A REVIEW OF LUNGSHANOID SITES USING CLUSTER ANALYSIS AND MULTIDIMENSIONAL SCALING

by

SHYH-CHARNG LO
B.A., National Taiwan University, 1970

A Thesis Submitted in Partial Fulfillment of
The Requirements for the Degree of
Master of Arts

in

The Dept. of Anthropology and Sociology

We accept this thesis as conforming
to the required standard

THE UNIVERSITY OF BRITISH COLUMBIA

February, 1977

In presenting this thesis in partial fulfilment of the requirements for an advanced degree at the University of British Columbia, I agree that the Library shall make it freely available for reference and study. I further agree that permission for extensive copying of this thesis for scholarly purposes may be granted by the Head of my Department or by his representatives. It is understood that copying or publication of this thesis for financial gain shall not be allowed without my written permission.

Department of Anthropology

The University of British Columbia
2075 Wesbrook Place
Vancouver, Canada
V6T 1W5

Date Feb 9. 1977

Abstract

Lungshanoid cultures are distributed in approximately the same area as the Yangshao Culture and the Classic Lungshan Culture in the north as well as along the southeast coast of China including Central and Southwest Taiwan. All these cultures represent a mixed or transitional culture between Yangshao and Lungshan. In the past decades, a great number of these sites have been found, excavated and classified into several cultures with different local names, such as the Ch'u-chia-ling culture, the Liang-chu culture, the T'an-shih-shan culture, the Ta-wen-k'ou culture and the Ch'ing-lien-kang culture. These sites date from the 2nd to 4th millennia B.C..

Cluster analysis is employed to review the present classification of these Lungshanoid cultures. Nineteen sites scattered throughout Southeast China are chosen as the OTU or data units and 80 characters are isolated as the variables in this Q mode test. Seven cluster emerged as a result of this statistical analysis. Cluster I, II, III and IV fit into the traditional Ch'u-chia-ling culture, Liang-chu culture, T'an-shih-shan culture and Ta-wen-k'ou

culture. However, the previous Chiang-pei type of the Ch'ing-lien-kang culture is shared by cluster V and VII; the Feng-pi-t'ou site and traditional Chiang-nan type of the Ch'ing-lien-kang culture are grouped into cluster VI. The configuration from the multidimensional scaling on the first and second vectors seems that the patterning of the sites on these two vectors agree with the clusters represented by the dendrogram. Especially, the vertical dimension can be seen as a shift in pottery character and variation of implements.

The probable meaning of these clusters, such as different time periods, different people, different languages, or even different technologies, has also been briefly discussed. This study presents the first attempt at the application of clustering and scaling techniques to Chinese archaeological data. More detailed study of these site reports are necessary.

TABLE OF CONTENTS

Acknowledgement

My thanks are due to Professors Richard Pearson and Patricia Hitchins for their continuous encouragement and advice through the last two years, their many suggestions on the early drafts, and their kind and patient help in rendering the manuscript into readable English, and to Professor E. G. Pulleyblank for his suggestions and comments.

I also wish to thank Professor Richard Matson, from whom I learned cluster analysis and multidimensional scaling. Without this knowledge the present study could not have been undertaken.

S. C. Lo

Chapter 1

Introduction

In the past decade, the importance of Southeast China in Far Eastern archaeology has increased markedly. One of the reasons for this interest is that more and more archaeological evidence has been discovered thereby making available more material with which to compare, analyze, and study the prehistory of the area. After the pollen analysis at Jih-yueh-t'an was done by Tsukada Matsuo in 1964-65 (Tsukada 1966), and the excavation at Spirit Cave in Thailand by Chester F. Gorman in 1967-68 (Solheim 1969), Carl O. Sauer's (1952) theory on a Southeast Asian Agricultural heartland began to attract renewed attention. For an illustration of this development we can refer to Chang's work (1970: 175-185), in which he sets down the archaeological and botanical evidence for the beginnings of agriculture in East and Southeast Asia and, on this basis, argues for agricultural origins there. Thus, the increased importance initially attributed to the whole of

Southeast Asia by Carl O. Sauer has stimulated further archaeological research in the southeastern regions of China.

In addition, a number of C14 dates for this area have been published during the last four years (LIA 1972a, 1972b, 1974). Some of these are so early that archaeologists have had to shift their original theories and make adjustments for the new data. K.C. Chang, for instance, insisted several years ago that the neolithic culture in South and Southeast China was the result of the rapid extension of "Chung-yuan culture" of the North China Nuclear Area (Chang 1969). But now, he seems to have dramatically modified his view on this matter. For instance, in a recent article (1974: 34-38), he proposes a cultural relationship among North China, South China and Southeast Asia along the following lines:

(1) Various cultures developed in different parts of the Far East during the neolithic age. All of them developed their own culture to adapt to their different environments. Owing to contact, they were similar to some degree (p. 36).

(2) Since a continued cultural development -- from the Yangshao culture to the Lungshan culture and to the Shang

civilization -- only occured in North China, the Yellow River Valley was the earliest nuclear area in the Far East (pp. 36-37).

(3) However, the Lungshanoid cultures in South China probably developed from Cord-marked pottery as another cultural category. Some aspects of this culture were derived from the Yangshao culture, while the Lungshanoid cultures made some cultural contributions to North China. The peoples of the Lungshanoid cultures seemed to be among the ancestors of the Malayopolynesians (p. 37).

(4) It is obvious that the new evidence in Thailand is extremely important in the prehistory of Indochina but "they don't have to be made to bear -- ineffectively -- upon the origin of distant China" (p. 37). In his article in Current Anthropology (1973), Chang also clearly points out that:

> "the Pan-p'o dates of North China (ZK-38, ZK-121, ZK-127) and Tainan date of Taiwan (SI-1229) show that by at least 4000 B.C. two ceramic cultures existed side by side in North and Southeast China. Neither can be said to represent the initial form of its ceramic tradition, and neither can at this time be seen as derivative of the other" (1973: 55).

He also notes in the same article

> "the possibility is certainly strengthened that the Lungshanoid horizon first began to form in the Lower Yangtze Valley and its adjacent coastal areas; in any event, the Miao-ti-kou II Culture has now further diminished in stature as the ancestral culture of all other Lungshanoid cultures. ... As a horizon, the Lungshanoid could still have come about, on the foundation of prior culture in the Lower Yangtze Valley (possibly a southern cord-marked pottery culture not dissimilar to the one represented by the Hsien-jen Cave remains in Wan-nien, Kiangsi), as the result of a strong and stimulating cultural impact from the Yangshao Culture" (1973: 527).

In other words, it is quite obvious that an another "Nuclear Area" seems to have emerged in Southeast China. Mainland Chinese archaeologists, in spite of their own fixed ideology have stated that it is "notable" that the radiocarbon dates of the Neolithic Culture in Southeast China are not later than those for the Chung-yuan (An 1972: 40, Wu 1973: 56-7).

This paper has been written primarily as a pilot study to test the traditional classification of Lungshanoid sites in this area by using cluster analysis and multidimensional scaling.

TABLE 1

Some Important Radiocarbon Dates from China

Sample	Archaeological Site	Associated Culture	B.C.(5730±40 half-life)
North China			
Zk-38	Pan-p'o (Shensi)	Yang-shao	4115±110
Zk-121	-	-	3955±105
ZK-122	-	-	3890±105
ZK-127	-	-	3635±105
ZK-134	Hou-kang (Honan)	-	3730±105
ZK-76	-	-	3535±105
ZK-110	Miao-ti-kou (Honan)	-	3280±100
ZK-185	Ta-ho-ts'un (Honan)	-	3075±100
ZK-111	Miao-ti-kou (Honan)	Miao-ti-kou II	2310±95
ZK-126	Wang-wan (Honan)	Lung-shan	2000±95
ZK-133	Hou-kang (Honan)	-	1960±90
Southeast China			
ZK-39	Hsien-jen Tung (Kiangsi)	Lungshanoid(?)	8920±240
ZK-90	Ta-tun-tzu (Kiangsu)	Ch'ing-lien-kang	3835±105
SI-1229	Kuei-jen (Taiwan)	Cord-marked	3639±60
ZK-55	Sung-tse (Kiangsu)	Ch'ing-lien-kang	3395±105
ZK-49	Ch'ien-shan-yang (Chekiang)	Liang-chu	2750±100
ZK-51	P'ao-ma-ling (Kiangsi)	Lungshanoid	2335±95
ZK-91	Huang-chien-shu (Honan)	Ch'u-chia-ling	2270±95
ZK-124	Ch'u-chia-ling (Hupei)	-	2195±100
ZK-125	-	-	2245±160
ZK-242	Chueh-mu-chiao (Chekiang)	Liang-chu	1990±95
ZK-98	Tan-shih-shan (Fukien)	Lungshanoid	1140±90

Sample SI-1229 from Chang (1973 p.525), and the rest of the samples selected from LIA (Laboratory of the Institute of Archaeology) 1972 (p.56-58), 1974 (p.333-338).

Chapter 2

The Lungshanoid Cultures

The great number of Neolithic sites in China which have been discovered in the last one or two decades have been classified into several different local cultures, such as the Ta-wen-k'ou culture, the Ch'u-chia-ling culture, and the Ch'ing-lien-kang culture (KKYCS 1961). All these cultures somehow share a similarity to Lungshan-like sites in the north; that is, they represent a mixed or transitional culture between Yangshao and Lungshan. K.C. Chang (1959) terms the culture at these sites Lungshanoid. According to Chang (1968: 144), these Lungshanoid cultures are distributed in approximately the same area as the Yangshao Culture and the Classic Lungshan Culture in the north as well as along the southeast coast of China including Central and Southwest Taiwan. As a matter of fact, the name "Lungshanoid" is the by-product of his earlier hypothesis of the rapid expansion of advanced village farmers from the North China Nuclear Area south-

eastward to new frontiers (1968: 130). Despite some revision of this hypothesis, the term is still quite meaningful today.

In order to further understand the term Lungshanoid, Yangshao and Lungshan culture must be discussed first. Yangshao, the earliest well-established cultural stage of Northern China, is named after the site of Yang-shao-ts'un, in Mien-chih Hsien, Western Honan which, in 1921, was excavated by the Swedish geologist J.G. Andersson. The associated painted pottery has long been regarded as one of the very important diagnostic features of Yangshao culture. The distribution of this culture extends from Southern Shansi, Western Honan, and Central-Eastern Shensi to Eastern Kansu, Central Shansi, and Northern Honan (Chang 1968: 88-89). In 1928, seven years after the excavation of Yang-shao-ts'un, the Lungshan culture was discovered by Wu Chin-ting at Ch'eng-tzu-yai, near the town of Lung-shan in the heart of Shantung province. Its thin, hard, lustrous black pottery was dramatically different from the painted red sherds at Yang-shao-ts'un. Only several years after the excavation at Ch'eng-tzu-yai in 1931, the Black Pottery culture (Lungshan) was found to have a

distribution not only in Eastern Honan and Shantung, but also in the area along the Pacific coast from Pohai Bay to Hang-chow Bay in Northern Chekiang (Chang 1968: 122-124).

Since the initial discovery of these two different cultures, the interrelationship between the two of them has been energetically discussed. General speaking, Chinese archaeologists during the 1930's regarded the Painted Pottery culture (Yangshao) of western Honan, Shansi, Shensi, and Kansu, and the Black Pottery culture (Lungshan) of Eastern Honan and Shantung, as a pair of opposing but parallel cultures of the late Neolithic period immediately preceding the rise of Shang civilization (Chang 1968: 124, 1969: 3-4). However, this "Two Culture" framework faced a dilemma when Lungshan-like gray pottery was discovered in the Weishui Valley of Shensi in 1943. In attempting to resolve this problem, the discoverer of Lungshan-like cultures, Prof. Shih Chang-ju, added a third culture -- Gray Pottery Culture -- to the Chinese Neolithic Cultures in his subsequent publication (Shih 1952: 65-75). On the other hand, two Japanese scholars, Mizuno Seiichi (1956) and Sekino Takashi (1956), were the first to suggest that it was quite possible for the black pottery of the Lungshan culture to have developed from

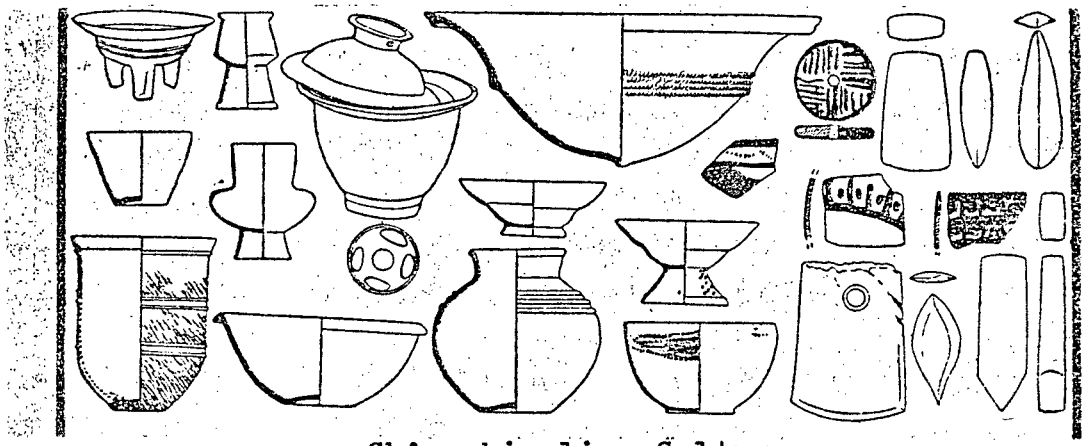
the painted pottery of the Yangshao cultures. In other words, they would rather believe that these two cultures belonged to one single culture of two different time periods than contemporary cultures in two different geographical areas. Nevertheless, both of them still accepted Prof. Shih's Gray Pottery Culture as a separate entity. Finally, in 1961 the authors of Hsin Chung-kuo ti K'ao Ku Shou Huo (The Archaeology of New China) stated that new discoveries in the last decade had forced a change in viewpoint: the hypothesis that the Lungshan cultures of the Chung-yuan were developed out of the Yang-shao culture had been generally accepted by archaeologists; no longer were they regarded as cultures of different origins (pp. 20-21). K.C. Chang expanded on this hypothesis. Having carefully studied many aspects of Yang-shao and Lungshan culture such as settlement patterns, cultivation patterns, principal domestic animals, pottery techniques, burials, community patterns, art, cult and ceremonial practices, Chang formulated his "Lungshanoid" hypothesis which could contend with the problem of mixed cultures (or Lungshan-like cultures). He viewed Lungshanoid cultures as the results of expansion of advanced village farmers from the North China Nuclear Area to new frontiers. To him,

Yangshao cultures represented the establishment stage of village farming and the Lungshan cultures represented the formation stage of local cultures (1968: 128-131, 1969: 9-11).

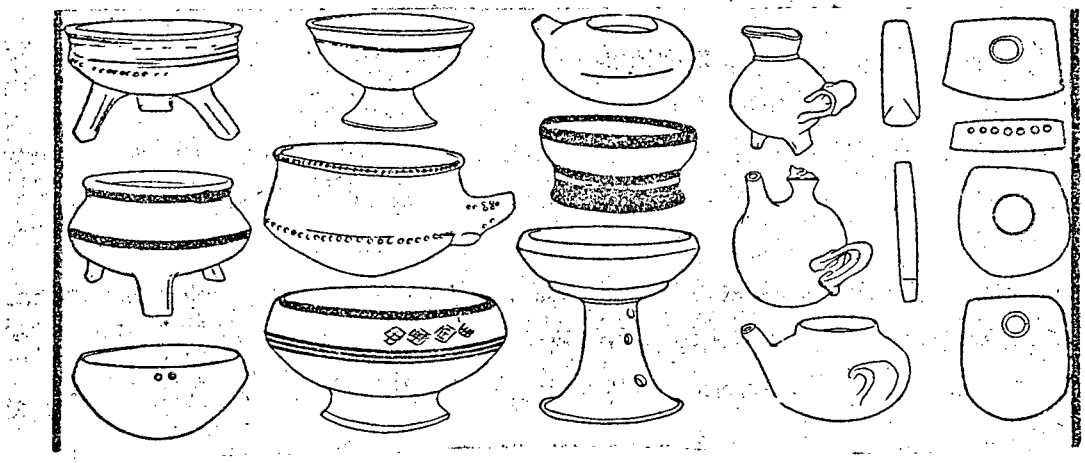
All these Lungshanoid cultures have polished stone implements that include rectangular adzes, perforated knives, and sickles. The pottery at all these sites is a mixture of red, gray and black wares, and in decoration there is a mixture of impressed, incised, and painted patterns. The pottery shapes, although different in detail, share several basic forms: ting tripods with solid legs; tou with cut-out ring feet; kui-type jars, and the wide occurrence of lids (Fig. 1) (Chang 1968: 145-146). Also according to Chang (1968: 128-129), there were 15 items in Lungshanoid cultures very different from typical Yang-shao cultural elements: (1) permanent settlement; relatively permanent occupation; (2) probable irrigation, use of fertilizer and a fallow field system; (3) cattle and sheep in sharply increased number in addition to pigs and dogs; (4) far-reaching expansions into the eastern plains, Manchuria, Central and South China, indicating population pressure from

permanent settlement and greater productivity (?) (5) emergence of many regional styles; (6) more asymmetrical edges than symmetrical; more rectangular cross sections indicating extensive use of carpenters' tools (adzes, chisels, antler wedges); (7) semilunar and double-holed, or sickle-shaped stone knives and shell sickles, a finding which indicates more extensive use of havesting tools; (8) beginning of wheel-made pottery indicative of intensified craft specialization; (9) scapulimancy which indicates intensified occupational specialization; (10) appearance of "hang-t'u" village walls and weapons indicating a necessity for fortification and means for offensive action; (11)growing number of otherwise differentiated burials,which possibly indicates more rigidly constituted classes, (12) concentration of jade artifacts at isolated spots in one site indicating more intensive status differentiation, (13) art not conspicuously associated with domestic crafts; possible association with theocratic crafts(?) (14) ceremonial wares (eggshell forms and fine, well-made cups, fruit stands and shallow dishes), (15) evidence of an institutionalized ancestor cult; ceremonials far beyond the merely agricultural type, possibly associated with specialized groups of people.

A great number of Lungshanoid sites have been found and excavated in the last two decades and also generally been classified into several cultures with local names, such as the Ch'u-chia-ling culture, the Liang-chu culture, the T'an-shih-shan culture, the Ta-wen-k'ou culture and the Ch'ing-lien-kang culture. Since the number of sites classified into the Ch'ing-lien-kang culture is so great -- in Kiangsu province alone there are more than 65 sites -- and as the study has been so intensive, Wu Shan-ching, a Chinese scholar in mainland, recently has suggested that the Ch'ing-lien-kang culture should be subdivided into a Chiang-pei (northern bank of Yang-tzu River) type and a Chiang-nan (southern bank of Yang-tzu River) type (Fig.2,3). He also suggested that the Chiang-pei type can be classified into four stages, the earliest being Ch'ing-lien-kang, followed by Liu-lin, Hua-t'ing, and Upper Ta-wen-k'ou. The Chiang-nan type can be divided into three stages, namely, Ma-chia-pin, Pei-yin-yan-ying and Sung-tse (Wu 1973: 45-55).



Ch'u-chia-ling Culture



Ch'ing-lien-kang Culture

Liang-chu Culture

Fig. 1 Artifacts of the Ch'u-chia-ling Culture, the Ch'ing-lien-kang Culture and the Liang-chu Culture. (all from Hsin Chung-kuo ti k'ao-ku Shou-huo, 1961, p. 29).

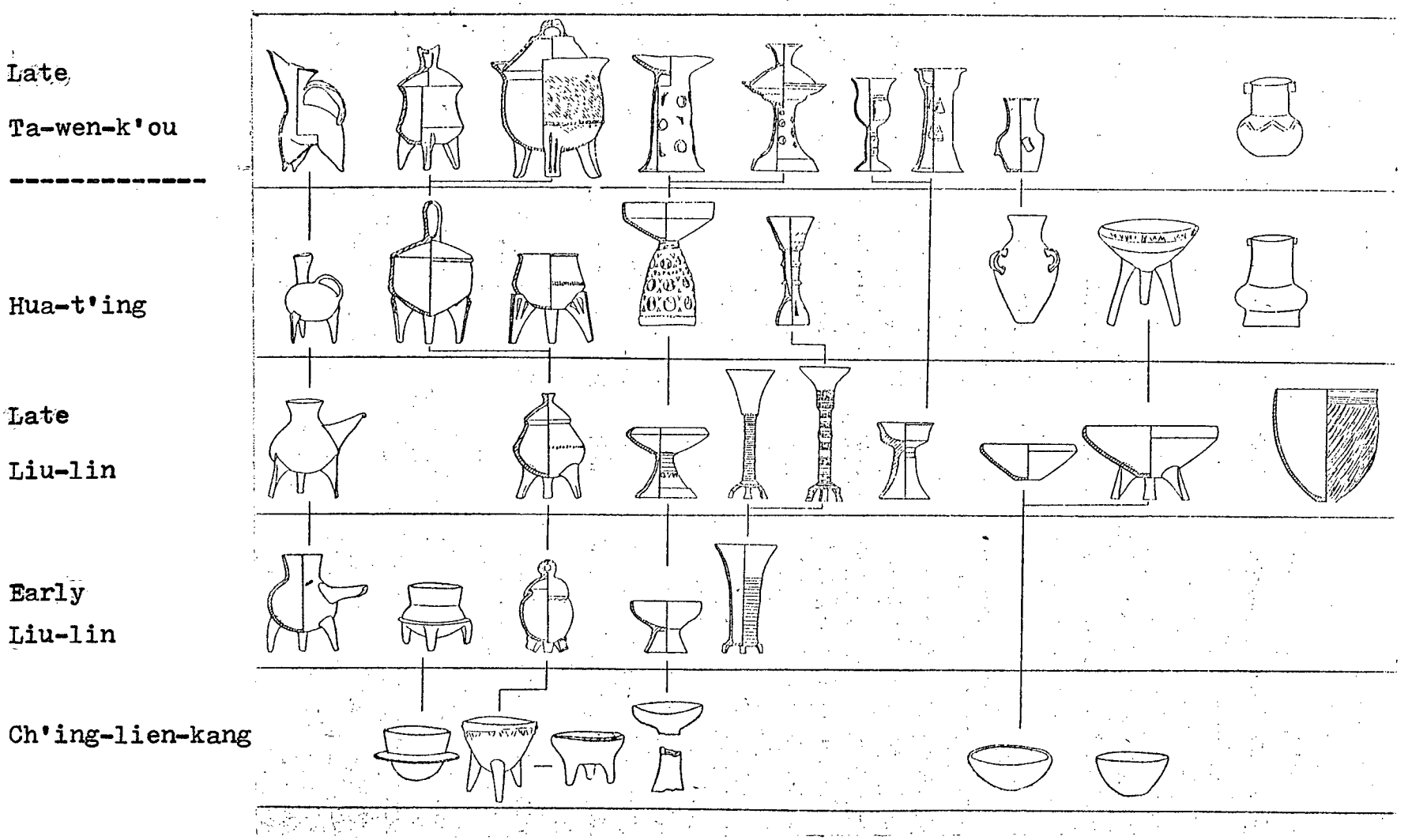


Fig. 2 Stages of Artifacts (Chiang-nan type).
(From Wu 1973: 50).

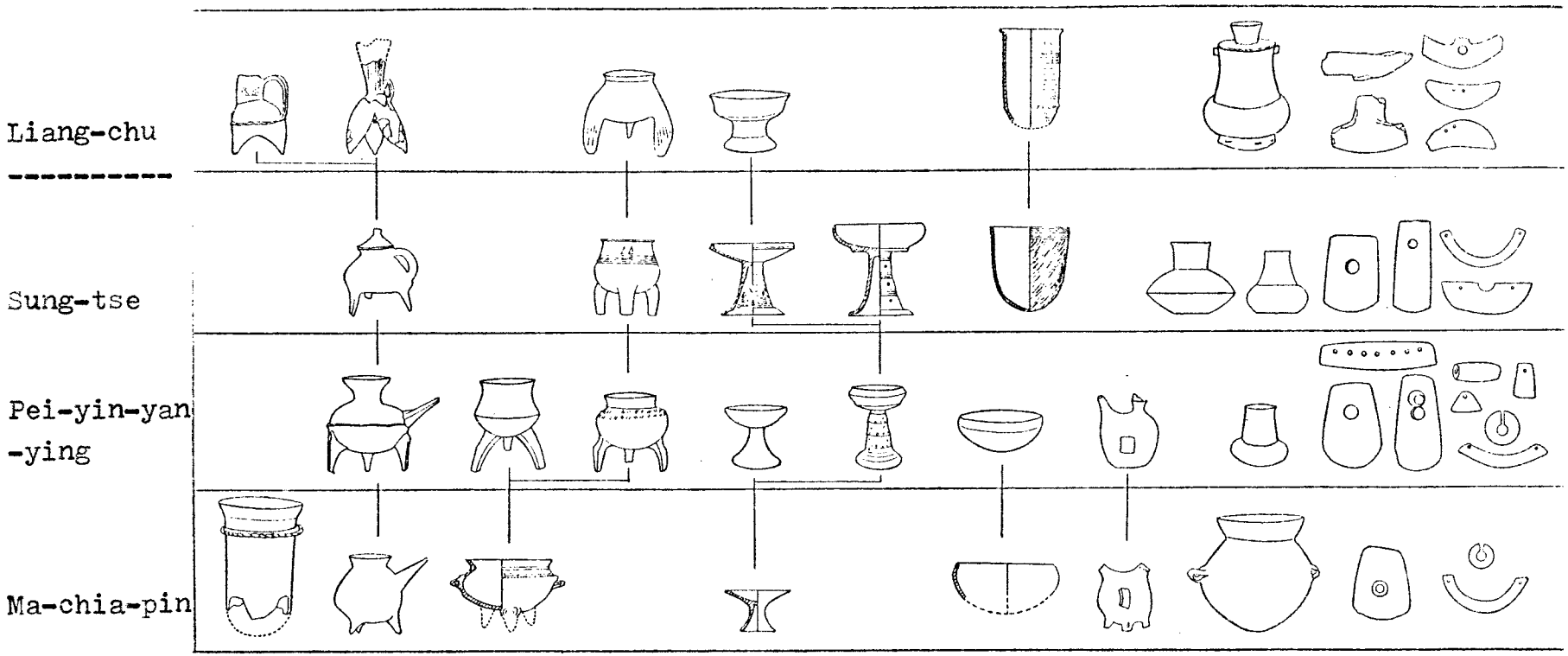


Fig. 3 Stages of Artifacts (Chiang-pei type).
(From Wu 1973: 50).

Chapter 3

The Difficulty of Classification

The position of classification in the study of archaeology has its undeniable importance, since archaeologists cannot avoid the step of classification whenever they deal with archaeological studies at any level. As a matter of fact, archaeology has been treated more as a discipline of science during the past decade. No archaeologist is pleased to be described as an "old archaeologists" who treats archaeology as art. In addition, R.C. Dunnell argues that "Classification is the systematic foundation of science" (1971: 87). Thus, the importance of classification in archaeology is very obvious.

However, no classificatory system is without some inherent shortcomings. First of all, the meaning of the term "classification" has not always been clearly defined when used by archaeologists. According to R.C. Dunnell (1971: 44), classification is only a kind of arrangement which archaeologists usually treat as "classification",

and the other kind of arrangement is grouping (Fig. 4).

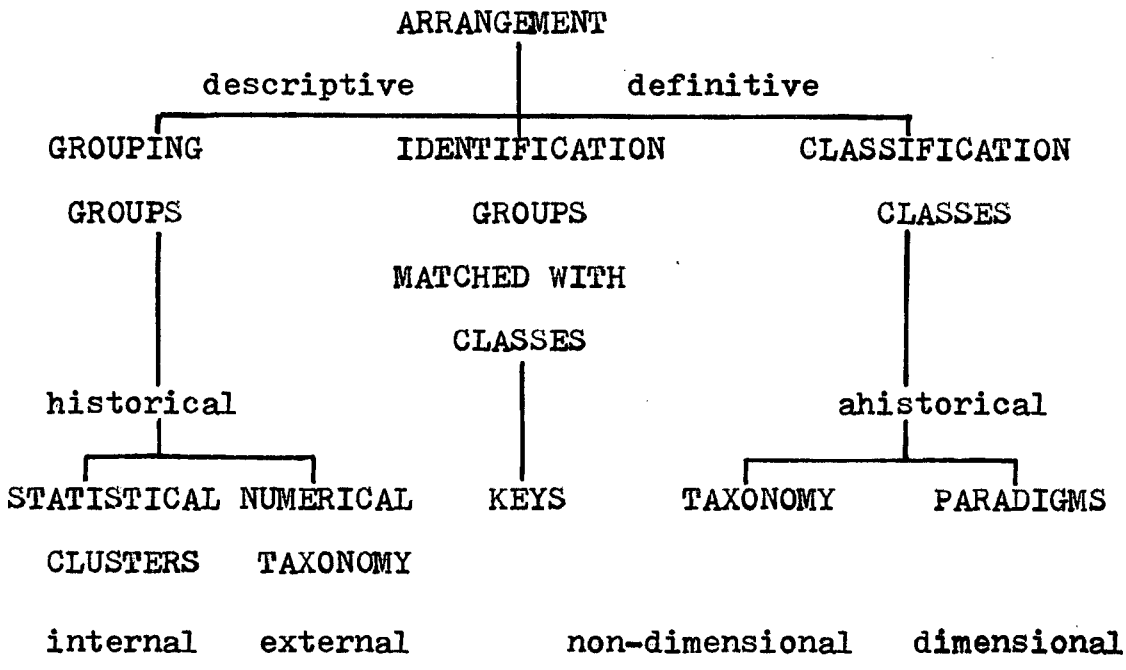


Figure 4. Kinds of arrangement. (From Dunnell 1971: 44).

Dunnell's definitions for these terms is:

> "Classification will be restricted to arrangement in the ideational realm and defined as the creation of units of meaning by stipulating redundancies (classes). Grouping will be used to denote arrangement in the phenomenological realm and defined as the creation of units of things (groups). Grouping and classification are articulated with one another

> by means of identification, the process of using classes to assign phenomena to groups, essentially matching a system of classes with a body of phenomena to create groups which are analogous to classes" (1971: 44).

The reason Dunnell states for making such a distinction is also clear. He writes:

> "In the course of day to day living, a distinction between classes and groups is not necessary, for no new information is being conveyed within a singly cultural system and evaluation is not overtly conducted; however, for the purposes of scientific inquiry and the evaluation of its results, it is necessary to make such a distinction. Without it evaluation is impossible. The lack of such a distinction in much of the archaeological literature has created a great deal of the confusion in evidence and represents the transfer of a commonsense approach to scientific inquiry" (1971: 44-45).

To bridge the gap between the "old archaeologists" and the "new archaeologists" and to encourage archaeologists to be more explicit, Dunnell has very deliberately defined most of the terminology used in archaeology so that archaeologists can communicate efficiently. Besides clarifying the terminology from time to time throughout his book, he also points out the limitations and charac-

teristics of each different classification. Only when classificatory problems are fully resolved, will archaeology be able to reach the realm of science.

Nevertheless, the reason for this difficulty in classification (or arrangement) is also that archaeologists are easily led into subjectivity when making decisions on classification. Most archaeologists are aware of the problem. A.C. Spaulding's "Statistical Techniques for the Discovery of Artifact Types" clearly illustrates this point. In this article, he states that if artifact types really do exist, then they can be discovered by statistical methods (1953: 305).

In order to gain some knowledge of the use of classification in Chinese archaeology, I have selected a number of examples dealing with both artifacts and larger cultural units. Li Chi's Hsiao-t'un, vol. III, Fascicle I, part I, was the first work done. In this work, the author tried to use a consistent format for organizing the material from one site.

The primary scheme used by Li Chi (1956: 36-37) in his classification of pottery vessels from Hsiao-t'un is as follows:

1. The ceramics were coded using a three digit number. The shape of the bottom portion is described by the first digit. Vessels with pointed or rounded bottoms are set in the categories with the ordinal number from 000 to 099, vessels with flat bottoms in that of 100 and 199, the vessels with ringfeet with the ordinals between 200 and 299, the vessels with tripods with the ordinals between 300 and 399, the vessels with four legs with the ordinals between 400 and 499, the covers of the vessels with the ordinals between 900 and 999.
2. According to the shape of the highest part of the vessels within the categories divided above, the value of 1-99 (the second and third digit) is set out under the following order: the vessels with bigger mouth and shallower depth are given a smaller value while those with smaller mouth and deeper body are given a larger value; in the meantime the angle of wall and bottom, and the construction of vessel's lip are also divided by several detailed criteria: the outward flaring rim is given a smaller value, while the inward curving rim is given a higher value.

It is obvious that Li Chi has set very firm and objective criteria to classify and seriate the pottery vessels.

Dr. Li (1956: 37) comments concerning the illustrations of the pottery vessels which are arranged under the rules described above that "perhaps some of those extremely similar in shape are divided into two different groups but some of those quite different in shape are grouped into one cluster". For example, both forms of pottery of 5P and 15N, which are similar in shape are divided into 005 and 015 groups (Fig. 5) (Li 1956: Corpus of Yin-hsu Pottery I), the same situation of 16G and 46D are also divided into 016 and 046 groups (Fig. 5,6) (Corpus of Yin-hsu Pottery I and II); while 107P and 107E or 107M quite different in shape are grouped into the 107 cluster (Fig. 7) (Corpus of Yin-hsu Pottery III), 279F and 279K into the 279 cluster (Fig. 8) (Corpus of Yin-hsu Pottery XI), 295D and 295G into the 295 group (Fig. 9) (Corpus of Yin-hsu Pottery XII), 309E and 309P or 309K or 309G into the 309 cluster (Fig. 10) (Corpus of Yin-hsu Pottery XIII), and so on. Nonetheless, K.C. Chang comments that Li Chi's work is "too Scientific" (Chang 1957). It is true, since the criteria he uses are without much cultural significance, his classification of Hsiao-t'un Pottery is too close to natural science to be useful to a social science.

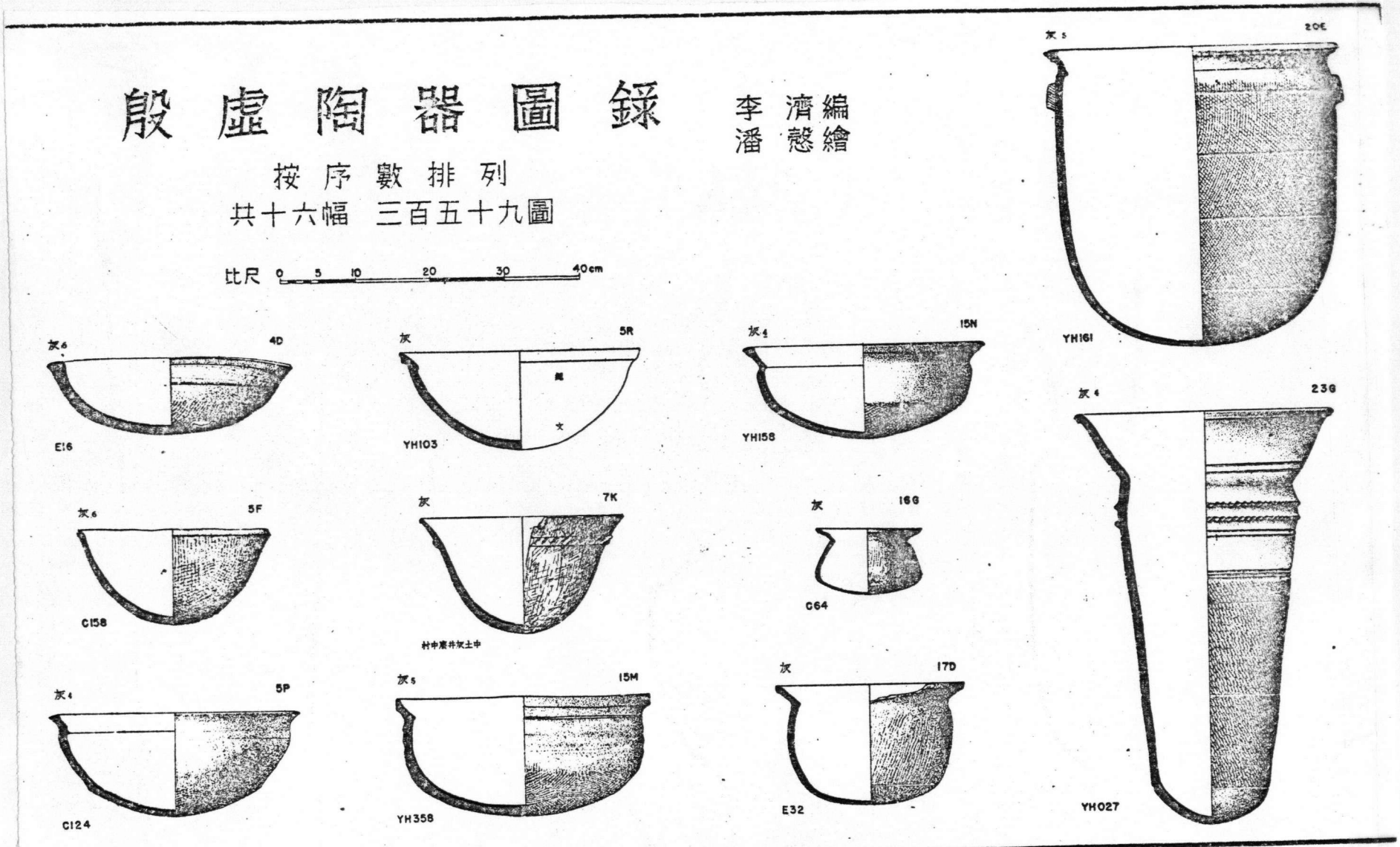


Fig. 5 Examples of Typological Grouping from Hsiao-t'un. 5P and 15N are placed in separate categories (From Li, C. 1956)

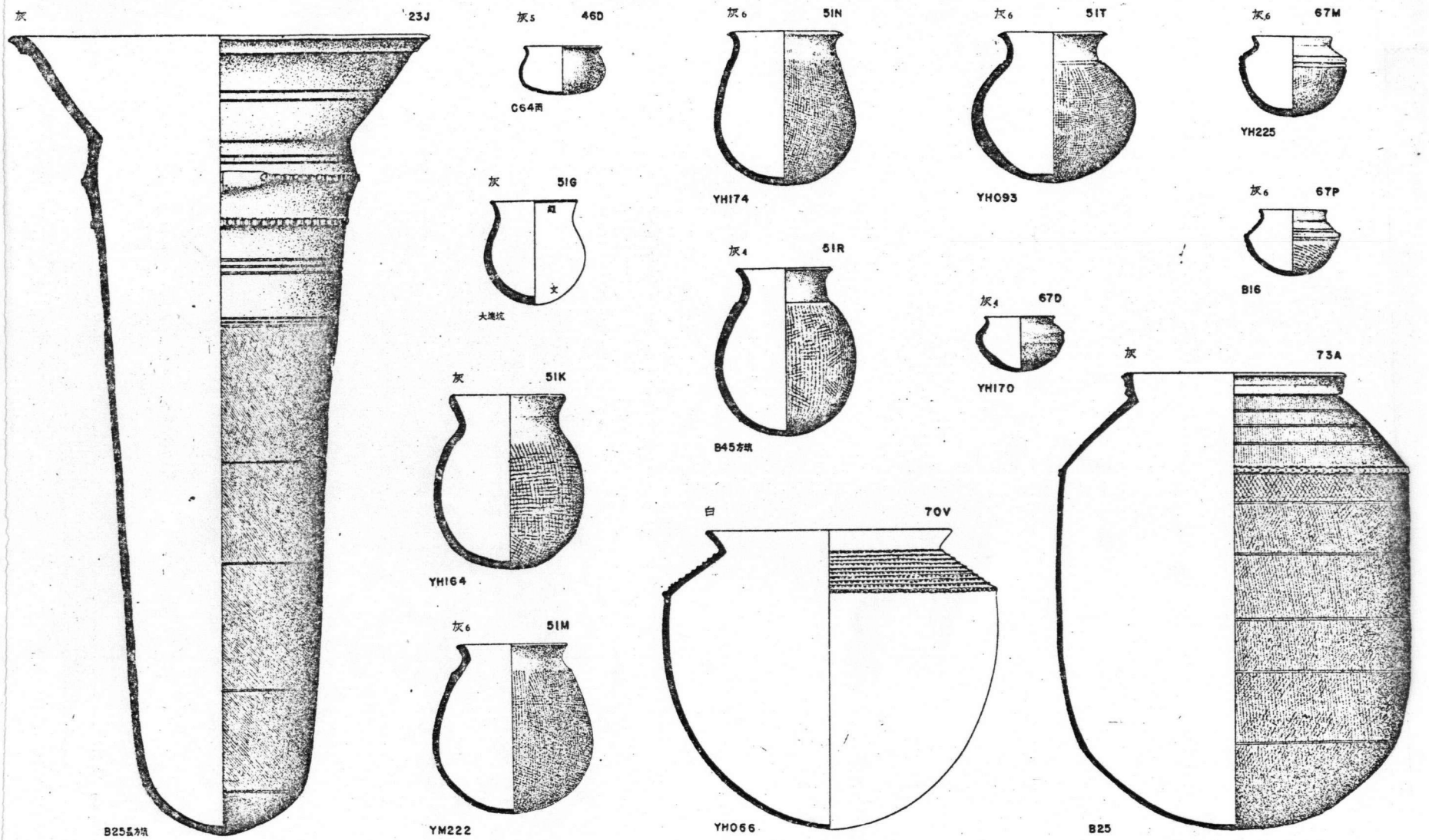


Fig. 6 Examples of Typological Grouping from Hsiao-t'un. 16G (see Fig. 5) and 46D are placed in separate categories (From Li, C. 1956).

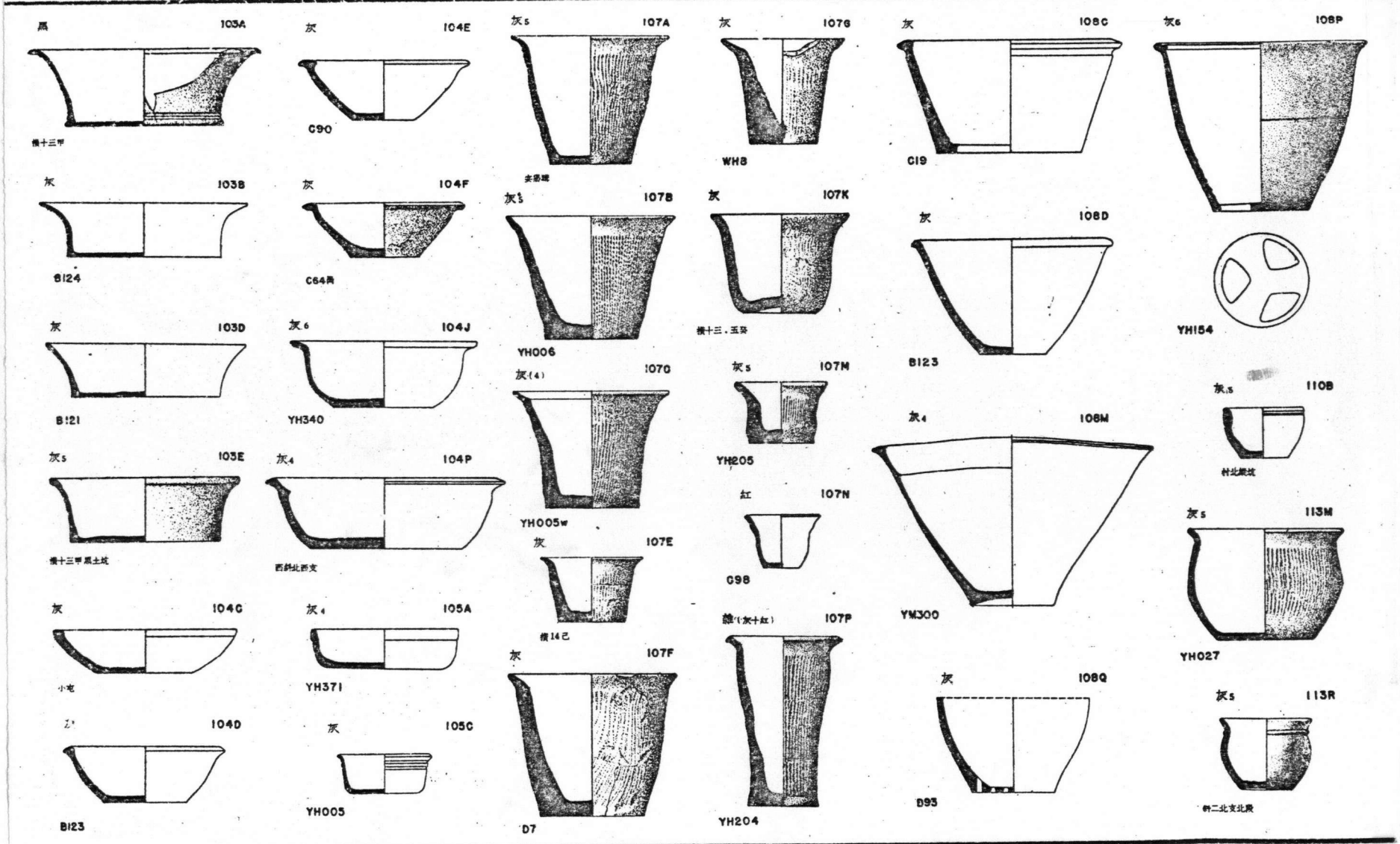


Fig. 7 Examples of Typological Grouping from Hsiao-t'un. 107P and 107E or 107M are placed in one category (From Li, C. 1956).

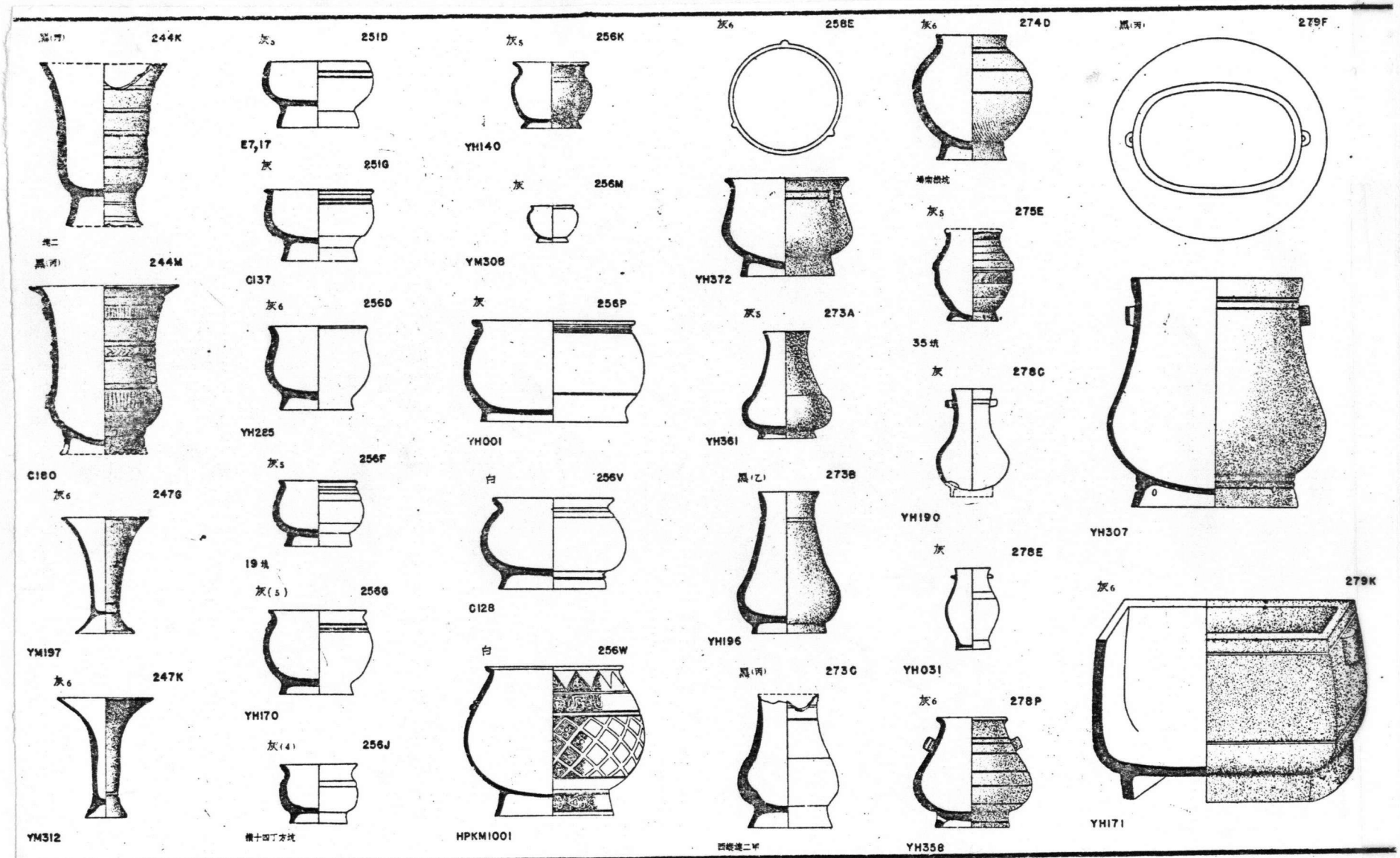


Fig. 8 Examples of Typological Grouping from Hsiao-t'un. 279F and 279K are placed in one category (From Li, C. 1956).

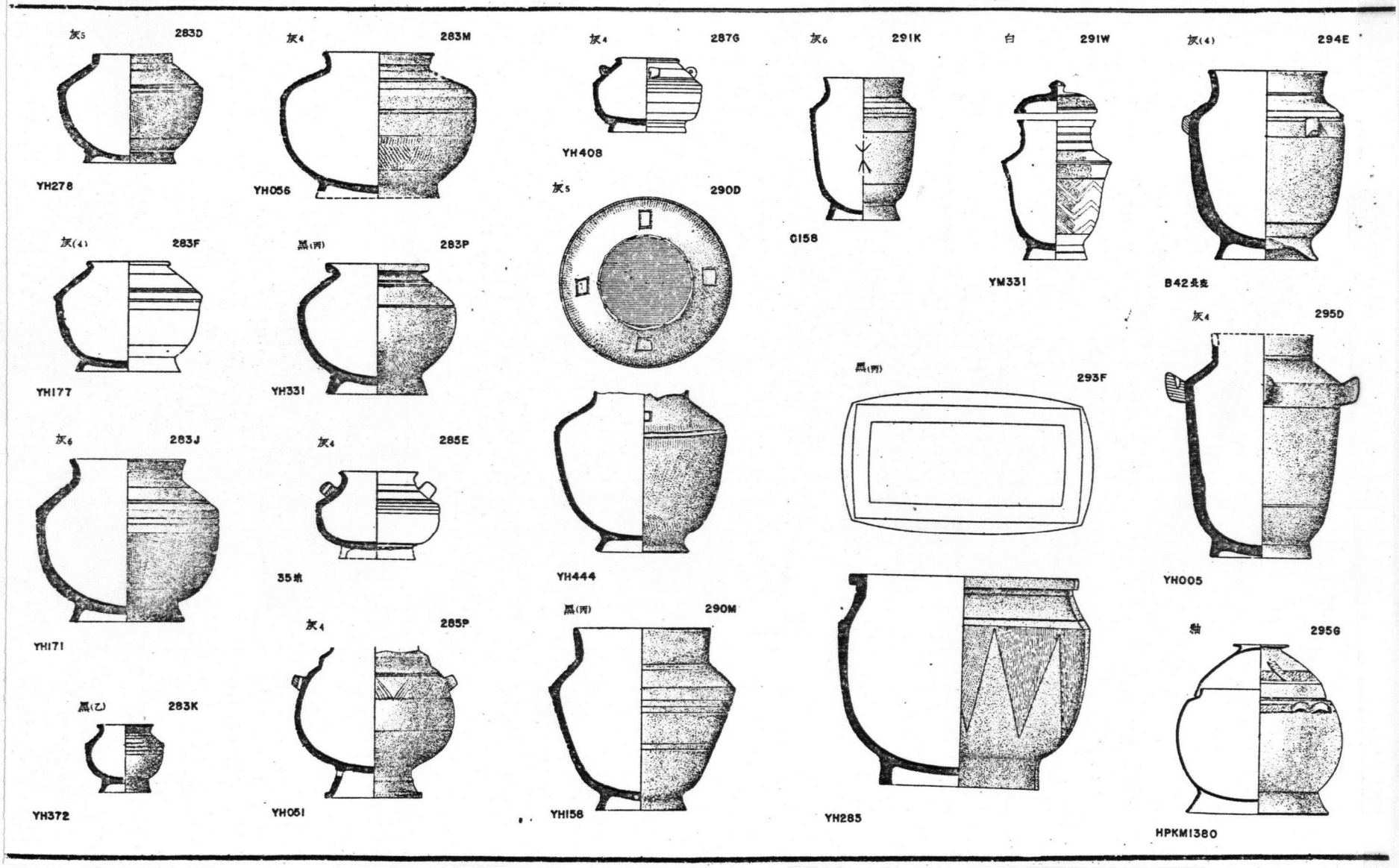


Fig. 9 Examples of Typological Grouping from Hsiao-t'un. 295D and 295G are placed in one category (From Li, C. 1956).

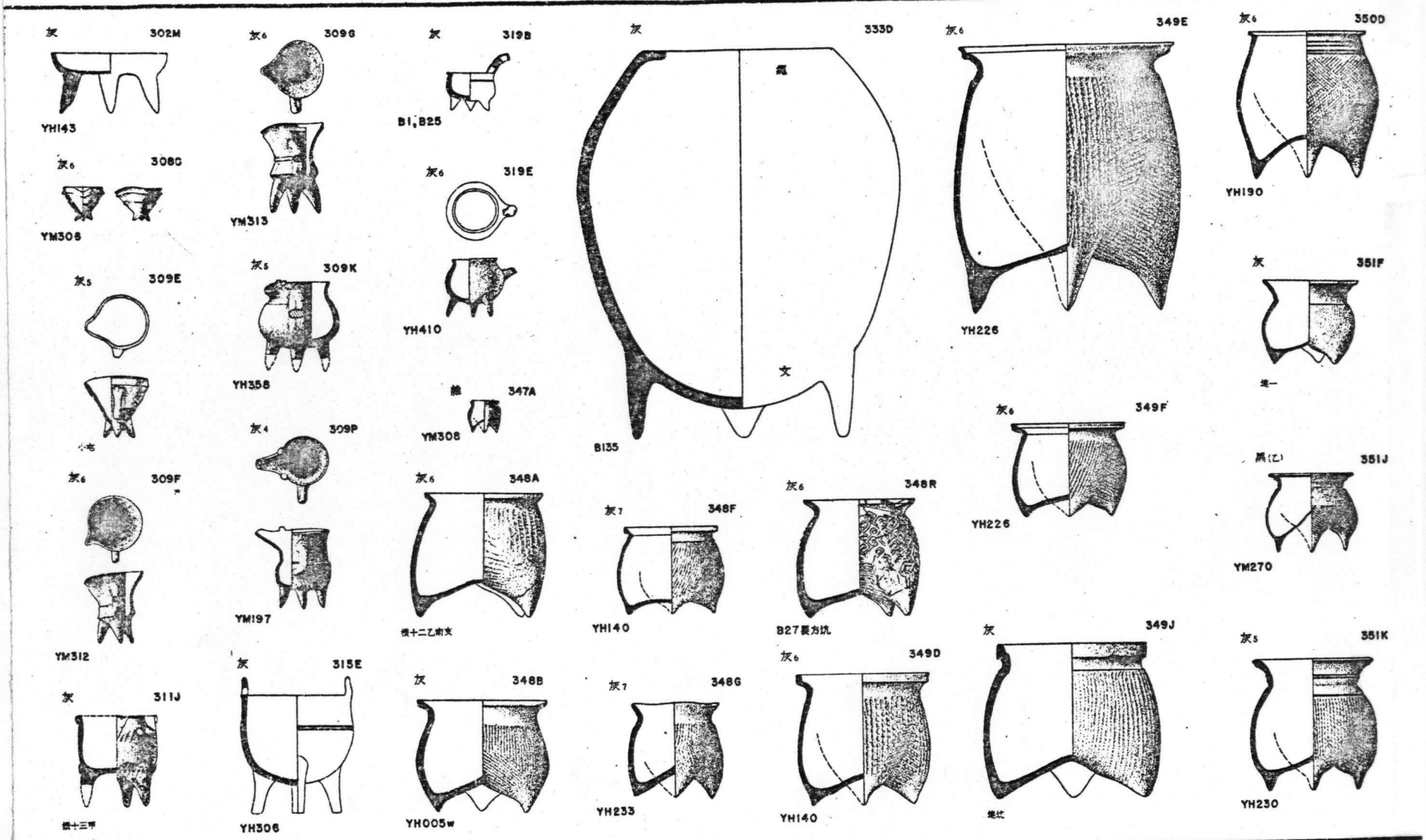


Fig. 10 Examples of Typological Grouping from Hsiao-t'un. 309E and 309P or 309K, 309G are placed in one category (From Li, C. 1956).

On the other hand, two years before Dr. Li's publication, Prof. Sung Wen-hsun's early work in the classification of the stone implements from the Yuan-shan shell mound was somewhat successful in overcoming the deficiencies noted above. The stone implements of the Yuan-shan shell mound which he classified were the specimens in the Dept. of Archaeology and Anthropology, National Taiwan University, collected before 1950 but without any stratigraphic control. This collection from the Yuan-shan shell mound is the largest one in Taiwan. The whole frame of his deliberated hierarchical classification or taxonomy is as follows (Sung 1954-55):

I. Edged stone tool

1. End-edged tool

A. Large thin shovel-shape tool

a. Large polished shovel

b. Large polished shovel with neck

c. Large chipped shovel

d. Large horned shovel

B. Large flat axe-shape tool and hoe-shape tool

a. Large convex hoe

b. Large spoon-shape hoe

c. Large flat hoe with neck

C. Various large adze-shape tools
   a. Large polished adze
   b. Large chipped adze
   c. Large columnar adze

D. Medium and small axe-shape, shovel-shape, hoe-shape tool
   a. Polished stone shovel with neck
   b. Partly polished stone hoe with neck
   c. Chipped stone axe
   d. Rough polished columnar stone axe
   e. Small rough polished shovel
   f. Small polished axe

E. Medium and small adze and chisel
   a. Columnar adze
   b. Columnar chisel
   c. Flat chisel
   d. Thin chisel
   e. Chipped columnar chisel
   f. Resharpened chisels

F. Stepped celt
   a. Stepped columnar adze
   b. Stepped columnar chisel
   c. Stepped flat chisel

G. Shouldered celt

2. Lateral-edged tool

    a. Shouldered lateral-edged tool

    b. Irregular shape lateral-edged tool

3. Double-edged tool

    a. Double-edged sounding stone

4. All-edged tool

A. Spearhead

B. Arrowhead

    a. Stone arrowhead with flat bottom.

    b. Stone arrowhead with concave and perforated bottom

    c. Stone arrowhead with flat and perforated bottom

    d. Stone arrowhead with convex and perforated bottom

C. Razor shape all-edged tool

II. Stone implement without edge

1. Hammer-shaped tool

2. Ball-shaped tool

3. Sinker

4. Lid-shaped tool

5. Tools of no definite shape

6. Other

    a. Perforated slender tool

    b. Rectangular columnar tool

    c. Quadrilateral flat tool

    d. Rectangular thin tool

It is obvious that his hierachy was built with "function" and shape, such as the presence or absence of the utilized edge and its varying position, as the prime criteria. Consequently, his classification with functional, or "use" criteria was more strongly connected to human activity than that of Dr. Li's work. Prof. Sung did not take the next step of many current archaeologists, namely grouping the artifacts into tool kits or activity sets.

The artifactural classifications which we have discussed so far are based on a few criteria such as vessel shape, position of cutting edges, or size. These are "dimensions" in Dunnell's terminology (1971:71). It is not very satisfactory to use this type of classification for larger units such as cultural phases of culture-types. The classification of the Lungshanoid cultures for instance, is not the same sort of thing as the classfication of stone implements of pottery vessels. It should be more complex since various aspects are involved in the concept of culture. During the last two or three decades, these problems have very rarely been discussed. Quite often, the newly excavated sites have been classified into already established local Lungshanoid cultures.

To determine the concept of culture and to determine the methodology used in the classificatory systems proposed for these Lungshanoid cultures are two of my original research goals.

The methodology used in the traditional classifications of Lungshanoid sites has never been clearly discussed as yet. It appears that there are no unquestionable or specific criteria to check how each site fits into the general classification; sites are viewed only in a very general way during the process of classification. Different cultures were named after the original sites in the various regions of South China. Consequently, the sites geographically close to each other were easily classified into the same group or culture phase. Although they perhaps will deny that they have been overly arbitrary in their decision-making, the archaeologists responsible for this classification have used a rather high degree of subjectivity. Not only the Ta-wen-k'ou culture, the Ch'u-chia-ling culture, the Ch'ing-lien-kang culture are so treated, but also the most recent classification of the Ch'ing-lien-kang culture into Chiang-pei, Chiang-nan and their various stages was done with unclear criteria or methodology (Wu 1973). In other words, although the

process of classification employed here looks like that of the Midwestern taxonomic method developed by W.C. Mckern (1939), the diagnostic traits used in this particular Lungshanoid classification are fairly obscure. For instances, basket weaving implements, wooden oars, wooden pestles and mortars, and a high percentage of black ware seem to be regarded as the diagnostic traits for the Liang-chu culture, while eggshell painted pottery and spindle whorls of painted pottery seem to serve as the diagnostic traits for the Ch'u-chia-ling culture. But most of the time the vague phrase "from the point of view of the cultural characteristic" (從文化特徵看)is widely employed. However, the basic concepts of culture underlying these classifications seemingly are the total traits of the artifacts. In other words, they use a normative approach and treat culture as a body of shared ideas, values and beliefs -- the "norms" of a human group as in Flannery's description of culture history. This is one of the differing views of culture summarized by Flannery (1967: 103).

Since the time that culture was defined as man's extrasomatic adaptation to his total sociological and

ecological environment (White 1959: 15), the necessity of a different kind of classification has become more urgent. Because artifacts are considered to be the product of human activities, only a classification which reflects the use of artifacts and the pattern of human behavior behind their manufacture is meaningful. In other words, an ideal classification should be neither too subjective nor too objective to reflect the artifacts' cultural or social meaning. Since it should deal with the objects in cultural terms, cluster analysis seems genuinely helpful in attempting to attain this aim of classification. The main reason for this lies in the fact that the process of cluster analysis involves two fundamental steps: subjectively selecting out as many as possible of the features which have cultural significance in many aspects of culture, and objectively viewing the features with equal weighting during the process of statistic computing.

Chapter 4

General Idea of Cluster Analysis and Multidimensional Scaling

Cluster analysis is a kind of statistical clustering. According to R.C. Dunnell's (1971: 95) classification, it belongs to the category of non-classificatory arrangement (Fig. 4). Cluster analysis is also a kind of hierachical grouping technique. This technique was first developed in biological taxonomy by Robert R. Sokal and Peter H. A. Sneath (1963). Basically they tried to use numeric values to describe the characters and then to calculate a taxonomic distance between organisms. Not long after this idea developed in biology, it was borrowed by archaeologists to analyse their numerous data. With the help of computers, many archaeologists, such as Matson and True (1970, 1974), or Binford (1966) and Hill (1970) have successfully used this technique to attempt to illuminate some difficult aspects of archaeology -- the social structure and human behavior, for instance. No wonder Michael R. Anderberg stated that "Cluster Analysis may be used to reveal

structure and relations in the data. It is a tool of discovery" (1973: 4).

According to Sokal and Sneath (1963: 120), and M.R. Anderberg (1973: 11), "data units" are the logical fundamental units in a large majority of individual organisms and can be looked at in terms of "subject", "observation", "case", "element", "object", or "event". Consequently, in archaeological applications, stone artifacts, pottery type, design element, or even the archaeological site can frequently be used as data units or OTU (operational taxonomic units). The other basic term in the use of cluster analysis is "variable". The distance of the difference or the degree of the resemblance among the data units must be consistently described in terms of their characteristics, attributes, class memberships, traits, and other such properties. Collectively, these descriptors are called "variables". The resemblance of data units completely depends on the values of all the variables. One very important and basic axiom in this technique of analysis is that every character (variable) is treated as having equal weight. Thus, it is possible to describe the data unit by calculating the value of the

presence and the absence of each variable in that unit. According to the coded value of the presence and absence of each variable in every single data unit, we can decide the degree of resemblance of any pair of data units.

The degree of resemblance of any pair of data units can be described by a concrete figure -- a similarity coefficient. According to Sokal and Sneath (1963: 129-130), and Anderberg (1973: 89), there are many formulas to calculate different similarity coefficients. After figuring out the similarity coefficients, not only are we able to do cluster analysis with them, but one can also do multidimensional scaling using these figures. The value of these coefficients is always between 0.0 and 1.0. The higher the value of the similarity coefficients the more resemblance between the pair of data units. In addition to the similarity coefficient, the degree of the resemblance among the data units also can be described by the distance of the difference among the data units. The distance of the difference of data units is calculated by the formula of 1.0-coefficient. Accordingly, the lower the value of the distance the higher the degree of the resemblance among data units.

After the correlation coefficients are figured out, the next step is to group all the data units into clusters depending on these coefficients or distances. This step is also open to many methods. There are single linkage (nearest neighbor), complete linkage (farthest neighbor), simple average, group average (unweighted pair group), Lance-Williams flexible, and Ward's method (Matson and True 1974: 55-61). However, not all of them are commonly used in the field of archaeology. Each method has different characteristics. Whatever method is going to be used, a half matrix of coefficients or distance should be prepared first. The first linkage of any method should be the smallest distance or the highest coefficient. Then the nearest neighbor should be chosen to make a new half matrix, if the single linkage method is used; while the farthest neighbor should be chosen in cases of complete linkage. The main procedure is to use these two methods alternately until all data units are linked together. The average method differs from the above only in using the average instead of the nearest or farthest neighbor. After the points of linkage are chosen, a dendrogram for these linkage clusters can be drawn on the basis of these linkage points.

On the other hand, basing the analysis on a matrix of correlation coefficients, the distance between two points (data units) also can be scaled in several dimensions. The distances among data units can be easily expounded on a pair of coordinates (two dimensions). But, when there are more than 3 characters (variables), the scaling of the distance between two data units becomes more and more complicated. In Euclidean hyperspace, the distance between two points (i.e. data units) is determined by all their dimensions (i.e. characters). Thus, the distance between 2 points in four dimensional space is defined as $d_{24}^2=(W_2-W_4)^2+(X_2-X_4)^2+(Y_2-Y_4)^2+(Z_2-Z_4)^2$. In an n-space, a hyperspace of n dimensions, therefore, the maximum distance will be n (based on characters with maximal values of unity). These multidimensional distances are scaled independently by each pair of dimensions. Sometimes the distribution of data units in each separate configuration based on two dimensions is helpful in interpreting certain phenomena in archaeology.

Neither similarity coefficients nor multidimensional scaling can be calculated by hand efficiently. Fortunately, nowadays the well-developed computer can execute these complicated processes in a few seconds.

Chapter 5

The Use of Cluster Analysis and Multidimensional Scaling

The use of these techniques in Chinese archaeology has not been attempted before. I believe these methods contribute a more objective but still culturally significant approach to the procedure of classification. From the general description of these techniques above, it is quite obvious that the variables (or features) are probably the most important links in the process of analysis. because the resemblance of data units completely depends on the values of the variables, the cluster of data units also depends on the value of the all of the variables in each data unit. Thus, the choice of variables to test the resemblance and to make the cluster is the crucial factor. This procedure of choosing variables is, in my opinion, the concrete expression of the values of social science, since we have to make a somewhat subjective decision in selecting variables which have cultural and/or social meaning. After choosing the variables, all the remaining

procedures are completely objective and fixed within the realm of natural science.

A pilot study of these techniques in Chinese archaeology on 19 Lungshanoid sites chosen for their relative importance is presented here (Fig. 11). These sites and their traditional classification are listed below (KKYCS 1961, K.C. Chang 1968, Wu 1973: 45-61).

I. The Ch'u-chia-ling Culture:

No. 13 (Ch'u-chia-ling)

No. 14 (Shih-chia-ho)

II. The Liang-chu Culture:

No. 10 (Ch'ien-shan-yang)

No. 11 (Shui-t'ien-pan)

No. 12 (Liang-chu)

No. 18 (Lao-ho-shan)

III. The T'an-shih-shan Culture:

No. 16 (T'an-shih-shan)

IV. The Ta-wen-k'ou Culture:

No. 15 (Ta-wen-k'ou)

No. 17 (Kang-shang-ts'un)

V. The Ch'ing-lien-kang Culture:

Va. Chiang-pei type

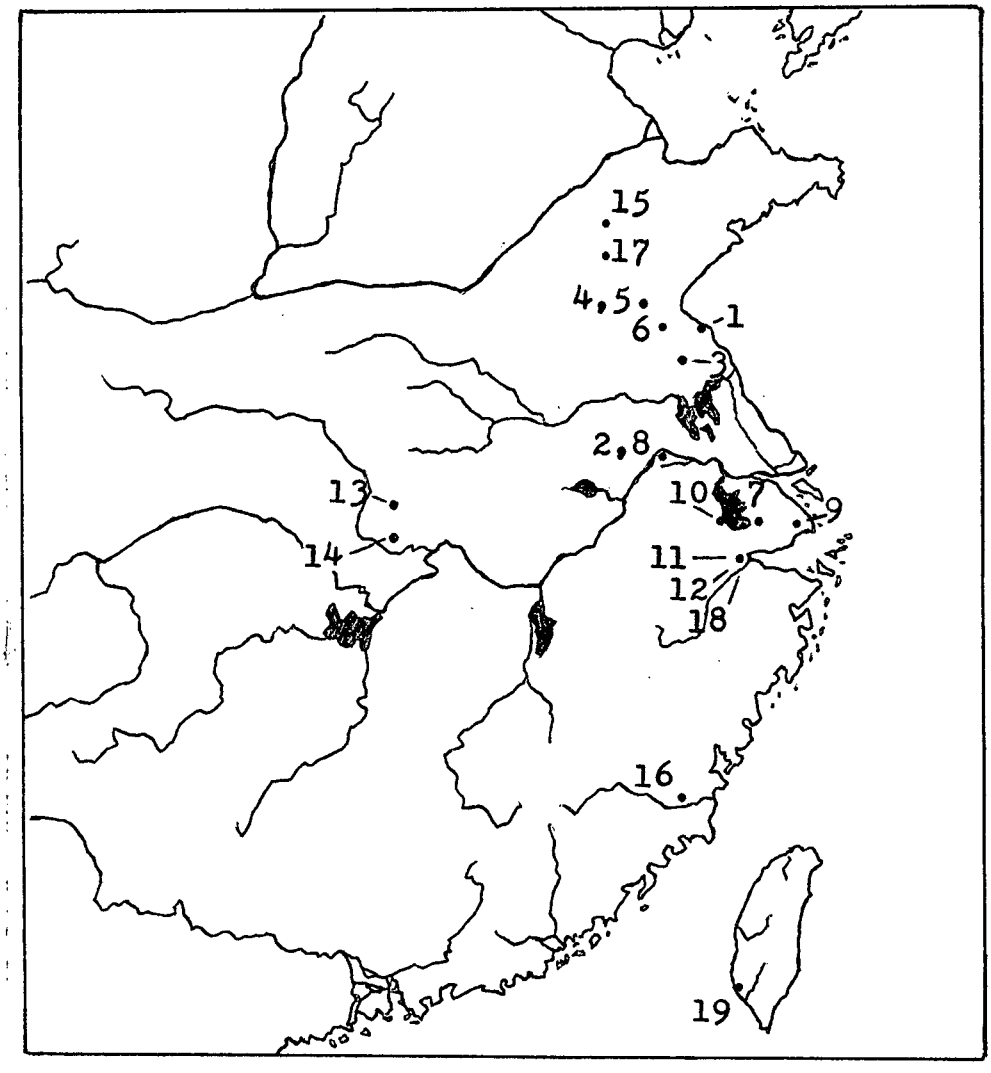


Fig. 11 Location of 19 Lungshanoid Sites
1, Erh-chien-ts'un 2, Tai-kang-shih 3, Ch'ing-lien-kang
4, Ta-tun-tzu 5, Liu-lin 6, Hua-ting 7, Ma-chia-pin
8, Pei-yin-yan-ying 9, Sung-tse 10, Ch'ien-shan-yang
11, Shui-t'ien-pan 12, Liang-chu 13, Ch'u-chia-ling
14, Shih-chia-ho 15, Ta-wen-k'ou 16, T'an-shih-shan
17, Kang-shang-ts'un 18, Lao-ho-shan 19, Feng-pi-t'ou

No. 1, (Erh-chien-ts'un)

No. 3, (Ch'ing-lien-kang)

No. 4, (Ta-tun-tzu)

No. 5, (Liu-lin)

No. 6, (Hua-t'ing)

Vb. Chiang-nan type

No. 2, (Tai-kang-shih)

No. 7, (Ma-chia-pin)

No. 8, (Pei-yin-yan-ying)

No. 9, (Sung-tse)

VI. The Feng-pi-t'ou site (Site No. 19).

The study was carried out in the following manner. Eighty characters were selected for the 19 selected sites which are scattered throughout Southeast China. These characters were scored as present or absent for each archaeological site. The characters are mainly pottery and lithic traits; no floral, faunal, or locational data were used. The main reason for this is that the degree of description in each individual site report is different. Some of them are too detailed for our purposes while others are too general. However, by using 80 characters, I felt that the sample would be sufficiently large to minimize any distortion of site relationships that might

follow from including possibly interdependent characters (Appendix B).

The use of a combined program written by R.G. Matson, Dept. of Anthropology and Sociology, the University of British Columbia, (for the main program), J.J. Wood, Dept. of Anthropology, Northern Arizona University, (for the subroutine of hierachical grouping), and R.J. Sampson, (for the subroutine to print dendrogram), permits the quick and accurate calculation of Jaccard's coefficient of distance among each pair of sites and the efficient grouping of similarity. The results of the cluster analysis (simple average) appear in the form of a dendrogram (Fig. 12). "There is no necessary implication of 'genetic' relationship in the dendrogram; it should be interpreted merely as an indicator of taxonomic distance, not as a family tree" (Matson & True 1970: 1202). The dendrogram exhibits the following patterns: (cluster I) sites 14, 13; (cluster II) sites 18, 12, 11, 10; (cluster III) site 16; (cluster IV) sites 17, 15; (cluster V) sites 6, 5, 4; (cluster VI) sites 19, 8, 9, 7, 2; and (cluster VII) sites 3 and 1. Cluster I, II, III and IV show exactly the same results as that of traditional classifications. In other words,

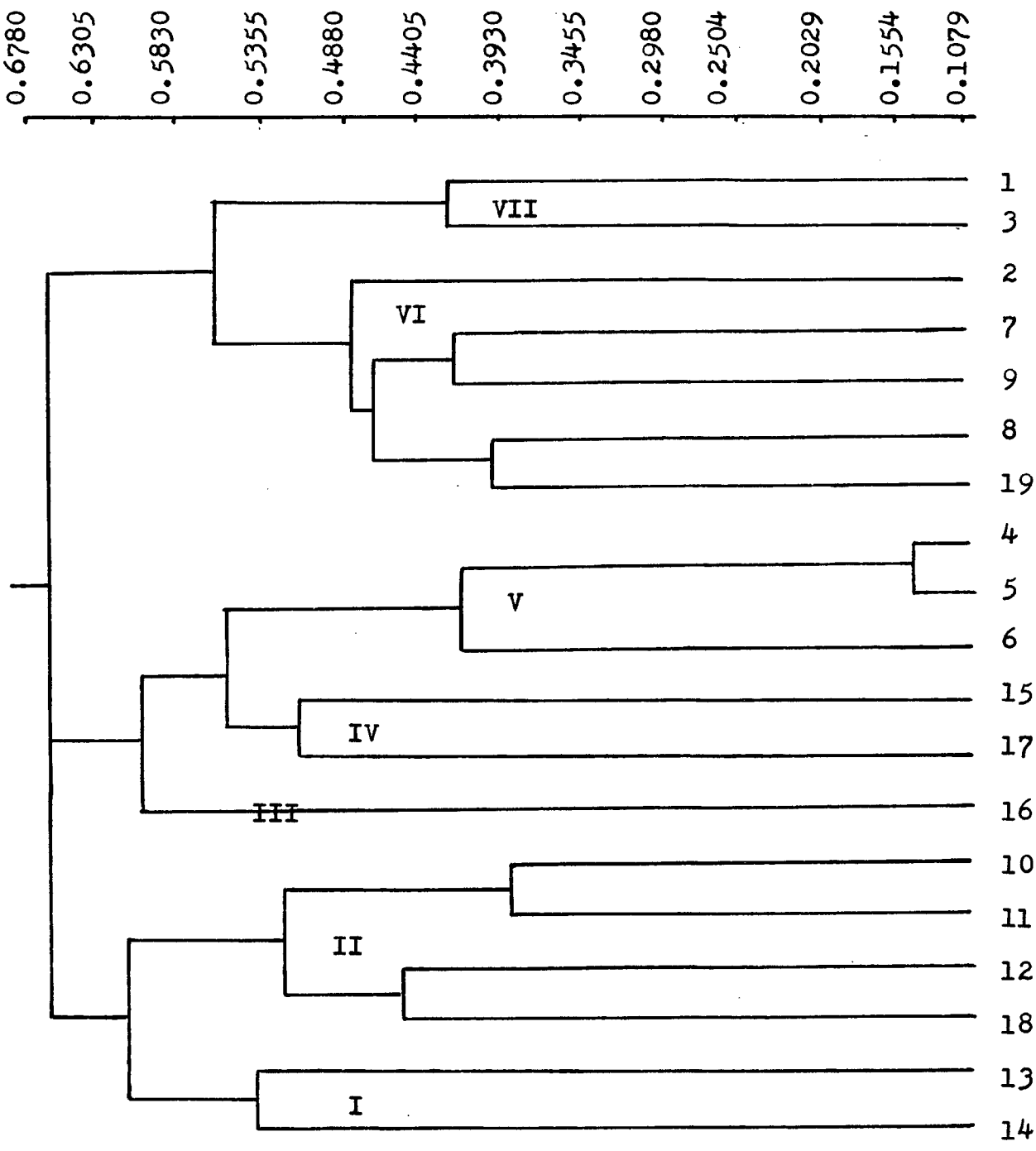


Fig. 12 Dendrogram of simple average linkage cluster analysis on a matrix of Jaccard's distances.

cluster I fits into the Ch'u-chia-ling culture, cluster II fits into the Liang-chu culture, cluster III fits into the T'an-shih-shan culture and cluster IV fits into the Ta-wen-k'ou culture. Nevertheless, the traditional Chiang-pei type of the Ch'ing-lien-kang culture is shared by cluster V and VII in the dendrogram of the cluster analysis. On the other hand, the Feng-pi-t'ou site in Southeast Taiwan and the traditional Chiang-nan type of the Ch'ing-lien-kang culture are grouped into a single cluster (VI).

The multidimensional scaling of these sites has also been carried out. This complicated process also depends on the manipulation of a computer. The computer program written for these multidimensional scalings is based on Torgerson's method (1952, 1958). "In this technique, a

> "In this technique, a matrix of the products of the distance from the centroid or origin of the configuration is calculated from a distance matrix. This product matrix then can be solved for the eigenvectors. The resulting factor matrix is the solution configuration, with the first factor being the most important axis, the second the next most important, and so on" (Matson & True 1974: 64).

The solution configurations do not quite fit the traditional classification. The percentage of trace of the first 4

factors (4 dimensions) are as follows: 22.63%, 17.33%, 10.94%, 8.94%, (Fig. 13, 14). Figure 13 is a plot of the configuration on the most important vectors (first and second dimensions). It seems that the patterning of the sites on these two vectors agree with the clusters represented by the dendrogram. The vertical dimension, in particular, (vector 1) can be seen as a shift in pottery character and variation of implements. It is quite clear that cluster II (sites 10, 11, 12, 18), in which the pottery is predominantly black ware and various kinds of impression or incision, is distributed in the top of the configuration. Cluster V (sites 4, 5, 6), on the other hand, in which the pottery character is dominated by red ware appears at the bottom of the configuration. In addition, cluster II is rich in wooden implements but lacks bone implements; cluster V is completely the reverse. Although the C14 date of 3835 B.C. (LIA 1974: 334) for point 4 (Ta-tun-tsu site) is the earliest date among all the Lungshanoid sites, it seems indefensible to interpret Vector 1 as the temporal dimension since point 16 (the T'an-shih-shan site) is dated 1140 B.C. (LIA 1974(5): 337) and point 10 (Ch'ien-shan-yang site) is dated to 2750 100 B.C. (LIA 1972(5): 57).

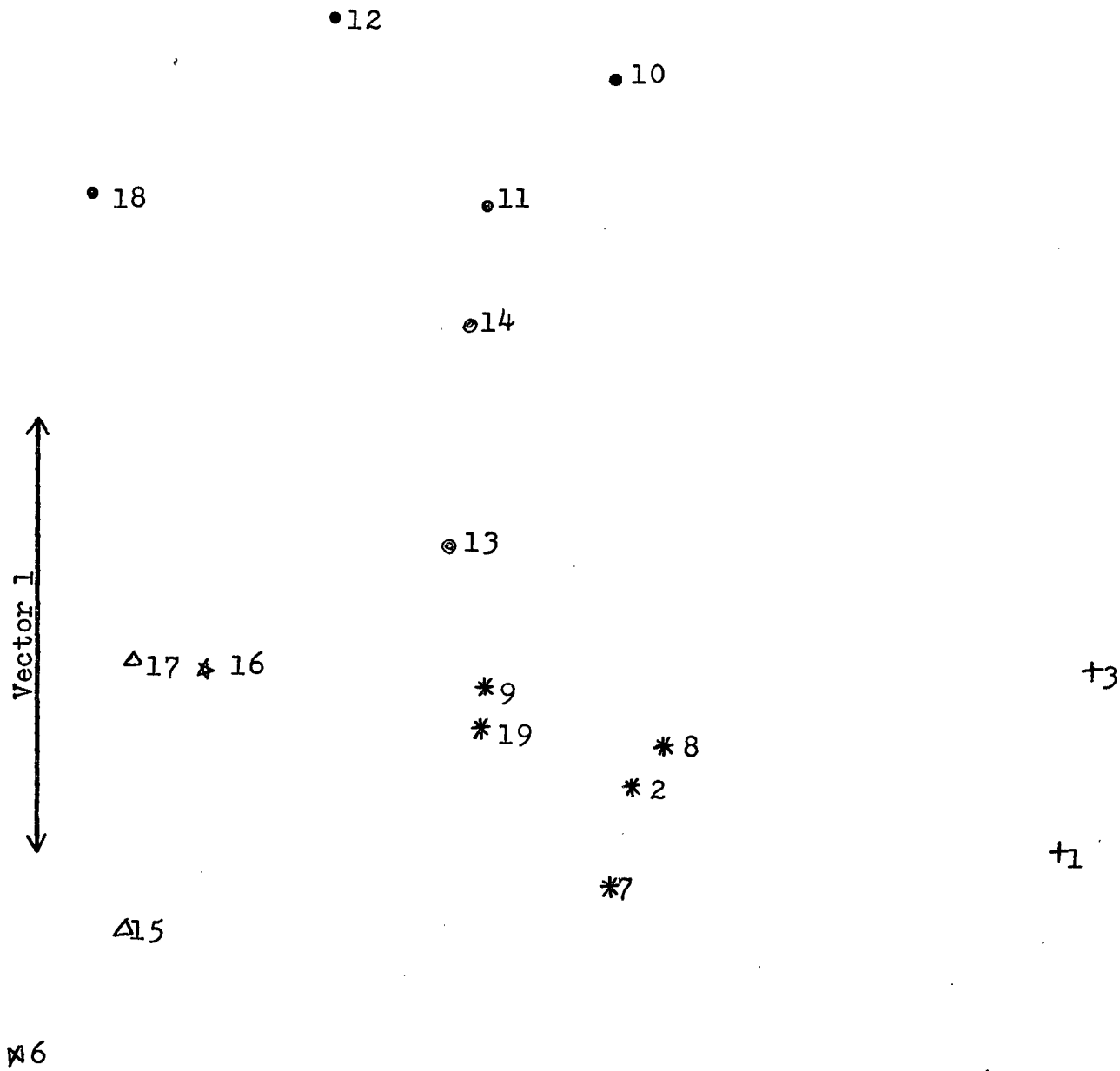


Fig. 13 Plot of site distributions obtained by multidimensional scaling (Vectors 1 and 2).

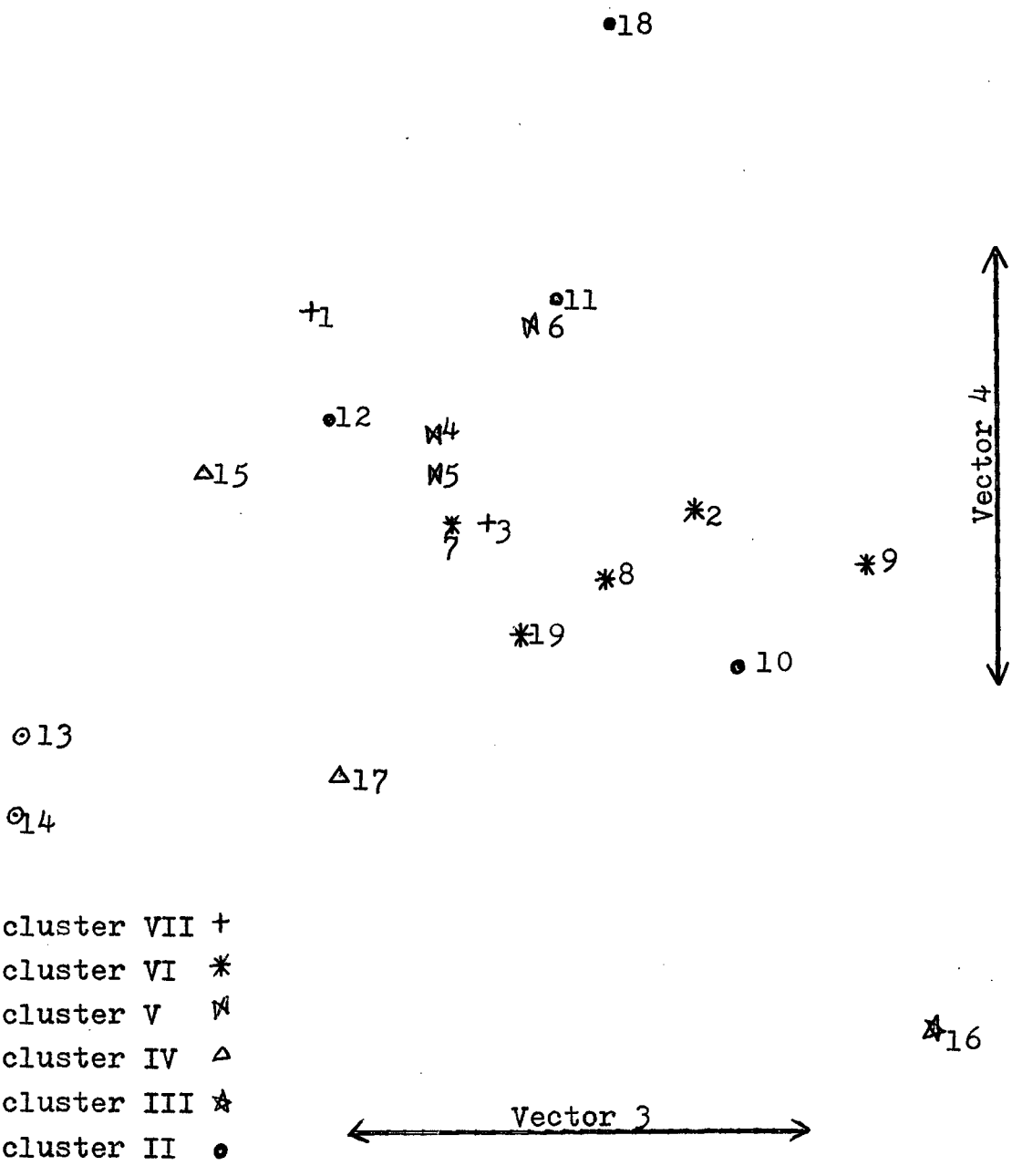


Fig. 14 Plot of site distributions obtained by multidimensional scaling (Vector 3 and 4).

The isolation of site 16 in the dendrogram is shown when plotted on vector 3 and 4 in Figure 14.

Chapter 6

Discussion

What do the clusters presented here mean? No doubt they are the result of the research method -- they may provide a new classification or R.C. Dunnell's (1971: 87-110) non-classificatory arrangement of the Lungshanoid sites. Thus, the seven clusters can stand for seven new categories of the 19 Lungshanoid sites. Since both the method and the results of this classification are different from those of the previous studies, some additional comments will be made.

The different methods of classification have been discussed above, thus the discussion here should emphasize the results of cluster analysis including its similarities and differences with traditional classification. Cluster I, II, III and IV fit into the Ch'u-chia-ling culture, the Liang-chu culture, the T'an-shih-shan culture and the Ta-wen-k'ou culture. This means that traditional classification of those sites is maintained in the cluster analysis

and vice versa. Although the remaining clusters are different from the traditional ones, they still reveal some degree of similarity to traditional classification. However, there must be some importance to the fact that the Feng-pi-t'ou site is put into the same cluster with the traditional Chiang-nan type of the Ch'ing-lien-kang culture and the traditional Chiang-pei type of Ch'ing-lien-kang culture is divided into two clusters. The position of Feng-pi-t'ou and the Chiang-nan types of the Ch'ing-lien-kang culture in the same cluster has at least two possible explanations: (1) The similarity in their cultural traits was ignored because of the geographical distance and political isolation of Chinese archaeologists on the mainland and in Taiwan. (2) Some mistakes may be present in the process of the cluster analysis carried out here, probably in the original selection of attributes. The reasons for the traditional Chiang-pei type of the Ch'ing-lien-kang culture being divided into two clusters can also be interpreted in two ways: (1) The difference or distance of cluster VII and cluster V in cultural traits really exists. (2) Some mistakes have been made during the process of doing the cluster analysis, probably in attribute selection. However, because of the close fit of clusters

I, II, III, and IV with those of the traditional classification, the selection of attributes appears to have substantial validity.

As a matter of fact, the meaning of the clusters can be further discussed with additional implications. The following questions can be asked: Do the clusters stand for different time periods, different peoples, different languages, different races, or even different technologies? Some of these alternatives are quite obvious, while some are not. After the publication of C14 dates in 1972 and 1974, the different and/or somewhat overlapping time periods of the clusters in the Lungshanoid horizon were made clear. Since the T'an-shih-shan site is dated at 1140±90 B.C. (LIA 1974), cluster III should be considered the latest of those clusters presented in this paper with C14 dates. The earliest clusters should be cluster V and VI, because the Ta-tun-tzu site of cluster V is dated to 3835±105 B.C. (LIA 1974) and the Sung-tse site of cluster VI is dated to 3395±105 B.C. (LIA 1972). Cluster II, in which the rice husks of Ch'ien-shan-yang site are dated to 2750±100 B.C. (LIA 1972), should be considered later than cluster V and VI but earlier than cluster I and III (Table 2).

TABLE 2

The Grouping Clusters With Some C14 Dates

Cluster	No. of Site	Name of Site	B.C.(5730±40 half-life)
I	13	Ch'u-chia-ling	2195±100
	14	Shih-chia-ho	
II	10	Ch'ien-shan-yang	2750±100
	11	Shui-t'ien-pan	
	12	Liang-chu	
	18	Lao-ho-shan	
III	16	T'an-shih-shan	1140±90
IV	15	Ta-wen-k'ou	
	17	Kang-shang-ts'un	
V	4	Ta-tun-tzu	3835±105
	5	Liu-lin	
	6	Hua-ting	
VI	2	Tai-kang-shih	
	7	Ma-chia-pin	
	8	Pei-yin-yan-ying	
	9	Sung-tse	3395±105
	19	Feng-pi-t'ou	1460±80
VII	1	Erh-chien-ts'un	
	3	Ch'ing-lien-kang	

The second question is also very important but fairly difficult to answer. Have the different clusters anything to do with different ethnic groups and their associated languages? In other words, were the different clusters produced by discrete groups of people speaking different languages? The answer to this question might shed light on the meaning of the clusters presented here. In view of the different dialects spoken in this area today, it is easy to accept the idea that many languages were present during the Lungshanoid horizon. Consequently, it quite possible that the different clusters may represent people speaking different languages. Sometimes in one cluster even more than one language may have been used. In ancient Chinese history, especially during the Spring and Autumn Annals and Warring States Periods, the cultures of Wu, Yueh and Ch'u have for a long time been noted as distinctive from the Chung-yuan cultures. It is very probable that cluster I was related to the ancestors of the Ch'u people. According to the research done by Prof. Wen Chung-i (1967: 1-21, 167), most of the Ch'u people were indigenous, except for some of the ruling class who immigrated from north China. Prof. Wen considers these to be a branch of the "Southern People", perhaps one of the "Indonesian" groups

in earlier times. Cluster II (the Liang-chu culture) was largely ancestral to the subsequent Yueh culture and cluster IV (the Ta-wen-k'ou culture) which geographically overlapped the area of the Shantung Lung-shan culture falls into the area occupied by the so-called Eastern Yi people according to historical texts (Chang 1968: 159). According to Prof. E.G. Pulleyblank, (personal communication), Eastern Yi, Wu, and Yueh may have been Mon-khmer language speaking people, and Ch'u may have been one of the Miao-Yao speakers.

To deal with ethnic groupings in this prehistoric context raises the discussion to a more difficult level. First of all, the definition of "different ethnic groups" is not an easy one to make. If this definition rests on linguistic considerations, the discussion will be the same as above. If the definition is based on social structure, it will be extremely difficult to see the relevance between the cluster and the ethnic groups. However, when we focus on the subsistence pattern, there are some hints for us to assume the possibility that some different clusters may represent different ethnic groups. Since natural resources, such as the flora and

the fauna, or even the soil type and climate, vary in different geographic areas (see Fig. 15, 16), it is obvious that the people of the different clusters employed somewhat different technologies to pursue their different subsistence patterns. Cluster II, which is especially rich in rice husks, basket-weaving implements, wooden oars, wooden pestles and mortars is a good example of technological adaptation to local environment. In addition, it also clearly illustrates that this cluster has its own long history of development of rice cultivation with the adaptation to the swampy lowlands. In fact, the moist and swampy lowlands led to the preservation of these implements which represented peoples' activities in that time and space. Cluster I, rich in rice husks and water fowl, appears to be an example of adaptation to a swampy lowland environment as well.

Nevertheless, the dendrogram of cluster linkages (Fig. 12) indicates three major clusters: VI and VII in one cluster, III, IV and V in the second cluster, I and II in the third cluster. On the basis of this third cluster in which the two smaller clusters are rich in rice husks, basket-weaving, wooden implements, and water fowl, it could be

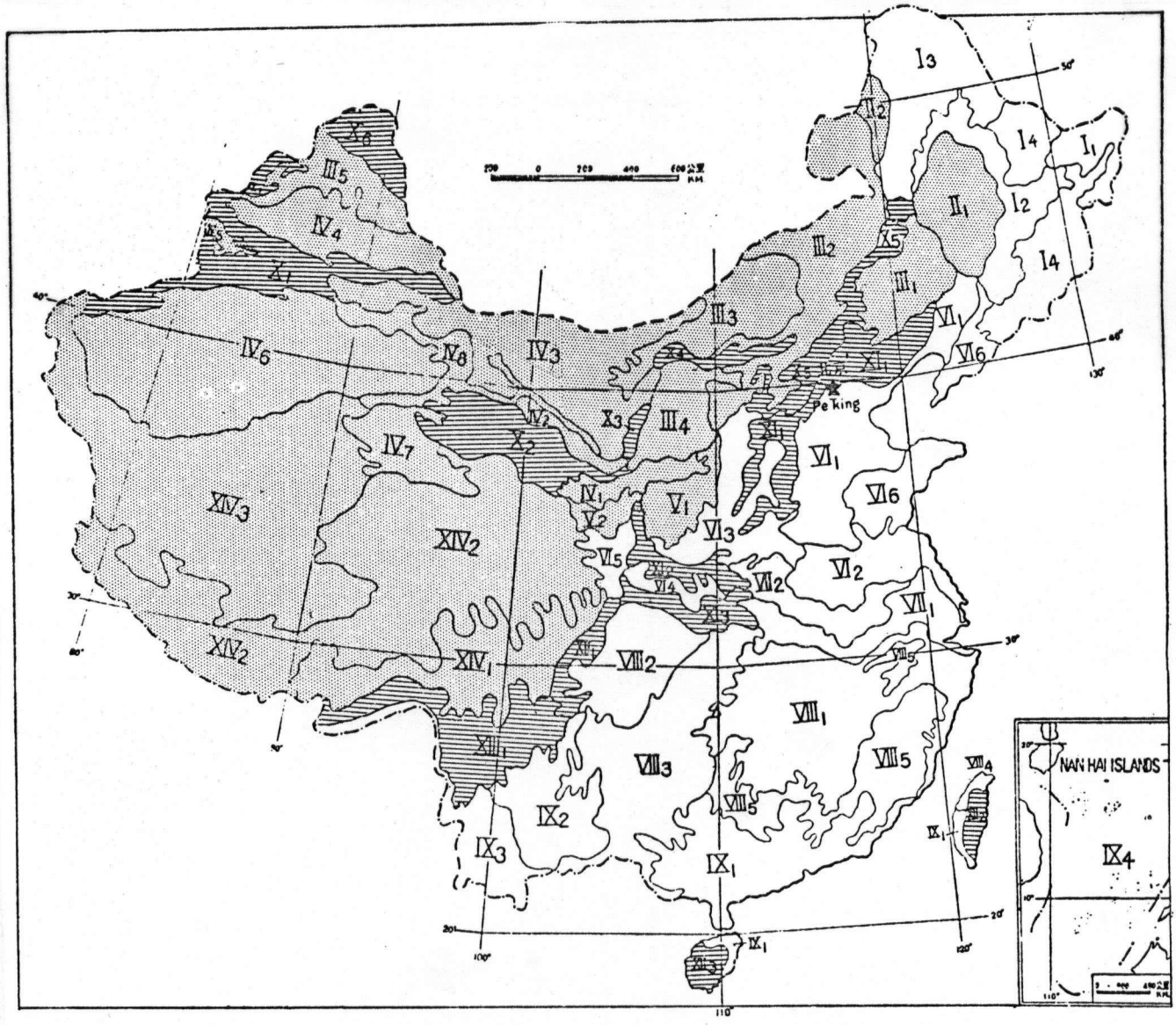


Fig. 15. Soil regions of China (Ma, Y.C., 1957a).
VI. Korichnevyi soil and brown earth. VII. Yellow-korichnevyi soil. VIII. Red and yellow earth. IX. Red earth. X. Mountain steppe soil and mountain dark-korichnevyi soil. XI. Mountain brown earth and mountain korichnevyi soil. (From Wang 1961: 17.).

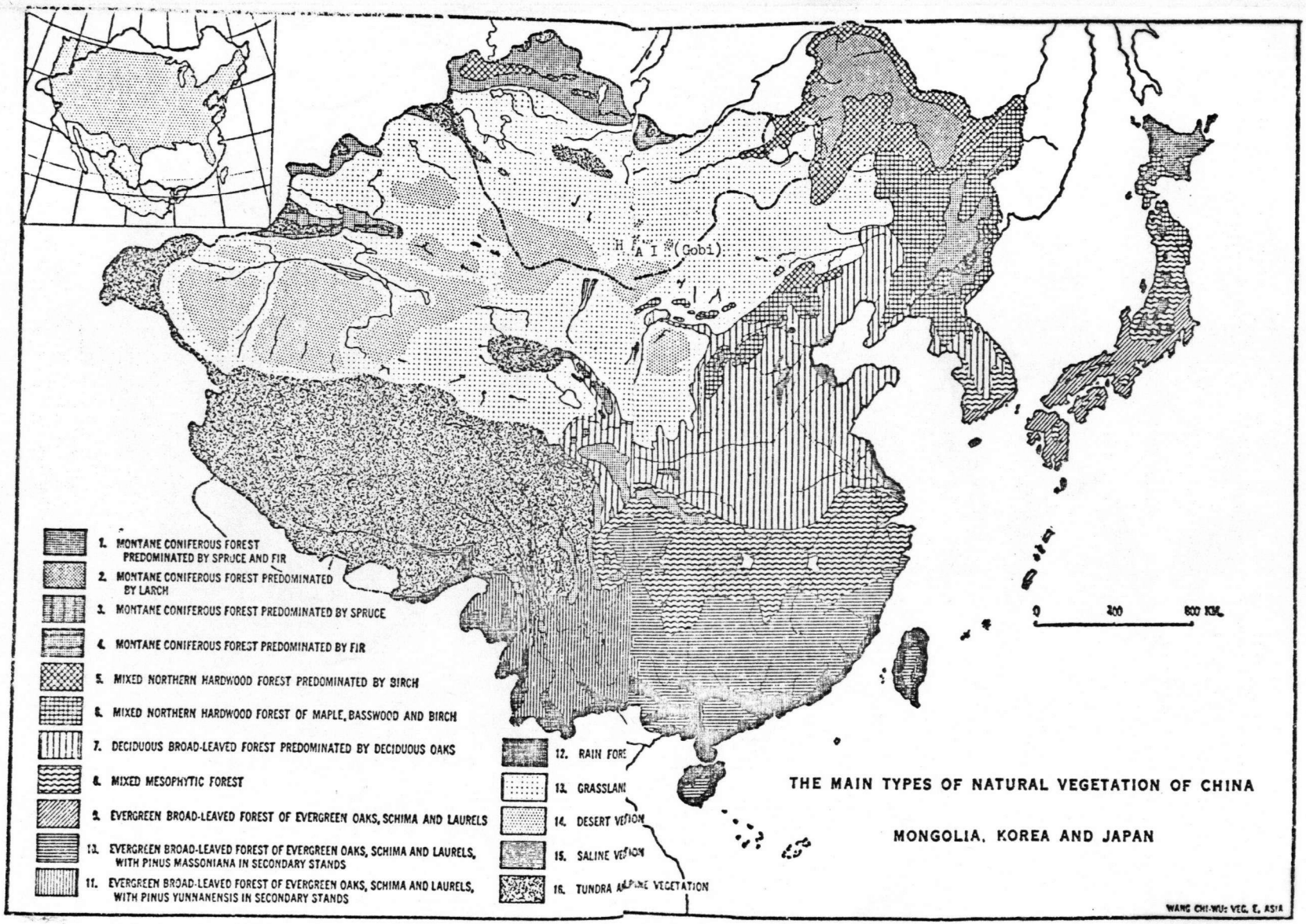


Fig. 16 The Main Types of Natural Vegetation of China and Adjacent Regions (From Wang 1961: 11).

concluded that the three major clusters are the result of environmental adaptation. However, this hypothesis is weakened by the fact that the other two clusters do not seem to reflect similar environmental adaptation, but are based on a wide variety of different characteristics. The relationship between these characteristics appeared to be too complicated for interpretation at this time. It is also very interesting that clusters I and II are clearly distributed in the upper half of Vector 1, and cluster III, IV and V are distributed in one end of Vector 2, while cluster VI and VII are distributed in the other (Fig. 13). The multidimensional scaling confirms the cluster analysis in broad outline. It is obvious that this pilot study employing cluster analysis and multidimensional scaling brings us some new and difficult phenomena to explain. However, from another point of view, the complexity and/or multidimensional nature of the Lungshanoid cultures is also revealed by this method.

Chapter 7

Conclusion

In view of the complexity and multidimensional nature of Lungshanoid cultures, I feel it is meaningful to discuss further the position of the Lungshanoid cultures within Chinese Neolithic culture as a whole, especially in the relationship with the Yangshao culture in the Chung-yuan region and the Lungshan culture in the eastern part of North China. During the long debate on the relationship between the Yangshao culture and the Lungshan culture in the past two decades, the Lungshanoid cultures have gradually assumed greater importance. In chapter 2, I mentioned that the debate almost reached a final conclusion when Hsin Chung-kuo ti K'ao-ku Shou Huo (The archaeology of New China) and Prof. K.C. Chang's The Archaeology of Ancient China (1963 and 1968) were published. This conclusion which suggested that Lungshan culture developed directly from Yangshao culture was strongly affected by the excavation of the Miao-ti-kou site, since the cultural

stratigraphy presented there shows that the Yangshao cultural elements were stratigraphically below those of the Lungshan cultural elements (KKYCS 1959). Besides the evidence of stratigraphy, the cultural features have also been examined carefully. Thus, Prof. K.C. Chang suggests (1968: 135):

> "The 'transitional' nature of the Miao-ti-kou II pottery is of particular significance; it has caused many scholars to embrace the view that the Honan Lungshan pottery could have been derived from the Yangshao."

Now, since the publication of C14 dates in 1972 and 1974, the theory that Miao-ti-kou II is the origin of all the Lungshan cultures has totally been disproved. Particularly, the date for Miao-ti-kou I of 3280±100 B.C. and for Miao-ti-kou II of 2310±95 B.C. show the impossibility of their continuity or the "transitional" nature; the dates of Ta-tun-tzu of 3835±105 B.C. and Sung-tse of 3395±105 B.C. reference point out a new direction from which to approach this issue.

As a matter of fact, long before the C14 dates were published, some scholars such as Dr. Li Chi in Taiwan and Prof. Su Ping-ch'i on the mainland, had pointed out the impossibility of that theory. The reason given by Dr. Li

(1963: 1-12) is based on the re-examination of the report on Miao-ti-kou. He pointed out: (1) the fundamental difference both in the method of firing and the general shapes of the ceramics of Miao-ti-kou I and II, (2) the people of Miao-ti-kou I culture seem to be much more sedentary than the Miao-ti-kou II people, (3) scapulimancy which perhaps was more important than black pottery in the Lungshan culture features was not found in Miao-ti-kou II. Dr. Li hints that the origin of the Lungshan culture should be in the east. Although Prof. Su (1965: 51-82) in his article, "Some problems concerning the Yangshao culture", did not definitely point out the transitional nature of Miao-ti-kou II, he strongly suggested that the Ch'ing-lien-kang culture or the lower Ta-tun-tzu culture could be contemporary with the early Yangshao culture (Su 1965: 77). In the same article, he also mentions that the later Yangshao culture of the Chung-yuan was strongly influenced by the Ch'ing-lien-kang -- Ta-wen-k'ou culture and the Ch'u-chia-ling culture (p. 79). In other words, the Lungshanoid cultures with their dynamic characteristics are treated as an antecedent culture of the Lungshan cultures, which in Kiangsu is approximately as early as the Yangshao culture at the Pan-p'o site.

Generally speaking, the main purpose of this attempt to employ cluster analysis and multidimensional scaling is to test traditional classifications of Lungshanoid sites by a more objective means while still maintaining somewhat subjective aspects assumed to have social or cultural meaning. In other words, using a great number of characters (variables) as the determinants in the process of classification with the computer is viewed as more objective than the use of only a few, but the process of choosing characters itself is subjective. A method including objective and subjective aspects in the procedure is optimal.

Since all cluster analysis and multidimensional scaling are executed by the computer, the only thing left for the archaeologist to do is the choosing of characters as the variables of OTU (operational taxonomic units) or data units. This step is not only very important but also very difficult, because the variables we choose should have as much cultural and/or social significance as possible. When one wants to deal with the published material on Chinese archaeology using this technique, one faces a serious problem in terms of the nature of these site reports -- the different degree of description in each individual site report. Some of them are to detailed for our purposes while others are too

general making it difficult for the researcher to isolate the variables for the comparison of each site. Especially when the presence and absence of variables show similar patterns at every site, with differences only in frequencies, it becomes extremely difficult to select a sufficient number of appropriate characters. It is also difficult to determine when variation within a variable is sufficiently significant to warrant the establishment of a distince variable.

However, this research represents only the initial step of statistical analysis of Lungshanoid sites in China. More detailed re-examination and study of these site reports are necessary. Nevertheless, this study does make clear the possible contributions to Chinese archaeology of further analysis using computer techniques.

- END -

Bibliography

An, Chih-min

1972 "Lueh lun wo-kuo hsin-shih-ch'i shih-tai wen-hua ti nien-tai wen-t'i," (Discussion on the chronological problems of our country's neolithic culture), K'ao-ku 1972, vol. 6, pp. 35-44.

Anderberg, Michael R.

1973 Cluster Analysis for Applications, New York and London, Academic Press.

Binford, Lewis R. and Sally R.

1966 "A preliminary analysis of functional variability in the Mousterian of Levallois Facies", American Anthropologist, vol. 68, pp. 238-295.

Chang, K. C.

1957 "Li Chi: Hsiao-t'un t'ao-ch'i shang chi", (Li Chi: A classified and descriptive account with a corpus of all the main types of the pottery of the Yin and Pre-Yin period). Bulletin of the Dept. of Archaeology and Anthropology, National Taiwan University. vol. IX-X, p. 153.

1959 "Hua-nan yuan ku min-tsu wen-hua-shih t'i kang", (An outline of ancient people's culture history in south China) Bulletin of the Institute of Ethnology Academia Sinica, no. 7.

1968 The Archaeology of Ancient China. New Haven and London: Yale Univ. Press.

1969 "Hsin-shih-ch'i shih-tai Chung-yuan wen-hua ti k'uo chang", (The extension of nuclear area culture in neolithic), The Bulletin of the Institute of History and Philology, Academia Sinica, vol. XLI, part 2, pp. 317-349.

1970 "The beginnings of agriculture in the Far East" Antiquity, vol. XLIV, no. 175, pp. 175-185.

1973 "Radiocarbon dates from China: Some initial interpretations", Current Anthropology, vol. 14, no. 5, pp. 525-528.

1974 "Comments on the interrelationship of North China, South China, and Southeast Asia in ancient times", Journal of the Hong Kong Archaeological Society, vol. V, pp. 34-38.

Davis, J. C.

1973 Statistics and Data Analysis in Geology, New York: John Wiley & Sons.

Dunnell, Robert C.

1971 Systematics in Prehistory, London: Collier-Macmillan.

Flannery, Kent V.

1972 "Culture history v. cultural process: A debate in American archaeology", Contemporary Archaeology, Mark P. Leone (ed.), Southern Illinois University Press, pp. 102-107.

Hill, James N.

1970 "Broken K Pueblo: Prehistoric social organization in the American southwest", University of Arizona Anthropological Papers, no. 18.

KKYCS, "K'ao-ku Yen-chiu Suo" (the Institute of Archaeology, Academia Sinica)

1959 "Miao-ti-kou and San-li-Ch'iao", Archaeological Excavations at the Yellow River Reservoirs Report, no. 2, Peking: Science Press.

1961 Hsin Chung-Kuo Ti K'ao Ku Shou Huo (Archaeology in New China), Peking: Wen-wu Press.

Li, Chi

1956 "Hsiao-t'un" Archaeologia Sinica no. 2, vol. 3, fascicle 1, part 1. Taipei: Institute of History & Philology, Academia Sinica.

1963 "Hei-t'ao wen-hua tsai Chung-kuo shang-ku-shih so chan ti ti-wei," (Position of the Black Pottery culture in the history of ancient China), Bulletin of the Dept. of Archaeology and Anthropology National Taiwan University, no. 21-22, pp. 1-12.

LIA (Laboratory of the Institute of Archaeology, Academia Sinica)

1972a "Report on C14 Dates (1)"K'ao-ku vol. 1. pp. 52-56.

1972b "Report on C14 Dates (2)" K'ao-ku vol. 5, pp. 56-58.

1974 "Report on C14 Dates (3)" K'ao-ku vol. 5, pp. 333-338.

Matson, R.G. and True, D.L.

1970 "Cluster analysis and multidimensional scaling of archaeological sites in Northern Chile," Science, vol. 169, pp. 1201-1203.

1974 "Site relationships at Quebrada Tarapaca, Chile: A comparison of clustering and scaling techniques", American Antiquity, vol. 39, no. 1, pp. 51-74.

McKern, W.C.

1939 "The midwestern taxonomic method as an aid to archaeological culture study", American Antiquity, vol. 4, no. 4, pp. 301-313.

Mizunô, Seiichi

1956 "Prehistoric China; Yang-shao and Pu-chao-chai", Proceedings of the Eighth Pacific Science Congress and the Fourth Far Eastern Prehistory Association, vol. I, fascicle 1.

Sauer, Carl O.

1952 Agricultural Origins and Dispersals, New York: American Geographic Society.

Sekino, Takeshi

1956 "On the black and grey pottery of ancient China", Proceedings of the Eighth Pacific Science Congress and the Fourth Far Eastern Prehistory Association, vol. I, fascicle 1.

Sokal, Robert R. and Peter H. Sneath

1963 Principles of Numerical Taxonomy, San Francisco: W. H. Freeman.

Solheim, II, W.G.
1969 "Reworking Southeast Asian prehistory", Paideuma, Band XV, pp. 125-139.

Spaulding, A.C.
1953 "Statistical techniques for the discovery of artifact types", American Antiquity, vol. 18, no. 4, pp. 305-313.

Su, Ping-ch'i
1965 "Kuan yu Yangshao wen-kuo ti jo-kan wen-t'i", (Some problems concering the Yangshao culture), K'ao-ku Hsueh-pao 1965, vol. 1, pp. 51-82. Peking: Wen-wu Press.

Sung, Wen-hsun
1954-55 "Pen hsi chiu tsang Yuan-shan shih ch'i", (Stone implements from Yuan-shan shell mound collected before 1950) (Parts 1-3), Bulletin of the Dept. of Archaeology and Anthropology, National Taiwan University, no. 4, pp. 28-38, no. 5, pp. 44-58, no. 6, pp. 34-45.

Tsukada, M.
1966 "Late pleistocene vegetation and climate in Taiwan (Formosa)", Proc. Nat. Acad. Sci., vol. 55, pp. 543-548.

Wang, Chi-wu
1961 "The forests of China", Maria Moors Cabot Foundation Publication Series, no. 5, Harvard University.

Wen, Chung-i

1967 "Ch'u wen-hua ti yen-chiu," (Aspects of the culture of Ch'u), Monograph of the Institute of Ethnology, no. 12, Taipei: Institute of Ethnology, Academia Sinica.

White, Leslie A.

1959 The Evolution of Culture, New York: McGraw-Hill.

Wu, Shan-ching

1973 "Lueh lun Ch'ing-lien-kang wen hua," (Discussion on Ch'ing-lien-kang culture), Wen-wu, 1973 vol. 6, pp. 45-61.

APPENDIX A

Original Reports of 19 Sites

Site No.

1. K'ao-ku, 1962(3).
2. K'ao-ku, 1962(3).
3. K'ao-ku Hsueh-pao, 1955(9) and K'ao-ku T'ung-hsun, 1958(10).
4. K'ao-ku Hsueh-pao, 1964(2).
5. K'ao-ku Hsueh-pao, 1961(1) and 1965(2).
6. Wen-wu Tsan-k'ao T'zu-liao 1956(7).
7. K'ao-ku, 1961(7).
8. K'ao-ku Hsueh-pao, 1958(1).
9. K'ao-ku Hsueh-pao, 1962(2).
10. K'ao-ku Hsueh-pao, 1960(2).
11. K'ao-ku Hsueh-pao, 1960(2).
12. Chekiang Neolithic Culture Illustration, 1958.
13. K'ao-ku T'ung-hsun, 1956(3).
14. K'ao-ku T'ung-hsun, 1956(3).
15. Wen-wu, 1959(10).
16. K'ao-ku Hsueh-pao, 1955(10).
17. Wen-wu, 1959(10).
18. K'ao-ku Hsueh-pao, 1958(2).
19. Chang, K.C. Fengpitou, Tapenkeng, and the Prehistory of Taiwan, 1969.

APPENDIX B

Attribute List

1. predominance of sandy red ware
2. sandy red ware
3. predominance of sandy grey ware
4. sandy grey ware
5. predominance of fine red ware
6. fine red ware
7. predominance of black ware
8. black ware
9. predominance of grey ware
10. grey ware
11. painted pottery
12. black pottery with red painting
13. eggshell pottery
14. eggshell painted pottery
15. spindle of painted pottery
16. pottery spindle
17. pottery ball
18. pottery pestle and/or mortar
19. pottery paddle and/or pad
20. pottery bracelet and/or ring
21. pottery net sinker

22. white pottery
23. ting
24. tou (without the cut-out holes)
25. tou (with the cut-out holes)
26. jar
27. pot
28. bowl
29. basin
30. dish
31. beaker
32. cistern (crock)
33. li
34. kui
35. tsun
36. fu
37. lip spouted water vessel
38. pointed bottom water vessel
39. long neck bottle (or jar)
40. cord impression
41. mat impression
42. check impression
43. basket impression
44. small dots punctuated

45. incised by comb and/or fingernail
46. engraving
47. applique decoration
48. net impression
49. shell impression
50. stone axe (cylinder, without hole)
51. stone axe (flat, with hole)
52. stone adze
53. stone chisel
54. stone knife
55. stone knife with holes
56. stone pestle and/or mortar
57. grindstone (or whetstone)
58. stone spindle
59. stone net sinker
60. stone plough
61. stone ball
62. stone arrowhead
63. semilunar stone knife
64. stone axe with shoulder
65. stone adze with step (step adze)
66. stone hoe
67. shoe-shaped stone knife

68. ring of jade or agate
69. oyster shell implement
70. basket weaving (implement)
71. wooden oar
72. wooden pestle and/or mortar
73. bone needle
74. bone ornament
75. bone arrowhead
76. bone awl
77. bone knife
78. bone harpoon
79. bone chisel
80. head east and/or south (burials)

APPENDIX C

CHINESE CHARACTERS FOR PROPER NAMES AND TECHNICAL TERMS

An Chih-min 安志敏

Chekiang 浙江
Ch'eng-tzu-yai 城子崖
Chiang-pei 江北
Chiang-nan 江南
Ch'ien-shan-yang 錢山漾
Ch'ing-lien-kang 青蓮崗
Ch'u-chia-ling 屈家嶺
Ch'u 楚
Chueh-mu-chiao 雀幕橋
Chung-yuan 中原

Erh-chien-ts'un 二澗村

Feng-pi-t'ou 鳳鼻頭
fu 釜
Fukien 福建

Hang-chow Bay 杭州湾
hang-t'u 夯土
Honan 河南
Hou-kang 后岡
Hsiao-t'un 小屯
Hsien-jen Tung 仙人洞
Hsin Chung-kuo ti K'ao-ku Shou Huo 新中國的考古收穫
Hua-t'ing 花厅
Huang-chien-shu 黃棟樹

Jih-yueh-t'an 日月潭

Kang-shang-ts'un 崗上村
Kansu 甘肅
K'ao-ku 考古
K'ao-ku Hsueh-pao 考古學報
K'ao-ku T'ung-hsun 考古通訊
Kiangsi 江西
Kiangsu 江蘇
Kuei-jen 歸仁
kui 嬀

Lao-ho-shan 老和山
li 鬲
Li Chi 李濟
Liang-chu 良渚
Liu-lin 劉林
Lung-shan 龍山

Ma-chia-pin 馬家濱

Miao-ti-kou 廟底溝
Miao-Yao 苗傜
Mien-chih Hsien 澠池縣
Mizuno Seiichi 水野清一

Pan-p'o 半坡
P'ao-ma-ling 跑馬嶺
Pei-yin-yan-ying 北陰陽營
Pohai Bay 渤海湾

Sekino Takeshi 関野雄
Shang 商
Shansi 山西
Shantung 山東
Shensi 陝西
Shih-chia-ho 石家河
Shih Chang-ju 石璋如
Shui-t'ien-pan 水田畈
Su Ping-ch'i 蘇秉琦
Sung-tse 崧澤
Sung Wen-hsun 宋文薰

Ta-ho-ts'un 大河村
Ta-tun-tzu 大墩子
Ta-wen-k'ou 大汶口
T'ai-kang-shih 太崗寺
Tainan 台南
T'an-shih-shan 曇石山
ting 鼎
tou 豆
Tsukada Matsuo 塚田松雄
tsun 尊

Wan-nien 萬年
Wang-wan 王湾
Wei-shui 渭水
Wen Chung-i 文崇一
Wen-wu 文物
Wen-wu Tsan-k'ao T'zu-liao 文物參考資料
Wu 吳
Wu Chin-ting 吳金鼎
Wu Shan-ching 吳山菁

Yin-hsu 殷墟
Yuan-shan 圓山
Yang-shao-ts'un 仰韶村
Yang-tzu River 楊子江
Yi 夷
Yueh 越