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Eating Acorns: What Story Do the Distant, Far, and Near Past Tell Us, and Why?

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ABSTRACT

"In archaeological contexts the absence of evidence cannot be taken as evidence of absence." To nothing does this sentence apply more pointedly than to the absence of acorns in the archaeological record. There has been a relatively generalized dismissal of their possible importance in human nutrition and the significance of the role they would/could have played in various different forms of socioeconomic development. Renewed interest in the possible significance of acorns faces the additional problems related to acorn preservation as compared to other nuts, and especially to seed grasses.

To these "archaeological" handicaps must be added an epistemological bias. The terms "incipient agriculture" or "proto-agriculture" clearly show that any form of social organization between hunter-gatherer and agriculture has generally been considered a kind of non-equilibrium state desperately trying, as it were, to attain the implicitly "better" or "more advanced" state of agricultural-based societies.

This review attempts to explore the history of the story of acorns in our history, presenting the new approaches to the question, as well as evidence that may, in the future, lead to quite a different story about the importance of acorns in human social evolution.

Keywords: Neolithic revolution, agricultural revolution, Natufian, long-term social memory, Proto-Indo-European, Hittite

Introduction

Although many readers of this Journal are passionately interested in acorns, it probably would not be too risky to affirm that this passion does not include consuming them. Though many of us have probably succumbed to the temptation of tasting one, how many of us have actually gone through all the steps involved in acorn processing to make a meal of them? The fact is that today, except for in Korea, acorns are not a major or easily accessible food source in any country or civilization. But has this always been the case?

Were acorns a major food source in protohistorical and historical times in different civilizations and countries in the Old World? Were acorns and important part of prehistorical diet? Did acorn consumption play a role in developing the complex set of behaviors that eventually led to what is referred to as the Neolithic Revolution?

The geographic focus of this review is the area that archaeologists refer to as the Near East (Fig.1). Pertinent ethnographic and archaeological records from Western Europe and North Africa will also be presented.

Figure 1/ The Near East includes the Zagros Mountains and Mesopotamia, the Levant, the Syro-Arabian desert and the Sinai Peninsula. Most of the relevant archaeological sites are located in Anatolia, the foothills of the Taurus and Zagros Mountains, and in the Levant.

Why eat plant foods anyway?

There are indeed many different viewpoints on the causes, effects, and mechanisms of human dispersal out of Africa (Anton 2002; Arsuaga, 1999; Bar-Yosef, 1998; McBrearty et al. 2000; Quintana-Murci et al. 1999; Stewart and Stringer 2012) but there is one undeniable factor that must be taken into account in all the scenarios: meat-eating members of the genus *Homo* moving northwards had to acquire new food sources that would lower below toxic levels the nitrogen load that results from metabolizing meat protein. This can be done in two ways. In cold environments, consuming large amounts of fat, as do the Eskimos, fulfills this role. In temperate climates, it is achieved through the consumption of plant foods that deliver bulk carbohydrates and some fat. Plants can represent as much as 25% of the diet of hunter-gatherers in the Temperate Zone compared to only 1-4% in the Eskimo diet (Jones 2009).

Although there is a great degree of variation in specific nutritional content between acorns of different species of oak, generally they are low in protein (when compared to other nuts), fairly high in fat content (though significantly lower when compared to pine nuts or almonds) and extremely high in carbohydrates, near or even higher than 90% for some White Oak species (Table 1).

Species	Water	Protein	Fats	Carbohydrates	Ash
Q. brantii	5.0	3.7	3.7	91.4	1.3
Q. coccifera	12.3	2.4	3.9	92.5	1.2
Q. infectoria subsp. *boissieri*	3.1	2.6	1.8	94.3	1.3
Q. ithaburensis subsp. *macrolepis*	6.1	4.4	6.0	88.1	1.6
Q. robur	5.5	7.5	1.5	89.4	1.6

Table 1/ Nutritional data for five European oaks (adapted from Mason 1992).

This new-sources-for-plant-food challenge would have been exacerbated by the fact that Temperate Zone plants and the food that these could offer would have been quite different from the plants growing in the lands left behind, requiring greater, sometimes multiple-step, processing before they could be eaten. Moving from equatorial latitudes to more northerly ones implies several things including only seasonal availability of soft, plant tissue production, and the fact that to survive from one growing season to the next, as well as for protection from predators, these soft-tissue parts would be increasingly enclosed in hardened shells and woody coats or present spines, toxins, etc. Of all the edible nuts in the Near Eastern paleobotanical record only acorns need multi-step processing including cooking to be eaten. Even cereals, can, and were initially, eaten raw. This "timely dexterous unpacking" – in other words knowing when and knowing how to use a resource – can be considered one of the components of the baseline of modern cognition (Jones 2009).

Long-term collective memory

At Gesher Benot Ya'aqov (Israel), a site dated to the early Middle Pleistocene (oxygen isotope stage 19; 780,000 years old) archaeologists have discovered both paleobotanical evidence of seven species of nuts eaten by hominins, and lithic artifacts of the tools used to process them. One of these nuts is the fruit of a member of the genus *Quercus*. *Q. ithaburensis* Decne. and *Q. coccifera* subsp. *calliprinos* (Webb) Holmboe were also identified in the wood assemblages (Goren-Inbar et al. 2002). Roughly a short 775,000 years and several major climatic changes later, there are references to acorns as fruit in the earliest written sources known to man: the cuneiform tablets written in Sumerian in the early part of the third millennium BCE (Postgate 1987).

And what significance will archaeologists of the future accord the unearthing of two publications, "Is Reintroducing Acorns into the Human Diet a Nutty Idea?" (Starin 2014) and "Supercritical Carbon Dioxide Extraction of Acorn Oil" (Bernardo et al. 2007), dated to (what would be then) the ancient years of 2007 and 2014? Perhaps simply that acorns-as-food continues to be a very tenacious element of our collective memory.

It has been argued that "long-term social memory" is an important resource in times of stress and that it is a key factor in social resilience and adaptive change (Rosen and Rivera-Collazo 2012). A logical extension of this is that the persisting presence of an "experience" in the collective memory is indicative, on the one hand, of its significance, and, on the other, of the relative frequency of the "stressful" situations requiring its use. Generally speaking, references to acorn consumption in the Near East and in Europe agree that acorns would have been consumed in times of famine but that they did not constitute a staple resource. If we consider however that difficult times have been the rule

rather than the exception throughout recent and not so recent history if only judging from the frequency of war, the collapse of civilizations, and general upheaval, then perhaps acorns were a staple resource precisely because they were a famine food.

Proto-Indo-European sources

The Proto-Indo-Europeans are thought to have inhabited Eastern Europe in the western part of the Pontic-Caspian steppe. There is disagreement as to when exactly, with dates ranging from the Late Neolithic in the 4th millennium BCE to the Early Neolithic in the 8th millennium BCE.

According to the *Oxford Introduction to Proto-Indo-European and the Proto-Indo-European World* (Mallory and Adams 2006) and to the *Encyclopedia of Indo-European Culture* (Mallory and Adams 1997) linguistic anthropologists have examined the botanical systems of many peoples in an attempt to determine whether "universals" exist in "folk taxonomies".[1] What has been hypothesized is that words are created that correspond to various degrees of botanical distinction and that these stages pass from the specific to the generic. For example, at Stage One there would be only a word created to refer to a specific kind of tree. At Stage Two, a generic word for "tree" would be created.

Proto-Indo-European is considered to be a Stage Two language in which **dóru* means "tree". In Celtic and Greek (two of the surviving Indo-European languages) cognates of **dóru* mean specifically "oak". Some scholars argue therefore that this was its original meaning in a Proto-Indo-European Stage One system, where there would have been no generic term for "tree" but rather a specific word designating "oak" and that this word then shifted to fill out a Stage Two taxon. Cognates of **dóru* exist in eleven different Proto-Indo-European groups, either under its root form or in derivation.

The word for oak would have been **pérk^{w}us*, easily recognizable in the Latin, *quercus*, or in the Gaulish, érkos (oak forest*)*. It would seem that the Proto-Indo-European etymon **pérk^{w}*, strongly attested in five Indo-European languages, is the origin. There is a second oak name, **h$_a$eig-*, that is supported by only two stocks, Germanic and Greek, in which there are metonymic extensions to artifacts for which oak wood is singularly suited, e.g., ship, spear, shield. Probably cognate with **h$_a$eig-* is the first element in the Latin *aesculus* (mountain oak). It would seem that **h$_a$eig-* is dialectally limited and probably a late form, possibly used for a particular species of oak.

The word for "acorn", **g^{w}elh$_a$-*, is widely reflected and almost universally accepted as very early Indo-European, and, interestingly, is of the animate gender, unlike the names of all other edible fruits. This, and generally the rich semantics of the acorn word are, for linguistic anthropologists, indications of the importance of the acorn in Indo-European culture. The meaning is at least once extended metonymically to the tree itself and this was probably the basic connotation of the term in Proto-Indo-European. Interestingly, the generic Proto-Indo-European word **h$_a$o'geh$_a$-*, meaning "berry" or "fruit", appears in many Indo-European groups in different forms, all of which should retain our attention: *eirin, *agrinua, aeron, aecern, acorn, akarn, akran, *-agren-, akam, acem, buch-eckern.*

1. Many semantic fields of a language are structured by its speakers into a hierarchical system of categories. In English, for example, we tend to divide the natural world intro three categories : animal, vegetable, and mineral, and these may be further subdivided in reasonably Linnean fashion but also according to different, folk taxonomic criteria, e.g., Ishmael who was adamant that a whale was a fish or the common tendency for English speakers to classify the tomato as a vegetable (Mallory and Adams 2006).

That the oak was central in Proto-Indo-European myth and religious ritual is shown by the presence, in half of the Indo-European stocks, of sacred oak groves, sacred oak-wood fires, rites involving the ingestion of acorns and the cultivation of mistletoe, and the association of the oak with such things as thunder and a creation god (Beckman 1999; Watkins 1995; West 2007).

The earliest attested written traces of Indo-European languages belong to the extinct Anatolian group. By the middle of the second millennium, texts in Anatolian languages are found in abundance, particularly in the archives of the Hittite capital, Hattusa, in central Anatolia whence some 25,000 clay tablets have been recovered. These documents deal primarily with administrative, matters, rituals, and mythology. In Hittite mythology, when the god Télipinu, disappears,

"Mist seized the windows. Smoke seized the house. On the hearth the logs were stifled. On the altars the gods were stifled. In the fold…and corral the (animals) were stifled. The sheep refused her lamb. The cow…her calf. Télipinu… took away…growth (and) plenty... The mountains (trees, pastures, and springs) dried up. Famine appeared in the land. Humans and gods perish from hunger." (Beckman 1999). One might suspect that such poetry is to be taken figuratively but according to Hittite scholar Raphaël Nicole (personal communication) it is to be understood literally. Télipinu was the god of many things, but he was specifically associated with providing food (Fig. 2).

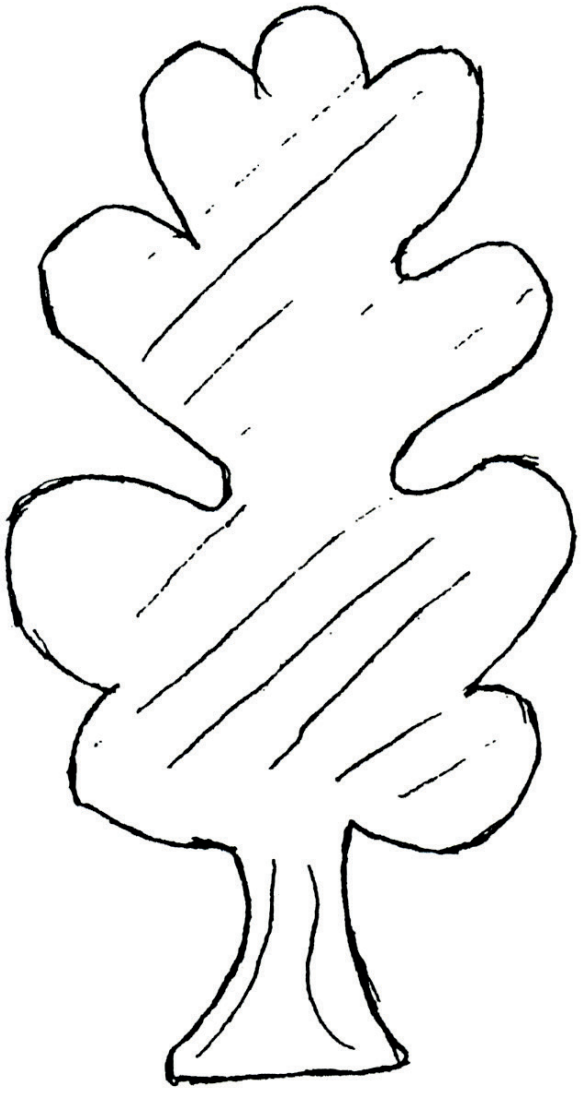

Figure 2/ The Hittite hieroglyph representing the god Télipinu (Laroche 1960).

The cuneiform sources

What do the cuneiform sources (3,000-1,100 BCE) and specifically those from the Akkadian Empire (2,350-2,100 BCE), the Third Dynasty of Ur (2,100-2,000 BCE) and the Assyrian Kingdom (2,400-1,000) tell us? Significantly, aside from acorns,

pomegranates and walnuts, the occurrence in these sources of fruits and vegetables is exceptional (Michel 1997).

In a study on the fruit in the cuneiform sources dating from the third or second millennium BCE, the Sumerian word *URxA.NA* that appears repeatedly in administrative documents dealing with fruit continues to pose a problem. It is understood from the different texts in which it appears that it grew in local plantations and that, in addition to its fruit, its timber was valued. Mulberry has been suggested (Postgate 1987) – but it could just as well be oak. No generic word for nut is attested in Akkadian but the word for oak, also used to designate the acorn, is *allänum* though in some texts it appears to designate walnut or almond (Nesbitt and Postgate 2001).

The beginning of the second millennium BCE saw the establishment of Assyrian trading posts extending to central Anatolia with the most important of these in Kaniš. Very few written sources have been found from this period from the city of Assur, but archaeologists have recovered roughly 21,000 tablets written by the Assyrian traders of Kaniš. In these documents we find requests for *allänum* and learn also that there are several varieties of *allänum*, specifically that one of them is easily recognizable by its length (Michel 1997). Interestingly there is a word that designates a specific oak, *allänkaniš*, not native to Assyria, perhaps introduced from Anatolia (Postgate 1992). Also in Postgate (1992) we find references to a document that attests to the sale of a 2-hectare plantation of *allänum*.

In the *Assyrian Dictionary of the Oriental Institute of Chicago* we find that in the Ur III period (21st century BCE), the term *haluppu* seems to have been used to designate an oak tree native to the East as opposed to the Western species called *allänum* (Oppenheim 1998). In this Dictionary can also be found the word *mësu*$^{+}$ that refers to a "scarlet oak" (the "+" symbol at the end of the word indicates a meaning added from Aramaic).

Wilcox in his study of the trees and shrubs native to Ancient Irak (Mesopotamia) based on the cuneiform sources lists nine including *Quercus infectoria* G. Olivier and *Quercus* spp. These were not cultivated but provided products gathered from the wild that were widely exploited. For *Quercus* we learn that not only the acorns but also the galls and bark were employed for various purposes (Wilcox 1987).

The culinary tablets at Yale, dated to the second millennium BCE, yield no information about acorns (or about any vegetables, fruits or nuts). "The culinary techniques revealed in the Yale tablets were restricted to the mighty and perhaps especially, given what we know about Mesopotamian religious practices, to the kitchens of the gods." (Bottero 1985; see also, Michel 2012, for a general review of the available sources of information on Ancient Near Eastern eating habits). Also worth noting is "Oaks are the dominant species throughout the hills and mountains enclosing Assyria to the East and North, yet they are surprisingly rarely mentioned in texts (and)…never mentioned in the royal inscriptions because it was so readily accessible geographically (naturally) and hence so in general use throughout society that it was neither necessary nor prestigious for kings to acquire or make use of it." (Postgate 1992). But this was probably not true for the common folk, as Hoffner points out "Few ordinary persons in the Ancient Near East could afford to eat meat." (Hoffner 1974).

Thompson (1949) (and thereafter cited by Bainbridge 1985) identifies certain inscriptions in the cuneiform sources as the word *belut* to mean oak whereas in fact the word is *tillutu* and means grapevine (Nesbitt et al. 2001).

From Pausanias to Pliny

In the construction of the Greek foundation myths, and thereafter in many literary sources, eating acorns is linked to a "Golden Age". The first literary references to this "Golden Age" are in Hesiod's (8th century BCE) *Works and Days*. "Honest people do not suffer from famine since the Gods gave them abundant subsistence: acorn-bearing oaks, honey, and sheep." (Evelyn-White 2014).

In his *Description of Greece*, Pausanias (2nd century CE poet), quoting Asius of Samos (a 7th century BCE poet) tells us that "The Arcadians[2] say that Pelasgus was the first inhabitant of this land… Pelasgus on becoming king invented huts that humans should not shiver, or be soaked by rain, or oppressed by heat…(He) also invented coats made from sheep hides…and checked the habit of eating green leaves, grasses, and roots always inedible…He introduced as food the nuts of trees, not those of all trees but only the acorns of the edible oak." (Pausanias Vol. VIII).

As Aurenche (1997) points out it is reasonable to assume that these Greek writers did not "invent" the habit of eating acorns to serve the purposes of their mythologies but rather that this was still common practice at the time of writing.

References to the simultaneous use of cereals and acorns can be found in the works of these early poets and this continues to be the case up until Ovid's *Metamorphoses* – but in the works of other 1st century BCE poets such as Virgil, Lucretius, and Tibullus, all references to acorn collecting and consumption disappear.

Historia Plantarum, *Book III*, *Wild trees and shrubs*, written by Theophrastus (371-

Photo 1/The very tempting acorn of *Quercus macrolepis*.

2. Though Arcadia is indeed the name of a Greek province that dates to antiquity, the "Arcadia" referred to above is the mythical site of the original "Golden Age".

288 BCE) comprises eighteen sections, the first seven of which deal with botanical generalities. The first section devoted to a specific group of trees (section eight) is devoted to the deciduous oaks, and the first aspect that is discussed is fructification. From his research in the regions of Assos and Mytilene, Theophrastus recognizes five oaks giving indications of the degree of "sweetness" of their acorns. The sweetest acorns are those of *Q. macrolepis* Kotschy (*phègos*; perhaps related to the verb *phagein*, meaning to eat) followed by those of *Q. infectoria* (*hémèris*)[3], *Q. frainetto* Ten. *(platyphyllos) Q. cerris* L. (*haliphloios*), and *Q. robur* L. (*quercus*). Upon returning from Macedonia, where he also encountered *Q. macrolepis*, he adds to this list *Q. petraea* (Matt.) Liebl. (entirely inedible acorns), *Q. trojana* Webb. (no indication given), and, possibly a form of *Q. pubescens* Willd. with sweet acorns (Amigues 2010).

The evergreen oaks are treated in section sixteen. *Prînos*, refers to *Q. coccifera* subsp. *calliprinos*; *smilax*, refers to *Q. ilex* L. (found in Peloponnese); and *phelladrys*, to *Q. suber* (also found in Peloponnese)[4]. Except for *Q. suber* L., no information is given about the edibility of the acorns of these species. According to Theophrastus, *Q. infectoria* is referred to as the "domestic oak" whereas *Q. macrolepis* is referred to as the "wild oak" because it grows in the mountains and is associated with the beginnings of humanity at which time, we are told, it provided food before the existence of agriculture and materials for other technologies such as tanning (the galls of *Q. infectoria* being used for this).

Four centuries later, in Pliny the Elder's, *Natural History, Book XVI*, we find: "Next will come an account of the acorn-bearing trees which first produced food for mortal man and were the foster-mothers of this helpless and savage lot…" (I)."(In) the vast expanse of the Hercynian oak forest, untouched by the ages and coeval with the world…(the trees) are practically all of the acorn-bearing class of oak, which is ever held in honor at Rome." (II). "Acorns at this very day constitute the wealth of many races, even when they are enjoying peace. Moreover also when there is a scarcity of corn they are dried and ground into flour that is kneaded to make bread; beside this, at the present day also in the Spanish provinces a place is found for acorns in the second course at table. Acorns have a sweeter flavor when roasted in the ashes. Moreover it was provided by law in the Twelve Tables that it was permissible to gather up acorns falling on to another person's land." (VI). Acorns are thus considered both as the food of savages and the food of civilized Romans and Spaniards; equally they constituted in the 1st century CE both "the wealth of many races even when they are enjoying peace" and a famine food. Pliny's description of the "trees that bear acorns in the proper sense" is rather confusing and it is not always clear to what species he is referring. In section VIII, an interesting comment may suggest that the taste of acorns was perhaps not only related to species but to maturation, or some other factor, which is in turn indicative of knowledge about collecting, processing, and eating them. "Those acorns are also esteemed the kernel of which at each extremity taken lengthwise has a stony hardness, those having this in the husk being better than those with it in the flesh of the nut…"

3. Both *Q. macrolepis* (*Q. aegilops*) and *Q. infectoria* are recognized in the cuneiform tablets (Postgate 1992).
4. *Q. suber*'s current geographical range does not include Greece. In addition to the fact that the Greek word means literally cork (*phellos*) oak (*drys*), Theophrastus's description of the color of the wood once it has been stripped is unquestionably the color of naked *Q. suber*. According to him this species would have been found in different regions of Peloponnese. Observation confirmed by the Greek poet Pausanias, who describes a tree from Arcadia (a region in Peloponnese) whose bark is so light and porous that it was used to make buoys for anchors and fishing nets. This either suggests that *Q. suber*'s natural range did at one time include Greece or that these trees were present because they had been cultivated.

From source of wealth to food for the poor

After Pliny, written references to acorn consumption are almost inexistent until about the 8th century. From then on, there is a definite shift, that continues on through modern times, during which acorn consumption is reported almost exclusively as something resorted to in difficult times or more generally by the poor (Table 2). Acorns are generally characterized as unpalatable, even detestable and poisonous. Maurizio (1932) cites a certain G. Ferrero who states that some historically and morally backward populations in Sardinia continued to nourish themselves with inedible (acorn) bread, and that certain Apennine populations who ate large quantities of chestnuts and acorns were in a similar situation.

References to acorn consumption are not abundant, and one finds generally always the same ones. They all suffer from a great lack of detail such that it is impossible to determine the importance of the described activity (Bainbridge 1985; Loewenfeld 1957; Logan 2005; Mason 1992; Maurizio 1932; Parsons 1962).

REGION	CENTURY	REFERENCES TO ACORN CONSUMPTION
Wales	13th	Malted acorns used for brewing; acorn bread recommended by physicians.
Western and Eastern Europe	16th	Acorns used by the poor to pay their tributes to landowners.
Bavaria	16th	Production of acorn flour for human consumption.
France and Russia	18th	Production of acorn bread.
Sardinia	18th	Staple part of the diet.
Italy	19th	Acorn bread commonly sold in village markets.
Poland	19th	"Normal" bread always made with a mixture of acorn and cereal flour.
Germany	20th	Large-scale collecting of acorns during World War I; during World War II bakers officially allowed to use acorn flour.
Spain and Italy	20th	Considered to make up 20% of the diet of the poor.

Table 2/ A few frequently found references to acorn consumption since the Middle Ages (Bainbridge 1985; Loewenfeld 1957; Logan 2005; Mason 1992; Maurizio 1932; Parsons 1962).

Perhaps most significant in these historical references, although there are not very many of them, are those that discuss some sort of "acorn legislation". For example, in the 8th century, the Bishop of Metz (Saint Chrodegang) included in the Rule for the religious community he founded that the Bishop be responsible for acquiring acorns and beechnuts "…in meager years, in other words, when acorns and beechnuts were in short supply."[5] (Maurizio 1932). In the 16th century in both Eastern and Western Europe acorns were one of the legally required tributes paid to landowners (Maurizio 1932) – and though the point has been made that it is not clear whether the acorns were destined to be consumed by the landowners or by their livestock (Mason 1992), it would seem rather a lot of useless work to collect acorns for animals who could do just as good a job, if not better,

5. My translation of "…dans les années maigres, c'est-à-dire celles où le gland et la faîne viennent à manquer, la charge de les procurer incombe à l'évèque." Mason (1992) has translated this as "…passed a law requiring bishops to ensure a supply of acorns to the populace *in years of food shortage*."

themselves (Jorgensen 1977). The consumption of acorns in Southwest Asia has also been recorded by different authors and generally these references also suffer from lack of detail (Hedrick 1972; Mason 1992; Thompson 1949).

Nearly the only historical reference to acorn consumption in the current era that is not lacking in detail is the *Kitâb Al-Filâha* (*The Book of Agriculture*) written by Abû Zakariyva Yabhyâ ibn Muhammed ibn Ahmad ibn al-'Awwâm sometime in the latter half of the 12th century or the beginning of the 13th in Seville. Of the fifty odd trees and shrubs discussed therein, aside from the oak, only two plants (the olive and the grape) are worthy of more than one article. In between chestnut (Article 9) and pear (Article 12), oak cultivation is Article 10 and "Procedures for transforming acorns for consumption" is Article 11. It is in Article 10 that Ibn al-'Awwâm gives a very detailed recipe for making "good quality bread", including instructions on the best time to collect the acorns for this purpose, as well as the different steps to be followed for the leaching, drying, and grinding of the acorns (Ibn al-'Awwâm 2000). The source for this recipe (and one of Ibn Al-'Awwam's three main sources) is *The Book of Nabatean Agriculture*, thought to be a kind of encyclopedia of ancient Babylonian tradition and knowledge, and written in the 3rd or 4th century CE by Qûthâma, agronomist and doctor, born in Sura, south of Babylon[6].

Photo 2/ Oak woodland in central Turkey.

6. *The Book of Nabatean Agriculture* was translated into Arabic in the 10th century by Abû Bakr Ahmad b. 'Alî, who lived in Qussîn (a locality in present-day Irak). The indigenous population of Irak, that represented what was left of Babylonian culture, was referred to by the pejorative Arab term "Nabatean" (El Faiz 1995).

Ethnographic sources[7]

Ruas et al. (2005-2006) looking at the fruits both wild and cultivated used in 12th to 14th century southeastern France compared three sources of information: 1) market transaction/taxation documents 2) the carpological remains in the rubbish pits and 3) recipes used in preparing food for noble and middle class tables.

Market transactions and taxation records show that acorns appear as frequently as do chestnuts, walnuts and pine nuts (Table 3a). The carpological studies revealed that acorn remains were as recurrent as peaches, plums, wild cherries, strawberry and elderberry (Table 3b).

Market transactions / Taxation records
Almond, dried fig, raisin
Date, hazelnut
Chestnut, walnut, pine nut, **acorn**
Citrus fruit, peach, pear, cherry, pomegranate
Jujube, medlar, apple

Table 3a/ Frequency of appearance in market transaction and taxation records from the 12th to 14th sites studied in southeastern France (Ruas et al. 2005).

Carpological remains
Grape, walnut, fig, hazelnut, blackberry
Peach, plum, wild cherry, wild strawberry, **acorn**, sloe, black elderberry
Olive, mulberry, apple, cultivated cherry, roe hips, dogwood fruit
Almond, pear, medlar, pine nut, raspberry
Gourd, coqueret, red elderberry

Table 3b/ Frequency in the carpological remains from the 12th to 14th sites studied in southeastern France (Ruas et al. 2005).

The only source examined in this study with no mention of acorns were the French culinary texts, representative of the food eaten by nobles and members of the middle class. The authors conclude that acorns were indeed an important part of domestic rural life.

At the end of the 1970s, Frank Hole (1978-1979) interviewed an 80-year-old man, Atawak, who lived in the Zagros region of Iran (Louristan). This investigation revealed that 1) throughout Atawak's life families in his village practiced the age-old art of transhumance, leaving the lowlands of the Mesopotamian plain for the high mountains at more than 2,000 m; 2) during the journey, their food source consisted of acorns and wild cereals growing in the forest; 3) the acorns were first roasted in 2.25 m^2 stone ovens that had been built for this purpose and that could be found in different places in the forest

7. In contrast with Europe, Southwest Asia, Mexico, and Central America, there is a well-documented corpus of ethnographic information regarding the balanocultures of Western North America and, to a lesser extent, those of Eastern North America (for example, Abrams and Nowacki 2008; Bainbridge 1987; Driver 1952; Hastorf and Popper 1988; Mason 1992; Shipek 1989; Yarnell and Black 1985).

along the route, and; 4) the acorns (and the cereals) were then ground on different types of stone structures, that had also been built as permanent structures in the forest for this purpose. As Aurenche (1997) points out, the interesting facts to be noted here are that there is a "natural" association between eating acorns and cereals, that the same tools were used for processing both, and that these tools were permanent structures far from where these people lived.

From 1994-1995, in an attempt to provide clues for archaeologists in reconstructing ancient diet, Füsun Ertuğ, ran a very comprehensive ethnobotanical study in Central Anatolia, in the Melendiz Plain area, focusing on the village of Kızılkaya (Ertuğ 1999), situated not far from a pre-ceramic Neolithic site, Aşıklı. Remnants of a steppe-forest vegetation belt include *Q. cerris, Q. pubescens, Q. infectoria, Q. ithaburensis, Q. robur, Q. trojana,* and *Q. vulcanica*. Boiss. & Heldr. ex Kotschy. Ertuğ's methodology inluded questioning 30 households from three different income groups in order to determine whether or not there were different attitudes about wild plant foods and wild plant food gathering activities. A rich knowledge of wild plant food resources was revealed in the lower-income category (acorns of all of the above-mentioned species were collected and eaten either fresh or roasted) whilst those in the upper-income category denied that such practices still existed (much as Louis Lémery, a 17th century French physician reported incredulously and with some repugnance that in certain parts of France people were still eating acorns (Maurizio 1932)).

Paleolithic archaeobotanical evidence

Direct evidence of plant material from Southern Levant archaeological sites in the form of carbonized, mineralized or waterlogged seed, fruit, bark, or wood is very rare throughout the Paleolithic – direct evidence for their use as food even more so. Nevertheless there is evidence to suggest that hominins have been eating acorns for a very, very long time.

1. Lower Paleolithic

a) Gesher Benot Ya'aqov (Israel). A waterlogged site from the Lower Paleolithic (oxygen isotope stage 19; 790,000 years old) Gesher Benot Ya'aqov is located in the Dead Sea Rift on the shores of a paleolake, Lake Hula. Though archaeologists have been working there since the 1930s, it was only in the beginning of this century that an assemblage of pitted hammers and anvils associated with edible nuts was revealed. According to Goren-Inbar et al. (2002) this is the first time that a site offers both paleobotanical evidence of plant foods eaten by early hominins and lithic artifacts of the tools used to process them. Nuts identified as acorns (59 fragments) were part of the recovered plant material along with the hard nuts of six other species, two of which are extinct today. The remaining three taxa are edible and still eaten all over the world today: almonds, pistachios and water chestnuts. Though it is not possible to identify the acorns to species level, both *Q. coccifera* subsp. *calliprinos* and *Q. ithaburensis* have been identified in the wood assemblage. More recently evidence has been presented for the hominin control of fire at Gesher Benot Ya'aqov (Goren-Inbar et al. 2004).[8]

8. Perhaps acorns have been a food source for hominins for even longer than 780,000 years. At Tel Ubeidya, south of Gesher Benot Ya'aqov and that dates from about 1.5 million years ago, archaeologists have recovered stone hammers and anvils and one pitted stone like the ones found at Gesher Benot Ya'aqov. Not surprisingly, no plant remains have been recovered (Goren-Inbar et al. 2002).

2. Middle Paleolithic

a) Kebara Cave (Israel). A limestone cave found in the Carmel Range, Kebara Cave, first excavated in the early 1930s, dates from the Middle Paleolithic, and is thought to have been inhabited between 60,000 and 48,000 years ago. During excavations lasting from 1982 to 1990, a wealth of carbonized plant remains was uncovered: 4,205 seeds, including 43 acorn shell fragments (in comparison with, for example, 503 nutlet fragments of pistachio) (Lev et al. 2005). The authors hypothesize that since the faunal remains clearly indicate that the cave was seasonally inhabited from October to December, when acorns but also game would have been abundantly available, it is possible that the inhabitants stored the acorns (and the pistachios) that they would have then consumed elsewhere and later in the winter and the spring, when other resources would have been scarce.

b) Amud Cave (Israel). Not far from Kebara Cave, Amud Cave is located on the margin of the Dead Sea Rift Valley, and also dates to the Middle Paleolithic. Though the charred material that was found was too fragmented to be useful, phytolith analysis has revealed the presence of different types of these microfossils that were subsequently classified into five morphological groups: 1) a general category for those with insufficient diagnostic morphology; 2) those that could be identified as belonging to taxa other than grasses, including phytoliths from dicotyledonous wood and leaves; 3) phytoliths that form the lumens of long and short epidermal cells of monocotyledonous leaves and stems; 4 and 5) phytoliths that form in the lumens of non-epidermal monocotyledonous cells. The characteristic morphotypes of woody and grass plants are equally prominent (Madella and Jones 2002).

3. Upper Paleolithic/Epipaleolithic

a) Ohalo II (Israel). The site, comprising the remains of six brush huts, open-air hearths and a human grave, is located on the southwestern shore of Lake Kinneret (Sea of Galilee) in the Rift Valley, and has been radiocarbon dated to 22,500-23,500 cal BP. It is outstandingly well preserved, probably due to a combination of charring and the rise in water level of the Lake that sealed the site with deposition of silt and clay. In 1989, following a dramatic drop in the water level due to drought and excessive pumping, the site became exposed thus allowing for three seasons of excavation before the water rose again. The site has yielded 90,000 plus plant remains with all but 152 seeds in a charred state (Kislev et al. 1992; Weiss et al. 2004, 2008). 43 acorn fragments were recovered.

b) Öküzini and Karain Caves (southwest Anatolia, Turkey). Both located in the foothills of the Katran Mountains, 30 km north of Antalya, with 1 km between them, these two caves are natural cavities. The site was first identified and excavated in the 1950s. At Öküzini Cave (17,000 to 11,800 cal BP), initial soundings (trenches) destroyed a vast part of the layers. The epipaleolithic layers of Karain Cave are dated to roughly 15,000 uncal BP. The deposits in both caves were processed with simple bucket flotation for recovery of plant remains including wood charcoals. Very low densities of charred material were recovered and the plant remains were poorly preserved (an identification category “nutshell fragments less than 0.5 mm thick” was created for small and badly preserved specimens). 51 fragments of acorn cotyledons were recovered (Martinoli 2005b; Martinoli 2009; Martinoli and Jacomet 2004).

SITE	AGE	IDENTIFIABLE ACORN FRAGMENTS
Tel Ubeidya	1,500,000	0
Gesher Benot Ya'aqov	780,000	59
Kebara Cave	60,000	43
Amud Cave	60,000	0
Ohalo II	23,000	43
Öküzini Cave	17,000	51

Table 4/ The Near Eastern Paleolithic sites where acorn remains have been found and their number.

How are these numbers to be interpreted?

Once all the fragments are counted, what do the numbers represent? What is a fragment indicative of? How can a quantity and type of fragment in one context (charred sites) be compared to a quantity and type of fragment in another context (waterlogged sites)? What does ubiquity of a taxon signify when compared to number of fragments retrieved? How does this information compare with results of the presence of cereals in the archaeological record? How is this data to be interpreted in a global paleoeconomic analysis?

a) Taphonomic bias

Taphonomy is the study of decaying organic material and all of the depositional and post-depositional processes involved in their preservation. Because different types of material are affected by different selective processes, not all organic material stands the same chance of being preserved. This in turn leads to bias in the archaeological record. "Any realistic assessment of the original extent of dietary diversity at the site must take account of possible gaps in the archaeological record. Plant remains inevitably provide

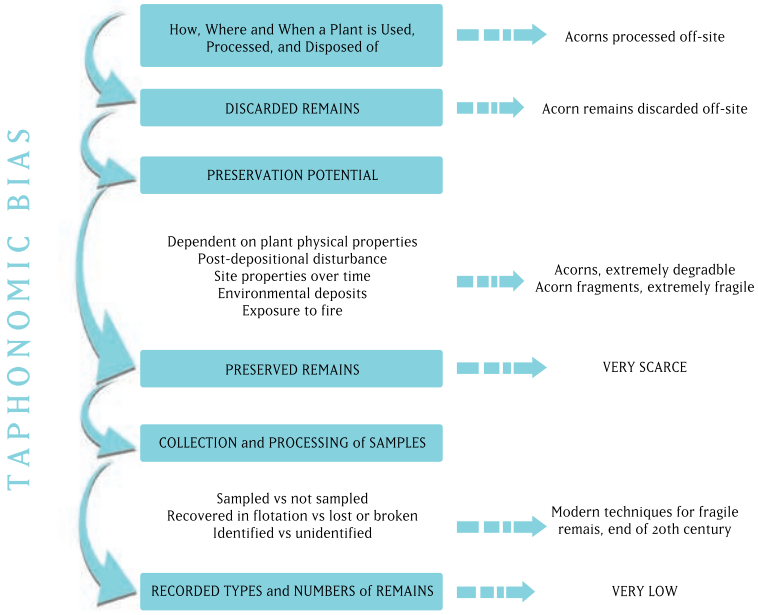

Figure 3/ Interpreting acorn finds in the context of taphonomic bias (adapted from Hastorf and Popper 1988).

an incomplete picture of past diet and this is especially true when preservation is by charring. Clearly, then, reconstructions of past diet which fail to take explicit account of these gaps in the record are potentially misleading." (Hillman 1989). "The preservation of wild fruits in charred state is strongly biased in comparison to cultivated plants. They are very frequently consumed outside the settlement and, in many occasions, there is no need for their processing, therefore very few archaeological traces of them are left. For this reason the charred record for the Neolithic period is dominated by cereal remains. Only when waterlogged conditions prevail is it possible to identify consumed kernels of some fruits." (Antolín 2013).

Photo 3/ Charred acorn cotyledon fragments (Campo del Colomer, Andorra, ca. 4,500 cal. BC).

Until fairly recently, acorn remains (indeed, this seems to be the case for nearly all plant remains) on archaeological sites were rarely considered in terms of any of the aspects relating to taphonomy (Fig. 3). In addition, because of widely different methodologies,

Photo 4/ Recovery of uncharred, water-logged acorn shell fragments (Banyoles, Catalunya, ca. 5,200 cal. BC).

especially in sampling and in interpretive models, it is difficult to compare the existing data (Mason 1992; Antolín, 2013) to determine "whether apparent differences over time and space are due as much to real differences in the use of acorns in the past as they are to the differing levels of recovery, analysis, and interpretation." (Mason 1992).

It is widely recognized today that acorn processing would have been carried out at the collection site and not at the settlement site where archaeological excavations take place. Whatever remains were discarded would therefore also have been at the collection site and not at the settlement site. It is also widely accepted that the degradation of very fragile acorn remains during formation processes accounts in large part for their relative scarcity in the archaeological record. Acorn remnants are usually found as single or joined cotyledons, shells, or bases. Generally only fragments of these are found rather than whole parts. Whole acorns and cupules are rare.

Finally, intensive recovery techniques crucial for recovering very small and fragile remains like acorn pericarps or cotyledons were developed only in the 1970s and their widespread adoption dates only from about the 1990s. All of the sites mentioned above were initially excavated in the first half of the 20th century. Though more recent sites like Ohalo II, first excavated in 1992, have used modern flotation and sieving techniques it is now thought that for water-logged sites samples require even gentler treatment than sieving in order not to destroy fragile remains (Antolín 2013).

b) Epistemological bias

In addition to this taphonomic bias that needs to be considered in order to properly interpret the archaeobotanical record there is an important epistemological bias composed of four components that needs to be taken into consideration.

1) **The modern status of the acorn**. All of the other nuts in the Near Eastern paleobotanical record, specifically hazelnuts, pistachios, and almonds, are still eaten today. Acorns are not. They have therefore not generally been sampled, analyzed or interpreted as a possible food source.

2) **The focus on animal food sources.** Decades of archaeological research specifically occupied with the dynamics of hunter-gatherer societies have generally stressed the role of animal food sources (Hastorff 1999). The assertion that plant remains are rarely found in Paleolithic excavations (Lev 2004) is certainly true, but is perhaps more a reflection of methodology (one can at best only find what one is looking for) than prehistoric reality.

3) **Gender.** The relatively meager importance given the study of plants other than their domestication in much of archaeology's history certainly also has to do with the fact that wild plant food gathering and processing activities were female duties. "Such household aspects of life perhaps were not thought to be important avenues of study when big questions could be addressed." (Hastorff 1999). Consequently, when the role of wild plants and the gathering/processing activities associated with them have been looked at, they have generally been viewed as secondary. Paradoxically, it could of course be reasonably argued that if women were the detainers of "plant knowledge" then they were certainly also the ones responsible for the "big question": plant domestication and the beginnings of agriculture.

4) **Looking for cultivation and missing the point.** By far the most important component of this epistemological bias is that agriculture has long been represented as the "goal" of social evolution. Implicit in this is that hunter-gatherer societies/ subsistence economies were without complex food management practices and without highly developed ecological intelligence. The use of the word "subsistence" to describe

what was "before" reflects not a body of fact but a certain frame of mind.

Smith (2001) has pointed out that these mental constructs produce representations of late Paleolithic hunter-gatherer behavior as little more than specific "…preadapations on the way to an anticipated agricultural destination on evolutionary interstates with no exits." Traditionally the terms "Neolithic revolution" and "agricultural revolution" are used synonymously but increasingly it appears that agriculture was one of the last elements to appear in Neolithic development and not, as has been thought for a long time, the first one that would have then enabled all of the other ones. Evidence from Mexico, South America, Asia and from the Near East suggests for example that increase in population density was not a result of agriculture but preceded it.

Except in a few, very rare, cases subsistence economies no longer form the basis of organization of human societies. At some time between the Upper Paleolithic and the Neolithic, presumably somewhere in the Southern Levant (though, increasingly this too is being questioned, see for example McBrearty et al. 2000), social organization based on hunter-gatherer activities was replaced by sedentary societies with agricultural practices. The search for the "exact" place, time, and mode of this transition has motivated, and continues to motivate, archaeologists (Bar-Yosef 1998; Jones 2009; Liebermann 1993; Roberts et al. 2011; Rosen and Rivera-Collazo 2012; Tchernov 1997; Weiss et al. 2004).

The focus on the domestication of cereal crops, has meant that archaeologists have generally paid little attention to the role of wild plants and the various possible forms of human interaction with these (other than what is generally understood as domestication) in the hunter-gatherer societies at the boundary between the Upper Paleolithic and the Neolithic, and even well into the Neolithic (Binford 1980; Fairbairn et al. 2002; Mason 1992; Olszewski 2009, 2010; Smith 2001). "Because nearly all considerations of subsistence in Europe, from the Neolithic (and sometimes earlier) onwards, have been biased towards analysis of domesticated plants and animals and agricultural products, wild plant foods have often merely been recorded as present on archaeological sites, with little consideration given to their potential importance…(T)he potential role of acorns… has yet to be fully addressed in the European/Mediterranean region" (Mason 1992).

The recognition of these various different biases has of course led to new and exciting ways of thinking about these questions and the zone between hunter-gatherer and agricultural-based societies is increasingly understood as a rich and complex zone in prehistory rather than a thin line, both in space and time (Smith 2001). Nearly 80 years ago V.G. Childe, one of the founding fathers of archaeology, wrote that this discipline could only recognize a result and not the processes leading to it (Childe 1936). Increasingly over the past two or three decades, the dominant methodological position is a reversal of this, as eloquently stated by Lewis Binford "The archaeological record is at best a static pattern of associations and co-variations among things distributed in space. Giving meaning to these contemporary patterns is dependent upon an understanding of the processes which operated to bring such patterning into existence."(Binford 1980).

A case in point: the Natufians

The Natufian civilization (13,000 – 11,000 BP) developed in the Southern Levant in the Mediterranean forest belt dominated by oak and pistachio. This civilization is characterized by what are considered to be many significant cultural developments such as a high degree of sedentism, rituals, stone sculptures, jewelry, etc. The "classical"

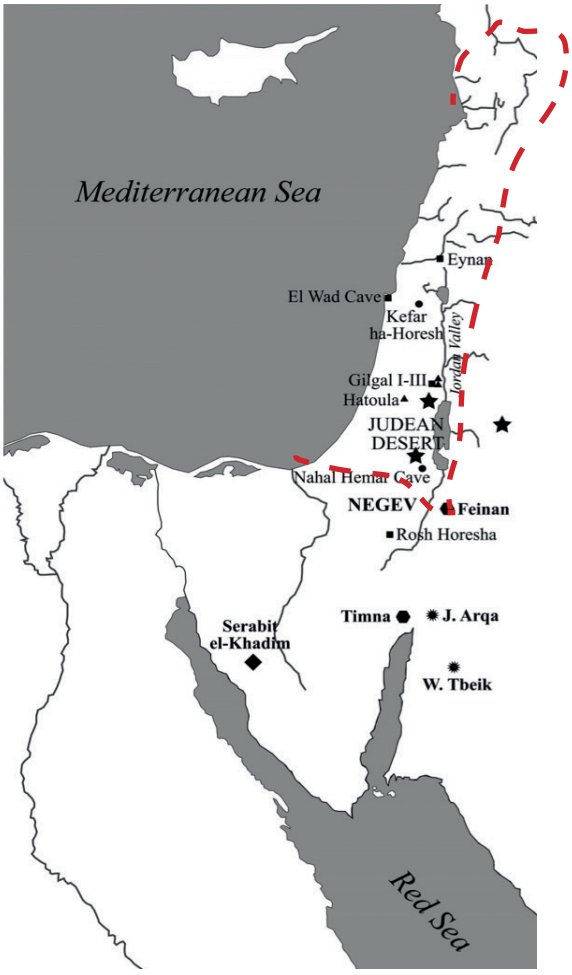

Figure 4/ The territory of the Natufian civilization (ca.13,000 – 9,500 BCE).

model of interpretation of Natufian development (Bar-Yosef and Belfer-Cohen 1992) is that Early Natufian flourished in the Mediterranean forest belt (Mt. Carmel, Galilee, and the Upper Jordan Valley) and during the Late Natufian new technologies allowed for adaptation to more arid environments. The advocates of this model argue that as population pressure increased and available territory for hunter-gatherer activities decreased, these first Natufian communities (in the forest) would have improved their resource management by utilizing a broader range of resources. This would include the grasses growing in the forest, but, according to the advocates of this model, probably not acorns in a significant manner except in times of famine. Eventually, these communities would have focused their attention on specific legumes and wild grasses and this in turn would lead to the first attempts at cereal domestication and eventually to the first true Neolithic communities in the region.

Contrary to this "classical" model, there is a new school of thought that has asked the question: why would these people have focused on grasses when they would have had acorns, a much more abundant and efficient resource?

Acorns or cereals?

During the Last Glacial Maximum (24,000 uncal BP to 15,000 uncal BP) as the general climate became colder and drier, the Southern Levant region would have benefitted from the influence of the Mediterranean. The coastal region and the western slopes of the north-south mountains would have had wetter conditions, denser vegetation and greater forest cover. After the LGM, warmer and wetter conditions prevailed until about 13,000 uncal BP and there would have been forest expansion, the appearance of small lakes, and the restoration of large ones, like the Dead Sea, for example (Tchernov 1997). During this general warming trend, two episodes between 12,000 BP and 10,000 BP mark a rapid return to colder, drier conditions.

A large part of the "classical" model reposes on the idea that during these two

episodes when the climate became drier and colder there would have been a reduction in forest cover during which time the wild cereals growing in the forest would have expanded making this resource more attractive. However, based on Near Eastern pollen records (Fig. 5), it appears that these two climatic events may have had very limited impact in the Levant (Weinstein-Evron 2002; Langgut et al. 2011). Wood charcoals and palynological samples at the El-Wad (Mount Carmel) site dating from the Natufian period reflect a similar species composition as currently (Weinstein-Evron 1994; Lev-Yadun and Weinstein-Evron 1994). The arboreal vegetation of the Central Negev Highlands during the Natufian seems also to indicate that climatic change during these periods was not prominent in this region (Baruch and Goring-Morris 1997). Preliminary analyses of phytoliths from Early Natufian sites also suggest that woody plants were indeed more prominent during this period and most phytoliths from Late Natufian sites have been identified to non-cereal grasses thus again raising questions about the classical model that proposes increased intensive management and cultivation of cereal grasses to explain Natufian development (Rosen 2010; Power et al. 2014). Additionally, recent work using marine oxygen isotope cores, polar ice cores and cave speleotherms, suggests that during the entire Late Pleistocene, climate changes thought to have occurred gradually over several thousand years occurred in fact extremely rapidly over the course of a few centuries, if not merely decades (Roberts 2011; Shea 2007). If this is true, then hominin populations would have had to rely on diverse resources and behaviors, adapting to rapidly changing situations in food supply. An implication of this is that hominin cultural evolution must have been a complex dynamic of knowledge and behaviors that would not have been abandoned one by one along the deterministic road towards agriculture.

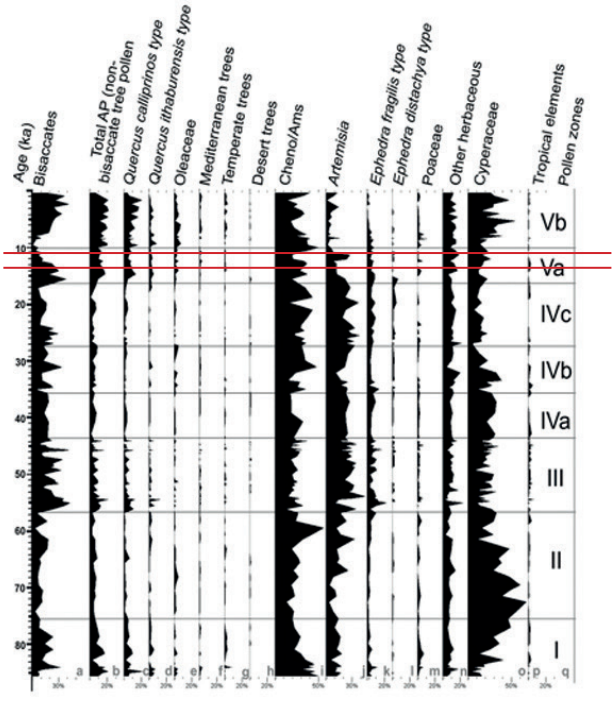

Figure 5/ Palynological diagram based on core samples from the South Eastern Levantine Basin (adapted from Leggut et al. 2011).

More Natufian sites have been discovered over the last two decades than in the preceding 80 years (Kuijt 2002). In addition, many already-known sites have been studied again concentrating on the Natufian layers. The Natufian culture has been traditionally divided into "Early" and "Late Natufian" with the former occupying the Mediterranean forest belt and coastline, and the latter in the grass/steppe areas. Currently, however, there is increasing evidence that the Natufian culture that developed in the woodlands is not any older than that which flourished in the grasse/steppe region. The implication of this is not insignificant: it means that the transition from hunter-gatherer to agriculture was not

linear and that in fact these two cultures coexisted in time and space.

Plant remains of any kind from Natufian sites are very scarce (Table 5) and this is generally attributed to the poor preservation of charred remains and the lack of appropriate techniques for systematic retrieval during older excavations. That there is a very poor acorn record in Neolithic sites is certainly the case.

SITE	PLANT REMAINS FOUND
Hayonim Cave	wild barley, almonds, lupines, peas (?)
Hayonim Terrace	wild barley, small legumes
Wasi Hammeh 27	Wild barley, lentils, legumes (?)
Ain Rahub	undescribed
Nahal Oren	undetermined

Table 5/ The only plant remains known from Natufian sites (Olszewski 2010).

But, although direct evidence of acorn use is scarce, direct evidence of the use of cereals is scarce as well. And, contrary to acorns, cereals, especially in charred or carbonized conditions, as is the case for these sites, stand a great chance of being well preserved. So, while taphonomic bias could explain the absence of acorn remains it does not appear to explain the scarcity of seed grasses that we would expect to find in greater numbers if indeed they were the main food source of the Natufians. It has been hypothesized that the lack of seed grasses from Natufian sites could be due to the fact that these communities were not particularly interested in them: their economy was instead actively based on the acorn (Moore 1983, 1991; Olszewski 1993, 2010). The advocates of this model also contest the idea that the Mediterranean forest at the time of the Natufians was favorable to dense cereal growth, so that while grasses were most likely a part of a "broad spectrum economy", collecting and processing acorns as principle resource would have been a much more efficient strategy given their abundance in the forest. "The widespread abundance…of acorns in the woodlands was not replicated in the steppe. On the other hand, while cereals and other edible grass seeds would have been obtainable in the woodlands, their abundance was likely to have been greater in the open contexts of the steppe and parkland. There thus were two primary, seasonally differentiated plant foods (acorns/cereals and other grasses) available to Early Natufians in the woodlands…" (Olszewski 2010). "Epipaleolithic plant management practices do not emerge as "pre-adaptations" en route to food production. They should be more realistically perceived as a diverse array of foraging adaptations to locally fluctuating plant resources. Cereals were not the focus of plant gathering and are also unlikely to have been cultivated…(T)his does not imply that cereals were not used at all, only that they are unlikely to have been long-term staple foods as is sometimes implied in the literature." (Asouti et al, 2012).

Of grinding stones and dental pathologies

True ground-stone assemblages begin to appear in the Upper Paleolithic and become especially numerous during the Natufian. (Aurenche 1997; Belfer-Cohen and Hovers 2005; Rosenberg 2008; Wright 1991, 1994). Traditionally the relationship between cereals and grinding tools is emphasized and they are often considered to be direct

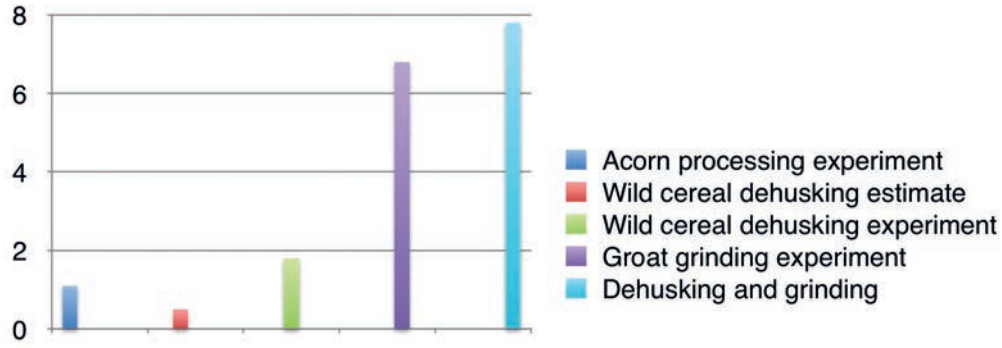

Figure 6/ Acorn vs cereal processing (time in hours per kilo) (adapted from Wright 1994).

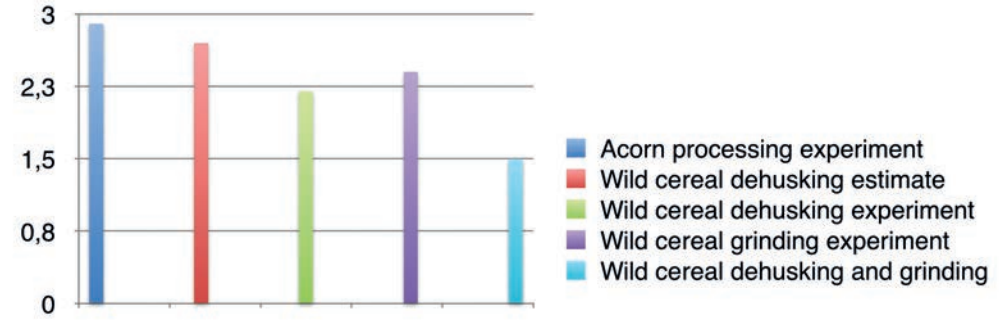

Figure 7/ Acorn vs cereal processing (kcal per hour/1,000)(adapted from Wright 1994).

evidence of cereal exploitation although there is a good deal of archaeological, historical and ethnographic evidence to the contrary (Wright 1994).

The arduousness of grinding cereals has long been underestimated and a brief look at some data about processing acorns vs cereals shows, on the one hand, that cereal processing would have been much more time consuming (Figure 6), and, on the other, that acorn processing would have had higher calorific yields (Figure 7) (Wright 1991).

In the cuneiform sources, an interesting letter dated from the first half of the second millennium BCE, also sheds some doubt on the attractiveness, from a labor point of view, of processing cereals (Oppenheim 1967): "Come back before your wife and daughter die from the work of constantly grinding barley while in detention. Please, get your wife and daughter out of this." Clearly, one of two things must be true here: either these woman had been imprisoned for some crime and grinding cereals was their punishment (sort of the Mesopotamian equivalent of the chain gang) or they were being detained specifically to accomplish this task. Either way, it makes one stop and think about how truly difficult it must have been to grind (even) cultivated cereals – and also possibly about the social and political organization of these young agricultural societies that needed to link the organization of their food supply with their penal system.

Starch-residue analysis studies of most Natufian ground-stone assemblages are largely hindered by the fact that until very recently excavated material was washed to remove adhering sediments (Olszewski 2009). Research into the Neolithic Peiligang culture (7,000-5,000 BCE), using starch-residue and use-wear analysis has shown that these early Neolithic people were grinding principally acorns (Photos 5a-d; Liu et al. 2010).

Equally interesting is that the plant remains excavated from the same studied sites did not include any acorn fragments. The only remains that were found were of hazelnuts, walnuts, elm fruit and jujube. The authors conclude, "The presence of grinding stones should no longer be used as an indicator of intensive agriculture based on cereals but is more likely to suggest a wide-spectrum subsistence economy with a particular focus on acorn exploitation."

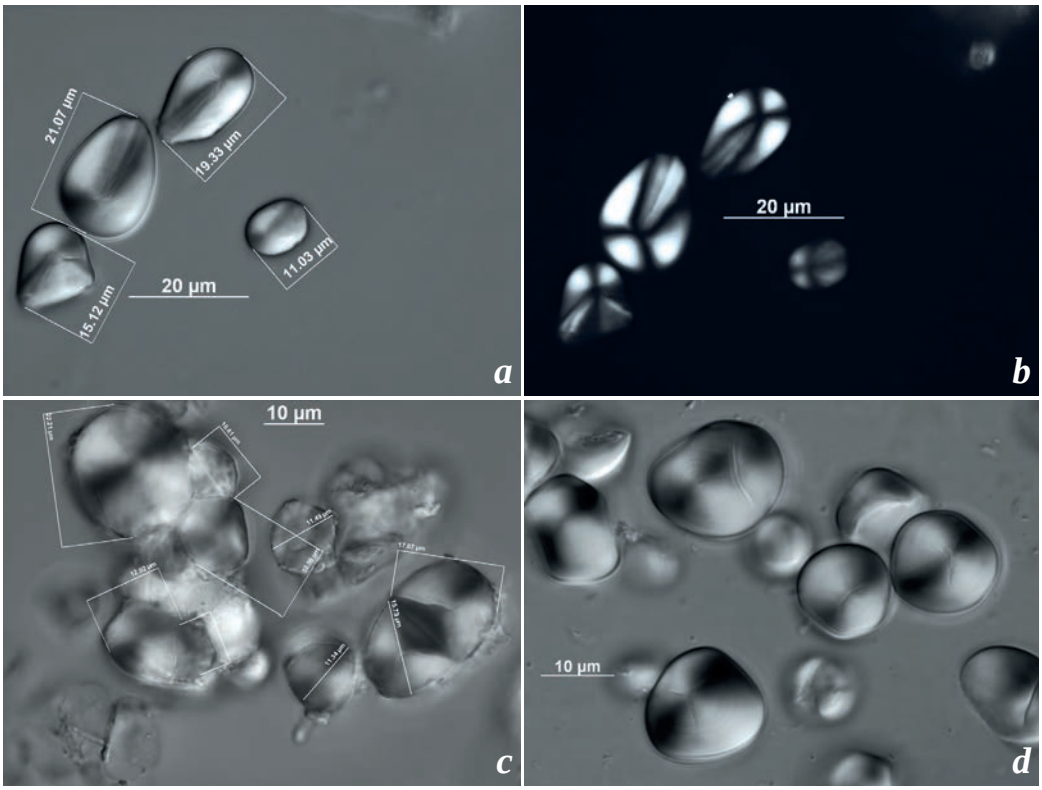

Photo 5/ Results of starch residue analysis on grinding stones from Shigu (Peligang culture, China, ca 7,000 – 5,000 BCE). a-b) *Quercus fleuryi* c) *Lithocarpus fenestratus* d) *Lithocarpus glaber*.

Much like grinding stones are traditionally taken as evidence of the beginnings of agriculture, the onset of dental pathologies in prehistoric populations has also been traditionally linked to cereal exploitation. However, Humphrey et al. (2014) present evidence linking a high prevalence of caries to reliance on wild plant foods in Pleistocene hunter-gatherers from North Africa (Moroccon site, the Grotte des Pigeons, 15,000-12,600 cal BP) predating the first signs of food production by several thousand years.

Neolithic considerations

According to Fairbairn et al. (2002), since the end of the 1990s, the notion of agricultural production in Turkey during the Neolithic has been challenged. "For the most part these early settlements had developed "foraging economies", relying mainly on the gathering and hunting of a wide variety of wild plants and animals, with only minor contributions from cultivated crops." (Assouti and Fairbairn 2002). The macrobotanical evidence has

led some scholars to reject agricultural production as a major element of the subsistence strategy for some, but not all, sites.

The Capsian culture of North Africa was an advanced culture with rituals, abstract and figurative rock art, jewelry etc. Until recently the only information about their diet related to animal food sources. Systematic sampling and processing of sediments for plant foods has only recently been undertaken. The El Mekta site (10,000-7,500 BP) 10 km north of Gafsa in southwest Tunisia, though first excavated in the 1950s, was only excavated for plant remains in 2012. From the extensively charred and damaged remains only three taxa were identified, *Pinus halepensis* (47% of the plant assemblage), *Quercus* sp. (38%) and *Stipa tenacissima* (one fragment). According to the authors, "…despite their low frequency, the presence of charred cupules and seed scales in all of the trenches strongly suggests that both acorns and pine nuts were regularly collected, processed and consumed at El Mekta." (Morales et al. 2015).

Çatalhöyük, in present-day Turkey, is one of the most important Neolithic archaeological sites of the Levant. Founded sometime in the 8th millenium cal BP, it became an important center of commerce and culture with an estimated population of 5,000. This site is thought to have been occupied for roughly 1,000 years. During the original 1958 excavations, plant remains were not collected but qualitative appreciations noted acorn remains as being present throughout the excavated layers. More recent excavations, finished in 1999, resulted in the collection of over 4,000 botanical samples from 61 excavation units dated from the middle of the 8th millenium. A little less than 1.5 kg of acorn pericarps and twenty acorn bases were recovered (Fairbairn et al. 2002).

Evidence from the wood charcoal data shows that during the early phases of settlement the inhabitants of Çatalhöyük, exploited the riverine forest (mostly *Salicaceae*) for firewood rather than the oak-pistachio-almond woodlands. Is it possible that this was because the latter were a source of food? "Similar patterns are evident in several sites in the northern Euphrates (Mureybet, Abu Hureyra, Jerf el Ahmar, Dja'ade, Halula)." (Fairbairn et al. 2002).

The authors conclude "Rather than rapid deforestation and the diminution of park woodland the evidence from Çatalhöyük (also) suggests that the exploitation of trees for timber, firewood and fruits was sustainable for several centuries…The archaeobotanical evidence considered in context indicates that the Neolithic community of Çatalhöyük routinely exploited and managed widely dispersed territories…Perhaps Çatalhöyük serves to demonstrate how the construction of permanent dwellings and the exploitation of plant domesticates should not be assumed to go hand in hand with reduced seasonal mobility."

Tagerup, in the province of Scania, Sweden, a site dated to 6,700-4,900 cal BCE is located where two small rivers converge and bordered by hills where numerous archaeological finds from prehistoric periods have been made. Plant macroremains were analysed from 49 samples. Of the terrestrial plants, the highest numbers of finds are from *Betula, Quercus, Malus sylvestris,* (L.) Mill. *Sorbus aucuparia* L., *Corylus avellana* L. and *Cornus sanguinea* L. All of the acorn fragments were carbonized or partly carbonized, strongly indicating heat treatment as part of their processing for consumption. The authors also note that acorns and hazelnut fragments, easily identifiable, are often treated in the Nordic countries as any other artifact, and not often discussed in the literature specifically reporting on archaeobotanical finds. Acorns in Nordic prehistory are known from three other Mesolithic sites and four Neolithic sites (Regnell 2010).

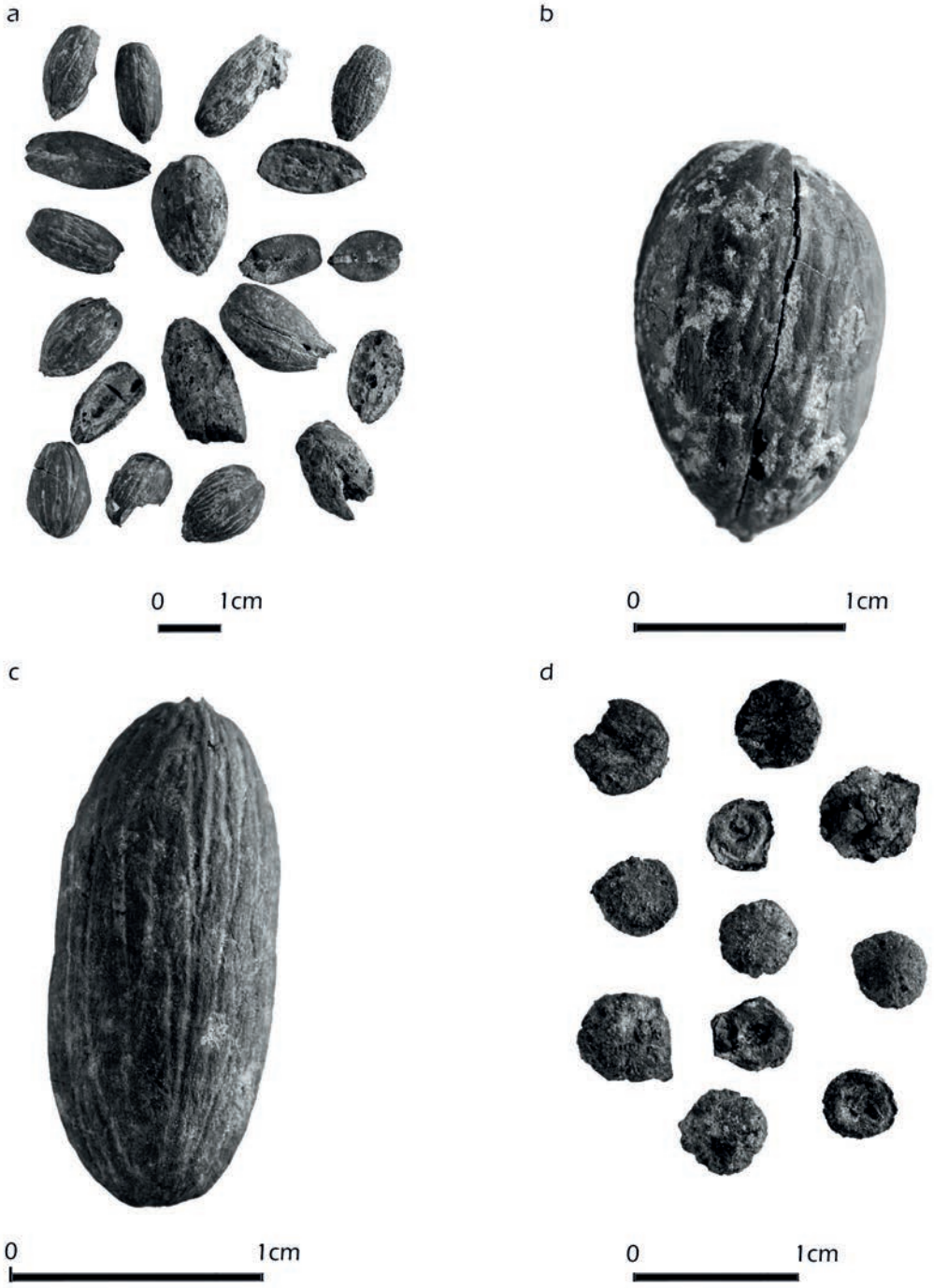

Photo 6/ Charred acorns from the pit found at Caesar's Nose, Boezinge (West-Vlaanderen, Belgium, ca. 2,275 BP). a-c) cotyledons d) hilums.

The results of a several-year-long study of 17 Neolithic archaeological sites in the north east of the Iberian Peninsula using extremely laborious recovery techniques show that *Corylus avellana* and *Quercus* sp. were the best represented woodland taxa considering both the charred and waterlogged record for the Early Neolithic (5,400-4,500 cal BC); for the charred record for the Middle Neolithic (4,500-3,200 cal BC), again, these two taxa were the best represented; and in the Late Neolithic (3,200-2,300 cal BC), *Abies alba* Mill. and *Quercus* sp. were the best represented taxa in the charred record. In addition, *C. avellana* was only identified in certain sites (those above 900 m); *Olea* sp. and *Arbutus unedo* L. were found only in the central coast area; *Pistacia* sp. in the central coast area and in the Western Plain area; and *Vitis* only in the eastern area, linked to riverine or lakeshore sites. Acorn remains were recovered in the entire studied region (Antolín 2013). In a previous study of forest resources exploitation in one of the sites included above, Cova Fosca, the author concludes "Cova Fosca shows how the arrival of agriculture had a sudden and long-lasting effect on the environment even at fairly high altitudes, but it also demonstrates how wild resources keep being of economical importance for the subsistence of these groups." (Antolín 2010).

An example from the Iron Age

In 2005, excavations at a site in Boezinge in northwest Belgium dated to 2,275 BP revealed a pit that measured 2m30 by 1m75 for a depth of 0.30m, that was completely filled with charred organic material. Half of the fill has been sampled and this has revealed that the charred material is almost exclusively composed of acorn remains (acorn bases, cotyledons, embryos, and pericarps but no cupules). Apart from the acorns, only a few seeds of five other plants have been found. To estimate the number of acorns that the pit could have contained, the "minimum number of individuals" (MNI) was assessed by counting a clearly distinguishable character that occurs only one time on each cotyledon: the place where the embryo attaches to the cotyledon. The average number of acorns per litre of sediment was determined to be 147. Since the volume of the pit is 470 litres, the estimate of how many acorns the pit could have contained comes to 69,000. The authors point out that this is probably an underestimation given that highly fragmented acorns would not have been included in the MNI count. Clearly the Boezinge assemblage did not originate through a set of natural processes. Were they stored for human consumption? The authors point out that the acorns could have been collected for fodder for pigs or for tannin, but that in those two cases there would have been no need to remove the cupules. How did they get charred? The cotyledons were charred in a very homogeneous way, suggesting that this happened very slowly and in an atmosphere with little oxygen. Were the acorns shelled? The authors suggest that since pericarp fragments were found in the pit, the pericarps were fragmented during charring, and that the acorns had not been peeled before storage. (Deforce et al. 2009). The authors conclude, "(T)he high number of prehistoric sites where acorns have been found and the large number of acorns recovered from some of these sites make it unlikely that the consumption of acorns by man has been restricted to periods of famine. The growing number of archaeobotanical finds of acorns should stimulate us to reconsider the role of acorn eating in prehistoric food economy."

Conclusion

If indeed acorns have been an important food source in human social evolution, especially in the "Fertile Crescent" where not only cereals were domesticated, but many fruit and nut trees as well, then a most interesting question – that leads to many others – needs to be addressed: were oak trees also cultivated as food source, and, if so, why was this practice abandoned?

If we adopt the position that agriculture can not be represented as the inevitable outcome of Paleolithic or Neolithic social evolution, if we accept that there is nothing objectively or inherently superior about cereals vs. acorns, and if we consider the evidence that seems to show that the adoption of cereal-based agriculture in the Southern Levant was not forced by climate change then how/why was this choice made?

A tempting answer to this question is that the masting behavior of oak trees would have made acorns an unreliable food source. But, aside from the fact that this statement implies that the beginnings of cereal cultivation were not fraught with frequent penuries, can we affirm that early man's ecological intelligence and social organization would not have been able to confront this problem? And, do we know enough about masting behavior to determine what magnitude of problem it would have represented? Although some years are mast years and some years there are no acorns whatsoever, intermediate-crop years are most common, and some trees will produce good crops every year regardless of what the other ones are doing (Pearse, this volume pp. 245-253).

Perhaps also, the question needs to be investigated from different angles. History has shown time and time again that societies do not necessarily make rational decisions regarding their future. In other words, that these decisions are not objectively coherent with the available, rational information on hand simply because there is a significant ideological component that forms the context of the decision-making process (Diamond 2005; Fressoz 2012; Mandosio 2000; Roberts 2011; Servigne and Stevens 2015; Tainter 1988). Telling examples of this include the Early and Late Bronze Age collapses, the fall of the Western Roman Empire, the demise of Easter Island, and, sadly, one is tempted to add, the world at large in the 21st century. In trying to answer the question, "why were acorns abandoned?" it seems at the very least plausible that one avenue of investigation would be the possibility that the choice for a cereal-based agricultural model of socioeconomic organization would also have had an ideological component to it.

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Photographers. Title page: Ferran Antolín (acorn bases). Photo 1: Eike Jablonski. Photo 2: Béatrice Chassé. Photos 3, 4: Ferran Antolín. Photos 5a-d: Judith Field (reprinted with permission from Liu et al. 2010). Photo 6: Hans Denis (reprinted with permission from Deforce et al. 2009)

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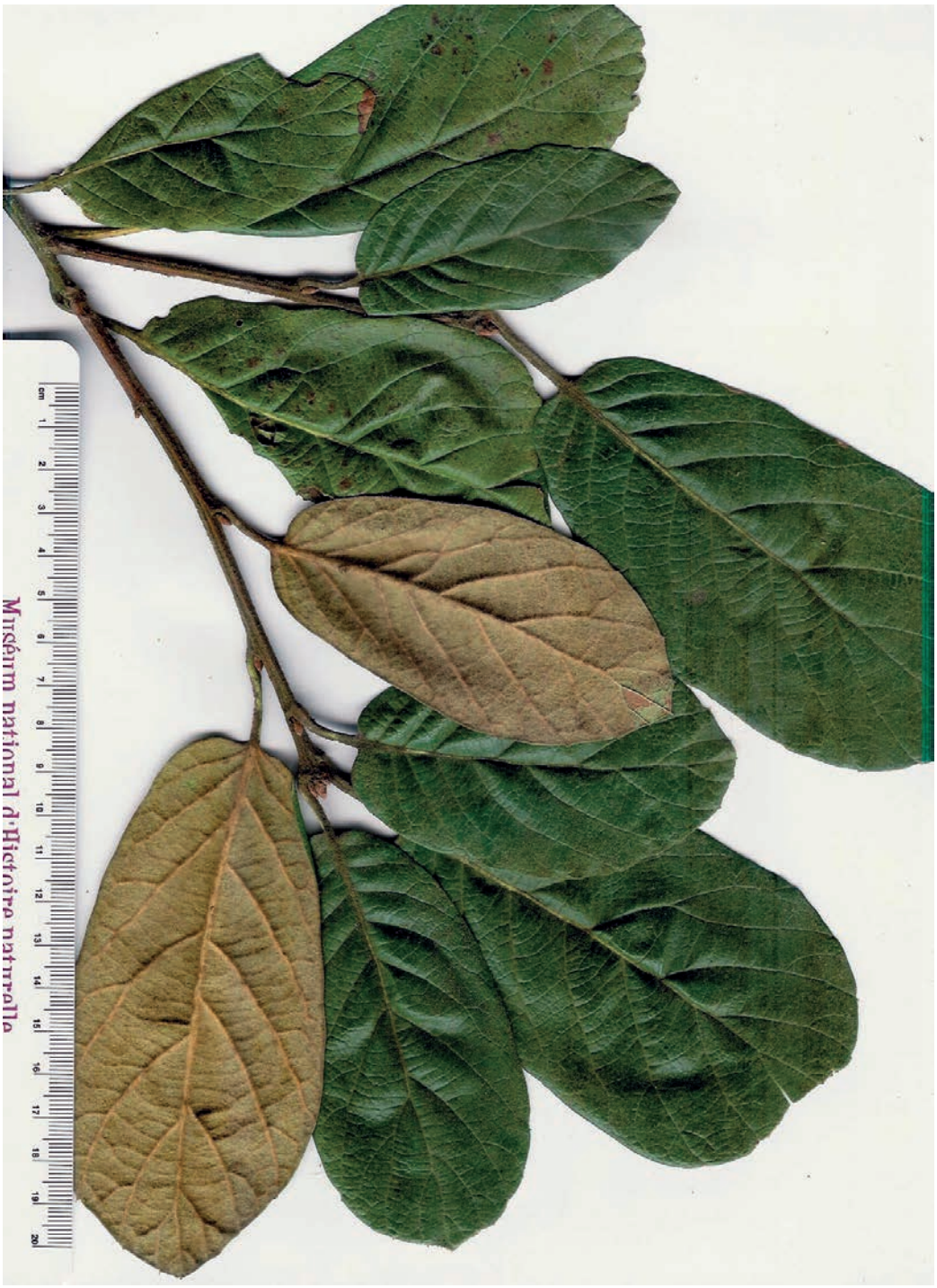

Photo 1/ *Quercus crassifolia* 'Flamingo'