

# 19th INDO - PACIFIC PREHISTORY ASSOCIATION CONGRESS

29th November - 5th December  
HA NOI, VIET NAM



# IPPA 2009

## AGRICULTURE IN ABORIGINAL AUSTRALIA: WHY NOT?

Ian Gilligan

School of Archaeology and Anthropology, The Australian National University, Australia;  
ian.g@bigpond.net.au

### ABSTRACT

*Material and behavioural elements associated with the term Neolithic are almost completely absent in Australia. Among the few exceptions are the domesticated dog (originating in the Near East and reaching Australia by 3,500 years ago as the dingo), together with limited evidence for permanent settlements, food storage, long-distance trade and manipulation of wild resources in some areas. While it has been suggested that the latter developments represent independent local trends toward more complex societies that might have led to an Australian Neolithic if not for the arrival of Europeans, the Neolithic is essentially conspicuous by its absence. Particularly striking is the absence of agricultural practices, despite recent claims to the contrary. Also not present is another one of the original (though generally over-looked) defining attributes of the Neolithic: the weaving of textile fibres for clothing. Claims for indigenous Australian agriculture are reviewed here, and the few purported cases are found to be weak. An unconventional model for the transition to agriculture is presented, advocating a significant formative role for clothing, specifically textiles. This suggests that a typical absence of clothing (and total absence of textile clothing) provides a clue as to why agriculture did not develop in Australia.*

### INTRODUCTION

The transition to agriculture was one of the pivotal developments in human prehistory, yet the reasons why some groups of hunter-gatherers—though not others—began to grow crops (with or without domesticated animals) remain unclear (e.g. Bellwood 2005:19-43). Gilligan (2007a) has proposed a general model for the initial transition, arguing that production of textile fibres for clothing rather than food for human consumption was the primary factor. In advocating this unconventional motive for prehistoric people to embark upon agricultural practices *de novo* (that is, independent of any influence from, or contact with, pre-existing farming communi-

ties), two fundamental problems with conventional ideas based on the assumed priority of food production are highlighted. One is the failure to demonstrate why food production would be favoured over foraging, and the other is that many of the first domesticates were not well-suited for the purpose of feeding humans. On the other hand, production of textile fibres suitable for weaving cloth is documented in every independent early agricultural centre, and many of the early crops were used either to yield textile fibres or to feed domesticated animals rather than humans. One corollary of the “textile proposal” is that agriculture should not develop *de novo* among forager groups who were not routinely wearing garments manufactured from woven cloth. In discussing the archaeological evidence for textiles among early agriculturalists in the Indo-Pacific region, Gilligan (2007a:17) cited as key evidence the failure to develop farming in two areas where clothing was not used habitually: Aboriginal Australia, and the Andaman Islands.

The “total absence” of agriculture in pre-colonial Australia has been described as “very striking” (Bellwood 1996:487), yet a couple of recent reviews have questioned the validity of that observation (Gerritsen 2008, 2010; Denham et al. 2009). Insofar as Australia represents a test case for the textile proposal, these claims for indigenous agriculture in Aboriginal Australia represent a significant challenge to the argument. The purpose of this paper is two-fold: firstly, to consider whether these claims for “agriculture” in Australia may refute the textile proposal and, secondly, to critically examine the extent to which these recent reviews provide a more tenable explanation than the textile proposal for the paucity (if not total absence) of agriculture in Aboriginal Australia.

Before discussing this evidence for agriculture in Australia and its relevance to the textile proposal, the essential points concerning both the deficiencies in conventional theories of agricultural origins based on food production and the principles of the textile proposal (Figure 1) are summarized briefly here. This introductory background section is fol-

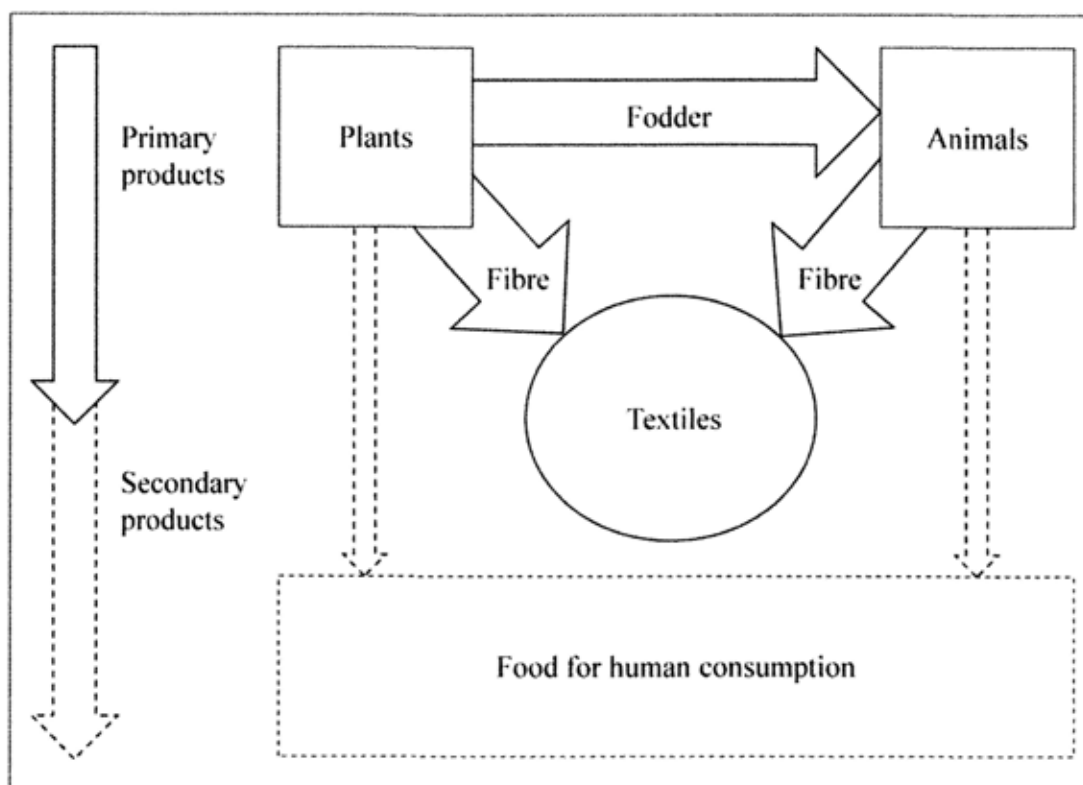


Figure 1. The textile model.

lowed by a review of the recent claims for agriculture in Australia and the explanations proffered for the Australian evidence. Gilligan's (2007a) overview of textiles in early farming within the Indo-Pacific region is then supplemented with an outline of the role of textiles in three early agricultural centres beyond the Indo-Pacific region (the Near East, Mesoamerica and Peru). Finally, it is suggested that, while an emphasis on production of fibres (and, in some cases, fodder for fibre-yielding animals) as a basis for the initial management of plants and certain animal species is indeed unconventional, it not only offers the most viable interpretation of the Australian evidence regarding agriculture but also finds considerable support in a wider global context.

#### *Seeds of doubt*

Far from revolving around production of food staples for human consumption, the various suites of plant and animal species brought under domestication in early farming centres worldwide served multiple functions, with non-comestible purposes dominated by production of textile fibres for clothing (Gilligan 2007a:13). Even among food crops, for example, feed for domesticated animals often took priority over food for humans (with the animals themselves often serving as sources of textile fibres). This pattern is, as Hayden

(1990:32) observed, most "puzzling" given conventional assumptions about the presumed importance of feeding people as a primary motive for hunter-gatherers to begin experimenting with agriculture. Even where early crops were evidently destined for human consumption, they frequently involved non-staple foods such as peppers and spices—odd choices which pose "a major problem for theories of domestication" (Hayden 1995:294). Such misgivings are not new. Carl Sauer (1969:88-90) was always sceptical about whether early farming revolved around feeding humans, noting the "curious" choice of domesticates and maintaining that archaeologists were inclined to "overstress" the role of meat. He observed that some of the early crops served other purposes, "especially as sources of fiber", and went on to say that food was "perhaps not the most important reason for bringing plants under cultivation" (Sauer 1969:27,115). David Clarke (1976:449) likewise remarked on the prevailing "meat fixation" in prehistoric archaeology and similarly Chang (1970:180), noting that wild foodstuffs were abundant throughout Eastern Asia, wondered whether food crops may have played only a "minor role" in the oriental transition to farming.

Agricultural centre	Early products useful primarily for fibre, fodder and other purposes	Early products useful primarily as staple human foods
Near East	Sheep, goats, dog (herding), einkorn wheat*, barley, rye, oats*, flax, legumes*	Emmer wheat*
Peru	Cotton, llama/alpaca, peppers (condiments)	Beans, guinea pig**
China	Hemp, millet*, ramie, jute, soybeans*, rice*, silkworms, mulberry tree, bottle gourd	Rice*, pig**, fowl**, millet*, soybeans*
Mesoamerica	Maguey (sisal hemp), cotton, bottle gourd, tobacco, chillies (condiment)	Squash, avocado, Muscovy duck**
Papua New Guinea	Banana	Taro, yams
*combined fodder/human food **likely commensal		

Table 1. Farming centres and major products.

#### TEXTILES AND EARLY AGRICULTURE

The presence of textiles in early agricultural contexts has been known since the first neolithic communities were identified during the mid-Nineteenth Century, when spindle whorls and fragments of woven linen cloth were recovered in Swiss lake-dwelling sites (Lubbock 1890:196-200). Textile industries, with loom-woven cloth (using flax and wool in the Near East, and cotton in the Indus Valley), were a feature of Childe's "Neolithic Revolution" (Childe 1956:86-87). Subsequent archaeological research has confirmed that production of textile clothing fibres (derived from plant and animal domesticates) occurs in all the undisputed independent agricultural centres, whereas reliance on food production (for humans) is sometimes delayed until relatively late; indeed, a continuing dependence on the hunting and gathering of wild food resources for the bulk of their food diet is not uncommon among early agriculturalists.

#### *The textile proposal*

As outlined in Gilligan (2007a:14), the textile proposal maintains that *de novo* transitions to agriculture only occurred in regions where clothing was used regularly, with an early Holocene shift in clothing materials (from animal hides and furs to woven fabrics) being favoured for reasons of thermal physiology in the warmer, more humid post-glacial world

(Figure 1). Ecological changes in the availability of suitable faunal and plant resources also contributed: large hide-bearing animal species declined in some regions with the onset of warmer climatic regimes, while alternative clothing materials (in the form of fibre-yielding animal and/or plant species) often became more widespread. The weaving of fibres to manufacture perishable items such as baskets, bags, mats, string and ropes (and, possibly, some items of clothing) was a technology that had existed since at least late Pleistocene times (Gilligan 2010:56-58; Soffer 2004; Soffer et al. 2000). For instance, the weaving of wild bast (probably flax) fibres is documented at Dzudzuana Cave on the foothills of the Caucasus region in southeastern Europe from around 30,000 years ago (Kvavadze et al. 2009, 2010). In those areas where clothing had become a basic requirement — initially for reasons of survival among populations in colder regions during the latter stages of the Pleistocene (Gilligan 2010:17-57), with clothing subsequently acquiring social functions — natural fibres for weaving cloth became an important resource. In those parts of the world, however, where the use of clothing had not become commonplace, or where adequate supplies of fibres for textile manufacture could be obtained by the exploitation of wild resources, there was little incentive to engage in agricultural practices. In other words, the requirement for a reliable food supply was not a sufficient

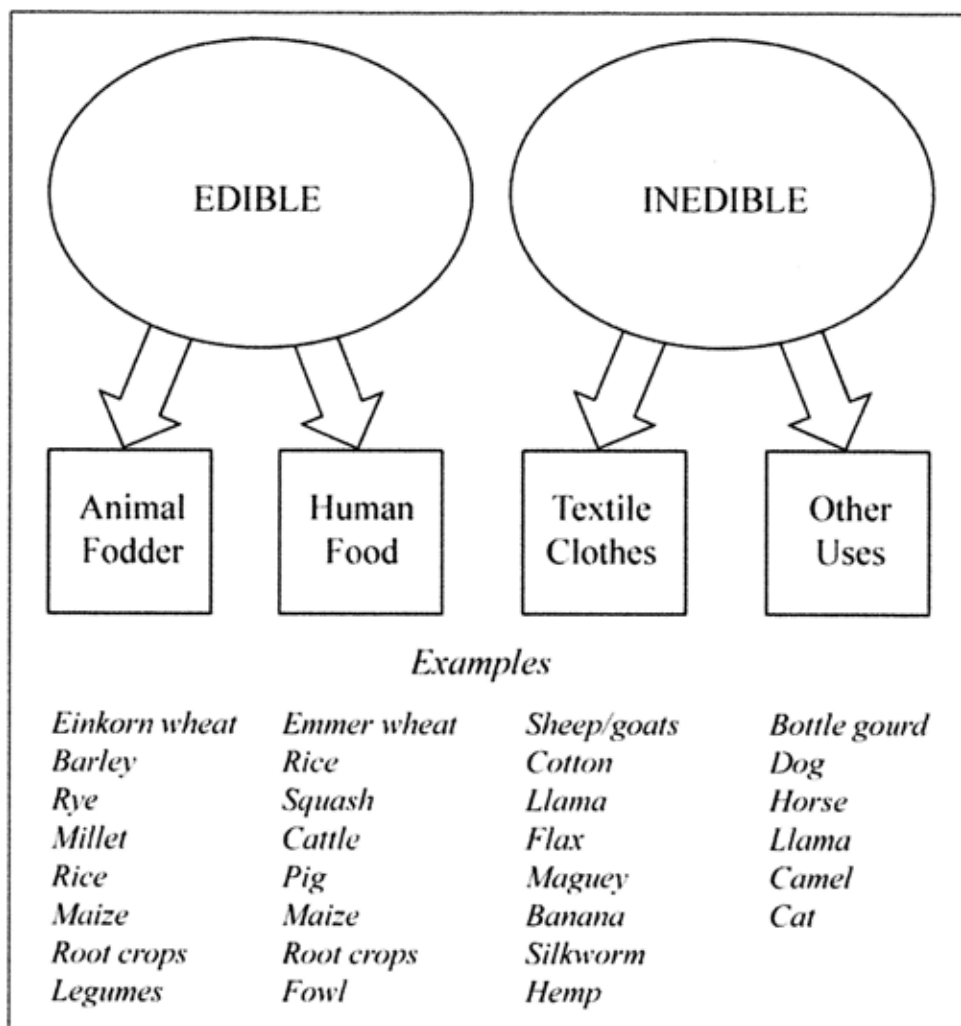


Figure 2. Multiple roles of early domesticates.

reason, in itself, for humans to abandon foraging strategies in favour of agriculture.

*Multi-purpose domesticates*

This model highlights the multiple purposes served by early agricultural products (Table 1), with comestible products including crops that were suitable for feeding animal domesticates as well as — or instead of — humans (Figure 2). Most of the cereal grasses, for instance, offered limited food returns for humans in their wild state (Hayden 2003:464), whereas they were eminently suitable (along with other crops such as legumes) for sustaining grazing herbivores such as sheep and goats on a year-round basis. The likelihood that cereals were first cultivated to feed domesticated animals and not humans was noted by Lewis Henry Morgan in the late Nineteenth Century:

It seems extremely probable, therefore... that the cultivation of the cereals originated in the necessities of the domestic animals" (Morgan 1877:26).

Recent studies have also pointed in this direction. For instance, at two well-known early agricultural sites in the Near East, Ali Kosh and Abu Hureyra, the archaeological context of most carbonised seed remains suggests that the grain was eaten primarily by the animals and that the "vast majority of seed remains were not destined for human consumption" (Miller 1996:524-527). Isotope analyses of human and animal remains also suggest that cereals featured prominently in the diet of farm animals when first brought under cultivation. An example is the Yellow River basin, where millet was cultivated and pigs domesticated from around 8,000 years ago: stable isotope analyses confirm that millet was used to feed both farm animals and humans (Pechenkina

et al. et al. 2005). In the Near East, stable isotope ratios from human and animal remains (domesticated sheep, goats and pigs) at the PPNB site of Nevalı Çori, where einkorn wheat was cultivated, showed little evidence for consumption of meat in the human diet, nor of cereal foods. However, the domesticated animals were evidently consuming cereals, and their diet appears to have been supplemented with legumes. "Contrary to our expectations", write the researchers, their findings suggest that conventional assumptions about early agriculture providing humans with "enhanced security and predictability" of the food supply may be "flawed" (Lösch et al. 2006:190).

#### CLOTHING IN ABORIGINAL AUSTRALIA

If a human requirement for textile clothing rather than food provided the main incentive for hunter-gatherers to begin agriculture, then the minimal presence of agricultural practices in Aboriginal Australia should be associated with a relatively minimal use of clothing in general and, in particular, an absence of textile clothing. The available archaeological evidence suggests that humans reached the continent by 45,000 years ago (O'Connell and Allen 2004), and their ancestors had probably travelled from Africa around the northern rim of the Indian Ocean without needing to stray far outside the tropics (Bulbeck 2007). They would have needed little if any clothing for thermal protection, and the ethnographic record documents a typical absence of clothing in Aboriginal Australia during the period of early European contact; what little clothing was worn comprised single-layered draped garments such as kangaroo skins and sewn possum-fur cloaks used as protection from cold in the cooler southern areas (Gilligan 2008). There are indications that more substantial clothes manufactured from wallaby skins may have been utilized during the Last Glacial Maximum (LGM) among Aborigines in Tasmania (Gilligan 2007b, 2007c:107-109; cf. Hiscock 2008:136), but there is no evidence for any use of garments made from woven fabrics by Aborigines anywhere in Australia. Without needing textiles for clothing, there existed no pressing demand for textile fibres, and hence agriculture held little economic attraction for the indigenous inhabitants of the continent.

#### INDIGENOUS AGRICULTURE IN AUSTRALIA

The long-held belief that agriculture was completely absent in Aboriginal Australia has been challenged recently in a number of critiques (Gerritsen 2008; Denham et al. et al. 2009). Central to these revisions of the received wisdom is the claim that a couple of cases of adoption of domesticated species from external contacts and also certain instances of resource manipulation (sometimes with associated behaviours such as the use of semi-sedentary settlements) represent cases that qualify as indigenous "agriculture" or, at least, "incipient/proto-agriculture" (Gerritsen 2008:68). For exam-

ple, botanical evidence in northern Australia for the domesticated yam (*Dioscorea alata*), introduced from New Guinea, perhaps as early as the terminal Pleistocene or early Holocene, and requiring deliberate planting (or, at least, replanting of viable portions) for its continued presence, is interpreted as demonstrating that Aboriginal Australians were engaged in "horticultural experimentation" (Denham et al. 2009). To what extent do these revisionist critiques constitute a valid refutation of the received wisdom?

#### Four Australian cases

Gerritsen (2008) documents three purported cases of "agriculture" prior to the colonial era in Australia (Figure 3):

1. Exploitation of domesticated yam (*Dioscorea hastifolia*) on the west coast of Western Australia, by the *Nhanda* and northern *Amangu* groups;
2. The sowing (or, more specifically, the broadcast sowing) and "harvesting" of the seeds of wild cereal grasses, particularly native millets (*Panicum decompositum*), by the *Paakkantyi* group along the Darling River basin in western New South Wales, extending to other groups in the "Corners" region centred on the Lake Eyre drainage area in northeastern South Australia; and
3. The propagation (intentional or unintentional, by digging) of wild Murnong roots (*Microseris lanceolata*), together with the use of fish and eel traps, by groups in southwestern Victoria.

Each of Gerritsen's three cases of indigenous agriculture in Australia is problematical, however. The first case, deliberate propagation of the domesticated yam by the *Nhanda*, — resulted from the adoption of Dutch castaways (along with the yam) by local Aboriginal groups on the west coast during the Seventeenth Century, and clearly does not constitute a *de novo* emergence of agriculture among the indigenous population (Gerritsen 2008:32-38). The second case, broadcast "sowing" of wild millet and other grain seeds in the Corners region, probably provides the closest approximation to truly indigenous, *de novo* "agriculture" in Aboriginal Australia. Nonetheless, this practice lacks the other features that should be present for it to qualify as agriculture. Deliberate dispersal of seeds onto unprepared soil with the knowledge that subsequent growth of the grain will yield food barely qualifies as "sowing", while the absence of any plant husbandry (nurturing and protecting the crop) is significant. Gerritsen's (2008:113) third case, the "accidental" or "incidental" propagation of murnong roots in southwestern Victoria is, as he concedes, somewhat short of "gardening", or horticulture. Indeed, his third case of indigenous agriculture in Australia rests heavily on other, non-agricultural (and, in themselves, debatable) aspects of this "Australian Early Neolithic" in the region, particularly permanent or semi-permanent "villages", food storage, trade between groups, and evidence for increased sociopolitical "complexity", with Gerritsen

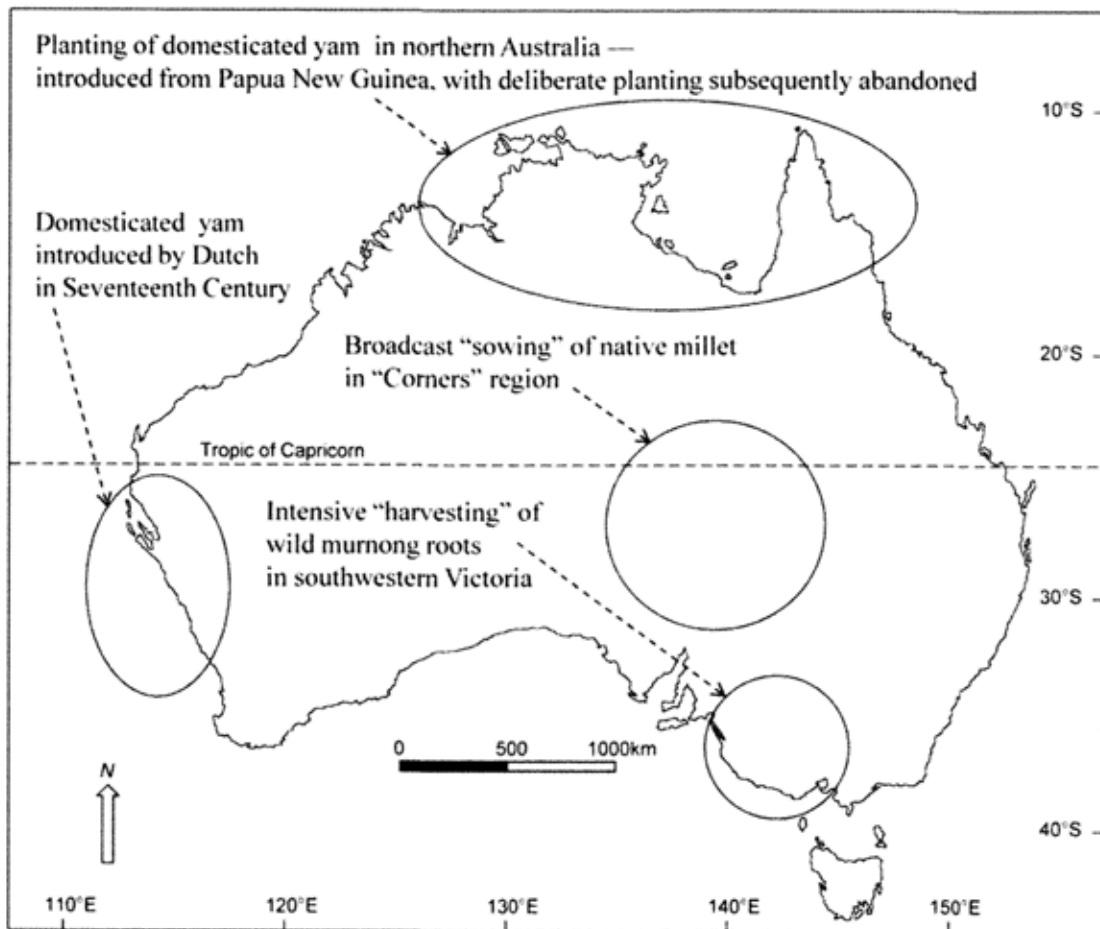


Figure 3. Cases of indigenous “agriculture” in Australia.

(2008:118) admitting that many of the ethnographic accounts cited for the latter (including Dawson’s dubious descriptions of “chiefs”) suffer from considerable “shortcomings”. Nevertheless, it is these attributes of Aboriginal society in southwestern Victoria during the late Holocene, together with the weirs, dams, channels and other structures for trapping fish and eels, which serve as “likely indicators of a food production economy” (2008:135). Notwithstanding claims that these are “the same characteristics as Neolithic societies elsewhere” (Gerritsen 2010:36), explaining the comparative paucity of compelling evidence for signs of a “Neolithic Revolution” still stands as “one of the larger problems in Australian prehistory” (White 1971:182).

The case for “horticultural experimentation” by Aboriginal groups in northern Australia (Denham et al. 2009) rests on the presence of domesticated yam (*Dioscorea alata*) in Arnhem Land and northeastern Queensland. That these yam populations were, in all likelihood, introduced into the region after having been first domesticated elsewhere is not disput-

ed, with the botanical evidence suggesting “no reason to consider them indigenous” (Denham:640). The co-occurrence of pockets of wild taro (*Colocasia esculenta* var. *aquatilis*) and domesticated banana (*Musa acuminata* ssp. *banksii*) in these northern zones is strongly suggestive of a New Guinea origin for the domesticated yam, with its introduction to Australia dating possibly to either the mid-Holocene or even the terminal Pleistocene/early Holocene. Viable populations of the yam could presumably only become established in the north if the local inhabitants were, at the outset, receptive to the practice of deliberately planting yams (or replanting viable portions while digging the tubers). However, any such horticultural practices (possibly involving, more speculatively, taro and banana as well as yams) were subsequently abandoned by the Aboriginal population. In other words, whilst Aboriginal groups were indeed prepared to explore “experimental horticultural tendencies”, probably under the influence of external cultural contacts, they were evidently not inclined to persist with the practices, and eventually

ceased deliberate management of yams in northern Australia (Denham 2009:644).

### *Two questions*

The obvious questions that need to be asked about each of these alleged cases of indigenous agriculture in Aboriginal Australia are:

1. Is it agriculture? In other words, to what extent does each case constitute "agriculture" in a meaningful sense of the term?
2. Is it a *de novo*, indigenous phenomenon? In other words, does the alleged case document a local agricultural innovation independent of contact or influence from external, pre-existing agricultural communities?

Addressing the second question first, it is evident that two of the four cases do not qualify as *de novo* innovations by Aboriginal Australians: the use of domesticated yam by the Nhanda in Western Australia and also by coastal groups in northern Australia are both clearly attributable to exogenous influences. That Australian groups were prepared to experiment with, or adopt, pre-existing domesticates introduced from outside the continent is not in question. This is demonstrated, for instance, by their adoption of the domesticated dog (the dingo) for which archaeological evidence dates from 3,500 years ago (Gollan 1984:924), although recent genetic studies suggest it may have arrived earlier from Southeast Asia, between 5,000 and 10,000 years ago, during the early to mid-Holocene (vonHoldt et al. 2010). With neither of the two independent cases involving yams being a *de novo* agricultural innovation, there remain the other two alleged cases of indigenous agriculture in Australia: the use of grain seeds (especially millet) in the Corners region, and of murnong roots (along with the trapping of fish and eels) in southwestern Victoria.

There would appear no reason to doubt that these two remaining cases of purported agriculture were indeed local innovations. The first question, though, is whether either case constitutes "agriculture". Without embarking upon arguments concerning criteria for defining the term agriculture (see Winterhalder and Kennett 2006; Zeder 2006), what is apparent in both instances is that they represent very weak cases. Like hunter-gatherers everywhere, Aboriginal Australians engaged in the "management" of wild resources, yet it is only when these behaviours are described in terms that hitherto were restricted to agricultural practices—terms such as "sowing" and "harvesting"—that they can be construed or depicted as constituting agriculture. To engage in agriculture is, by definition, to "cultivate" a resource, meaning to take active measures to at least nurture and protect, if not modify, the resource in question. In neither the Corners region nor southwestern Victoria is there sufficient evidence for any cultivation; rather, there is evidence that the resources (seeds, roots, and aquatic resources, at times naturally abundant)

were exploited by successful hunter-gatherers using efficient, flexible management strategies.

### *Advantages and disadvantages*

Gerritsen's two weak cases of *de novo* indigenous agriculture only highlight the major problem with the evidence for agricultural developments in Aboriginal Australia: there is very little (if any) evidence and this, in itself, is an important finding. Whatever the status of these few cases as "agriculture", the Australian evidence needs to be accommodated by any general models or theories concerning the origins of agriculture. If agricultural practices or "experiments" were so limited on the continent, how might this be explained?

Gerritsen (2008:141-165) confronts this question directly, and offers an explanation for the paucity (if not total absence) of agriculture in Australia. He suggests that, compared to other parts of the world where agriculture became established (e.g. the Near East, eastern China, Mesoamerica, Peru, southeastern North America, west Africa, and Papua New Guinea), Australia was ecologically disadvantaged by its relatively dry climate and generally poor soils. This low NEPP (Net Effective Primary Productivity) resulted in low population densities and correspondingly low innovation rates. These factors, combined with the continent's comparative isolation from major trans- and inter-continental communication routes, resulted in low IIG (Innovation Information Gain). This explanation, Gerritsen contends, has the great advantage of eschewing the traditional (and highly problematic) "causes" of agriculture that have been advocated (and largely discounted) over the years: population pressure, climatic change/stress, availability of suitable domesticates, and social complexity/competition. Despite the innovative (NEPP/IIG) terminologies, however, Gerritsen's explanation suffers from a few disadvantages that are only too traditional.

### *Explaining — or explaining away?*

In attempting to explain why agricultural innovation was not favoured in Aboriginal Australia, Gerritsen sees agriculture as the outcome of a general trajectory in human evolutionary history, based on its assumed benefits as a means of securing the food supply:

... climate changes came and went, but humans continued throughout on a trajectory of increasing in numbers in concert with slowly increasing technological and cultural complexity and sophistication, underwritten by increasing productivity in the form of greater yields from hunting and gathering. This trajectory ultimately led to broad-spectrum procurement, intensification and finally food production (Gerritsen 2008:149).

The underlying assumption here is that agriculture will eventually develop, or begin to develop, given sufficient time and favourable circumstances, due to its inherent advantages



over hunting and gathering as a food procurement strategy. A corollary of this position is that the “original affluent society” (Sahlins 1972) is a myth, and hunter-gatherers were far from “affluent”, even in optimal environmental conditions. On the contrary, they needed to contend with the “vagaries of nature”, the “constraints” and “exigencies” of their mobile lifestyle, and harbored a constant “desire” for a “better life”—all difficulties for which agriculture offered a “solution” (Gerritsen 2008:149-150). Such a scenario is clearly at odds with the well-documented resistance of Aboriginal Australians to the adoption of agricultural practices. Indeed, they evidently had “no economic motive” to surrender their “efficient adaptation” and, on the contrary, were content to avoid the seeming “drudgery” of agriculture (Peterson 1976:274).

Gerritsen’s explanation is not dissimilar to Nineteenth Century ideas and suggests, in essence, that there is nothing to explain about the reason(s) for the transition to agriculture. It offers obvious attractions that easily justify its additional labor, risks and its adverse impact on human nutrition and health (although these disadvantages of agriculture are not mentioned by Gerritsen, and presumably were not apparent to hunter-gatherers). The obvious attractions of an agricultural lifestyle pertain even with the most comfortable or “affluent” of hunter-gatherer groups, and it is only in chronically disadvantaged regions like Australia that its emergence will be delayed unduly. Such a perspective, needless to say, is tenable only if early agricultural developments worldwide are seen to involve primarily changes in human food procurement strategies. The available evidence, however, is hardly consistent with this scenario.

## GLOBAL PERSPECTIVE

Archaeological evidence of textile production (and also of fodder production for animals) exists in all the early agricultural centres, as well as in most of the “secondary” agricultural zones where agriculture was adopted (Figure 4). The evidence within the Indo-Pacific region, including China, Japan, Korea, Taiwan, the Indus Valley, and Papua New Guinea, was reviewed in Gilligan (2007a:15-16). Evidence from outside the Indo-Pacific region can only be summarized briefly here. The major independent agricultural centres are most relevant, namely the Near East and two independent agricultural centres in the Americas, Mesoamerica and Peru.

### *The Near East*

Sheep, goats and dogs (with the latter useful for herding the former) were the first animal domesticates in the Near East, beginning around 11,000 years ago; cattle, a more obvious choice for meat, were a later addition. Unlike cattle, wild sheep and goats produce useful textile fibres. Before the development of a permanent fleece—a result of intensive human selection for wool—wild sheep and goats yielded abun-

dant wool for weaving textiles, as seen with surviving primitive breeds of sheep where the wool crop is simply collected as it molts or is plucked from tame animals (Ryder 1983:736-745, 1987:105-107). As Ingold (1984) emphasised, the fundamental difference between hunting and herding animals is that, in the latter instance, they are kept alive rather than being killed. Acquisition of meat (or, for that matter, hides) requires the killing of animals, whereas wool is produced in quantity on an ongoing basis when the living animals are protected and fed. From a hunter-gatherer perspective, hunting represents the most efficient strategy for extracting meat resources from wild herds, whereas herding and breeding makes economic sense when wool is the resource in question.

The other key feature of early agriculture in the Near East is the first cultivation of certain crops, with cereals being most prominent, especially wheat, which was first cultivated around 11,000 years ago (when sheep and goats were domesticated). In their wild form, the cereal grasses constitute ideal food for grazing animals. This has long been known to farmers and biologists (e.g. Botkin et al. 1988:171) though not, it would seem, to prehistoric archaeologists. Cultivating grasses was, in effect, growing wool. All the major Near Eastern early plant domesticates (einkorn wheat, barley, rye and legumes) are grown primarily as fodder crops for grazing animals in the world today, and there is no compelling reason to assume that the situation was very different 11,000 years ago. Emmer wheat, grown nowadays primarily for human consumption (though suitable for feeding animals as well), is not among the most common of early Near Eastern crops.

The suite of early Near Eastern plant domesticates includes flax, a major fibre crop. Flax seeds, sometimes numerous, have been recovered at sites dating between 10,000 and 9,000 years ago and its cultivation is likely by at least 8,000 years ago (van Zeist and Bakker-Heeres 1975), though its use for fibre probably antedates its deliberate cultivation (Zohary and Hopf 1993:119-120; Kvavadze et al. 2009, 2010). In its wild state flax grew throughout the Near East. It has various uses, with extraction of fibres for making linen cloth the most important, along with edible linseed oil. Vavilov (1992:103) regarded flax as one of the small group of primary cultivated plants, and the earliest surviving cloth fragments in the world are made from linen, dating to around 9,000 years ago at Nahal Hemar in Israel (Schick 1988; Shimon and Jucha 1988).

### *Mesoamerica*

Maize and squash were first domesticated in Mesoamerica, with maize becoming an important crop as food for both humans and animals. Maize cultivation is documented from 9,000 years ago in the Balsas basin in southwestern Mexico (Ranere et al. 2009), while direct dating of early domesticated squash from the Guilá Naquitz cave in Mexico has yielded dates ranging between 8,000 and 10,000 years ago (Smith

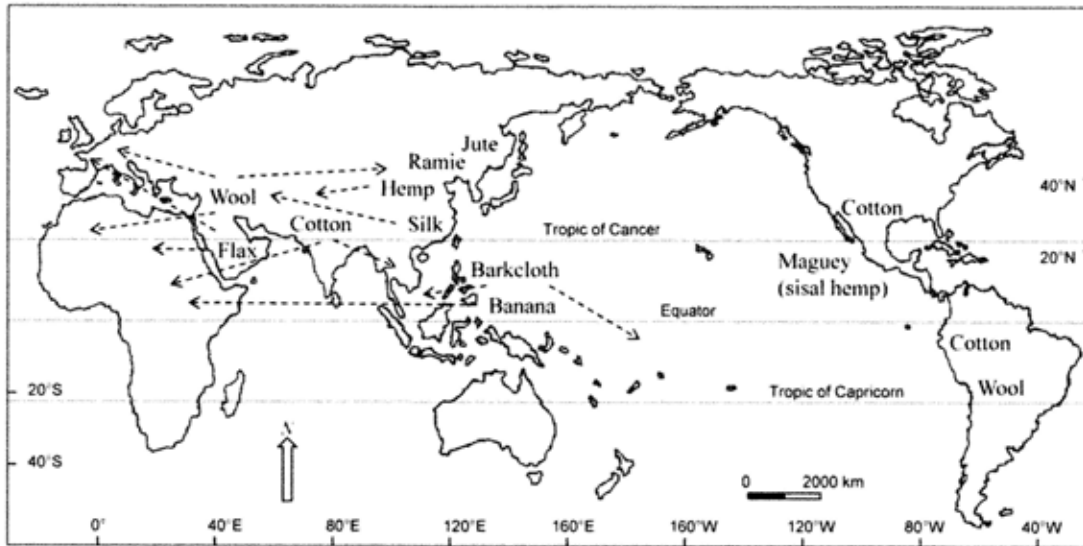


Figure 4. Early fibre domesticates in agricultural centres.

1997). Evidence of weaving, in the form of woven blankets, exists from as early as 9,000 years ago in the Tehuacán Valley (MacNeish 1983:134), and a well-developed textile industry is confirmed by cotton garments in cave burials from 7,000 years ago. In addition to cotton and squash, the range of cultivated crops included tobacco, avocados, chillies and the bottle gourd, as well as another major fibre crop called maguety. Not all of these can be construed as major foods, and direct AMS dating suggests that beans and other comestibles such as the Cushaw (or Mexican pumpkin) may have been domesticated more recently, with the earliest domesticated beans at Coxcatlan dating to around 2,000 years ago (Smith 2005).

#### South America

Cotton was cultivated in coastal South America long before maize was a staple food. During the formative phase of Peruvian agriculture, remains of food crops are "far outnumbered" by non-food crops, especially cotton (Moseley 1992:105). Cultivation of cotton typifies early coastal Peruvian farming villages, even at sites where human dependence upon agriculture for food was "apparently minimal" (Bruhns 1994:79-80). Cotton also occurs in the Ecuadorian Valdivia culture from 4,700 years ago, which has numerous spindle whorls as well as imprints of cotton textiles on pottery. Maize from Mesoamerica appears at Valdivian sites from 4,200 years ago (from where it spread to the Andes), but stable isotope analyses from human remains show that maize "clearly was *not* a staple crop" [*italics original*] and its dietary role was modest (Tykot and Staller 2002:674).

Wool-bearing South American camelids were the only significant early animal domesticates in the New World (the

few other animal species such as the guinea pig, dog and muscovy duck that later came under domestication being likely commensals in sedentary communities). Llamas were probably domesticated in the Andean highlands between 7,500 and 6,500 years ago (Clutton-Brock 1981:127; Wheeler 1984:395), though they may have been herded from 9,000 years ago (Browman 1989:258). From 6,000 years ago alpaca bones begin to appear; these animals, with their heavier coat of wool, are a hybrid of llama and vicuña and evolved under human selection pressure. Llamas were multi-purpose animals, being sources of wool and meat and serving as beasts of burden, while the alpaca was herded exclusively for its fine wool, harvested every two years. Llamas and alpacas were grazed on wild grassland foods at high altitudes where cold conditions promoted wool growth but where cultivation of fodder crops was not feasible; more recently some were foddered with maize by sedentary villagers (Finucane et al. 2006).

#### CONCLUSIONS

The evidence for indigenous agriculture in Aboriginal Australia is extremely limited and, in terms of independent (or de novo) experimentation with agricultural practices, virtually non-existent. Indeed, it is only when the definition of "agriculture" is stretched by including hunter-gatherer strategies such as broadcast "sowing" of wild seeds and intensive "harvesting" of wild resources as falling within the gamut of agricultural practices (as "incipient agriculture" or "proto-agriculture") that the few potential cases can even be considered as suggesting the possible existence of indigenous agriculture. On the other hand, the introduction of domesticated yam to northern Australia from Papua New Guinea, perhaps

as early as the terminal Pleistocene or early Holocene, and more recently to coastal Western Australia by Dutch visitors, demonstrates that Aboriginal Australians were indeed prepared to “experiment” with agriculture. While they may have been “receptive” to the idea, however, this same evidence—particularly in the case of northern Australia—suggests a reluctance or resistance to making a transition to agriculture, for “as yet unknown reasons” (Denham et al. 2009:643-644). Furthermore, as Gerritsen (2008) points out, a lack of indigenous potential domesticates does not explain the picture in Australia: the continent is home to a wide range of species suitable for agriculture (wild rice, bananas, palmgrass, various millets and potatoes, and *Pandanus spiralis*), not to mention kangaroos and wallabies, which could be domesticated. On that basis, Australia “ought to have been among the first, not the last” to yield signs of agriculture (Gerritsen 2008:145). In other words, while suitable potential domesticates were available and certain economic activities of Aboriginal Australians may have verged on “incipient” agriculture at times, and while they were prepared to adopt pre-existing domesticates such as the yam (and the dingo) from external contacts, the continuing practice of agriculture seems to have held little attraction (or offered insufficient benefits) as a worthwhile food-procurement strategy, in comparison to their long-standing hunter-gatherer lifestyle.

Gerritsen (2008:141) concedes that his argument for an indigenous trend towards agriculture in Aboriginal Australia (limited almost entirely to the late Holocene) is based upon “extremely limited” evidence. It is debatable whether these purported late Australian agricultural “developments” can be viewed as “paralleling” those that occurred earlier in agricultural centres elsewhere in the world, yet he nonetheless makes the perfectly valid point that the Australian evidence—or lack thereof—must be incorporated into “whatever theory is proposed to explain the origins of agriculture” (Gerritsen 2008). His own explanation rests heavily on old notions of the seemingly obvious benefits of agriculture compared to foraging as a means of securing the human food supply, and accounts for the limited and delayed appearance of agricultural practices in Australia—if any—in terms of the continent being inherently disadvantaged. In contrast, the alternative theoretical model advocated here offers a new perspective on the problem of explaining both the origins of agriculture and its lack of appeal to Aboriginal Australians.

#### ACKNOWLEDGEMENTS

This paper is based on a presentation at the 2009 IPPA conference in Hanoi. The author thanks Peter Bellwood, convenor of the C1 session (“The Neolithic in East and Southeast Asia”), for his support and encouragement. It also expands on an earlier paper dealing with textiles and farming origins in the Indo-Pacific region, which benefitted greatly from the

critical comments of Colin Groves, Brian Hayden and Peter White.

#### REFERENCES

- Bellwood, P. 1996. The origins and spread of agriculture in the Indo-Pacific region: gradualism and diffusion or revolution and colonization? In D.R. Harris (ed.), *The Origins and Spread of Agriculture and Pastoralism in Eurasia*, pp. 465-498. London: UCL Press.
- \_\_\_\_\_. 2005. *First Farmers: The Origins of Agricultural Societies*. Oxford: Blackwell.
- Botkin, M.P., Field, R.A. and Johnson, C.L. 1988. *Sheep and Wool: Science, Production, and Management*. Englewood Cliffs, New Jersey: Prentice Hall.
- Browman, D.L. 1989. Origins and development of Andean pastoralism: an overview of the past 6000 years. In J. Clutton-Brock (ed.), *The Walking Larder: Patterns of Domestication, Pastoralism, and Predation*, pp. 256-268. London: Unwin Hyman.
- Bruhns, K.O. 1994. *Ancient South America*. Cambridge: Cambridge University Press.
- Bulbeck, D. 2007. Where river meets sea: a parsimonious model for *Homo sapiens* colonization of the Indian Ocean rim and Sahul. *Current Anthropology* 48:315-321.
- Chang, K.C. 1970. The beginnings of agriculture in the Far East. *Antiquity* 40:175-185.
- Childe, V.G. 1956. *Man Makes Himself*. Third (illustrated) edition, 1981. Bradford-on-Avon: Moonraker Press.
- Clarke, D.L. 1976. Mesolithic Europe: the economic basis. In G. de G. Sieveking, I.H. Longworth and K.E. Wilson (eds.), *Problems in Economic and Social Archaeology*, pp. 449-481. London: Duckworth.
- Clutton-Brock, J. 1981. *Domesticated Animals from Early Times*. London: British Museum (Natural History).
- Denham, T., Donohue, M. and Booth, S. 2009. Horticultural experimentation in northern Australia reconsidered. *Antiquity* 83:634-648.
- Finucane, B., Agurto, P.M. and Isbell, W.H. 2006. Human and animal diet at Conchopata, Peru: stable isotope evidence for maize agriculture and animal management practices during the Middle Horizon. *Journal of Archaeological Science* 33:1766-1776.

- Gerritsen, R. 2008. *Australia and the Origins of Agriculture*. BAR International Series 1874. Oxford: Archaeopress.
- \_\_\_\_\_. 2010. Evidence for Indigenous Australian agriculture. *Australasian Science* 31(6):35-37.
- Gilligan, I. 2007a. Clothing and farming origins: the Indo-Pacific evidence. *Bulletin of the Indo-Pacific Prehistory Association* 27:12-21.
- \_\_\_\_\_. 2007b. *Another Tasmanian Paradox: Clothing and Thermal Adaptations in Aboriginal Australia*. BAR International Series 1710. Oxford: Archaeopress.
- \_\_\_\_\_. 2007c. Clothing and modern human behavior in prehistoric Tasmania. *Archaeology in Oceania* 42:102-111.
- \_\_\_\_\_. 2008. Clothing and climate in Aboriginal Australia. *Current Anthropology* 49:487-495.
- \_\_\_\_\_. 2010. The prehistoric development of clothing: archaeological implications of a thermal model. *Journal of Archaeological Method and Theory* 17:15-80.
- Gollan, K. 1984. The Australian dingo: in the shadow of man. In M. Archer and G. Clayton (eds.), *Vertebrate Zoogeography and Evolution in Australasia: Animals in Space and Time*, pp. 921-927. Perth: Hesperian Press.
- Hayden, B. 1990. Nimrods, piscators, pluckers, and planters: the emergence of food production. *Journal of Anthropological Archaeology* 9:31-69.
- \_\_\_\_\_. 1995. A new overview of domestication. In T.D. Price and A.B. Gebauer (eds.), *Last Hunters — First Farmers: New Perspectives on the Prehistoric Transition to Agriculture*, pp. 273-299. Santa Fe, NM: School of American Research.
- \_\_\_\_\_. 2003. Were luxury goods the first domesticates? Ethnoarchaeological perspectives from Southeast Asia. *World Archaeology* 34:458-469.
- Hiscock, P. 2008. *Archaeology of Ancient Australia*. New York: Routledge.
- Ingold, T. 1984. Time, social relationships and the exploitation of animals: anthropological reflections on prehistory. In J. Clutton-Brock and C. Grigson (eds.), *Animals and Archaeology: 3. Early Herders and Their Flocks*, pp. 3-12. Oxford: BAR International Series 202.
- Kvavadze, E., Bar-Yosef, O., Belfer-Cohen, A., Boaretto, E., Jakeli, N., Matskevich, Z. and Meshveliani, T. 2009. 30,000-year-old wild flax fibers. *Science* 325:1359.
- \_\_\_\_\_. 2010. Response to comment on "30,000-year-old wild flax fibers". *Science* 328:1634-c.
- Lösch, S., Grupe, G. and Peters, J. 2006. Stable isotopes and dietary adaptations in humans and animals at Pre-Pottery Neolithic Nevalı Çori, southeast Anatolia. *American Journal of Physical Anthropology* 131:181-193.
- Lubbock, J. 1890. *Pre-historic Times: As Illustrated by Ancient Remains and the Manners and Customs of Modern Savages*. Fifth edition. New York: D. Appleton and Company.
- MacNeish, R.S. 1983. Mesoamerica. In R. Shuter (ed.), *Early Man in the New World*, pp. 125-135. Beverly Hills, CA: Sage.
- Miller, N.F. 1996. Seed eaters of the ancient Near East: human or herbivore? *Current Anthropology* 37:521-528.
- Morgan, L.H. 1877. *Ancient Society, or Researches in the Lines of Human Progress from Savagery through Barbarism to Civilization*. Chicago (1908): Charles H. Kerr & Company.
- Moseley, M.E. 1992. *The Incas and their Ancestors: The Archaeology of Peru*. London: Thames and Hudson.
- O'Connell J. F. and Allen J. 2004. Dating the colonization of Sahul (Pleistocene Australia—New Guinea): a review of recent research. *Journal of Archaeological Science* 31:835–853.
- Pechenkina, E.A., Ambrose, S.H., Xiaolin, M. and Benfer, R.A. Jr. 2005. Reconstructing northern Chinese neolithic subsistence practices by isotopic analysis. *Journal of Archaeological Science* 32:1176-1189.
- Peterson, N. 1976. Ethno-archaeology in the Australian Iron Age. In G. de G. Sieveking, I.H. Longworth and K.E. Wilson (eds.), *Problems in Economic and Social Archaeology*, pp. 265-275. London: Duckworth.
- Ranere, A.J., Piperno, D.R., Holst, I., Dickau, R. and Iriarte, J. 2009. The cultural and chronological context of early Holocene maize and squash domestication in the Central Balsas River Valley, Mexico. *Proceedings of the National Academy of Sciences of the United States of America* 106:5014-5018.
- Ryder, M.L. 1983. *Sheep and Man*. London: Duckworth.
- \_\_\_\_\_. 1987. The evolution of the fleece. *Scientific American* 256:100-107.

- Sahlins, M. 1972. *Stone Age Economics*. Chicago: Aldine-Atherton.
- Sauer, C.O. 1969. *Agricultural Origins and Dispersals: The Domestication of Animals and Foodstuffs*. Second edition. Cambridge, MA: M.I.T. Press.
- Schick, T. 1988. Nahal Hemar Cave: cordage, basketry and fabrics. *'Atiqot XVIII:31-43*.
- Shimony, C. and Jucha, R. 1988. Nahal Hemar Cave: the fibres and yarn measurements. *'Atiqot XVIII:44*.
- Smith, B.D. 1997. The initial domestication of Cucurbita pepo in the Americas 10,000 years ago. *Science* 276:932-934.
- \_\_\_\_\_. 2005. Reassessing Coxcatlan Cave and the early history of domesticated plants in Mesoamerica. *Proceedings of the National Academy of Sciences of the United States of America* 102:9438-9445.
- Soffer, O. 2004. Recovering perishable technologies through use wear on tools: preliminary evidence for upper paleolithic weaving and net making. *Current Anthropology* 45:407-425.
- Soffer, O., Adovasio, J.M. and Hyland, D.C. 2000. The "Venus" figurines: textiles, basketry, gender, and status in the upper paleolithic. *Current Anthropology* 41:511-537.
- Tykot, R.H. and Staller, J.E. 2002. The importance of early maize agriculture in coastal Ecuador: new data from La Emerenciana. *Current Anthropology* 43:666-677.
- van Zeist, W. and Bakker-Heeres, J.A.H. 1975. Evidence for linseed cultivation before 6000 bc. *Journal of Archaeological Science* 2:215-219.
- Vavilov, N.I. 1992. *Origin and Geography of Cultivated Plants*. Cambridge: Cambridge University Press.
- vonHoldt, B.M., Pollinger, J.P., Lohmueller, K.E., Han, E., Parker, H.G., Quignon, P., Degenhardt, J.D., Boyko, A.R., Earl, D.A., Auton, A., Reynolds, A., Bryc, K., Brisbin, A., Knowles, J.C., Mosher, D.S., Spady, T.C., Elkahloun, A., Geffen, E., Pilot, M., Jedrzejewski, W., Greco, C., Randi, E., Bannasch, D., Wilton, A., Shearman, J., Musiani, M., Cargill, M., Jones, P.G., Qian, Z., Huang, W., Ding, Z-L., Zhang, Y-p., Bustamante, C.D., Ostrander, E.A., Novembre, J., and Wayne, R.K. 2010. Genome-wide SNP and haplotype analyses reveal a rich history underlying dog domestication. *Nature* 464:898-903.
- Wheeler, J.C. 1984. On the origin and early development of camelid pastoralism in the Andes. In J. Clutton-Brock and C. Grigson (eds.), *Animals and Archaeology: 3. Early Herders and their Flocks*, pp. 395-410. Oxford: BAR International Series 202.
- White, J.P. 1971. New Guinea and Australian prehistory: the 'neolithic problem'. In D.J. Mulvaney and J. Golson (eds.), *Aboriginal Man and Environment in Australia*, pp. 182-195. Canberra: Australian National University Press.
- Winterhalder, B. and Kennett, D.J. 2006. Behavioral ecology and the transition from hunting and gathering to agriculture. In D.J. Kennett and B. Winterhalder (eds.), *Behavioral Ecology and the Transition to Agriculture*, 1-21. Berkeley: University of California Press.
- Zeder, M.A. 2006. Central questions in the domestication of plants and animals. *Evolutionary Anthropology* 15:105-117.
- Zohary, D. and Hopf, M. 1993. *Domestication of Plants in the Old World: The Origin and Spread of Cultivated Plants in West Asia, Europe, and the Nile Valley*. Second edition. Oxford: Clarendon.