

Prehistoric Archaeology of Taiwan

Received 26 April 1967

KWANG-CHIH CHANG

INTRODUCTION

IN an introduction to the special Taiwan issue of this journal (*AP* VII, 1963), I suggested that to place Taiwan in the larger context of prehistoric East and Southeast Asia and to fully explore its considerable archaeological potential, it would be necessary to elicit the collaboration of natural scientists who could tighten Taiwan's prehistoric chronology and provide more precise environmental information. I stated further that these endeavors would have to be carried out with reference to scientific excavations at stratified sites (Chang 1964*a*). During the years 1964-1966, initial steps were taken in precisely these directions throughout the island with investigations undertaken by the Department of Anthropology and Department of Biology of Yale University, and the Department of Archaeology-Anthropology and Department of Geology of National Taiwan University. In this paper I will attempt to summarize the results of these investigations and will discuss current problems for further research. (For preliminary reports on the 1964-1966 work, see Chang 1967*a*, 1967*b*; Chang and Stuiver 1966; Sung 1965; Sung and Chang 1964; Tsukada 1966, 1967.)

CHRONOLOGY OF PREHISTORIC CULTURES

Until evidence of man appears on Taiwan from pleistocene deposits, no useful purpose will be served from reviewing the data on climatic and geological changes of the island before the last glaciation (cf. Tsukada 1967). Whatever geological evidence for glaciation is available, however, seems to be attributable to the latest Würm phases, for "the mechanical weathering is rapid and severe in the mountainous regions of Taiwan, and formations from older glaciations have not survived to this date" (Lin 1964: 205).

Some elements of the modern biota on the island, such as the Formosan salmon (*Oncorhynchus formosanus*) and the alpine flora and insects, are considered to be glacial

Professor Chang is a member of the Department of Anthropology, Yale University.

remnants surviving from the Ice Age (Lin 1964: 206). Palynological evidence of vegetational history during the last glacial and postglacial periods was collected by Matsuo Tsukada (1966) from Sun-Moon Lake (Jih-yüeh T'an) in central Formosa in 1964. A core of sediments was obtained from the bottom of the lake to a depth of 12.79 m, dating back to more than 60,000 radiocarbon years before the present. Four pollen zones, (T for taliglacial) T1, T2, T3, and R (Recent), were established in relation to a changing series of boreal and subtropical elements considered to result from appreciable climatic changes.

Zone T1. A relatively moderate climate is indicated by pollen species, although the temperature in the area was 5° to 9° C lower than it is at present. Radiocarbon dates place the T1-T2 boundary at approximately 60,000 years B.P. This interval can be correlated tentatively with the late third interglacial or early fourth glacial epochs of the Himalayas.

Zone T2. Zone T2 opens with a fast expansion of boreal elements and pine and ends with the displacement of the boreal elements by cool temperate ones. The peak of the boreal forests suggests a remarkable coldness, providing a reduction of 8° to 11° C in annual temperature. This zone appears to correspond to the early fourth glacial epoch of the Himalayas or the early Würm of the Alps.

Zone T3. Zone T3 is distinguished by the dominance of cool temperate elements, but several species that show minor changes indicate a relatively warm interval at the beginning of this stage, about 48,000 to 40,000 years B.P., followed by a slightly colder climate with a temperature approximately 4° to 6° C lower than the present. This zone may correspond to the main Würm or the main phases of the fourth glacial epoch preceded by a period of interstadial; but apparently more pollen diagrams are needed before a finer subdivision of this zone can be made.

Zone R. Zone R begins with the destruction of primeval forests and the rise of the subtropical and warm temperate species, indicating a rapid amelioration of climate from about 14,000 to 12,000 B.P. The hypsithermal interval reached its peak between 8000 B.P. to 4000 B.P., and during that time the temperature might have been 2° to 3° C higher than at present. At the middle of Zone R, dated to 4200 ± 60 B.P., the steep increase of grass pollen (about one-third of the total grass pollen is considered by Tsukada to be cereal), together with *Liquidambar* and *Chenopodiaceae*, suggests intensified agricultural activities.

Evidence of human occupation has been available on the island only since the beginning of the Recent period, but for the study of culture history the relevance of the foregoing information is apparent. Closely related to it are changes, caused largely by shifts in shorelines, in the topography of the western coastal areas where prehistoric sites are concentrated. Lin (1964: 205) is convinced that "eustatic movement of the Taiwan Quaternary is probably a glacial eustasy associated with climatic changes, as elsewhere in the world. Major regressions indicate cold glacial periods, whereas major transgressions warm interglacial periods." The postglacial peak of transgression apparently is related to the climatic hypsithermal, although additional minor transgression-regression fluctuations can be not only assumed but also demonstrated. The major evidence for shoreline changes consists of the distribution of prehistoric sites chronologically ordered and the distribution of shell mounds containing various proportions of marine and estuarine mollusks (Lin 1960, 1963). Other evidence of coastal eustasy is provided by written records, the distribution of peats, and geological sediments along the coasts (Lin 1964). These combined lines of research provide a chronological framework for the initial placement of prehistoric sites and a context which suggests approaches to further study of cultural ecology in prehistoric times.

The hypsithermal interval witnessed the emergence of the earliest evidence of human occupation in the archaeological record of the island, characterized by cord-marked pottery beginning several millennia before Christ. Stratigraphical evidence from several sites— notably Ta-p'en-k'eng (Liu 1964; Chang 1967*b*; Chang and Stuiver 1966), Yüan-shan

TABLE 1
PREHISTORIC CHRONOLOGY OF TAIWAN

DATE	AREA OF TAIWAN		
	NORTH	CENTRAL	SOUTHWEST
1600	MODERN ABORIGINES	MODERN ABORIGINES	MODERN ABORIGINES
1000	SHIHSANHANG CULTURE		
A.D. 500	BOTANICAL GARDEN CULTURE	?	?
0			
B.C. 500		LUNGSHANOID CULTURE: (Blackware phases)	LUNGSHANOID CULTURE: (Buffware phase)
1000			
1500	YÜANSHAN CULTURE	LUNGSHANOID CULTURE: (Redware phase)	
2000		(Intensive agriculture at Jih-yüeh T'an)	LUNGSHANOID CULTURE: (Redware phase)
2500			
	CORDED WARE CULTURE		
10,000	(beginning of deforestation)		
	TALI GLACIAL		

(Chang 1954a) in the north and Feng-pi-t'ou (Chang 1967b; Chang and Stuiver 1966) in the southwest—indicates a disconformity between the terminal occupation of the cord-marked pottery layers and the subsequent prehistoric cultures of a higher level of development. The latter include at least two different cultural traditions: the Lungshanoid, consisting of several apparently related phases in central and southern Taiwan, and the Yüanshan of the Taipei basin in the north (Chang and Stuiver 1966). A series of Carbon-14 dates has firmly placed the beginning of these two parallel cultures at approximately 2,500 B.C. Table 1 outlines the current prehistoric chronology of Taiwan.

THE CORDED WARE CULTURE

The establishment of the cord-marked pottery assemblages as members of a cultural horizon and the characterization of this horizon are among the most significant results of the 1964–1965 work. It has long been suggested by Tadao Kano (1956: 110–111), among other scholars, that the oldest pottery of the island is probably the cord-marked, and the 1952–1953 excavations at the Yüanshan shell mound of Taipei uncovered stratigraphical evidence to support this view (Chang 1954a, b). However, no corded ware stratum had been isolated from the south, and inadequate knowledge of this cultural layer led to the erroneous conclusion that the cord-marked pottery stratum in central Taiwan also belonged to the same cultural horizon (Sung and Chang 1954; Chang 1954a, 1956). New data from the sites of Ta-p'en-k'eng in the north and Feng-pi-t'ou in the south have led to a reclassification of the cord-marked pottery assemblages on the west coast: an earlier one characterized by thick, coarse, brown buff sherds and a later one characterized by fine, soft, red orange sherds. The cord-marked pottery of central Taiwan must now be classified into the latter group, which probably belongs to the Lungshanoid culture. The oldest ceramic culture of the island is represented by the first category of cord-marked pottery.

Available corded ware sites form three clusters: the first, in the southernmost area of the west coast (Chang 1967b; Chang and Stuiver 1966; Kokubu 1941, 1962); a second, in the lower Tamsui Valley and on the northwest coast (Chang 1954a, 1954b, 1967b; Chang and Stuiver 1966; Sheng 1960, 1962a, 1962b, 1963); and a third, along the east coast from Suao to Taitung (Pearson 1966). Sites of this type, widely scattered on the island, indicate cultures that share a number of essential features, in contrast to all other prehistoric cultures in Taiwan, and belong without any serious doubt to a single culture derived from a single source. The salient features of this culture can be enumerated as follows (Chang 1967a):

1. *Pottery.* Fragile and heavily eroded, potsherds of this ware are usually fragmentary, thick, and gritty. The color ranges from creamy buff to dark brown, and the major shapes of the vessels are large globular jars and bowls. Low and perforated ring feet are often found attached to the bottoms of the jars. The rims have medium flare, and many have a circumferential ridge below the lip. The entire body of the vessel is invariably impressed with cord marks, probably applied with a cord-wrapped stick or paddle, but the rim is never so impressed. The rim surfaces and frequently the upper part of the shoulder are decorated with incised designs composed of wavy lines and short parallel strokes, applied with a gourd instrument.
2. *Pecked pebbles.* Only a small number of stone types are known to be associated with the cord-marked pottery; among them, worked pebbles are the most common. These are

natural river pebbles, at most 20 cm across, with pecked and flaked ends, sides, or circumferences, or all three. They were probably used as net sinkers.

3. *Bark beater*. A fragment of stone bark beater with a polished and grooved surface was discovered from the corded ware stratum of Yüanshan shell mound in 1953 (Chang 1954a).
4. *Stone adzes*. Most of the adzes, of a variety of rocks, are highly polished, asymmetrical of edge, and rectangular in cross section. A few have two small notches or depressions on a side, reminiscent of the "steps" of the stepped adze in the subsequent Yüanshan assemblages.
5. *Points*. Small (ca. 4 cm long) points of greenish slate are often found. They are invariably thin, flat, triangular, and perforated at the center.

The archaeological inventory of the Corded Ware culture is indeed very small, but nevertheless suggestive and interesting. It may be recalled that at about 11,000 B.P. the vegetational history in the Jih-yüeh T'an area underwent a clear and persistent change, indicating a constant burning of the primeval forests and their continuous replacement by secondary growth. Accidental burnings of the forest (such as forest fires) cannot account for the persistence of the new pattern of growth, and forest clearance by human hands could have had little purpose at that time other than for plant cultivation. Since the sequence after 4200 B.P. shows evidence of intensive farming and grain cultivation, the contrast seems to suggest that the earlier form of agriculture was probably characterized by the planting of root and fruit crops. The inventory of the Corded Ware culture is consonant with a horticultural type of subsistence.

Several ethnobotanists and cultural historians (Barrau 1965a, 1965b, 1966; Sauer 1948, 1952) have speculated about an early horticultural revolution—or evolution—in the tropical regions of Southeast Asia. They agree in characterizing the early garden culture as follows:

1. The area where the first plant domestication and cultivation took place was probably a permanently humid tropical region with a rich flora and an abundance of marine and, to a lesser extent, freshwater resources.
2. Some "progressive fishermen" dwelling on riverbanks or near estuaries in the Southeast Asian tropics were probably the progenitors of the earliest growers of root crops.
3. The first gardening in this area was probably done by individual farmers who propagated perennials (such as taro and yams) in fenced gardens. The technique was at most a "swidden cultivation," with periodic cuttings into the forests from the river banks and estuaries.
4. In this early stage of cultivation, when fishing had an important role, fiber was a material of prime importance for making fishlines and nets and as a kind of oakum for caulking canoes. In fact, the first uses of plants in this area may have been related to the gathering of fibers. Furthermore, fibrous and edible barks were important items of material culture, and "barking" was possibly the first technique of land clearing, perhaps discovered by accident through the gathering of fibrous material from wild plants.

Sites of the Corded Ware culture in Taiwan are never far from water or ancient sites of water. Ta-p'en-k'eng and Feng-pi-t'ou, for instance, were located on old coastal terraces some 30 m above the level of the plains, which are about $1\frac{1}{2}$ miles wide and separate these foothill terraces from the present coastline. When the sites were inhabited they were probably on the coast. Eustatic changes are held responsible for the emergence of the narrow

strip of coastal plain just below the hills. Moreover, the sites are near estuaries of major rivers where both marine and freshwater resources abounded. The dating of this culture is uncertain, but apparently it antedates, by a considerable interval, the subsequent prehistoric cultures that began around 2500 B.C. (Chang and Stuiver 1966). We can estimate that this culture reached a peak perhaps a few thousand years before our era, coinciding with the peak of the postglacial hypsithermal interval. It was, in any event, a culture in a humid and warm subtropical-tropical region adapting to marine, estuarine, riverine, and lacustrine microenvironments.

To judge from the impressions made by the cords on the pottery surfaces, the cords were all made of several strands twisted together; their diameters range from a fraction of a millimeter to nearly half a centimeter. Sophisticated techniques apparently were used to make a variety of cords. Obviously, cordage was of some importance in the material culture of the people, and fibers must have been obtained for making cord from plants among the abundant flora in the region.

For what were the cords used other than decorating pottery? The stone inventory described above indicates the use of net sinkers and carpenter's tools. Regardless of whether or not canoes were built by the carpenters, the locations of the sites and the stone sinkers show that net fishing was important to subsistence, and cordage probably found its widest use in the making of nets. In fact, the relatively large size of the sinkers tends to suggest that large nets and canoes were used for fishing rather far from shore.

From whatever material the cords were made, these people must have gathered the fibers from plants, wild or domesticated, and presumably were familiar with the local plant resources. The finding of the bark beater at Yüanshan suggests that fibrous bark may have been one source of the fibers for cordage, and barking indicates activities dealing with the forest. If the forests around Sun-Moon Lake were burned by men continuously after 11000 B.P., the only people on the island at that time were the people who made the corded ware. There is strong indication that these people were among the early horticulturalists about whom the ethnobotanists have been speculating. Numerous stone hoes have been found from the Yüanshan and the Lungshanoid sites, but none have been found from the earlier stratum. The absence of identifiable implements for cultivation from the Corded Ware culture sites would seem to indicate that if any planting was done at all it was of root crops and fruits. The large globular pots and urns are not likely to have served many purposes other than temporary storage and cooking of plant food.

Until direct evidence of the ancient horticulture—such as carbonized roots and tubers, identifiable plant protein crystals, pollen grains from the earth in the fenced gardens, and perhaps bamboo and wooden dibbles—is available to support the existence of a precereal plant cultivation and domestication in Southeast Asia, the Corded Ware culture in Taiwan is by far the best indication of a horticultural evolutionary process that probably took place in the Asian tropics during the postglacial hypsithermal interval.

Taiwan, of course, was not the sole habitat of the ancient people who made the corded ware, for cord-marked pottery is widespread throughout South China and Southeast Asia (Chang 1964*b*; Kuo and Li 1963; Ku 1962; Mansuy 1924, 1925; Mo 1959, 1961; Mo and Ch'en 1961; Mo and Li 1960; Mo, Li, and Huang 1964; Saurin 1940) as well as Japan (from the Jōmon periods). New archaeological work at the Niah Cave in Borneo (Harrison 1964; Medway 1960) and in a number of caves on Palawan (Fox n.d.) indicates a recent geological interval during which estuarine mollusks suddenly became abundant. This

interval has been carbon dated to a few millennia B.C. Quite possibly the postglacial hypsithermal interval was more conspicuously present in the Asian tropics than heretofore expected. An ameliorated climate with abundant water resources and plant life during this period could have provided the food gatherers of Southeast Asia with the right kind of new environment for an ancient horticultural evolution to take place. The new archaeological work in Taiwan firmly suggests that such a process should be explored in the prehistoric interval throughout Southeast Asia that is characterized by the cord-marked pottery.

THE LUNGSHANOID CULTURE

Beginning around 2500 B.C., a culture essentially identical with the Lungshanoid culture of southeast China emerged in central and southwestern Taiwan. In different areas and different time periods at least three distinct wares predominate in the archaeological assemblages: fine-paste and cord-marked red pottery; sandy, incised brown buff pottery; and incised and impressed black pottery (cf. Kokubu 1962). Each type may be considered to represent a separate phase of the Lungshanoid culture.

Stratigraphical evidence from the sites of Feng-pi-t'ou (Chang 1967*b*) and Niu-ma-t'ou (Liu 1955) indicates that the fine-paste, cord-marked red pottery was the first to occur in Taiwan. The shapes of the pottery vessels include bowls, *tou*-pedestaled basins and bowls, large wide-mouthed urns, and jars with long narrow necks. Associated with this ware are flat, polished stone hoes; stemmed arrowheads; rectangular and saddle-shaped slate knives; and rectangular adzes. Neither the shouldered ax nor the stepped adze, typical of the Yüanshan culture to be described below, has been found from sites of this phase. Dating this phase to the last half of the third millennium B.C. would place it at approximately the same time in the Jih-yüeh T'an sequence when evidence of intensified agricultural activities emerged. And the character of the cultural inventory is suggestive of advanced farmers. Shell mounds are not found at this level.

The sandy brown buffware, typified by the site of Feng-pi-t'ou, and the blackware, typified by the site of Ying-p'u (Kanaseki and Kokubu 1949*a*), occurred in Taiwan at about the same time; that is, around the middle of the second millennium B.C. Sites of the former ware, however, are seen in southwestern Taiwan, while those of the black pottery predominate in the central part of the island. Cord, basket, and mat impressions and incisions (including shell-combed) are distinctive decorative patterns, and painting (in dark red or brownish pigment) occurs at a few sites (Chang 1967*b*; Kokubu 1964). Jars, bowls, basins, mugs, cups, and *tou* bowls and basins are characteristic shapes. Shell mounds occur in great abundance, in which bones of deer, wild boar, monkey, fish, crab, and turtle are found alongside molluscan shells. Bone and shell implements are also found. A reed impression on a piece of black pottery (Liu 1955) and two potsherds with rice-husk impressions from the site of Ying-p'u (Sung, personal communication) suggest grain agriculture (probably millet and rice), which agrees with the occurrence of hoes, slate knives (semilunar as well as rectangular), and other agriculture-related artifacts (Kaneko 1953; Kanaseki and Kokubu 1949*b*). Several distinctive burial patterns are recognized, and head-hunting is indicated (Kanaseki 1957).

The variety and change of pottery throughout the Lungshanoid sites are very interesting and suggestive. Although an internal history of development from one ware to another is not impossible, the variety of wares and stone implements at the Lungshanoid sites of different

places and periods suggests that it is more likely that the Lungshanoid inhabitants arrived on the island in different groups at different times. This viewpoint is supported by the fact that the redware, buffware, and blackware phases of the Lungshanoid culture of Taiwan can be traced back to southeast China where they occur in different areas at diverse time levels (Chang 1967c).

THE YÜANSHAN AND THE BOTANICAL GARDEN CULTURES

The Yüanshan Culture is the first prehistoric culture revealed on the island of Taiwan, the discovery of Yüanshan shell mound having been made in 1897 (Kanaseki and Kokubu 1950). Intensive excavations were undertaken at the shell mound in 1952 and 1953 (Chang 1954a), but the results remain to be reported in detail. The estimates of the age of this culture ranged from "several thousand years ago" to the Ming dynasty (Sung and Chang 1964). Before the Yüanshan was dated, its status could not be established in the larger context of Taiwan and eastern Asian prehistory. The excavations at the site of Ta-p'en-k'eng (Chang 1967b) and the Yale Radiocarbon Laboratory's work in determining the dates of the carbon samples from Ta-p'en-k'eng and Yüan-shan (Sung and Chang 1964; Chang and Stuiver 1966) were an initial step toward a fuller understanding of the context of this culture.

No fewer than twenty prehistoric sites found in northern Taiwan can be assigned to the Yüanshan group (Sheng 1960), and at least three of them have been excavated: Ta-p'en-k'eng, Yüan-shan shell mound, and T'u-ti-kung-shan (Sheng, Liu, and Wu 1961). The major concentration of the sites is along the Hsintien River and the lower Tamsui River, that is, the northern and eastern portions of the Taipei basin. A few of them have been found on the coast, and only rarely have Yüanshan remains been found in the Takokan Valley.

The characteristic features of the Yüanshan stratum at Ta-p'en-k'eng are also characteristic of the Yüanshan culture as a whole. The pottery is characterized by a buff sandy ware, with the urn (constricted mouth, occasional spout, vertical strap handle, and low ring foot) as the principal form. The exterior of the pots has a thin coat or slip, in most cases left plain but sometimes brushed with discernible designs in red and dark brown pigment, incised with short, oblique, parallel strokes and net patterns, and impressed with small rings. Cord, mat, and basket impressions are nonexistent in the Yüanshan ware, although check impressions appeared in a later interval. In addition to its use to make vessels, clay was also employed for spindle whorls and pot-supporters.

The stone inventory includes such distinctive types as shouldered axes, stepped adzes, long, spatula-like hoes (*patu*), and perforated triangular points. Large numbers of rings and beads made of jade and serpentine were found in the assemblages. Bone and antler points, chisels, and awls were recovered from the shell mounds.

Shell mounds occur at some of the sites on the lower Tamsui River, and the predominant molluscan species is *Corbicula maxima* Prime. This semimarine species is currently found only near the estuary, thereby attesting to the geological changes that have since taken place (Tan 1934). It has been suggested that the Yüanshan inhabitants followed the retreat of marine mollusks along the lower Tamsui River—and the radiocarbon dates of the Yüanshan shell mound and of Ta-p'en-k'eng tend to bear this out—but no shell mounds were located at Ta-p'en-k'eng from the Yüanshan stratum. In the shell mounds are also found bones of wild animals, chiefly boar and deer (Su 1959).

In sharp contrast to the Lungshanoid culture to the south, the characteristic features of the Yüanshan culture are not duplicated to any significant degree at the Lungshanoid sites in coastal southeast China, even though isolated fragments (such as an occasional handle form, ring foot as an elemental base appendage, or a stepped adze) do recall the mainland Lungshanoid assemblages. As an articulated culture, the Yüanshan apparently has a different derivation.

Despite the time difference and the basic demarcation of cultural types that separate the Yüanshan culture from the much earlier Corded Ware culture of Taiwan, these two do share a few characteristics in common. The only point found in the Corded Ware culture, the perforated triangular type, is also the diagnostic type of arrowhead and spearpoint of the Yüanshan culture, and slate was the common material. The *kuei* pot is characteristic both of the Corded Ware and Yüanshan cultures, while both lack tripods. It can be said that Corded Ware culture continuities occurred in the Yüanshan culture of a later period. But these continuities could not be the dominant elements of the new culture, which presumably derived its basic inspirations elsewhere. If there was such continuity, there were also important breaks, for cord-marking no longer appeared on the Yüanshan pottery.

As to the direction in which we must look for the inspiration from which the new Yüanshan culture emerged, the stone implement types provide the only definite clues. The only area in the Far East in the vicinity of Taiwan where there is a combination of chipped and partially polished rectangular hoes, stepped adzes, and shouldered axes—a combination that characterizes the Yüanshan culture and sets it apart from the southern Lungshanoid—is the northern coast of the South China Sea and the Gulf of Tonkin; that is, the coastal areas of Kwangtung, Hainan Island, and the coasts of North Vietnam. Discussing the various ax and adze types of the Haifeng-Hong Kong area, Beyer (1948: 34) arrived at the following conclusions:

1. Rather typical oval adzes of early Neolithic Type I are found in small numbers both at Hong Kong and at Hoifung.
2. There are numerous transitional types, especially at Hoifung, between the oval adze and the shouldered adze and between the plain-backed oval adze and the semiridged or tanged type; also between the round or oval shouldered-adze and the semiridged or tanged "stepped" adze.
3. There also appear similar transitional types between the peculiar Hoifung rectangular or trapezoidal body—some of which closely resemble certain early Philippine stepped types.
4. In Luzon—and, for the later types, in Cebu and Mindanao also—there are almost exact duplicates of some of the Hoifung stepped and semiridged or tanged types.

Beyer (1948: 34) further stated, "Considering the above four items together, it is reasonable to assume that there was direct contact between the Hoifung-Hongkong areas and the Island of Luzon. Furthermore, that this contact occurred more than once." The same observations can be applied to the Haifeng-Hong Kong and northern Taiwan interrelationship. It is on the basis of a study of stone implement types that Sung (1964: 99) suggests that "the Yüanshan Series is a local series of the Neolithic [rectangular] stone adze culture which is widely distributed along the southeast coast of China and in the South East Asia area. In conclusion, . . . if it was not diffused oppositely from Taiwan to the China mainland, the home of the Yüan-shan culture should be in the area between Haifeng and Canton."

A combination of stepped adze and shouldered ax, however, is not confined to the coastal region between Haifeng and Canton but is widely seen on the Kwangtung coasts from the

eastern end of the province (Jao 1951) to the island of Hainan (Mo 1960). On the island of Hainan, in addition to the stone ax-adze types, there are scattered findings of the double-grooved stone sinkers and small loop handles of pottery appliquéd to the neck of the pot—both characteristic of the Yüanshan stratum at the site of Ta-p'en-k'eng. The pottery of Hainan, furthermore, is a sandy brown buffware, lacking the impressed geometric patterns (cord, mat, basket, and checked patterns) that are found on pottery of the Kwangtung coasts between Haifeng and Canton.

Brief mention must be made of the Botanical Garden culture of northern Taiwan. First recognized at the Botanical Garden in the southern part of Taipei city, this culture is characterized by a fine-paste, thick-walled brown and buff pottery with checked impressions. The stone implements are similar to the Yüanshan inventory, but chipped hoes and axes are as abundant as polished ones, shouldered axes are fewer, and the stepped adzes are characteristically thick rather than flat as with the Yüanshan type. Patu-type long hoes occur, but a bend is conspicuous in the long section, whereas the Yüanshan type is usually straight. In distribution, the hoes occur mostly in the Takokan Valley and in the lower Tamsui River, and few if any of their remains have been located in the eastern half of the Taipei basin (Sheng 1960).

The contrast between the Botanical Garden and the Yüanshan cultures has long been recognized, but before their respective ages were known their interrelationship was difficult to determine. The 1943 excavations of the Kuantu shell mound by Kanaseki and Kokubu (1953) showed that "check-impressed potsherds" occurred stratigraphically above Yüanshan remains, but these potsherds are said to be of the northern coastal types, of the Ketangalan culture. Our excavations at Ta-p'en-k'eng demonstrate beyond reasonable doubt that at least at the lower Tamsui area the Botanical Garden elements *intruded into* the Yüanshan occupation around 500–700 B.C. Since Botanical Garden remains do not occur at the Yüan-shan shell mound, which antedates the entire Ta-p'en-k'eng sequence, it seems probable that the Botanical Garden culture did not occur side by side with the Yüanshan culture at the heart of the Taipei basin. It seems probable also that in the basin as a whole this culture emerged sometime during the latter half of the Yüanshan occupation, that is, after 1000 B.C.

Two alternative hypotheses can be made regarding the origin of the Botanical Garden culture: it could either be a development of the Yüanshan culture, or it could have arisen independently in the southwestern part of the Taipei basin in the Takokan Valley. The latter alternative is strengthened by the fact that in this area and in the coastal region of Hsinchu, the northern cultural remains and pottery with central Taiwan affinities occur in mixed contexts (Kokubu et al. 1949; Sheng 1963, 1965). Geometrically stamped and impressed pottery is characteristic of the central Taiwan prehistoric cultures since at least the second millennium B.C. It is entirely possible that the Botanical Garden culture represents a northern offshoot of the impressed pottery traditions and horizons. The question cannot be considered as solved, however, until the relative chronology of this culture is known throughout its area of distribution, to demonstrate its greater antiquity in the southwest.

INTERRELATIONSHIP OF ETHNOLOGY AND ARCHAEOLOGY

In addition to the twelve million Han Chinese on the island of Taiwan there are considerable numbers of Malayopolynesian-speaking aboriginal inhabitants. Among them, approximately one hundred seventy thousand, known as the *Kaoshantsu*, or mountain

tribes, inhabit the Central Mountain Range and the eastern coast. Unknown numbers of the remainder, referred to as *P'ingb'ufan*, or plain tribes, blend with the Han Chinese on the western and northern coasts. Aside from the Malayopolynesian languages they speak or are known to have spoken in the past, the aborigines are characterized by cultures decisively different from the Chinese but similar to the native cultures of the Philippines, Indonesia, and Malaysia, and they are commonly thought to have come to the island long before the Chinese immigration more than three hundred years ago.

The archaeologist is interested in the island's ethnology for a number of obvious reasons, and his research into the island's prehistory no doubt has bearing upon the problem of the derivation of the aboriginal population. The modern ethnographic situation can throw light on cultural classifications during the prehistoric period. Ethnohistoric information on migrations and settlements of peoples during the recent past helps interpret prehistoric movements and contacts of peoples and cultures, and ethnological knowledge of aboriginal life would be of use for prehistoric cultural reconstruction. However, the archaeologist must be able to demonstrate that cultural continuity or continuities exist from the prehistoric past to the present. Demonstration of cultural continuity in Formosa, furthermore, carries historic significance far beyond the borders of the island. To be able to demonstrate such continuity is to show, concurrently, that the dominant culture of at least a portion of the modern Malayopolynesian speakers was derived from China. The implications of this theory for studies of the cultural history of the entire Pacific area are manifold and wide-ranging. I have elaborated on these implications repeatedly (Chang 1959; 1964a); it would be superfluous to reiterate them here.

There is no question that the study of Formosan prehistory now provides a firmer basis for the study of the interrelationships between archaeology and ethnology. It is necessary, however, to distinguish at the outset the two kinds of continuity that we deem essential to demonstrate: *general* and *specific*. Within *specific*, there are two kinds of continuities: *cultural* and *ethnic*. By *general continuity* we mean that the modern aboriginal cultures, or some of them, can be classified in the same general cultural types or groupings as the prehistoric cultures, or some of them. By *specific continuity* we mean that continuity can be demonstrated from a prehistoric cultural phase all the way down to a modern ethnic group. If specific continuity can be demonstrated in terms of group identity, such specific continuity can be referred to as *ethnic*; on the other hand, if specific continuity is only probable, in view of the occurrence of a cluster of cultural items, then we can talk about nothing more than a culturally specific continuity. These different kinds of continuities serve different purposes. On the problem of the Malayopolynesian culture history and the question of prehistoric cultural reconstructions, general continuities are sufficient. For ethnohistoric studies and for prehistoric cultural classifications, however, the continuities must be specific.

Both Kano (1956: 96-99) and Miyamoto (1956) have pointed to the fact that huge stones are being used for house construction among some eastern groups; that slab coffins are being used among the Ami of the eastern coast; that chipped stone hoes are known to have been used by some groups until recently; that some prehistoric pottery vessels have counterparts among the natives; and that some ornaments of modern peoples have prototypes from archaeological sites. On the basis of these common occurrences Miyamoto (1956: 334) concludes that he "cannot believe that the people who left such relics in all the islands had perished completely or migrated to other lands. It is probable that the descendants of the Stone Age man have survived in this island."

Miyamoto's conclusion is highly credible, and it can be reinforced by other archaeological and ethnological occurrences such as head-hunting, in both the Yüanshan culture (Chang 1957) and the Lungshanoid (Kanaseki 1957); tooth extraction (Kanaseki 1951, 1952; Chang 1957); shell beads (Chang 1958); betel-chewing (Miyamoto 1956: 332), and pile buildings. All of these, plus the physical anthropological studies of prehistoric skeletons—for whatever they are worth—(Kanaseki 1952, 1956), suffice to show that there is *general* continuity from the prehistoric to the present, and that the prehistoric inhabitants belonged to the cultural type characterized as Ancient Southeast Asian, Indonesian, or Proto-Malay. The significance of this conclusion regarding the culture history of the western Pacific region is at once apparent (Chang 1964a): it enables us to speculate upon the culture and society of the prehistoric inhabitants by means of a direct ethnological approach.

Specific ethnic continuities, however, are another matter. Which prehistoric phase was ancestral to which modern ethnic group? There must have been, during the interval, plenty of migrations, fissions, fusions, and extinctions. It would be the exception rather than the rule that a one-to-one equation could be made. As I have pointed out before (1964a: 199): “an undertaking of great urgency would be to trace the routes of inland migrations of the various modern ethnic groups on the island, with all the historical methods at our disposal, and to identify the former settlement sites of each group along the general areas of such routes. Specific connections may eventually be pinned down between individual ethnic groups of today and the prehistoric cultural phases of various periods.”

George Murdock (1964) subtitles his summary article of Isidore Dyen's recent study on the genetic classification of the Austronesian languages “A Key to Oceanic Culture History.” Indeed, the genetic classification of the Austronesian languages of Formosa is, in the absence of the kind of reliable and detailed ethnohistoric study characterized above, the *only* available key to the historical categorization of the speakers, and this categorization in turn provides a useful basis for archaeological correlation.

Various attempts have been made since the beginning of modern ethnography in Taiwan to classify the aboriginal population on the basis of culture in general and language in particular (Kano 1956: 121-177; Mabuchi 1953a). A commonly used classification is as follows:

Mountain tribes: Atayal (Atayal, Sediq), Saisiat, Bunun, Tsou, Paiwan, Rukai, Puyuma, Ami, Yami.

Plains tribes: Lulilang, Ketangalan, Kavalan, Taokas, Pazeh, Papura, Babuz, Hoanya, Thao, Siraya.

The contrast between the mountain tribes and the plains tribes is obviously both inaccurate and misleading, not only because some groups of the former (Ami, Puyuma, and Yami) in fact inhabit the plains and some of the latter (Thao) are found in the highlands but, more particularly, because this contrast is based upon the respective extents of their sinicization and not upon their inherent genetic relationships. The relationship between two mountain tribes is not necessarily closer than one between a mountain tribe and a plains tribe. Inasmuch as the aboriginal cultural patterns of many of these groups—especially the plains group—are difficult or impossible to reconstruct, the only feasible approach to a historically meaningful hierarchy of their grouping is a linguistic one.

A recent lexicostatistical comparison undertaken by Dyen (1964) among the available Taiwan languages is shown in Table 2. According to Dyen (1964: 263), “these results suggest that at the highest level there are three language groups in this comparison: F_1 containing

elements, while the cognates it shares with all other groups within F_3 are well below 20 percent.

2. Kavalan also stands out by itself. Its percentages with the other groups are higher than that of Rukai; but only with its southern neighbors, the Ami, is it significantly above 20 (24.1; 24.7).
- 3 All others—Thao, Bunun, Pazeh, Ami, Puyuma, and Paiwan—can be comfortably placed together, as they invariably share cognates well above 20 percent.

The significance of these subcategories within F_3 is not readily apparent, but this at least shows that group F_3 has itself had considerable time depth. As Ferrell (1966: 100) maintains, it is possible that their arrival on Formosa "may have spread over a long period of time." On the basis of the most recent studies, Dyen (personal communication) thinks that the percentage of the Atayalic groups among themselves should be higher than appeared in the accompanying table; also, he is not sure whether Tsouic should indeed be a group by itself or whether it should be a subgroup within Paiwanic. Purely as a matter of interest we can, on the basis of the latest information, compute the theoretical times of separation of the three major language groups according to the glottochronological standard figures (Swadesh 1952: 460), although recent studies (Dyen, personal communication) have shown that these figures tend to give short results, especially when the time depth involved is great. We arrive at the interesting result that both the Atayalic separation from Tsouic and Paiwanic and the beginning of the Paiwanic internal differentiation (lowest percentage being 14.8 between Pazeh and Rukai) could be placed at about 2500 B.C. (In a personal communication Raleigh Ferrell arrived at a somewhat different set of figures by using Dyen's published percentages [Dyen 1964]. Dyen's latest figures, raising the Atayalic percentages, do not alter the grouping of the languages but alter the glottochronological results considerably.) In other words, around 2500 B.C. both major events indicated by the lexicostatistical comparisons could have taken place: (1) separation of Atayalic from Paiwanic; and (2) the separation of the languages within the Paiwanic group, which nevertheless continued as a group lexicostatistically. These results are certainly both interesting and instructive. A comparison with similar results obtained elsewhere within the Malayopolynesian area would provide some food for thought over a number of historical problems concerning the Malayopolynesian culture history.

The precise figure of 2500 B.C. may well be highly suspect, but the low critical percentages involved in the lexicostatistical comparisons among the Taiwan languages suggest very strongly that their linguistic breakdown has gone on for a matter of millennia. The conclusion is thus inescapable that among the prehistoric cultures described in this paper there were direct ancestors of the modern aborigines.

An attempt to identify archaeologically the ancestral groups with the three major Taiwan linguistic groups was initiated by Raleigh Ferrell (1966). His identifications are marred, however, because the latest archaeological information of the island was not available to him at the time he wrote. His general approach and many specific comparisons nevertheless show original insight, to which I am greatly indebted in this discussion.

Let us forget for a moment about specific cultural characteristics of the populations involved, and concentrate on this logical fact: lexicostatistical study shows that at a time period of considerable antiquity (ca. 2500 B.C., glottochronologically speaking) the two major language groups on the island—Atayalic and Paiwanic—began to separate, and at approximately the same time the Paiwanic group began to diversify within itself. The latter tends to suggest that the internal Paiwanic differentiation probably took place within the island after the group's arrival.

At once we are struck by the remarkable coincidence of this with the archaeological picture. At about 2500 B.C., two major cultures emerged in the Taiwan scene—Yüanshan in the north and the Lungshanoid in the south. At about the same time, moreover, the Lungshanoid culture already consisted of several divergent phases, each one of which could be traced to a cultural group on the mainland. Since the glottochronological results suggest that at exactly this same time the ancestral Atayalic and Paiwanic had just begun to separate, whereas the two prehistoric cultures already showed sharp contrasts, it would not be possible to identify the two ancestral linguistic groups with the two prehistoric cultures. It appears more likely that both Atayalic and Paiwanic split from a single prehistoric ancestor. Which—Yüanshan or Lungshanoid—is the more likely?

There are many indications that the Lungshanoid-Paiwanic identification is entirely possible. The geographical spread of the Paiwanic languages—the southern half of the island plus the northern coasts—agrees with the spread of the Lungshanoid. The intrusion of the check-impressed ware into the Yüanshan territory around 500 B.C. and the continuation of the geometric stamping tradition into the Ketangalan agrees with the linguistic positions of the Ketangalan and the Kavalan. Check-impressed pottery is known to have been manufactured and used until recently among the Bununs, a Paiwanic member. The pottery jars kept today among the Paiwans as heirlooms exhibit many features that are found in the fine Redware, such as the ridges on the exterior of the rim, the interior of the rim serving as a support for the lid, the low ring-feet, and the decoration techniques (Jen 1960). As pointed out by Solheim (1967), the similarities between the Paiwan wood-carving motifs and some Kalanay ceramic decorations serve as indirect supporting evidence in the same direction.

I agree with Ferrell (1966) that the Lungshanoid-Paiwanic correlation is the strongest archaeological identification of ancestral groups of the modern population that can be made on the basis of the available evidence. The archaeological picture shows that much of the island's prehistory was a succession of the different phases of the Lungshanoid cultures. This succession, as shown by the Ketangalan evidence, leads to the present. It would be entirely surprising if the expansion and diversification of the Lungshanoid cultures in Taiwan did not directly reflect the expansion and diversification of the Paiwanic language group.

We are then left with a major prehistoric culture, the Yüanshan, and we want to know what became of it. Geographically, the Atayalic group occupies the northern part of the mountainous area, overlapping with the Yüanshan distribution in the upper courses of the Tamsui system. The customs of tooth-extraction (Chang 1954*a*) and head-hunting (Chang 1957) that can be inferred for the Yüanshan culture are both prominent features of the Atayalic (even though they were also found among the other groups as well). If the Southwest China affinities with the Yüanshan culture suggest partial derivation of this culture and population from that direction, Ferrell's suggestion (1966) that the Atayalic group exhibits cultural and linguistic similarities with ethnic groups in Southwest China and Assam is especially noteworthy.

There is one factor that seems to point strongly in an opposite direction, however. According to the legendary traditions of the Atayal, their original homeland was in the southwestern corner of their present sphere of distribution rather than in the northern valleys required under a Yüanshan identification hypothesis (Mabuchi 1953*b*). If the southwestern corner of their sphere of distribution is indeed their original homeland, then this would point to the middle and upper Choshui River, where the prehistoric cultures were characterized by the central Taiwan Black Pottery culture. This theory would fit the

glottochronological beginnings better—that is, an ancestral Atayalic split from a Lungshanoid ancestor. The legendary tradition, however, has a time depth of no more than three hundred years, as suggested by Mabuchi, and this evidence alone is insufficient to rule out an Atayalic-Yüanshan identification. A more precise linguistic time depth for the Atayalic and a further effort to trace the aboriginal legendary tradition would be necessary to decide between at least these two possibilities.

In conclusion, the strong probability that the bulk of the modern Malayopolynesian speakers on the island descended from the two major prehistoric cultures, Lungshanoid and Yüanshan, is of the utmost importance, not only for the reconstruction of the culture history of Taiwan but also for the reconstruction of the culture history of Oceanic regions and the prehistory of the Malayopolynesian speakers.*

REFERENCES

BARRAU, JACQUES

1965a Gardeners of Oceania. *Discovery* 1: 12-19.

1965b Witnesses of the past: notes on some food plants of Oceania. *Ethnology* 4: 282-294.

1966 The Indo-Pacific area as a center of origin of plant cultivation and domestication. Paper read at the Symposium on Ethnobotany, 26 October 1966, Centennial of the Peabody Museum of Natural History, Yale University.

BEYER, H. O.

1948 Philippine and East Asian archaeology and its relation to the origin of the Pacific islands population. National Research Council of the Philippines Bulletin No. 29. Quezon City.

CHANG, KWANG-CHIH

1954a The Yüanshan excavations and their contribution to the prehistory of Taiwan. *Talu Tsachih* [Taipei] 9(2): 36-41. (In Chinese.)

1954b Prehistoric cultures in Taipei Basin. *Taiwan Feng't'u*, nos. 174 and 180. Literary supplement to *Kunglunpao* [Taipei]. (In Chinese.)

1956 A brief survey of the archaeology of Formosa. *Southwestern Journal of Anthropology* 12: 371-386.

1957 A human tooth unearthed from Yüanshan shellmound. *Department of Archaeology and Anthropology, National Taiwan University Bulletin*, nos. 9-10: 146-148. (In Chinese.)

1958 Shell-bead money of the Taiwan aborigines. *The Ethnological Society of China Bulletin* 2: 53-133. (In Chinese, with English summary.)

1959 A working hypothesis for the culture history of South China. *Institute of Ethnology, Academia Sinica Bulletin* 7: 43-103. (In Chinese and English.)

1964a Introduction to the special Taiwan section. *AP* 7: 195-203.

1964b Prehistoric and early historic culture horizons and traditions in South China. *CA* 5: 359.

1967a The Yale expedition to Taiwan and the horticultural evolution of Southeast Asia. *Discovery* 2: 3-10.

1967b Preliminary notes on the excavations in Formosa, 1964-65. *AP* 9: 140-149.

1967c The Neolithic cultures in the coastal areas of Southeast China. Paper read before the Symposium on Early Chinese Art and its Possible Influence in the Pacific Basin, held at Columbia University, August 1967.

CHANG, KWANG-CHIH, AND MINZE STUIVER

1966 Recent advances in the prehistoric archaeology of Formosa. *Proceedings of the National Academy of Sciences* 55: 539-543.

DYEN, ISIDORE

1964 The position of the Malayopolynesian languages of Formosa. *AP* 7: 261-271.

FERRELL, RALEIGH

1966 The Formosan tribes: A preliminary linguistic, archaeological, and cultural synthesis. *Institute of Ethnology, Academia Sinica Bulletin* 21: 97-130.

* This work was carried out by Yale University and was supported by a National Science Foundation grant (GS-410). The Yale scholars included, in addition to the author, Dr. Matsuo Tsukada, Dr. Richard J. Pearson, and Mr. Jonathan H. Kress. Collaboration was rendered by Dr. Minze Stuiver of the Yale Radiocarbon Laboratory.

- FOX, ROBERT
n.d. *Ancient man in Palawan*. Manila: The National Museum.
- HARRISSON, TOM
1964 50,000 years of stone age culture in Borneo. *Smithsonian Institution Annual Report* 1964: 521-530.
- JAO, TSUNG-YI
1951 *Prehistoric sites and cultures of Hankiang*. Hong Kong: privately printed. (In Chinese.)
- JEN, HSIEN-MIN
1960 The ancient urns of the Paiwan, Taiwan. *Institute of Ethnology, Academia Sinica Bulletin* 9: 163-224. (In Chinese.)
- KANASEKI, TAKEO
1951 Examples of tooth extraction in ancient China. *Kaibōgaku Zasshi* 26(2). (In Japanese.)
1952 The anthropology of East Asian peoples as seen from the Formosan aborigines. *Fukuoka Igaku Zasshi* 43(2): 1-13. (In Japanese.)
1956 On the human skulls excavated from the prehistoric site K'entingliao, Hengch'un prefecture, Formosa. *Proceedings of the Fourth Far Eastern prehistory and the Eighth Pacific Science Congresses Combined* pt. 1: 303-308. Manila.
1957 On a human jaw found at the Niaosung shell mound near Tainan, Formosa. *Jinruigaku Tanpō* 18: 347-354. (In Japanese.)
- KANASEKI, TAKEO, AND NAOICHI KOKUBU
1949a Preliminary report on the prehistoric site at Yingp'u in Taichung Prefecture. *Taiwan Wenhua* 5(1): 29-34. (In Chinese.)
1949b The boot-shaped stone implements in prehistoric Taiwan. *Jen-wen Ko-hsüeh Lun-ts'ung* 1: 73-100. (In Chinese.)
1950 Outline of prehistorical researches in Taiwan. *Taiwan Wenhua* 6(1): 9-15. (In Chinese.)
1953 Recent researches in the prehistoric archaeology of Taiwan. *Minzokugaku Kenkyū* 18(1-2): 67-80. (In Japanese.)
- KANEKO, ERIKA
1953 Stone implements and their use in the agriculture of Taiwan. *Wiener Völkunkliche Mitteilungen* 1(2): 22-31.
- KANO, TADAO
1956 *Outline Review of Taiwan Archaeology and Ethnology*, W. H. Sung, trans. Taipei: Provincial Commission for Historic Research. (In Chinese.)
- KOKUBU, NAOICHI
1941 Prehistoric remains in Southern Taiwan. *Nanpō Minzoku* 6(3): 179-196. (In Japanese.)
1962 On the prehistoric shell mound of Formosa. *The Journal of the Shimonoseki College of Fisheries, Civic Science* 7: 52-72. (In Japanese.)
1964 Prehistoric sites located along the base of Shou-Shan hill, Kao-hsiung prefecture. *The Journal of the Shimonoseki University of Fisheries, Civic Science* 8: 1-10. (In Japanese.)
- KOKUBU, NAOICHI, et al.
1949 Report on the research work in the prehistoric sites of Hsinchu Prefecture and coastal district of Taipei Prefecture recently visited. *Taiwan Wenhua* 5(1): 35-40. (In Chinese.)
- KU, YÜ-MIN
1962 Report of the investigations of caves in Ling-Shan, Kwangtung. *Vertebrata Palasiatica* 6(2): 193-199. (In Chinese.)
- KUO, YÜAN-WEI, AND CHIA-HO LI
1963 Test excavation of a cave site at Hsien-jen-tung near Ta-yüan, in Wan-nien, Kiangsi. *K'ao-ku-hsüeh-pao* 1: 1-16. (In Chinese.)
- LIN, CH'AO-CH'I
1960 Shellmounds in Southwest Taiwan and their geo-historical significance. *Department of Archaeology and Anthropology, National Taiwan University Bulletin* nos. 15-16: 49-94. (In Chinese.)
1963 Quaternary in Taiwan. *Taiwan Wenhua* 14(1-2): 1-92. (In Chinese.)
1964 Geology and ecology of Taiwan prehistory. *AP* 7(1-2): 203-213.
- LIU, PIN-HSIUNG
1955 Report of the investigation at the Niu-ma-t'ou site in Ch'ing-shui Chen, Taichung County. *Taiwan Wenhua* 6(4): 69-83. (In Chinese.)
1964 Excavations and discoveries at Tapenkeng and other prehistoric sites of Pali district. *AP* 7(1-2): 214-223.

MABUCHI, TOICHI

1953a Classification of the Formosan aborigines—a historical perspective. *Minzokugaku Kenkyū* 18(1-2): 1-11. (In Japanese, with English summary.)

1953b Migrations and distribution of the Formosan aborigines, Part 1. *Minzokugaku Kenkyū* 18(1-2): 123-154. (In Japanese, with English summary.)

MANSUY, H.

1924 Stations préhistoriques dans les cavernes du massif calcaire de Bac-Son (Tonkin). *MSGI* 11.

1925 Nouvelles découvertes dans les cavernes du massif calcaire de Bac-Son (Tonkin). *MSGI* 12.

MEDWAY, LORD

1960 Niah shell—1954-8. *SMJ* 9(15-16): 368-379.

MIYAMOTO, NOBUTO

1956 A study of the relation between the existing Formosan aborigines and stone-age remains in Formosa. *Proceedings of the Fourth Far Eastern Prehistory and the Anthropology Division of the Eighth Pacific Science Congresses Combined* pt. 1: 329-334. Manila.

MO, CHIH

1959 Stone implements unearthed at Hsi-chiao-shan in Nan-hai, Kwangtung. *K'ao-ku-hsüeh-pao* 4: 1-15. (In Chinese.)

1960 Primitive culture sites on Hainan island, Kwangtung. *K'ao-ku-hsüeh-pao* 2: 121-131. (In Chinese.)

1961 Shellmound sites in Ch'ao-an, Kwangtung. *K'ao-ku* 11: 577-584. (In Chinese.)

MO, CHIH, AND CHIH-LIANG CH'EN

1961 Shellmound sites of the Neolithic period in Tung-hsing, Kwangtung. *K'ao-ku* 12: 644-649. (In Chinese.)

MO, CHIH, AND SHIH-WEN LI

1960 Neolithic remains in the lowlands of central Kwangtung. *K'ao-ku-hsüeh-pao* 2: 107-119. (In Chinese.)

MO, CHIH, SHIH-WEN LI, AND PAO-CH'UAN HUANG

1964 Prehistoric sites at Nien-yü-chuan and Ma-t'i-p'ing in Ch'ü-chiang and Tsou-ma-kang in Shao-kuan, Kwangtung. *K'ao-ku* 7: 323-332. (In Chinese.)

MURDOCK, GEORGE P.

1964 Genetic classification of the Austronesian languages: a key to oceanic culture history. *Ethnology* 3(2): 117-126.

PEARSON, RICHARD J.

1966 Temporal and spatial variation in Ryukyu prehistory. Ph.D. dissertation, Yale University.

SAUER, CARL O.

1948 Environment and culture during the last glaciation. *Proceedings of the American Philosophical Society* 92(1): 65-77.

1952 *Agricultural origins and dispersals*. New York: The American Geographical Society.

SAURIN, EDMOND

1940 Stations préhistoriques du Qui-Chan et de Thuong-Xuan (Nord Annam). *Proceedings of the Third Congress of Prehistorians of the Far East*, Singapore, 1938, pp. 71-90.

SHENG, CH'ING-CH'I

1960 *Cultural geography of Taipei county*; Vol. 4, *Prehistory*. Taipei: Commission for Historic Research of Taipei County. (In Chinese.)

1962a Report of investigations of prehistoric sites on the northern coast of Taiwan. *Taiwan Wenhsien* 13(3): 1-93. (In Chinese.)

1962b Report of investigations of prehistoric sites in the upper Tamsui River. *Taiwan Wenhsien Chuan-k'an* 13(4): 111-191. (In Chinese.)

1963 Report of investigations of prehistoric sites in the coastal and tableland areas of T'ao-yüan county. *Taiwan Wenhsien* 14(2): 117-138. (In Chinese.)

1965 Report of the investigations of prehistoric sites in Miao-li county. *Taiwan Wenhsien* 16(3): 91-156. (In Chinese.)

SHENG, CH'ING-CH'I, PIN-HSIUNG LIU, AND CHI-JUI WU

1961 *Report of the excavation of the T'u-ti-kung-shan site near Ta-an-liao in Taipei county*. Taipei: Commission for Historic Research of Taipei County. (In Chinese.)

SOLHEIM, WILHELM G. II

1967 The Sa-huynh-Kalanay pottery tradition: past and future research. In *Studies in Philippine Anthropology*, Mario D. Zamora, ed., pp. 151-174. Manila: Alemar Phoenix.

SU, CHAO-K'AI

- 1959 A study on the bones of animals from the prehistoric sites in Formosa. *Jenruigaku Kenkyū* 6(1): 133-170. (In Japanese.)

SUNG, WEN-HSÜN

- 1964 The stone, bone, and horn industries of the Yüan-shan shellmound. *The China Council for East Asian Studies Bulletin* 3: 98-99.
- 1965 The chronology of Western Taiwan. *Taiwan Wenhsien* 14(4): 144-155. (In Chinese.)

SUNG, WEN-HSÜN AND KWANG-CHIH CHANG

- 1954 Digging of prehistoric sites by the banks of the Shuiwei River, Taichung Prefecture. *Department of Archaeology and Anthropology, National Taiwan University Bulletin* no. 3: 26-38. (In Chinese.)
- 1964 The chronology of the Yüanshan culture. *Department of Archaeology and Anthropology, National Taiwan University Bulletin* nos. 23-24: 1-11. (In Chinese.)

SWADESH, MORRIS

- 1952 Lexicostatistical dating of prehistoric ethnic contact. *Proceedings of the American Philosophical Society* 96: 452-463.

TAN, KEINOSUKE

- 1934 *Corbicula maxima* Prime: On the variation of recent and prehistoric specimens. *The Venus* [Kyoto] 4(5): 289-302.

TSUKADA, MATSUI

- 1966 Late pleistocene vegetation and climate in Taiwan (Formosa). *Proceedings of the National Academy of Sciences* 55: 543-548.
- 1967 Vegetation in subtropical Formosa during the pleistocene glaciations and the Holocene. *Palaeogeography, Palaeoclimatology, Palaeoecology* 3: 49-64.