN PROCESSING OF FLAX YARN PRODUCTION IN THE NORTHWEST OF THE IBERIAN PENINSULA: THE SPINNING BOWL

ABSTRACT

In space, the Castreña culture was located in the north-western part of the Iberian Peninsula, whereas in time it stretched from the Late Bronze Age to the beginning of the Roman period. This study focuses specifically on the invention and use of the spinning bowl in the Castreña culture. Theoretical and conceptual tools will enable tackling this item with a rigid research methodology and help answer the question of why the invention of the spinning bowl and the innovations in processing

of flax yarn production occurred, and how they were transmitted to other areas in the forms of innovation or technical loan. To explain its presence within the limits of this geography and chronology, the use of *Linum usitatissimum* L. is discussed. This specific raw material is closely related to the entire innovation process on the one hand, and on the other opens an avenue for research into its function within the technical chain of the creation of linen thread or yarn.

STRESZCZENIE

MISA PRZĘDZALNICZA – INNOWACJA TECHNICZNA W WYTWARZANIU PRZĘDZY LNIANEJ W PÓŁNOCNO-ZACHODNIEJ CZĘŚCI PÓŁWYSPU IBERYJSKIEGO

Kultura Castreña rozwijała się w północno-zachodniej części Półwyspu Iberyjskiego od późnej epoki brązu po początki okresu rzymskiego. Autorka skupia się na kwestii wprowadzenia w kulturze Castreña specjalnych narzędzi wykorzystywanych przy wyrobie przędzy, tzw. mis przędzalniczych. Ich pojawienie się i użytkowanie

analizowane jest w odniesieniu do występowania i wykonywania lnu na Półwyspie Iberyjskim. Ramy teoretyczne dla tych rozważań stanowią koncepcja innowacji i zapożyczeń technologicznych oraz sposób, w jaki innowacyjność (w tym przypadku dotycząca technologii przędzenia) manifestuje się w kulturze materialnej.

Keywords: invention, spinning techniques, spinning bowl, Iberian Peninsula

Theoretical and practical aspects of technological invention and technological loan

The first theories of invention and diffusion arose in the 19th century from various study areas. The interest in technological and cultural changes stems in principle from anthropological postulates that discuss cultural changes through an amalgam of perspectives.

The theoretical aspects that bear highlighting were addressed by such important theorists, to state only the most lasting examples, as: A. Comte regarding the theory of knowledge, H. Spencer – society, K. Marx – economy, L.H. Morgan – agency, and E.B. Tylor – religion (for an

overview see O'Brien, Shennan 2010: 4–6; Godin 2013: 1–8).

It was not until the 20th century that two explanatory models, or theories of innovation, took centre stage. These have been known as the linear and the sequential models of innovation. Both attempt to explain how inventions emerge and explore the channels of their diffusion, rejection, or adoption. These models were created by V. Bush in 1945 in his *Science: The Endless Frontier* and were introduced to the field of innovation studies in the mid-1980s. He postulated that an innovation starts with basic research, followed by applied research and development, and is concluded with production and diffusion (Bush 1945; Godin 2013: 1, 12).

It also bears discussing the technological loan as a cultural transmission and a phenomenon of acculturation. According to B. Godin, acculturation is understood in a dual aspect, creative and destructive. It may synchronize and merge inventions of two cultures or completely disintegrate one of the cultures through internal or external conflict. Acculturation does not imply reception of a new culture and departure of one's own; acculturation is not a one-way process from one society to another. Rather, it is a source of change, diffusion, imitation, assimilation of new techniques, a loan or transfer of artisans, and a process of adoption and incorporation of new raw materials and tools adapted for a new environment (Eerkens, Lipo 2007: 239–242; Godin 2013: 12).

Reasons for the invention of the spinning bowl in the Iberian Peninsula

Invention is a vital part of the creation of a new material or non-material culture internalised within and adapted by a society or agency sector that creates it. Invention, as defined by Kristian Kristiansen, signifies an introduction of a new or original idea and is an innate ability of human agency (Kristiansen 2005: 113).

This definition of invention will be used as the operating concept to understand the evolution of material culture – in this case, the spinning bowl in the Castreña culture (Spain and Portugal) (Fig. 1). Our purpose is to lay a groundwork and create an explanatory model for the technological change in textile production in the period of protohistory through the use of a series of operational concepts such as invention, innovation, technological loan, and acculturation (*cf.* Ruiz 2017).

To this end, the study will focus on the technological chain (based on a general review of the technology used) and the operational-technical chain (based on a general review of the agents and their skills in the crafts being developed).

The examination of the technological and operative chains enables better understanding of the emergence and employment of the spinning bowl in the Iberian Peninsula, as well as the raw material, *Linum usitatissimum* L., and the techniques used in spinning and splicing. The knowledge of the technological chains and the artisan agents will help us to understand the process of invention and innovation.

The first step is an analysis of the term 'artefact', understood as both a tool and technique. Artefacts should not be studied in an empirical way. Instead, researchers should go a step further and see a textile tool in operation in conjunction with the artisan. In other words, to pursue a valid archaeological study one must contextualize. For this, a theoretical framework developed by anthropologists, ethnographers, and archaeologists will

be used (O'Brian, Shennan 2010: 11–12; Ruiz 2017). The relationship between material culture and the materiality of the cultural fabric of the agency has to be properly recognised, that is to say, comprehensive understanding of the relationships between the tools, textile products, and craftsmen who produced them should be sought. The present paper focuses on the lifecycle of an artefact, namely the spinning bowl, following A. Appadurai (Appadurai 1986) according to whom an artefact is created through a series of steps forming a sort of *curriculum vitae*.

The invention of the spinning bowl seems to have occurred in the southern Levant during the Chalcolithic period. From there, it was transmitted through a process of innovation, continuing northwards, to the region of the Balkans, and to the south, towards Egypt. The spinning bowl has been documented in the eastern Mediterranean from the Chalcolithic period to the Iron Age (Ruiz 2018).

The motivation for the introduction of a new spinning system appears to have been related to cultivation of flax and new processing techniques for other fibres that developed during the Neolithic period, including various techniques used for making yarn. The spinning bowl occurs again as an invention at the other end of the Mediterranean Sea, in the Iberian Peninsula, probably to answer the demand for a linen thread of a certain quality. Thus, the spinning bowl is found exclusively within the Castreña culture a few millennia after its invention in the eastern Mediterranean. Another possible impetus for this invention was the introduction and increased cultivation of *Linum usitatissimum* L. in the Iberian Peninsula and adoption of new aesthetic concepts and clothing in this culture. These new aesthetics and clothing were, in turn, driven by the impact of trade in Semitic fabrics and accessories such as *fibulae* (Ruiz 2018).

Indeed, the overarching factor in the invention of the spinning bowl in the Iberian Peninsula may well be that of business motivation itself; it behoves us to understand trade with Canaanite and Cypriot merchants on the routes towards the Atlantic – from the Hesperides to the columns of Hercules – as an aspect of social agency that acquires all novelties through trade and co-existence with other cultures. When items were traded among Canaanite and Cypriot merchants – in this case textiles, garments, and ornaments to fasten them – this apparently generated an inventive and innovative initiative among *habitus ingenius* (Ruiz-Gálvez 2013). Trade can be an intense transmitter of cultural information, explaining developments in material culture found in the archaeological record and, specific to our review, technological inventions. The consumer of such material culture re-contextualises it and becomes a promoter of the new inventions. This, in turn, leads to creation of another unique material culture (Antoniadou 2005: 66–67).

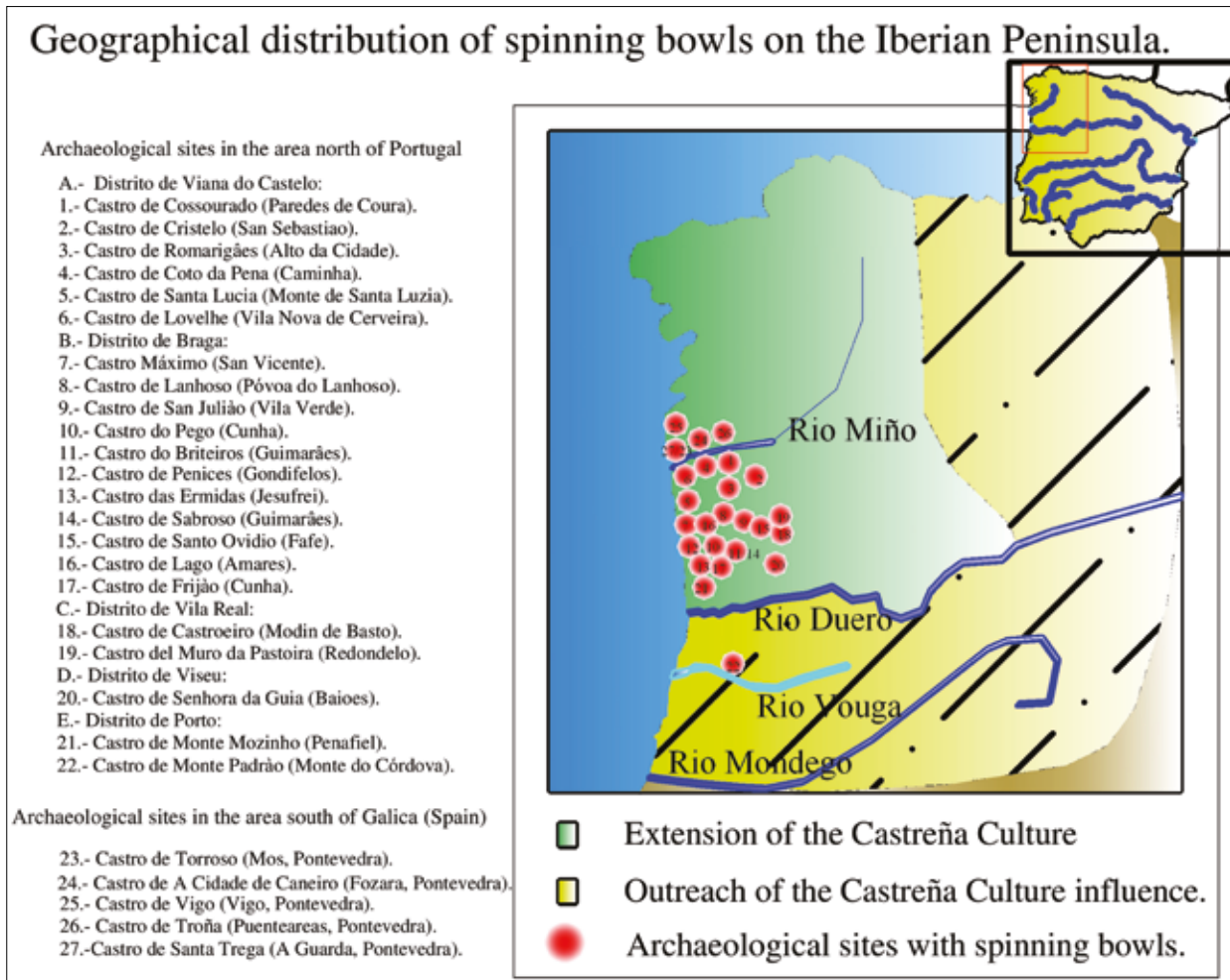


Fig. 1. Castreña culture and the distribution of the spinning bowl on the Atlantic shore of the Iberian Peninsula (drawing by the author).

The curious thing about the spinning bowl is that in the Iberian Peninsula its invention did not pass through cultural boundaries to other surrounding areas as an innovation (as for example to the Tartessian cultural area or the Phoenician coastal settlements). Rather, it remained deeply rooted as a strong tradition of spinning for one thousand years within a very specific area of the Castreña culture located between northern Portugal and southern Galicia (Spain) (Fig. 1) (Ruiz 2018).

The development of spinning technology in the northwest of the Iberian Peninsula during the Late Bronze and Iron Ages

The spinning bowl: a tool for spinning

The spinning bowl is a vessel made of ceramic or stone (ceramic types being the most common), of a shape that can be classified within the ceramic typology

as a shaped bowl with a handmade or wheel-thrown body and a handmade, internal handle or handles (Fig. 4).

Despite the variations in body shape, the feature that is common to all these vessels is the presence of internal handles that vary in number from one to four. They may be arranged in the centre of the bottom or elsewhere on the inside, with the handle or handles extending vertically to just below the rim of the bowl (Fig. 4). These internal handles, which are a defining feature of these objects, usually have a number of grooves worn on the inside of the loop. This tool was used in the process of textile production, specifically in the production of linen yarn (Ruiz 2018).

Spinning techniques related to the spinning bowl

There are four spinning techniques used in conjunction with the spinning bowl, such as splicing, spinning with a hooked stick, spinning with grasped and supported spindle, and suspended spindle (Crowfoot 1931:

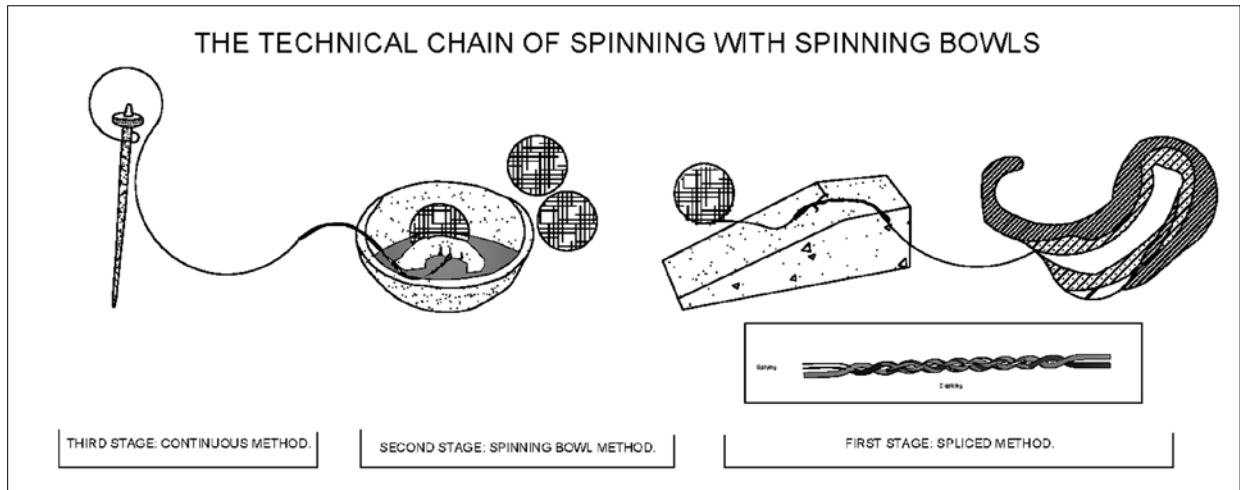


Fig. 2. Operational sequences of spinning with a spinning bowl (drawing by the author).

7–31; Barber 1991: 39, 41–50; Ruiz 2018). These techniques of creating thread are clearly confirmed in Egypt through wall paintings and models from the necropolises. They were used to achieve a linen thread of high quality (Kemp, Vogelsang-Eastwood 2001).

The present study aims at exploring the process of making a high quality linen thread by a skilled artisan. Fine properties of the yarn were possibly achieved thanks to the spinning bowl (Fig. 2). The grooves of the internal handles and the process of moistening the flax seem to be crucial, as these two techniques result in linen thread of high quality (flexibility and strength). We do not discard religious and symbolic beliefs connected to spinning that give the fabric qualities of not only extrinsic but also intrinsic character. From the above it can be concluded that this tool was essential for creation of a thread of high quality and certain characteristics that are present in textile remains from Egypt (Cooke *et al.* 1991; Hearle *et al.* 1998; Granger-Taylor 1998: 104; Ruiz 2018).

Spinning systems employed within the Castreña culture during protohistory: textile fragments of Tartessian and Semitic origin in Iberia, *fibulae*, and spinning tools in the Castreña culture

The extreme acidity of the soil in the region occupied by the Castreña culture makes it impossible to collect and study samples of textiles from this area (Santos 1984: 55; Matos 2006: 305, 319, 545). It also hinders survival of textile tools made of perishable materials, even those made of clay. Yet, the archaeological record offers us a series of materials directly or indirectly associated with textiles, such as *fibulae*, clothes pins, buttons, and Castreña iconography. The research is also aided by examining preserved textile remains of the same age but from other cultural contexts in Iberia.

An attempt was also made at identifying the social and symbolic changes, and the value of the new fashion that emerged between the Late Bronze Age and the Early Iron Age (Fig. 3).

Textile fragments of Tartessian and Semitic origin in Iberia

To understand spinning in the Iberian Peninsula better, it is necessary to describe some textile fragments coming from the cultural environment of the Castreña culture, *e.g.* the Tartessian and Phoenician necropolises. The Phoenician colonies and small settlements in Iberia were composed of Canaanite and Cypriot people who settled on the Iberian coast. The Tartessos or Tartessian culture corresponds to the autochthonous culture with a large population and pronounced cultural hybridity. It begins in the Late Bronze Age (the 9th century BC) and extends geographically to the south of Portugal and the current region of Andalusia (Spain) (Collado 2017: 22–24).

The Phoenician and Tartessian textiles preserved in tombs help visualise textile traditions in the region:

1. Semitic tombs located in Cadiz, ancient Gadir. One contained several textile fragments inside a woman's anthropomorphic sarcophagus dated to approximately the 5th century BC (Alfaro Giner 1983).

The analysis of these textile pieces shows that the deceased was buried with an outfit composed of several overlapping tunics (three or four). These tunics were made of fine s-spun linen threads in a 1/1 tabby. This spinning direction is significant, since until the arrival of the Semitic people in the Iberian Peninsula z-spun threads dominated. Dr Carmen Alfaro Giner points to the possibility that this clothing, designed and manufactured for the person for the afterlife, may have come from outside the Iberian Peninsula, given the



Fig. 3. Reconstruction of the clothing of a Castro warrior (Rey o 'Princeps' galaico de Lezenho, parroquia de Campos, en la Gallaecia meridional. Estatua del siglo III a.C) (by André Pena Graña).

quality of the s-spun threads. This is, however, not to totally discard the theory that these textiles might have been of local production (Alfaro Giner 1983: 281–289).

2. Tartessian tombs with textile remains, particularly those located in Seville Angorilla (Alcalá del Rio, Seville). Various carbonised textile remains have been found and dated to the 7th century BC. They comprise pleated fabrics and tapestries (Alfaro Giner 2007).

The textile remains were found by G. Bonsor in the Tartessian necropolis of Alcantarilla (Carmona, Seville). The textiles have been dated by other relics found with them, such as buttons and pieces of ivory, to approximately the 7th century BC (Alfaro Giner, Tébar Megías 2007).

The study carried out by Alfaro Giner describes two types of Tartessian textiles. The first were made of z-spun threads in a 1/1 tabby and were most likely pleated. This clearly demonstrates that the pleated vestments documented in the Phoenician iconography were introduced into the Tartessian culture. There are also representations of the pleated garments on the ivory objects from these tombs, such as combs and decorated wooden boxes for ointments and personal items (Alfaro Giner, Tébar Megías 2007: 65–66).

The other type of Tartessian fabrics demonstrates a different technique which imitates tapestries. They were made of 2S-ply z-spun yarn in a 1/1 tabby. The fabrics were made of flax, but, since they were studied under difficult conditions, it could not be conclusively excluded

that animal fibres, such as wool, were also used for their production (Alfaro Giner, Tébar Megías 2007: 65–68).

These fabrics, probably of Tartessian manufacture, show how this culture adopted the technique of making fabrics that imitate tapestries and pleating, which was widely used in the Eastern Mediterranean, as well as in the Semitic and Egyptian environments. In addition, with z-spun threads (in contrast to the local tradition of making s semi-spun threads), it also exemplifies how new techniques partly integrated the traditional technology and how innovations were introduced and adopted (Alfaro Giner, Tébar Megías 2007: 69).

There is another textile fragment from the Tartessian necropolis of Angorilla (Alcalá del Rio, Seville), also studied by Alfaro Giner and dated to between the 7th and 6th century BC. The textile is in a mineralised state. Studies conducted with the SEM reveal that it is a 1/1 tabby made of s-spun linen threads of an extreme fineness (0.2–0.3 mm diameter in weft, 0.3–0.4 mm diameter in warp) and a density of 14 threads per centimetre (Alfaro Giner 2007: 1–5).

It is to be assumed that the fabrics used in the Castreña culture might have been similar to the described ones, since both cultures maintained intense commercial contacts with the Phoenicians, with whom not only goods were exchanged but also ideas, techniques, knowledge, and the artisans themselves (Naveiro 1991: 23–115; González 2011: 171–172).

Fibulae

Valuable information about textiles comes also from the *fibulae* (La Salette 1999), especially when they are analysed in a socio-economic context, delving deeply into typology, chronology, and its introduction into the Castreña culture. *Fibulae* in this period might have had a symbolic meaning, beside their purely utilitarian function and possible other uses, *e.g.* as an object of exchange or for some medical or hygienic purposes. As suggested by Maria La Salette (1999), evidence for the *fibulae* in the Iberian Peninsula is definitely an indicator of supra-regional trade between the Atlantic and Mediterranean regions and Central Europe, especially from 1250 BC to the 8th century BC. Moreover, it should be noted that the prevalence of *fibulae* in the Iberian Peninsula would have been accompanied by new styles of clothing. Initially, the *fibulae* were transmitted through trade from the Central and Eastern Mediterranean and were later manufactured locally in the Castreña culture.

Spindle whorls in the Castreña culture

Spindle whorls provide the most useful evidence of spinning techniques in protohistory. The study of these items in the Castreña culture indicates that in the areas where the use of the spinning bowl was attested, ceramic spindle whorls made *ex professo* were also found. In contrast with these fine spindle whorls, their counterparts from other areas were made of pierced pot-sherds (Rodríguez 2014: 402). Within the class of whorls made from reused ceramic, fragments of containers, plates, and other elements of domestic ware are worth noting. These pieces had undergone special treatment, *e.g.* rounding out the shape or perforation of the centre, thereby achieving optimal dimensions, shape, and weight to perform their new function. Neither the reason nor the social and technical implications are known in regard to this pan-Mediterranean tradition of recycling ceramic fragments of containers and domestic tableware as spindle whorls (Naveiro 1991: 113–114; Rodríguez 2014).

It is also noteworthy that the spindle whorls found in the same contexts as spinning bowls were made of fine clays distinct from those used in other areas. The whorls from *castros* (settlements in the Castreña culture), *e.g.* in Castro de Vigo, where spinning bowls were found as well, were also carefully manufactured.

The cultivation of flax (*Linum usitatissimum* L.) in the north-west of the Iberian Peninsula in the Late Bronze Age and the Iron Age

At present, no flax remains are known from the north-western region of the Iberian Peninsula dated to

the period of the Late Bronze Age and the Iron Age. Thus, it is still unknown what type or variety of flax was used, if any. Neither is it clear what fibres were potentially used to manufacture yarns during this time and in this region.

However, the historian Pliny, who collected information on the territory of the Zoelae (Celtic tribe of Gallaecia) in the northern part of the Iberian Peninsula, left a written account that mentions flax in the area of the Roman Gallaecia, *i.e.* modern-day Galicia. Specifically, Pliny highlights the fame of the linen fabrics from this region (Pliny, NH, XIX, 10) (Naveiro 1991: 76; Alfaro Giner 1997: 22–24). There is also a mention by Strabo, who conveys information about the Lusitanos and, specifically, the inhabitants of the area along the river Douro (in northern Portugal and southern Galicia). He describes their warriors who wore shirts made of flax and also mentions the taxes collected in linen fabrics (Strabo III, 3, 5). Further evidence comes from stone sculptures that depict Iron Age male clothing. These sculptures and other archaeological findings in Galicia and northern Portugal (Arias 1984: 23–24) reveal that the people wore wool and linen clothing, following a new fashion that mixed Celtic attires with an Oriental or Mediterranean touch. Thus, they achieved an individual style, termed 'Atlantic', as indicated by the uniqueness of some geometric patterns that can be observed in the sculptures (Ruiz-Gálvez 2013) (Fig. 3). For their daily wear, the men usually wore black clothes with small cloaks; the women, light-coloured clothes with long capes. As in the surrounding cultures, clothing, social functions, rites, and festivities were inherently linked and harmonised. It is also known that both male and female warriors wore light clothing and a harness or breastplate made of linen. The king and local leaders used also knitted chainmail and helmets, *fibulae*, amulets (and glass beads), and ornamental belts of Phoenician, Celtic, and Tartessian origin (Naveiro 1991: 163; González 2011: 171–172).

Pollen diagrams from the regions of southern Galicia in Spain and northern Portugal indicate that flax was not a cultivated crop in that region in the period from 3500/3000 to 1500 BC. The absence of flax in the area is indicated not only by the lack of pollen but also by the lack of seeds and remains of other plant material from this time. We only found evidence of domesticated flax in the diagrams of pollen studies from Casim de Conimbriga (northern Portugal), a habitat within our study area (Ramil, Aira 1996: 278–279).

For the Castreña culture, pollen studies have also been undertaken at various archaeological sites of the Late Bronze Age. Surprisingly, there is no documentation in the databases of pollen extracted from *Linum usitatissimum* L., although this area possessed an extremely humid and temperate-to-cool climate during this period (González 2006–2007: 80–81).

There is evidence showing that throughout the entire Castreña culture, in the northernmost part of the studied region, Castro de Camoca (Asturias, Spain), plants of the genus *Linum* were cultivated during the 1st millennium BC, but this is far from the archaeologically-traceable distribution area of the spinning bowls. A series of pollen analyses made for this area and covering the Iron Age demonstrates that flax has been cultivated at this site from that age until the present (Barroso *et al.* 2008: 179, 183).

Analysis of the contexts of discovery of the spinning bowls in the Iberian Peninsula

The spinning bowl in the domestic context: household production

The Castreña housing architecture is very unique within the Iberian Peninsula, as it is a mixture of two cultures, the Celtic and the indigenous (Rey 1990–1991). This resulted in the emergence of fortified settlements. Inside such residential complexes there were individualised and independent domestic areas (Fig. 5). The Castreña housing consisted of four areas: the housing area itself, a separate area differentiated and compartmentalised at the entrance, another building adjoining it used for manufacturing activities and storage, and a patio.

The interior of a typical household within the entire area of the Castreña culture contains clear and repeated evidence of several types of activities, such as metallurgy, textiles, processing of agricultural products, pottery-making, goldsmithing, woodworking, *etc.* (Rey 1999: 174). These activities in the domestic space correspond to a general maintenance area (fireplace and kitchen) and a space for craft activities, such as textile production for domestic purposes or exchange, as evidenced by the presence of spinning bowls and whorls (Ayán 2001: 47).

The spinning bowl in the artisanal context: the first specialised production in Castreña workshops

Two spinning bowls were found within two large elongated structures, possibly workshops, at the site of Castro de Cossourado in Portugal, dated to between the 5th and 2nd century BC. The multifunctional buildings where these spinning bowls were found comprise a part of an artisanal area used for storage and processing of raw materials. The site consists of several buildings in close proximity to each other and at some distance from other houses within this fortified settlement (Matos 2006).

The spinning bowl in the religious context

The spinning bowl was also found in a ritual pit in Castro de Frijao. In the pit, there were deposited artefacts witnessing a religious symposium (*e.g.* a European-type bronze cauldron, tableware, and other items used in rituals) (Fontes 2013).

The spinning bowl inside this ritual pit could be connected to other sacred areas in temples, sanctuaries, or places of worship where textile tools were found. Whorls, needles, and loom weights were possibly given to the divinity as offerings or were used in rituals (Vílchez 2015).

The spinning bowl in the Roman *thermae* in the Roman period

There is a spinning bowl in the atrium or entrance area of a Roman public bath in Castro de Monte Padrão (Brito 2010). The location of the spinning bowl in the archaeological context suggests it may be contextualised as a part of the construction. That is to say, it might have been reused as construction material in one of the building phases. It is also possible that the portico entrance was designed for some manufacturing activities, one of which could have been spinning (Coelho 1995: 522).

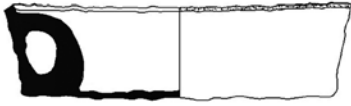
Conclusions

The spinning bowl as an invention in the Castreña culture did not cross that culture's borders. We only locate this tool in other areas of the Eastern Mediterranean. There is a gap in its distribution in the Central and a part of the Western Mediterranean, as well as in Central and Western Europe.

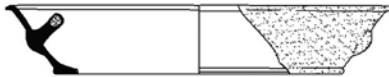
The possibility that the spinning bowl in the Castreña culture was an innovation that was transferred through contact with Canaanite people living in Iberia should be discarded, since this tool has not been documented in Phoenician colonial contexts.

Other communities of the Iberian Peninsula did not adopt this tool as an innovation or technological loan from the Castreña area. The reason for this may be two-fold. On the one hand, older methods of spinning and fibre processing might have been maintained for symbolic or religious reasons. On the other hand, certain specialised commercial trade goods, such as fabrics with certain characteristics, made of unique raw materials, such as flax, and manufactured with specific techniques and tools, such as spinning bowls, might have been produced for exclusive markets or for craft groups that did not openly share their secrets. This may explain why the invention of the spinning bowl did not progress outside the restricted area in the Iberian Peninsula, despite being used there for more than a thousand years. The geographically and culturally restricted use of the spinning

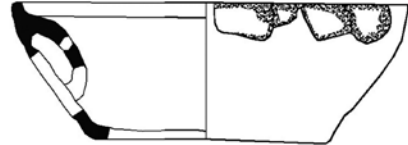
Atlantic Final Bronze/Iron Age I



Castro de Torroso

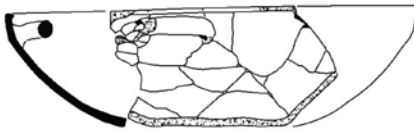


Castro de Frijao



Castro de Cossorado

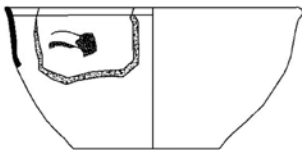
Iron Age II



Castro de Castroeiro



Castro de Vigo



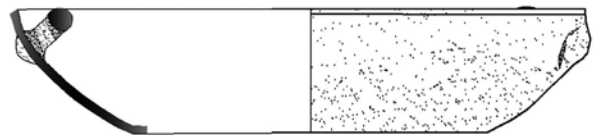
Castro de Cristelo



Castro de Trega



Castro de Santo Ovídio



Castro de Muro da Pastoria

Fig. 4. Typology of the spinning bowls in the Iberian Peninsula (drawing by the author).

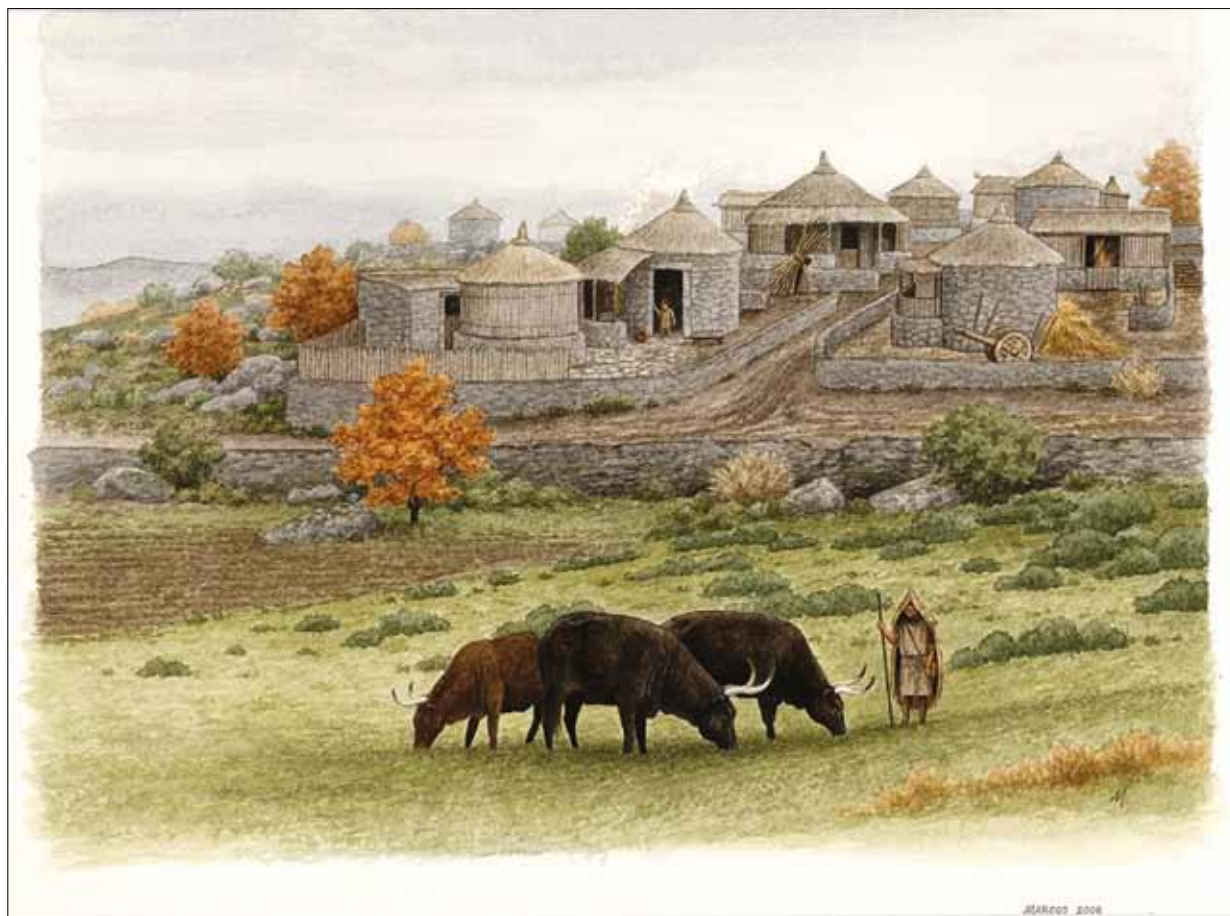


Fig. 5. Reconstruction of a Castreña habitat (watercolour by Marcos Oliveira Silva).

bowls may be associated with the use of fine spindle whorls made by professionals.

It may be suggested that the invention of the spinning bowl emerged in association with flax processing. Both the spinning bowl as a new tool for making thread and *Linum usitatissimum* L. as a new type of a cultivated textile plant gave birth to a new technological chain that expanded towards southern Galicia and northern

Portugal. However, pollen analyses from this area indicate that *Linum usitatissimum* L. was absent in the Late Bronze Age and the Iron Age, *i.e.* during a large part of the time-span of the Castreña culture. Indeed, evidence of this crop has only been found in two fortified settlements. This suggests a possibility that a more diversified and specialised chain of production might have been involved and flax might have been imported as a raw material.

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