

THE PACIFIC AREA

THE Pacific Ocean, which extends nine thousand miles east and west at the equator and eight thousand miles north and south from Alaska to Antarctica, is the world's largest body of water. Its area is greater than that of all the continents, or about one-third the surface of the globe. It is the ocean with the greatest depths, the steepest sides, the longest currents, the greatest volcanic activity. It has many other interesting oceanographical features but we are concerned primarily with its islands, of which there are more than thirty thousand—or many times the number in all the other oceans combined—for they provide the homelands for human occupation. These islands are not equally distributed throughout this vast expanse of water. The majority, including the continent of Australia and the very large islands, are found in the western third of the Pacific. Most of the remainder, generally in clusters or chains, fall within the central third, whereas virtually none is present in the eastern or American third. With the important exceptions of Tasmania and the southern portions of New Zealand and Australia, and the Aleutian and Japanese islands which lie outside the bounds of our area of interest, all the Pacific islands are confined to tropical latitudes.

This island world is traditionally divided into five major areas, on the basis of the cultural differences prevailing in the sixteenth century when Europeans first visited the region to "discover" islands already settled for periods varying from a few hundred years in the eastern Pacific to possibly three-quarters of a million years in Java. These grand divisions are: Australia, Melanesia, Polynesia, Micronesia and Malaysia (See map, p. 6).

The Australian area includes the island of Tasmania as a sub-area.

Melanesia, named after the dark complexion of its inhabitants, extends from western New Guinea to Fiji and includes New Britain, New Ireland, the Admiralties, the Solomons, the Santa Cruz and Banks Islands, the New Hebrides, the Loyalty Islands and New Caledonia. In many respects Fiji is associated with Polynesia.

The Polynesian area is generally defined as a vast triangle delimited

by the Hawaiian Islands on the north, Easter Island on the east and New Zealand on the southwest. Within this triangle are Samoa, Tonga, the Society Islands, the Cook Islands, the Australs, the Marquesas and many smaller groups and isolated single islands. Fiji belongs in part to this area.

Micronesia extends east and west from the Pelew (Palau) Islands to the Ellice Islands and includes the Marianas, the extensive Carolines, the Marshall Islands, the Gilbert Islands and a few isolated islands such as Nauru. The vast majority of these islands are tiny, hence the name Micronesia.

Indonesia includes all the islands of the East Indies, Sumatra, Java, Borneo, Celebes, the Sunda Islands to Timor, the Halmaheras, Ceram and many small islands to the west of New Guinea, the Philippines, Formosa, the Malay Peninsula and the Andaman Islands. Western Indonesia from Sumatra and Java to the Philippines is generally known as Malaysia.

The boundaries of culture areas are fluid, for they may change over the course of time as the content of culture changes. Thus they have no fixed relationship to natural phenomena and do not correspond to divisions of the region as determined by the various natural sciences.

It is unnecessary for our purposes to discuss in detail the geology, geography or climate of the islands. The East Indies, New Guinea, New Britain and New Ireland are similar in geological structure to Asia and Australia, and millions of years ago, before the advent of the placental mammals, were joined in a single land mass. All the remaining or oceanic islands originated independently of the continents and are of two types: volcanic islands and coral islands. The former generally are mountainous and, compared to the latter, relatively large, whereas the coral islands are tiny and low, with elevations which seldom exceed twenty feet above sea level. There are few coral islands in the southwestern area, but they are numerous in the central Pacific and, with a few important exceptions, typical of the Micronesian chain. Coral islands usually are based upon an underwater volcanic structure which extends to within two hundred feet of sea level. If attached to a submerged mountain range they may form a chain of long narrow islands. If the foundation is more extensive they may follow the circumference, as at Bikini, and form a rough circle or atoll.

Of far greater significance to man than the differences in structure

of volcanic and coral islands are the effects of these differences. The two may lie in the same latitude, be washed by the same currents and mark the path of the same winds, but their dissimilar fundamental characters, combined with other natural phenomena, have produced very divergent conditions for the accommodation of living matter. The high islands extract abundant rainfall from the passing clouds and issue it in streams and springs to nourish a varied plant life rooted in rich volcanic soil. In the low islands the rainfall is much more uneven and in some coral islands fresh water is unavailable except as collected rainwater. As a result, the flora is limited to the few species of plants which live in sand and subsist on brackish nourishment.

It is one matter for the volcanic islands to provide the conditions suited to a varied flora and quite another to acquire the plants. Wild plants migrate relatively easily on the great land masses but in an oceanic area only those with special characteristics can cross the great distances of sea. Although an interesting indigenous flora is found in many high oceanic islands, particularly above the 1,200-foot line, a large proportion of the plants along the coasts and in the mountain valleys are those with seeds which are either lightweight and readily wind-carried, eaten by birds and deposited by them over great distances, or floated by ocean currents from one island to another.

The characteristics of the flora of the Pacific thus vary not only in terms of distance from Asia and Australia—the greater the distance the fewer the number of related species—but also in terms of high islands versus low islands. This situation is of particular importance in respect to wild plants valuable to man as food, whether in their seeds, fruit, stems, leaves or roots; for such sources of diet are relatively abundant in the East Indies, less common in the New Guinea area and Australia, scarce in the volcanic islands of the central Pacific and virtually lacking in the coral islands. Of all the cultivated food plants in the world, none has been developed from the indigenous flora of areas to the east of Malaysia.

A similar progression from west to east is to be noted in respect to fauna. The western islands of the East Indies harbor the typically continental animals of southeastern Asia, including the higher mammals, whereas from Bali and Celebes eastward to New Ireland, Australia and Tasmania, only marsupials and a few other primitive forms are found. In the remainder of Oceania are only rats and mice, presumably intro-

duced by human agency. Crocodiles and poisonous snakes are lacking in general east of the New Guinea area, although a few harmless snakes are present as far as Samoa. The number of species of lizards and birds likewise diminishes from west to east. Fish, on the other hand, abound in the sea and rivers everywhere, and various crustaceans usually are plentiful.

Thus, if we divide the Pacific Islands into sub-areas on the basis of natural phenomena, a varying number of divisions can be delimited, depending on the criteria selected. A classification based on land mammals sets off the western East Indies as the area of placental animals, the remainder of the East Indies and the islands eastward to New Ireland, Australia and Tasmania as the area of marsupials; whereas central, eastern and southeastern Melanesia, Polynesia and Micronesia constitute a gameless area. From the viewpoint of flora, various lines of demarcation can be drawn depending on the basis for grouping or counting genera. Geologically, the islands associated with the continents comprise a region distinct from that of the oceanic islands and several sub-divisions can be made for each. Finally, on a geographical basis, we can distinguish an area of closely spaced islands which as a group are separated from the oceanic islands by a broad strait, almost two hundred miles in width at its narrowest point, which can be conveniently called "The Pacific Moat". This moat passes between Japan and the Marianas in the north; between the Pelews and the Carolines, and in a somewhat narrower form between Morotai and the Pelews, on the west; between San Cristoval, the southernmost island of the Solomons, and the Santa Cruz Islands, on the east; and finally, as the broad Tasman Sea, between Australia and New Zealand, on the southeast. By selecting the proper but often circuitous route almost all the significant islands to the west of this moat—from the Malay Peninsula to San Cristoval in the Solomons, and from the Philippines to Tasmania—can be reached without crossing water barriers more than about thirty-five miles wide and usually less than twenty miles wide. Exceptions are three wider gaps, none of which exceeds sixty miles: in the Moluccas, at Torres Strait between New Guinea and Australia, and at Bass Strait between Australia and Tasmania. These distances exist at present sea level, but during the last Glacial Period were considerably less and in some cases even eliminated by the drop in water level, variously estimated to have been as much as four hundred feet. A drop of only one hundred and fifty feet

would have provided Bass Strait with a chain of islands; Australia and New Guinea would have been connected by an isthmus ninety feet in altitude; and many of the islands in the East Indies would have been joined or their areas so enlarged that the gaps between them would have been considerably reduced. In addition, various submerged reefs and shoals would have been exposed to become islands or landmarks visible for great distances. On the other hand, it is important to note that the straits between many of the islands in the East Indies would not have been lessened during any of the Glacial Periods, for some of them are several thousand feet deep, although the distances across may be only a few miles. Nevertheless, it seems clear that during periods of lower sea levels the problems of migration for primitive man involved not only fewer but lesser difficulties than at the present time.

Although negotiating a distance of twenty or forty or sixty miles between islands not visible one from another may not seem a difficult task in the light of modern knowledge, we should not assume that prehistoric hunters with only simple floats and rafts would voluntarily have put to sea far enough to sight distant islands, nor that curiosity necessarily would have impelled them to attempt the crossing of dangerous straits merely because land was visible. For example, the hunting Tasmanians in good weather floated their rafts across eight miles of sea to the Hunter Islands; but the Australians of the southern and southwestern coastal areas, with only swimming logs, have shown no interest in reaching Rottnest Island, eleven miles from Fremantle, or Kangaroo Island, ten miles from Cape Jervis. Kangaroo Island, it should be noted, was occupied at one time, possibly when it was connected with the mainland during a period of lower sea level. That a mere log can, under favorable conditions, be sufficient equipment for visiting islands several miles at sea is demonstrated on the northwestern coast of Australia where the tides provide the currents for the round trip.

In decided contrast to the situation in the area of closely spaced islands is that in the islands to the east of the Pacific Moat. Not only are they as a whole separated from the western islands by a minimum gap of two hundred miles, but in many cases they also are isolated from each other by distances of several hundred miles. This isolation would not have been reduced during the Glacial Age, for a drop in sea level of many hundred feet would not have narrowed the Pacific Moat nor changed to any noticeable extent the tremendous distances between the

great groups of islands. This entire oceanic world, far beyond the horizon of early man, remained unknown and out of reach until the perfection of the art of off-shore navigation.

The history of watercraft in southeastern Asia and the East Indies is imperfectly known, but there are no reasons for believing that substantial craft capable of ocean voyaging were present there prior to their appearance in other parts of the ancient world. The Egyptians used sturdy craft possibly early in the third millennium B.C., and it may be that a similar situation prevailed at about the same time all along the southern coast of Asia and in the adjacent islands of the East Indies. We may presume that in prehistoric times as today, the conditions in the eastern East Indies and New Guinea were progressively more primitive than in the westernmost islands and that considerable time elapsed before cultural introductions from Asia to Sumatra diffused to eastern New Guinea. Hence if sturdy craft such as outrigger canoes began to be used in Malaysia as early as the third millennium B.C., they may not have reached New Guinea until very much later, in spite of very receptive natural conditions throughout the area of closely spaced islands. The geographical factors are exceedingly favorable for the use of watercraft all the way to the northern and eastern coasts of Australia and Tasmania; yet it is important to note that it has been less than two centuries since the dugout was introduced by Timorese into North Australia, where it was adopted eagerly and spread subsequently for hundreds of miles to the west, and only slightly longer since outrigger canoes reached Cape York, whence they have spread southward. These considerations and the situation along parts of the southern coast of New Guinea, where the most advanced types of craft of the northern coast are still lacking, suggest that even coastwise sailing is not an ancient practice in this region. That southern New Guinea has been by-passed by many cultural influences seems clear, and although this consideration in itself cannot be used to infer a relative recency of watercraft along the northern coast of the island, it does not support a contention that an antiquity of several millenia is involved.

The possession of staunch watercraft, however, is only one factor in the problem of reaching distant islands, except by accident. Of equal importance are the concept and techniques of navigating long distances between landfalls. Such developments imply not only a long experience in the art of building sturdy craft, and in handling them in rough waters

and storms, but also the accumulation and organization of an extensive knowledge of astronomy, of prevailing winds and currents and of their local and seasonal variations over wide areas, before distant exploration can be attempted and a successful return home logically anticipated. It is important to note that experienced Egyptian and Phoenician sailors, and Europeans until the time of the Norsemen, seldom sailed their craft far from land but followed the coasts on their distant journeys. That similar practices prevailed in the Indian Ocean is indicated by the migration of the Malayo-Polynesian speaking peoples who left the East Indies and settled Madagascar, off the coast of Africa, by following the coastlines of southern Asia and eastern Africa to reach the western, rather than the eastern, side of the island. It was not until late in the first millennium B.C. that more daring voyages were made in the Indian Ocean, and not until the Christian Era, as a result of the discovery of the monsoons, that direct voyaging between southern Arabia and Bombay became common. In the Far East, the southern Chinese seem to have sailed close to shore until about the beginning of the Christian Era, and the northern Chinese continued this tradition until several centuries later.

We have no basis for an assumption that conditions in the East Indies were ever more advanced than those on the continent. The proximity of Sumatra and the Malay Peninsula on the sea route between southern and eastern Asia indicates that developments in one would soon diffuse to the other. It therefore seems warranted to assume that coastwise sailing and short inter-island voyaging in the East Indies did not change to ocean voyaging across wide expanses of sea until late in the first millennium B.C., the approximate time such a development was taking place in other regions along the Asiatic coast. Indeed, the tradition of shoreline sailing continues to prevail throughout most of the area of closely spaced islands even today.

It thus appears that although human movements and migrations in the Pacific regions have always had to overcome water barriers, the specific problems have varied from place to place and from time to time, depending on man's cultural attainments. When the Pacific Moat was first crossed, possibly not long before the beginning of the Christian Era, there vanished the last barrier to the islands of Micronesia, Polynesia and eastern Melanesia, and with it a frontier along which man had lived for thousands of years without knowing of lands beyond. The importance

of this gap is apparent because of its greatness. It is more difficult to realize that other much smaller gaps may likewise have served to delay man's eastward expansion for great periods of time. Some day archaeology should be able to indicate which of the various prehistoric peoples and cultures reached, but, for one reason or other, did not pass, respectively: Wallace's Line east of Bali, the Molucca sea, the strait between New Ireland and the Solomons, and, in several localities, the Pacific Moat. To early prehistoric man such breaks in the close continuity of islands may have constituted insuperable obstacles in much the same manner that Bass Strait has barred the Australians of the proto-historic period from reaching Tasmania.

Since the geology, geography, fauna and flora of all the Pacific areas were essentially the same in the Pleistocene Period as they are today, the problems of early human occupation can be visualized in terms of the natural conditions now prevailing. Landsmen who lacked swimming logs or rafts and were unable or unwilling to swim straits of shark-infested waters could have walked to Sumatra, Java and Bali during various periods when the ocean level was one hundred feet lower than at present, but could not have passed the Bali-Lombok Strait.

Raftsmen could have proceeded along the Sunda Chain to Flores and Timor without crossing straits wider than twelve miles at present sea level, and from Flores to Celebes and the western Moluccas without negotiating more than twenty-five miles of open but protected sea between any two islands. Possibly a long halt was required at the Molucca Sea, if we may judge by the present minimum width of about sixty miles separating the western and southern islands from those to the east; but once the latter islands were reached there would have been no important obstacles to the occupation of all of New Guinea, New Ireland and New Britain. New Ireland, separated from Bougainville in the Solomons by a permanent strait, may have served as another frontier point until a few millennia ago, for although the greatest distance of water to be crossed is only about thirty-five miles, via Feni, Nissan and Buka Islands, the straits are rough, deep and unprotected. From Bougainville raftsmen would have little trouble in reaching the remainder of the Solomons to San Cristoval on the edge of the Pacific Moat.

Possessors of more efficient watercraft, such as dugouts or outrigger canoes, who conceived of seafaring in terms of coastwise movements or inter-island voyages between visible landmarks, would be limited to the

same general region as the raftsmen. It is quite possible that they overtook the raftsmen at certain points such as New Ireland, and in relatively late times pioneered the occupation of the Solomon Islands.

Only experienced navigators with sturdy craft could have crossed the Pacific Moat to reach the Carolines, Santa Cruz, New Caledonia, Fiji, New Zealand, Hawaii and all the great groups of islands in Polynesia.

There are, however, other factors which served as major limiting agents in the migrations of both early and late prehistoric peoples. Regardless of their means of traversing water barriers, primitive hunting and wild food collecting peoples would have remained in an environment satisfactory to their traditional activities only as far as New Ireland, Australia and Tasmania, for in the Solomon Islands and southern and eastern Melanesia, and in Micronesia and Polynesia, there would have been no game to hunt and virtually no edible wild plants to collect.

Fishermen, provided they were properly equipped, would have had no difficulty in making a living anywhere in the Pacific. But in most of the islands fishing requires not only a complexity of special equipment but also the mobility provided by good watercraft for the exploitation of the principal sources of fish in the great banks, often far from land. Since the most primitive hunters, such as the Tasmanians and early Australians, lacked nets, bows and arrows, fish-hooks and proper craft for putting to sea, it seems likely that they would have had great difficulty in maintaining even a sparse population in the volcanic islands east of New Ireland, and might have starved to death in some of the coral islands. The Tasmanians, futhermore, did not fish. The southwestern Australians, for lack of watercraft, nets and hooks, still confine their fishing activities primarily to spearing in the shallow rivers and along the shoreline. Since the only peoples who could have reached the oceanic islands were navigators in good watercraft, it can be presumed that they already had developed the art of offshore fishing in the closely spaced islands where they had been sustained by hunting and in later times by horticulture.

Horticulturalists who migrated east of the East Indies would have found fairly suitable conditions everywhere, including Australia and Tasmania, which they had not yet reached at the beginning of the historic period, although in some of the coral islands gardening would have been limited to certain plants. But it would have been necessary for horticulturalists to have brought their plants with them, or subse-

METHOD OF MIGRATION REQUIRED	ACCESSIBILITY	AREA	NATURAL FOOD RESOURCES	TYPE OF ECONOMY POSSIBLE
GOOD WATERCRAFT AND CONCEPT OF OCEAN NAVIGATION	AREA, CLOSELY SPACED ISLANDS	WESTERN EAST INDIES (to Bali)	Abundant animals and birds. Numerous edible wild plants. Abundant fish.	HUNTING AND WILD FOOD COLLECTING
		CENTRAL EAST INDIES Wallace's Line Molucca Passage EASTERN EAST INDIES NEW GUINEA Torres Strait NEW BRITAIN AUSTRALIA Bass Strait NEW IRELAND TASMANIA SOLOMON ISLANDS	Abundant animals and birds. Less numerous edible wild plants. Abundant fish along coasts and in rivers.	
PACIFIC MOAT				
SIMPLE OR GOOD WATERCRAFT SAILED CLOSE TO LAND RAFTS	Within easy reach of prehistoric man at all times.	Localized difficulties for primitive raftsmen at present sea level, but more easily reached during periods of lower sea level, such as during Glacial Periods.	No animals. Few birds. Very few edible wild plants. Abundant fish in sea.	FISHING, HORTICULTURE AND DOMESTICATED ANIMALS
GOOD WATERCRAFT AND CONCEPT OF OCEAN NAVIGATION	OCEANIC AREA OF GREAT DISTANCES	HAWAII MARIANAS CAROLINES PELEW MARSHALLS ELLICE IS. SOCIETY ISLANDS SAMOA TONGA MARQUESAS FIJI EASTER ISLAND NEW ZEALAND NEW HEBRIDES SANTA CRUZ IS. NEW CALEDONIA	No animals. Few birds. Very few edible wild plants. Abundant fish in sea.	FISHING, HORTICULTURE AND DOMESTICATED ANIMALS

quently to have secured them from the west, for the flora in all areas east of the East Indies is unsuitable for cultivation.

Similarly, peoples with domesticated animals, such as pigs and chickens, would have had to bring them from the west. Although natural conditions were receptive in all parts of the Pacific, except for some coral islands, pigs and chickens were never introduced into Australia and Tasmania nor the dog into Tasmania. On most of the islands in Micronesia and some in Polynesia, one or another of these animals is lacking.

We might note in passing that the most recent migrants into the Pacific regions, the Europeans, have been subjected to the same general restrictions as their predecessors. Australia and Tasmania have become great centers for agriculture and domesticated animals. Mining is now important in Australia, New Guinea, the East Indies and some of the other islands. But in all cases the plants, animals and techniques have been brought in from other parts of the world.

That the environmental features of the Pacific regions have not defined the basic economic activities of the historic cultures found there is clear. There have been many local adjustments, but these have been confined to minor improvements within each basic cultural context. The natural conditions have not been altered in hundreds of thousands of years, but man's activities within each area have changed from time to time as new cultural developments have been introduced by diffusion or migrations from other regions. As elsewhere in the world, environmental factors have served principally as limiting agents, not as the determinants of culture.

The accessibility of the various areas and the methods of migration required to reach them are shown in the chart on page 16. The kinds of natural food resources and the types of economy possible also are indicated. This chart should be used with the map on page 6.

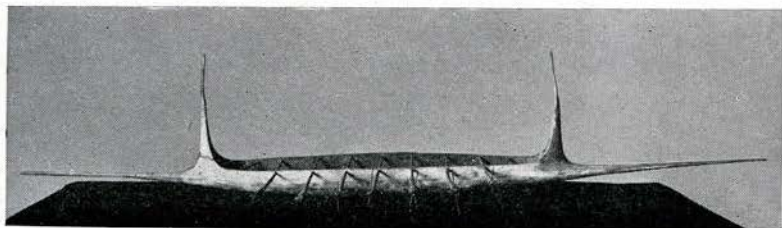


Fig. 2. Outrigger canoe model, Aua Island. (length 6' 8 $\frac{3}{4}$ ")