Li, Xueqin (1985) *Zhou and Qin Civilizations.* Yale University Press.

Mongch'on [Mongch'on T'osŏng Palgul Chosadan] (1985) *Mongch'on T'osŏng palgul chosa pogo* [Mongch'on T'osŏng excavation report]. Seoul: n.p. (in Korean)

Nogami, Jōsuke, ed. (1991) *Ronshū bugu* [Collected works on armour]. Tokyo: Gakuseisha. (in Japanese)

Pusan University Museum (1982) *Tongnae Pokch'ŏn-dong kobungun 1* [Tongnae Pokch'ŏn-dong tomb cluster 1]. Pusan University Museum Site Reports, no. 5: figures and plates. (in Korean)

Pusan University Museum (1983) *Tongnae Pokch'ŏn-dong kobungun 1* [Tongnae Pokch'ŏn-dong tomb cluster 1]. Pusan University Museum Site Reports, no. 5: text. (in Korean)

Pusan University Museum (1990) *Tongnae Pokch'ŏn-dong kobungun 2* [Tongnae Pokch'ŏng-dong tomb cluster 2]. Pusan University Museum Site Reports, no. 14, 2 vols.: figures and plates, text. (in Korean)

Shin, Kyŏng-ch'ŏl (1992) "Reinan no jōsei to Kannichi kōshō" [Conditions in Yŏngnam and negotiations between Korea and Japan]. In *Shinpojiumu higashi ajia no saihakken: nazo no go-seiki o saguru*, ed. N. Egami & S. Ueda, pp. 115-44, 270. Tokyo: Yomiuri. (in Japanese)

Shinpō, K. (1975) "Shichishitō no kaishaku o megutte" [Focus on interpretations of the seven-branched sword]. *Shigaku zasshi* 84.11. (in Japanese)

Suematsu, Y. (1958) "Japan's relations with the Asian continent and the Korean peninsula (before 950 AD). *Cahiers d'histoire mondiale* 4.3: 671-87.

Szczesniak, Boleslaw (1946) "Japanese-Korean wars in AD 391-407 and their chronology." *Journal of the Royal Asiatic Society* 15: 54-66.

Tokyo National Museum (1992) *Kaya—ancient kingdom of Korea.* Exhibition catalogue. Tokyo: Asahi. (in Japanese with English list of exhibits)

Yang, Hong (1985) *Zhongguo gubingqi luncong* [Treatise on ancient Chinese military implements]. Beijing: Wenwu Press. (in Chinese)

Yoshimura, Kazuaki (1991) "Tankō keitō shiron" [Investigations on cuirass types]. In *Ronshū bugu*, J. Nogami (ed.), pp. 468-93. Tokyo: Gakuseisha. (in Japanese)

Objects, sinkers, nets, behaviour and subsistence:

the use of culturally specific and relational analogies in archaeological reasoning

Youn-sik CHOO

I am the very model of a modern Archaeologist:
a geoethnoarchaeoeconomobiologist.
I've seventeen research degrees, from fifteen different colleges...

Patty Jo Watson, 1986

Introduction

Many of the generalisations about archaeological cultures are drawn by analogy with living ethnographic or folk cultures. Whether the very early uses of analogical inference in archaeology are traced back to the ancient Athenian times (Charlton 1981: 133) or to the 16th century in England (Orme 1981: 3), they show that the use of analogy has a long history. Such analogical inference has been accomplished through different types of analogy used in different geographical regions according to the nature of the archaeological record archaeologists deal with.

Broadly speaking, in the Old World, paralleling the expanding ethnographic knowledge of the New World, general comparative analogy had been widely applied to prehistoric culture of the Old World "for the understanding of artefacts and for the comprehension of development in human culture" (Orme 1981: 13), and it became conceptually linked with the 19th century unilineal evolutionary schemes. A typical example of general comparative analogy conceived in the tradition of unilineal evolutionism was Sollas's *Ancient Hunters* (Sollas 1924). However, these

Papers of the British Association for Korean Studies (BAKS Papers), vol. 5 (1994), pp. 131-86.

formal relations of comparison through analogy and "enthusiasm about analogy" (Wylie 1985: 65) gradually decreased in response to the criticisms by diffusionists and functionalists of unilineal evolutionism during the first two decades of the 20th century. After that, there were few significant developments until the middle of this century in the Old World (Orme 1981: 15). In contrast, since the late 18th century (Hodder 1982: 35), specific historical analogies have been well developed in the New World, especially in the southwestern United States where comparisons of excavated material with contemporary Indian material culture in the same areas were carried out. The tradition of a specific historical problem orientation in American archaeology began with this kind of analogy, and it was elaborated through Boasian historical particularism, creating the direct historical approach (Steward 1942).

Analogues in archaeological reasoning had been used for a long time, as mentioned above, but it was only in the 1950s that critical evaluations of the sources, content, and types of analogy was carried out in the Old and the New World. Both people who were trying to exploit one of the methodological options for upgrading analogy, accepting that research is unavoidably limited or unavoidably speculative (Clark 1951: 1953, 1954; Ascher 1961; Anderson 1969), and people who avoided interpretive extensions beyond the archaeological record (Hawkes 1954; Thompson 1956) attempted to come to grips with "a fundamental dilemma that archaeologists confront whenever they seriously undertake to use their data as evidence of the cultural past, namely, that any such broadening of the horizons of inquiry seems to be accomplished only at the cost of compromising actual or potential methodological rigour" (Wylie 1985: 81).

In the 1960s and 1970s, the New Archaeologist, who was against traditional forms of research, insisted that the use of analogical inference in archaeological research should be strictly limited, and analogy should serve only as a means of generating hypotheses whose credibility must be established on independent, non-analogical grounds (Binford 1967, 1968, 1972). After that, the importance of analogy was not in the forefront of theoretical discussions until logical positivism had lost some of its sway (Kelley & Hanen 1988: 368-9).

In recent years, epistemological viewpoints about analogy have been suggested by several archaeologists and archaeologically trained philosophers (Charlton 1981; Gould 1980; Gould & Watson 1982; Hodder 1982; Kelley & Hanen 1988: 256-74; Murray & Walker 1988; Ravn 1993; Salmon 1982: 57-83; Small 1987; Wylie 1980, 1982, 1985, 1988, 1989). Through these arguments, methodological approaches for strengthening and evaluating analogical inferences have been advocated. Consequently, much more has been said about the usefulness of analogical inference in archaeology and analogy as an integral part of scientific explanation (Kelley & Hanen 1988: 261). Furthermore, it has been argued that causal, functional, and structural analogies (according to Wylie's term, relevance-based analogies or relational analogies; Wylie 1985, 1988) are more likely to be theoretically relevant than mere similarities. Even though most archaeologists agree that a proper use of analogical arguments in archaeology is a field awaiting systematic development (*e.g.*

Murray and Walker 1988: 251; Trigger 1989: 391), the actual practice in archaeological fields has made little progress.

This paper attempts to examine the potential of the use of reliable analogical arguments through an archaeological case study. For clarity of exposition, first of all, types of analogy will be classified into two groups based on two different aspects: a substantive aspect and a logical aspect. On the basis of this argument, the strongest form of analogical arguments will be suggested. In the second part of this paper, culturally specific and relational analogies will be applied to a case study. Through these analogical arguments, the explanation of 198 perforated clay cylindrical objects from Tomb 20 of the Jopo-ri B site[1] in Korea, the type of net associated with these kinds of archaeological objects, the fishing behaviour involved in the use of specific nets, and daily subsistence of Jopo-ri people in the 4th century AD will be attempted using several different sorts of data: geographic data; floral data; faunal data such as fish ecology; data of fishery science such as fishing gear technology and fishing methodology; folklore data including the folk-culture study at Woljam-ri; historical texts; and archaeological data. This paper will show that even when the archaeological evidence is incomplete, the use of many classes of data, in ensuring culturally specific historical context and in establishing causal relations, provides a stronger basis for inference than the use of only a few classes of data in formal similarities.

Analogy in logical usage and types of analogy

Analogy is a form of inductive inference by which the identity of unknown items (subject) may be inferred from those that are known (source). An argument by analogy is founded on the premise that if two classes of phenomena are alike in one respect, they may be alike in other respects as well (Copi & Cohen 1990: 357-76). In this case, one of the classes of phenomena to be compared must be a confirmed phenomenon since an analogy is to be inferred within the interrelationship between known and unknown items or relations. Therefore, when inferring an archaeological phenomenon through analogy, we must have a correct knowledge of known items or relations.

Generally speaking, the known items used in archaeological inference come from five kinds of sources: 1) historical accounts that describe societies in the past; 2) ethnographic or folk-culture studies that describe present-day societies; 3) experimental studies that attempt to duplicate conditions that existed in the past (Sharer & Ashmore 1979: 465-73) and that attempt to understand the natural processes involved in the formation of the archaeological record (Bower 1986: 394; Gifford 1981: 366); 4) palaeontological knowledge that provides general analogies for materialist inquiry into remains from the past; and 5) biological knowledge that

[1] Place names, personal names and Korean terms are spelled in accordance with the prescriptions of the Ministry of Education, Korea (Ministry of Education 1984). For Chinese the pinyin romanization is employed and for Japanese the Hepburn system.

provides analogies of the interconnectedness of different classes of natural phenomena, ecological analogies that humans form part of the natural world, and an awareness that the evolution of specific organisms may offer an analogy for developmental adaptations by past communities (Murray & Walker 1988: 253-254). However, although we have all these substantial sources, they are not sufficient to draw a reliable analogy. That is to say, even where analogies are based primarily on a comparison for total similarities through all these sources, there are a number of logical criteria that can be used to determine their relative strength. Therefore, archaeologists have developed several types of analogy in order to draw an accurate explanation or interpretation about past human behaviour and culture.

Such types of analogy can be basically divided into two groups according to different aspects. One aspect (1), a substantive aspect, is whether historical or ethnological continuity is assumed. According to this aspect, analogy can be divided into two types: 1-i) general comparative analogy, and 1-ii) specific historical analogy. Although slightly different types of analogy have been named new analogy (Ascher 1961: 319) and general ethnographic analogy (Rouse 1972: 147), the earlier terms continue to be used by archaeologists under the influence of Willey's grouping (Willey 1953: 229).

General comparative analogy (1-i) "can be applied in areas where the ethnographic or historic people no longer lead traditional lives and where ethnographic literature is incomplete" (Gould 1974: 38). In this analogy, explanations of the past "are projected through broadly comparative and essentially universalistic observations and generalisations about human cultural behaviour rather than being derived from the narrow confines of a specific historical context" (Willey & Sabloff 1980: 205-6). Therefore, this type of analogy was widely used by unilinear cultural evolutionists. However, although the resulting explanations might be said to be based on methodological rigour, they often prove to be displaced resemblances. The limitations of this type of analogy have been pointed out by many archaeologists; nevertheless it has been argued that in order to cover a vast temporal and spatial tract, consisting of over 95% of human history and a large proportion of the globe, a slightly different sort of general comparative analogy has to be used with great care (according to Ascher's term, new analogy; Ascher 1961: 319-20).

The second type is specific historical analogy (1-ii). This is made when living, ethnographic societies can be shown to be historically continuous with the archaeological culture of the same areas (Gould 1974: 39). Therefore, the archaeologist can be fully aware of such variables as cultural continuity, comparability in environment and similarity of cultural form in this analogy rather than in general comparative analogy (Sharer & Ashmore 1979: 460-5). Consequently, specific historical analogy guarantees a higher degree of probability than general comparative analogy, and can provide a clue to a series of specific problems involving archaeology. This is more commonly called ethnographic analogy and is found in folk-culture studies in the Old World (Clark 1951), in the direct historical approach in the New World (Steward 1942) and in ethno-

archaeological researches nowadays (Gould 1978; Kramer 1979; Gould and Schiffer 1981; Gould 1990).

The second aspect of analogy (2), a logical aspect, is whether analogy is based upon the formal similarities between source and subject or the functional and structural interrelations between source and subject. This logical aspect was first introduced into archaeology by Wylie in her brief conference paper (Wylie 1980) and was later adopted by Hodder (1982). More detailed arguments were expressed through a series of articles (Wylie 1985, 1988, 1989).

She divided analogy into two types: 2-i) formal analogy, and 2-ii) relational analogy. According to her, formal analogy (2-i) is "when analogs are compared for the simple presence or absence of the properties considered independently of one another" (Wylie 1985: 95). Therefore, formal analogy "may be entirely accidental and may not be indicative of further similarities" (*ibid.*: 94).

In contrast, relational analogy (2-ii) is "when analogs are compared for the relations that hold among the properties they share" (*ibid.*: 95). That is, "analogies that incorporate considerations of relevance are typically relational analogies" (*ibid.*: 95). Therefore, this analogy may be nonaccidental and may be indicative of further similarities because "relational comparisons involve demonstrations that there are similarities between source and subject with respect to the causal mechanisms, processes, or factors that determine the presence and interrelationships of their manifest properties" (*ibid.*: 95).

In logic there are various ways in which the different types of analogical inference can be systematically strengthened and evaluated (see Achinstein 1964; Cohen 1989; Copi & Cohen 1990; Helman 1988; Hesse 1959, 1966; Russell 1989; Shaw & Ashley 1983; Uemov 1970). Among them the following are general criteria that are mentioned in connection with the appraisal of analogical arguments: "(1) the greater (fewer) the number of analogous features mentioned in the premises, the stronger (weaker) the argument; (2) the more dissimilar the entities mentioned in the premises, the stronger the argument;...[3] causally relevant factors [or causal relations] are extremely important in strengthening analogies" (Salmon 1982: 62-3). From this, it can be said that formal analogy is based on just the first two logical criteria, and relational analogy heavily on the third in addition to the first two.

Analogical inferences in archaeology have been accomplished through different types of analogy, used in different geographical regions and with different kinds of sources, according to the nature of the archaeological record archaeologists deal with and according to different perspectives on or thoughts about the whole archaeological subject matter. In practice, analogies of substantive and logical aspects are not isolated but reinforcing. That is to say, such analogies can be connected to each other according to which region or period is being considered. In theory, the combination of specific historical analogy and relational analogy will be ideal and offer a high degree of probability in explanation (Table 1).

Table 1 *The various combinations of analogies in terms of relative strength.*

Substantive aspect / Logical aspect	General comparative analogy	Specific historical analogy
Formal analogy	The lowest probability	
Relational analogy		The highest probability

The use of culturally specific and relational analogies

The methodological framework

In drawing both general comparative analogies and specific historical analogies (Figure 1), three variables which the archaeologist must be aware of are the degree of cultural continuity, comparability in environment, and similarity of cultural form, between source and subject (Share & Ashmore 1979: 460).

Among these, the maximum cultural continuity between source and subject is the most important, so that specific historical analogy commonly offers a higher degree of probability than general comparative analogy. However, even in making a specific historical analogy, the situation in the Old World seems very complicated in contrast with the New World's case, especially the case in the southwestern United States (Steward 1942: 337-40). In other words, since the historic period is several times as long in Korea as in the United States, it is reasonable to say that as the time span between source and subject increases, the possibility of change in other variables (cultural material form, natural environment and cultural complexity such as economic and social life) increases.

Ever since the Bronze Age, however, it is possible to trace the continuity of cultural material forms down to our own day in Korea. The peasant basis, incorporating even elements from the Bronze Age farmer-fisher way of life, continues to exist in the rural community of modern Korea. The most familiar example is provided by a prehistoric bronze engraving which depicts one man digging a narrow bed of soil with an angled two-pronged implement (*ttabi*), while another breaks up the clods with a hoe. This kind of agricultural implement is still used by Korean peasants (Han 1971; Bray 1984: 216-8). Another instance with reference to the fisher way of life will be provided in this paper. In order to reduce the temporal gap between Jopo-ri's case of the 4th century AD and Woljam-ri's case of the present day, I shall utilise historical texts, historical-geographic data such as old maps and folklore data including folk-culture study.

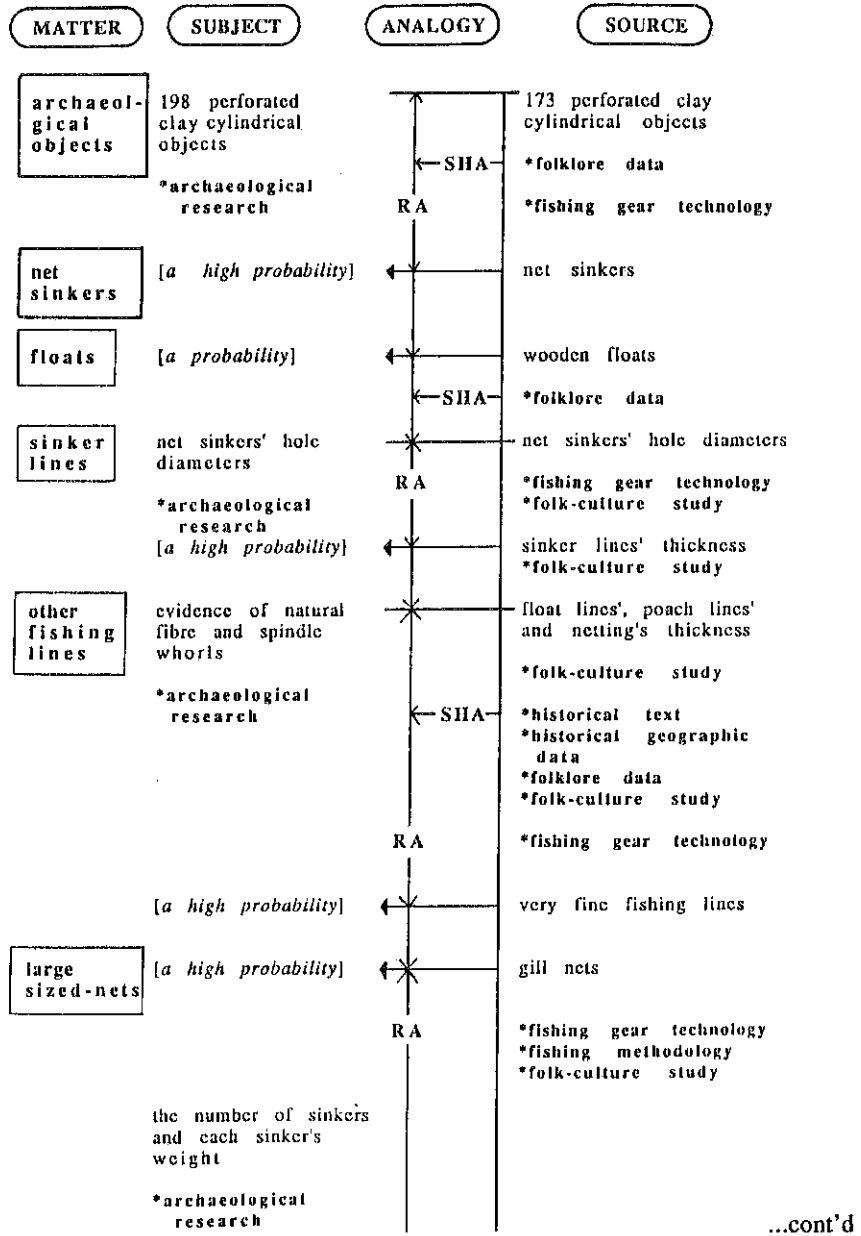
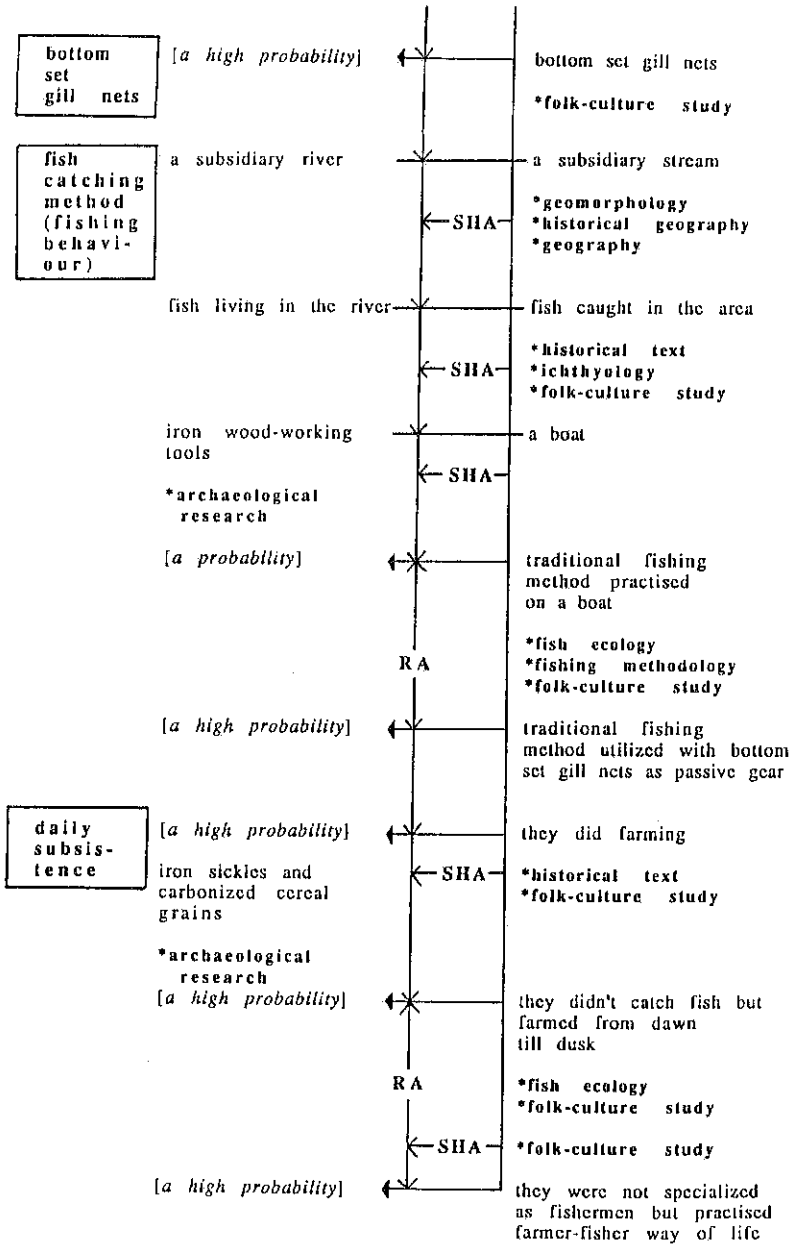


Figure 1 *A flow model of the use of culturally specific and relational analogies.*
SHA= specific Historical Analogy, RA = Relational Analogy
(detailed arguments appear below in relation to individual artefact categories; *cf.* Figure 25)



Although we can ensure the maximum cultural continuity between Woljam-ri and Jopo-ri, if the analogies are based only on formal similarities between source and subject, the analogical arguments will be formal analogies. That is to say, "point for point assessment of similarities or differences in the properties of source and subject" (Wylie 1985: 94) can hardly justify a conclusion which can elucidate further similarities.

In contrast, having relevant knowledge about underlying causal connections "that structure source and subject" (*ibid.*: 94), we can draw relational analogies. In this case, the meaning of relevance is extremely important. This "is to be explained in terms of causality" (Copi & Cohen 1990: 366). That is to say, "one attribute or circumstance is relevant to another, for purposes of analogical argument if the first affects the second, that is, if it has a causal or determining effect on that other" (*ibid.*: 366). In other words, relational analogies "are those that deal with causally related attributes or circumstances" (*ibid.*: 366). Therefore, we can elucidate further similarities on the basis of relational analogies.

In order to understand unknown archaeological objects (198 perforated clay cylindrical objects), the cultural material form (bottom set gill nets), the fishing behaviour behind the use of bottom set gill nets, and daily subsistence of Jopo-ri people in the 4th century AD, I will draw relational analogies (Figure 1, vertical arrows) to be supported by specific historical analogies (Figure 1, horizontal arrows) using several kinds of knowledge about fishing gear technology, fishing methodology, fish ecology, ichthyology, palaeoethnobotany, geomorphology, historical geography, geography, archaeology, history, folklore and philosophy. Using such types of knowledge, I will stress the functional and causal mechanisms that determine interrelationships of the manifest properties between source and subject.

The Jopo-ri site and the folk-culture study at Woljam-ri

The archaeological research

Excavations in the middle reaches of the Hwang River basin were intensively conducted from 1986 to 1988 as a rescue project associated with the construction of Hapch'ŏn dam (Figure 2). During this period, 1 Mesolithic open site, 3 Neolithic pit-dwelling sites, 5 Bronze Age pit-dwelling sites, 6 Bronze Age dolmen sites, 3 Kaya Period pit-dwelling sites and 11 Kaya-period tomb sites were excavated (Figure 3). Among them, the Kaya-period sites are mainly close to one another at the Jopo area and Ponggye area during the period from the 2nd to the 7th century AD.

In the Jopo area (Figure 4), it was known that past Jopo-ri people used different hills in different periods for their cemeteries, with a careful succession from A hill to E hill through time(Jeong *et al.* 1987: 289; Park and Choo 1988: v; Yun 1987: 141). Moreover, it was observed that cemeteries which belong to the period from the middle 5th to the early 6th century AD were not constructed in the Jopo area (Lee

1987: 137; Yun 1987: 141). Instead, the cemeteries were made in the Ponggye area on a large scale.

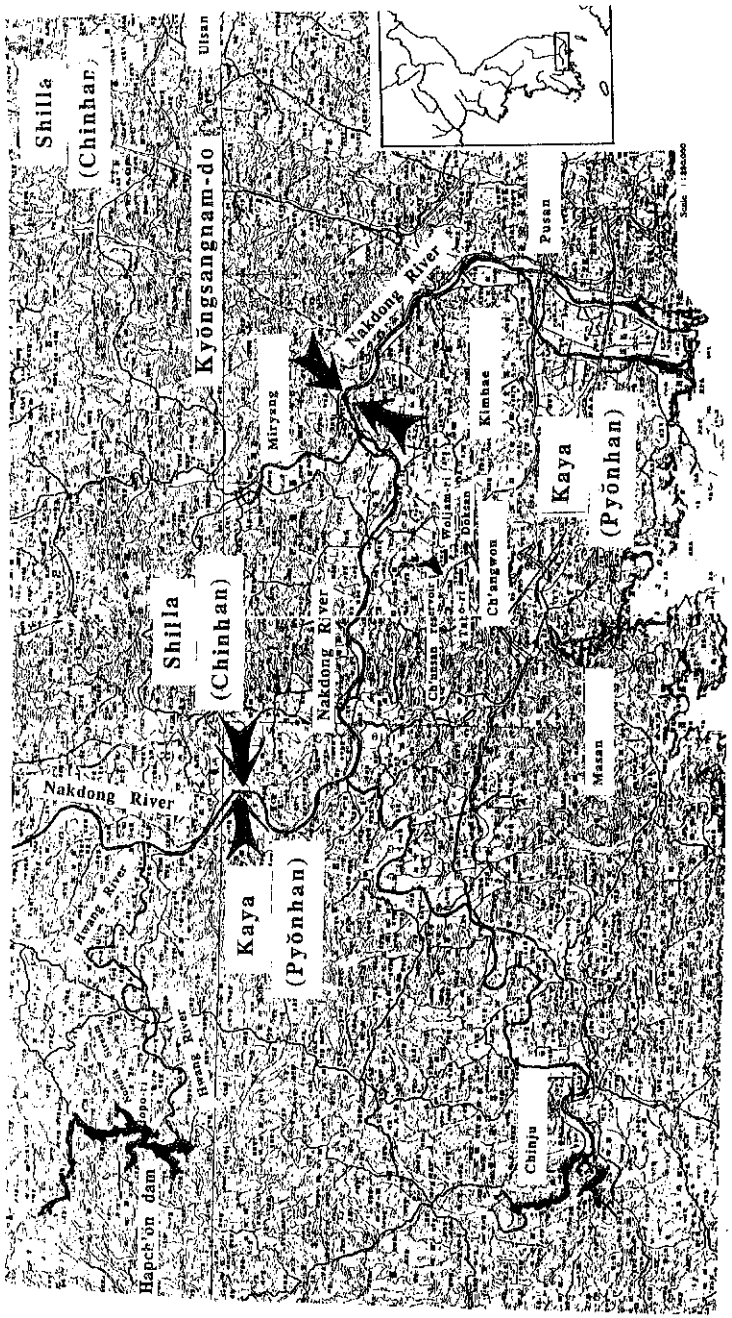


Figure 2 *Topographic map of the Nakdong River basin.*

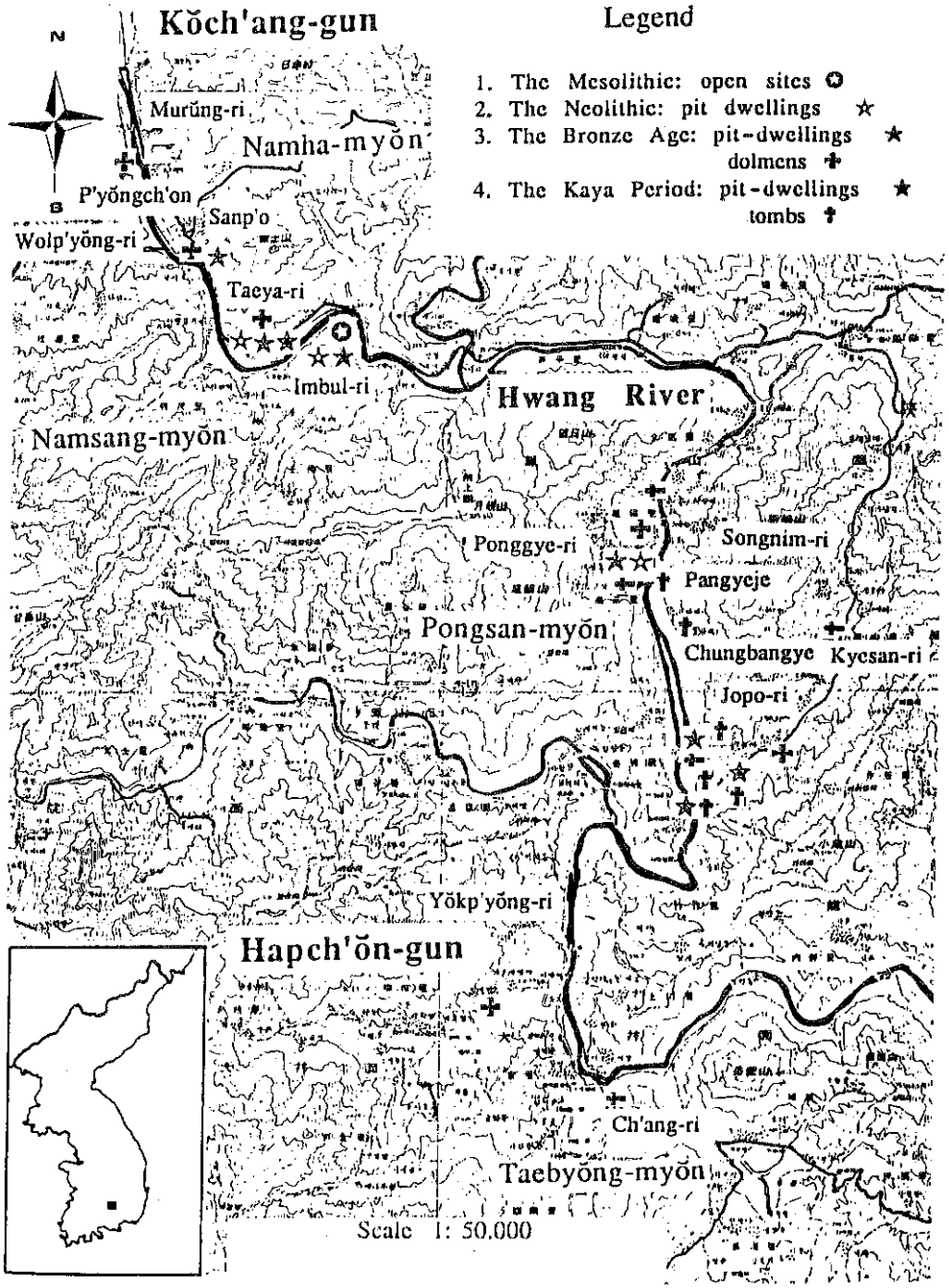


Figure 3 *Distribution map of sites in the middle reaches of the Hwang River basin.*

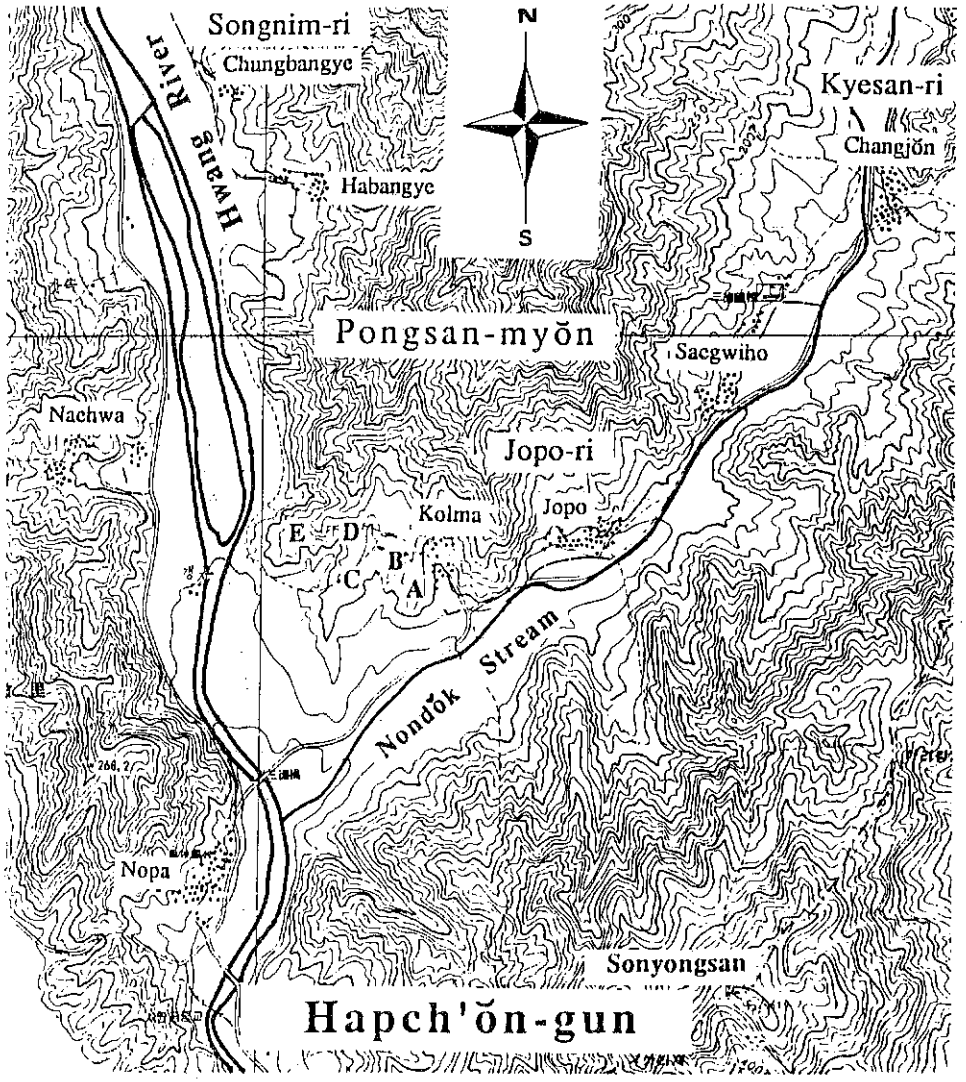


Figure 4 *Locations of Jopo-ri A, B, C, D, and E sites.*

The Jopo-ri B was excavated in 1987 for 54 days (4th May - 26th July) under my supervision (Park & Choo 1988). The excavation was conducted using a grid system over the whole Jopo-ri B hill (Figure 5). The features excavated at this site were 1 jar coffin tomb and 23 wooden coffin tombs. The artefacts excavated from those wooden coffin tombs included: various types of pottery, iron implements such as weapons and tools, jade objects, spindle whorls and net sinkers, *etc.* Through examining the features and the excavated artefacts, it was known that people who lived at Jopo utilized the Jopo-ri B hill as their public cemetery for about 100 years from the late 3rd or the early 4th century AD to the late 4th or the early 5th century AD (Park & Choo 1988: 174-217).

Most notable among the excavated artefacts were 198 net sinkers recovered en masse from Tomb 20, located on the top of Jopo-ri B hill (Figure 5). Most features of the tomb were destroyed due to natural and cultural factors, and artefacts on the tomb's floor were found at a depth of only about 27cm from the present ground surface. The floor area measured 3.83m long x 1.09m wide. The net sinkers were found to the north part of the centre (Figures 6, 7). If the rest of the floor level had not been disturbed in the process of making modern holes, more net sinkers would have survived (Park & Choo 1988: 95-108).

The folk-culture study

When I recovered such a large number of net sinkers, I primarily concentrated my efforts on understanding the type of net on which more than 198 net sinkers could be threaded. I did so by inquiring of the people who presently live at Jopo-ri what kind of net they had used in order to catch freshwater fish in the Hwang River. A local villager stated, "we used gill nets and cast nets until the 1970s, but after that—because we have used electrical stupefying gear, which is prohibited by law, instead of using those kind of nets—no actual fishing gear such as gill nets and cast nets remains." I had to find another place where a net, on which net sinkers similar to Jopo-ri's were threaded, had been used in a similar environment. Although I tried to find a specific area to observe among the areas which are situated along the Hwang River and the Nakdong River, I could not.

The first season of folk-culture field work at Woljam-ri was conducted on 16th March 1988 when I visited the Taho-ri site (*cf.* Yi *et al.* 1989), which is a remarkable burial site in Korean archaeology (*cf.* Figure 2). At that time, I accidentally found bottom set gill nets at the Park house where the excavation team stayed. Net sinkers threaded on Woljam-ri's bottom set gill nets were very much the same as Jopo-ri's net sinkers (Figure 8), and they still use this kind of net to catch freshwater fish in the Ch'unsan reservoir (commonly called the Chunam reservoir).

The second season of field work at Woljam-ri was carried out on the 8th of January 1991 in order to get more information and check the data I had already collected. This field work was conducted by participant observation and informal interviews with Mr. Hye-sik Park, my informant. The Parks live near a subsidiary stream flowing into the Nakdong River. Mr. PARK Hye-sik, 46 years old, first moved to the area at the age of 20 in 1965. He lives with his wife and two children,

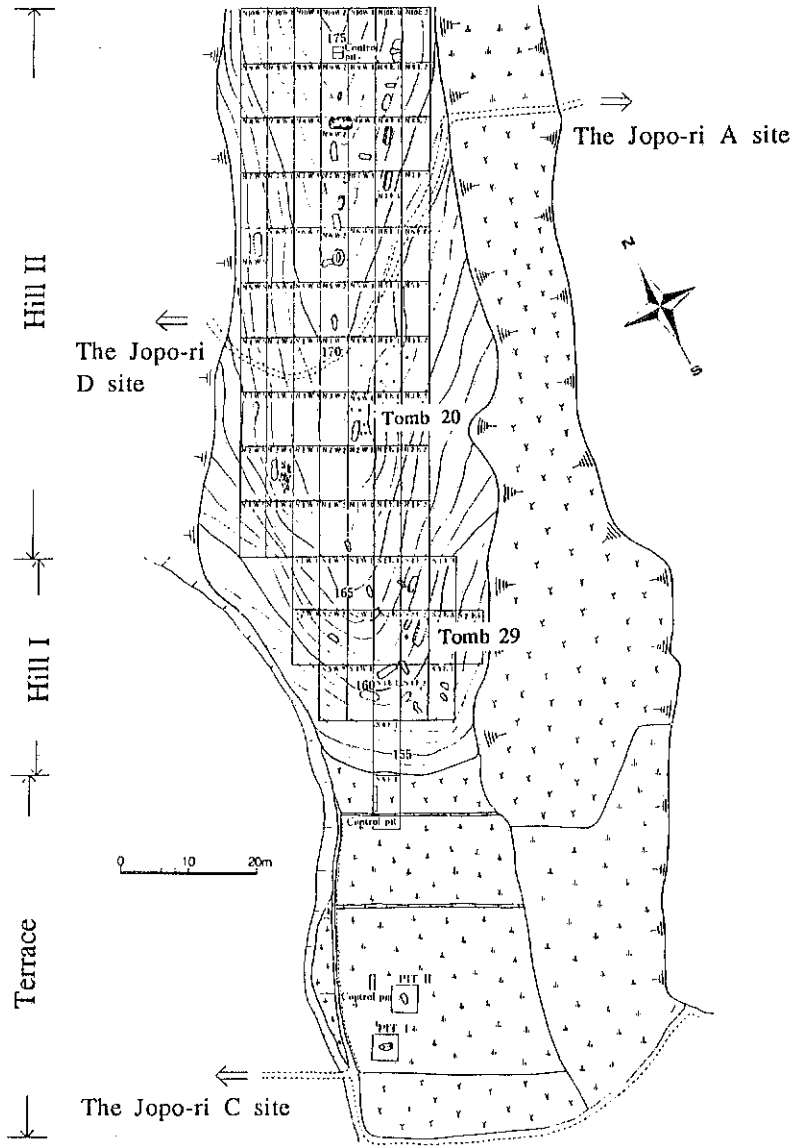


Figure 5 *Site grid on Jopo-ri B hill.*

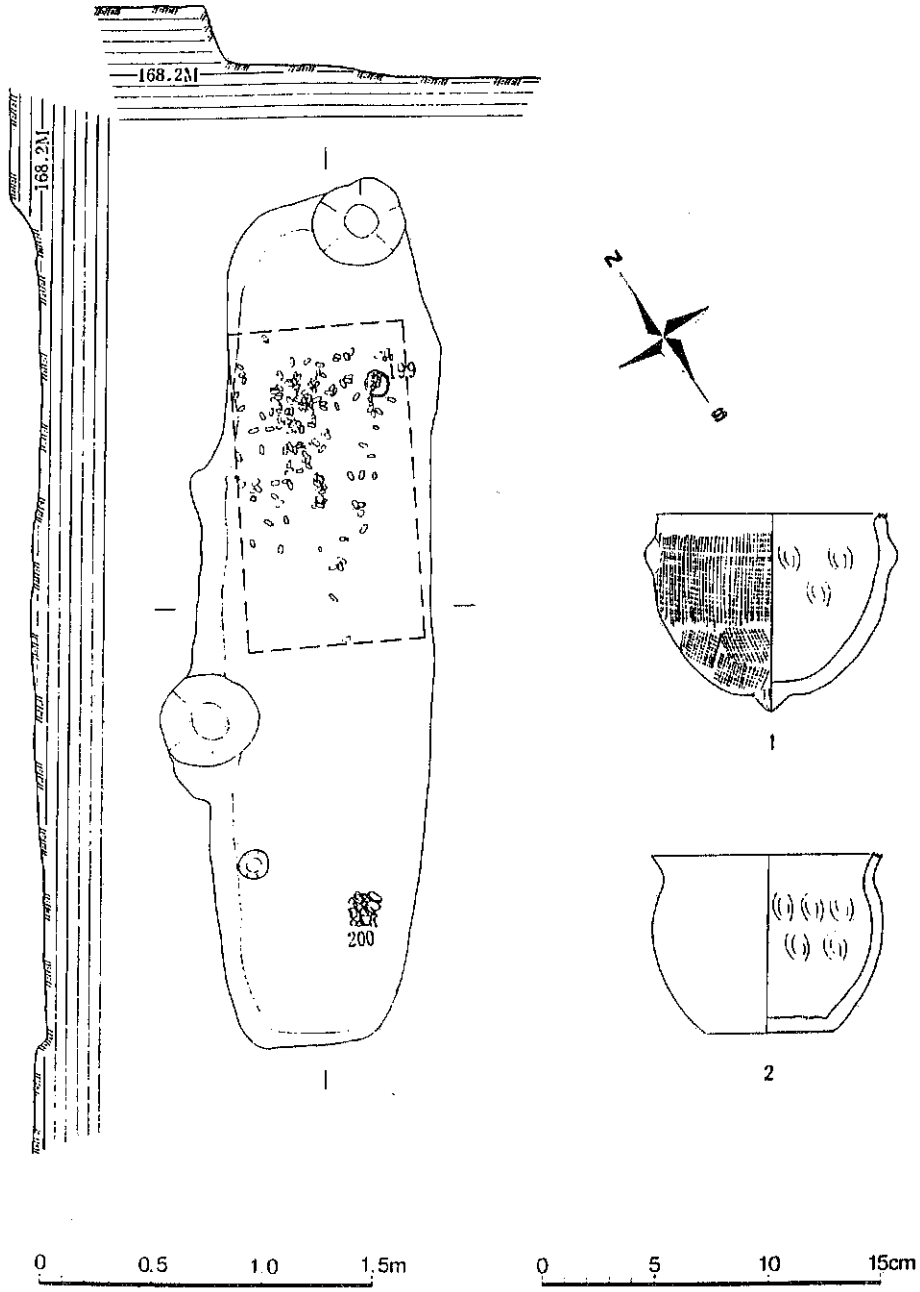


Figure 6 *Plan and section of Tomb 20 and its pottery contents.*

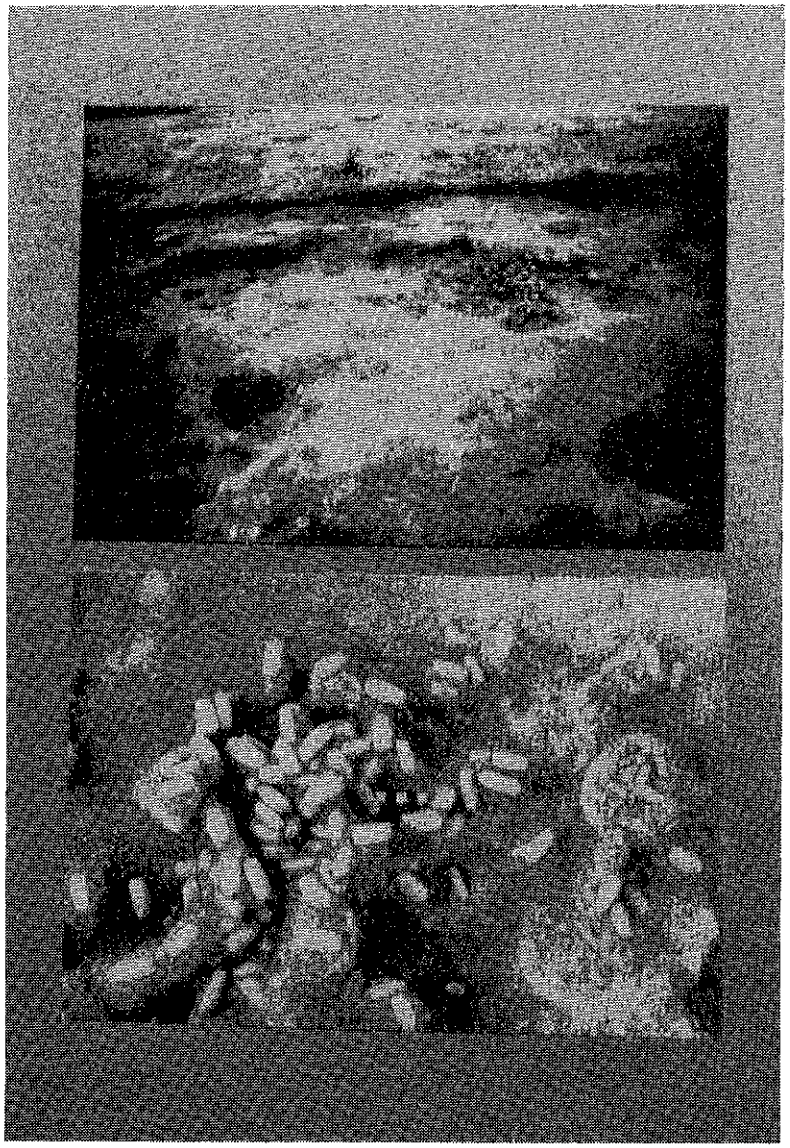


Figure 7 *Excavated scene of Tomb 20 (above) and detailed scene of excavated cylindrical net sinkers (below).*

Figure 8 *Woljam-ri's bottom set gill net (above) and cylindrical net sinkers threaded on bottom set gill nets (below).*

running a raw fish restaurant (Haehunjang Hoetgib Shikdang) at 270 Woljam-ri, Tong-myŏn, Ch'angwon-gun, Kyŏngsangnam-do. When I conducted my first field season in 1988, he was catching freshwater fish with bottom set gill nets for his customers; but after enlarging his restaurant and extending his business, he stopped catching fish and has purchased freshwater fish/marine fish from his neighbours and the fish market in Masan (*cf.* Figure 2) since 1989. Although the situation had changed when I conducted the second field season in 1991, he was a good informant because he had not only been a fisherman before but had been able to listen to all kinds of village news through his restaurant.

During the first season of this field work, I mainly concentrated on observing and participating in the fish catching method, the kinds of fish caught, and the drying and keeping method of nets. At that time, I bought one piece of bottom set gill net and measured items of the net. After that, in the course of my research on fishing gear technology/fishing methodology/fish ecology by consulting with specialists in these subjects, I felt that the first field season's work was inadequate, especially because the fishing method I had observed was not a traditional but a reformed one designed for use in a reservoir. Therefore, during the second season, I relied on informal interviews with my informant and solicited information directly from him, prompting him to speak by posing specific questions about traditional fishing methods/kinds of fishing gear/the materials of the items, manufacturing process of fired clay net sinkers, the transformation of the topographic situation of the area, and fish ecology of the area.

Fishing gear in Korea

In Korea, the natural setting suggests intensive utilization of aquatic resources (Figures 2, 9). Historically the sea, surrounding the Korean peninsula on three sides, and a large number of rivers and streams have provided valuable resources for and played important roles in developing the fish communities and industry (Park 1981). For this reason, traditionally, most of the animal protein consumption of the Korean people has been provided by sea food and freshwater fish (Kang 1990; Park 1974). Therefore, Korean archaeologists have paid particular attention to understanding to what extent past people based their subsistence economy on aquatic resources, and especially to understanding the interaction between fish and human beings in prehistory.

However, in Korean archaeology, although some ichthyologists have contributed a number of works concerned with the identification of fish species from shell middens based on osteological remains, they have only answered the questions posed to them by archaeologists. As a result, many Korean archaeologists are still not aware of the wide range of data that ichthyologists or palaeontologists can provide from their own disciplines: the environment of deposition of the matrix sediments; the season of occupation of sites; and the range of aquatic environments exploited by past people (Shackley 1981: 181). Consequently, they have focussed heavily on just

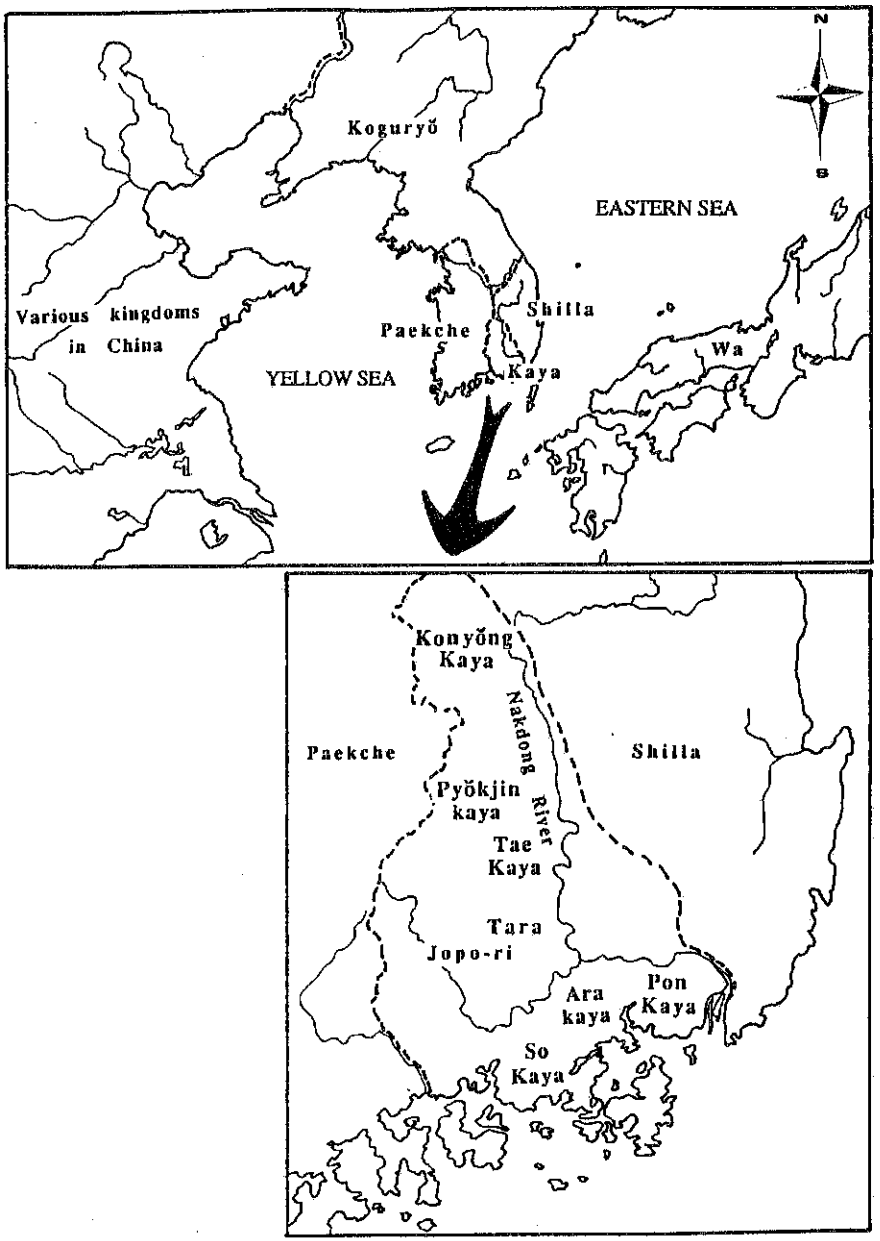


Figure 9 *Historical map of East Asia in the 4th century AD.* (based on Collcutt *et al.* 1988; Lee & Lee 1985)

the archaeological remains related to fishing behaviour because of the lack of an adequate methodological framework in economic approaches.

From the Neolithic there are archaeological remains related to fishing behaviour, recovered from various archaeological contexts such as shell middens, pit-dwellings, dolmens and several types of tombs in historical times. These are divided into three groups according to different fishing methods (Park 1987: 16-82). It can be said that spears, harpoons and arrowheads made of stone, bone and iron are related to the grappling method, which extends the range of the human arm with long-handled implements which can be pushed, thrown or shot. The second group involved the use of lines. The gorge made of bone is the simplest type of hook which belongs to this method. It functions by lodging in the fish's throat, and, when caught, the fish can be pulled in. A more elaborate manner of capture is for the fish to be offered a real or supposed bait which is presented in such a manner that it is difficult for the fish to let it go once it is taken. One-piece hooks and composite hooks made of stone, bone and iron may be related to this fishing method. The third one is the netting method. Although there are no actual remains of netting found in the archaeological context, the existence of net sinkers suggests that the netting method could have been practised.

In Korea, various types of net sinkers have been recovered at sites from the Neolithic to the historical period. Twelve types—identified by clusters of attributes that occur together repeatedly in the same artefacts (*cf.* Sharer & Ashmore 1979: 277)—are distinguished on the basis of form, technological, stylistic and functional attributes. Form attributes include the forms of parts of net sinkers: side-notched or grooved; presence/ absence of a hole; a central short bore hole or a long one; and overall shape such as irregular, shell, disk, oval, spherical and cylindrical forms. Technological attributes include characteristics of the raw materials used to manufacture net sinkers (stone, potsherd, shell and clay) and whether the material was altered or not (raw material and altered material such as ceramic). Stylistic attributes involve secondary alterations (chipped, polished, scraped and bored). Functional attributes are based upon the assumption that the forms of parts of net sinkers can be directly used to infer the way in which sinkers are weighted on the bottom edge of a net (Table 2, Figure 10).

Some researchers are sceptical about using such archaeological materials, mainly side notched small flat river cobbles (Type I), always being used to interpret fishing behaviour. Kent and Nelson suggest an alternative use such as weaving behaviour in addition to fishing behaviour, using an analogy with Ainu ethnography (Kent & Nelson 1976: 152). In fact, in the cases of disk-shape and spherical net sinkers (Types VI, IX and X), it is also hard to distinguish them from spindle whorls and clay beads in terms of size, so that it might be argued that there are some difficulties in relating all these materials to fishing behaviour.

Attribute / Type	Form attributes: the form of parts: without a hole: A: side-notched, B: grooved	Form attributes: the form of parts: with a hole: 1: a central short bore hole, 2: a central long bore hole	Form attributes: overall shape: a: irregular, b: shell, c: disk, d: oval, e: spherical, f: cylindrical	Technological attributes: raw material: 1) stone, 2) potsherd, 3) shell, 4) clay	Technological attributes: raw or altered: a) raw material, b) altered material = ceramic	Stylistic attributes: secondary alteration: i) chipped, ii) polished, iii) scraped, iv) bored	Functional attributes: the way to be weighted: ① dangled, ② secured, ③ secured and threaded, ④ threaded
I	A		a (c)	1)	a)	i)	②
II	A		a	1)	a)	ii)	②
III	A	1	a	1)	a)	ii) + iv)	③
IV	A		a (c)	2)	a)	iii)	②
V		1	b	3)	a)	iv)	①
VI		1	c	4)	b)		③
VII	B		d	1)	a)	ii)	②
VIII	B		d	4)	b)		②
IX	B	1	c (d)	4)	b)		③
X		1	e	4)	b)		④
XI		1	d	1)	a)	iv)	①
XII		2	f	4)	b)		④

Table 2 *Typology of net sinkers in Korea.* (Roman numerals are the same as in Figure 10)

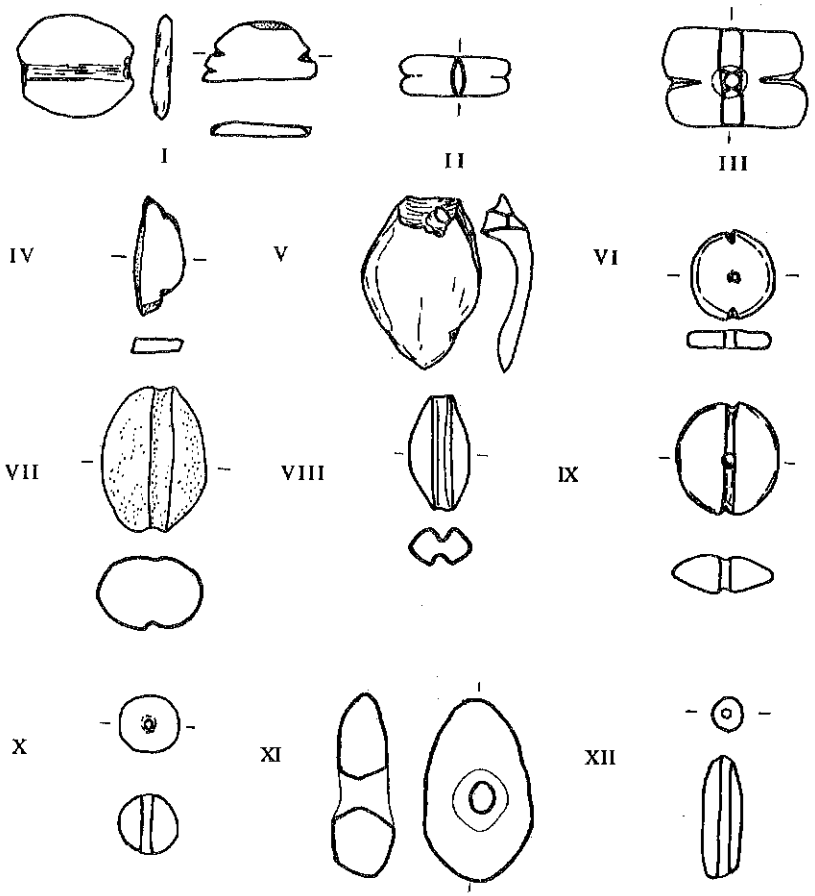


Figure 10 *Various types of net sinkers in Korea.*
(not to scale; Roman numerals are the same as in Table 2)
Type I from House 31 of the Namgyŏng site (after Kim and Sŏk 1984) and from the ground surface of the Ponggye-ri site (after Sim 1989). **Type II** from the Shinhŭng-dong site (after Sŏ 1964). **Type III** from P'yŏngch'anggang (after Institute of Asian Culture 1986). **Type IV** from House 9 of the Ponggye-ri site (after Sim 1989). **Type V** from the Tongsam-dong site (after Choi 1971). **Type VI** from House 4 of the Jopo-ri E site (after Jeong et al. 1987). **Type VII** from the Ch'odo site (after Institute of Archaeology and Folklore 1956). **Type VIII** from the Togok-ri site (after Kim 1967). **Type IX** from House 15 of the Taeya site (after Im *et al.* 1989). **Type X** from House 3 of the Taeya site (after Im *et al.* 1988). **Type XI** from the Kwakji shell midden (after Lee & Lee 1985). **Type XII** from House 13 of the Hunamni site (after Im 1978).

Perforated clay cylindrical objects, net sinkers, bottom set gill nets, fishing behaviour and daily subsistence

Perforated clay cylindrical objects, net sinkers and bottom set gill nets

It is true that there are some difficulties in relating all materials to be shown in Figure 10 to fishing behaviour. However, it is my view that the perforated clay cylindrical objects (Type XII) should be regarded as net sinkers.

When comparing Jopo-ri's ancient perforated clay cylindrical objects with present-day ones from Woljam-ri in terms of morphological similarities, we can see at a glance that the two cases look very similar in overall shape, material (clay), perforated form, size, hole diameter and colour (Figure 11). Archaeological objects of these shapes—such as those recovered from Tomb 20 at Jopo-ri B—are found from the early phase of the Bronze Age onwards (Choi *et al.* 1985: 12); in the historical period larger objects of the same type are found at the Mongch'on fortress site (Kim *et al.* 1984: 256). This type of material object is used even in the present-day as net sinkers (Yang 1987: 127) (Figure 12). This comparison of formal similarities between source (Woljam-ri's cylinders) and subject (Jopo-ri's cylinders) based on morphological similarities and the continuity of the material form comprises a formal analogy of net sinkers.

When we are looking at present-day cylindrical net sinkers in terms of causal mechanisms, they should have a certain shape and be heavy enough to weight the bottom edge of a net to hold it taut in order to keep sinking force. That is to say, according to fishing gear technology (Fridman 1986: 48-52), the shape, position and steady-state dimensions of fishing gear depend on the magnitude and direction of the external forces acting on it. These forces include gravity, hydrostatic forces and hydrodynamic forces (Figure 13). Among these, gravity is directed downwards, while hydrostatic lift or buoyant force is directed upwards. Consequently, in order to maintain the shape of fishing gear in a steady-state from the pressure of the water moving in relation to the gear, the important factor is how the lift force (buoyant force) and sinking force (gravity force) harmonize well in water.

Therefore, in order to maintain the sinking force in water, two relevant factors in constructing a relational analogy for net sinkers are sufficient weight for sinking and the proper shape for being weighted solidly to the net. In the Neolithic, side-notched objects made of river cobbles (Type I) and potsherds (Type IV) were mainly used (Sŏ 1986: 96). If these objects are net sinkers, they were secured to the net in various ways. Although they were heavy enough to sink the nets (judging from the fact that the weight of these types is similar to that of Woljam-ri sinkers [Park & Choo 1988: 202-204]), they were easily lost because of insecure fastening to the net. Since the Bronze Age, a new type of object (Type XII) has been made in order to mitigate inconvenience in securing a sinker to the net; this object was made with a central bore hole so that the material would weight the bottom edge of the net more firmly by being threaded on a sinker line (*ibid.*: 198) (Figure 14).

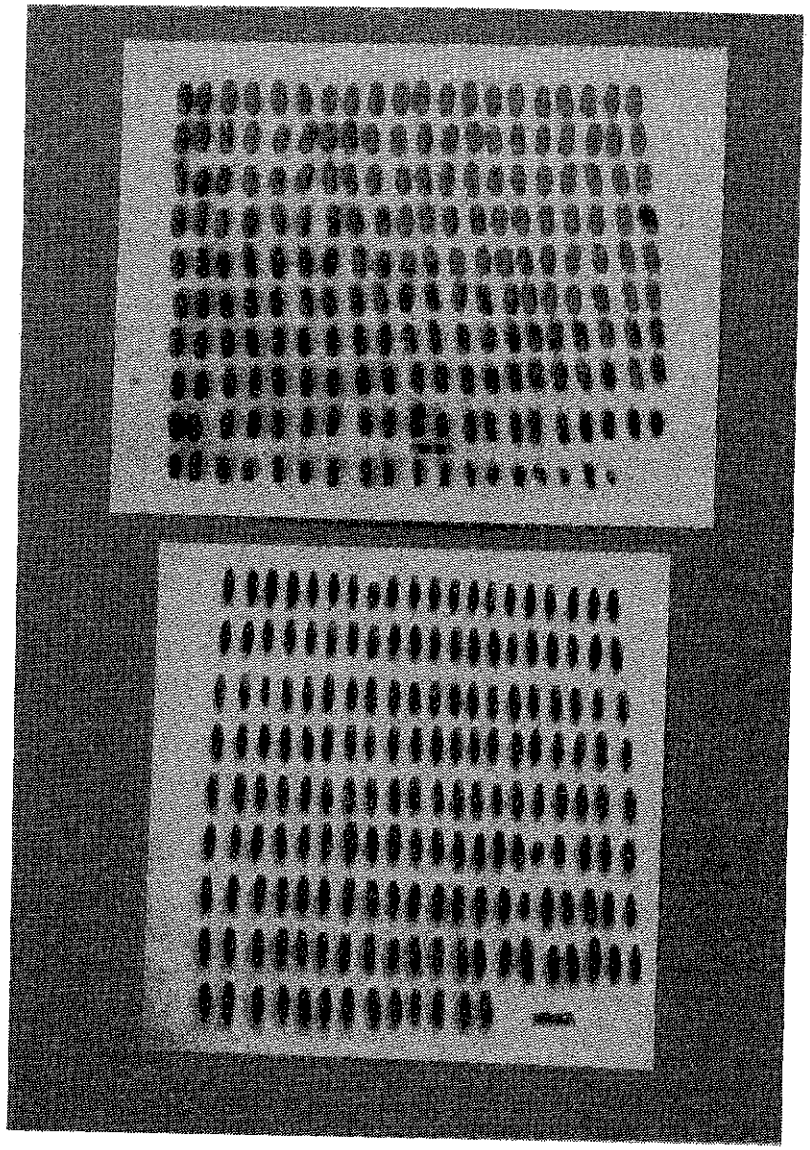


Figure 11 *Cylindrical net sinkers from Tomb 20 at Jopo-ri B (above) and those threaded on the Woljam-ri bottom set gill net (below).*

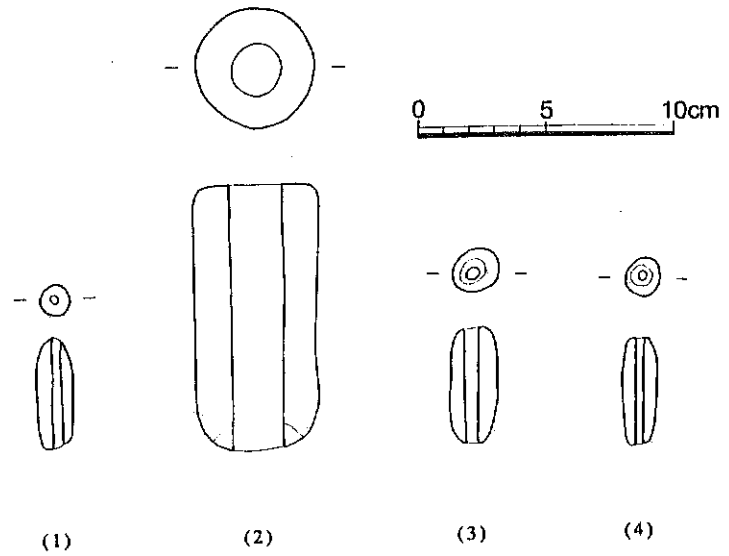


Figure 12 *Cylindrical net sinkers from various periods.*
(1) a net sinker from House 13 at Hunamni (after Im 1978); (2) a net sinker from the Mongch'on site (after Kim *et al.* 1984); (3) a net sinker from Tomb 20 at Jopo-ri B; (4) a present-day net sinker secured to Woljam-ri's bottom set gill nets.

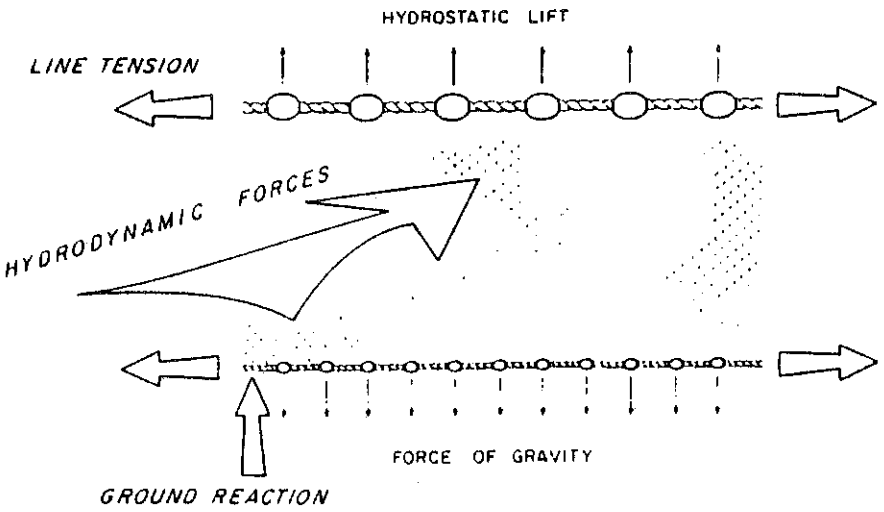


Figure 13 *Classes of external forces acting on fishing gear.* (after Friedman 1986)

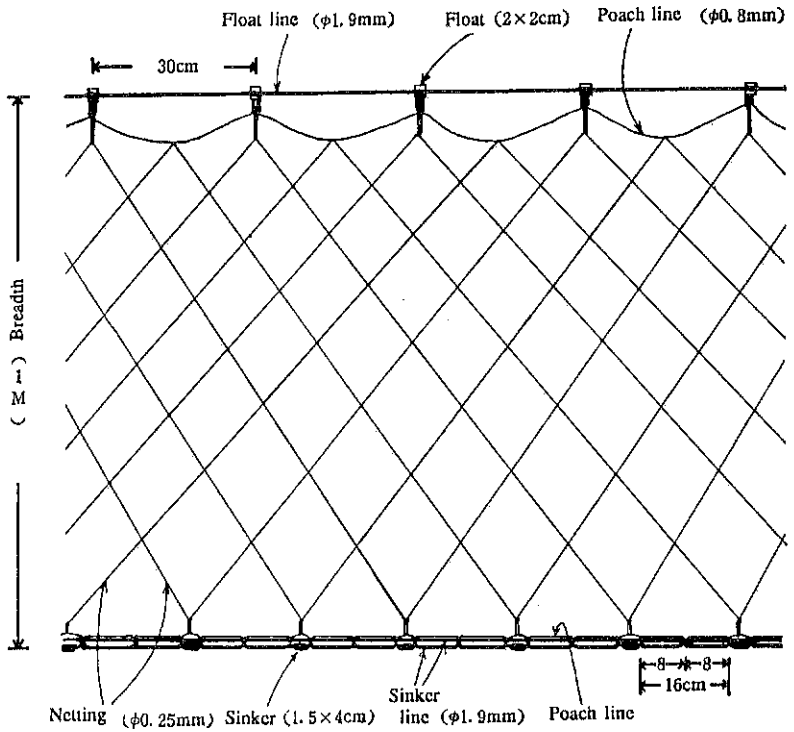


Figure 14 Construction and terms of present-day Woljam-ri's bottom set gill net.

From this causal relationship, I believe the reason why these perforated cylindrical archaeological objects have been continuously used since the Bronze Age is because of the functional advantage of being weighted easily and solidly, with enough weight given to the net by being threaded on a sinker line—somewhat as the v-shape of a ship has been kept on because of the functional advantage. Consequently, there is a high probability that these cylindrical archaeological objects were used as net sinkers in the past, judging from the continuity of the material form and its functional advantage. This also implies that there will not be a great difference between past nets and present-day nets in terms of the type of net. Using this hypothesis, I drew an analogy between the attributes of 198 net sinkers excavated from Tomb 20 of the Jopo-ri B site and the attributes of 173 net sinkers threaded on

the present-day Woljam-ri's bottom set gill net (Park & Choo 1988: 199-205).[2] However, as I did not examine the situation very much, focussing only on net sinkers, in this paper a finer analysis will be presented using the data I have collected previously and utilizing other kinds of data I have newly secured through my second season of folk-culture field work at Woljam-ri.

The present-day bottom set gill net of Woljam-ri (Figure 14) is composed of several items such as sinkers attached to a sinker line to keep it under water, the sinker line threaded through the holes of sinkers, floats attached to the net to support it in water, a float line secured to floats, netting knotted into a net, and poach lines connected to float line and sinker line (Park & Choo 1988: 200). From among these kinds of items, only sinkers have been preserved in Jopo-ri Tomb 20 (*cf.* Figure 11). Nevertheless, judging from the fact that wood was utilized as the material of floats before synthetic resins were introduced (Yang 1987: 127), it seems that floats made of wood could have been secured to the net in the past (Park & Choo 1988: 201). Floats are made of sponges in the case of Woljam-ri's bottom set gill net.

As for fishing lines, although there is not any direct information about fishing lines in either historical documents (Park 1984: 24-40) or among archaeological data for the 4th century AD, through the analysis of the net sinkers' hole diameters, the thickness of the sinker line can be estimated. That is to say, as a sinker line is going to be threaded through the hole in the sinkers, there is a functional relationship between the thickness of sinker line and the size of sinkers' hole diameters. In Figure 15, we can see very similar frequency distributions between the hole diameters in the two cases. In Woljam-ri's case, most hole sizes cluster at a diameter of 4mm, and in Jopo-ri's case at a diameter of 4 to 5mm. Therefore, in light of the frequency distribution of hole sizes, it can be said that Jopo-ri's sinker line was similar in thickness to Woljam-ri's. From this, it is reasonable to say that a thickness of about 2mm was the approximate size of Jopo-ri's sinker line, judging from the thickness of Woljam-ri's sinker line (Park & Choo 1988: 201-202).

As we can see in Figure 14, if the Jopo-ri sinker line has a thickness of 2mm, the rest of the fishing line will be thinner than the sinker line in light of the construction of fishing lines. According to current fishing methodology, which is a scientific discipline to contribute to a better understanding of the fishing and related processes and of the interaction between fish, fishing gear and the fishing vessel (Lee 1981: 5), netting used in gill nets is so thin that it is almost impossible for the fish to identify the net, and the net is a flexible one (Ko 1975: 357). Although synthetic fibres are presently used in Woljam-ri, according to my informant, silk was used until the 1960s.

---

2 I have previously described the present-day nets of Woljam-ri as 'drift gill nets' (*yujamang*) before (Park & Choo 1988: 199), according to my informant's explanation. However, I now feel that this term is incorrect in terms of the classification adopted by the Fisheries Administration, Korea (O *et al.* 1987). I therefore amend the term 'drift gill nets' to 'bottom set gill nets' (*padak kojŏng kŏlgŭmul*) on the basis of the classification adopted in this paper.

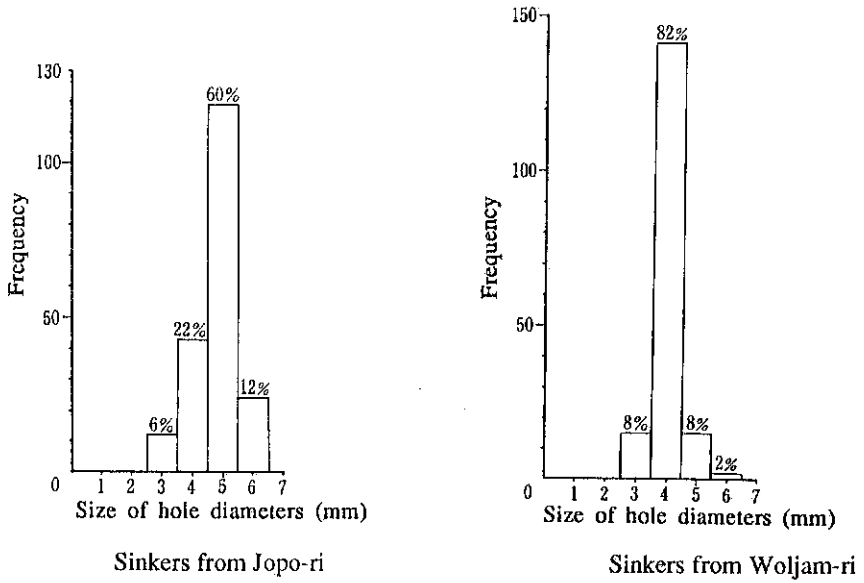


Figure 15 Histograms of net sinker bore diameters.

Was it possible to produce such a fine thread as silk at the Jopo-ri in the early 4th century AD? The *Dongyi zhuan* ("The account of the eastern barbarians") in the Chinese historical text *Sanguo zhi* (Chronicles of the Three Kingdoms Period)—in which detailed historical circumstances of the 3rd century AD are described—states that the people of Pyŏnhan, which is the name of the socio-political entity of this region in the 3rd century AD (Figure 2), grew mulberry trees, reared silkworms and produced silk (Chen 232-97: 52). Moreover, evidence of the natural fibre was recovered from Tomb 29 of the Jopo-ri B site (Park & Choo 1988: 129) (Figure 5), and spindle whorls aiding the rotation process of a spindle were excavated from Tombs 9, 14, 25 and 33 at Jopo-ri B (*ibid.*: 181). Furthermore, the Chinese character *jo* (苧) of the Jopo-ri means ramie fabric (K. *mosi*) and *po* (浦) means an inlet. Therefore, although we do not know exactly when this location name appeared, it is true that there was an inlet used to transport ramie fabric produced at this village. In addition, as I have observed, the people who lived at Jopo-ri also grew mulberry trees and reared silkworms until their village was submerged by the Hapch'ŏn dam waters. According to this evidence, it is reasonable to say that in the 4th century A.D., the Jopo-ri people produced very fine fibre such as silk, and they may have made large-sized nets such as gill nets whenever they needed. This means that they could have intensively exploited the aquatic environment (*e.g.* the Hwang River and the Nondŏk Stream, *cf.* Figure 4) using such large-sized nets.

The invention of nets made of fibrous materials was an important technological innovation in the development of fishing. Although we do not know whether a text

with reference to fishing methodology existed at that time (the first appearance of fishing methodology in a historical text was in the middle of the 18th century (Park 1987: 116; Kim 1989: 207-22), it seems that people knew how to select fishing grounds, fishing gear and fish-catching methods through learning from their predecessors.

According to current fishing methodology, six engineering and technological problems arising in the activities of a fisherman are as follows (Fridman 1986: xxi-xxii):

1. Selecting fishing gear and type of vessel according to fishery resource data for the given area;
2. Determining optimal technical parameters for the fishing gear, taking into account the characteristics of the area, type of catch and available vessels;
3. Designing fishing gear and calculating the quality and quantity of the materials required for its construction and rigging;
4. Prescribing the best pattern of operation (towing speed, fishing position, rigging details, *etc.*) under various conditions;
5. Demonstrating possibilities for improvements and implementing them in existing fishing gear used in a given fishing area;
6. Modifying traditional fishing gear for operation under different conditions.

In order to solve these problems, the following factors need to be considered (Fridman 1986: xxii):

1. Fish (species, type and size of concentration, behaviour, migration speed, biometric characteristics of individual fish, *etc.*);
2. Fishing grounds (fishery resources, food availability, distance from the port, depths, currents, temperature, salinities, availability of bait, *etc.*);
3. Technological level (skills of fishermen, availability and types of fishing vessels, appropriateness of fishing gear, availability of materials, *etc.*);
4. Economic conditions (general demand and specific market preferences, distance to markets, availability of capital, *etc.*).

Although it is beyond the scope of this paper to examine commercial aspects of fishing, other factors (fish, fishing grounds and technological level) will be considered in order to determine whether Jopo-ri people could have in the past used large-sized nets to intensively exploit the aquatic environment. What also needs to be emphasized is that these three factors are interrelated. In order to understand the exact type of fishing gear (tools of the ancient Jopo-ri people) and their fishing methods (fishing behaviour enacted with the fishing gear), the aquatic environmental situation (fishing grounds and fish) must first be examined. This is because fishing behaviour was the way that Jopo-ri people adapted to the Hwang River and the Nondŏk Stream, utilizing the knowledge of freshwater fish behaviour in order to subsist.

Korea is largely mountainous and has a relatively large number of rivers and streams. The Nakdong River (521km) is the second longest river in the southern part of Korea. The river is slightly meandering and has a slight slope especially in the

middle and lower reaches (Hong 1985: 399-402). Its role in irrigation has played a significant part in the development of Korea's ancient civilisations: Kaya (Pyŏnhan) and Shilla (Chinhan) (*cf.* Figures 2, 9).

The Hwang River (111 km) is a subsidiary river flowing into the middle reaches of the Nakdong River. The slope of its bed is so steep that erosion of the basin has occurred everywhere (*ibid.*: 402). The Jopo area is also a sort of erosion basin. The Nondŏk Stream flows into the Hwang River and the Jopo-ri site is at the junction of two rivers. In Figure 4, the river is about 80m wide, but if the summer rainy season has set in, the river becomes about 300m wide. At the same time the Nondŏk Stream also becomes about 100m wide (personal observation). It might be argued that environmental change due to erosion could have occurred and the river flow patterns could have changed in this region. There is no way to rule out this possibility, but judging from the steep topographic situation, it is unlikely that the river flow patterns have changed in the last 1700 years. Moreover, no large-scale engineering works had been practised before the construction of Hapch'ŏn dam (Hong 1985: 391-590). Therefore, it is considered that the characteristics of the river should be the same, and consequently the kind and quantity of freshwater fish are also the same.

It is known that a relatively large number of freshwater fish live in the middle reaches of the Hwang River. According to ichthyological research carried out before this area was submerged by Hapch'ŏn dam, 23 species lived in this location (Han & Park 1985) (Figure 16; Table 3), comprising about 28% of the species of freshwater fish in the Nakdong River and about 14% of those in Korea.

In the lower reaches of the Nakdong River, alluvial plains have developed everywhere (Hong 1985: 402) (*cf.* Figure 2). Therefore, when the summer rainy season comes, people suffer from a flood annually. Consequently transformation of the topographic situation is frequent. Two recent studies on the Kimhae delta using the method of a borer in an archaeological context clarified that the geomorphological situation of the Kaya period was quite different from the present-day situation (O & Kwak 1989; An, Kim & Pan 1990).

The Woljam area is not exceptional either. As we can see in Figure 2, several reservoirs are formed in the Woljam area. However, a mid-19th century map of the area (Figure 17) shows no reservoirs (Kim 1861: 63). In fact, according to my informant, the Ch'unsan reservoir and the others were made in the 1960s. Although Woljam-ri's fishermen have reared and caught freshwater fish in these reservoirs through reformed fishing methods since the 1960s, according to my informant, the traditional fishing methods were practised in a subsidiary river of the Nakdong River using bottom set gill nets made of silk twine until the 1960s. Through the traditional methods, their elders caught 10 species of freshwater fishes (Table 4).

The classification of fishing gear in Korea has been made on the basis of the International Standard Statistical Classification accepted by FAO (Food and Agriculture Organization of the United Nations), because this classification includes all catching methods throughout the world in sea and freshwater fisheries (O *et al.*

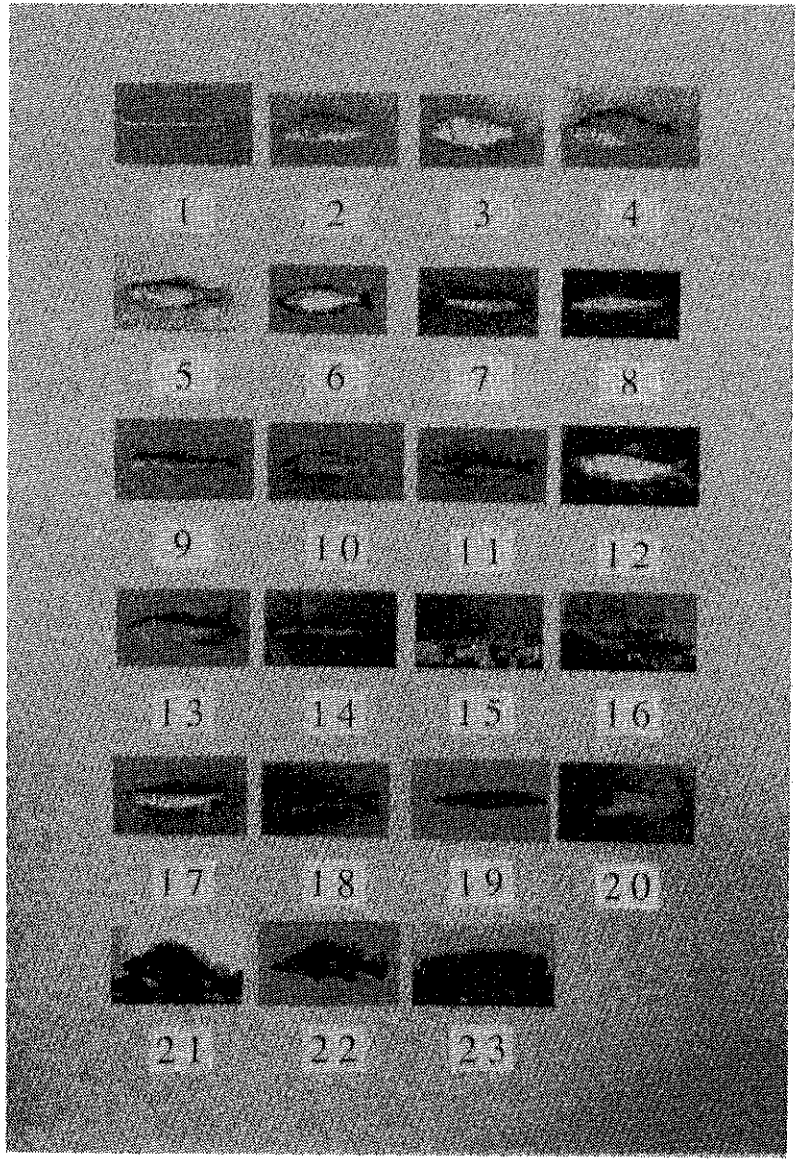


Figure 16 *Freshwater fish living in the middle reaches of the Hwang River.* (Arabic numerals are the same as Table 3)

Table 3 *List of freshwater fish living in the middle reaches of the Hwang River.*
(Arabic numerals are the same as Plate 4)
(compiled from Han & Park 1985; Choi *et al.* 1990)

	Family	Genus	Species	English name	Korean name
1	*Anguillidae*	*Anguilla*	*japonica*	Eel	Paemjangô
2	*Cyprinidae*	*Cyprinus*	*carpio*	Carp	Ingô
3	"	*Carassius*	*auratus*	Crusian carp	Pungô
4	"	*Rhodeus*	*uyekii*		Kakshi bungô
5	"	*Acheilognathus*	*yamatsutae*	Korean striped bittering	Chulnap charu
6	"	*Acheilognathus*	*imtermebia*	Slender bittering	Nap charu
7	"	*Hemibarbus*	*labeo*	Steed barbel	Nuch'i
8	"	*Hemibarbus*	*longirostris*	Long nose barbel	ch'ammaja
9	"	*Pseudogobio*	*esocinus*	Goby minnow	Moraemuji
10	"	*Abbottina*	*rivularis*	Chinese false gudgeon	Pôdûl myaech'i
11	"	*Microphysogobio*	*koreensis*		Morae chusa
12	"	*Zacco*	*platypus*	Pale chub	P'irami
13	"	*Zacco*	*temmincki*	Dark chub	Kalgyôni
14	*Cobitidae*	*Misgurnus*	*mizolepis*	Chinese muddy loach	Mikkuraji
15	"	*Cobitis*	*sinensis*	Spined loach	Kirum chonggae
16	"	*Nemacheilus*	*toni*	Siberian stone loach	Chonggae
17	*Plecoglossidae*	*Plecoglossus*	*altivelis*	Sweet smelt	Unô
18	*Bagridae*	*Pseudobagrus*	*fulvidraco*	Korean bullhead	Tongjagae
19	*Siluridae*	*Silurus*	*asotus*	Far Eastern catfish	Megi
20	*Oryzlidae*	*Oryzias*	*latipes*	Songsari	Songsari
21	*Serranidae*	*Coreoperca*	*herzi*	Korean auch perch	Kkôkchi
22	"	*Siniperca*	*scherzeri*	Mandrin fish	Ssogari
23	*Channidae*	*Channa*	*argus*	Snake head	Kamulch'i

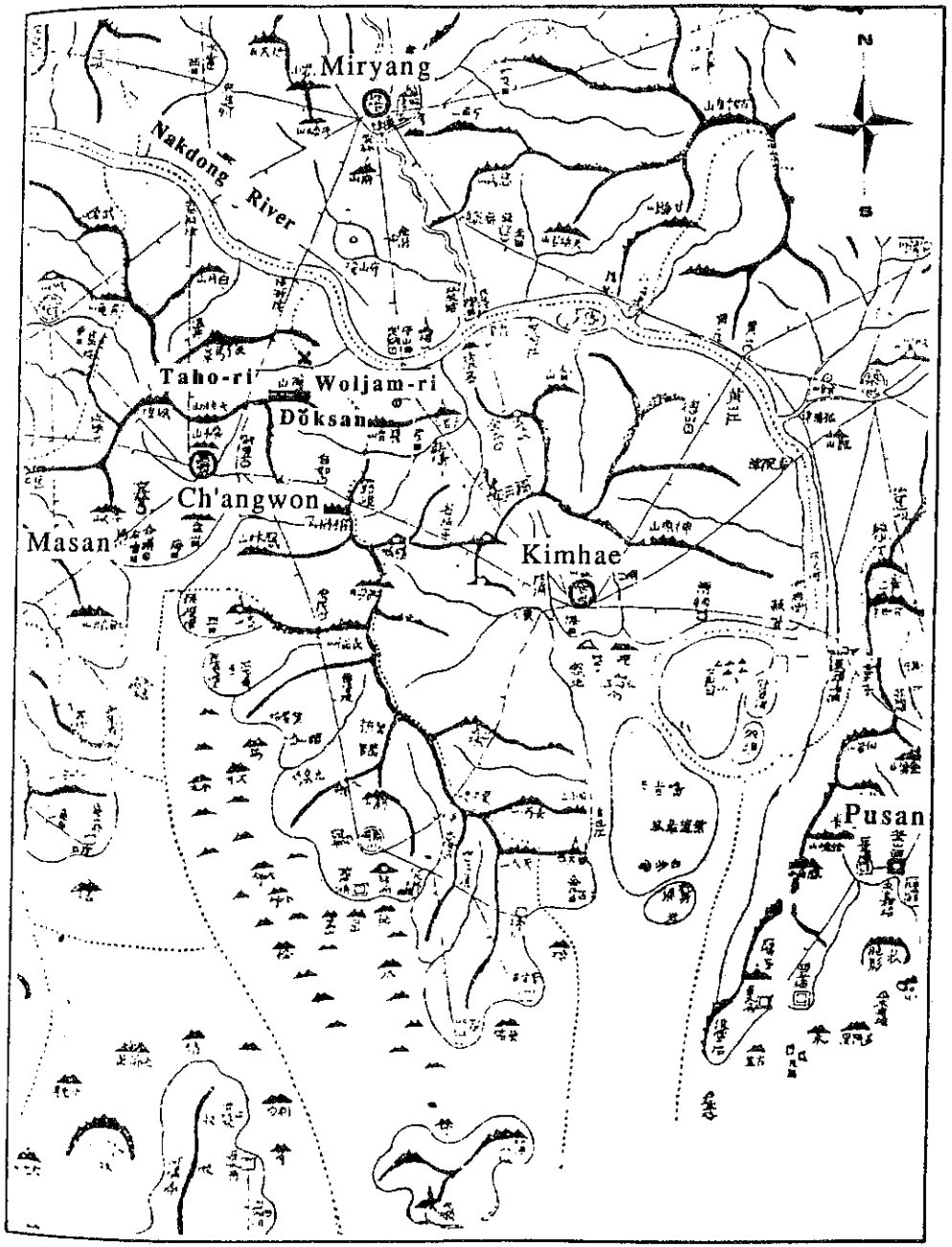


Figure 17 *A mid-19th century map of the Woljam area.* (after Kim 1861)

Table 4 *List of freshwater fish tcaught in the Woljam area.* (Choi *et al.* 1990)

	Family	Genus	Species	English name	Korean name
1	*Anguillidae*	*Anguilla*	*japonica*	Eel	Paemjangô
2	*Cyprinidae*	*Cyprinus*	*carpio*	Carp	Ingô
3	"	*Carassius*	*auratus*	Crusian carp	Pungô
4	"	*Rhodeus*	*ocellatus*	Rose bittering	Hinjul nabjulgae
5	"	*Pseudogobio*	*esocinus*	Goby minnow	Molaemuji
6	"	*Zacco*	*platypus*	Pale chub	P'irami
7	"	*Erythroculter*	*erythropterus*		Kang chunch'i
8	*Cobitidae*	*Misgurnus*	*mizolepis*	Chinese muddy loach	Mikkuraji
9	*Siluridae*	*Silurus*	*asotus*	Far Eastern catfish	Megi
10	*Channidae*	*Channa*	*argus*	Snake head	Kamulch'i

1987; Brandt 1984: 387-93). The basis for the classification is the principle of how the fish are caught, that is the fish-catching method, and subdivisions are based on such factors as material, construction and method of operation. Sixteen main groups are the following (O *et al.* 1987: 9-12):

1. Fishing without gear
2. Grappling and wounding gear
3. Stupefying devices
4. Lines
5. Traps like barriers, fences and fyke nets
6. Aerial traps
7. Bag nets like scrape net and gape nets without wings
8. Dragged gear like bottom trawls and midwater trawls
9. Seine nets like double stick nets, beach seines and boat seines
10. Surrounding nets
11. Drive-in nets
12. Lift nets like hand lift nets
13. Falling gear like cover nets and cast nets
14. Gill nets like bottom set gill nets, drift gill nets, encircling gill nets and lay out on bottom gill nets
15. Tangle nets like entangling nets and trammel nets
16. Harvesting machines like fish pumps.

Fishing gear having netting is classified in groups 5 to15. Of these, there are five groups of net having sinkers to catch freshwater fish: fyke nets with one or three wings (among traps); double stick nets and boat seines (among seine nets); cast nets (among falling gear); bottom set gill nets (among gill nets); and trammel nets (among tangle nets) (Table 5; Figures 18 and 19). These can be grouped into active and passive gear. That is to say, seine nets and falling gear belong to active gear.

Table 5 *Five groups of nets having sinkers to catch freshwater fish in modern Korea.* (Cho *et al.* 1989; O *et al.* 1987)
(Arabic numerals are the same as in Figures 18 and 19)

Figure number	Group	Type of net	Quantity of sinkers	Weight of each sinker
(1)	Traps (*Hamjông ôguryu*)	Fyke nets with one wing (*Ilgakmang*)	a large number	c. 80 g
(2)		Fyke nets with three wings (*Samgakmang*)	a large number	c. 85 g
(3)	Seine nets (*Huriô kuryu*)	Double stick nets (*Ch'aehuri kûmul*)	a small number	-------
(4)		Boat seines (*Paehuri kûmul*)	a large number	-------
(5)	Falling gear (*Tôpô kuryu*)	Hand thrown cast nets (*Son t'umang*)	a small number	c. 40 g
(6)		Cast nets with gallows (*Kalûmdae t'umang*)	a small number	-------
(7)		Cast nets for boats (*Pae t'umang*)	a small number	-------
(1)	Gill nets (*Kôrô kuryu*)	Bottom set gill nets (*Padak kojông kôlgûmul*)	a large number	5 g
(2)	Tangle nets (*Olgae kuryu*)	Trammel nets (*Samjung olgaegu*)	a large number	7 g

A double stick net (Figure 18-3) has small sheets of netting held between two sticks. Fish are captured by surrounding a certain area and scooping up the catch. Although this net is popular with river fishermen, the net should be the right length for handling in water; consequently this net is operated by one person, and it has a few net sinkers, although the weight of each sinker is similar to Jopo-ri's.

Boat seines (Figure 18-4) are operated by a single boat or by two fishing boats. Fish are captured by surrounding and towing the net over an area with both ends tied to a fixed point on a boat. This kind of gear is used to catch both coastal and freshwater fish, but in order to use this net in the river, the river must be very wide and deep (Cho *et al.* 1989: 438). Consequently, the weight of each sinker is more than 100g (Watanabe 1983, 36) because of the water current. In the case of beach seines, the weight (more than 750g) is much heavier than the boat seines' sinker (Cho & Chŏng 1908: Appendices 1) (*cf.* Figure 13).

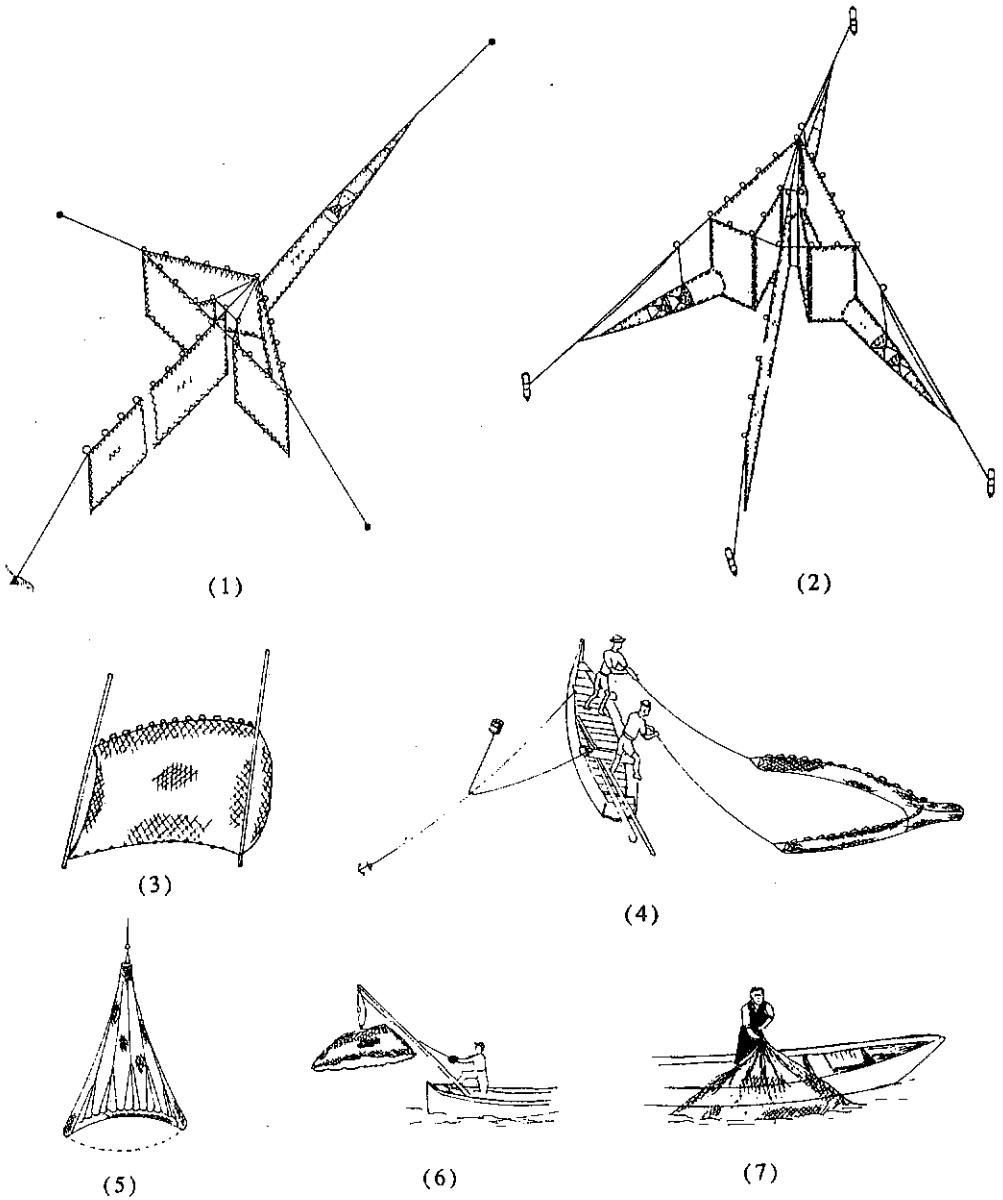


Figure 18 *Nets having sinkers to catch freshwater fish in modern Korea.*
(Arabic numerals are the same as in Table 5)
1) fyke nets with one wing (after Choi *et al.* 1989); 2) fyke nets with three wings (after Choi *et al.* 1989); 3) double stick nets (after O *et al.* 1987); 4) boat seines (after O *et al.* 1987); 5) hand thrown cast nets (after O *et al.* 1987); 6) cast nets with gallows (after O *et al.* 1987); 7) cast nets for boats (after O *et al.* 1987)

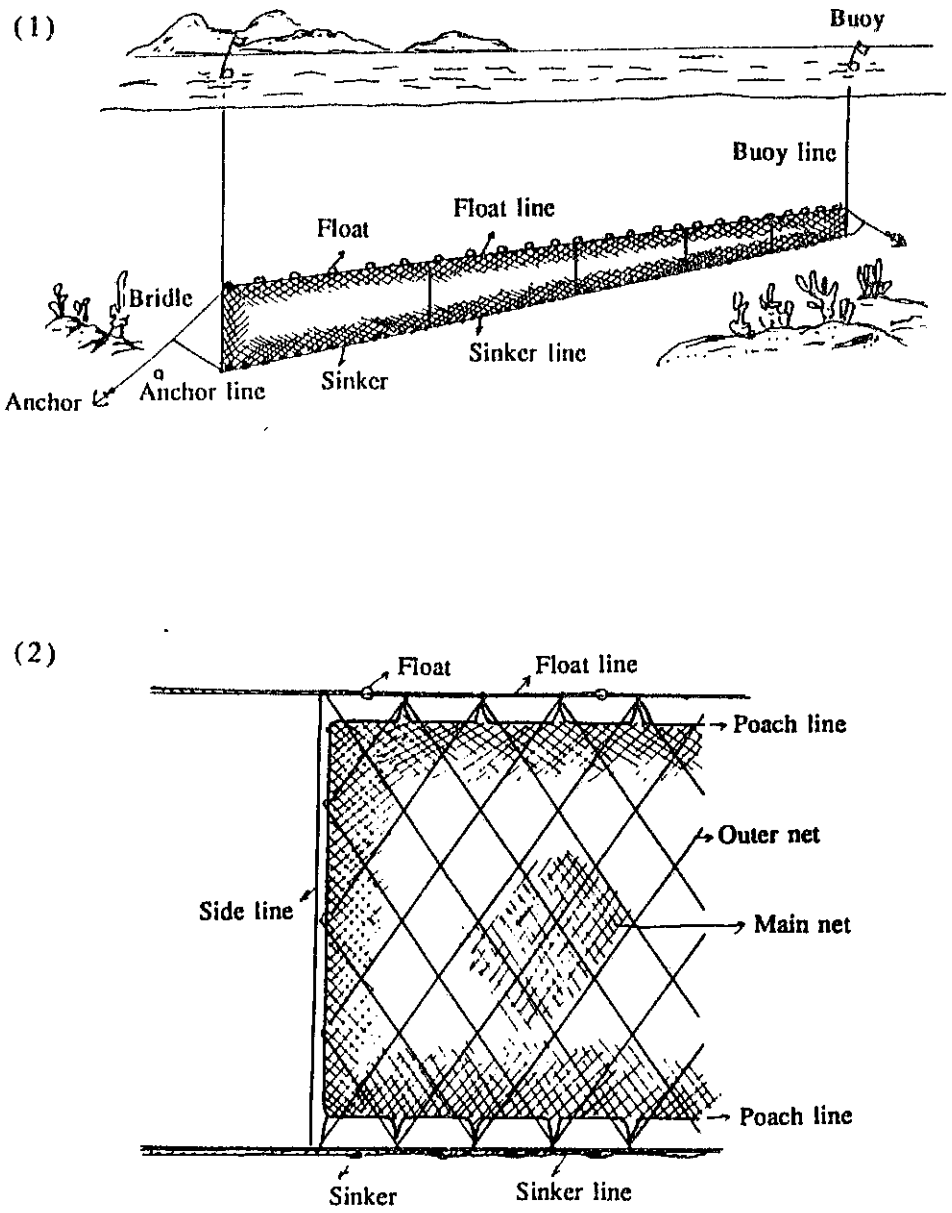


Figure 19 *Construction and terms of bottom set gill nets (1, above) and trammel nets (2, below).* (after O *et al.* 1987)
(Arabic numerals are the same as in Table 5)

Another group of active gear is falling gear (Figure 18-5, -6, -7). The manner of capture is to cover the fish with falling gear. This can be done in shallow water, but is difficult in deeper water (Cho *et al.* 1989: 490). There are three kinds of falling gear with sinkers being used in the river, but all nets are operated by one person on a boat or in water. The size of the net should thus be restricted for convenient handling on board or in water. Consequently the quantity of sinkers is small, but the weight of each sinker (*ca.* 40g) is heavier than Jopo-ri's sinkers (*ibid.*: 491-2).

When looking at the recovery situation of 198 net sinkers from Tomb 20 (Figure 3), we find that the circumstances are quite particular. In contrast with the small number of net sinkers at Jopo-ri E (Figure 11) heaped up in a restricted area (15cm x 20cm; 51 net sinkers) (Jeong *et al.* 1987: 235-8), at Jopo-ri B, a large number of net sinkers are distributed over a wider area (>143cm x 80cm; >198 net sinkers). This means there is a high possibility that nets having more than 198 sinkers would be large-seized nets such as gill nets rather than being a small-sized net such as a double stick net or cast net (Park & Choo 1988: 204).

When using passive gear, the fish have to come voluntarily—as in traps, gill nets and tangle nets. There are several kinds of passive gear for catching freshwater fish in Korea (Table 5; Figures 18 and 19). Two types of traps made of netting (Figures 9-1, 9-2) have been used for catching pond smelt, crusian carp, carp and eel (Cho *et al.* 1989: 145, 165). Traps are implements in which the fish enters voluntarily but is hampered from coming out (*ibid.*: 97). The devices are semi-permanent barriers having one or three wings to be fixed like the longline method in a river (*ibid.*: 145). Therefore, the weight of each sinker (*ca.* 80-85g) to be threaded is much heavier than Jopo-ri's. Nowadays, the sinkers are made from cement *(ibid.*: 146, 166).

As both gill nets and tangle/trammel nets (Figure 19) are similar in terms of their construction and method of operation, these two groups of nets are usually classified into one category (*ibid.*: 566). Strictly speaking, however, the fish catching methods are different. Bottom set gill nets (Figure 19 above) are set on or near the bottom and have a mesh opening of such a size that the fish can gill themselves in the netting voluntarily (*ibid.*: 493). That is to say, "the pressure of the mesh twine on the throat of the fish can cause the opercula to spread, and the net twine then hooks behind them so that the fish can go neither forward nor backward" (Brandt 1984: 355).

In contrast, in the case of tangle nets the fish entangle themselves in the netting by voluntarily coming into single-, double- or triple- walled nets (Figure 19, below) (Cho *et al.* 1989: 566-7). Of these, "trammel nets are triple-walled. Between the two wide-mesh stretched outer walls, a rather loose interior netting with smaller meshes is inserted. This small-meshed inner sheet of netting has plenty of slack. When a fish swims through the large outer meshes it encounters and pushes against the lose interior net so that a pocket is formed around the fish in which it becomes entrapped" (Brandt 1984: 373-4) (Figure 20).

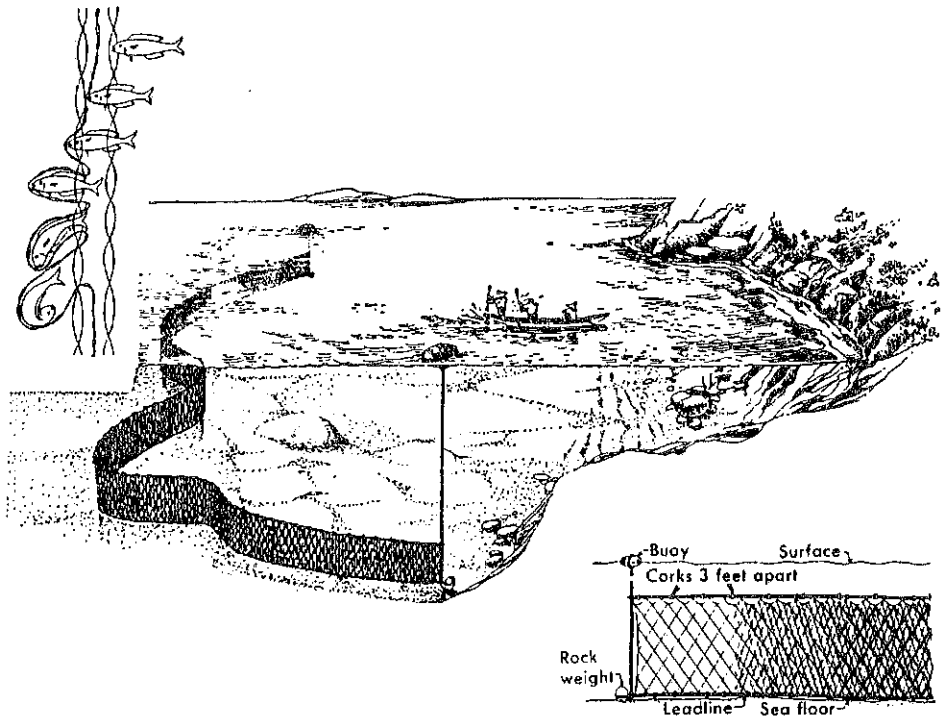


Figure 20. *Trammel net illustrating how fish are captured by the three layers of netting.* Net illustrated is a Philippine example set on the bottom. (from Rounsefell 1975)

As we can see in Table 5, both bottom set gill nets and trammel nets are similar in terms of having a large number of sinkers of similar weights. These factors resemble the Jopo-ri case: in terms of weight, each sinker for bottom set gill nets and trammel nets is 5 and 7 grams in weight, respectively. In fact, at Woljam-ri, most sinkers are 7 to 9 grams and comprise about 74% of whole net sinkers (Figure 21). At Jopo-ri, each sinker does not fall into one cluster in weight, but sinkers at both Woljam-ri and Jopo-ri weigh 21 grams or less (Park & Choo 1988: 202-3). Despite their similar sinkers, trammel nets can be used by fishermen to catch bottom fish like flatfish and cuttlefish which can not be caught with bottom set gill nets due to their construction (Cho *et al.* 1989: 566). Moreover, trammel nets are a very specialized gear; they are considered too complicated in their construction, too difficult to repair, and also more labour-intensive (Brandt 1984: 375-8). In this sense, although nowadays people use both bottom set gill nets and trammel nets for catching freshwater fish, it is reasonable to say that it would not have been possible to make such specialized and developed form of nets as trammel nets in the 4th century AD.

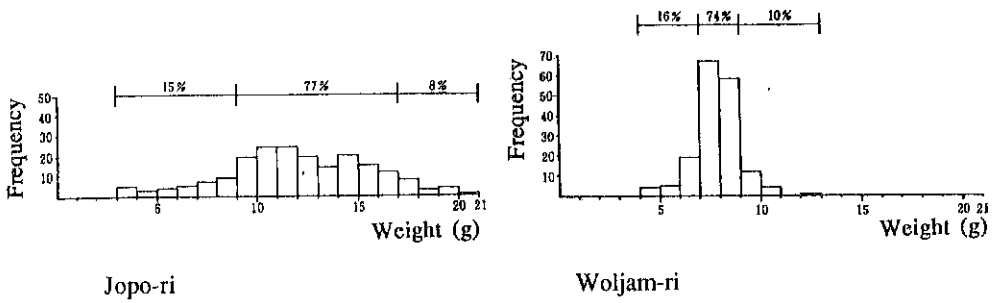


Figure 21 *Histograms of net sinker weights.*

Fishing behaviour and daily subsistence

So far it has been argued that it is highly probable that the 198 net sinkers from Tomb 20 at Jopo-ri B may have been secured to nets similar to Woljam-ri bottom set gill nets. Passive gear like bottom set gill nets requires detailed knowledge of fish behaviour, in contrast with active gear operated by skilled fishermen or by communities with a high level of technology (Brandt 1984: 4-5). That is to say, in the case of passive gear, the knowledge of the fisherman about the behaviour of his prey is a major factor in his success.

Since the 1960s, Woljam-ri fishermen have practised fish culture in several reservoirs using professional knowledge about fish behaviour. Consequently, the cultural form has changed from subsistence fishing to commercial fisheries. Since they supply their catch to several restaurants in the Woljam area, they must use a reformed fishing method in order to catch more fish within a short time. They usually work by day using the technique of drive-in fishing with bottom set gill nets. The mode of capturing is as follows: five pieces of net (each 40m long) are set in the form of a circle on the bottom in 2-metre deep water using two bamboo sticks by one or two people on a boat. For frightening the fish, a boat is usually placed in the middle of a shoal encircled by nets. The fish are then frightened by striking the water with sticks or oars. When frighted by this method, they will gill themselves in the surrounding netting. In this way, original passive gear is changed into active gear.

However, according to my informant, the traditional fishing method utilising bottom set gill nets as passive gear was used before the construction of reservoirs. Older fishermen were interested only in catching sufficient fish for their daily needs—that is, subsistence fishing. They used bottom set gill nets as passive gear, using knowledge about fish behaviour, in a subsidiary stream flowing into the Nakdong River.

The most recent estimate of the number of fish known from the Nakdong River was made from April 1972 to March 1973. According to ichthyologists, fish from the river comprised 82 species from 60 genera in 24 families—about 36.6% of the species of freshwater fishes in Korea (Yang 1973: 17). Of these, according to my

informant, 10 species from 10 genera in 5 families were caught in the Woljam area in the mid-20th century (Table 4). These species of freshwater fish are still reared and caught in the reservoirs. These bony freshwater fish (*Osteichthyes*) are divided into two groups: primary and secondary. Most primary freshwater fish are physiologically incapable of surviving exposure to salt water and are therefore restricted to the fresh waters of the landmass in which they have evolved (Wheeler & Jones 1989: 32). The family *Cyprinidae* is representative of primary freshwater fish (Choi *et al.* 1990: 6). Only eels belong to secondary freshwater fish, which can tolerate salt water even though individually they may never be exposed to it (Wheeler & Jones 1989: 32; Choi *et al.* 1990: 6).

The size of these freshwater fish varies from 20 to 70cm. They are omnivorous, eating planktonic organisms as well as animalcules living on the bottom of a river. Their most important habit is that they live on the bottom. That is to say, they hide themselves on the bottom and do not move by day but set about their feeding activities by night on the bottom (Choi *et al.* 1990: 22-216).

As older fishermen knew such fish behaviour, they used bottom set gill nets as passive gear. According to my informant, the traditional fishing method was as follows: four pieces of nets were set out in lines on the bottom using two bamboo sticks by one or two people on a boat. This operation was conducted in the evening. When morning dawned, they got on the boat and hauled in the bottom set gill nets on which many freshwater fish were gilled (Figure 22). Therefore, they did not catch fish but farmed from dawn till dusk, when the fish hid on the bottom. In fact, according to my informant, they were not specialized as fishermen but practised a farmer-fisher way of life. Fishing was just part of their subsistence economy. Fish-catching methods traditionally utilising bottom set gill nets in the Woljam area can give us insights into the fishing behaviour involved in the use of bottom set gill nets practised by Jopo-ri people in the 4th century AD.

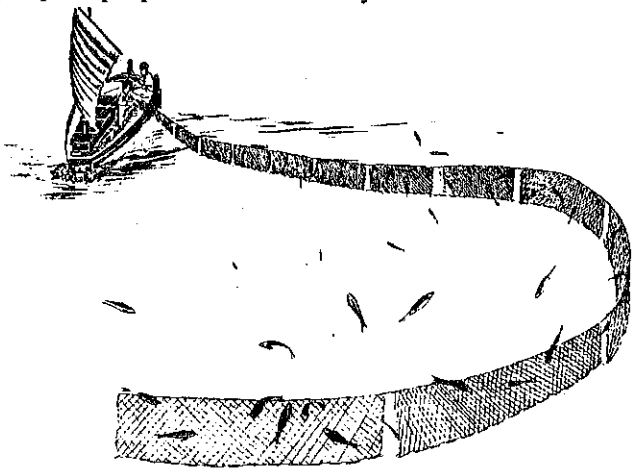


Figure 22 *A scene of hauling in bottom set gill nets which were set in a river.* Net illustrated is a Manchurian example. (after Nozawa 1937)

According to a historical text, *Shinjŭng tongguk yŏjisŭngnam*, and collections by ichthyologists, the total species of freshwater fishes from the middle reaches of the Hwang River are 23 species from 23 genera in 9 families (Han & Park 1985: 284). Of these, 8 species caught in the Woljam area were also identified in the Jopo area. These 23 freshwater fish also belong to the bony fish and are divided into primary and secondary freshwater fish (Table 3, Figure 16).The size of these species varies from 3 to 70 cm, but most cases are 10 to 30 cm. These freshwater fish mainly inhabit the middle and upper reaches of a river, and they like warm and clean water. Their omnivorous eating habits are the same as in the Woljam area, and they too feed on the bottom by night as in the Woljam area (Choi *et al.* 1990: 22-216).

This kind of information on fish ecology increases the probability that the 198 net sinkers from Tomb 20 at Jopo-ri B may have been secured to bottom set gill nets. The problem is whether or not Jopo-ri people had fishing boats. In order to set bottom set gill nets on the bottom of the Hwang River or the Nondŏk Stream, they would have needed a boat or a substitute such as a raft. Unfortunately, there is no direct evidence of boat building in either the historical documents or archaeological data. However, at the Taho-ri site near Woljam-ri (Figure 2), a boat-shaped wooden coffin containing lots of iron wood-working tools with wooden hafts intact was recovered from Tomb 1. This wooden coffin was made of a split oak log, one part hollowed out to form a corpse container and the other part serving as a lid. It looks like a log boat (Figure 23) and its date was estimated as the 1st century BC in the Early Iron Age (Yi *et al.* 1989: 14-27). This suggests that the Pyŏnhan people could have built boats with iron wood-working tools. Moreover, iron wood-working tools for cutting (axes), planing (adzes) and carving (chisels) were recovered from Tombs 5, 6, 8, 29, 30 and 32 at Jopo-ri B (Park & Choo 1988: 181) and from Tombs 24, 25, 37, 40, and 42 at Jopo-ri A, belonging to the same period as Jopo-ri B (Chŏng *et al.* 1987: 246-7). Therefore, it is reasonable to say that in the 4th century AD the Jopo-ri people could have built a sort of boat and thus may have practised the same kind of fishing method as Woljam-ri's traditional fish catching method on the similar fishing ground, catching the similar species of fishes at the similar technological level.

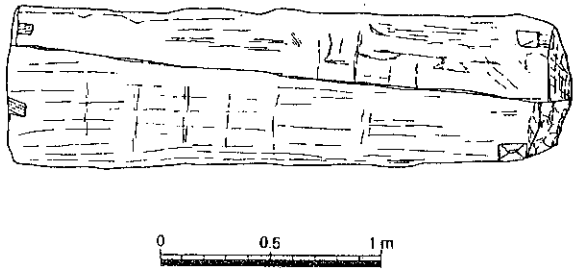


Figure 23 *The wooden coffin from Tomb 1 of the Taho-ri site.* (after Yi *et al.* 1989)

If they did, we can elucidate further similarities on the basis of fishing method. It is reasonable to suppose that Jopo-ri people also set the bottom set gill nets in the evening and hauled in the nets the next morning. If so, what activities did past Jopo-ri people practise from dawn till dusk? The *Dongyi zhuan* in the Chinese historical text *Sanguo zhi* states that as the soil of the Pyŏnhan region was rich, the people of Pyŏnhan produced rice and five species of cereals (Chen 232-97: 52). Iron sickles for cutting such cereals were recovered from Jopo-ri B Tombs 5, 6, and 29 (Park & Choo 1988: 181) and from Jopo-ri A Tombs 7, 8, 22, 25, 37 and 42, all of which belong to the same period (Chŏng *et al.* 1987: 246-7). In fact, palaeoethnobotanical evidence verifying both this historical document and archaeological material was recovered from the Jopo-ri C pit-dwelling site (Lee 1987, 232; Lee 1988: 159). While the Jopo-ri people used Jopo-ri A and B hills as their public cemeteries, they occupied the Jopo-ri C hill for their dwelling space (Figure 4). Plentiful carbonized rice, barley, adzuki beans, mung beans and foxtail millet were recovered through flotation techniques from House A-7 and House I-1 (Figure 24).

It is thus reasonable to say that in the 4th century AD, the subsistence economy of the Jopo-ri people was a mixed system in which various subsistence patterns were combined (Park & Choo 1988: 216). Therefore, they were interested only in catching sufficient fish for their daily life and also practised a farmer-fisher way of life as the Woljam-ri people did. That is to say, they farmed from dawn till dusk, set bottom set gill nets on the bottom of the Hwang River and the Nondŏk Stream using a sort of boat in the evening, and hauled in by boat bottom set gill nets on which lots of freshwater fish were gilled the next morning (Figure 25).

Conclusions

A great many arguments met with not only in archaeology but in most scientific disciplines are inductive rather than deductive (Copi & Cohen 1990: 373). Some serious misconceptions about the distinction between inductive and deductive arguments, belonging to the Baconian scheme and introduced into archaeology by some New Archaeologists (Fritz & Plog 1970; Watson *et al.* 1971), have been disputed by archaeologically trained philosophers (Salmon 1976; Kelley & Hanen 1988, 44-59).

In logic, it has been clarified that the fundamental difference between these two kinds of argument lies not in the idea that deductive inferences move from the general to the particular, while inductive inferences from the particular to the general, but in the relation between premises and conclusions (Copi & Cohen 1990: 45-9). In other words, in a correct deductive inference "the truth of the premises guarantees the truth of the conclusion, while in an acceptable inductive inference all the premises may be true and the conclusion yet be false" (Kelley and Hanen 1988, 46). This means that "the conclusion of a valid deductive inference is said to be implicit in the premises of the inference....In contrast, inductive inference is said to be *ampliative*" (*ibid.*: 47-8; emphasis in original).

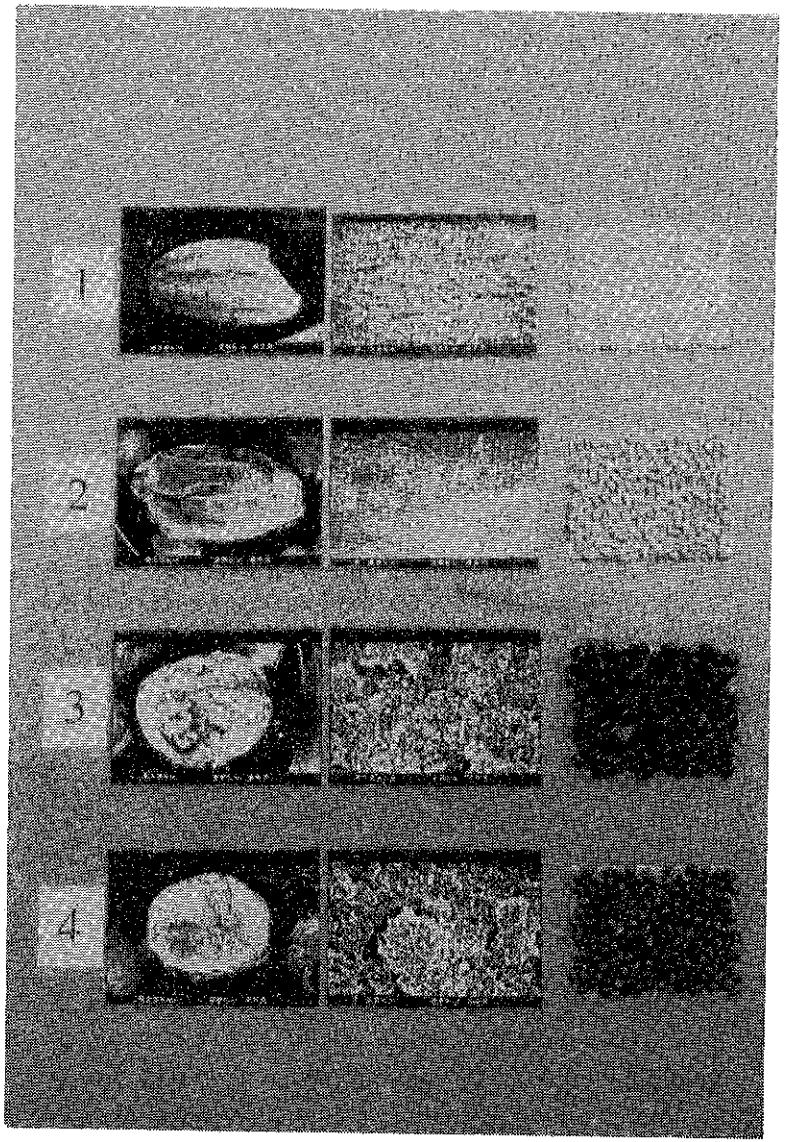
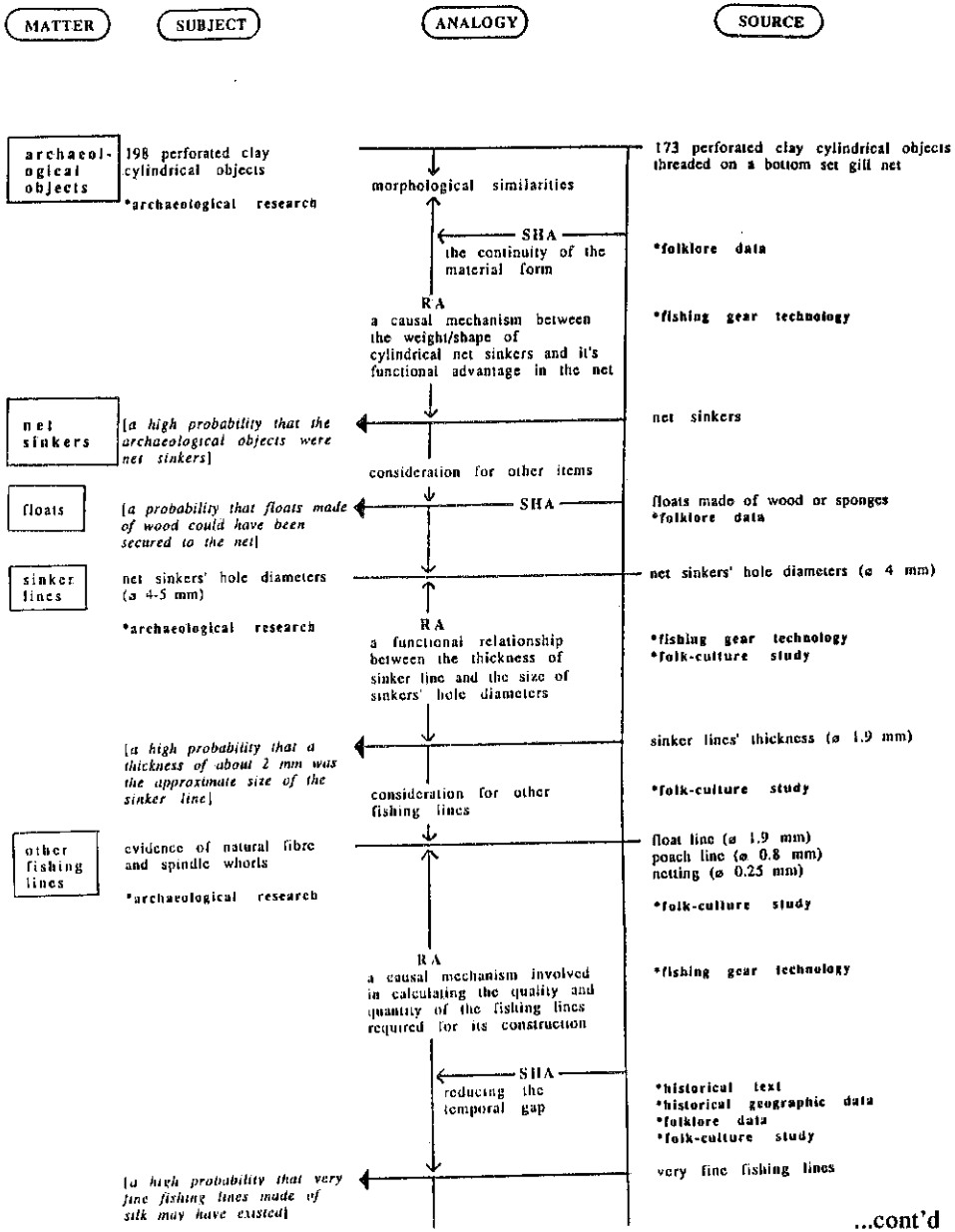
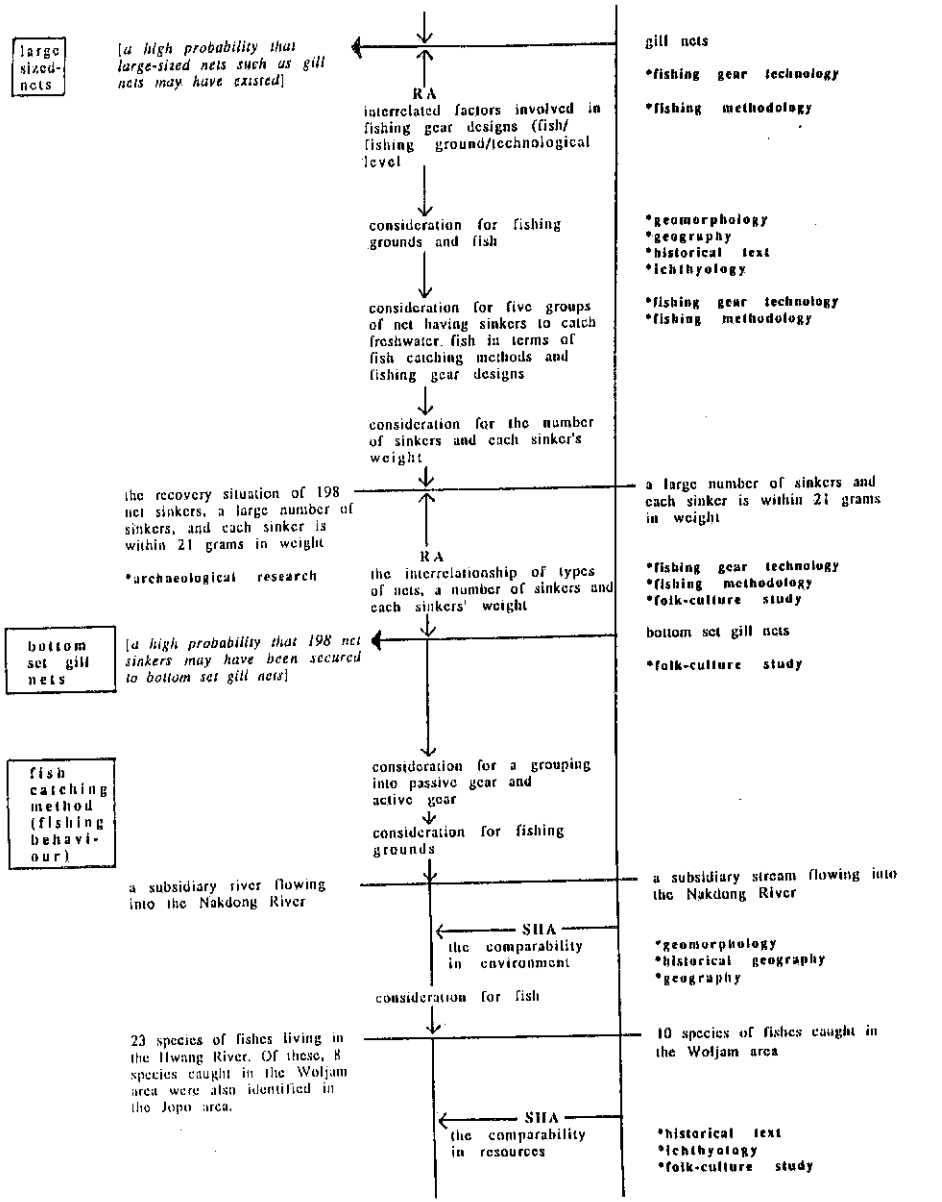


Figure 24 *Photomicrographs of various plant species recovered from House A-7 at Jopo-ri C and their modern counterparts.*
(1. rice, 2. barley, 3. adzuki beans, 4. mung beans)

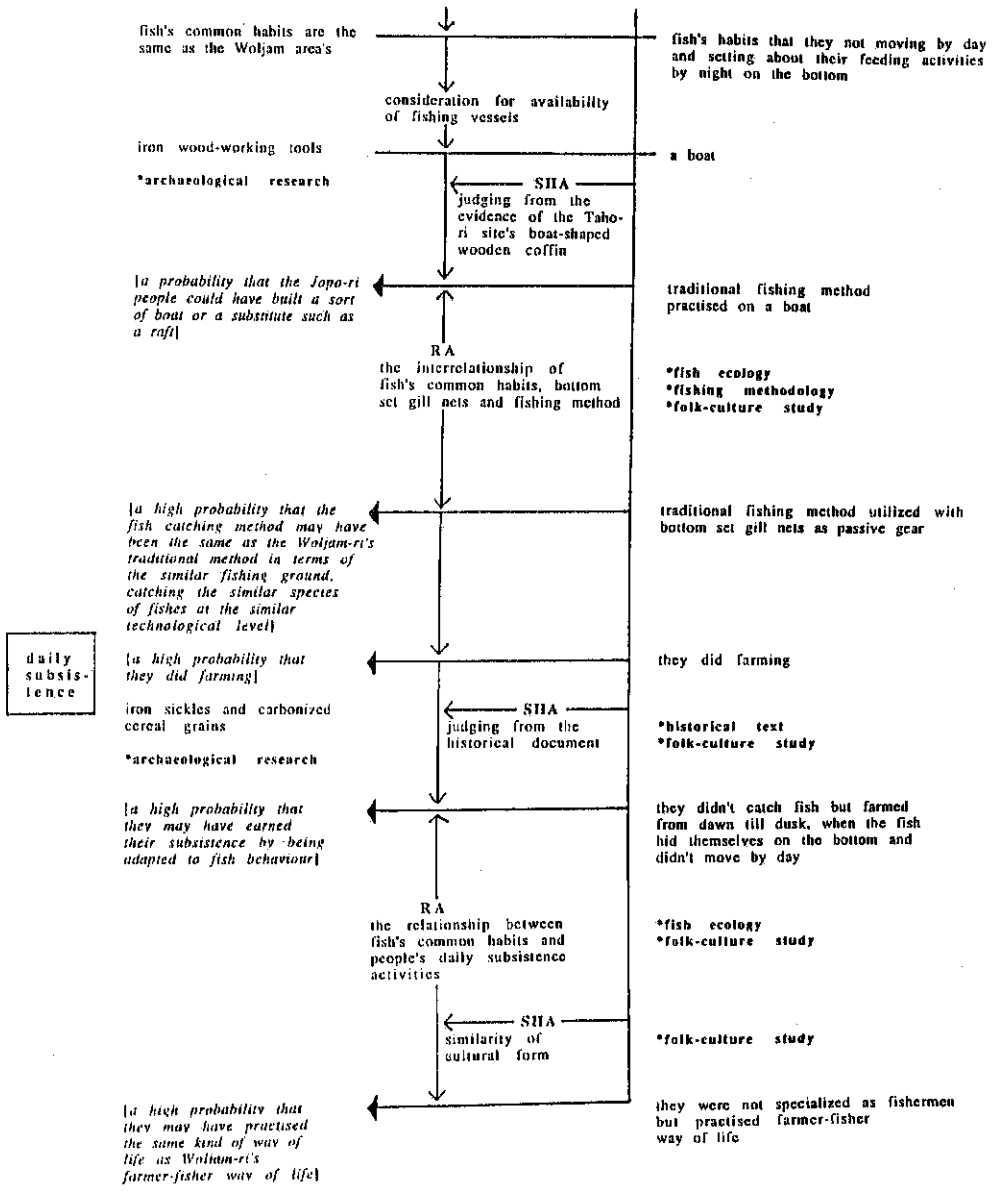


...cont'd

Figure 25 *Flow chart summarizing the use of culturally specific and relational analogies.*
SHA = Specific Historical Analogy, RA = Relational Analogy


large sized-nets
[a high probability that large-sized nets such as gill nets may have existed]
gill nets
*fishing gear technology
*fishing methodology
RA
interrelated factors involved in fishing gear designs (fish/ fishing ground/technological level
consideration for fishing grounds and fish
*geomorphology
*geogruphy
*historical text
*ichthyology
consideration for five groups of net having sinkers to catch freshwater fish in terms of fish catching methods and fishing gear designs
*fishing gear technology
*fishing methodology
consideration for the number of sinkers and each sinker's weight
the recovery situation of 198 net sinkers, a large number of sinkers, and each sinker is within 21 grams in weight
*archaeological research
a large number of sinkers and each sinker is within 21 grams in weight
RA
the interrelationship of types of nets, a number of sinkers and each sinkers' weight
*fishing gear technology
*fishing methodology
*folk-culture study
bottom set gill nets
[a high probability that 198 net sinkers may have been secured to bottom set gill nets]
bottom set gill nets
*folk-culture study
fish catching method (fishing behaviour)
consideration for a grouping into passive gear and active gear
consideration for fishing grounds
a subsidiary river flowing into the Nakdong River
a subsidiary stream flowing into the Nakdong River
SHA
the comparability in environment
*geomorphology
*historical geography
*geography
consideration for fish
23 species of fishes living in the Hwang River. Of these, 8 species caught in the Woljam area were also identified in the Jopo area.
10 species of fishes caught in the Woljam area
SHA
the comparability in resources
*historical text
*ichthyology
*folk-culture study

..cont'd


fish's common habits are the same as the Woljam area's
fish's habits that they not moving by day and setting about their feeding activities by night on the bottom
consideration for availability of fishing vessels
iron wood-working tools
*archaeological research
a boat
SHA
judging from the evidence of the Taho-ri site's boat-shaped wooden coffin
[a probability that the Jopo-ri people could have built a sort of boat or a substitute such as a raft]
traditional fishing method practised on a boat
RA
the interrelationship of fish's common habits, bottom set gill nets and fishing method
*fish ecology
*fishing methodology
*folk-culture study
[a high probability that the fish catching method may have been the same as the Woljam-ri's traditional method in terms of the similar fishing ground, catching the similar species of fishes at the similar technological level]
traditional fishing method utilized with bottom set gill nets as passive gear
daily subsistence
[a high probability that they did farming]
they did farming
iron sickles and carbonized cereal grains
*archaeological research
SHA
judging from the historical document
*historical text
*folk-culture study
[a high probability that they may have earned their subsistence by being adapted to fish behaviour]
they didn't catch fish but farmed from dawn till dusk, when the fish hid themselves on the bottom and didn't move by day
RA
the relationship between fish's common habits and people's daily subsistence activities
*fish ecology
*folk-culture study
SHA
similarity of cultural form
*folk-culture study
[a high probability that they may have practised the same kind of way of life as Woljam-ri's farmer-fisher way of life]
they were not specialized as fishermen but practised farmer-fisher way of life

Therefore, deductive arguments are to be classified as either valid or invalid, so whether an inference is deductively valid (or invalid) is about "an all-or-nothing matter" (*ibid.*: 185). On the other hand, in strong inductive arguments, the conclusion "ventures beyond the factual claims made by the premises...It risks the possibility of leading from true premises to a false conclusion, [but it has] the possibility of discovery and prediction of new facts on the basis of old ones" (Skyrms 1975: 8-9; cited in Kelley & Hanen 1988: 48). That is, whether an inference is inductively strong is a matter of degree. I believe that in archaeology "explanatory worth is not an all-or-nothing matter but one of degree" (Kelley & Hanen 1988: 185).

Analogical arguments as a form of inductive inference are aimed to support a conclusion as probably true. This means that arguments by analogy "are not to be classified as either valid or invalid. Probability is all that is claimed for them" (Copi & Cohen 1990: 358). In this case, the problem is the degree of probability: to explain is to show what something was, may have been and could have been, or, what past people did, may have done and could have done. As we can see in Figure 16, I have argued that the cylindrical archaeological objects *were* net sinkers; floats made of wood *could have been secured* to the net; a thickness of about 2 mm *was* the approximate size of the sinker lines; very fine fishing lines made of silk *may have existed*; large-sized nets such as gill nets *may have existed*; 198 net sinkers *may have been secured* to bottom set gill nets; past Jopo-ri people *could have built* a sort of boat or a substitute such as a raft; the past Jopo-ri's fishing method *may have been* the same as the Woljam-ri's traditional fishing method; they *did* farming; they *may have earned* their subsistence by being adapted to fish behaviour; and they *may have practised* the same kind of way of life as Woljam-ri's farmer-fisher way of life.

The fact that analogical arguments are inductive or ampliative forms of inference means that the truth of the conclusion cannot be guaranteed (Kelley & Hanen 1988: 264). However, if the different sorts of knowledge are subsumed in functional/causal relations and in culturally specific historical context, the conclusion by analogical arguments will indicate a high degree of probability. This means that it is likely that cuturally specific and relational analogical arguments will be acceptable *truthlike* conclusions. Thus, the conclusions made here —that more than 198 archaeological objects from Tomb 20 of the Jopo-ri B site were net sinkers; that these net sinkers may have been secured to bottom set gill nets; that the past Jopo-ri's fishing method utilized with the bottom set gill nets may have been the same as the present-day Woljam-ri's traditional fishing method; and that past Jopo-ri people may have practised a farmer-fisher way of life as the Woljam-ri people did—are hypotheses with high probability, and likewise it is possible that these conclusions are going to be the best current hypotheses.

Such inductively strong analogical arguments (culturally specific and relational analogies) afford us the possibility of proposing new facts on the basis of previous facts. I believe that without this kind of procedure, science cannot create new models and theories, and it is essential to scientific progress.

This means that we can explore further cultural aspects of past Jopo-ri people on the basis of these strong arguments. So far I have argued—despite incomplete archaeological evidence—how culturally specific and relational analogies can be used in understanding the unknown archaeological objects (net sinkers), the cultural material forms (bottom set gill nets), the fishing behaviour involved in the use of bottom set gill nets, and daily subsistence of past Jopo-ri people. By the way, what also needs to be emphasized is that the socio-cultural meaning of nets in the 4th century AD, the daily subsistence, the fishing behaviour, and bottom set gill nets are not discrete entities independent of one another. It has been argued that behaviour (socio-economic actions interpreted within a system of meaning) is not separate from culture (a system of meaning, symbols and ideals) or from cultural material forms (the tangible products of behaviour)—but culture, behaviour, and cultural material forms are interrelated. They can be separated only analytically in order to examine parts of the whole (Kent 1984: 12-13).

In the Jopo-ri case, the 198 net sinkers were recovered not in a pit-dwelling but in a wooden coffin tomb. From the evidence at Tomb 20 (Figure 6), it can be said that the people at Jopo-ri used bottom set gill nets for their ancestor's funeral ceremony. Although it is not an obvious case, another example is Tomb 29, which contains a relatively larger number of artefacts—including evidence of natural fibre, iron wood-working tools and an iron sickle—than others (Park & Choo 1988: 181). Both tombs belong to the early 4th century AD, and there is no evidence that net sinkers have been recovered from other tombs which belong to the same period at Jopo-ri A and B (*ibid.*: 214-216). This interesting situation allows us to explore the symbolic meaning of nets in the Jopo-ri culture and the socio-economic behaviour inter-related with a system of meaning (Figure 26).

These cultural aspects will require different databases such as knowledge about the historical situation in the 4th century AD (a transitional historic period in East Asia), socio-economic relationships and socio-political organisation among Kaya federation including Tara (which is the name of the socio-political entity in the 4th century AD past Jopo-ri people belonged to, *cf.* Figure 9), and religious beliefs which can be inferred from past Jopo-ri people's funeral ceremonies. These socio-cultural systems will be explored in the near future through another paper. On the basis of future discussions, I will examine whether or not Hawkes's ladder of inference (Hawkes 1954)—which is his postulation about archaeological reasoning that there is...

> an ascending scale of difficulty in interpreting archaeological data in terms of human activities: technology [is] the easiest category, while economy, social and political organisation, and ideology [exhibit] escalating difficulties[3]

—still has relevance to archaeology, especially in the proto-historic period of Kaya.

---

[3] as reported in Trigger (1989: 392).

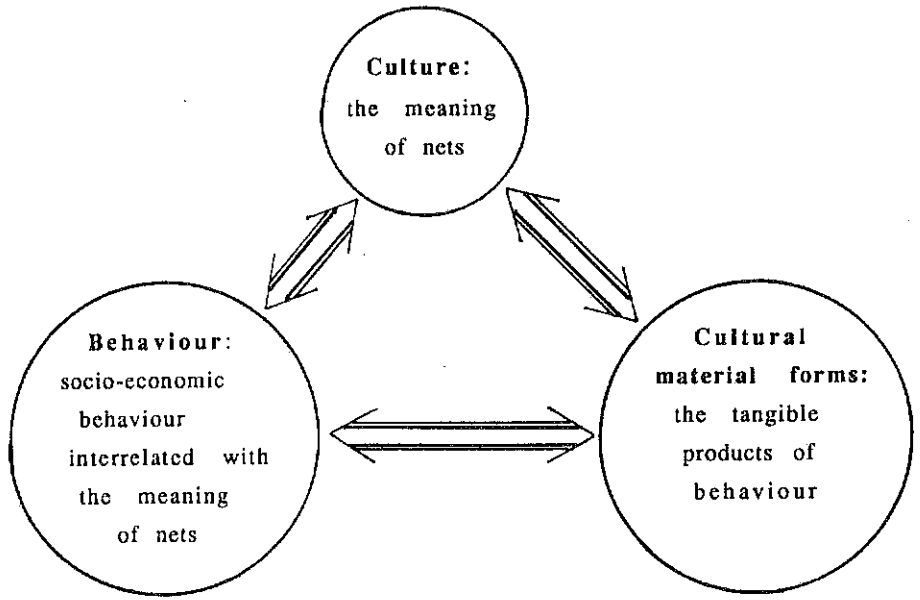


Figure 26 A schematic model of the interrelationship of culture, behaviour and cultural material forms at Jopo-ri in the 4th century AD.

Acknowledgments

This paper is a slightly revised version of my M.Phil. dissertation submitted to the Department of Archaeology, University of Cambridge in May 1991. I would like to thank many people in Cambridge, notably Gina Barnes, Geoff Bailey, Ian Hodder, Todd Whitelaw, Sander E. van der Leeuw, Marie L.S. Sørensen, Simon Kaner, who made thoughtful comments that helped me clarify my thinking. I, of course, take full responsibility for the contents of this paper.

References

Achinstein, P. (1964) "Models, analogies and theories." *Philosophy of Science* 31: 328-50.

An, C.B.; Kim, W.K. and Pan, Y.B. (1990) "Kayasahoeŭi hyŏngsŏng kwajŏngyŏngu: Kimhae chiyŏkŭl chungsimŭro" [A study of formation process of Kaya society with particular reference to the Kimhae region]. *Kaya munhwa yŏngu* 1: 45-114. (in Korean)

Anderson, K.M. (1969) "Ethnographic analogy and archaeological interpretation." *Science* 163: 133-8.

Ascher, R. (1961) "Analogy in archaeological interpretation." *Southwestern Journal of Anthropology* 17: 317-25.

Binford, L.R. (1967) "Smudge pits and hide smoking: the use of analogy in archaeological reasoning." *American Antiquity* 32: 1-12.

Binford, L.R. (1968) "Archaeological theory and method." In Binford, S.R. and Binford, L.R. (eds.) *New perspectives in archaeology*. Chicago: Aldine, pp. 5-32.

Binford, L.R. (1972) "Archaeological reasoning and smudge pits-revisited." In Binford, L.R. *An archaeological perspective*. New York, Seminar Press, pp. 52-8.

Bower, J. (1986) *In search of the past: an introduction to archaeology*. Chicago: The Dorsey Press.

Brandt, A. von. (1984) *Fish catching methods of the world*. Farnham: Fishing News Books, 3rd edition.

Bray, F. (1984) *Science and Civilisation in China, Vol. 6: biology and biological technology, Part II: agriculture*. Cambridge University Press.

Charlton, T.H. (1981) "Archaeology, ethnohistory, and ethnology: interpretive interfaces." In Schiffer, M.B. (ed.) *Advances in Archaeological Method and Theory* 4. New York, Academic Press, pp. 129-176.

Chen, S. (232-297) *Sanguo zhi* [Chronicles of the Three Kingdoms Period]. (in Chinese). Pages cited from Park, Y.S. (ed.) (1986) *Kugyŏk Chungguk chŏngsa chosŏnjŏn* [Korean translation on the account of Chosŏn in Chinese authentic history]. Seoul: National History Compilation Committee. (in Korean)

Cho, T.H.; Yi, P.M.; Yun, C.A.; Cho, K.U. and O, H.K. (1989) *Hyŏndae Han'guk ŏgudogam* [Modern fishing gear of Korea]. Kyŏngnam: National Fisheries Research and Development Agency. (in Korean)

Cho, C.U. and Chŏng, C.H. (1908) *Han'guk susanji* [A gazeteer of Korean fishing]. Hanyang [Seoul]: Fisheries Bureau, Ministry of Agriculture, Trade and Industry. (in Korean)

Choi, K.C.; Chon, S.L.; Kim, I.S. and Son, Y.M. (1990) *Wonsaek Han'guk tamsuŏ togam* [Colored illustrations of the freshwater fishes of Korea]. Seoul: Hyangmunsa. (in Korean with English summary)

Choi, M.L. (1971) "Han'guk sŏnsa wonsayujŏk ch'ulto ŏguryu, 1" [Fishing gear excavated from prehistoric and protohistoric sites in Korea, 1] *Komunhwa* 9: 17-21. (in Korean)

Choi, M.L.; Yi, Y.N.; Park, S.P. and Park, Y.C. (1985) "Yŏju Hunamni sŏnsa ch'wilakji ch'ulto sŏkkilyu, I" [Stone implements excavated from the Hunamni site, Yŏju, I]. *Pyŏn T'ae-sŏp paksa hoegabkinyŏm sahaknonch'ong* [Essays in honour of Dr. Pyŏn T'ae-sŏp on his 60th birthday]. Seoul: Samyŏngsa, pp. 11-39. (in Korean)

Chŏng, Y.H.; Yang, T.Y. and Kim, Y.S. (1987) *Hapch'ŏn Jopo kobun A palgul chosabogo* [A group of tombs at Jopo-ri A area of Hapch'on]. Archaeological Research Report 8. Taegu: The Yongnam University Museum. (in Korean)

Clark, J.G.D. (1951) "Folk-culture and the study of European prehistory." In Grimes, W.F. (ed.) *Aspects of archaeology.* London: Edwards, pp. 49-65. Page cited from and reprint in Clark, J.G.D. (1989) *Economic prehistory.* Cambridge University Press, pp. 136-148.

Clark, J.G.D. (1953) "Archaeological theories and interpretation: old world." In Kroeber, A.L. (ed.) *Anthropology today: an encyclopedic inventory.* The University of Chicago Press, pp. 343-60.

Clark, J.G.D. (1954) *Excavations of Star Carr.* Cambridge University Press.

Cohen, L.J. (1989) *An introduction to the philosophy of induction and probability.* Oxford: Clarendon Press.

Collcutt, M., Jansen, M. and Kumakura, I. (1988) *Cultural atlas of Japan.* Oxford: Phaidon.

Copi, I.M. and Cohen, C. (1990) *Introduction to logic.* New York: Macmillan, 8th edition.

Fridman, A.L. (1986) *Calculations for fishing gear designs.* Food and Agriculture Organization of the United Nations (FAO) fishing manuals. Farnham: Fishing News Books, Revised edition.

Fritz, J.M. and Plog, F.T. (1970) "The nature of archaeological explanation." *American Antiquity* 35: 405-12.

Gifford, D.P. (1981) "Taphonomy and paleoecology: a critical review of archaeology's sister disciplines." In Schiffer, M.B. (ed.) *Advances in Archaeological Methods and Theory* 4. New York, Academic Press, pp. 365-438.

Gould, R.A. (1974) "Some current problems in ethnoarchaeology." In Donnan, C.B. and Clewlow, C.W., Jr. (eds.) *Ethnoarchaeology: monograph 4.* Los Angeles, Institute of Archaeology, University of California, pp. 27-48.

Gould, R.A. (ed.) (1978) *Explorations in ethnoarchaeology.* University of New Mexico Press.

Gould, R.A. (1980) *Living archaeology.* Cambridge University Press.

Gould, R.A. (1990) *Recovering the past.* University of New Mexico Press.

Gould, R.A. and Schiffer, M.B. (ed.) (1981) *Modern material culture: the archaeology of us.* New York: Academic Press.

Gould, R.A. and Watson, P.J. (1982) "A dialogue on the meaning and use of analogy in ethnoarchaeological reasoning." *Journal of Anthropological Archaeology* 1: 335-81.

Han, B.S. (1971) "Sŏnsashidae nonggyŏngmun ch'ŏngdonggi-e taehayŏ" [On the prehistoric bronze engraving on which agricultural scene is depicted]. *Kogomisul* 112: 2-13. (in Korean)

Han, C.K. and Park, Y.S. (1985) "Hapchŏn dam sumoljigu tongmulbunya haksuljosa pogosŏ" [Research report on zoology in the submerged area by Hapch'ŏn dam]. In *Hapch'ŏndam sumoljigu chip'yojosa pogosŏ* [Field survey report in the submerged area by Hapch'ŏn dam]. Ch'angwon: Kyŏngsangnam-do Provincial Government, pp. 271-90. (in Korean)

Hawkes, C. (1954) "Archaeological theory and method: some suggestions from the Old World." *American Anthropologist* 56: 155-68.

Helman, D. (ed.) (1988) *Analogical reasoning: perspectives of artificial intelligence, cognitive science, and philosophy.* Dordrecht: Kluwer Academic Pub.

Hesse, M.B. (1959) On defining analogy. *Proceedings of the Aristotelian Society* 60: 79-100.

Hesse, M.B. (1966) Models and analogies in science. Notre Dame: University of Notre Dame Press.

Hodder, I. (1982) *The present past: an introduction to anthropology for archaeologists.* London: Batsford.

Hong, S.W. (ed.) (1985) *Han'guk chiji: chibangp'yŏn II Pusan, Taegu, Kyŏngbuk, Kyŏngnam* [Korean geography: regional series III]. Seoul: National Physical Environment Planning Board, Ministry of Construction. (in Korean)

Im, H.J. (1978) *Hunamni chugŏji, IV* [The pit-dwelling site of Hunamni, IV]. Archaeological and Anthropological Papers 8. Seoul: The Seoul National University Museum. (in Korean with English summary)

Im, H.T.; Kwak, T.C. and Cho, H.P. (1988) *Taeya-ri chugŏji, I* [The pit-dwelling site of Taeya-ri, I]. Academic Series 2. Pusan: The Tongŭi University Museum. (in Korean)

Im, H.T., Kwak, T.C. and Cho, H.P. (1989) *Taeya-ri chugŏji, II* [The pit-dwelling site of Taeya-ri, II]. Academic Series 3. Pusan: The Tongŭi University Museum. (in Korean)

Institute of Archaeology and Folklore (1956) *Najin ch'odo wonshiyujŏk p'algulbogo* [Excavation report on the Najin ch'odo site]. Site Excavation Report 1. P'yŏngyang: Kwahak paekgwasajŏn ch'ulp'ansa. (in Korean)

Institute of Asian Culture (1986) *Kangwon-doŭi sŏnsamunhwa* [Prehistoric culture in Kangwon-do]. Ch'unch'ŏn: Hallim University. (in Korean)

Jeong, J.W. *et al.* (1987) *Hapch'ŏn Jopo-ri E chigu yujŏk* [The site of Jopo-ri E area, Hapch'ŏn]. Site Excavation Report 11. Pusan: The Pusan National University Museum. (in Korean)

Kang, I.H. (1990) *Han'guk shiksaenghwalsa* [A history of Korean foodways]. Seoul: Samyŏngsa, 2nd edition. (in Korean)

Kelley, J.H. and Hanen, M.P. (1988) *Archaeology and the methodology of science.* University of New Mexico Press.

Kent, K.P. and Nelson, S.M. (1976) "Net sinkers or weft weights?" *Current Anthropology* 17: 152.

Kent, S. (1984) *Analyzing activity areas: an ethnoarchaeological study of the use of space.* University of New Mexico Press.

Kim, C.H. (1861) *Taedongyŏjido* [Map of Korea]. Page cited in An, C.B.; Kim, W.K. and Pan, Y.B. (1990) "Kayasahoeŭi hyŏngsŏng kwajŏngyŏngu: Kimhae chiyŏkŭl chungsimŭro" [A study of formation process of Kaya society with particular reference to the Kimhae region]. *Kaya munhwa yŏn'gu* 1: 45-114. (in Korean)

Kim, J.H. (1967) "Han'guk Mumuntogi munhwaŭi yŏngu" [A study on the Mumun pottery culture]. *Paeksanhakbo* 3: 1-98. (in Korean)

Kim, W.Y.; Kwon, H.S.; Lee, H.J.; Im, Y.J.; Han, S.I. and Choo, Y.S. (1984) *Chŏngbi, pokwonŭl uyihan Mongch'on tosŏng palguljosa pogosŏ* [Excavation report on the Mongch'on fortress site]. Seoul: The Seoul National University Museum. (in Korean)

Kim, Y.G. and Sŏk, K.J. (1984) *Namgyŏng yujŏke kwanan yŏngu* [A study on the Namgyŏng site]. P'yŏngyang: Kwahak paekgwasajŏn ch'ulp'ansa. (in Korean)

Kim, Y.J. (1989) *Nongnimsusan komunhŏn piyo* [A summary of historical texts with reference to agriculture, forestery and fishery]. Research Series 9, Institute of Agricultural Economic Studies, Korea. Seoul: Samhwa ch'ulp'ansa, 4th edition. (in Korean)

Ko, K.S. (1975) *Ogu ŏbŏphak* [Fishing gear technology and fishing methodology]. Seoul: Koryŏ ch'ulp'ansa. (in Korean)

Kramer, C. (ed.) (1979) Ethnoarchaeology: implications of ethnography for archaeology. New York: Columbia University Press.

Lee, K.B. and Lee, K.D. (1985) *Han'guksa kangjwa: kodaep'yŏn* [An introduction to ancient Korean history]. Seoul: Ilchokak, 2nd edition. (in Korean)

Lee, P.G. and Lee, C.G. (1985) *Kwakji paech'ong* [The shell midden of Kawkji]. Site Excavation Report 1. Cheju: The Cheju National University Museum. (in Korean)

Lee, P.K. (1981) *Obŏphak wollon* [An introduction to fishing methodology]. Pusan, T'aehwa ch'ulp'ansa. (in Korean)

Lee, S.J. (1988) "Jopo-ri C chigu chugŏji ich'a palgulsŏngkwa" [The result of second season of excavation at Jopo-ri C area]. *Abstracts of Papers Presented at the 12th Annual Conference of the Korean Archaeological Society*, pp. 153-65. (in Korean)

Lee, U.C. (1987) *Hapch'ŏn Jopo-ri C, D chiguyujŏk* [The site of Jopo-ri C and D areas, Hapch'ŏn]. Archaeological Research Report 3. Taegu: The Hyosong Women University Museum. (in Korean)

Mackie, J.L. (1972) "Fallacies." In *The encyclopedia of philosophy* 3. New York: MacMillan, pp. 169-79.

Ministry of Education (1984) *Taehanminguk chuyo chimyŏngŭi romat'cha p'yogi yongnyegip* [Korean gazetter]. Seoul: Ministry of Education. (in Korean with English summary)

Murray, T. and Walker, M.J. (1988) "Like what? a practical question of analogical inference and archaeological meaningfulness." *Journal of Anthropological Archaeology* 7: 248-87.

Nozawa, S. (1937) *Manshuūkoku gyŏgu benran* [Illustrations of fishing gear in the Empire of Manshū]. Dalian: National Fisheries Development Agency in Yingkou, the Empire of Manshū. (in Japanese)

O, H.K.; Cho, T.H.; Yi, P.M.; Cho, K.U. and Yun, C.A. (1987) *Ogubullyu mit kakbumyŏngch'ing* [Classification and terms of fishing gear]. Pusan: National Fisheries Research and Development Agency. (in Korean)

O, K.H. and Kwak, C.C. (1989) *Kimhae p'yŏngya-e taehan kogohakjŏk yŏngu I: chihyŏng hwangyŏnggwa yujŏk* [An archaeological study of Kimhae plain: geographical environment and sites]. *Kodaeyŏngu* 2: 3-49. (in Korean)

Orme, B. (1981) *Anthropology for archaeologists: an introduction.* London: Duckworth.

Park, D.B. and Choo, Y.S. (1988) *Hapch'ŏn Jopo-ri B Kobungun* [A group of tombs at Jopo-ri B area of Hapch'ŏn, Kyŏngsangnam-do]. Archaeological Research Report 2. Ch'angwon: The Ch'angwon National University Museum. (in Korean)

Park, K.B. (1984) *Han'guk ŏŏpsa* [A history of Korean fishery]. Seoul: Chŏngŭmsa. (in Korean)

Park, K.B. (1987) *Hyŏndae Han'guk susansa* [A history of modern Korean fishery]. Seoul: Sadanbŏpin suuhae. (in Korean)

Park, K.S. (1981) *Han'guk ŏŏp kyŏngjesa yŏngu: ŏŏp gongdongch'aelon* [A study of fishing economic history of Korea: a theory of fishing community]. Seoul: Yepung ch'ulp'ansa. (in Korean)

Park, Y.G. (1974) *Han'guk shikyopumsa* [A history of Korean food]. Seoul: Jŏngŭmsa. (in Korean)

Ravn, M. (1993) "Analogy in Danish prehistoric studies." *Norwegian Archaeological Review* 26: 59-90.

Rounsefell, G.A. (1975) *Ecology, utilization, and management of marine fisheries.* Saint Louis: Mosby.

Rouse, I. (1972) *Introduction to prehistory.* New York: McGraw-Hill.

Russell, S.J. (1989) *The use of knowledge in analogy and induction.* London: Pitman.

Salmon, M.H. (1976) "'Deductive' versus 'inductive' archaeology." *American Antiquity* 41: 376-81.

Salmon, M.H. (1982) *Philosophy and Archaeology.* New York: Academic Press.

Scriven, M. (1976) *Reasoning.* New York: McGraw-Hill.

Shackley, M. (1981) *Environmental archaeology.* London: George Allen and Unwin.

Sharer, R.J. and Ashmore, W. (1979) *Fundamentals of archaeology.* Menlo Park: Benjamin and Cummings.

Shaw, W.H. and Ashley, L. (1983) "Analogy and inference." *Dialogue* 22: 415-32.

Sim, B.K. (1989) *Hapch'ŏn Ponggye-ri yujŏk* [The site of Ponggye-ri, Hapch'ŏn]. Site Excavation Report 15. Pusan: The Dong-A University Museum. (in Korean)

Skyrms, B. (1975) *Choice and chance.* Encino: Dickenson, 2nd edition.

Small, D.B. (1987) "Toward a competent structuralist archaeology: a contribution from historical studies." *Journal of Anthropological Archaeology* 6: 105-21.

Sŏ, K.T. (1964) "Shinhŭng-dong p'aengigŭrŭt chibjari" [The pit-dwelling site of Shinhŭng-dong]. *Kogominsok* 64.3: 35-45. (in Korean)

Sŏ, K.T. (1986) *Chosŏnŭi shinsŏkgishidae* [The Neolithic in Korea]. P'yŏngyang: Sahoe Kwahak Ch'ulp'ansa. (in Korean)

Sollas, W.J. (1924) *Ancient hunters and their modern representatives.* London: Macmillan, 3rd edition.

Steward, J.H. (1942) "The direct historical approach to archaeology." *American Antiquity* 7: 337-43.

Thompson, R.H. (1956) "The subjective elements in archaeological inference." *Southwestern Journal of Anthropology* 12: 327-32.

Trigger, B.G. (1989) *A history of archaeological thought.* Cambridge University Press.

Uemov, A.I. (1970) "The basic forms and rules of inference by analogy." In Tavanec, P.V. (ed.) *Problems in the logic of scientific knowledge.* Dordrecht: D. Reidel, pp. 266-311.

Watanabe, M. (1983) *Jōmon jidai no chishiki* [A guide to Jōmon culture]. Tokyo: Tokyo Bijutsu. (in Japanese)

Watson, P.J. (1986) "Archaeological interpretation, 1985." In Meltzer, D.J.; Fowler, D.D. and Sabloff, J.A. (eds.) *American archaeology past and future: a celebration of the Society for American Archaeology 1935-1985.* Washington: The Smithsonian Institution Press, 439-57.

Watson, P.J.; LeBlanc, S.A. and Redman, C.L. (1971) *Explanation in archaeology: an explicitly scientific approach.* New York: Columbia University Press.

Wheeler, A. and Jones, A.K.G. (1989) *Fishes.* Cambridge Manuals in Archaeology. Cambridge: Cambridge University Press.

Willey, G.R. (1953) "Inference and analogy in archaeology." In Tax, S.; Eiseley, L.C.; Rouse, I. and Voegelin, C.F. (eds.) *An appraisal of anthropology today.* Chicago: University of Chicago Press, pp. 251-52.

Willey, G.R. and Sabloff, J.A. (1980) *A history of American archaeology.* San Francisco: Freeman, 2nd edition.

Wylie, M.A. (1980) "Analogical inference in archaeology." Paper presented at the 45th annual meetings of the Society for American Archaeology.

Wylie, M.A. (1982) "An analogy by any other name is just as analogical: a commentary on the Gould-Watson dialogue." *Journal of Anthropological Archaeology* 1: 382-401.

Wylie, M.A. (1985) "The reaction against analogy." In Schiffer, M.B. (ed.) *Advances in Archaeological Method and Theory* 8. New York, Academic Press, pp. 63-111.

Wylie, M.A. (1988) "'Simple' analogy and the role of relevance assumptions: implications of archaeological practice." *International Studies in the Philosophy of Science* 2: 134-50.

Wylie, M.A. (1989) "Archaeological cables and tacking: the implications of practice for Bernstein's 'Options beyond objectivism and relativism'." *Philosophy of the Social Sciences* 19: 1-18.

Yang, C.M.; Chang, S.D.; Kang, Y.C.; Ko, K.S.; Chang, C.W.; Kim, I.P.; Yi, U.N. and Chang, S.H. (1987) *Susanhak kaeron* [An introduction to fishery science]. Seoul, Chip'yŏnsa. (in Korean)

Yang, H.J. (1973) "Nakdonggangsan ŏryuŭi chosa: mongnokkwa punp'oe taehayŏ." [Studies on the fish from the Nakdong River: the list of fishes and their distribution]. *Han'guk yuksuhakhaeji* 6: 19-36. (in Korean with English summary)

Yi, K.M.; Yi, Y.H.; Yoon, K.J. and Shin, D.G. (1989) "Uich'ang Taho-ri yujŏk palguljinjŏnbogo I."[A preliminary research report of excavation of the Proto-Three Kingdoms burial site at Taho-ri in Uich'ang-gun]. *Kogohakchi* 1: 5-174. (in Korean with English summary)

Yun, Y.J. (1987) *Hapch'ŏn Jopo-ri D chiguyujŏk* [The site of Jopo-ri D area, Hapch'ŏn]. Site Excavation Report 4. Taegu, Department of Archaeology and Anthropology, Kyŏngbuk National University. (in Korean)