

CHAPTER ONE

INTRODUCTION: A YOUNG MAN'S QUEST CONTINUED

This work was in part inspired by a statement of Harold Brookfield's in a 1972 paper on 'Intensification and Disintensification in Pacific Agriculture':

Despite the work already done, the task of recording, surveying, classifying and above all understanding the past and present forms of intensive agriculture is still before us. It calls for combined efforts from a whole group of disciplines, and if it is to have form and purpose, it demands also an effort to relate the field evidence to other ecological, demographic and social phenomena (1972: 31).

The thesis seeks to make a contribution to the recording, surveying, classifying and hopefully the understanding of a particular avenue of agricultural intensification, that of irrigation.

Various archaeologists, anthropologists and geographers working in the Pacific have talked of evidence for intensive agriculture or discussed agricultural systems in use today or in the recent past as end points in a process of intensification (see for instance Bellwood 1978a: 145, 238; Earle 1980; Golson 1977; Golson in press; Kirch 1976: 31, 61; Kirch 1980: 47; Yen 1973a; Yen 1981). These scholars refer either implicitly or explicitly to three seminal works - Clifford Geertz's 'Agricultural Involution' (1963), Ester Boserup's 'The Conditions of Agricultural Growth' (1965), and the 1972 paper by Brookfield quoted above which integrates and extends the approaches of Geertz and Boserup. Brookfield gives a concise definition of intensification which applies equally to hunter-gatherer as to agriculturally based economies, as well as to transitions from one to the other:

In regard to land, or to any natural resource complex, intensification must be measured by inputs only of capital, labour and skills against constant land. The primary purpose of intensification is the substitution of these inputs for land, so as to gain more production from a given area, use it more frequently, and hence make possible a greater concentration of production (ibid: 31).

Irrigation is often assumed to represent one of the peaks of intensification in Oceania, but this judgement needs to be examined.

It has come from the presence of easily recognisable structural remains - stone-faced terraces, long canals, raised beds in swamps, and the like - rather than from a study of labour inputs, importance within total production, and environmental and social conditions under which irrigation systems have operated. While it could be argued that all irrigation systems are intensive, it is equally true from an Orwellian viewpoint that some are more intensive than others. Irrigation cannot be viewed solely within a presence/absence framework and its importance assumed. Similar assumptions could of course be criticised in relation to any intensive technique or suite of techniques observed in the Pacific.

Irrigation has been chosen for detailed study for three main reasons - its importance within wider anthropological theory, its archaeological visibility, and its pan-Pacific distribution. Related to the assumption that irrigation necessarily represents one of the peaks of intensification in the Pacific is the much debated view that irrigation is important on a world-wide basis as a factor in social evolution. At its basic level the debate over the importance of irrigation in social evolution is a debate over the relationship between technology and political power (Downing and Gibson 1974; Earle 1978; Mitchell 1973; Wittfogel 1957).

On occasion the discovery of the most miserable diversion of a trickle of water into a minute parcel of land has led to pilgrimages of academics from far and wide and assumed some mystical aura as a decisive first step on the road to despotism or to, as it is often more quaintly labelled, 'the Rise of Civilization'.

Other agricultural techniques also found in the Pacific such as yam mounding, or genetic selection of tree crops have not (yet) been invoked by name in similar debates. The question to be considered is one of whether there is something qualitatively different about irrigation that lends it more than a purely technological significance in Oceanic Prehistory?

Among the most common categories of archaeological remains encountered in the region are those associated with agriculture. Remains of dry land agricultural systems are usually in the form of plot boundaries or simple terracing and are generally not distinctive as to the crop grown, the exception being the large yam mounds typical

of New Caledonia (Barrau 1956: 67). Irrigated garden techniques often leave distinctive archaeological traces, and the range of crops that can be grown in them is severely restricted, as established from the evidence of crop water requirements and from recent historical and ethnographic sources. As one moves out into the Pacific from New Guinea the number of hydrophytic food plants for which irrigation would be suitable narrows even further. In most cases we can be reasonably sure that the main crop (if not the only one) grown in Oceanic irrigation systems is the taro (Colocasia esculenta) or under certain conditions another aroid, the giant swamp taro (Cyrtosperma chamissonis).

Irrigation systems have been reported in an area stretching from the Hawaiian Islands in the east to New Guinea and beyond in the west, in a range of environmental and social contexts. Many of the other intensive techniques have a much more restricted distribution within Oceania.

Several early European visitors to the Pacific commented on the irrigation practices associated with the cultivation of taro. The Spaniards of Mendaña's expedition which 'discovered' the Solomon Islands were the first of these, observing irrigation systems on Guadalcanal in use in May 1568:

We saw many villages up in the hills and many plantations of food on the slopes, arranged very well so that they could irrigate them, which they did. It was well laid out; and by each there was a stream of water. (Amherst and Thomson 1901 (II): 306).

Members of Cook's expeditions in the 1770s commented on and were obviously impressed by taro irrigation systems in the Hawaiian Islands Tahiti and New Caledonia (Cook [Beaglehole] 1961: 538; 1967: 269; Forster 1777 (I): 341-2). Early accounts by visitors to other island groups also mention the presence of taro irrigation. Williams (1838: 206-7) described the practice as it was on Rarotonga in 1823, Wilkes (1845 (III): 42-3) reports it from the Fijian archipelago during the US Expedition of 1838-1842, while the missionary John Geddie mentions taro irrigation in an account (See App. 3: item 5) written soon after he settled on Aneityum in Vanuatu (formerly the New Hebrides) in 1848.

Many were obviously impressed by the technological sophistication of the irrigation systems, and in their (sometimes grudging) enthusiasm

clearly expressed their own feelings of racial and moral superiority. De Rochas, speaking of the Balade area (New Caledonia), found there:

une sorte de monument de cet art ingénieux, et qu'on est étonné de trouver avec une telle perfection chez un peuple sauvage. C'est un aqueduc de 8 à 10 kilomètres de long, conduit sur la croupe des montagnes, avec un habileté qui ferait honneur à un peuple civilisé (1862: 170).

Erskine who visited an area 30 miles southeast of Balade, on the river Kalaut, observed that:

From all we see it is evident that this part of the country is not generally fertile, but a degree of pains seems to be taken in its cultivation that I never expected to see among savages. The face of the hills above the river is covered with rectangular fields, surrounded by channels of irrigation, which as far as can be seen from below, is conducted on a careful and scientific system ... (1853: 355).

Anderson, again speaking of New Caledonia, is slightly more grudging in his praise:

The idea of irrigating the plantations by this means is, perhaps, one which would occur to the most uncivilized savage; but a certain amount of skill displayed in cutting the channels on the side of the hills, which are sometimes wooded, oftentimes rocky, and also in constructing them at a constant, very gradual descent, imperceptible to the naked eye, is sufficient to alter any previously assumed notion that the Melanesian is a know-nothing specimen of the 'genus Homo' (1880: 229-230).

Some were sceptical that such work could have been carried out by Pacific Islanders, for instance Brenchley, also talking of New Caledonia:

It would appear ... that a more advanced Civilization must have at one time existed on this island. Remains of ancient aqueducts are to be found, one eight miles in length ... It is evident that the skilful irrigation which has so surprised those who saw it, must be a practice that has been transmitted from better times (1873: 347).

This was a sentiment echoed by other writers (such as Inglis 1882: xxii-xxiii), but the Reverend James Copeland on seeing the irrigation systems on Aneityum in Vanuatu refused to be impressed whoever had built them, commenting that there are:

aqueducts for the irrigation of plantations which, though extensive, come far short of that which now unites Glasgow and the Highland Lochs (RPM, Oct. 1860: 346).

Even today many otherwise liberal Europeans, hearing of my own research, have assumed that it is something to do with teaching irrigation to Pacific Islanders. Similarly Meggitt (1958: 306-7) assumed that irrigation techniques he observed in Enga Province (PNG) had been learned from European goldminers! Patrol Officer Stitt (quoted in Gorecki 1979a: 117) felt the need to ask the local people if irrigation systems he observed in the Western Highlands of PNG in 1961 had been learned from Europeans, as did Whiteoak (quoted in Lacey 1979: 15) in Enga in 1953.

As well as the evidence from early travellers' accounts and historical sources, archaeologists have also noted widespread remains of irrigation systems in many parts of the Pacific. Abandoned irrigation systems were first reported by Glaumont (1897) from New Caledonia. Pioneering archaeological and ethnographic surveys by the Bishop Museum record the presence of abandoned canals, terraces and other features associated with taro irrigation from the Hawaiian Islands (Bennett 1931; Emory 1924; Handy 1940; McAllister 1933), Mangareva (Buck 1938: 226-7), Marquesas Islands (Handy 1923: 182-7), Austral Islands (Aitken 1930: 16-17, 33-4), Society Islands (Emory 1933: 33), Cook Islands (Buck 1944: 249-250), and the Wallis and Futuna Islands (Burrows 1936: 140). From Fiji, Ward (1960: 40-2, 47) reports widescale abandonment from the nineteenth century onwards of formerly irrigated terrace systems. Shutler and Shutler (1966: 160) reported seeing extensive areas of abandoned agricultural terraces on Aneityum in the first archaeological survey of southern Vanuatu, while Chikamori reported similar systems from his survey work on New Georgia in the Solomon Islands (1966).

We now need to examine in more detail the crop usually associated with irrigation in Oceania, and then to define more closely the meaning of the term irrigation as used in this study.

TARO

Taro (Colocasia esculenta) is one of the major staples of Pacific subsistence systems. It can be grown in unirrigated gardens in areas of moderately high rainfall, 2500 mm/year usually being necessary but

with 1750 mm sufficient if spread evenly throughout the year (Kay 1973: 169). Practices such as irrigation, planting in naturally wet valley bottoms or swamps, or heavy mulching are necessary however in many areas throughout the Pacific to ensure year round production. It is a perennial plant usually 0.4 m to 2 m tall and is grown particularly for its edible corm and cormels, while young leaves and its flowers can also be eaten. It is identifiable by its peltate leaves (only the Hawaiian 'Piko' group having hastate leaves). Leaf shape is the easiest way to distinguish it from the other edible Araceae found in the Pacific such as the Giant Swamp Taro (Cyrtosperma chamissonis), Elephant Ear Taro (Alocasia macrorrhiza), Elephant Yam (Amorphophallus campanulatus), and Chinese Taro (Xanthosoma sagittifolium) which has been recently introduced from the Americas. Taro is most commonly propagated vegetatively by using stem cuttings consisting of about 0.75 cm of the corm or cormel and the lower 25 cm or so of the stem. Botanical and general descriptions and bibliography are given by Bird and Rotar (1979), Kay (1973), Plucknett et al. (1970) and Purseglove (1972).

Taro is naturally a plant of wet and even swampy areas in the Indo-Pacific region and human management by cultivation has sought to replicate such conditions. Various areas of origin have been claimed in India and Mainland and Island Southeast Asia (Burkill 1935: 638; De Candolle 1882: 73; Engler and Krause 1920: 65; Spier 1951; Vavilov 1949-1950: 27), and supposedly wild taros have been reported from India, Ceylon, Sumatra and elsewhere in Indonesia.

A cytological study by Yen and Wheeler (1968) suggested an Indian origin but the lack of samples from Indonesia and lowland New Guinea renders the conclusions very tentative. Obviously, further useful cytological research could be done on taro to examine questions of origin.

The possibility that the area of natural distribution of taro may have included the island of New Guinea should be borne in mind. Golson (1977: 613) has suggested the possibility that agricultural evidence for ditching of swamps in the Wahgi Valley, Western Highlands Province, PNG dated to 9000 BP may have been associated with the growing of taro. The ditch systems dating to 6000 BP and later are certainly similar to those attested ethnographically to be for taro production in the

Highlands (ibid: 616). A tentative identification of taro pollen as an element of the lowland New Guinea flora at 8500 BP has also been made by Garrett-Jones (1979: 295,329). This raises the possibility of an independent domestication of taro in New Guinea itself without transfer from Island Southeast Asia being necessary. Aboriginal exploitation of Colocasia esculenta is known from the Northern Territory (R. Jones and B. Meehan, pers. comm.; cf. Ewart and Davies 1917: 65) and Queensland (Golson 1971: 217; Harris 1977: 433) and the species is also known from New South Wales (Evans 1962: 7, 10). Exploitation of the plant in these areas may well date back to the period pre-8000 BP when New Guinea and Australia were still joined (cf. Jones and Bowler 1980).

IRRIGATION

Irrigation is a term which has often been loosely applied to describe a range of wetland agricultural techniques. In discussing irrigation I will follow the definition of its purpose as given by More (1969: 44):

The purpose of irrigation is the control of soil moisture between a lower limit that will not restrict plant growth and an upper limit that avoids the disadvantages of waterlogging.

The term thus embraces all forms of 'wetland' agriculture from the use of naturally swampy areas to systems whose water supply comes from long supply canals.

Irrigation may allow the speculative use of rain-fed land that would not otherwise be used. Rain-fed farming on soils with marginal rainfall is in many cases only possible because irrigation production guarantees some yield reliability. The overall advantages have been well-summarised by Ruthenberg:

By regulating the water, levelling the land, maintaining a high degree of fertilization ... the farmer has obtained almost complete control of all growth factors except natural catastrophes. Thus the irrigation farmer is not as dependent as the rain-fed farmer on his daily assessment of the soil and plants, and on choosing the type of labour operations and when to terminate them. Instead, the production process is similar to that in manufacturing, which permits relatively exact planning (1971: 159-60).

For taro the yield/hectare with irrigation is considerably higher than that of the yield in rain-fed (dry land) conditions in a similar environment. Some taro varieties require a very wet environment in order to be grown at all. Irrigation allows a measure of permanent land use and yield fluctuations/year can usually be reduced (assuming an adequate water supply). It is relatively adaptable with regard to both type and intensity of production. Some crop pests can also be cut out by growing taro in flooded fields.

Three main categories of irrigation can be identified in the Pacific (Damm 1951): true irrigation, swampland and pit cultivation techniques. True irrigation refers to diversion of water from source to fields. Swampland cultivation techniques generally consist of the management by ditching of freshwater swamps where the aim is not complete drainage to create a dry land environment for planting but is only to control the water table within required limits. Pit cultivation is found mainly on coral atolls and other low islands where pits are dug to tap the freshwater lens beneath the ground surface. It is also found on some high islands, particularly in Micronesia.

The issues outlined above concerning the irrigated cultivation of taro are discussed in chapters 2, 3 and 4 in relation to the island of Aneityum in southern Vanuatu (formerly the Franco-British Condominium of the New Hebrides). Fieldwork was undertaken on Aneityum in 1978, 1979 and for a short period in 1980.

Previous archaeological reconnaissance had shown Aneityum to have extensive remains of abandoned terraced agricultural systems, some of them irrigated (Groube 1975; McArthur 1974; Shutler and Shutler 1966). These led one of these authors to describe the island as 'the Easter Island of Melanesian Agriculture', a claim I would not dispute. Groube's excavation had also shown the possibility that long stratigraphic sequences could be obtained from the valley floors, relating to agricultural use of the island. Aneityum was the first island in Melanesia to be successfully missionised and there exists a wealth of early historical accounts by the missionaries and by visitors to the island, starting in the 1830s, including early maps with coastal settlement locations marked on them. A census was taken in 1854 before the main period of devastating population decline from 1860 onwards (studied in detail by McArthur 1974) and population figures were also published for several named districts and divisions on the island at

this time. These figures together with other historical and archaeological data provide valuable information, probably unique within Island Melanesia, for establishing a baseline geography of the island at European contact. Permanent mission settlement commenced only 18 years after the first known direct contact with Europeans, hence McArthur's (ibid) perhaps justified designation of this period as 'the Late Phase of Prehistory' on Aneityum.

It is the agricultural economy of the island at this period which I attempt to reconstruct, bearing in mind the questions concerning intensification outlined previously. The productivity of irrigated and dry land agriculture on the island and the social and demographic contexts within which the agricultural systems were operated are thus examined.

In Chapter 5 a historical dimension is added to the picture and the evidence of agricultural and landscape change during the prehistory of the island is used to examine processes of intensification. In Chapter 6 comparative material from other high Pacific islands is examined to see whether similar processes have been operating elsewhere.

In Chapter 7 currently working pondfield irrigation systems on Maewo Island in northern Vanuatu are described, based on fieldwork undertaken in 1978 and 1979. Comparative material on other forms of irrigation is also discussed to show the range of techniques used traditionally in Oceania and their archaeological manifestations. Although such traditional or semi-traditional irrigation systems are still found in some parts of the region, there is evidence of a general decline or even total cessation of these techniques in many areas (cf. Brookfield 1972). There is thus a need to record these technologies in detail before they disappear or are transformed, technologies which form a direct link to the archaeological remains of abandoned systems. Such work has been undertaken in Polynesia (Allen 1969, 1971; Earle 1978; Handy and Handy 1972; Kirch 1975a; Petersen 1972) but much less in Melanesia and in much less detail (Barrau 1956; 1958; Bonnemaïson 1974; M. Brookfield 1980; Curry 1962). The chapter then goes on to consider the distribution of particular irrigation techniques within the Pacific, examining environmental, social and culture-historical factors to explain the presence or absence of irrigation in particular island groups.

In the concluding chapter the themes discussed in the opening paragraphs of the thesis are again taken up and the wider ramifications of the study are discussed.