

The Rise of Agriculture: A New Perspective

BY DAVID A. BAINBRIDGE

The oak tree, today revered primarily for its beauty, may once have been the central food bearer around which entire societies (balanocultures) built their diet and lifestyle. Recent evidence shows that tools used for grinding and pounding food existed long before corn became popular and may have been used to process acorns into meal. Factors such as the domestication of goats and the burning of oaks for fuel may have contributed to the movement away from balanoculture. By the end of this century severe crises in agriculture world-wide may make a return to some modified form of balanoculture a viable alternative.

The origin of agriculture has received increasing attention in the last twenty years. Harlan (1), Streuver (2) and Cox (3) have summarized much of this work. A key link between the three centers where granoculture is presumed to have developed has been ignored—the oak forests. I propose that the acorn resource and the balanoculture (from the Greek *balanos*—acorn) it supported were essential for the evolution of agriculture as we know it today.

We can begin by looking at the oak woodland link. The limited evidence from central China makes any firm statement impossible, but it appears likely that the loessial highlands north of the Tsingling Shan mountains were forested during the Mesolithic (4) period. The mixed hardwood forest would have included many oaks, and the Chinese use of acorns as food continued until modern times (5). The occurrence of pottery before agriculture, which has puzzled archeologists, may be explained by the need to heat water for leaching acorns.

The evidence in Mexico is much clearer, as sites such as the Coxcatlan cave in the Tehuacan Valley were once at the edge of the oak forests and acorns were found in both the Palo Blanco and Coxcatlan digs (6). The discovery of relatively few acorns should not be construed as proof that they were not a key food resource for the same reasons that Byers suggests corn did not show strongly in coprolitic studies: "If the maize kernels were boiled with ashes or lime to remove the pericarp, and the resulting hulled corn meal ground to a very fine meal... there would be no identifiable trace" (6).

The use of ash to neutralize tannin in acorns predates the use of ash to improve digestibility of corn and quite likely led to it. The acorn must be ground before it can

be eaten, so it would be eaten as mush or fine meal. Many grinders and mortars are found in the Tehuacan 1,500 years before corn became important (7). Furthermore, the acorn is large enough that it will not be lost and turn up in debris as often as smaller grains. And finally, the outside storage of acorns, so successfully practiced by the California Indians, would leave no trace in the archaeological record.

In the Near East the major sites are virtually all in present or past oak woodlands (8). Acorns were common in the sites at Jarmo and Catal Hüyük, and as Bohrer (9) points out, the seeming paradox of many mullers but few sickles at Catal Hüyük (10, 11) may be explained by the use of acorns. Acorns are still used by the Bahktiyari people in the Zagros Mountains (11) and were a staple food in Kurdistan and West Iran in the late 1800s, according to Bishop (12) and Hooper (13). Acorns also were regularly featured in the markets in Mosul (14) and Bagdad (15). André Michaux found the best acorns he had eaten were those grown in Mesopotamia and Kurdistan and sold in Bagdad (16). This is to be expected after more than 7,000 years of selective pressure.

The importance of acorns to the gatherer-hunter has been ignored by all of the investigators working on the rise of agriculture except Bohrer (9). This is primarily the result of cultural bias that has led to a characterization of acorns as a "starvation food" (11) when they are more likely to have been the staple food. The underlying assumption is that grains are somehow "better" because we use them today. Little ethnographic data is available from the areas where agriculture arose, so Bishop's comments on life in western Iran near the turn of the century are a rare

exception and are most instructive. She reported that the villagers along the Sahid River near Gokun relied on a diet of acorns, curds, and wild celery. Grain was grown for barter and exchange but not eaten (12).

For a more complete review of acorn-based societies or balanoculture we must turn to the experience in California. Here an incomplete but still instructive look at life among the oak woodlands can be gained, although cultural beliefs and practices may have differed among balanocultures.

The acorn was the staple food of these California Indians, making up more than 50 percent of their diet (17). In comparison with wild grains or early domestic grains, acorns were an ideal food. The oak forests are very productive in California, up to 3,500 kg/hectare (18), and gathering more than 50–100 kg per hour is possible (19). This enabled a family to collect a two- or three-year supply working part-time for two or three weeks. Storage bins of up to 5.5 m³ made of simple materials (20) would keep these acorns in good condition up to five years (21). Acorns were also stored in mud, which not only leached the bitter tannins but also lengthened storage time up to 30 years (22). Interestingly enough, the major oak species in California used by the Indians all have bitter acorns, and taste, yield and oil content were more important than relative bitterness. The Cahuilla tribal legends tell of the fall from grace when acorns became bitter. This is probably based on fact, as the area of tribal origin to the east includes several favored species with sweet acorns. Information on tannin level and yield in oak forests in other parts of the world would be most helpful in determining whether this pattern was unique or whether sweetness



Cahuilla Indian woman filling a granary with acorns (annual precipitation 5 to 25 mm) about 1898.
Photo: The California Historical Society.

was relatively unimportant everywhere.

The harvest and use of wild grains with a brittle racis and tight hull would have been much more arduous and time-consuming even in areas with relatively low acorn yield. Steensburg's harvest studies with flint sickles (23) suggest that at current wheat yield (24) in Iraq, acorns could be collected ten times as fast. The acorn stores much better than other nuts because the relatively low oil content prevents rancidity, a problem with more oil-rich nuts (11). Acorns also store better than small grains because their larger size reduces the threat of mold and decay.

The archeological record from these balanocultures is also worth reviewing. One of the key elements throughout the thousands of years of occupation in California is the occurrence of millers and grinders (20). It is thought that these were used primarily for acorns, although Chenopods, Bromus, Hordeums, Avenas, and other grains were also collected and eaten (25, 26).

Acorns not only are easily collected and stored but are nutritious as well, with reasonably well-balanced amino acids (27) and plentiful vitamin A and C (28, 29). They are an excellent food in combination with animal protein or legumes and it is not surprising that villages of 1,000 people and population densities of 180–360 per

100 km² were reached in the balanocultures of California (30). The value of the acorn is indicated by the willingness of the Mono Indians to enter hostile country to collect acorns (31), which then had to be carried 50 km over a 3,000-meter pass.

The Indians' great respect for the acorn was demonstrated in festivals and celebrations. They also planted acorns, as a Maidu song relates (20): "The acorns come down from heaven. I plant the short acorns in the Valley. I plant the long acorns in the Valley." It is likely that the prehistoric people in the Far East, China, and Mexico were equally knowledgeable and that respect for the oaks as holy trees in the Middle East (32) and throughout Europe (33) dates to these times.

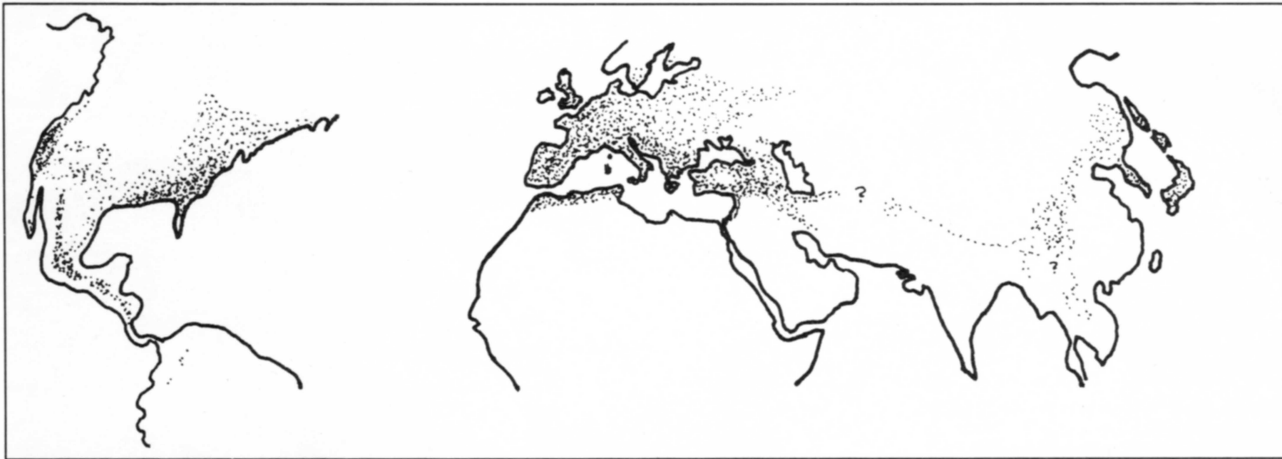
WHITHER THE ACORN?

The question therefore becomes, "Why did the more time-consuming and tedious granoculture replace balanoculture?" I suspect the answer is a complex one interrelating four factors: (a) the domestication of goats, which browse on oak foliage and seedlings and thus not only damage existing trees but also prevent regeneration; (b) cutting of trees for fuel, not only to keep warm but also to leach and cook acorns, and for construction (a stable village would have a marked effect on nearby

woodlands); (c) field burning to improve hunting, grazing, and acorn harvesting; and (d) climatic fluctuation.

Grazing by goats has well-documented, detrimental effects on oaks and other vegetation (34, 35). The record suggests that goats were domesticated by 8,500 BC and common at Jarmo (36). Goats would not only eliminate natural regeneration but would prevent stump-sprouting success on trees that were cut for timber or fuel. Oak branches have been used for fodder in many areas of the Mediterranean, leaving no part of the tree safe. In Iraq *Quercus infectoria* is a favorite for fodder, being pollarded for better production even today (15). The effect would have been strongest near the village and would have favored the annuals in the existing woodland flora, including wild wheat and barley. As the time and effort required to collect and haul in acorns became greater the attractiveness of these grains would increase.

The type of domestic animals kept and favored would have a marked effect on oak-forest survival and the continued use of acorns. The pig/oak relationship is relatively harmonious, and continues to this day in some areas. It was a dominant interaction in England, Italy, Spain and the United States until modern times. The goat/oak interaction is more destructive, and the preference for goats rather than



World oak distribution. (Map adapted from *Weltforstatlas*, Verlag Paul Parey, Hamburg, 1973.)

pigs for cultural or religious reasons would strongly influence the survival of balanophagy and ultimately the survival of the oak forests.

The second element (37) must also have been important. Even a small village would quickly exhaust local fuel resources and with a considerable investment in buildings might continue to occupy a site even when fuel had to be hauled some distance. Eventually the village would be relocated to a new fuel supply. One of the reasons that the Jōmon people of Japan and the native tribes of central California managed to sustain their acorn-based agroforestry systems for thousands of years with little change may have been milder climates—requiring less fuel.

The cutting of timber may also have played a role. Oak timbers were used at Catal Hüyük (10) and are well-represented later in the Middle East. For example, at Nea Nikoneidia (6000 BC) the seven structures are all oak framed (38). The impact of timber cutting would probably have been of minor importance, however.

The third activity with an adverse effect on the acorn resource and possibly a beneficial effect on annual grasses and grains is field burning. This was very common in California and indulged in for three reasons: to improve browse and concentrate game for easier hunting (20, 39), to clear ground for growing tobacco (40) (lending support to those who believe recreational drugs were the first crop), and to make the acorn harvest easier (41). The effect on the oaks of this repeated burning is uncertain and disputed (42). It may have been more important in favoring the annual grasses and grains.

The final influence on the Middle Eastern balanoculture might have been climatic fluctuation, although the climate has apparently changed little in several thousand years (43). Acorn crops are related to weather, with temperature more critical than precipitation (44). When the crop is small after a cold year or drought, a much higher percentage of acorns is infested with pests (45). An extended cold period would lead to a drawdown of acorn supplies and make restocking difficult if

not impossible. This would provide strong incentives for utilizing annual grains. It is perhaps not coincidental that the eruption of Mt. Mazama and the resulting temporary drop in the temperature of the Northern Hemisphere occurred 6,600 years ago (46) when agriculture began to make gains. A cool period would also increase fuel use, further limiting the acorn resource when milder temperatures returned.

Before the transition to the more labor-intensive granoculture was made, many people would move on. The occurrence of neolithic village sites throughout Europe and North Africa coincides extremely well with oak distribution. Acorns as a readily available staple would make migration easier than might otherwise be expected and movement may have been relatively fast. A tribe could move in the summer, when travel is easy, and settle in the fall, after collecting acorn stocks to carry them through the winter. They might also carry selected acorns with them for planting.

Acorns retained their importance throughout Europe for much longer than is commonly realized and are still eaten in Morocco (47), Iraq (11) and no doubt other areas in the Middle East. They were widely used in Spain and Portugal, Arabia, Algeria, Italy, Greece, and Palestine in the 1800s (48–50). Acorn oil, which is very similar to olive oil, was used in North Africa (51). During medieval times acorns were used in England, France, and Germany (33, 52).

Acorns certainly played an important role in Biblical times. The vast oak forests of Palestine are now vanished, but some remained as late as 1850 as H. B. Tristram reported (53). "There are splendid forests of this oak in Gilead." There were also good forests in Bashan, south of Hermon, near Baniyas, and in Lebanon. These rich forests were virtually pure oak (32), not unlike the valley oak stands in California's central valley. The last big oak forests on the Huleh Plains were destroyed to fuel the Turkish army trains in World War I (35). Other evidence for the distribution of oaks in lands now denuded, not only of oaks but in many cases of topsoil as well,

can be gained by studying the remnant "holy trees" and "sacred groves" in Syria, Transjordan, Turkey, Mount Carmel, and the Upper Galilee (32). Recent studies in the Negev desert reveal the arboreal dominance of oaks from 50,000 BC to 11,000 BC, with mortars and pestles common until 11,000 BC (54).

In Greek and Roman times oaks were also important, and Pliny (55) and Theophrastus (56) both describe the various kinds and their uses. The Arcadians' strength and toughness was attributed to their reliance on acorns (16). The Romans had to move grain from England to their troops in Europe because the Gauls still relied on acorns (53). Acorns also appear in the Iron Age funerary pyres on Cyprus. Moving further back in time (11) we find acorns in the ruins at Iolkos in Greece; in Bronze Age sites in Switzerland with millet and also in Raskanopitza, Bulgaria; and in neolithic sites in Greece at Sesklo and Achilleion and at Lengyel, Hungary.

In Assyria during the time of Sargon II (721–700 BC), acorns were of vital importance. The records include an inventory of the Harran District (now southern Turkey) listing 49,300 belut (acorn) trees (57). If these trees each produced 225 kg. of acorns in an average year they would support 50,000 people. Oaks in this region also produce manna, the sugary secretion of scale insects, and yield tannin from the cups and dye from insect galls.

CONCLUSION

The use of acorns has been an integral element in the Middle Eastern cultures for more than 10,000 years. In early times the acorn was probably a staple food, as the occurrence of acorns in digs and prevalence of grinders in the Natufian period (1) and at Zawi Chemi Shan suggests (58). Grazing, woodcutting, and burning, exacerbated by climatic fluctuation, probably led to granoculture by limiting the acorn resource. As the acorn resource declined, some of the people moved on, taking domestic animals east and west through the oak forests to new lands and



The use of acorns as food in the Mediterranean region and the Middle East. Shaded areas are those without oaks in natural climax before destructive effects of man. ▲ = prehistoric site; ◻ = 700 BC to 1000 AD; ○ = 1000 AD to 1900 AD; ◐ = 1900 AD to present.

leaving a changed environment and granoculture behind.

The picture is muddier in China and Mexico but is likely to clear as new sites and information become available. It is very possible acorns played an equally important role in these areas as well, and that wood cutting for fuel led to a gradual transition to annual crops. The discovery of hill sites in Tehuacan, or a good site on the north margin of the Tsingling Shan mountains, would be most helpful.

It is not unlikely that the continuing desertification of the world (59) is nothing more than a culmination of a trend begun 8,000–10,000 years ago as a result of detrimental environmental impacts associated with the buildup of population made possible by the successful balanocultures, and aggravated by the domestication of the goat. To establish a sustainable agriculture on these arid and semi-arid lands we may have to learn our lessons from prehistory and re-establish agroforestry systems, including acorns, rather than continue to rely on environmentally costly annual grains or the ever-more-destructive grazing animals.

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