

## G. Peopling of the Pacific in the Light of Radiocarbon Dating

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### INTRODUCTION

These comments are an attempt to evaluate the radiocarbon dates from the Pacific, and their significance in constructing a chronological framework for the migrations into this wide expanse of ocean. This is a slightly revised version of the paper read at the Tenth Pacific Science Congress in Honolulu, August 1961.

A disadvantage in assessing the value of the radiocarbon dates is the lack of published reports for the more recent work in Polynesia which would give the detailed information of the archæological context. My remarks are based upon the information I have been able to obtain.

I would liked to have applied a more rigorous set of criteria in evaluating the radiocarbon dates, both as to the provenance of the samples dated, and their archæological significance; but in most instances lack of detailed information has prevented this. Whether or not there are single or multiple dates from a site is very important. Multiple dates make possible the checking of internal consistency. Internal consistency is an important consideration in evaluating radiocarbon dates, as this factor may give hints as to whether or not a sample, or series of samples is contaminated or not. This is one important reason it is desirable to have multiple dates from a site, and preferably from the same profile. In discussing these factors, I am approaching the problems from the point of view of what should be done in the way of collecting samples, number of samples, and so forth, fully aware that this 'ideal' situation is never realized. The criteria I mentioned are based upon the kind of material dated, provenance (i.e. archæological context), and the event or period of time the sample is supposed to date.

### THE RADIOCARBON METHOD

Radiocarbon is produced by cosmic rays which bombard the upper atmosphere of the earth, producing neutrons. These neutrons combine with nitrogen atoms to produce hydrogen and carbon-14. There is carbon with atomic weights of 12 and 13, but radiocarbon has an atomic weight of 14. Vegetation absorbs carbon dioxide containing carbon-14 from the air, and animals obtain radioactive carbon by eating the plants or other animals which are plant eaters. When a plant or animal dies, its supply of carbon-14 is not renewed but gradually disintegrates. The amount of radiocarbon left in the remains of plants or animals may be measured by very sensitive electronic equipment, after the conversion of the sample to a gas, usually CO<sub>2</sub>, by a chemical process. All radioactive material has a half-life; the half-life of carbon-14 is approximately 5,568 years. After an organism has been

dead for this amount of time, its rate of radiation will be half of the living organism, after 11,136 it will be one-fourth, and after 16,705 years one-eighth.

All finite radiocarbon dates are reported with a plus and minus  $\pm$  value. This value is expressed in years, and is calculated from the standard deviation of the counting data, and represents the standard error. Actually the error is not symmetrical, but since it is most properly used as an index of precision, the procedure is satisfactory. This standard error is supposed to reflect the statistical uncertainty, background fluctuations, and variations in efficiency. Some radiocarbon laboratories raise the plus and minus value so that the standard deviation figures are larger than the purely statistical error. This is done to account better for such factors as general consistency of the calibration runs, consistency within the individual runs, and so forth, which are not reflected in the standard deviation. Many archæologists use this value to assess multiple dates from the same level or feature, assuming that if the dates fall within the plus and minus figure that they are internally consistent. This is an improper application of the technique. The plus and minus factor is generally expressed as one sigma, therefore, statistically, the actual date in years will only fall within the plus and minus value two out of three times. Thus, to assume that because dates fall within the plus and minus figure of each other that they are correct, is an unwarranted assumption.

#### PROBLEMS OF RADIOCARBON DATING IN THE TROPICS

Tropical soils are important in radiocarbon sampling. The typical soil of the tropics and subtropics is the laterite or lateritic type of soil formation.

The reactions associated with the genesis of soils in the humid tropics and subtropics are summarized as follows: *i.* Rapid disintegration and decomposition of the parent rock in the direction of the end-products of weathering. *ii.* Release and removal of  $\text{SiO}_2$ . *iii.* Separation of sesquioxides and their fixation in the profile. *iv.* Decomposition and loss of organic matter, notwithstanding the luxuriant vegetation. *v.* Distinctive red colour of the soil. There are of course types and subtypes of laterites, and in the Pacific there are other types of soils when there are great elevation differences, such as in Hawaii and New Zealand. In radiocarbon sampling, a portion of the matrix surrounding the sample should also be taken for analysis. Analysis of the matrix may provide a clue as to the contamination of a sample.

Tropical soils by nature of their position are subjected to heavy and continuous leaching, thereby providing excellent conditions for the contamination of samples. Radiocarbon dates from dry deposits have, on the whole, proved to be more reliable than those from wet conditions. The matrix of the sample is of particular concern when dealing with tropical environments. Dry caves and rock-shelters should be searched for, as they offer the best prospects for uncontaminated samples. New Zealand, not being in the tropics, seems to have less trouble with the soil problems, as multiple dates from a number of sites exhibit good internal consistency by a close clustering of dates for samples run from the same level or feature, but found on different material.

## RADIOCARBON DATES FOR THE PACIFIC AREA

Of the 131 radiocarbon dates reported from the Pacific, 89 are from Polynesia, 15 from Melanesia, 8 from Micronesia, 11 from the Philippines and Southeast Asia, and 8 from Australia. Although there are 89 dates from Polynesia, 38 of these are from New Zealand, and 18 from Hawaii, the rest being scattered among the Marquesas, Samoa and Easter Islands, and there are only a few single dates from smaller islands, giving a disproportionate distribution of dates over this large area.

As it would be impossible to discuss each radiocarbon date, I need confine my remarks to commenting on whether or not there are multiple dates for sites, and on the dates pertinent to our main consideration as to when did people arrive at a certain island.

We have two early dates of 1174 B.C., and 994 B.C. from Hoifung in South China (Beyer 1956: note p. 86). The 1174 B.C. date is based upon shell, and is associated with adzes ancestral to the rectangular type and 'net' decoration on pottery. The 994 B.C. date on charcoal, purports to date the end of the Neolithic, and is associated with 'glaze pottery', and dark stoneware. As detailed information on their provenance is lacking, I cannot critically evaluate these dates. The material culture dated is potentially ancestral to the later Oceanic artifact types.

Of four dates from different sites in the Philippines, one on charcoal of 754 B.C. from a dry cave on Masbate Island apparently is late Neolithic. In the future we hope for earlier dates, more exactly placing in time the earlier Neolithic cultures of the Philippines. The lack of multiple dates from any one site prevents the checking of internal consistency, but the archaeological evidence tends to support this date for the late Neolithic.

Moving to Micronesia, seven charcoal dates are reported by Gifford from Yap. Three of these are from the same site, Pemrang. These three dates of A.D. 1706 for the 18-24 inch level, A.D. 1856 for the 24-30 inch level, and A.D. 176 for the 48-72 inch level are not internally consistent. A possible explanation for this is that the sample with the A.D. 1856 date was collected from four different rectangles. Although the levels were all the same depth below the present surface, the report does not state that this was the case where the material was deposited; this may account for the discrepancy. The A.D. 176 sample was collected from four different levels. While it is consistent with the stratigraphy, this is bad methodology, and could be misleading. Should there be a typological change within the 24 inches represented by this sample, there would be no way of knowing which period had been dated. Lumping material from different rectangles of the same level, and from different levels for dating should be avoided at all costs.

Two other islands in Micronesia have single radiocarbon dates. A date of 1527 B.C. on oyster shell from a depth of  $1\frac{1}{2}$  ft. from the Cholan Piao site on Saipan is the earliest date for Micronesia. Uncalcinated shell is poor dating material as it is susceptible to contamination. However the geological evidence, according to Spoehr, tends to support the date. In evaluating radiocarbon dates, the supporting evidence particularly of geology and stratigraphy is of utmost importance.

The other date of A.D. 845 on a *Tridacna* shell, from a depth of  $1\frac{3}{4}$  ft. from the Blue I site on Tinian dates the *latte* structure and appears to be good.

Turning to the south, from the Niah Caves in Sarawak, we have three very important dates, internally consistent. They are 17,570 B.C., for the 42 inch level, 30,673 B.C. for the 72 inch level, and 39,543 B.C., for the 100 inch level. These dates indicate an early occupation of the area by man, but are too early to have a direct bearing on the time of migration into Melanesia, unless an early occupation of Papua in New Guinea is eventually defined.

For Melanesia, Gifford obtained six radiocarbon dates from Viti Levu. Two from Site 26 are from charcoal, and internally consistent. The other four are from Site 17, two from Location A, and two from Location B, all are internally consistent. The important Fiji date in determining the time of arrival of the first inhabitants, is 46 B.C., from Site 17, Location A, 104-110 inches deep. These dates, multiple from each site, and internally consistent, are an example of the proper application of radiocarbon method; we have every reason to feel confident of these dates.

We obtained nine dates from our New Caledonia excavations. Five of them are single dates from separate sites. Of the other four, two from Site 26, are consistent. The two early dates from Site 13 are reversed. The site was a yam field, with ridges and depressions, which I believe accounts for the reversed order. The date of 847 B.C. is significant in defining the time of the first arrivals in New Caledonia. Although we collected several hundred charcoal samples, most were too small to date, which is why we do not have multiple dates for more of the sites.

Moving to Polynesia, there are four reported dates from Samoa, three are from the same site. The earliest date for Samoa, A.D. 9, is included in the three from the village near Vailele, west of Apia. The association of these dates with the culture, other than pottery is not clear, so it is difficult to evaluate them. But the closeness of the dates, A.D. 79, 109, and 9, suggest the occupation of Samoa by the beginning of the Christian era.

The number of dates from New Zealand reflect the amount of archæological research being carried on there. The number and clustering of the dates from the same sites is encouraging, and this we should strive to get from all sites. The radiocarbon evidence indicates occupation of New Zealand by A.D. 1000. Numerically, only New Zealand has produced enough radiocarbon dates, and on different materials that correlate, such as shell and charcoal, to be able to define with a degree of assurance any archæological period, this being the Maori Mōa-hunter culture period, beginning about A.D. 1000 and continuing into the classic Maori culture of historic time.

Dates of A.D. 1778 and 1338 from Raivavæ and Rapa Island, with no associations available, provide little information as to archæology, other than that people were already there.

Ten dates from the Marquesas present the problem of interpreting dates from features in close association within the site, but not in direct stratigraphic sequence. A series of four dates from Haatuatua, in essential agreement, includes the earliest date for the Marquesas of 122 B.C.

The 18 dates from the Hawaiian Islands give no opportunity to test internal consistency, because the only multiple dates from a site are considered to be contaminated. These are from the South Point site on Hawaii. The early date for Hawaii, A.D. 124, from this same site, was treated for contamination, and if the

association is correct, it is a significant date. There is no explanation given as to why the other samples were not treated for contamination.

For Easter Island we have an early date of A.D. 400. However, this date was obtained on Totora seeds which seem to be rather unstable in regard to dates obtained from them, as other dates on these seeds have been erratic, and the associations are unclear; I must therefore consider this date as unsatisfactory, even though it is not out of line with the evidence for the time of occupation of the island, on the hypothesis that the migration came from the Marquesas.

For the rest of the Pacific, significant results from radiocarbon dates is progressing at a constantly increasing rate. Dates from the various islands and the mainland of South China though useful, are by no means numerous enough to define the cultural development on individual islands, let alone the detailed time table for the peopling of the Pacific. Pacific prehistory should progress by developing the cultural history of each island, with enough radiocarbon dates from each site to establish the cultural chronology. By building a firm foundation as more and more islands divulge their archæological secrets, we shall gradually fill in the pieces of this large puzzle. Hopping from island to island, picking up a date here and there, would only serve to confuse the picture, as each new date would tend to cause a revision of the working hypothesis without knowing the archæological context. There would be no way of knowing whether or not the date represented the earliest or latest cultural sequence. What we need is artifact typological correlation from island to island with dates.

The present data is far from conclusive as to time and routes, but we are able to make a start in constructing the chronological framework, and probable routes of migrations into the Pacific. This construction is based upon the present radiocarbon dates and distribution of certain artifact types. Publication of the results of recent work in Polynesia will permit clarification of this suggested framework.

The inhabitants of the South China Coast had seagoing vessels by 2000 B.C. From this area the ancestors of the future occupants of the Pacific left, following at least two routes. Through the Philippines into Micronesia, and through Indonesia into Melanesia. The wanderers arrived in the Marianas Islands by 1500 B.C. and Yap by A.D. 176. Those that took the Melanesian route arrived in New Caledonia by 847 B.C., and Fiji by 46 B.C. Eastern Polynesia, that is, the Marquesas were occupied by 122 B.C., and Easter Island by A.D. 400. Samoa presumably by A.D. 9, New Zealand by A.D. 1,000 and Hawaii by A.D. 124. Since Hawaii seems to have been occupied from the Society Islands, this means Tahiti would have to have been settled sometime before Christ. The first radiocarbon dates from Tahiti, on the order of 600 years before the present, indicate that the early sites have not yet been excavated.

With the discovery of pottery in Samoa and the Marquesas, and the fact that pottery was made on Tonga, the old theory that pottery was absent in Polynesia had to be revised, and thereby strengthened the idea that the migrants came through Melanesia.

Polynesian pottery is obviously of Melanesian origin, and the discovery of a highly decorated type of pottery on Tonga similar to that found at a few sites on Fiji, the Ile de Pins, and at Site 13 on New Caledonia, presents the possibility that

the initial occupation of Melanesia and Central Polynesia was by a group coming up through Melanesia making a single landing on the various islands they touched at on the way to their final stopping place, which may have been the Marquesas, although the similarity of adze and house types suggests that Easter Island was probably occupied from the Marquesas. The radiocarbon dates so far published, although not the last word on the subject, tend to support this hypothesis, as does the ethnographic material, art motifs, linguistics, and artifacts. Examples of these are: the stick figure and anthropomorphic mask in the Marquesas are similar to those found in Fiji and New Caledonia. The bonita trolling hook (*pa*), a Western Polynesian trait; absence of the composite bait-hook, common in Hawaii and New Zealand; the presence in the Marquesas of the pearl-shell disc-bead ornaments with elaborately carved tortoise shell overlays which is a Melanesian trait; small shell knives that are common in Melanesia; and the early adze complex of the Marquesans is similar to the Western Polynesian-Melanesian types, that is, non-tanged, quadrangular, plano-convex and oval cross-section adzes, these diverse items suggest that the Marquesas were occupied from Western Polynesia, by way of Melanesia. The round and oval structures in Polynesia may be of Melanesian origin according to Barthel.

A major contribution of radiocarbon dating to Pacific archæology has been to show that the early conceptions of the time of migrations into this region were out by several hundred years; migrations were much earlier than anticipated.

Where multiple consistent dates have been made on a single site and where individual radiocarbon dates agree with other evidence, the archæologist has every reason to place confidence in radiocarbon dates.

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