



## NEW ZEALAND JOURNAL OF ARCHAEOLOGY



This document is made available by The New Zealand Archaeological Association under the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.

To view a copy of this license, visit  
<http://creativecommons.org/licenses/by-nc-sa/4.0/>.

# The Value of High Latitude Models in South Pacific Archaeology: A Critique

Atholl Anderson

Anthropology Department,  
University of Otago

## ABSTRACT

Several recent interpretations of prehistoric economies in the South Pacific (mainly Australasia) have argued that coastal subsistence patterns reflect convergent adaptation to environmental conditions of a subantarctic or high latitude kind. This paper reviews the environmental, archaeological and ethnographic evidence and concludes that high latitude models are inappropriate in the southern temperate zone to which they refer. High latitude environmental conditions do not exist in the inhabited South Pacific to any significant degree. Neither socio-economic nor technological evidence disclose convergence upon an adaptation type. Faunal data used to support high latitude models are biased by inadequate sampling and insufficient attention to annual economic systems.

*Keywords:* HIGH LATITUDE MODELS, CONVERGENT ADAPTATION, SOUTH PACIFIC, DIETARY FAT, TASMANIANS, MAORIS, MORIORS.

## INTRODUCTION

Recent archaeological research in Tasmania, the Chathams and southern New Zealand has disclosed evidence of apparently similar socio-economic patterns amongst these marginal southern hemisphere islands and those, though more remote, of similar latitudes. Explanation of these similarities has been sought in an idea which has lurked on the edge of Pacific archaeology for several years: that they are the result of convergent adaptation to similar environmental conditions.

This hypothesis, developed in terms of cold-water archipelagoes by McCartney (1975) and primarily aimed at coastal economic adaptations, has appeared under the guise of a "high latitude" model for southern hunters in Allen (1979), as a postulated "Subantarctic Zone" in Sutton and Marshall (1980) and as a "southern circumpolar" model which I considered for some time and eventually rejected (Anderson 1979). As is apparent from the terms it is not merely convergent adaptation which is at issue but equally the accompanying hypothesis of adaptation to a cold or high latitude environment. For convenience I have included these various terms and ideas together under the title "high latitude models".

This paper considers the following questions which are prompted by reading Allen (1979) and Sutton and Marshall (1980) and which are fundamental to the validity of the models:

1. Were marginal southern hemisphere environments sub-polar or typical of high latitudes?
2. Do protohistoric socio-economic patterns suggest that there has been convergent adaptation towards similar societies of coastal hunters?
3. Do archaeological remains support a contention of coast-bound economies?
4. Were apparently fat-rich diets an adaptation to cool environmental conditions?
5. Is adaptational convergence suggested by technological features?

For the most part I consider evidence from southern South America, southern New Zealand, the Chathams and Tasmania, since only Sutton and Marshall (1980) would include South Africa in their Subantarctic Zone (Fig. 1).

## SOUTHERN ENVIRONMENTS

### OCEANIC BACKGROUND

The most explicit argument for a pan-hemispheric adaptation zone is presented by Sutton and Marshall (1980:25) who define their Subantarctic Zone as "... the broad band between the Subantarctic and Subtropical Convergences, approximately 50-55°

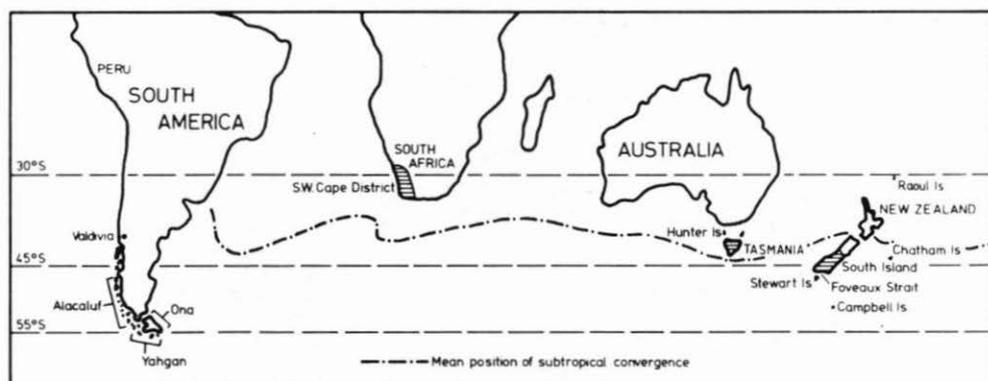


Figure 1: Latitudinal distribution of peoples, places and features mentioned in text.

and 42–47°S respectively". The zone thus corresponds to an oceanic water mass in which the northern edge moves seasonally between Stewart Island and Cook Strait. It follows that not only southern New Zealand, as shown in Sutton and Marshall (1980: Figure 1), but also much of central New Zealand and all of Tasmania (Dartnall 1974) is sometimes in their Subantarctic Zone and sometimes not. On the other hand the Subtropical Convergence Zone does not seem to reach as far south as southern South America nor as far north as southern Africa during its oscillations (mean position shown in Figure 1), so that while the former region may belong to a Subantarctic Zone the latter cannot.

More complicating still, in the case of southern New Zealand, is the fact that the inshore waters, out to approximately 70km from the coast of Otago, are comparatively warm and saline reflecting their origin in east Australian rather than subantarctic conditions. This "Southland Current" which Sutton and Marshall (1980: Figure 1) depict as sweeping from south Otago to the Chathams, actually seems to flow up the east coast as far as Banks Peninsula (Knox 1975) or Kaikoura (Brodie 1973:69) before turning south and east.

#### SEALS

Similar problems arise in attempting to characterise their Subantarctic Zone by its potential marine resources, especially seals and colonial-breeding seabirds (Sutton and Marshall 1980:25). The breeding colonies, which represent the major resource concentrations, are found predominantly south of the limits of pre-European settlement in what is usually regarded as the genuine Subantarctic Zone. North of this region the distribution is quite complex and by no means zonal. Fur seals (*Arctocephalus* spp) breed in southern South America, mainly the Argentine and Uruguay coasts, up to about 33°S and on the Galapagos islands athwart the equator. They also breed on the Chathams, in New Zealand where they may once have done so as far north as the Coromandel at 37°S in prehistoric times (Smith 1978), in Bass Strait and along the southern coast of Australia up to about 32°S, and on the southwest African coast between 21° and 34°S (King 1964, Green 1974). Sea lions have a similarly a zonal distribution. In South America, for example, they breed most extensively on the Falkland Islands, the south-eastern coasts and the Peruvian coast between 7° and 12°S (King 1964, Osborne 1977). The elephant seal now has a distinctly subantarctic distribution but once bred in Bass Strait (Green 1974) and possibly throughout New Zealand before the depredations of man (Fleming 1979:99).

Within the areas at issue the distribution of seal rookeries is distinctly uneven. They

tend to be concentrated on western and southern coasts in Australasia and South Africa but on eastern coasts in southern South America. No precise data is available about the Chilean archipelago, but my impression from Scheffer (1958:77, 131) King (1964) and Pine *et al* (1978) is that seal colonies are sparse north of the Straits of Magellan.

In short, the breeding stations of the main southern seals, let alone their annual ranges, are far from being concentrated in Sutton and Marshall's Subantarctic Zone and certainly not within the inhabited part of it. In fact the distribution seems to be most closely related to the cool ocean currents of the West Wind Drift and those which slide off it along the western coasts of the continents (Benguela, West Australian and Humboldt currents) into the equatorial regions at the Galapagos Islands and into the subtropical regions elsewhere.

#### SEABIRDS

It would be tedious to make the same points in respect of colonial-nesting seabirds, but a brief look at the New Zealand region reveals, in finer detail, that similar criticisms are valid. In our region, penguins and albatrosses tend to be confined to the subantarctic islands, but *Procellariidae* (petrels, shearwaters etc.) — the most economically important family — is broadly distributed from subantarctic to subtropical regions. The data in Falla *et al* (1979) show that more species nest in the North Island (13) than in the South Island (11) or the Chathams (9), and "muttonbirding" for them was carried out from Stewart Island to Raoul Island (Richdale 1948, Morton 1957). It is true that the southern South Island supported very large populations, but there were colonies of considerable size elsewhere, including on Raoul Island (29°S) where the Kermadec petrel alone has been estimated at 500,000 before the arrival of feral predators (Merton 1970).

#### CLIMATE

A more conventional means of defining a Subantarctic Zone is from climatic evidence, and here the answer, at first sight, appears quite plain. With the exception of the Cape District, which generally has a "Mediterranean" type of climate, all the regions in Sutton and Marshall's (1980:43) Subantarctic Zone have mild maritime climates typical of areas in the belt of mid-latitude westerlies (Trewartha 1954, Boucher 1975). Even the Chilean archipelago, which generally has a climate like that of western Britain (Linacre and Hobbs 1977:174), is usually regarded as being at the cool end of the temperate maritime range (Köppen Cc). The common mild maritime climate (Köppen Cb) which prevails in the other regions is the type most fit to be called "temperate" (Boucher 1975) and is the "... one mesothermal type which extends into the higher mid-latitudes, being found as far polewards as 60° or more..." (Trewartha 1954:289). In general terms, then, Sutton and Marshall's Subantarctic Zone is part of the "Mid-Latitudes Zone" which extends from 30°S to 55°S (Linacre and Hobbs 1977:169).

A closer look at some climatic data (Fig. 2) reveals, however, that mean temperatures and sunshine hours in Tasmania, the Chathams and southern New Zealand are approximately double those of southern Chile and these facts, together with whatever reinforcement of them is provided by the extreme windiness of the latter region and its high rainfall (Kendrew 1937), suggest significantly dissimilar climatic conditions. Since southernmost Chile has a climate like that of subantarctic Campbell Island (New Zealand), it may not be stretching a point too far to call this region "subantarctic" but doing so will serve to emphasise that all the others are temperate.

Humanly experienced climate is, of course, a different matter from meteorological statistics, and deserves some consideration in the present context. Human climates have been estimated for Australia (Linacre and Hobbs 1977) and New Zealand (Tuller 1977). In the latter case the southern South Island has very similar conditions to the remainder of the east coast South Island and the Wellington district. Summer effective temperatures lie just below the comfort range of about 15–20°C and windchill is mild to cool, while in winter the values of these indices drop sufficiently to require clothing

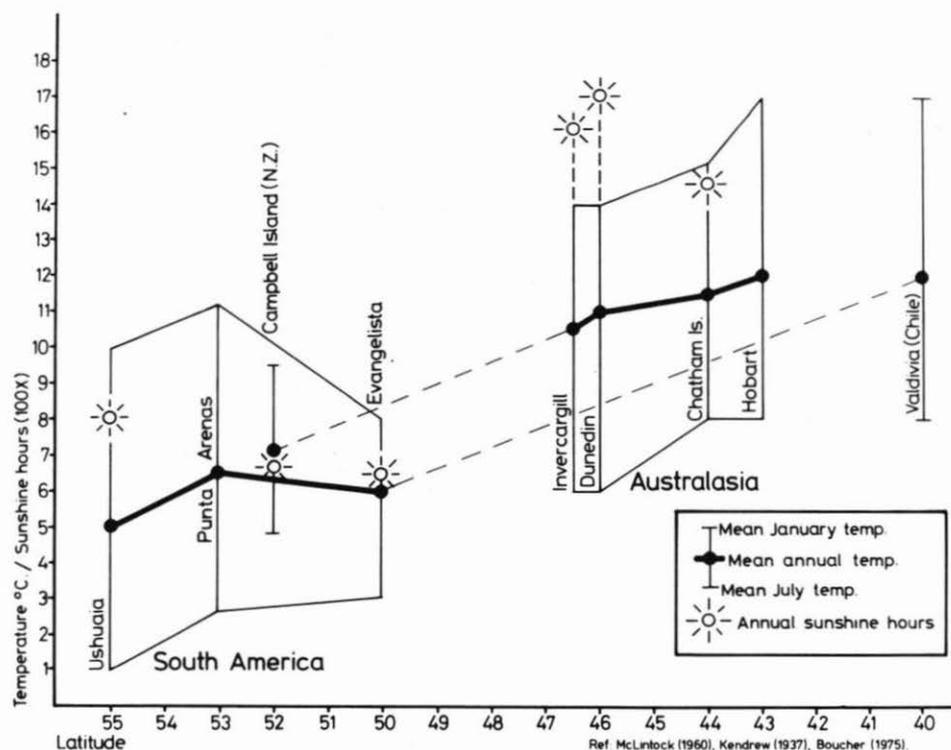


Figure 2: Correlation of latitude, temperature and sunshine hours in the southern hemisphere.

comparable to a suit and overcoat for European comfort out of doors. This human climate, by world standards, is unquestioningly moderate (Tuller 1977).

#### CONCLUSION

Sutton and Marshall's Subantarctic Zone has no monopoly upon seals and colonial-nesting seabirds nor is it generally sub-polar. With the possible exception of southernmost South America the inhabited regions are within the temperate Mid-Latitudes.

#### PROTOHISTORIC SOCIO-ECONOMIC PATTERNS

All the regions of the mid-latitude southern hemisphere were profoundly affected by the arrival of Europeans. Most of the indigenous societies became extinct between the 1870s and 1930s (Chono, Haush, Tasmanians, Morioris) or survived in populations on the brink of extinction (Yahgan, Alacaluf, Ona). Only the southern Maoris absorbed the shock and are thriving. Nearly all the ethnographic records thus refer to socio-economic systems under severe pressures, including loss of territory and people, declining marine mammal populations, and the introduction of new resources and artefacts. The complexities of this topic are beyond the scope of the present paper but it would be as well to note that culture-contact deformations were probably least influential in the observed lifestyles of the Alacaluf, more so in the case of the Tasmanians and Ona and most important in those of the southern Maoris and Morioris.

## SOUTHERN SOUTH AMERICA

Among the variety of societies in this region the Ona of Tierra del Fuego and the Alacaluf of the southern Chilean archipelago are representative of two different socio-economic systems. The Ona were predominantly terrestrial hunters and foragers for whom "... the guanaco (*Lama guanicoe*, a large American camelid) was the most important single species on a year round basis" (Stuart 1977:274). The guanaco was mainly hunted in autumn and winter, frequently with the assistance of dogs (Furlong 1917), and at other times of the year foxes, geese, ducks, tuco-tuco (*Ctenomys* sp.) and various fungi, berries and seeds were obtained inland, and seals, fish, shellfish and cormorants along the coast (Cooper 1946a, Stuart 1977).

Although several dialectal differences in the Ona language suggest there may once have been a higher level of organisation, the largest effective social unit was a band of 50-60 people comprising 10-12 patrilineally related families under the titular control of a non-hereditary headman (Cooper 1946a, Steward 1949). Each of the 39 bands claimed a separate and well-defined territory within which subsistence activities were seasonally ordered.

In contrast, the Alacaluf were a maritime people who had but limited access to terrestrial resources. Their subsistence depended largely upon shellfish, sea lions and marine birds. Of the relative importance of these we have no reliable data. McCartney (1975) believes sea birds and mammals were most important, but ethnographic observations stressed shellfishing and Bird (1946:58) notes that "... the possession of a good meat supply did not interrupt shellfish gathering". In beech bark canoes the Alacaluf foraged along the channels and fiords, occasionally reaching the outer coast where the sea lion rookeries were located (Bird 1946). Fishing was relatively unimportant, although probably for technological (Bird 1946:62) and ecological (Steward and Faron 1959:399) reasons rather than Coon's (1976:157) belief that the Alacaluf were an outstanding example of "maritime ichthyophobes".

The territorial and social patterns of the Alacaluf were unusually rudimentary. There were no permanent settlements and patrilineal families lived alone or at most in groups of two or three, except on ceremonial occasions. They foraged in no particular seasonal pattern and according to no known territorial limits (Bird 1946, Steward and Faron 1959).

## TASMANIA

In the early historical period Tasmanians were organised into nine dialectal and territorial "tribes", each of 200-700 people. Each tribe was divided into bands of 40-50 people and these, in turn, into 5-10 families (Jones 1971, 1977). The band was the normal economic unit which travelled around, and occasionally beyond, the tribal estates in regular seasonal movements ranging up to 480 kilometres.

All the tribes had some access to marine resources but, as Hiatt (1967-1968) has shown, macropods and vegetables ranked alongside marine invertebrates as the principal objects of the food quest. For western tribes, as for many aboriginal groups, the spring and summer was a time of plenty during which young seals and colonial marine birds could be obtained from the coast and islands, whereas late autumn and winter were periods of stress during which terrestrial game assumed a greater importance (Jones 1971, Horton 1979). Shellfish and vegetables were collected continually through the year.

Thus, although marine resources in general were important, plant foods constituted a large part of the diet, even on the coast, and Hiatt (1968:218) remarks that "The concept of an economy totally specialised to exploit a marine environment would be unfounded in Tasmania".

## THE CHATHAM ISLANDS

At the time of European contact the Chatham Islands were divided into seven clan or tribal areas. Social organisation was typically Polynesian (Skinner 1923) but whether

it was markedly less stratified than in New Zealand is difficult to tell. There was a chiefly (*ariki*) rank, evidently hereditary (Skinner 1923:51), from which the political leaders were drawn (Shand 1895:87), but whether there were further hierarchical distinctions is open to question; Baucke (Skinner and Baucke 1928) at least, believed that there were two main tribes (Wheteina and Rauru) within which the others were subtribes or clans.

The Morioris had access to a wide range of resources which they exploited in a regular seasonal fashion. Late summer and autumn seems to have been the busiest time since during it colonial seabirds were taken and preserved, vast quantities of ducks were moulting on the lagoon and the main eel runs occurred in the streams. Pigeons and other birds were speared and snared in the forest, fish caught with hook and line and a variety of nets and traps, and shellfish and stranded whales gathered along the coast. Seals, which were clubbed at their rookeries, were an important resource but they were severely depleted by the protohistoric period.

Plant foods seem to have been more important than Sutton and Marshall (1980) allow. The pith of the *mamaku* (*Cyathea* sp.) was regarded as a prestige food and fern root, abundant but not often of high quality, was semi-cultivated (Skinner and Baucke 1928). Exceeding these in importance was the very abundant *karaka* (*kopi*) nut (*Corynocarpus* sp.). This, which Skinner and Baucke (1928:360) describe as "... the most relied upon food to be preserved for winter use ..." was evidently harvested in considerable quantity and ownership of *karaka* stands was a notable form of wealth, the produce of which was traded for sealskin capes (Skinner and Baucke 1928:367).

Settlement patterns appear to have centred around permanent villages which were occupied during the winter. At other times of the year the population may have dispersed according to the availability of different resources, but whether for the whole of the warmer part of the year or simply in specific trips to and from the village is not clear.

#### SOUTHERN NEW ZEALAND

In the protohistoric period the southern Maoris belonged to a highly stratified chiefdom which enclosed elements of two main tribes; the Ngai Tahu who were the dominant people and the Ngati Mamoe whom they had invaded and intermarried. Land ownership, access to resources and the organisation of activity groups was fully as complicated as anywhere in Maori society (Anderson 1980a).

The ethnographic evidence discloses intricately connected and regionally variable economic networks, two of which have been idealised in Figure 3. Coastal villages were mainly occupied during the autumn and winter when preserved food resources were adequate, but at other times most of the population was dispersed at hamlets and camps along the coast and through the interior where a wide range of resources was exploited (Fig. 3). Regional differences included a greater reliance upon *ti* (*Cordyline australis*), open country birds and offshore fish along the east coast, particularly north of Otago peninsula, and a stronger emphasis upon forest birds, eels, lamprey and colonial seabirds in the south (Beattie 1920, Leach 1969, Bathgate 1969a).

In southern New Zealand, more than in any of the other areas, the role of resource distribution was most important. Preserved muttonbirds (*Puffinus griseus*), *kauru* (a food prepared from *ti*), eels and terrestrial birds such as the *weka* (*Gallirallus australis*) were customarily exchanged throughout the region, and some of them to areas as far north as Taranaki and the Wairarapa (Leach 1969, Anderson 1980a). What the important constituents of subsistence would be is thus not easy to determine as a whole, but marine fishing followed by terrestrial fowling, eeling and the gathering of plant foods appear to have been the most common activities. Colonial seabirds and marine mammals, though they were seasonal delicacies and preferred foods for preservation, rank well down the list.

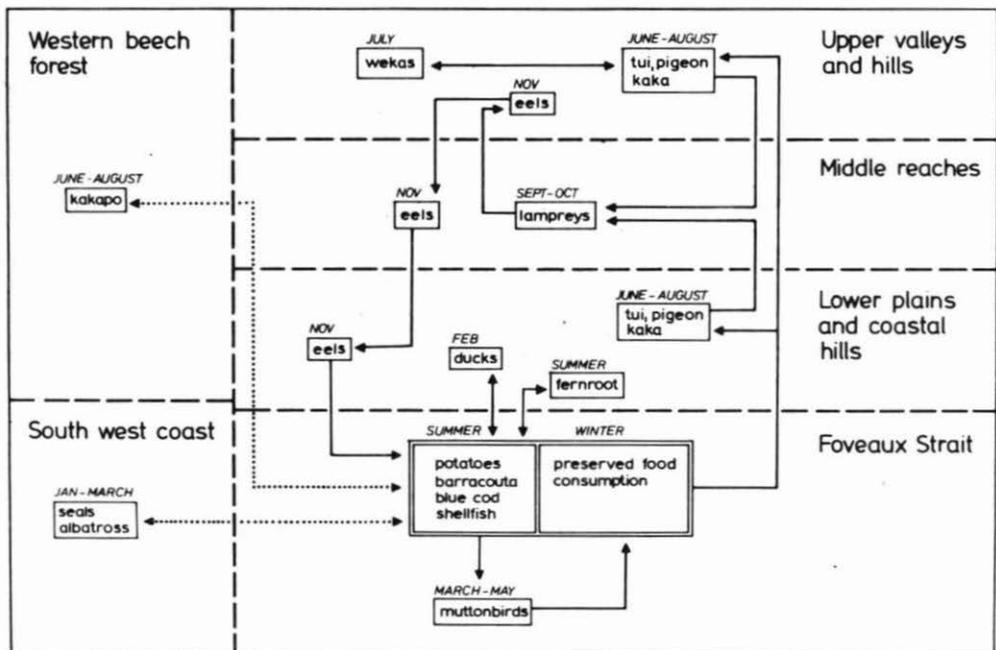
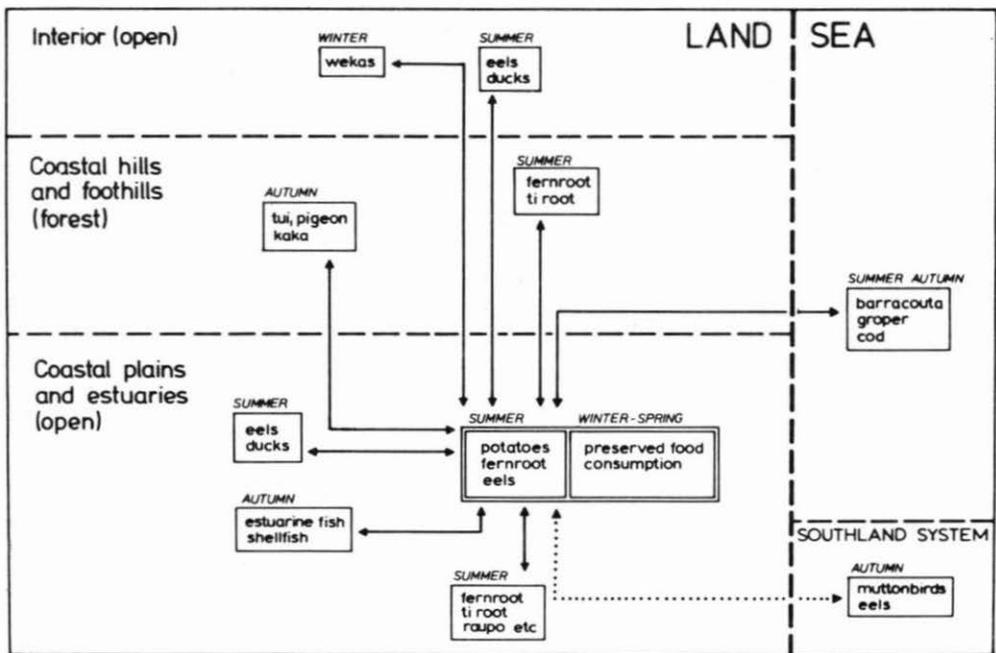


Figure 3: Annual subsistence patterns in protohistoric southern New Zealand. Upper: eastern Otago. Lower: Southland. Double-line box = main settlement. Dotted lines = connections or journeys outside main system.

## CONCLUSIONS

1. Socio-economic patterns of these southern mid-latitude societies were clearly different and can be summarised as belonging to a cline of increasing complexity as follows:  
 Alacaluf: family organisation, non-territorial, irregular mobility.  
 Ona: band organisation, territorial, regular mobility.  
 Tasmanians: linguistic tribes and bands, territorial, regular mobility.  
 Morioris: relatively egalitarian clans or tribes, territorial, regular mobility with a permanent base.  
 Southern Maoris: chiefdom, territorially complex, regular mobility with permanent bases and resource distribution.  
 Such differences inspire little confidence in the utility of a single determinist model.
2. While marine resources in general were important everywhere except amongst the Ona, the label "coastal hunter" is appropriate only in the case of the Alacaluf. The other peoples hunted coastal resources at certain times; equally they allocated substantial proportions of their subsistence efforts to terrestrial hunting, fishing or foraging.

## ARCHAEOLOGICAL EVIDENCE OF SUBSISTENCE PATTERNS

The proponents of high-latitude models have argued that archaeological evidence indicates the development of coastally oriented subsistence patterns in which seals and colonial seabirds were particularly sought after.<sup>1</sup> There is insufficient evidence from southern South America or the southwest Cape district of South Africa bearing on these matters and the most useful evidence is from northwest Tasmania, the Chathams and southern New Zealand.

## SUBSISTENCE PATTERNS

*Tasmania*

In the fauna of the Rocky Cape site of northwest Tasmania shellfish contributed about half the represented meat weight throughout the sequence (Jones 1971). Of the remaining half, seals contributed about 70% and fish, which contributed 21% in the lower (pre-3800 B.P.) levels were replaced by birds and marsupials in the upper levels (Jones 1978).<sup>2</sup> Similar coastal patterns are known from West Point, where elephant seals contributed 65% of the represented food energy, and from Cave Bay Cave on Hunter Island (Jones 1978). These patterns are distinctly at odds with the ethnographic evidence, but there is reason to think that they are not at all representative of annual subsistence in this district.

The sites above are not a fair sample of all the site types in northwest Tasmania, let alone a proportional one. Bowdler (n.d.) for example, has recently excavated a site three kilometres inland on Hunter Island in which the remains of terrestrial mammals were dominant, and she considers that it belongs to the same economic system as Rocky Cape. Likewise, Jones (1978) points out that the population was probably dispersed at small camps along the coast during the winter, at which time shellfish were the principal article of diet. He believes seals were consumed at Rocky Cape on only one of each four or five visits and that an allowance of about one-third of the total diet should be made for non-surviving vegetable foods (Jones 1978). If Jones is right a diet much like the ethnographic one, rich in shellfish and plant foods, is indicated.

*The Chathams*

The reconstructed diet of the 16th century Morioris in the Durham area of Chatham Island (Sutton 1979) was dominated by marine mammals (68% of edible flesh), followed by fish (24%) and birds and shellfish (4% each). The archaeological sampling problem is apparent here even more starkly than in Tasmania. The Durham results

arise from the excavation of seven sites, including a small village (the Waihora mound). If we compare this sample against the total number and type of sites within a two kilometre radius of the Waihora mound, i.e. the Durham area as defined by Sutton (1979), the following are the results (number of sites excavated in brackets): village sites 1(1), seal bone middens 1(1), ridge-top muttonbird middens 2(2), lowland middens 12(0), specialised shellfish middens 64(0). Although the results of three excavations of shellfish middens elsewhere are included in Sutton's analyses, it is quite clear that there is unlikely to be a representative sample of the potential diet.

Moreover, since Sutton's painstaking faunal analyses have revealed the specialised nature of the small middens, we might expect that evidence of activities which were carried out more than two kilometres from the Waihora mound, such as catching ducks and eels in the main lagoon and Lake Huro, would simply not be represented in the sites of the Durham area in any proportional fashion. In this connection it is worth noting that the Lake Huro site, excavated but unanalysed, lies within the same 19th century tribal territory as the Durham area (Simmons 1962).

### *Southern New Zealand*

The sampling problem is not so crucial here because many more sites in a wider range of microenvironments have been excavated. In the early (Archaic) phase the broad pattern revealed is one of a dominance of moas in sites on the coast from Otago Peninsula to the Rakaia River and through the interior, with the proportion of marine mammals increasing towards the south and becoming dominant in Foveaux Strait. In the later (Classic) phase fish, marine birds and shellfish are predominant in coastal sites everywhere.

The extent to which these patterns are representative of the annual subsistence strategy depends, in part, upon whether the coastal settlements were occupied all year round, as Sutton and Marshall (1980:40) believe Tiwai Point to have been. Their evidence consists of the seasonal availability limits of various species, mainly birds, which when added together cover the whole year. This is an odd use of seasonality data in that it seeks to find the maximum period during which the site could have been occupied. An alternative approach which seeks the minimum occupation span represented in Sutton and Marshall's (1980:38-39) data reveals that all the species could have been obtained in the period mid-November to mid-May; a conclusion similar to that reached by Higham (1976). The remaining part of the year was the time when, according to protohistoric data, many of the Foveaux Strait people moved inland to fishing, fowling and foraging camps. During the 13th century when Tiwai Point was occupied it is likely that terrestrial resources were of even greater importance since moas were still available and were hunted far into the Otago mountains. Sites in the latter region suggest that their occupants did, in fact, come from or have connections with Foveaux Strait (Anderson 1980b).

Thus Tiwai Point, in which there is no structural evidence suggestive of a village, nor the abundance of fish and shellfish which usually accompanies long-settled sites in southern New Zealand, was more probably a seasonally occupied sealing and manufacturing site from which the inhabitants dispersed at other times. It is important to recall that the southern Maoris had reliable means of storage enabling them to preserve seal meat for later consumption (Leach 1969:67). The early existence of the kelp-bag storage technique is suggested, in fact, by the butchery patterns of the muttonbirds at Tiwai Point (Sutton and Marshall 1980).

### CONCLUSIONS

1. Prehistoric subsistence patterns in southern Australasia included stronger emphases upon marine invertebrates and terrestrial resources than is allowed for in the high latitude models.
2. There is no evidence of settlement being confined to the coast.

## FAT-RICH DIETS

A further proposition of the high latitude model is that environmental conditions in the marginal southern hemisphere prompted the consumption of diets rich in fat. Its proponents offer no direct evidence in support of this assertion beyond the opinion that "... there is reason to believe that hunting people in high latitudes require large quantities of fat or oil for survival ..." (Allen 1979:3) and the even more oblique comment of Sutton and Marshall (1980:44) that "The high dietary fat requirements of hunters in high latitude situations are well documented".

This is a very difficult argument to examine, because the relationship of prehistoric diet to cold stress is largely beyond measurement. It is particularly difficult when the representativeness of the archaeological samples of dietary evidence are open to question, as they are in the cases of Tasmania and the Chathams. However, two aspects of the general problem can be considered: the validity of the underpinning assumption that high latitude peoples had and needed fat-rich diets, and the implications of apparently fat-rich diets in southern Australasian archaeology.

*Dietary Fat and Environment*

It is a gross over-simplification to assume that high latitude hunters had fat-rich diets. For many peoples of the sub-arctic interior, where diets of fish and venison prevailed, just obtaining enough fat to avoid the "rabbit-sickness" condition (Eidlitz 1969) was a perennial problem (Anderson n.d.a.), whilst coastal hunters, who had access to abundant fat supplies, normally used a large proportion of them as fuel (Eidlitz 1969:79-80) and do not seem to have consumed unusually large amounts overall (Table 1).

The fact is that there is no simple relationship between fat requirements and environmental conditions; dietary fat has no particular cold-resisting properties. The value of fat is that it provides a concentrated food (9 cal/g) which is an advantage in conditions where energy requirements are increased. This can occur in hot arid conditions (Newman 1962:23) or in cold conditions where shivering (Carlson and Hsieh 1965:29) and to a lesser extent the ingestion of fat itself (Kasper *et al* 1975) raise the rate of metabolism. Provided that there is an adequate balance of fat in the diet — approximately 30% although the proportion is very flexible — carbohydrates will do as well as fat if they are more readily available. Increasing carbohydrate availability and decreasing dependence on fat are reflected in the historical examples of Table 1.

Since there is no reason to believe that southern Australasians were denied ready access to carbohydrate sources or lived in anything but temperate conditions and since there is no direct or necessary correlation between cold stress and the proportion of fat required in the diet, the basic assumption of Allen (1979) and Sutton and Marshall (1980) must be rejected.

*Fat in Southern Australasian Diets*

The specific argument that southern Australasians consumed fat-rich diets is based on the implicit assumption of Allen (1979) and Sutton and Marshall (1980) that faunal remains from Tiwai Point, Waihora (all sites) and Rocky Cape, reflect local consumption patterns;<sup>3</sup> an assumption which I suggest is highly questionable in terms of protohistoric patterns and the deficiencies of archaeological sampling (above). Nonetheless it ought to be examined from a dietary point of view.

By converting the total flesh weights estimated for these sites into calorific proportions of fat, protein and carbohydrate, according to the different distribution of these constituents amongst the various food resources, it can be seen that fat was indeed available in abundance (Table 1). Could it have been consumed in these proportions?

A fat-rich diet is by no means an unqualified advantage. One of the problems is that fat metabolism produces strongly acidic ketone bodies which can accumulate in the bloodstream and cause serious illness and death (Denniston 1972:214-216). This most frequently occurs in situations where carbohydrate oxidation is severely curtailed (Robinson 1968:76, 94) and is thus a problem for high-latitude hunters,

TABLE 1  
HISTORICAL AND ARCHAEOLOGICAL DIETS

DIET	PERCENT CALORIES <sup>1</sup> IN:				DATA SOURCE
	Protein	Carbo- hydrate	Fat	C:F <sup>2</sup>	
<i>Historical</i>					
Coastal Eskimo 1855 A.D.	47	7	46	1:7	Sinclair (1953)
Coastal Eskimo 1914 A.D.	44	8	47	1:6	Draper (1980)
Coastal Eskimo 1971 A.D.	22	43	36	1:1	Draper (1980)
Inland Eskimo 1950 A.D.	18	31	51	1:2	Rodahl (1967)
Inland Lapp 1970 A.D.	17	47	36	1:1	Draper (1980)
<i>Archaeological</i>					
Ashishik Point (Aleutians)					
with blubber	23	2	75	1:38	Denniston (1972)
without blubber	55	5	39	1:8	Denniston (1972)
Waihora (all sites)					
with blubber	24	2	74	1:37	Sutton (1979)
without blubber	46	4	49	1:12	Sutton (1979)
Tiwai Point					
with blubber	17	2	81	1:40	Sutton and Marshall (1980)
without blubber	35	5	61	1:12	Sutton and Marshall (1980)
Rocky Cape (pre-3800 B.P.)					
with blubber	43	6	51	1:9	Jones (1978)
without blubber	60	8	33	1:4	Jones (1978)
Rocky Cape (post-3800 B.P.)					
with blubber	48	6	46	1:8	Jones (1978)
without blubber	59	8	35	1:4	Jones (1978)

## Notes for Table 1

1. Fat contains 2.25 times the calories of carbohydrates and protein.
2. Carbohydrate-Fat ratio.
3. All figures to nearest whole number.
4. Seal constituents after Sinclair (1953), land mammal uses venison figures (Altman and Dittmer 1968), bird and fish after Sutton (1979), shellfish uses abalone figures (Altman and Dittmer 1968).
5. Ashishik Point and Waihora have separate edible seal meat and blubber figures. For other sites it is assumed that given edible meat weights do and do not contain blubber.

despite the fact that some of them appear to have developed physiological mechanisms which ameliorate the effects (Sinclair 1953, Feldman *et al* 1975, Itoh 1980). The critical dietary relationship is determined by the ratio of carbohydrate to fat. Carbohydrate intake usually has to exceed 100–200 g per person/day, or generally about 15% of the daily diet, to ensure that the onset of ketosis (or ketonuria) is averted (Davidson *et al* 1972; Loten: pers. comm.).

Denniston (1972:215) argues from biochemical data that the blubber-rich and low carbohydrate Ashishik Point diet (Table 1), had it been consumed, would have been highly ketogenic. If so, then the similar diets of Waihora and Tiwai Point (Table 1) would have made their consumers severely ill. Even if they had discarded all the blubber they would still have had diets in which the carbohydrate-fat ratios were distinctly less favourable than in the blubber-free Ashishik Point diet, which Denniston (1972) describes as mildly ketogenic. These effects could have been reduced in any of three ways: by discarding the blubber and perhaps the fattier cuts of meat as well, or more likely by preserving the flesh for later consumption, and by consuming more carbohydrates. The latter course is reflected in the figures from Rocky Cape (Table 1) where the influence of a high shellfish consumption — a food which generally contains more carbohydrates than fats — is apparent.

Jones' (1978) suggestion of an occasional seal being eaten may reflect a deliberate policy of light but steady culling on the part of the Tasmanians rather than periodic bursts of slaughter. Certainly the stealthy killing and removal of one or a few animals under cover of darkness and without alerting the remainder of the herd was the aim of the Moriori sealer (Skinner and Baucke 1928:366), and it suggests that we should view sealing as an occasional foray for pelts and for meat and fat to add a welcome but modest contribution to an already varied diet.

To these considerations and those concerning archaeological sampling must be added the fact that exploitation of seals and colonial seabirds is not confined to the cooler districts of Australasia. In New Zealand, for instance, one of the largest sea-mammal hunting sites is at Houhora, in Northland (Shawcross 1972), and seals and muttonbirds are predominant in the fauna of the Low Flat site on Raoul Island (Anderson n.d.b.). In neither place can a thesis of fat consumption for cold resistance be seriously maintained.

Indeed it is unduly narrow, in my view, to ascribe food choices primarily to food quality; there are other aspects as well and an important one of these is food availability. Since seals and colonial seabirds present seasonally concentrated reserves of high quality food, in the former case in large packages, they are more economically exploited than most other coastal resources. Their combination of high quality *and* high quantity thus makes them desirable anywhere, irrespective of any role which they might play in alleviating environmental stress.

In short, while the argument that cold was the motive for consuming a great deal of fat in southern Australasia is virtually non-testable, there is little to support it as a general thesis and reason to believe that fat-rich foods were spread more evenly through the diet than appears solely from faunal analyses of selected coastal sites.

#### CONCLUSIONS

1. There is no necessary correlation between environmental conditions and the need for dietary fat.
2. Some archaeologically inferred diets from southern Australasia may have caused serious illness, if they had been consumed.
3. Fat-rich coastal resources could have been dispersed through the diet by culling policies and/or preservation techniques.

#### TECHNOLOGICAL ADAPTATIONS

In developing the theme of adaptational convergence amongst the regions of their Subantarctic Zone, Sutton and Marshall (1980:43) claim "... notable parallels in material culture between these areas", and cite watercraft and a few domestic implements in support. Allen (1979:4) also suggests a similarity of watercraft between Tasmania, the Chathams and Tierra del Fuego. Since it is amongst the artefactual types bearing directly upon survival and subsistence that any such convergence should be apparent, the validity of these claims can be checked in relation to forms of shelter, clothing, watercraft and the main types of hunting, fishing and preparation equipment.

#### SHELTER

The common Ona shelter was a windbreak of guanaco hides, although they also built small bark or foliage covered tipis, sometimes with a shallow scoop in the floor (Bennett 1949). Alacaluf normally lived in brushwood covered dwellings of a beehive shape with no floor scoop and a hearthless fire. These were about 3-4m in diameter (Bird 1946:64). Both Ona and Alacaluf periodically constructed temporary lodges up to 18m long for use in initiation rites (Bennett 1949). Tasmanians used caves and built bark windscreens and bivouacs (Bryden 1974). Similarly rudimentary forms of shelter are known amongst the Morioris (Taylor 1870) and the southern Maoris (Murison 1871), but these people, who shared the same full range of dwellings as other Maoris (Skinner 1923:76), also built large frame houses with porches, stone-built hearths and

carved barge boards. Such substantial dwellings bear no comparison with those of the other regions, and it is worth pointing out as well that had they been built in genuinely sub-polar conditions then northern hemisphere parallels would lead us to expect evidence of semi-subterranean construction. With one questionable exception (Duff 1961) it has not been reported.

#### CLOTHING

All the southern mid-latitudes peoples smeared their bodies with grease or oil and Ona, Alacaluf, Tasmanians and Morioris sometimes wore skin capes. The Ona and Tasmanians also made skin robes and the Morioris and southern Maoris a variety of woven flax capes and mats (Skinner and Baucke 1928, Bird 1946, Bryden 1974, Coon 1976). The closed multi-layered clothing, mittens, boots and hoods of northern circumpolar peoples are missing.

#### WATERCRAFT

Sutton and Marshall (1980:43) say that the wash-through raft was common to Tasmania, New Zealand, the Chathams and southern South America. This is not the case. In the Chilean archipelago the Ona had no known watercraft and the Alacaluf and Yahgan had only a sewn beechbark canoe until the arrival of planked canoes and dugouts in the later historical period (Lothrop 1932; Cooper 1946a:112; 1946b:88; Bird 1946:67). Reed bundle rafts were used in southern New Zealand, mainly in the northeast as river-crossing craft (*mokihi*), whereas similar craft in Tasmania, which were poled rather than paddled, were used in short ocean voyages as well (Jones 1976). In the Chathams *mokihi* rafts of fern and flax stalk bundles seem to have been used only as ritual vessels (Shand 1895:86). Similar craft are found, of course, in Easter Island, Peru, Iraq and elsewhere. The Chathams wash-through raft was an altogether more substantial and different vessel, of which one type had inflated kelp bags and a flooring of flax stalks lashed within a wooden frame which was furnished with seats. Unlike anywhere else this craft was rowed and it was capable of ocean voyages to islands lying 40 kilometres offshore (Skinner and Baucke 1928). Another kind used dried flax stalks for buoyancy but was otherwise of similar construction (Skinner 1923).

In southern New Zealand there were at least six types of watercraft: log rafts, reed bundle rafts and dugouts which were used on rivers and sheltered waters as well as large built-up canoes, double canoes and outrigger canoes which were used at sea (Bathgate 1969b). These latter were typically Polynesian ocean-going vessels on a scale utterly beyond anything found in other southern mid-latitude regions, and it was the use of them which was instrumental in giving southern Maori life its mobility and complex resource gathering and distribution qualities.

#### HUNTING AND FISHING EQUIPMENT

Amongst the Ona the bow and arrow was the main hunting device (Cooper 1946a:113). This was found rarely amongst the Alacaluf and was unknown to Tasmanians, Morioris and southern Maoris. Harpoons were used in the Chilean archipelago (Bird 1946:69) and in the Chathams and southern New Zealand (Skinner 1974). They are widespread in Polynesia and are not found in Tasmania. Shaped stone sealing clubs were used in the Chathams, but elsewhere wooden clubs, often of makeshift form, served the same purpose (e.g. Bird 1946:60). Alacaluf and Yahgan also used sealing nets and snares, not reported elsewhere.

The Ona fished with hook and line, fish spear and gill net whereas the Alacaluf used the spear, gill or seine net, a noose and possibly a dip net (Bird 1946:62, Cooper 1946a:110). Southern Maoris and Morioris used a wide range of nets and trolling and bait hooks but no spear, whilst Tasmanians had no specific fishing gear and, in the historical period at least, little regard for fish (Jones 1978).

### PREPARATION EQUIPMENT

Sutton and Marshall (1980:43) cite "large stone knives or scrapers" as a common element. Such a description could apply to many kinds of artefacts. Large stone blades are found in southern New Zealand and perhaps elsewhere, although I can find nothing answering this description amongst the archipelagic Chileans whose basic all-purpose implement was a honed mussel valve (Bird 1946:68). The ulu, a typical southern New Zealand implement, is not found in the other regions, although it occurs in Easter Island and Hawaii (McCoy: pers. comm.), in Asia and the northern circumpolar region (Loewenstein 1958). The Chathams *mataa*, or blubber knife, is not found in Tasmania or southern South America, but, like the ulu, it has a marginal Polynesian distribution (McCoy: pers. comm.). Finally, Morioris and especially southern Maoris were distinguished by their construction of polished stone adzes.

### CONCLUSION

This is far from being an exhaustive list but it makes the point that there is no convincing evidence of adaptive convergence in technology or of adaptations to a sub-polar regime. Many of the characteristic southern forms are widely spread elsewhere in the Pacific.

### SUMMARY AND CONCLUSIONS

The high latitude models contain two inter-related hypotheses. The first is that environmental conditions in the marginal lands of the southern hemisphere were of sub-polar severity and that, as a consequence, human settlement was bound to rich coastal resource zones where fat-rich seals and colonial seabirds were preferentially exploited. The second is that these subsistence constraints led to the development of similar socio-economic and technological adaptations between the peoples at the margins of the southern hemisphere landmasses.

The evidence above indicates that the first hypothesis is invalid. Environmental conditions were generally typical of temperate mid-latitudes and, except amongst the Alacaluf, settlement patterns integrated a wide range of maritime and terrestrial resources by seasonal mobility. Evidence for the existence of environmentally prompted fat-hunger is lacking and the apparently fat-rich diets of coastal settlement phases reflect differential survival amongst food remains, inadequacies of archaeological sampling and a failing to view coastal evidence in its wider economic framework.

The second hypothesis is also invalid. Historical data reveal as wide a range of socio-economic structures, from family-based foraging to mixed-economy chiefdoms, as might be found anywhere in the Pacific, and this diversity is manifested in the basic elements of material culture. If anything the evidence strengthens regional hypotheses of adaptational divergence in which constraints of dissimilar environments, landmass areas, population densities, degrees of isolation and lengths of occupation led to different courses of socio-economic adaptation being followed by Morioris away from southern Maoris, southern from northern Maoris, Tasmanians from mainland aboriginals and Ona and Alacaluf from Pampean forebears. But in all these courses the imprint of cultural antecedents is deeply stamped and in the final analysis it is this fact which drives constructs of environmental determinism back to the fringes of Pacific archaeology: high latitude models unreasonably favour the influence of environment against culture in adaptational process.

#### Notes

1. Sutton and Marshall (1980:43) claim that the allegedly similar settlement and hunting patterns have developed through time in each area and that this is supported by archaeological evidence. When Tiwai Point and the Waihora sites are the *earliest* known settlements in their areas how can this be?
2. A point which Allen (1979:2) notes but promptly ignores in his determination to have fishing replaced by sealing.
3. Sutton and Marshall (1980:43) do advise that the Waihora seal bone midden "... is to be seen as part of the overall structure of Moriori economics" but they do not elaborate.

## ACKNOWLEDGEMENTS

For valuable information I would like to thank Ian Smith (Anthropology Department, University of Otago), Pat McCoy (Bishop Museum, Hawaii) and Dave Loten (Otago University Medical School).

## REFERENCES

- Allen, H. 1979. Left out in the cold: why the Tasmanians stopped eating fish. *The Artefact* 4:1-10.
- Altman, P. L. and Dittmer, D. S. (Eds), 1968. *Metabolism*. Biological Handbooks Bethesda, Maryland.
- Anderson, A. J. 1979. Southern hunters: models of economic prehistory in Southern New Zealand. Paper delivered to ANZAAS Conference, Auckland, February 1979.
- Anderson, A. J. 1980a. Towards an explanation of protohistoric social organisation and settlement patterns amongst the southern Ngai Tahu. *New Zealand Journal of Archaeology* 2:3-23.
- Anderson, A. J. 1980b. Re-discovery of a moa-hunting site on the Old Man Range. *New Zealand Archaeological Association Newsletter* 23(3):169-172.
- Anderson, A. J. n.d.a. The prehistoric fur trade and economic change in Northern Sweden: the relevance of a Canadian model. *Norwegian Archaeological Review*. In press.
- Anderson, A. J. n.d.b. The archaeology of Raoul Island (Kermadecs) and its place in the settlement history of Polynesia. *Archaeology and Physical Anthropology in Oceania*. In press.
- Bathgate, M. A. 1969a. The Maori occupancy of Murihiku, 1000 to 1900 A.D.: A geographic analysis. Unpublished M.A. thesis, University of Otago.
- Bathgate, M. A. 1969b. Maori river and ocean going craft in Southern New Zealand: a study of types and change in relation to the physical, social and economic environment, 1773-1852. *Journal of the Polynesian Society* 78:344-377.
- Beattie, H. 1920. Nature lore of the Southern Maori. *Transactions of the New Zealand Institute* 52:53-77.
- Bennett, W. C. 1949. Habitations. In Steward, J. H. (Ed), 1949:1-20.
- Bird, J. 1946. The Alacaluf. In Steward, J. H. (Ed), 1946:55-80.
- Boucher, K. 1975. *Global Climate*. English Universities Press, London.
- Bowdler, S. n.d. Stone tools as economic markers? New evidence from the Stockyard Site, Hunter Island. Unpublished ms, Department of Prehistory and Archaeology, University of New England.
- Brodie, J. W. 1973. The Ocean Environment. In Williams, G. R. (Ed), *The Natural History of New Zealand: An Ecological Survey*: 61-92. A. H. and A. W. Reed, Wellington.
- Bryden, W. 1974. Aborigines. In Williams, W. D. (Ed), 1974:417-433.
- Carlson, L. D. and Hsieh, A. C. L. 1965. Cold. In Edholm, O. G. and Bacharach, A. L. (Eds), *The Physiology of Human Survival*: 15-51. Academic Press, London.
- Coon, C. S. 1976. *The Hunting Peoples*. Penguin, Harmondsworth, England.
- Cooper, J. M. 1946a. The Ona. In Steward, J. H. (Ed), 1946:107-126.
- Cooper, J. M. 1946b. The Yahgan. In Steward, J. H. (Ed), 1946:81-106.
- Dartnall, A. J. 1974. Littoral Biogeography. In Williams, W. D. (Ed), 1974:171-194.
- Davidson, Sir S., Passmore, R. and Brock, J. F. 1972. *Human Nutrition and Dietetics*. Churchill Livingstone, Edinburgh.

- Denniston, G. B. 1972. *Ashishik Point: An Economic Analysis of a Prehistoric Aleutian Community*. University Microfilms International, Ann Arbor.
- Draper, H. H. 1980. Nutrition. In Milan, F. A. (Ed), 1980:257-284.
- Duff, R. 1961. Excavation of house-pits at Pari Whakatau Pa, Claverley, Marlborough. *Records of the Canterbury Museum* 7:269-302.
- Eidlitz, K. 1969. Food and emergency food in the circumpolar area. *Studia Ethnographica Upsaliensia* 32.
- Falla, R. A., Sibson, R. B. and Turbott, E. G. 1979. *The New Guide to the Birds of New Zealand*. Collins, Auckland.
- Feldman, S. A., Rubenstein, A. H., Ho, K. J., Taylor, C. B., Lewis, L. A. and Mikkelsen, B. 1975. Carbohydrate and lipid metabolism in the Alaskan Arctic Eskimo. *American Journal of Clinical Nutrition* 28:588-594.
- Fleming, C. A. 1979. *The Geological History of New Zealand and its Life*. Auckland University Press, Auckland.
- Furlong, C. W. 1917. Some effects of environment on the Fuegian tribes. *Geographical Review* 3:1-15.
- Green, R. H. 1974. Mammals. In Williams, W. D. (Ed), 1974:367-396.
- Hiatt, B. 1967-1968. The food quest and the economy of the Tasmanian Aborigines. *Oceania* 38:99-133, 190-219.
- Higham, C. F. W. 1976. The economic basis of the Foveaux Straits Maori in prehistory. In Sieveking, G. de G., Longworth, I. H. and Wilson, K. W. (Eds), *Problems in Economic and Social Archaeology*: 221-233. Duckworth, London.
- Horton, D. R. 1979. Tasmanian adaptation. *Mankind* 12:28-34.
- Itoh, S. 1980. Physiology of circumpolar people. In Milan, F. A. (Ed), 1980:285-304.
- Jones, R. 1971. Rocky Cape and the problem of the Tasmanians. Unpublished PhD dissertation, University of Sydney.
- Jones, R. 1976. Tasmania: aquatic machines and offshore islands. In Sieveking, G. de G., Longworth, I. H. and Wilson, K. E. (Eds), *Problems in Economic and Social Archaeology*: 235-264. Duckworth, London.
- Jones, R. 1977. Man as an element of a continental fauna: the case of the sundering of the Bassian bridge. In Allen, J., Golson, J. and Jones, R. (Eds), *Sunda and Sahul: prehistoric studies in S.E. Asia, Melanesia and Australia*: 317-386. Academic Press, London.
- Jones, R. 1978. Why did the Tasmanians stop eating fish? In Gould, R. A. (Ed), *Explorations in Ethnoarchaeology*: 11-47. University of New Mexico Press, Albuquerque.
- Kasper, H., Schönborn, J. and Rabast, U. 1975. Behaviour of body weight under a low carbohydrate, high fat diet. *American Journal of Clinical Nutrition* 28:800-801.
- Kendrew, W. G. 1937. *The Climates of the Continents*. Oxford University Press.
- King, J. E. 1964. *Seals of the World*. British Museum (Natural History), London.
- Knox, G. A. 1975. The marine benthic ecology and biogeography. In Kuschel, G. (Ed), *Biogeography and Ecology in New Zealand* 353-403. Junk, The Hague.
- Leach, H. M. 1969. Subsistence Patterns in Prehistoric New Zealand. *Studies in Prehistoric Anthropology* 2. Anthropology Department, University of Otago.
- Linacre, E. and Hobbs, J. 1977. *The Australian Climatic Environment*. Wiley, Brisbane.
- Loewenstein, Prince J. 1958. The 'Eskimo Ulu' in the Malayan Neolithic. *Man* 38:37-41.
- Lothrop, S. K. 1932. Aboriginal navigation off the west coast of South America. *Journal of the Royal Anthropological Institute* 32:229-256.

- Loten, D. Senior lecturer, Clinical Biochemistry, Otago University Medical School.
- McCartney, A. P. 1975. Maritime adaptations in cold archipelagoes: an analysis of environment and culture in the Aleutian and other island chains. In Fitzhugh, W. (Ed), *Prehistoric Maritime Adaptations of the Circumpolar Zone*: 281–338. Mouton, The Hague.
- McCoy, P. Visiting lecturer, University of Otago.
- McLintock, A. H. 1960. *A Descriptive Atlas of New Zealand*. Government Printer, Wellington.
- Merton, D. V. 1970. Kermadec Islands expedition reports: a general account of the birdlife. *Notornis* 17:147–199.
- Milan, F. A. 1980. *The Human Biology of Circumpolar Populations*. International Biology Programme, 21. Cambridge University Press.
- Morton, E. K. 1957. *Crusoes of Sunday Island*. G. Bell, London.
- Murison, W. D. 1871. Notes on moa remains. *Transactions of the New Zealand Institute* 4:120–124.
- Newman, M. T. 1962. Ecology and nutritional stress in man. *American Anthropologist* 64:22–34.
- Osborne, A. J. 1977. Strandloopers, mermaids and other fairy tales: ecological determinants of marine resource utilization – the Peruvian case. In Binford, L. R. (Ed), *For Theory Building in Archaeology*: 157–205. Academic Press, New York.
- Pine, R. H., Angle, J. P. and Bridge, D. 1978. Mammals from the sea, mainland and islands at the southern tip of South America. *Mammalia* 42:105–114.
- Richdale, L. E. 1948. *Maori and Muttonbird*. Otago Daily Times and Witness, Dunedin.
- Robinson, C. H. 1968. *Fundamentals of Normal Nutrition*. MacMillan, New York.
- Rodahl, K. 1967. Changes in Eskimo nutrition by imported foods. In Cremer, H. D. (Ed), *Proceedings of the Seventh International Congress of Nutrition, Hamburg 1966*: 127–128, Pergamon Press, Oxford.
- Scheffer, V. B. 1958. *Seals, Sea Lions and Walruses: a review of the Pinnepedia*. Stanford University Press, California.
- Shand, A. 1895. The Moriori People of the Chatham Islands: their traditions and history. *Journal of the Polynesian Society* 3:76–92.
- Shawcross, W. 1972. Energy and ecology: thermodynamic models in archaeology. In Clark, D. L. (Ed), *Models in Archaeology*: 577–622. Methuen, London.
- Simmons, D. R. 1962. The Moriori of the Chatham Islands. *New Zealand Archaeological Association Newsletter* 5:238–244.
- Sinclair, H. M. 1953. The diet of Canadian Indians and Eskimos. *Proceedings of the Nutrition Society* 12:69–82.
- Skinner, H. D. 1923. The Morioris of Chatham Islands. *Memoirs of the Bernice P. Bishop Museum* 9(1).
- Skinner, H. D. 1974. *Comparatively Speaking: Studies in Pacific Material Culture 1921–1972*. University of Otago Press, Dunedin.
- Skinner, H. D. and Baucke, W. 1928. The Morioris. *Memoirs of the Bernice P. Bishop Museum* 9(5).
- Smith, I. W. G. 1978. Seasonal sea mammal exploitation and butchering patterns in an Archaic site (Tairua N44/2) on the Coromandel Peninsula. *Records of the Auckland Institute and Museum* 15:17–26.
- Steward, J. H. 1946. The Marginal Tribes. *Handbook of South American Indians* 1. Smithsonian Institution, Washington.

- Steward, J. H. 1949. The Comparative Ethnology of South American Indians. *Handbook of South American Indians* 5. Smithsonian Institution, Washington.
- Steward, J. H. and Faron, L. C. 1959. *Native Peoples of South America*. McGraw-Hill, New York.
- Stuart, D. E. 1977. Seasonal phases in Ona subsistence, territorial distribution and organisation: implications for the archaeological record. In Binford, L. R. (Ed), *For Theory Building in Archaeology*: 251-283. Academic Press, New York.
- Sutton, D. G. 1979. Polynesian coastal hunters in the Subantarctic Zone: a case for the recognition of convergent cultural adaptation. Unpublished PhD dissertation, University of Otago.
- Sutton, D. G. and Marshall, Y. M. 1980. Coastal hunting in the Subantarctic Zone. *New Zealand Journal of Archaeology* 2:25-49.
- Taylor, R. 1870. *Te Ika a Maui or New Zealand and its Inhabitants*. Wertheim and MacIntosh, London.
- Trewartha, G. T. 1954. *An Introduction to Climate*. McGraw, New York.
- Tuller, S. E. 1977. Summer and winter patterns of human climate in New Zealand. *New Zealand Geographer* 33:4-14.
- Williams, W. D. 1974. *Biogeography and Ecology in Tasmania*. Junk, The Hague.

*Received 11 September 1980*