A brief overview of archaeological research on ancient mills and milling in Spain

Natàlia Alonso and Timothy J. Anderson

Abstract: This article presents a brief review of the history of research on archaeological mills and milling in the Iberian Peninsula. As elsewhere in Europe, molinological research began discretely in the 18th century. Early work was carried out by prestigious researchers including the Siret brothers, P. Bosch Gimpera and V. G. Childe. The seminal article by this last scholar, based on the research of Bosch Gimpera, introduced the notion which still stands today of a Western Mediterranean origin for the rotary mill. Another molinological milestone in Iberia was this research carried out by F . de Avilés, then director of the National Museum of Archaeology at Madrid. The findings of his vast data base in the form of a questionnaire sent out different archaeological institutions throughout the Peninsula, alas, remained incomplete and unpublished until it was presented by L. Berrocal more than a half century later. The turn of the millennium has seen a renewed interest on the subject as evidenced by six doctoral dissertations exploring different molinological aspects.

Keywords: quern, millstone, mill, research, historiography, Iberian Peninsula, Canary Islands, Balearic Islands

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Introduction

A review of the history of archaeological research on mills and milling in the Iberian Peninsula must heed to the fact that despite the large size of querns and millstones, these artefact have over time generally been disregarded. This neglect is not limited strictly to the Iberian Peninsula but widespread throughout Europe. One explanation is their cumbersome nature and the logistical problems linked to their transport and storage in research centres, universities and museum depositaries. These logistical problems have over time, in fact, served as an excuse to justify their abandonment as many that were collected were relegated to dark warehouses, bereft of any indication as to their find spot and stratigraphic or chronological context. There are exceptions, nonetheless, throughout the history of Iberian archaeology since its inception in the 19th century. A minority of archaeologists have actually recognised their value and revealed an authentic interest in them by undertaking a series of compelling studies.

This introductory article offers a broad overview of the research carried out by these early "molinologists". Although not intended to be exhaustive, this review clearly demonstrates that despite the widespread neglect, archaeological research on mills and milling in the Iberian Peninsula took its first steps over a century ago.

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The state of research on mills at the inception of archaeology in the Iberian Peninsula

The collection of data on manual grinding in both archaeological and ethnographic contexts in Iberia began in the mid-19th century. This line of study in Iberia was bolstered by a series of European publications, accompanied at times by drawings, essentially focusing on querns driven with a to and fro movement (e.g. Foulon 1868) (Fig. 1a). The oldest known depiction of an archaeological mill in Iberia is a quern illustrated in an unpublished site report dating to 1872 of the settlement of Ladera de San Antón (Orihuela, Alicante) by Santiago Moreno for the *Societat Arqueològica Valenciana*. This findings of this report, alas, did not see light until many years later in a publication of the *Servicio de Investigación Prehistórica* (SIP) of 1942 (Moreno 1942: 55) (Fig. 1b).

The first real published archaeological querns in Iberia correspond nonetheless to the series described and illustrated by the Belgian brothers Louis and Henri Siret in the ornate plates of the book *Las primeras edades del metal en el sudeste de España* (1890), a compilation of their research between 1881 and 1887 (Fig. 2). A fine example is the group of ten querns forming a milling installation brought to light at the Early Bronze Age Argaric settlement of Ifre in Mazarrón in the Province of Murcia:

… se encontraba una banqueta hecha de piedra y barro, sobre la cual descansaban diez muelas de dimensiones y naturaleza diversas: una de ellas es de traquita, otras son de micacita y otras de una arenisca fosilífera, rocas todas resistentes y que suministran fácilmente una superficie áspera…[1] (Siret and Siret 1890: 113).

On the same page the authors point out that these artefacts are omnipresent at the site and probably the largest assemblage of south-eastern Spain:

… su número sea mucho mayor que en ninguna otra de que tengamos conocimiento, a excepción tal vez de las de Hissarlik[2].

a

b

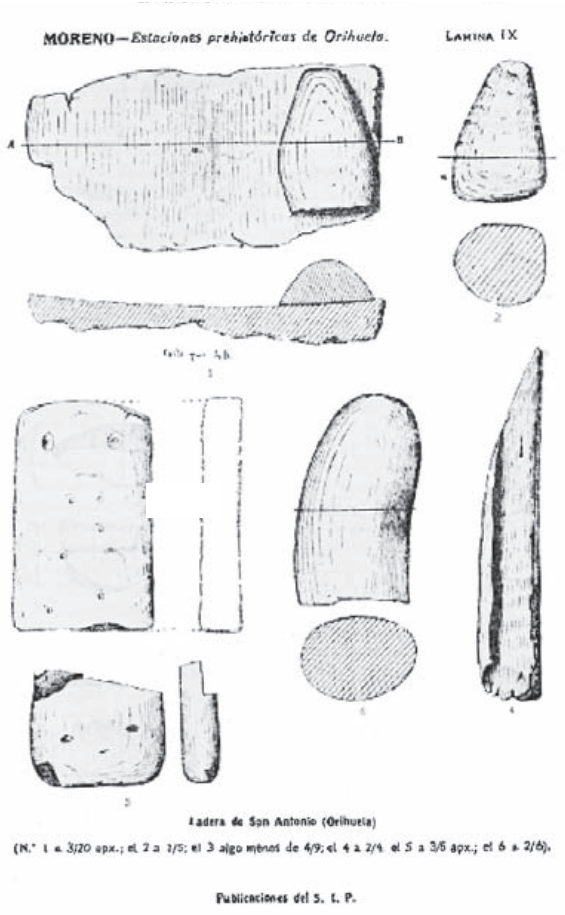


Fig. 1: Old illustrations of archaeological hand mills: (a) drawing of a quern from Guérande (France) and a reconstruction of a milling scene (Foulon 1868, plate 1); (b) drawing of a quern from the site of Ladera de San Antón (Orihuela, Alicante) by S. Moreno (1872) published many years later in 1942 (Moreno 1942: plate IX).

1. Editor translation: "... a bench made of stone and clay served as a support for ten querns of different size and rock type: one is a trachyte, the others are of mica-schist and fossiliferous sandstone, all resistant rocks offering coarse grindingsurfaces ..."

2. Editor translation: "... their numbers are much greater than anything else we know, except perhaps at Hissarlik".

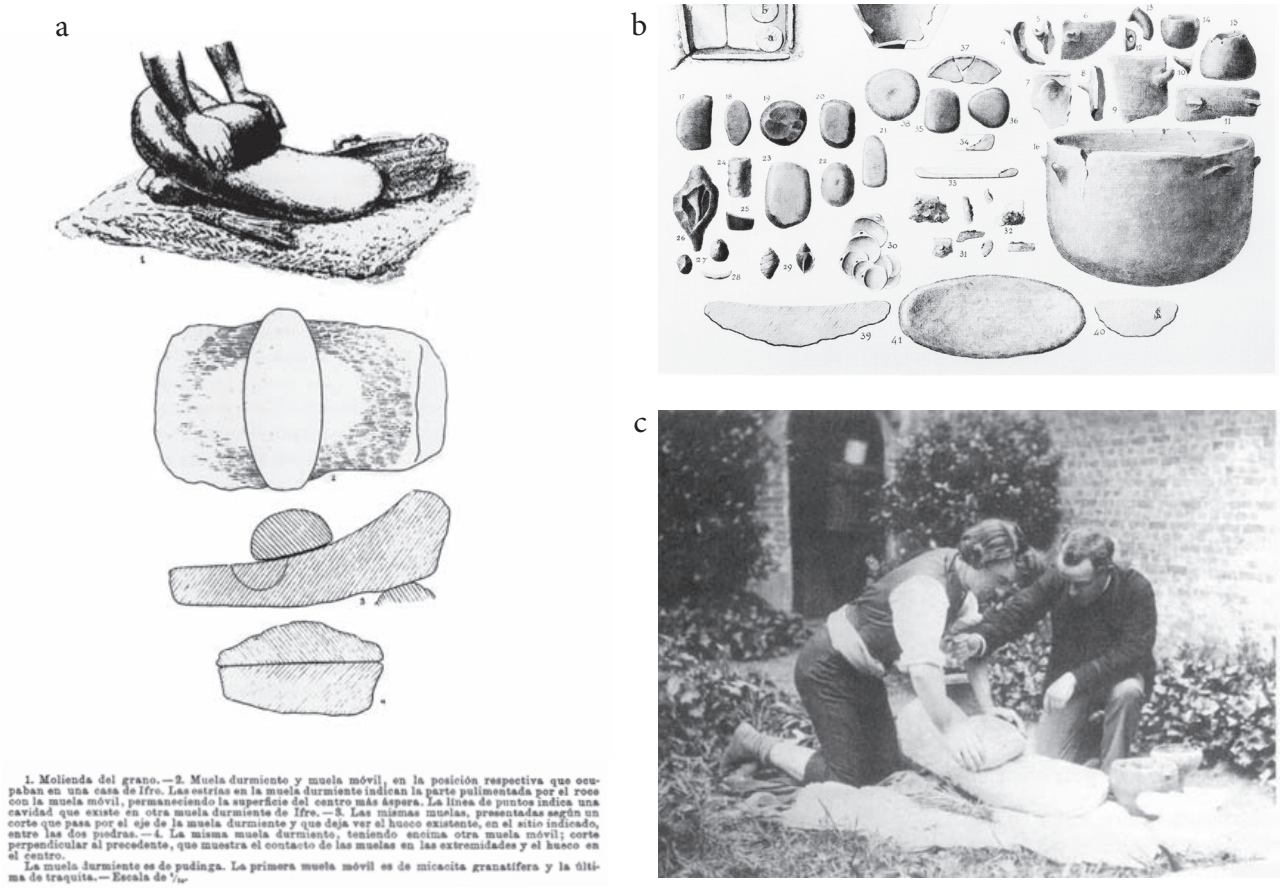


Fig. 2: Plates from Louis and Henri Siret's monograph Las primeras edades del metal en el sudeste de España *(Siret and Siret 1890): a) drawing of a quern from the site of Ifre (Mazarrón, Murcia) and explanatory text (plate XI); b) an assemblage of archaeological materials including a quern; c) photograph from 1882 depicting Louis, assisted by his brother Henri, testing a quern from the site of El Argar, Almería (from Cauwe 2003, fig. 8).*

Hissarlik is obviously a reference to the celebrated site of Troy excavated and published by Heinrich Schliemann.

The Siret brothers also noted the detailed dimensions of the quern finds and delved into the question of their spatial context. Moreover, not only was publication of the group of querns at Ifre probably the first identification of an *in situ* installation of this type in Europe, but also the first to be the object of use-wear analyses (Fig. 2a). The brothers also made an effort to define the rock types:

… la muela durmiente es de pudinga. La primera muela móvil es de micacita granatífera y la última de traquita.[3] (Siret and Siret 1890: 115)

Yet the brothers' observations went beyond petrographic determinations as they also carried out experiments to prove their grinding qualities. This is illustrated in a photograph from 1882 where Louis, assisted by Henri, tests a quern from the site of El Argar, Almería (Cauwe 2003, fig. 8) (Fig. 2c). It is noteworthy that the quernstones of the eponymous Early Bronze Age site of El Argar will more than a hundred years later be the focus of a specific study by R. Risch and S. Delgado (Risch 2002; Delgado 2008; Delgado and Risch 2008).

It is also of remarkable that several general historical and ethnographical studies of ancient milling published elsewhere in Europe at the end of the 19th century cited the research of the Siret brothers in southern Spain. These include the seminal molinological paper *Les origines du moulin à grain* published in France by L. Lindet (1899).

The outset of the 20th century: querns in dribs in drabs

The early 20th century saw another example of interest in recording and analysing archaeological mills, which also led to a compelling debate on the question of the origin of the rotary quern in the international arena, a subject that will be developed later in this paper. This was instigated by Pere Bosch Gimpera, one of Catalonia's most prestigious and recognised internationally scientists and, among other occupations, director of the *Servei d'Investigacions Arqueològiques del Institut d'Estudis Catalans* (Gracia 2011).

3. Editor translation: "... the lower stone is a puddingstone. The first upper quern is of granatiferous micacite and the last is of trachyte".

In the publications of this institute, mainly its excavations in the Lower Aragon region, Bosch Gimpera regularly referred to mills and millstones. In an article published in 1923 entitled *Les investigacions de la cultura ibérica al Baix Aragó*, for example, he described the finds of the excavations carried out between 1915 and 1929 at Sant Cristòfol (Maçalió, Teruel) (Fig. 3a) comprising a series of elongated upper querns bearing lateral "grips" to facilitate their use (Bosch 1923: 664). It is in fact this quern that is illustrated in the recent monograph penned by David Peacock (2013, fig. 3.1,a).

In the same publication, in the chapter on the site of El Piuró del Barranc Fondo (Maçalió, Teruel) that he excavated with Llorenç Pérez, he describes what is to our knowledge the first archaeological drawing of an Iberian rotary mill (Bosch 1923, fig. 490-491) (Fig. 3b). The author goes so far as to offer a reconstruction of its system of traction:

… la peça superior té dos apèndixs que corresponen als agafadors de les moles anteriors i en els quals apèndixs hi ha unes ranures que es degueren adaptar a un aparell de fusta destinat a fer girar la mola…[4] (Bosch Gimpera 1923: 654).

Yet Bosch Gimpera does not offer an explanation of the rationale of the mill reconstruction (Fig. 3c) that includes a podium appearing as a dotted line in the illustration, a feature that was not cited in the text (Bosch 1923, fig. 492). It therefore remains unclear if this sort of podium serving to raise the mill to be driven from a standing position was observed at the site or if the presence of this feature was gleaned from observations at other sites.

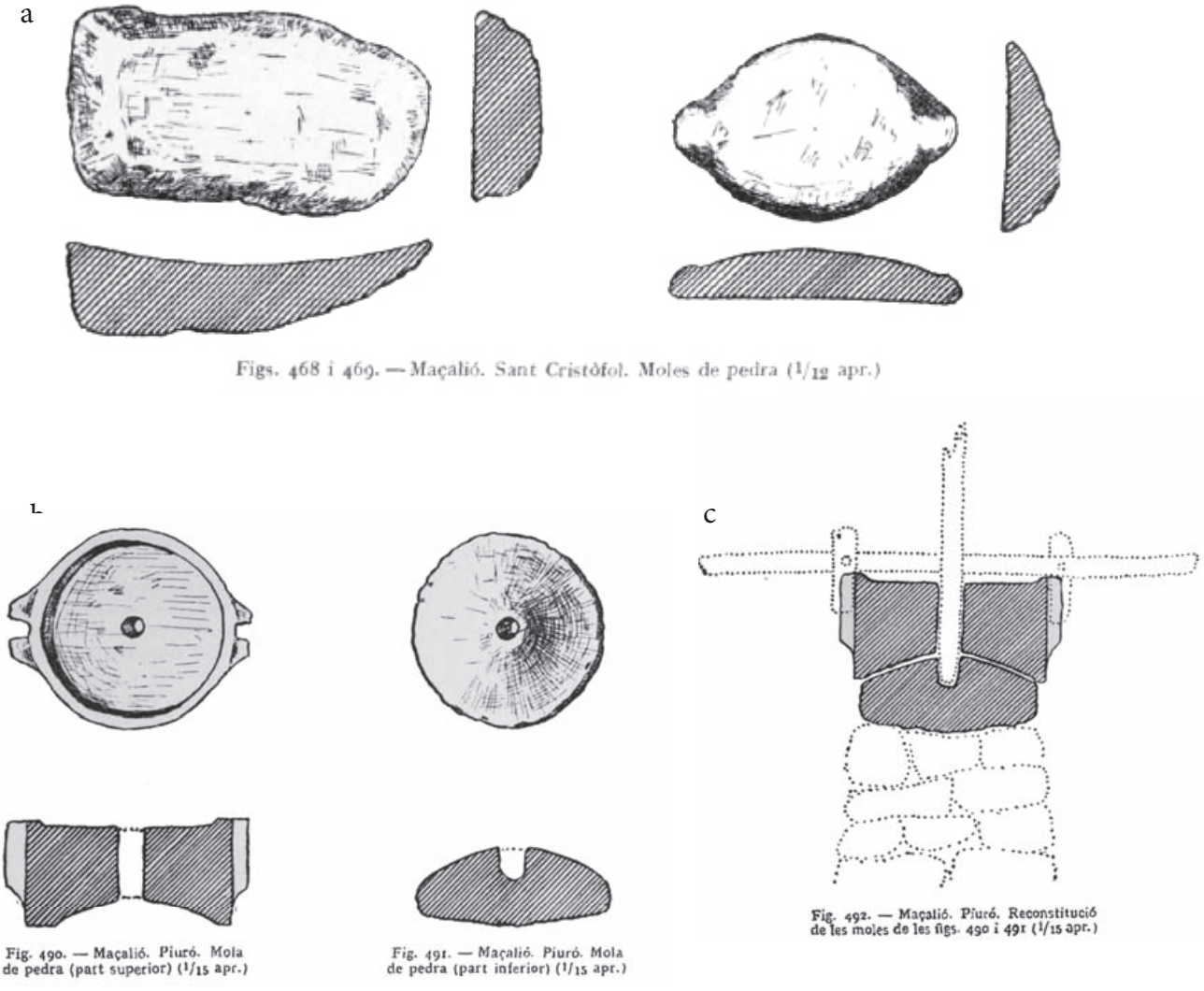


Fig. 3: Illustrations of querns and millstones from P. Bosch Gimpera's publication of 1923 of sites in the Province of Teruel. a) Maçalió: hand querns (the second with lateral grips; b) Sant Cristòfol: elements of a rotary mill, and c) El Piuró del Barranc Fondo: reconstruction of a rotary mill set on a theoretical podium (Iberian rotary pushing mill).

4. Editor translation: "… the upper stone has two appendages corresponding to lugs bearing cuttings that serve to lodge a wooden rig to drive the stone …"

Other researchers from the *Institut d'Estudis Catalans* at this time did in fact report the existence of these types of rotary mills on podia at settlements dating from the Iron Age Iberian Culture. An example is that of Tossal de les Tenalles (Colominas and Duran i Sampere 1920: 606-16):

Una de les habitacions d'aquesta banda tancava un piló cilíndric de molí voltat de grans gerres dretes clavades a terra…[5]

But these authors do not take the time to describe either the structure or the mill, and even reveal a certain amount of contempt toward the mills as seen through their comment:

Segurament les pedres del Tossal de les Tenalles que poden tenir un major interès arqueològic són uns quants fragments de motlles per a fer anells i altres ornaments…[6]

Furthermore, in the same region (Bajo Aragón) toward the middle of the 1920s, Vicente Bardaviu and his French colleague Pierre Paris carried out excavations (1924-1925) at El Taratrato (Teruel) with members of the *Institute d'Études Hispaniques* of Bordeaux. Among the finds, published in 1926, are a series of rotary querns set on podia in a building (unit 18). These constitute one of the better examples of collective milling in the Iberian Iron Age (*Maison des moulins*) and are described in detail (Paris and Bardaviu 1926: 67-72). Apart from a number of photographs and figures (Fig. 4), the authors offer several paragraphs of descriptions of the other mills (Paris and Bardaviu 1926: 107-108):

Les moulins nous arrêteront un peu plus. Grâce au déblaiement de la maison nº 17-18-19, nous connaissons l'installation des moulins à deux meules, l'une concave et l'autre convexe. Il est d'ailleurs inutile de décrire une à unes les nombreuses meules que nous avons trouvées; contentons-nous de dire qu'en majorité elles sont peu épaisses, et qu'aucune n'affecte la forme en sablier qui fut un heureux perfectionnement, puisqu'elle permet de verser d'une seule fois au moulin une plus grande provision de grains, et qui abonde à l'époque romaine. D'autre part, le mode d'attache des bois destines à la manoeuvre de rotation restes très primitive, si l'on juge pas les

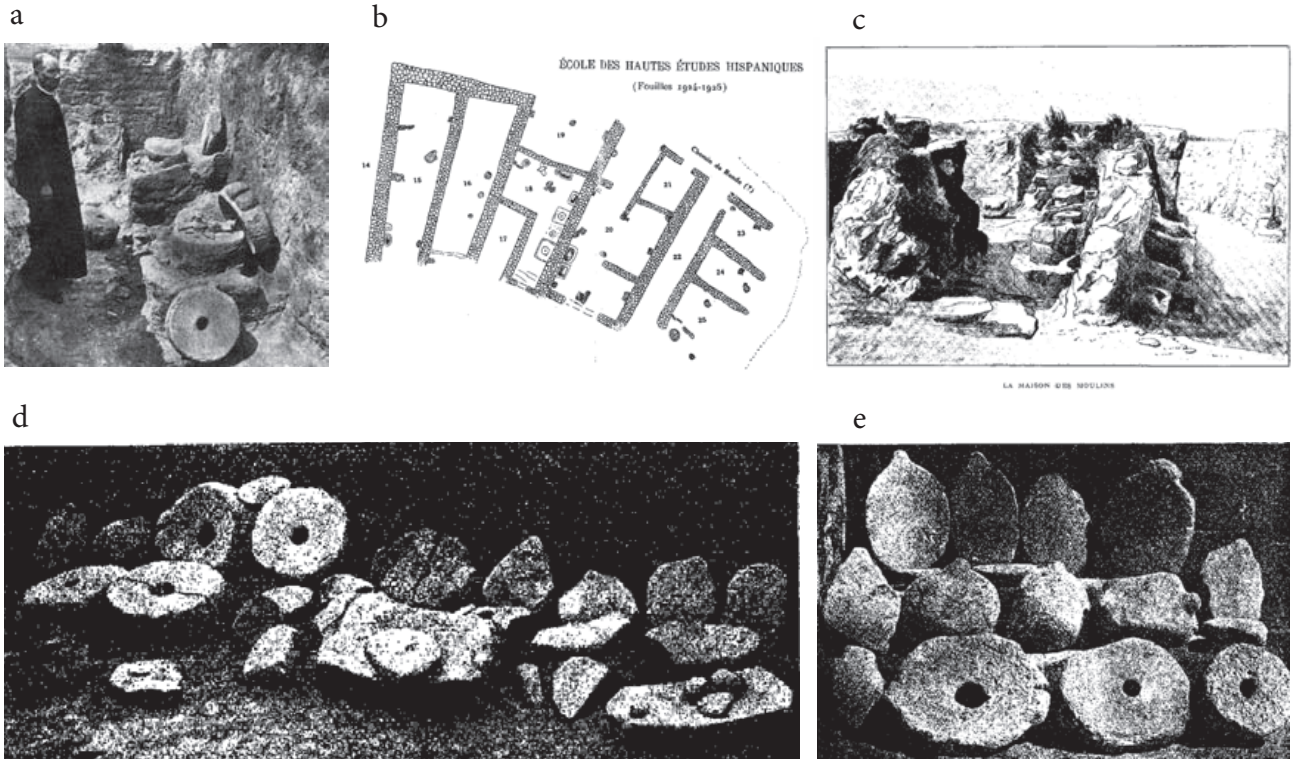


Fig. 4: El Taratrato (Teruel). a) Vicente Bardaviu standing before the rotary querns of Unit 18 (a from Benavente and Fatás 2009: 20); b) extract of the plan of the site indicating toward its centre the position of Unit 18; c) drawing of "la maison des moulins" (Unit 18) by Mme Paris; d) and e) photographs of querns and rotary querns (b-e from Paris and Bardaviu 1926: pl. XIII; pl. X; fig. 32, fig. 33).

5. Editor translation: "One of the rooms featured a cylindrical podium serving as a base of a mill surrounded by large vertical jars on the floor."

6. Editor translation: "Surely the only stones of Tossal de los Tenalles that have a great archaeological interest are the few fragments of moulds serving to make rings and other ornaments ..."

rares saillies, toujours très peu prononcées et à peine entaillées d'une rainura mince, qui se détachent au bord de quelques meules concaves (PL. X et fig. 32,33).

En revanche, les moulins à râpes, qui se sont rencontrés à profusion, ont des formes variées. La pierre fixe, qui atteint parfois d'assez grandes dimensions, était tantôt carrée et tantôt ovale ; elle était bientôt creusée et régulièrement ensellée par l'usure, et sans doute assez promptement mise au rebut. La râpe proprement dite était quelquefois laissée à sa forme naturelle, que l'on préférait un peu ovale, plate sur une face et bombée d'autre part, ceci afin qu'elle eût du poids et pût être facilement maniée. Mais un grand progrès, bientôt en grande faveur, cela n'est pas douteux, fut de tailler dans un bloc une râpe d'un bel ovale réguier, et de ménager à chaque pointe une corne forte et courte, pour qu'on pût bien saisir l'instrument, l'appuyer avec vigueur sur la meule dormante et lui imprimer sans trop de peine le nécessaire mouvement de va-et-vient. Nous avons eu soin de faire remarquer au passage que dans la maison des moulins à meules s'était trouvé le plus bel exemplaire de moulin à râpe à peu près rectangulaire, épaisse, presque plate par-dessus, avec deux grosses poignées fichées obliquement aux deux bouts. L'objet n'est pas élégant, mais il est spécialement vigoureux et pratique. (Fig. 32, 33).[7]

The *Junta Superior de Excavaciones y Antigüedades* also carried out excavations throughout the first decades of the 20th century at the celebrated ancient Celtiberian city of Numantia in the Province of Soria. The findings, including querns and millstones, were published in various reports appearing between 1908 and 1924. It is noteworthy that José Ramón Mélida, the director of the excavations, took note of the site's querns and millstones and had them safeguarded at the site's museum. He describes them in a general survey of the site published in 1922 (269-70) (Fig. 5):

Lo mismo sucede con otra clase muy distinta de utensilios de piedra caliza o arenisca y de tosca talla: nos referimos a los molinos de mano, de los que, sin duda, había uno en cada casa, y en algunas, dos, pues han salido casi juntos, habiéndose descubierto sobre un centenar, de los cuales hay muestras en el Museo. Se han hallado algunos grandes, hasta de 80 centímetros de diámetro; pero los más son de la mitad de tamaño. Se componen de dos piedras, macho y hembra, habiendo en ésta, que es la superior, un orificio al borde, para, con un palo, facilitar la rotación. Debieron usarlos principalmente para moler trigo (fig. 88). De este tipo de molinos usan todavía los rifeños.

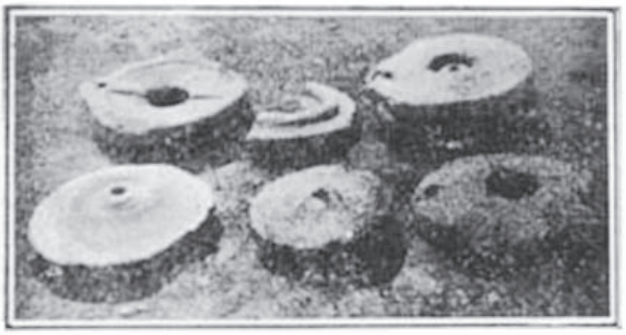


Fig. 88.—Molinos de mano, en piedra. *(Foto Mélida.)*

Fig. 89.—Piedras de moler. *(Foto Mélida.)*

Fig. 5: Numantia (Soria). Rotary querns and hand querns brought to light at the celebrated site of Numantia (from Mélida 1920, figs 88 and 89).

7. Editor translation: "The mills merit more explanation. The clearing of house nº 17-18-19 brought to light the installation of mills comprising two millstones, one concave and one convex. It is nonetheless useless to individually describe the many millstones we have found; let us content ourselves to note that, for the most part, they are not very thick, and that none have an hourglass shape which abound in Roman times and repesented a great improvement as they allow to be fed a greater supply of grains. On the other hand, the mode to attach the wooden rig intended for attatin a rotary motion remains very primitive, if one judges from the slightly pronounced rare projections bearing a thin groove on the edges of certain concave millstones (Plate X and Fig. 32, 33). On the other hand, the grater mills, which are common, have various forms. The fixed stone, at times of rather large, was at times square and at times oval; it was soon hollowed out and regularly worn by wear, and probably promptly scrapped. The rasp proper was sometimes left in its natural form, which was preferred a little oval, flat on one side and bulging on the other hand, so that it had weight and could be easily handled. But a great progress, soon in great favor, it is not doubtful, was to cut out in a block a grater of a beautiful oval reguier, and to arrange at each point a strong and short horn, so that one could well seize the instrument, press it vigorously on the millstone and print it without much trouble the necessary movement back and forth. We were careful to point out in passing that in the house of the mills had found the most beautiful example of grater almost rectangular, thick, almost flat on top, with two big handles stuck obliquely to both tips. The object is not elegant, but it is especially sturdy and practical. (Fig. 32,33)".

En menor número que los molinos se han hallado unas piedras de moler de forma oblonga y su superficie ligeramente curvada o cóncava (fig. 89).[8]

For its part, the recently created *Servicio de Investigación Prehistórica of Valencia* began in 1928 to excavate the site of Bastida de les Alcusses (Moixent, Valencia) under the direction of Isidro Ballester and Lluís Pericot. Their report also alluded to many Iberian Culture rotary mills (Bonet i Vives 2011). The same institution later initiated excavations (1933) at another exceptional settlement, Tossal de Sant Miquel (Llíria, Valencia), pursuing research until 1953 (with the exception of the years of the Civil War) (Fig. 6). The detailed excavation log penned by Lluís Pericot is great source of information for subsequent research on milling in the Iberian Culture (Bonet 1995).

A milestone in the history of Iberian molinology was the article *Rotary Querns on the Continent and in the Mediterranean Basin* by V. G. Childe published in 1943 in the journal *Antiquity* (Fig. 7). The celebrated scholar's work included a drawing of a rotary mill published in Bosch Gimpera's study of 1923 (cited above) of the Iberian settlement of Piuró del Barranc Fondo (Childe 1943, fig. 1). Childe's intention was in fact to rebut the argument of an Eastern Mediterranean origin for the rotary quern advanced by E.C. Curwen in his articles of 1937 and 1941 and propose the Western Mediterranean as its origin. This notion holds today as recent research corroborates an Iberian origin for the rotary quern (Alonso 1996; 1997; 2002a; Alonso and Pérez 2014; Alonso 2015; Alonso and Frankel 2017). Childe also drew attention to the importance of publishing quern and millstone finds from archaeological excavations (Childe 1943, 19), a notion that remains topical even today. Childe's paper was subsequently reviewed a year after its publication by Lluís Pericot in the

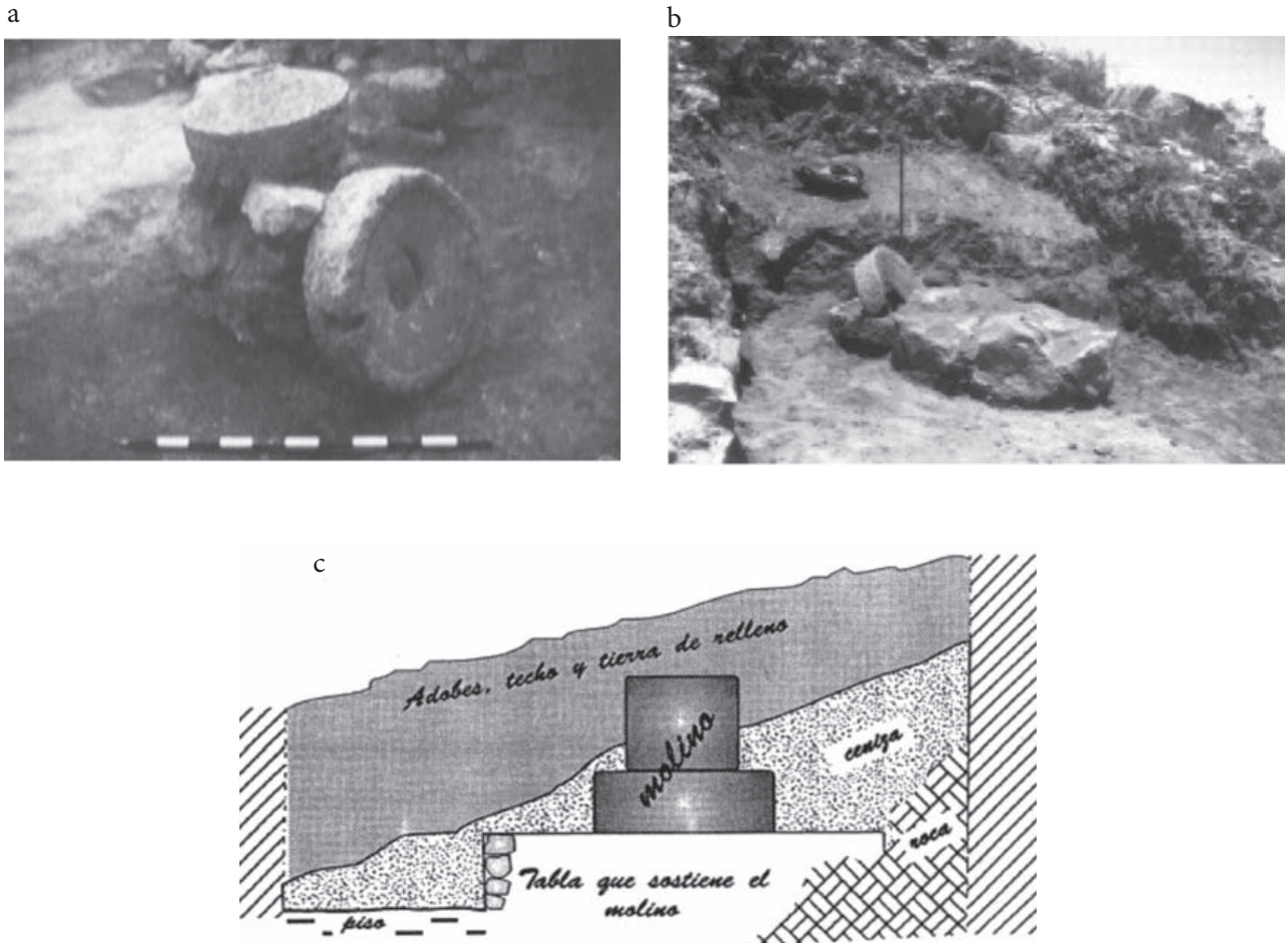
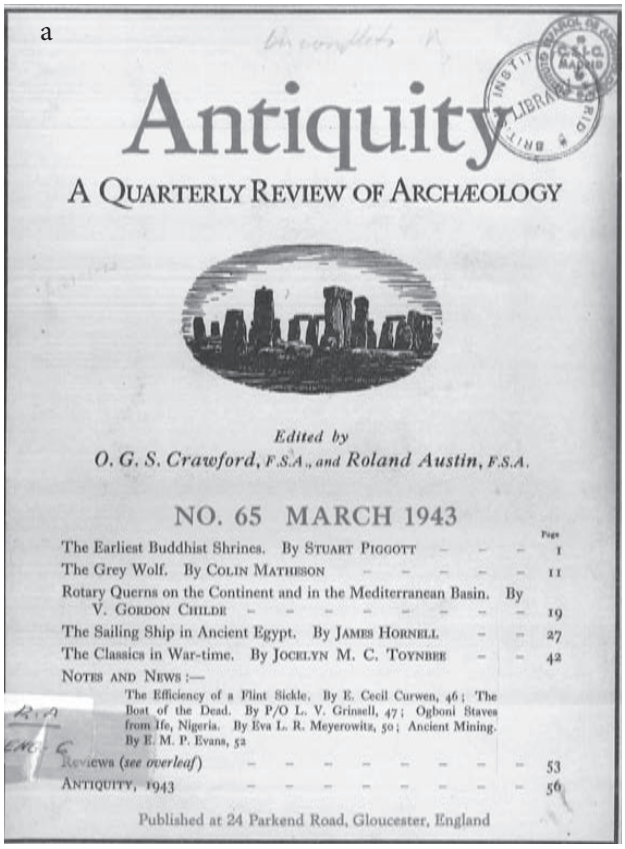


Fig. 6: Tossal de Sant Miquel, rotary pushing mills: (a) unit 46; (b) unit 42; (c) unit 100 (from Bonet 1995: fig. 2b, fig. 158, plate X).

8. Editor translation: "The same occurs for another very different catergory of tool roughly hewn from limestone or sandstone: we refer to hand mills, of which there is without a doubt one in each house, and at times two found together. Over a hundred have been discovered, of which there are samples in the Museum. Certain large models measure up to 80 centimetres in diameter; most, however, are half that size. They comprise two stones, male and female, of which the upper stone bears a hole along its edge for a handle to facilitate rotation. They mostly served to grind wheat (fig. 88). People of the Riff Mountains still use this types of mill. Less common are the elongated grinding stones with a slightly curved or concave surface (fig. 89)".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Rotary Querns on the Continent and in the Mediterranean Basin

by V. Gordon Childe

In his two articles on querns (1)* Dr Cecil Curwen has given us a really epoch-making contribution to prehistory and history. Not only has he provided the prehistorian with a new instrument for the establishment of chronology, but he has drawn the attention of excavators to a revolutionary but curiously neglected advance in technology. For the rotary mill is the first major application of rotary motion since the invention of the potter's wheel and the lathe in the remote Oriental Copper Age; it led on directly to the invention of geared machinery and the water-wheel and so to the first employment of inanimate motive power apart from the harnessing of the winds to the sail. Though this invention took place in the full light of history, the sole evidence for its origin, apart from a single reference in a writer so late as Pliny (2), is purely archaeological. Unfortunately it is still rather thin; excavators of classical and barbarian sites have generally been too preoccupied with statuary and art-objects on the one hand, with types accepted as chronologically significant on the other, to provide the historian of science with the data he craves. Truhelka for instance, generally so scrupulous in the full publication of all his finds, does not illustrate nor even describe a single quern from Dolja Dolina in Bosnia where he found plenty (3).

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spindle and with a gently tilted surface. South of the Alps similarly shaped querns are known from Algeria (8) and Delos (9).

From Delos besides the beehive or rather trunco-conical riders with horizontal handles flatter discs, probably with vertical handles, are reported by Déonna. None are very precisely dated. But some beehives come from areas that were scarcely inhabited before 246 nor after 88 B.C. So they may be accepted as going back at least to 11 B.C. But by that time donkey-mills, too, were at work on the island. Chamonard figures a characteristic hour-glass mill of Pompeian type, and found on the floors of several houses (10) circles of stone slabs that must have served as steps for beast or man working a revolving mill of this kind. Such co-existence plainly accords well with Curwen's thesis that our rotary querns derive from donkey-mills in the East Mediterranean.

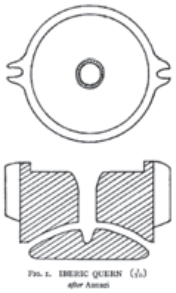

Fig. 1. Iberic quern (1/5) after Ascari

Fig. 7: a) Cover of the journal Antiquity (1943) containing the seminal article penned by V.G. Childe on the question of the origin of the rotary movement of millstones. Extracts of a) page 19 and b) page 20 of the artice. Childe's sketch of the rotary mill on page 20 is based on figure 1 of Bosch Gimpera's publication of 1923 (see Figure 3 of this article).

journal *Ampurias* (Pericot 1944: 356-357). This prehistorian realised, based on Childe's research, came to the following idea:

... en el molino por rotación tenemos uno de los notables progresos de la técnica, al que poca atención han solido dedicarle los arqueólogos[9].

Furthermore, Lluís Pericot recommended Childe's article to his Iberian colleagues as it contained suggestions of lines of research. Yet Pericot's contemporaries, alas, did not follow his advice.

The following years saw only a single archaeologist, Augusto Fernández de Avilés, dedicate an exceptional amount of attention to archaeological millstones. This researcher, director of the National Archaeological Museum in Madrid at the time, undertook a thorough diachronic survey to ancient querns and mills throughout the Iberian Peninsula. His painstaking research, unfortunately, was soon abandoned. It only came to light three quarters of a century later in 2007 when Luis Berrocal Rangel retook and completed the former museum director's old millstone records, sketches, references, as well as treatises on the objectives, methodology, and classification of mills, and published them in a seminal article in a *festschrift* dedicated to Fernández de Avilés.

The introduction of Berrocal's article reproduces a series of ideas penned by Fernández de Avilés in 1946 in a manuscript entitled *Molinos giratorios, a mano, del Museo Arqueológico Nacional* (Rotary hand mills of the National Archaeological Museum), a publication that never saw light. It reveals his concern for these types of artefacts and assesses the importance of their study and publication:

Distintas causas, y entre ellas la de conceder preferentemente atención a los objetos de mayor entidad artística o de aplicación cronológica ordinariamente aceptada, ha producido la postergación en el estudio y en la exposición museal, de una serie de piezas arqueológicas de carácter doméstico, cuyo examen como conjunto revestiría gran interés. A esta serie de objetos, de aparente humildad científica, pertenecen los molinos de mano giratorios que, técnicamente, significan la más primitiva y extensa aplicación de aquel movimiento después de la rueda de alfarero (...) En efecto, refiriéndonos a la Península, los molinos graneros de mano brindados por los poblados indígenas y romanos no han merecido generalmente en las

9. Editor translation: "... the rotary mill represents a remarkable advance in technology that has received little attention from archaeologists".

memorias de excavaciones sino ligeras menciones, pocas veces ilustradas…[10] *(Berrocal 2*007: 275).

In the same block of text he cites the articles of Curwen and Childe and reinforces the notion that archaeological mills also offer vital clues in determining the chronology and evolution of the history of milling technology (Berrocal 2007, 275).

In any case, Fernández de Avilés compiled a vast amount of data on different types of querns and millstones between 1945 and 1946, starting with that from the collection of the *Museo Nacional de Arqueología* in Madrid, within the framework of a project that was probably one of the most important contributions of his scientific career.

Furthermore, he attempted to expand his large corpus of data by distributing descriptive mill forms to be filled out by friends and colleagues in museums and collections throughout Spain. He initially only focused on rotary querns and mills before expanding interest in hand driven querns, hydraulic mills and oil mills. The form he developed and spread among his colleagues contained fields to describe the following items and informations (Berrocal 2007: 278, fig. 1 (Fig. 8a):

a) if the millstones are whole or fragmented and if they bear significant features

b) millstone sketches with sections (along the criteria of a model he developed)

c) rock type

d) find spot and, if possible, "archaeological context"

e) inventory number

f) photograph

Response from colleagues throughout Spain was at best very uneven. Figure 8b-7 illustrates an example of drawings returned by collaborators accompanied by his handwritten notes and own sketches. It must be noted, however, that certain museum directors never answered his survey, or at best responded evasively, as in the case of the director at the time of the Museo de Huesca (Aragon) (Berrocal 2007, 279):

... en este museo, no obra ningún molino giratorio, ni se tiene noticias de que existan en esta provincia ... [11]

This response was very misleading as Fernández de Avilés, in fact, was well aware of the existence of these types mills in the Province of Huesca.

In spite of the difficulties linked to the lack of interest of potential collaborators, Fernández de Avilés, with his modest means, established a detailed quern and millstone typology, a classification that could have been applicable elsewhere to European Antiquity. Unfortunately, he abandoned the project (despite compiling 406 records), published nothing, and confined his vast research project to a drawer where it remained until it was resuscitated by Luis Berrocal.

Ultimately, Spanish research in the 1950s began once again to reveal a modest interest in mills. Several articles referring to manual cereal mills of the indigenous pre-European population of Gran Canaria (e.g. Serra Ràfols and Cuscoy 1950; Hernández 1951; Jiménez 195) were published in the journal *Revista de Historia de La Laguna*. Another example, this time on the continent, is that of millstone brought to light during the excavations between 1954 and 1958 of the Iberian settlement of Puig Castellar (Santa Coloma de Gramanet, Barcelona). These annotations included millstone morphometric and petrographic analyses. These findings, alas, also remained unpublished until 1966 (Martínez and Vicente 1966).

Renewed interest and development: systematic and interdisciplinary studies at the turn of the millennium

Despite the exceptional examples cited above, archaeological research in the Iberian Peninsula until the 1970s practically ignored millstones and mills. This decade, however, saw the arrival of a new generation of archaeologists more aware of the necessity to record all types of mundane finds, including millstones.

Examples of this new approach include the paper by E. Junyent and V. Baldellou (1972) on the artefacts from the Iron Age house at the site of Mas Boscá (Badalona, Barcelona), the article by J. L. Maya and M. A. Blas (1973) of a decorated rotary quern from the Castro de La Picona (Asturias) and the mills published by N. Mesado and O. Arteaga (1974) from the site of Vinarragell (Burriana, Castelló). A specific molinological project that stands out at the end of the 1970s is the exhaustive typological classification undertaken by N. Borges of an assemblage of 55 hand and rotary querns/mills from the Roman site of *Conimbriga* in Portugal (Borges 1978). A descriptive catalogue of each millstone, including petrology and drawings, accompanies this important report.

Many researchers specialised in Prehistory and Protohistory of the subsequent decade of the 1980s, due to their greater methodological awareness, began to cite, describe and illustrate (drawings and photographs) millstones in their publications. Certain research, in fact, was monographic. M. T. Genís, for example, published a typology of the

10. Editor translation: "Different reasons, and among them that of granting preference to objects of greater artistic entity or of ordinarily accepted chronology, has led to the postponement in the study and museum exhibition of a series of domestic archaeological objects, whose study as a whole would be of great interest. Among these objects of apparent scientific humility are a series of rotary mills that, technically, represent the most primitive and extensive application of that type of motion after the potter's wheel (…). Indeed, in the case of the Iberian Peninsula, the hand driven cereal mills from indigenous and Roman settlements have generally not been afforded attention in excavation reports except for a few brief and rarely illustrated entries ..."

11. Editor translation: "... there are no rotary millstones in this museum, nor any news of their existence in this province..."

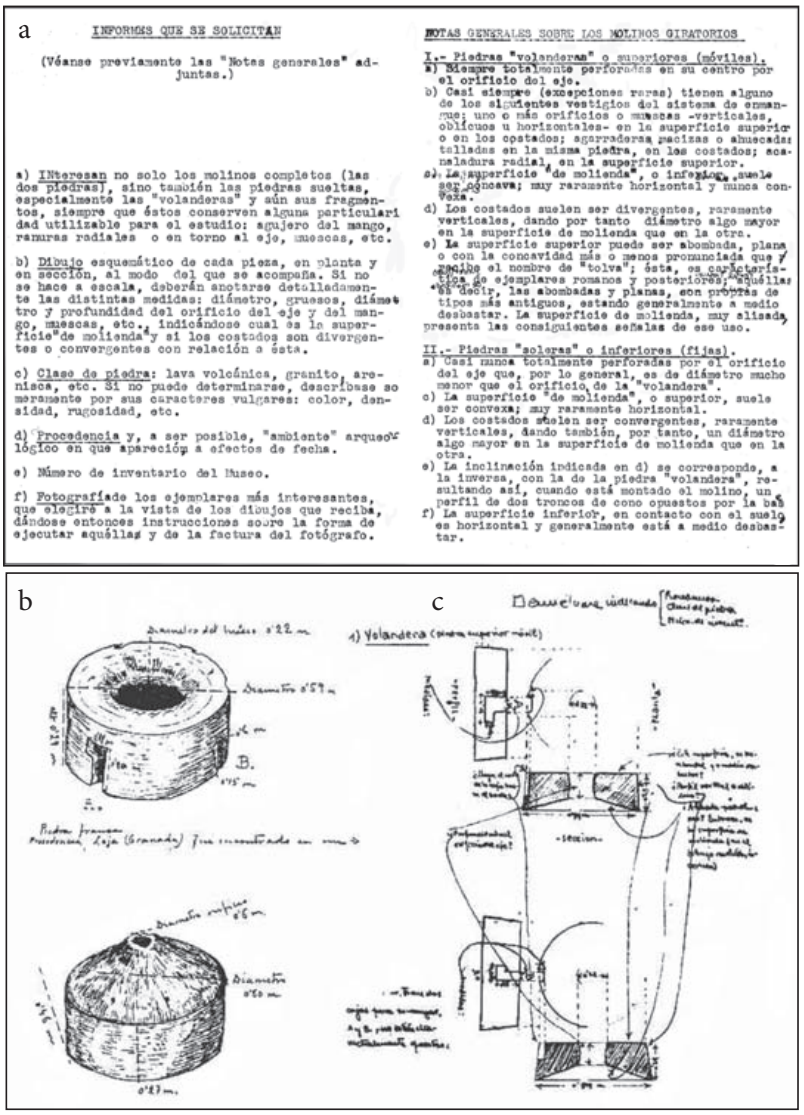

Fig. 8: a) Example of the millstone descriptive form designed by Fernández de Avilés dispatched in 1945 to the different archaeological institutions throughout Spain. b) Diagonal ink drawing by J. Eguaras of rotary quern D.1402 from Loja (Granada) and c) graphic representation of the same quern with annotations by Augusto Fernández de Avilés (from Berrocal 2007: fig. 1 and fig. 2).

Iberian Culture hand driven querns and rotary mills of the settlement of Puig de Sant Andreu (Ullastret, Girona) (Genís 1985; 1986). A year later appeared an article by the geologists O. Williams-Thorpe and R. Thorpe provenancingthe volcanic mills of north-eastern Catalonia. The intention of this little known study, published in Catalan in the local journal *Vitrina* (1987), was to form part of a wider project that never came to fruition.

This decade was also marked by a milestone in the history of mill research in the ancient Mediterranean with the publications in 1986 and 1987 by A. Arribas of the assemblage of millstones from the 4th-century BC shipwreck of El Sec off the coast of Majorca (Calvià, Majorca). This assemblage comprised two characteristic Morgantina style millstones and great number of Olynthian style hopper rubbers (identified previously by F. Pallarés, 1972). The ship was undoubtedly in transit through the Balearic Islands, and both types of mills have nothing to do with the Protohistoric types known in the Iberian Peninsula. The provenance of this assemblage was analysed by Williams-Thorpe and Thorpe and published an article in 1990.

But it is not until the decade of the 1990s that recognition of the role of mills will became generalised. Joan Maluquer de Motes and other researchers of the University of Barcelona in their publication of the First Iron Age settlement of Alto de la Cruz in Cortes de Navarra (Navarra) present the complete collection of querns with drawings. This study consisted of drawing of each quern and a systematic recording of their dimensions, petrography and traces of use-wear, resulting in a typological classification (Maluquer *et al*. 1990). The publication of the assemblage of querns of Tossal del Moro de Pinyeres (Batea, Tarragona) appeared the same year. A notable aspect of this study is a

very early rotary quern dating from the 5th century BC (Arteaga *et al*. 1990).

In 1991, M. Almagro also included hand querns, although not quantified, in a distribution of the different types of materials symptomatic of economic activity at the site of Cancho Roano (Badajoz). His research was based on data gleaned from J. Maluquer (Almagro Gorbea 1991).

The early 1990's, at least as far as the study of Protohistory is concerned, experiences a situation analogous to that of the 1940s when the publications of Curwen and Childe aroused interest at least by Fernández de Avilés and Pericot. This phase is marked by the publication in 1992 of the seminal typological classification by M. Py of the large assemblage of querns and mills of the site of *Lattara* in southern France (Py 1992). This systematic survey had a great influence on subsequent research taking place essentially in Catalonia. Furthermore, the proceedings of the colloquium "*Moudre et broyer*" held in 1995 in Clermont-Ferrand (France) and published in 2002 by H. Procopiou and R. Treuil included articles penned by Catalonian authors from the Universities of Lleida and Barcelona regarding millstones from the Iron Age (Alonso 2002; Asensio *et al*. 2002; Équipe Alorda Park 2002).

This period represents a turning point in the research and publication of the archaeology of mills and milling marked by an intensification of studies, notably doctoral theses and new approaches. For Late Prehistoric mills and milling, the pendulum swings back to the Argar Culture, cited at the outset of this paper in the framework of the research by the Siret brothers. Of note is R. Risch's doctoral thesis *Recursos naturales, medios de producción y explotación social* (Universitat Autònoma de Barcelona, 1995) published by the German Archaeological Institute of Madrid in 2002 that incorporates systematic analyses of macrolithic tools. This is the first of six doctoral dissertations exploring archaeological mills defended in Spanish (more precisely Catalonian) universities until now (Fig. 9). Risch's dissertation includes milling experiments and analyses of the mechanical properties of a variety of rock types and their effectiveness in the milling process along the lines of acquisition, work time, physical effort, etc. Risch proposes, for example, the occasional use of wooden upper "stones" (Risch 2002).

A second doctoral thesis entitled *De la llavor a la farina. Els processos agrícolas protohistòrics a la Catalunya Occidental* was completed by N. Alonso in 1997 at the University of Lleida. Published in 1999 by the CNRS, this study focuses on the Protohistoric agricultural systems in the Western Catalonian Plain. One chapter is dedicated specifically to the querns and mills of the second and first millennium BC, and the study offers notions defending the Western Mediterranean as the origin of rotatory querns.

It is the final period of this study, ranging from the late 1990s to the present, that saw the greatest increase in interest in the subject of mills and milling as evidenced by both specific and general publications. This concern stretched to other milling aspects such as spatial and gender archaeology. Examples of these types of studies include the publications of the Iron Age site of Castellet de Bernabé in Valencia (Guérin 1999), the Vacceo-Roman town of Pintia (Padilla de Duero/Peñafiel) in Valladolid (Sanz *et al.* 2009), the First Iron Age settlement of Barranc de Gàfols (Asensio *et al*. 2002) and the Bronze Age Nave of Closos de Can Gaià (Felanitx, Majorca) (Fonés *et al*. 2009).

As noted above, this period is also characterised by a more intense focus on millstones reflected a number of specific publications. Examples include the assemblages brought to light at a series of Galician and Portuguese *castros* (hillforts) (Carballo 1989; Carballo *et al*. 2003; Isidro 2002; Cancela 2006), the group of stones from Sector 3 of the site of Alarcos (Cuidad Real) (Rodríguez and López-Menchero 2009) and the survey of the querns and millstones of the celebrated site of Numantia (Soria) (Checa *et al*. 1999). The publication by H. Bonet of the settlement of Tossal of Sant Miquel (Lliria, València) stands out with its detailed descriptions of the millstones from both the old and the more modern excavations, as well as reconstructions of their driving mechanisms (Bonet 1995). Millstones are thus part of the studies of most of the Iberian Culture settlements of the Iron Age. These include Puntal dels Llops (Olocau, València) (Bonet and Mata 2002), Mas Castellar de Pontós (Girona) (Fernández *et al*. 2002) or that of the Facultat de Medicina de la UAB (Cerdanyola del Vallès, Barcelona) (Alonso 2002b).

Other examples are the monograph dedicated to the Prehistoric site of the Institut de Manlleu (Barcelona) which offers a typology of the earlier to and fro driven querns (Boquer *et al*. 1995) or the Neolithic sites of Bauma del Serrat del Pont (Tortellà, Girona) (Alcalde *et al*. 2008), Atxoste (Vírgala, Alava) (Alday *et al*. 2014) and Juberri (Andorra) (Augé *et al*. 2016). The publications of sites following this trend cannot, in fact, be cited individually as they are too numerous.

This newfound interest in mills and milling also applies the Roman period. Examples are the articles by A. Mederos and G. Escribano on the trade of mills in the Mediterranean, and along the Atlantic coast of North Africa to the Canary Islands (2001 and 2002). This period also saw the publication of a brief but seminal article penned by J. P. Brun identifying structural features of a Roman watermill at *Conimbriga* in Portugal (Brun 1997). This paper is particularly relevant as Conimbriga remains, to date, the only concrete example of a Roman watermill in the Iberian Peninsula and leads to the question as to why there is so little evidence of this type of technology in Iberia (state of research, other milling traditions?) when evidence of Roman hydraulic mills and millstones in the last decades is multiplying elsewhere in Europe, notably in Switzerland and France (Castella 1994; Leveau 1996; Brun and Borréani 1998; Anderson *et al*. 2005).

Another example is the study by Anderson *et al*. focusing specifically on Pompeian mills (2016), a mill type well known in the Italian Peninsula and the south of France but that does not appear, at

least now for the moment, to have established a foothold in Roman Iberia.

Also noteworthy are the publication of underwater excavations yielding assemblages of Protohistoric and Roman rotary querns, such as that of Cala Sant Vicenç (Majorca) (Vivar 2008), or the study of finds from old excavations of shipwrecks such as that of Illa Pedrosa (Gerona) containing a cargo of 70 whole rotary querns (Vivar 2004).

Furthermore, in spite of the publication of a few raw material trade or quern manufacture studies (Ceprián and Luna 2006; Alonso *et al*. 2011), a topic that heretofore received little or no attention, is that of quern and millstone quarries (*moleras* in Spanish). This situation changed in 2000 with the intense field work carried out in two independent regions. The first, La Rioja, is the work of historians P. Pascual and P. García (2007; 2010; 2011a and b), while the second is Minorca (Balearic Islands) carried out by the geologist J. Sanchez (2001; 2005; 2006; 2011; in this volume).

Further research on this subject was undertaken by T. J. Anderson in southern Spain, covering the time frame from Protohistory to Modern times (Anderson 2011; 2014; 2016; Anderson and Scarrow 2011; Anderson *et al*. 2011; Martínez *et al*. 2011). The doctoral thesis entitled *Millstone quarries in the South of the Iberian Peninsula: from Protohistory to Modern Times*, defended at the University of Grenoble in 2013 and published in 2016, resulted in the identification of a great number of quarries. One aspect gleaned from the study is the imbalance of data between from the south and the rest of the peninsula (with the exception of the earlier work carried out in La Rioja and Minorca).

Similar research was carried out by A. Rodríguez and her team on querns and quern quarries in Gran Canaria (Canary Islands), an interest that was spawned, as noted above, in the 1950s (Rodríguez Rodríguez *et al*. 2006a and b; Rodríguez Rodríguez and Francisco 2012; Naranjo *et al*. 2016, in this volume). In fact, the excavations of the quarries of

Fig. 9: Doctoral dissertations examining different aspects of millstones and mills in the Iberian Peninsula or carried out in Spanish universities between 1995 and 2015: (a) R. Risch (UAB, 1995, published in 2002); (b) N. Alonso (UdL, 1997, published in 1999); (c) M. Portillo (UB, 2005); (d) S. Delgado (UAB, 2009); (e) M. Bofill (UAB, 2015); (f) T.J. Anderson (UGR, 2013, published in 2016).

Fig. 10: Excavation of the quern quarry of Montaña Quemada in Gran Canaria (Canary Islands) carried out by A.Rodríguez and her team. Vertical quern extractions are visible along the quarry face behind the excavators (photo: A. Rodríguez).

Barranco Cardones, Barranco Cebolla or Montaña Quemada are the only cases of this type of field research carried out on Spanish territory (Fig. 10).

Also worth mentioning are the first studies of plant micro-remains recovered from the surfaces of grinding materials carried out by J. Juan-Tresserras (2001; 2002; 2004) and the consolidation of this type of methodological approach applied to querns in M. Portillo's doctoral thesis, *La mòlta i triturat d'aliments vegetals durant la Protohistòria a la Catalunya Oriental* (2006). This study comprises a substantial inventory of hand and rotary mills from the Iron Age from sites along Catalonia's coastline. Other publications by the same author have followed (Portillo and Albert 2012 and 2014; Portillo *et al*. 2013 and 2014).

Two doctoral dissertations in this time frame resorting to use-ware analyses were defended at the Autonomous University of Barcelona. The first, by S. Delgado, is entitled *Prácticas económicas y gestión social de recursos técnicos (macro) líticos en la Prehistoria Reciente (III-I milenios AC) del Mediterráneo occidental* (2008). It is essential also to highlight the research carried out by Delgado, together with R. Risch, on hand querns from the Bronze Age in south-eastern Spain (Adams *et al*. 2009; Risch 2002; 2008; Delgado 2008; 2013; Delgado and Risch 2008; 2009; Delgado *et al*. 2008a and b). The second thesis, penned by M Bofill (2015), is entitled *Inicio y consolidación de las Prácticas Agrícolas durante el neolítico en el Levante Mediterráneo (septentrional y central): el proceso de molienda y trituración a partir del análisis funcional del instrumental macrolítico*. Although her body of work focuses on milling in Neolithic settlements of the Near East (Bofill 2013; Bofill *et al*. 2013; 2014; Portillo *et al*. 2013), Bofill also included analyses of millstones from Neolithic sites in Catalonia such Sant Pau del Camp (Barcelona) (Bofill *et al*. 2008).

Finally, two recent scientific meetings held in Iberia have focused on the issue of mills and milling. The first, "*Molins i mòlta al Mediterrani Occidental durant l'edat del ferro*", was organised in 2013 by the University of Lleida. Its proceedings, published in a dossier of the *Revista d'Arqueologia de Ponent* (Alonso 2014), offers for the first time an overview of the current state research on Iron Age mills in the Iberian Peninsula and the South of France. It includes studies of the following geographical areas: the South (Adroher and Molina 2014), the East (Alonso and Pérez 2014), the North-West (Teira and Amado 2014), the Tartessian Culture of Extremadura (Rodríguez *et al*. 2014), Celtiberia (Cerdeño *et al*. 2014) and the South-East of France (Longepierre 2014).

A second meeting, with a wider chronological and geographical scope, and in the wake of earlier "millstone" meetings (La Ferté-sous-Jouarre, Grenoble, Rome, St. Julien, Bergen, Lons-le-Saunier, Lleida), took place in 2014 at the Archaeological Museum of Almería, and after a series of vicissitudes, its publication finally sees the light in the present volume.

Brief conclusions for present and future of molinological studies

As a brief conclusion we must note that, although research on mills has experienced its ups and downs during the twentieth century – and despite of the great number of researchers that have recognised their value as archaeological artefacts – research on this subject has really only experienced a real intensification in recent years. And much remains to do. This research usually appears, although not consistently, in site monographs, and in certain specific studies. A very interesting aspect, nonetheless, is that it is now carried out from an interdisciplinary perspective.

In fact, exploring the themes of production, distribution and use of millstones and mills requires an interdisciplinary approach focusing not only on the millstones and the mills themselves, but on a myriad of other aspects linked to manufacture, distribution, use and products. Complementary methodological applications that play a role in this vast production sequence include petrography, geochemistry, morphometry, use-wear, micro-remains analyses, archaeobotany, mining, experimentation, symbology, ethnographic parallels …

Only by following this approach to the research in this field can advances in the state of knowledge be made that transcend the mere analysis of the object and make strides toward the compelling matter of the individuals behind the millstones. This amounts to taking on the questions of quern and millstone makers, marketers, millers and a series of issues from the socioeconomic perspective, which is, in short, the goal of archaeological and historical research.

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